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The Asia Pacific Partnership: Its Role in Promoting a Positive Climate for Investment, Economic Growth and Greenhouse Gas Reductions

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EXECUTIVE SUMMARY

Background: The Asia Pacific Partnership on Development and Climate, an agreement signed in 2005 by India, China, South Korea, Japan, Australia and the United States offers an approach to climate change policy that can reconcile the objectives of economic growth and environmental improvement for developing countries. Together, the Partners have 45 percent of the world's population and emit 50 percent of man made CO2 emissions. Projections of very strong growth in greenhouse gases in developing countries over the next 20 years means that there is enormous potential for reducing emissions through market based mechanisms for technology transfer.

Promoting a Favorable Investment Climate: Institutional reform is a critical issue for the Partnership, because the lack of a market oriented investment climate is a principal obstacle to reducing greenhouse gas emissions in China, India and other Asian economies. China and India have both started the process of creating market-based economic systems, with clear benefits in the form of increased rates of economic growth. But the reform process has been slow and halting, leaving in place substantial institutional barriers to technological change, productivity growth, and improvements in emissions. The World Bank and other institutions have carried out extensive investigations about the role of specific institutions in creating a positive investment climate. These include minimizing corruption and regulatory burdens, establishing effective rule of law, recognition of intellectual property rights, reducing the role of government in the economy, removing energy price distortions, providing an adequate infrastructure and an educated and motivated labor force.

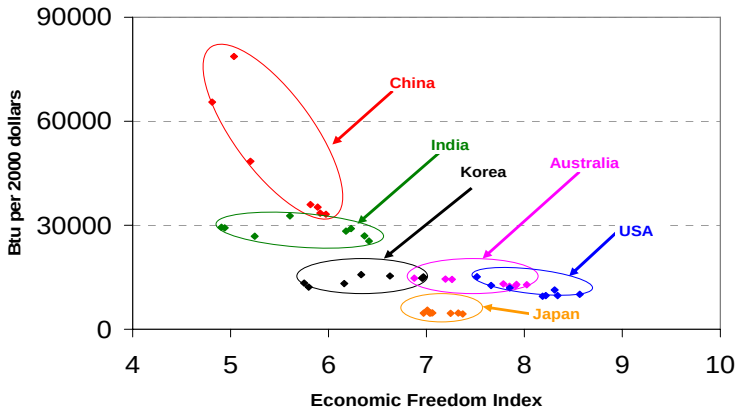
Role of Foreign Direct Investment in Technology Transfer: One of the key mechanisms by which developing countries gain access to resources for capital investment and technologies that support growth in productivity is through direct investment (FDI) by firms based in already-industrialized economies. FDI can provide the receiving country with multiple benefits: investment for expansion of production, opportunities to enhance technology and increase productivity, exposure to innovative managerial skills, access to potential export markets through the conduits of the foreign investor network, and spillover benefits that increase market competitiveness.

Since productive technology is largely embodied in capital investment (whether that capital be personal computers, chemical processes or high tech machinery), the process of technology transfer requires that foreign companies actually build factories and machinery using technology not possessed by the developing country. The foreign investor also gains through increasing its potential pool of human capital and natural resources. These benefits ultimately provide the impetus for economic growth.

Quantifying the Importance of the Investment Climate for Reducing Energy Intensity: The same institutional factors that are prerequisites for sustained economic growth – laws protecting property and contracts, fair and efficient administration of justice, reduction of the government's role in the economy, minimization of regulatory burdens and corruption, and openness to foreign investment – are closely associated with efficient use of energy and low greenhouse gas emissions per unit of output.

Two of the Partners, China and India, have far higher energy use and greenhouse gas emissions per dollar of output than the other partners and lag in technology. They also have relatively low scores on the Frasier Institute's Economic Freedom of the World which measures how well a country's institutions support a free and open market economy (see Figure 1). A large part of the difference in "emissions intensity" (or the amount of energy required to produce a dollar or euro of output) between China, India, and the rest of the Partnership is attributable to an institutional setting that creates pricing distortions and an unfavorable investment climate.

Figure-1:
Asia-Pacific Partnership
Energy Intensity and Economic Freedom (1980-2003)



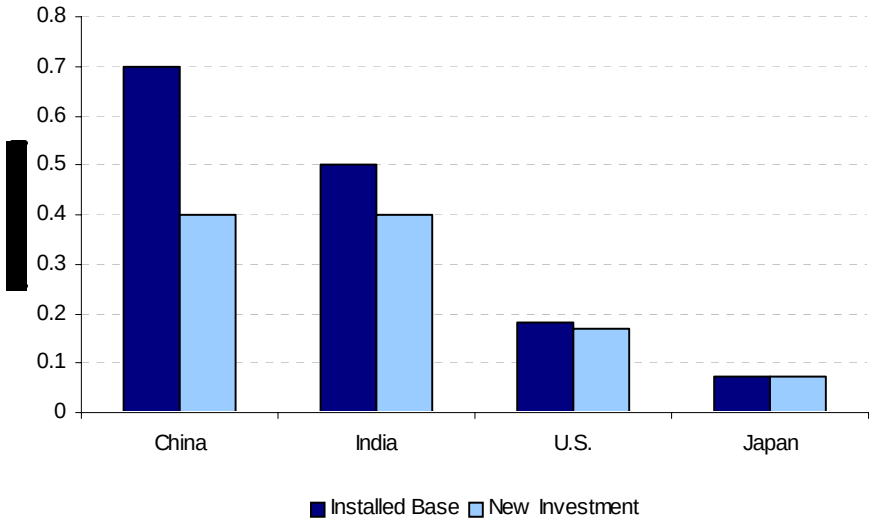
Our new analysis uses data on 91 countries from 1980 to 2003 and a regression model which assumes that energy intensity is a linear function of economic freedom or its subcomponents. We find an environmental "Kuznets curve" in the case of the poorest countries, as they emerge from subsistence agriculture and local production into a market economy. In the initial stages of economic growth brought about by greater economic freedom, rapid industrialization leads to increasing emissions per dollar of output for this group of countries. However, the ability of energy related institutional factors to explain energy intensity becomes quite large when we control for income level and economic structure in the country. Our analysis shows that almost 40 percent of the variation in energy intensity is explained by a country's economic freedom ranking. Thus, as countries develop, if they have market-

based economies and a favorable investment climate, they use less and less energy to produce each dollar or euro of output.

Quantifying the Importance of Technology Transfer for Emission Reductions: As described above, technology is critically important because emissions per dollar of income are far larger in developing countries than in the United States or other industrial countries. This is both a challenge and an opportunity. It is a challenge because it is the high emissions intensity – and relatively slow or non-existent improvement in emissions intensity – that is behind the high rate of growth in developing country emissions.

Opportunities exist because the technology of energy use in developing countries embodies far higher emissions per dollar of output than does technology used in the United States; this is true of new investment in countries like China and India as well as their installed base (See Figure 2). The technology embodied in the installed base of capital equipment in China produces emissions at about 4 times the rate of technology in use in the United States. China's emissions intensity is improving rapidly, but even so its new investment embodies technology with twice the emissions intensity of new investment in the United States. India is making almost no improvement in its emissions intensity, with the installed base and new investment having very similar emissions intensity. India's new investment also embodies technology with twice the emissions intensity of new investment in the United States.

Figure 2: Greenhouse Gas Emissions Associated with Existing and New Investment in 2001 (Million tons C per $Billion GDP at Market Exchange Rates)



Our calculations show that emission reductions can be achieved by closing the technology gap. The potential from bringing the emissions intensity of developing countries up to that currently associated with new investment in the United States is comparable to what could be achieved by the Kyoto Protocol (See Table 1). These are near term opportunities, from changing the nature of current investment and accelerating replacement of the existing capital stock. Moreover, if achieved through transfer of economic technologies it is likely that these emission reductions will be accompanied by overall economic benefits for the countries involved.

Table 1: Greenhouse Gas Emission Reductions Achievable Through Technology Transfer and Increased Investment

	To 2012 (MMTCE)	To 2017 (MMTCE)
Adopt US technology for new investment in China and India	**2600**	**5200**
Adopt US technology with accelerated replacement in China and India	**4200**	**7700**
Adopt continuously improving technology with accelerated replacement in China and India	**5000**	**9800**
EU under Kyoto Protocol (without hot air)	***600***	***1400***
All Annex B countries under Kyoto Protocol (including US and hot air)	***2800***	***7300***

The potential emission reductions estimated in Table 1 are derived from a study my colleagues and I performed using a model of economic growth based on the idea of "embodied technical progress." In the first case, we assumed that in 2005 new investment in China and India immediately moves to the level of technology observed in the United States, and calculate the resulting reduction in cumulative carbon emissions through 2012 and 2017. This is the technology transfer case. In the second case, we assume that policies to stimulate foreign direct investment accelerate the replacement of the oldest capital with new equipment, giving even larger savings. In the third case, we assume that the new technology continues to improve over time, as it will if policies to stimulate R&D into less emissions-intensive technologies are also put in place. Even the least aggressive of these policies has potential for emissions reductions comparable to those that would be possible if all countries (including the U.S.) achieved exactly the emission reductions required to meet their Kyoto Protocol targets.

How Can the Asia Pacific Partnership bring about Institutional Change? Although it is clear that there is a relationship between institutions, economic growth, and greenhouse gas emissions, there is no general formula that can be applied to identify the specific institutional failures responsible for high emissions per unit of output in a specific country. Answers to four key questions would provide a basis on which the Partnership could move forward on an agenda of institutional reform:

- How can cost-effective opportunities for improving energy efficiency and reducing carbon emissions in each country be identified?
- What types of institutional reform are most pressing in each country?
- How can institutional change be brought about?
- How large are the potential emission reductions and enhanced prospects for economic growth that could be achieved through institutional reform?

It is particularly challenging to design ways in which Australia, Japan, and the United States can make needed reforms more likely to happen in countries like China and India. Such reforms are clearly the prerogative of each sovereign country. However, China and India have clear interests in encouraging investment, gaining access to the world financial system, and acquiring new technology that can sustain productivity improvement and growth. This creates internal incentives for China and India to be interested in continued reform, as they clearly are. If incremental reforms are likely to occur where the greatest need is perceived, one important role of the APP is to make that need and the benefits of changes in energy-related institutions apparent.

Business Sector Has a Key Role in Achieving the Partnership's Goals: Experts, the private sector, and governments all have key parts to play in the Asia Pacific Partnership, if it is to be successful in bringing about fundamental institutional reform. However, the business sector's role is likely to be the key factor in the Partnership's success. Private companies will be best able to identify the most important opportunities for technology transfer and the institutional reforms needed to make them possible. The private sector will also of course be the source of the actual investments and technologies desired by China and India. The expectation of greater flows of investment and technology from the private sector is likely to be the most important factor making institutional change sufficiently attractive to lead to institutional reforms by the host country.

Businesses that are, or have been, active in China and India have the most direct experience on what institutional, legal and other practices are discouraging investment and technology transfer. Identification of problems and proposals for what would be an improved investment climate need to originate with the businesses that make the decisions on investment and technology. This seems obvious, but when a government-to-government initiative is

developed and staffed, there is a natural tendency to turn to studies done by government agencies and contractors rather than asking those who have actually tried to do business and apply technology in China and India. In the Partnership there is an opportunity to bypass the usual route of task forces and studies, and to involve the international business community directly in the diagnosis of needs for institutional reform. It may be that business needs to volunteer for this role rather than waiting to be asked, by recounting the history of their past ventures and the lessons they have learned.

A Plan for Institutional Reform: If there is to be progress on institutional reform, at minimum the key actors or stakeholders -- concerned businesses, other groups with influence on opinion and policy in China and India (including local and regional governments), and national governments -- must agree on the nature and scope of the problems and on reforms required to address the problems. There are four key steps in moving ahead: (1) Characterizing the investment climate and opportunities to reduce greenhouse gas emissions through growth-enhancing institutional reform;(2) developing proposals for specific institutional reforms, together with estimates of what they could achieve by way of emission reductions,(3) understanding the obstacles to change, in particular the opposition to the proposed reforms; and (4) identifying concrete actions that each government will take to bring about institutional reforms.

Making progress on the four steps can be accelerated if the governments of Australia, Japan and the United States would fund research on topics such as the investment climate, the level of technology embodied in new investment, the role of FDI and potential energy savings from technology transfer, and the nature and impacts of pricing distortions on energy supply, demand and greenhouse gas emissions in China and India. Government support for research to make clear the direct consequences of proposed reforms for energy efficiency and the benefits of a market based investment climate for the overall process of economic growth would also be helpful.

Turning Plans into Reality: To be successful, the negotiating process will need to bring forth a sufficient set of offers from each party to bring about meaningful changes in institutions with significant and quantifiable effects on greenhouse gas emissions. These offers would be embodied in an agreement on actions to be taken by all parties, and a framework under which actions would be monitored and additional steps could be agreed. This is the place where the current efforts of the Partnership's taskforces on clean fossil energy, renewable energy and distributed generation, power generation and transmission, steel, aluminum, cement, coal mining and building and appliances to identify technologies and investments that have profit potential and could also reduce emissions would become most useful. These investments would become in a way the reward to China and India for progress on institutional reform. The voluntary nature of private sector actions in the Partnership underscores the need for institutional reform to turn these potentially profitable investments into real projects.

Conclusions: This recommendation follows a long line of recommendations that to be successful climate negotiations need to follow the pledge and review model rather than the targets and timetables model. The pledge and review model deals directly with the unenforceability of future targets in an agreement among sovereign nations, and provides incentives to carry out promised actions by providing credible consequences for failure to do so. The Marshall Plan is a good example of such a process. After World War II, Europe pledged various actions with the money provided by the U.S., and when it made good on those pledges the program was extended and broadened. Exactly the same could be undertaken by the members of the Asia Pacific Partnership. Future actions by Australia, Japan and the United States desired by China and India would be contingent on success in implementing near term reforms agreed in the process.

1. INTRODUCTION

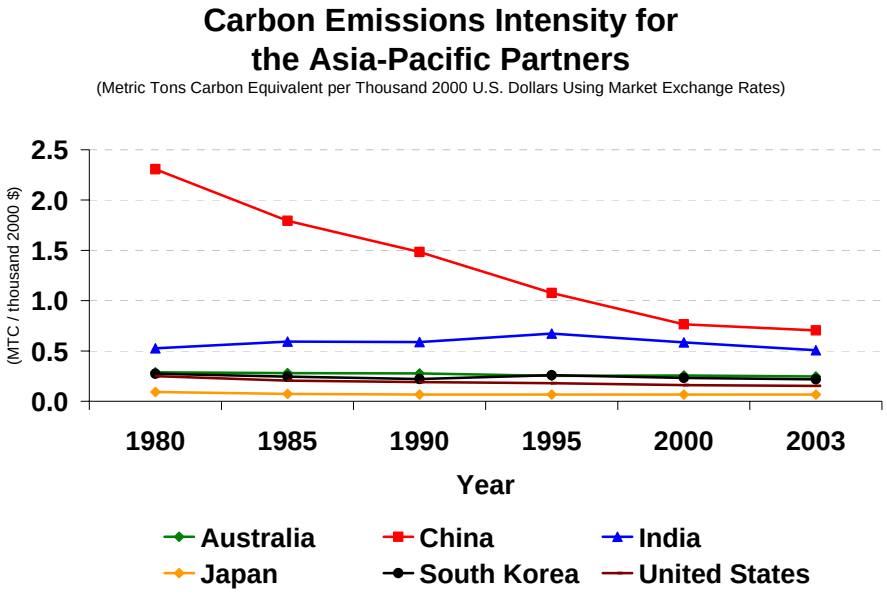
The Asia Pacific Partnership ("the Partnership") offers an opportunity to define an approach to climate change policy that can reconcile objectives of economic growth and environmental improvement for developing countries. The connections between political, social and economic institutions and economic growth have been established beyond doubt in studies of economic development. Well-functioning, competitive markets lead to efficient use of domestic resources and to greater flows of foreign direct investment and technology transfer. To perform efficiently and attract investment and technology, markets must be supported by an appropriate set of legal institutions and freed from dominance of state-owned or directed enterprises and controlled prices. These institutions are the key factors that explain the difference between rapidly growing economies and stagnant, impoverished economies.

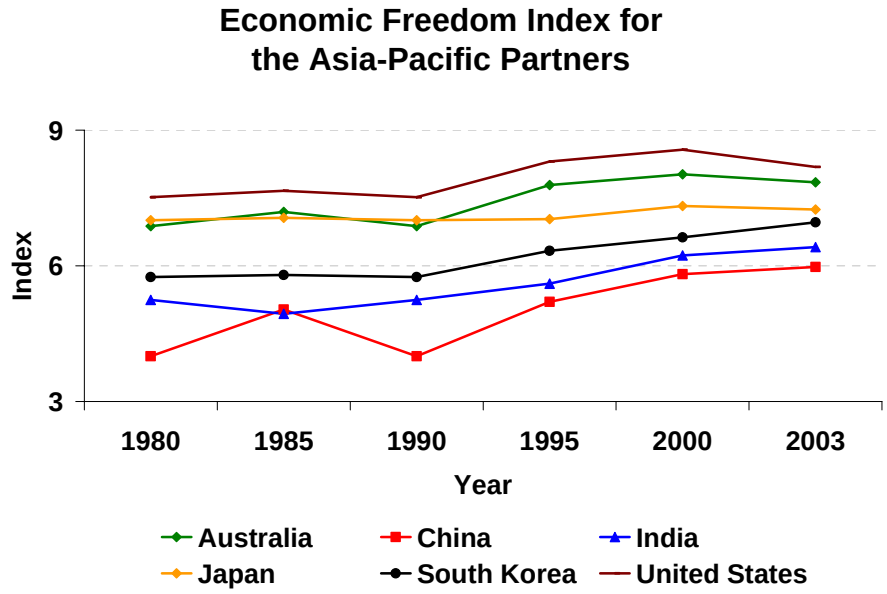
Institutional factors also play a key role in determining how efficiently societies use energy and how their economic growth and greenhouse gas emissions are related. Current research in development economics emphasizes the importance of incentives and institutions in promoting efficient use of all resources, and the key role of foreign direct investment in bringing about technological progress. China and India have far higher energy use and greenhouse gas emissions per dollar of output than the other partners (see Figure 1 below), and lag in technology. They also have relatively low scores on measures of how well their institutions support a free and open market economy.

A large part of the difference in "emissions intensity"[1] between China, India, and the rest of the Partnership is attributable to an institutional setting that creates pricing distortions and an unfavorable investment climate. The same institutional factors that are prerequisites for sustained economic growth – laws protecting property and contracts, fair and efficient administration of justice, reduction of the government's role in the economy, minimization of regulatory burdens and corruption, and openness to foreign investment – are closely associated with efficient use of energy and low greenhouse gas emissions per unit of output.

[1] Defined as the amount of energy and associated greenhouse gas emissions needed to produce a dollar's worth of output.

Figure 1: Carbon Emissions Intensity and Economic Freedom Index Asia-Pacific Partners





Prospects for sustained economic growth in China and India are not good unless both economies make steady progress on institutional reform. Such reforms, by removing pricing distortions and providing an investment climate promoting foreign investment and technology transfer, will also go a long way toward slowing growth in China and India's greenhouse gas emissions. By concentrating its efforts on bringing about these kinds of institutional reform, the Partnership provides a model of an approach to climate policy that can achieve reductions in global greenhouse gas emissions while actually improving developing countries' prospects for sustained growth.

From the beginning the Partnership has been designed to focus on institutional factors that frustrate technology transfer and lead to economically inefficient energy use. Institutional reform is a critical issue for the Partnership, because the lack of a market oriented investment climate is a principal obstacle to reducing greenhouse gas emissions in China, India and other Asian economies. At the same time, the Partnership starts with a tremendous advantage when it addresses institutional reforms that will facilitate technology transfer and reduced greenhouse gas emissions. Since China and India cannot expect sustained economic growth without continued economic reforms, addressing institutional issues is critical to the highest priority of both countries.

This essay describes a proposal for how the Partnership could identify and effectively promote institutional change that would lead to reductions in greenhouse gas emissions, and the potential benefits to all the partners of adopting such an approach. The proposal consists of four steps in two distinct phases.

The first phase would be a research and consensus building process, to provide a shared understanding of technological possibilities and institutional barriers. The first step in the research and consensus phase should be to identify and characterize the investment climate of China and India and the potential for emission reductions through transfer of technologies that would be economic, except for institutional failures. This process would take place in working groups with participation limited to disinterested experts, representatives of the business communities and the APP governments. Achieving consensus across stakeholders and countries on the basic facts about the current investment climate and the role of FDI in promoting technology transfer will go a long way toward developing support for reforms.

It is critical that businesses who have had direct experience in applying state-of-the-art technology and dealing with the institutional setting in China and India tell their stories as part of this process. The key to success is not an outstanding set of studies by the experts, but identification of real world opportunities and barriers. Private sector knowledge of technologies that can make it on their own in the global marketplace and experience with institutional obstacles to doing profitable business in China and India is the essential foundation of this approach.

The second step will be for the same working groups to develop proposals, given the benchmarking exercise of the first step, which will be sufficiently broad and specific to creating a receptive investment climate. These proposals must describe specific institutional reforms that will have direct benefits for technology transfer and efficient use of energy. Proposals should include actions by all parties, so that they are broadly perceived as equitable and cooperative. In this step in particular, opinions of international businesses on how much change is needed to create a receptive investment climate should be taken as a major input.

The third step would move from working groups to interaction among the APP governments to understand the difficulties associated with removal of obstacles for technology transfer in particular and institutional reform in general, and what each government could contribute. The current institutional climate in China and India exists because it is supported by strong interests, and how incremental reform can proceed in the face of interests that benefit from the status quo must be addressed directly. The interaction should identify actions that China and India would be willing to see Australia, Japan and the United States undertake to encourage, speed and reward the process of institutional reform, as well as feasible actions to be undertaken in China and India by their respective governments.

The final phase involves creating an ongoing process in which Partnership governments would agree to concrete actions that each would take to support institutional reforms and achieve the identified benefits for climate and economic growth. This should be designed as a pledge and review process, in which each government agrees to undertake an action desired by the others and to periodically review whether commitments were carried out. Such agreements tend to be self-enforcing, because any country that fails to abide by a commitment faces the credible consequence of losing future benefits.

1. ASIA-PACIFIC PARTNERSHIP: A VEHICLE FOR ECONOMIC GROWTH

"Some people have said the 21st century will be the Asian century. I believe the 21st century will be freedom's century." These are the concluding remarks of President Bush's address to the Asia Society on 22 February 2006 prior to his visit to South Asia.[2] The statement underlines two key points about economic growth. The newly industrialized Asian economies[3] have indeed exhibited remarkable growth over the past two to three decades. China, and to a lesser extent India, appear to be embarked on the same growth process. But for China and India to maintain their rate of progress toward levels of per capita income comparable to the "Asian tigers" will ultimately require broad and fundamental institutional change, to bring about improvements in the "rule of law" and other aspects of *economic* freedom that are prerequisites to sustained economic growth. These changes are also necessary to achieve reductions in greenhouse gas emissions while maintaining rapid improvement in per capita incomes.

1.1. STATUS OF THE ASIA-PACIFIC PARTNERSHIP

The Partnership now includes six countries, Australia, China, India, Japan, the Republic of Korea, and the United States, and is intended to address the growing challenge of managing energy and environment in a sustainable manner. A charter was agreed between the "Partners" on 12 January 2006 during the First Ministerial meeting in Sydney based on the "Vision Statement for a New Asia-Pacific Partnership on Clean Development and Climate." The shared vision, as stated, for the partnership is:

> *"The Partners have come together voluntarily to advance clean development and climate objectives, recognizing that development and poverty eradication are urgent and overriding goals internationally. By building on the foundation of existing bilateral and multilateral initiatives, the Partners will enhance cooperation to meet both our increased energy needs and associated challenges including those related to air pollution, energy security, and greenhouse gas intensities, in accordance with national circumstances. The Partners recognize that national efforts will also be important in meeting the Partnership's shared vision."*

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[2] President Addresses Asia Society, Discusses India and Pakistan, President George W. Bush, Mandarin Oriental Hotel, Washington, D.C., February 22, 2006.

[3] The Newly Industrialized Economies ("NIEs") -- Hong Kong, the Republic of Korea, Singapore, and Taiwan -- were also known as the "Asian Tigers" before the Asian financial crisis of the 1990s.

An overall governing body, the Policy and Implementation Committee, is responsible for policies, procedures, and direction of the Partnership. The substantive work of the Partnership will occur in eight sectoral taskforces: Cleaner Fossil Energy, Renewable Energy and Distributed Generation, Power Generation and Transmission, Steel, Aluminum, Cement, Coal Mining, Building and Appliances. Their charter is to: [4]

- review the current status of their sector with regard to clean development and climate;
- share knowledge, experience and good practice examples of how industrial efficiency, energy efficiency and environmental outcomes can be improved, including through valuable and practical short-term actions;
- identify specific opportunities for cooperation including relevant international financial organizations such as the Asian Development Bank and the World Bank;
- define the current state of the technology in terms of cost, performance, market share and barriers;
- identify cost and performance objectives and the actions needed to achieve these objectives; and
- identify, wherever possible, ambitious and realistic goals.

Each task force is chaired and co-chaired by two different partnering countries with sector specific objectives.

The Partnership could have a profound influence on global energy use and environmental impacts, because its members collectively account for about half of global population, energy consumption and emissions. The six partners accounted for about 49 percent of the world's energy consumption and 50 percent of total global greenhouse gas emissions in 2001. With the two most populous nations – China and India -- as members, the Partnership includes 45 percent of the world's population.[5] With the largest current and future emitters of greenhouse gases as members, the Partnership has the opportunity to initiate a truly global approach to climate change. Its challenge is to create an effective set of policy approaches

[4] Charter for the Asia-Pacific Partnership on Clean Development and Climate, Asia-Pacific Partnership on Clean Development and Climate, Sydney, Australia, January 12, 2006.

[5] Fisher, B.S., Ford, M., Jakeman, G., Gurney, A., Penm, J., Matysek, A. and Gunasekera, D. 2006, *Technological Development and Economic Growth*, ABARE Research Report 06.1, Prepared for the Inaugural Ministerial Meeting of the Asia Pacific Partnership on Clean Development and Climate, Sydney, 11–13 January, ABARE, Canberra.

that achieve the twin goals of reducing global greenhouse gas emissions and sustaining or increasing rates of economic growth in the global South.[6]

Rising to this challenge requires a focus on institutional change, and this focus is deeply embedded in the Charter of the APP. Function 3.1.3 of the Charter for the Asia-Pacific Partnership states that "[partners are to cooperate to] identify, assess, and address barriers to the promotion and creation of an enabling environment for development, diffusion, deployment, and transfer of exiting, emerging and longer terms cost-effective, cleaner, more efficient, and transformational technologies and practices in accordance with the Partners' priorities." The highest priority of the Partnership should be the removal of these barriers in order to accelerate the transfer and diffusion of low-carbon technologies to China and India, and to demonstrate the Partnership offers developing countries an opportunity to reduce emissions in the context of sustained growth.

The Partnership has initiated some very useful discussions involving China, India and multi-national enterprises that are identifying improvements in technology that would be economic in those countries and greatly reduce their emissions.[7] However, it is not entirely clear that task force structure of the Partnership is consistent with the need to focus on fundamental institutional reform. The current charge to the task forces only mentions "market barriers" in the context of specific technologies, and that last in a long list of topics to be considered. The task forces are organized by economic sectors and types of energy technology, and no specific group below the level of the Policy and Implementation Committee has the lead on cross-cutting topics such as institutional change. This is not necessarily a bad thing, because institutional change has to be incremental, and there is evidence that incremental improvements have been identified and achieved when governments realize that certain reforms would be necessary if a much-desired deal were to be accomplished.

Nevertheless, given this orientation of the task forces, maintaining a focus on institutional reform may well require active policy direction from the overall governing body, the Policy and Implementation Committee. Without such intervention, the sectoral organization of the task forces may lead members to concentrate on discussions of how to finance specific project undertakings and neglect cross-cutting issues entirely. Even if each task force addresses "market barriers" to specific projects, the task forces will lack perspective on

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[6] Ibid. The study showed that technology transfer focused within the Partners alone could reduce greenhouse gas emissions by 17 percent relatively to the baseline by 2050 level and by 23 percent if the technology transfer and diffusion covered beyond the Partners.

[7] Testimony of James Connaughton, Chairman, President's Council on Environmental Quality, before the U. S. Senate Committee on Commerce, Subcommittee on Climate, April 5, 2006.

broader root causes. In sections to follow, this essay will describe a way of addressing the cross-cutting issues of institutional change.

2. WHY IT IS IMPORTANT TO FOCUS ON INSTITUTIONAL CHANGE

Institutional reform is a critical issue for the Partnership, because the lack of a market oriented investment climate is a principal obstacle to reducing greenhouse gas emissions in China, India and other Asian economies. China and India have both started the process of creating market-based economic systems, with clear benefits in the form of increased rates of economic growth. But the reform process has been slow and halting, leaving in place substantial institutional barriers to technological change, productivity growth, and improvements in emissions intensity. In this context, institutional reform in China and India must be given the highest priority since it is necessary for any of the other objectives to be achieved, and will by itself go a long way to their accomplishment.

The Asia-Pacific Partnership has the potential to provide a prototype for effective cooperation between industrial and developing countries in addressing climate change. For this potential to be achieved, it is critically important the Partnership make creation of a market oriented investment climate its primary goal. Moving forward, the Partnership's agenda and financial efforts should be directed towards removal of barriers and improvement of the institutional environment and investment climate in areas that will have a direct bearing on greenhouse gas emissions. This alone can create the necessary environment to achieve the goals that are set for the Partnership. A great opportunity will be lost if the Partnership allows itself to degenerate into just another forum in which recipient countries and hopeful businesses discuss how to get funding from donor countries for favored projects. Indeed, offering government support or guarantees for projects could undermine progress now being made in institutional reform that is motivated by the desire of governments in China and India to make specific deals with private investors possible.

2.1. INSTITUTIONAL CHANGE AND ECONOMIC GROWTH

Institutional change is underway in China and India, and market-oriented reforms that have taken place thus far are recognized to be responsible for the remarkable growth both countries have experienced. Nevertheless, both countries have far to go in creating an investment climate that can support sustained, high rates of economic growth. Understanding the role that institutions play in economic growth is the first step toward moving the ongoing process of institutional change in directions that will lead toward lower greenhouse gas emissions as well as sustained growth.

The literature on economic development now emphasizes the importance of institutions in promoting economic growth. Research over the past several decades has linked the overall economic prosperity of a country to social conditions, political environment, freedom and democracy, and development of a supportive institutional framework for trade, investment

and innovation. Some of the key institutional features viewed as prerequisites for economic growth include: an independent and effective judiciary[8], impartiality and integrity of the court systems[9], level of overall good governance[10], adequacy of business and economic laws and regulations[11], protection of investment and recognition of ownership of intellectual property rights[12], and development of an enabling investment climate, policies, and institutions[13]. Collectively these building blocks for economic growth are sometimes referred to as "economic freedom."

Empirical testing of the intuitive proposition that economic freedom leads to economic growth has been made possible in the past decade by the publication of economic freedom indices.[14] Numerous studies find that there is a positive and significant relationship between economic freedom and economic growth.[15] This is illustrated in Figure 2, which illustrates

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[8] Berkowitz, D., K. Pistor, and J. Richard (2000), "Economic Development, Legality, and Transplant Effect," Center for International Development, Harvard University, Working Paper.

[9] Sen, A. (2001) "What is the Role of Legal and Judicial Reform in Development Process?" speech delivered at the first World Bank conference on Legal and Judicial Development.

[10] Kaufmann, D. and A. Kraay (2002) "Growth Without Governance." World Bank Policy Research Working Paper No. 2928, Washington, D.C. and

Kaufmann, D. and A. Kraayl (2003), "Governance and Growth: Causality which way? -- Evidence for the World, in brief," World Bank.

[11] World Bank (2003), "Building Institutions for Markets: World Development Report 2002".

[12] Maskus, K. (2000) "Intellectual Property Rights in the Global Economy," Washington, DC: Institute for International Economics.

[13] Moran, T. (1998), "Foreign Direct Investment and Development," Washington, D.C.: Institute for International Economics.

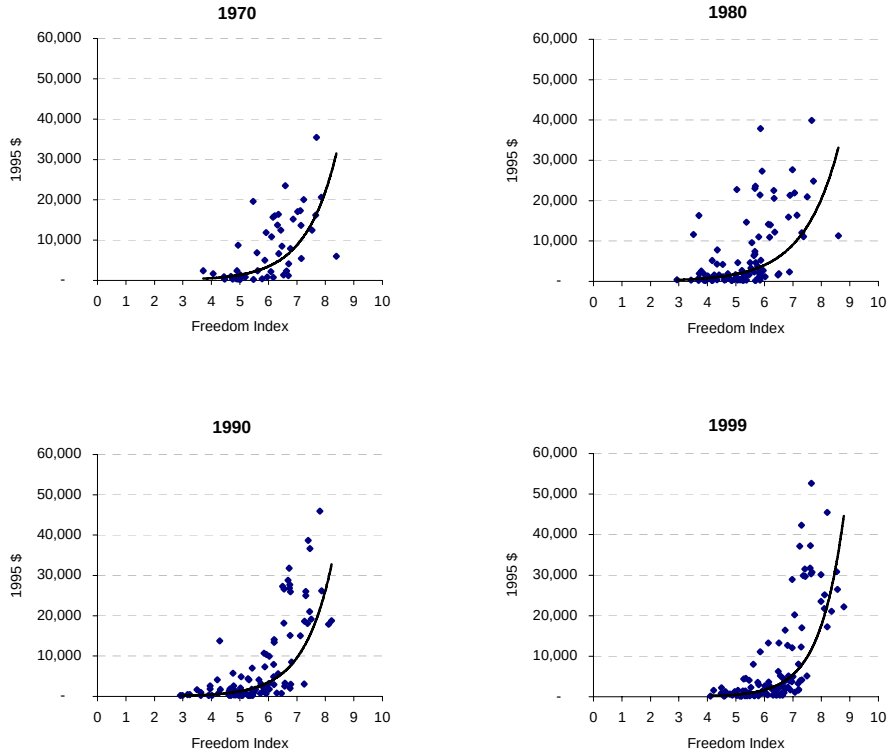
[14] Two indices of economic freedom are widely used for empirical studies. Heritage Foundation with the cooperation of the Wall Street Journal produces *Index of Economic Freedom*. The *2006 Index of Economic Freedom* 161 countries and takes into account 50 independent variables from 10 broad factors of economic freedom. Similarly, *Economic Freedom of the World* published by the Frasier Institute covers 123 countries and computes the index from 21 components grouped into 5 board areas. Both of these indices take into account similar economic measures and hence have a high degree of correlation between them.

[15] Dawson, J.W. (1998) "Institutions, investment, and growth: New cross-country and panel data evidence," Economic Inquiry, 36.; Gwartney L. and Holcombe, R.G. (1999) "Economic freedom and the environment for Economic Growth," Journal of Institutional and Theoretical Economics, 155, 643-663; De Haan J., and Sturm, J.E. (2000) "On the relationship between economic freedom and economic growth," European Journal of Political Economy, 16, 215-241; and Dawson, J.W. (2003) "Causality in the freedom-growth relationship," European Journal of Political Economy (Special issue on Economic Freedom) 19, 603-619.

An extensive list of survey of economic freedom and growth relationship can be found in Berggren, N. (2003) "The Benefits of Economic Freedom: A Survey," The Ratio Institute, Stockholm. There is also a growing literature on the relationship of

the relationship between freedom and growth based on data for approximately 90 countries between 1970 and 1999.

Figure 2: Economic Freedom and Per Capita Income[16]



the economic freedom on specific issues. Hasan provided linkage of economic freedom on poverty reduction (Hasan, R., M.G. Quibria, and Y. Kim (2003) "Poverty and Economic Freedom: Evidence from Cross-Country Data", East-West Center, Working Paper). Calvo demonstrated that economic freedom enhances foreign direct investment (Bengoa, Marta & Sanchez-Robles, Blanca, 2003. "Foreign direct investment, economic freedom and growth: new evidence from Latin America," European Journal of Political Economy, Elsevier, vol. 19(3), pages 529-545.)

16 Source: Montgomery, W.D. and R. Bate (2005), "A (Mostly) Painless Path Forward: Reducing Greenhouse Gases Through Economic Freedom," in Climate Change Policy And Economic Growth: A Way Forward to Ensure Both, International Council for Capital Formation, eds. Thorning, M. and Illarionov A. GDP per capita data comes from the World Development Indicators 2000 and the Freedom Index is from Economic Freedom of the World, Annual Report 2003.

Comparison to the Asian Tigers is also informative in this respect. Their growth strategy shares many features with that of China,[17] but unlike China and India, the Asian Tigers moved rapidly to having a high degree of what is referred to as Economic Freedom. Hong Kong, Singapore, Taiwan and South Korea were 1st, 2nd, 24th, and 35th respectively on the Frasier Institute's Economic Freedom of the World Index in 2003. India and China, on the other hand, were 66th and 86th, respectively.[18]

The designers of the Index of Economic Freedom define economic freedom as "*the absence of government coercion or constraint on the production, distribution, or consumption of goods and services beyond the extent necessary for citizens to protect and maintain liberty itself.*"[19] The authors of the Economic Freedom of the World posit that the index can be viewed as a measure of a country's institutional and policy environment.[20]

2.2. WHAT DOES INSTITUTIONAL CHANGE ACCOMPLISH

The connection between economic freedom and economic growth is consistent with both common sense and economic theory. Key components of the Index of Economic Freedom are clearly related to efficient use of economic resources, long term investment, stable commercial dealings and trade, and incentives for innovation. These components, as we discuss below, are also closely connected to efficient use of energy resources and lower greenhouse gas emissions per dollar of GDP.

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[17] Since the Asian Tigers were relatively poor during the 1960s, they had a large supply of cheap but uneducated labor. Coupled with educational reform, they were able to leverage this combination into a highly productive workforce. The characteristics that China and the Asian Tigers have in common are: focus on exports to richer industrialized nations, trade surplus with those countries, sustained rates of double-digit growth, non-democratic and relatively authoritarian political systems during the early years, high tariffs on imports, undervalued currencies, high level of U.S. treasury bond holdings, and high savings rate. Unlike China and India, the Asian Tigers committed to land reform early in their process of industrialization.

[18] According to the ranking of the Heritage Foundation's 2006 Index of Economic Freedom, Hong Kong, Singapore, Taiwan and South Korea, India, and China were 1st, 2nd, 37th, 45th, 121st, and 111th respectively.

[19] 2006 Index of Economic Freedom: Establishing the Link Between Economic Freedom and Prosperity, The Heritage Foundation and The Wall Street Journal, Washington DC.

[20] Economic Freedom of the World 2005 Annual Report, The Fraser Institute. The index is formulated taking into consideration of rule of law, security of property rights, enforcement of contracts, monetary and price stability, free trade, open markets, and avoidance of excessive taxes and regulations. These factors are common across such indices and have shown to be strong determinants.

2.2.1. Efficient Resource Use

The most fundamental conclusion of economic theory and lesson of economic history is that free and competitive markets lead to efficient use of all resources that are included in the market system. These include natural resources, human and physical capital. But, these markets must be supported by an appropriate set of laws and institutions that define property rights, create a framework for commercial dealings, and resolve disputes peaceably and efficiently. There are both static and dynamic components to economic efficiency.

Static efficiency demands a regulatory and property regime in which markets establish prices of all goods and services with minimal distortions through government price controls, taxes or subsidies. It also requires that agents face the consequences of their decisions, so that investors and managers have a stake in minimizing cost and serving their customers needs. Workers and investors also need incentives to stimulate effort and savings.

Dynamic efficiency requires that institutions provide confidence and security for transactions that occur over time, such as loans or investments in physical capital, so that future rewards will matter as much as present gains. Finally, trade requires an ability to protect property, enforce contracts and resolve disputes at a distance, so that commercial dealings across an entire market are possible.[21]

What these institutions produce is an economy in which resources – natural, human and technological – are used efficiently, and in which there are strong incentives for effort, saving and investment. These outcomes not only lead to economic growth, but also eliminate wasteful energy use and promote the diffusion of the most productive technologies for energy production, transformation and use.

2.2.2. Increased FDI and Technology Transfer

One of the key mechanisms by which developing countries gain access to resources for capital investment and technologies that support growth in productivity is through direct investment by firms based in already-industrialized economies. Called Foreign Direct Investment (FDI), this type of investment can provide the receiving country with multiple benefits: investment for expansion of production, opportunities to enhance technology and increase productivity, exposure to innovative managerial skills, access to potential export markets through the conduits of the foreign investor network, and spillover benefits that increase market competitiveness. The foreign investor also gains through increasing its

[21] See Kenneth W. Dam "Institutions, History and Economic Development," John M. Olin Law & Economic Working Paper No. 271 (2D Series) The Law School, The University of Chicago, January 2006 for an excellent overview of how the "rule of law" supporting static and dynamic efficiency developed in the West.

potential pool of human capital and natural resources. These benefits ultimately provide the impetus for economic growth.

A large part of the process of development is creating the educational systems and human capital required to carry out research, technology development and innovation. In the early and middle stages of development, increases in overall productivity require the transfer of that technology for countries in the global North that already have those capabilities. Since productive technology is largely embodied in capital investment (whether that capital be personal computers, chemical processes or high tech machinery), the process of technology transfer requires that foreign companies actually build factories and machinery using technology not possessed by the developing country.

Bengao et al. showed that economic freedom is a positive determinant for attracting FDI into the host country and that FDI is positively correlated to economic growth. The authors posit that foreign investment may help the process of technological diffusion from advanced to developing countries.[22]

2.3. WHAT CONSTITUTES A FAVORABLE INVESTMENT CLIMATE?

Lack of a market-based investment climate will retard both domestic and foreign investment required for economic growth, but the effects of the investment climate on technology transfer through FDI are particularly important. Moreover, a weak investment climate is frequently associated with distortions in energy pricing that also make adoption and diffusion of efficient technologies uneconomic. Lack of protection for intellectual property, weak enforcement of long term contracts, and bureaucratic delay and corruption are commonly mentioned problems in the investment climate. Academic researchers and institutions like the World Bank have carried out extensive investigations about the role of specific institutions in creating a positive investment climate. These include minimizing corruption and regulatory burdens, establishing effective rule of law, recognition of intellectual property rights, reducing the role of government in the economy, and providing an adequate infrastructure and an educated and motivated labor force.

2.3.1. Corruption and Regulatory Burdens

Official corruption at the highest levels of national government, either "organized" or "disorganized" [23] provides an obvious disincentive to FDI. Empirical work by Wei [24] shows

[22] Bengoa, M. and B. Sanchez-Robles, (2003) "Foreign direct investment, economic freedom and growth: new evidence from Latin America," European Journal of Political Economy, Elsevier, vol. 19(3). The authors empirically showed the results using a panel data analysis on a sample of 18 Latin American countries over the period 1970-1999.

[23] Shleifer, A. and R. Vishney (1993) "Corruption," Quarterly Journal of Economics, 108: 599-617.

that corruption has serious consequences on both the efficient operation of domestic markets and inward FDI. There is a reduction of 6 percent of inward FDI for one point increase in corruption index. Further, moving from a corruption-free society (Singapore) to a highly corrupt government (Mexico) is equivalent to increasing the marginal tax rate of all citizens by 21 to 23 percentage points, with resulting impacts on incentives and effort. [25]

2.3.2. Effective legal system and judiciary

The recognition of property rights, contract enforcement, commercial dispute resolution, and arbitration, supported by a viable legal framework and court system, has been fundamental in the development of the industrialized countries, and such legal protocols remain critical today for emerging economies to achieve economic success and attract needed FDI.

Multi-national enterprises seek integrity in the legal system, complemented by clear and non-conflicting laws, procedures, and regulations for business operations. Equally important is an effective and expeditious judicial system for providing justice quickly and impartially. An adequate legal system and effective judiciary provide the safeguards and incentives required to attract investment and economic development through FDI.

Investors may find that the costs of doing business in a certain host country cannot be justified by the manifest inadequacies of the existing legal and judicial systems. Dam surveys the extensive literature on the importance of the rule of law in economic growth, with particular reference on China.[26] Berkowitz et al estimate that a 1 percent increase in the

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[24] Wei, Shang-Jin (1997) "How Taxing is Corruption on International Investors?" National Bureau of Economic Research, Working Paper 6030.

[25] The most detailed institutional analysis is on the connections between corruption and FDI. In earlier studies, Wheeler and Mody (1992) "International Investment Location Decision: The Case of U.S. Firms," Journal of International Economics 33:57-76 did not find significant impacts of corruption on the investment decisions of U.S. manufacturing firms. Later studies contradict this finding, and one of the best known being, Wei Shang-Jin (2000) "Local Corruption and Global Capital Flows," Brookings Papers on Economic Activity 2000: 2 (2000) William C. Brainard and George L. Perry, editors. He documented a substantial suppressive effect of corruption on FDI inflows. Based on survey data from transition economies, Hellman, J.S. and G. Jones, and D. Kaufmann (2002) "Far from Home: Do Foreign Investors Import Higher Standards of Governance in Transition Economies?" The World Bank, found a different kind of linkage: FDI flows are only weakly affected by corruption but corruption reduces the quality of FDI inflows. One way to reconcile the findings from Wei (2000) with those from Hellman et al (2002) is to note that Wei (2000) is limited to FDI from OECD source countries (i.e., high-quality FDI). Thus it is possible that corruption deters FDI from OECD countries but does not deter FDI from other countries.

[26] Kenneth W. Dam "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" John M. Olin Law & Economics Working Paper No. 275 (2D Series) The Law School, The University of Chicago, January 2006.

effectiveness of institutions that enforce the law yields a 4.75 percent increase in GNP per capita. [27]

2.3.3. Intellectual Property Rights (IPRs)

Intellectual property rights are exclusive commercial rights given to institutions or persons to reward and stimulate innovation. In the absence of such rights there would be no return on the investments required for discovery and application of new technology. Proper protection of innovation is critical for multi-national enterprises to stay competitive within their various national economic environments. A lack of protection for intellectual property in developing countries can serve as a disincentive for investment in those countries, and discourage multinational corporations from incorporating their best available technologies when they do invest.

There is no unified empirical evidence concerning IPRs as a determinant for development and the inducement of FDI. IPRs constitute one strong prerequisite for high-end technology FDI, but they are only one set of conditions dictating extra-national investment. Mansfield's survey of 100 U.S. firms shows that 80 percent of chemical firms would prefer not to engage in joint ventures or transfers of new technology to subsidiaries or unrelated firms in India due to inadequate IPRs. [28] However, some studies have shown a weak relationship between IPR and FDI. Kumar finds no strong linkage between a multi-national enterprise's decision to invest and the patent protection afforded by strong IPRs. [29] This may be due to the fact, as observed in the case of China, that not all FDI includes technology transfer, so that a difference in IPR leads to a change in the quality rather than the quantity of FDI. Strong IPRs may have a negative impact on the domestic sector by crowding out domestic industries, resulting into an overall decrease in the welfare of the host country.[30] This appears to be an explicit issue in China and India, and a source of opposition to IPR reform.

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[27] Berkowitz d., K. Pistor, and J. Richard (2000) "Economic Development, Legality and the Transplant Effect, Center for International Development at Harvard University, CID Working paper.

[28] Mansfield, E. (1994). "Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer," IFC Discussion Paper 19.Washington, D.C.: World Bank; and Maskus, Keith E. (2000) "Intellectual Property Rights in the Global Economy." Washington, D.C.: Institute for International Economics.

[29] Kumar, N., (2003) "Intellectual Property Rights, Technology and Economic Development: Experiences of Asian Countries," Economic and Political Weekly, Vol.38, No. 3, January 18.

[30] Markusen, J. (2001) "Contracts, Intellectual Property Rights, and Multinational Investment in Developing Countries," *Journal of International Economics* 53(1): 189-204. With reference to energy sector, this might result in adoption of improved technology with better energy intensity. Within the climate change analyses a case with improved welfare could easily be provided.

2.3.4. Role of Government in the Economy

The role of government and its proper functioning are paramount in building a nation and achieving economic growth. Political stability and lack of internal conflict contribute to willingness to save and invest, both from citizens and through FDI.

There are also more specific aspects of the role of government that matter. If a large part of the economy is dominated by state-run enterprises that are protected from competition and able to cover losses through recourse to public funds, the incentive for efficient management will be diminished. In addition, the existence of such enterprises will either foreclose or discourage FDI.

Government manipulation of markets through price controls also sends warning signals to multinational enterprises contemplating FDI. By contrast, the establishment of special economic zones (SEZs), free trade zones (FTZs), and export processing zones (EPZs) has been found to create a business and commercial environment conducive to large-scale FDI, as exemplified in such countries/areas as China, Taiwan, the Caribbean, and elsewhere.[31]

2.3.5. Level of Infrastructure

Efficient, modern telecommunications and transportation infrastructures are pivotal for attracting investment by multinational enterprises. All other economic factors equal, the level of infrastructure development will have an important positive impact on the inflow of FDI.

The needs for access to good quality, reliable and affordable infrastructure are universal in developing countries, yet the nature of the infrastructure 'gap' varies. In low income areas, there is a large demand for increased access to basic infrastructure services, but service quality and reliability are also essential to maintaining economic growth and competitive-ness, and are of particular concern to middle income clients as well. In almost all countries, impediments to more efficient service delivery exist, such as difficulties in developing appropriate tariff policies, fiscal stress, weak government institutions, and lack of capacity to engage the private sector. Sustainable investment in infrastructure will require the establish-ment of tariffs that cover the costs of efficient service delivery, while taking into account affordability concerns using subsidies where appropriate to ensure equitable service provision. Improvements in governance, including legal and regulatory frameworks and the

[31] Lim, E (2001), "Determinants of, and the Relation Between, Foreign Direct Investment and Growth: A Summary of the Recent Literature," IMF Working paper (WP/01/175).

need for greater transparency, and capacity building at multiple levels of government—central, regional and local—will also be critical to the long term viability of investments.[32]

2.3.6. Human capital

Although there are conflicting claims in the literature regarding the exact quantitative importance of human capital, there is indisputable evidence that education and skill levels, including foreign language literacy, are critical factors in attracting FDI and hence promoting economic growth.[33] Obviously, a large pool of human capital, assuming lower labor costs in the host country, could attract labor-seeking investment and stimulate production cost-minimizing FDI. Likewise, a highly qualified human capital host country could easily attract technology-intensive investment.

2.4. INFLUENCE OF INSTITUTIONS ON EMISSIONS

Our own research shows that the influence of institutions extends to the efficiency of energy use and quantity of greenhouse gas emissions released per dollar of GDP. Substantial reductions in emissions would be made possible if new investment in China and India were at the level of technology already cost-effective in the more advanced countries in the Partnership.

This transfer of technology is not taking place for two reasons: an inhospitable investment climate that generally discourages FDI embodying the most advanced technologies, and specific distortions of market prices and other incentives that discourage the adoption of technologies that could enhance productivity and reduce energy use and greenhouse gas emissions. By altering these conditions, institutional reform will allow increased technology transfer and make more energy-efficient, lower-carbon technologies viable in the domestic market. The resulting elimination of the technology gap can produce substantial reductions in emissions.

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[32] Love, J. and Lage-Hidalgo, F. (2000) "Analyzing the determinants of US Direct Investment in Mexico", Applied Economics 32, 20, 1259-67. Chakrabarti, A. (2001), "The determinants of Foreign Direct Investment: sensitivity analyses of cross-country regressions". Kyklos 54, 1, 89-113.

[33] Feenstra, R.C. and J.R. Markusen. (1994), "Accounting for Growth with New Inputs," International Economic Review, 35, pp. 429-47; Wei, S. (1996) "Foreign Direct Investment in China: Sources and Consequences," in Takatoshi Ito and Anne O. Kruger, eds. Financial Deregulation and Integration in East Asia, Chicago: University of Chicago Press.

2.4.1. The Technology Gap

Greenhouse gas emissions are driven by population, income and technology. This fundamental relationship is described in an equation known as the "Kaya Identity."[34] It

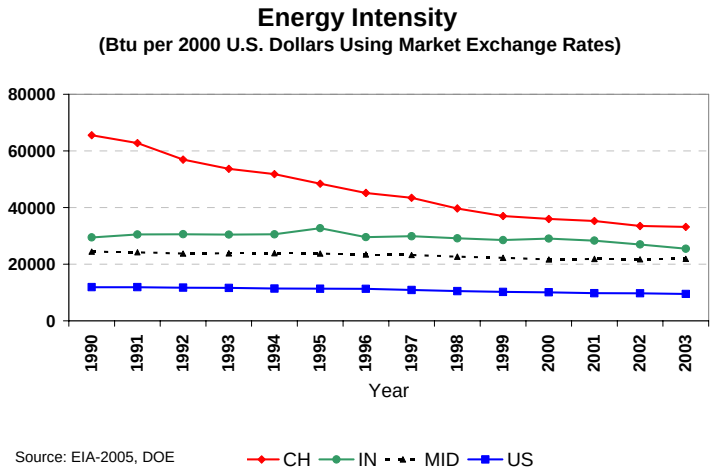
$$Population * \frac{Income(\$)}{Population} * \frac{CO_2}{Income(\$)} = CO_2$$

states that

The first two terms of this equation show that growth in total income comes from population growth and growth in per capita income. Technology appears in this equation in the third term, which describes CO_2 per dollar of income. The legitimate aspiration of poor countries is to keep per capita income increasing. Population is a separate and divisive issue– and in any event is not likely to be responsive to policies in the short run. Since per capita income growth and population growth are off the table, this leaves technology – CO_2/($) -- as the feasible object for change.

Technology is critically important because emissions per dollar of income are far larger in developing countries than in the United States or other industrial countries. This is both a challenge and an opportunity. It is a challenge because it is the high emissions intensity – and relatively slow or non-existent improvement in emissions intensity – that is behind the high rate of growth in developing country emissions.

Figure 3: Energy Intensity in China, India, Japan and the U.S.

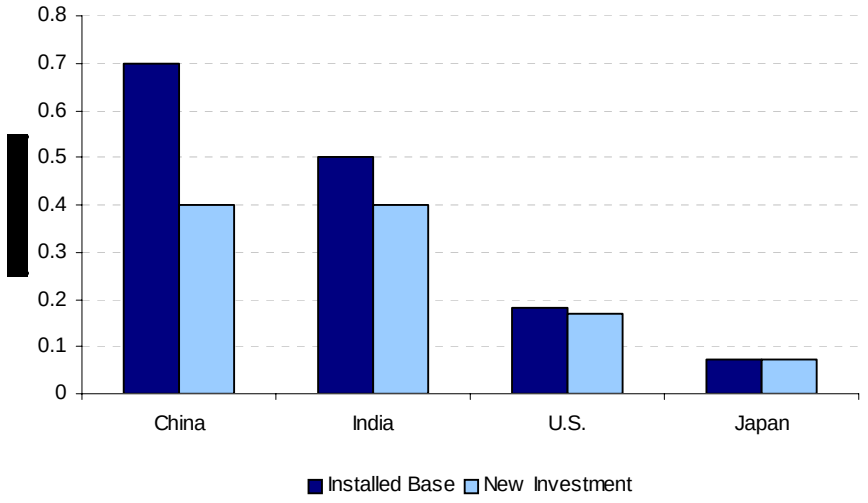


[34] Y. Kaya, "Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios." Paper presented to the IPCC Energy and Industry Subgroup, Response Strategies Working Group, Paris, 1990.

Opportunities exist because the technology of energy use in developing countries embodies far higher emissions per dollar of output than does technology used in the United States; this is true of new investment in countries like China and India as well as their installed base (See Figure 4). The technology embodied in the installed base of capital equipment in China produces emissions at about 4 times the rate of technology in use in the United States. China's emissions intensity is improving rapidly, but even so its new investment embodies technology with twice the emissions intensity of new investment in the United States. India is making almost no improvement in its emissions intensity, with the installed base and new investment having very similar emissions intensity. India's new investment also embodies technology with twice the emissions intensity of new investment in the United States.[35]

The United States is a good benchmark of technology that is economic at today's energy prices, without any additional incentives or regulations that would lead to adoption of more costly technologies for the purpose of reducing greenhouse gas emissions. Japan's emissions intensity is about half that of the United States, so that Japanese technology provides a benchmark for more aggressive efforts to reduce energy use.

Figure 4: Greenhouse Gas Emissions Associated with Existing and New Investment in 2001 (Million tons C per $Billion GDP at Market Exchange Rates) [36]



[35] See, Bernstein, P., W.D. Montgomery, and S.D. Tuladhar (2005), "Potential For Reducing Carbon Emissions from Non-Annex B Countries through Changes in Technology," forthcoming in Energy Economics for calculation for existing and new investment.

[36] Source: Montgomery, W.D. and R. Bate (2005), "A (Mostly) Painless Path Forward: Reducing Greenhouse Gases Through Economic Freedom," in Climate Change Policy And Economic Growth: A Way Forward to Ensure Both, International Council for Capital Formation, eds. Thorning, M. and Illarionov A. The calculations are based on EIA, International Energy Outlook 2003.

Similar findings, though identifying proportionally smaller emission reductions, are found in studies by researchers dealing with the electric power sector. Zhongyuan compares energy efficiency by sector in China to that in Japan, based on estimates of energy used per ton of output or the average efficiency of energy conversion. [37] He expresses the energy saving potential percentage reduction in energy use that would be made possible by moving from China's to Japan's measure of energy efficiency. Zhongyuan's calculations give the following results for potential reductions in energy use per unit of output:

Table 1: Potential Reductions in Energy Use Per Unit of Output

Sector	China Efficiency	Japan Efficiency	Energy Saving Potential
Power	33.2%	40.1%	17%
Oil refining	14.3kgoe/T	8.9kgoe/T	38%
Coal mining	13.6toe/kT	2.4toe/kT	82%
Coke	196kgce/T	161kgce/T	18%
Ammonia	970kgoe/T	664kgoe/T	24%
Ethylene	784kgoe/T	500kgoe/T	36%
Cement	171kgce/T	121kgce/T	29%
Aluminum oxide	970kgoe/T	454kgoe/T	53%
Aluminum smelting	14.3Mwh/T	13Mwh/T	9%
Residential urban	45%	60%	25%
Residential rural	25%	35%	29%
Transportation	10.8km/L	13.5Km/L	20%
Total -- technology			26%
Total -- structure			33%

Using shares of energy use by sector in China, Zhongyuan calculates that the overall reduction in energy use in sectors responsible for 70% of primary energy consumption possible by moving to technology characteristic of Japan would be 26%. He also calculates the change in aggregate energy use that would be achieved if the shares of these industries in China's GDP were the same as the shares in Japan, and concludes that with Japan's industry structure China would consume about 33% less energy.

2.4.2. Need for Industry by Industry Technology Comparisons

Less information is available at the industry level that compares technologies embodied in new investment in China and India to that in other Partnership countries. Developing such comparisons should be a high priority in the work of the Partnership, in order to reach a common understanding of the nature of the technology gap and where closing the gap can

[37] Shen Zhongyan, "China's Energy Saving Potential of Technology Improvement and Economic Structure Change," Institute of Energy Economics, Tokyo, Japan.

provide the greatest gains. Two exceptions to this lack of information are the power sector and cement industry, for which revealing comparisons of technology and diagnosis of the effect of institutional failures are available. These two sectors are also responsible for a large share of greenhouse gas emissions.

Studies of the power sector have found clear differences between the efficiency of new powerplants built by domestic companies and those built by foreign investors. A study by researchers at Resources for the Future (RFF) finds that the low energy efficiency of Chinese powerplants is due to their relatively small size, low thermal efficiency even after controlling for unit size, poor coal quality, and a lack of peaking capacity leading to inefficient cycling of coal units. The study finds that these technical inefficiencies stem from suboptimal management due to bureaucratization, lack of competitive market pressures, and bottlenecks in the transmission and distribution infrastructure that prevent efficient dispatching.

The RFF study finds that new powerplants built with FDI have better energy efficiency than powerplants built by domestic investors and comparable to those in the U.S. The authors conclude that "The principal factor that has hampered the contribution of FDI to energy-efficiency is an institutional bias in favor of small-scale plants…[that] can bypass the convoluted and costly … approval and regulatory processes…" and that "…the most important barriers to FDI are uncertainty associated with the approval process…, electricity sector regulation, and the risk of default on power purchase contracts." [38] In regard to the relation between institutional reform and FDI, they conclude that "If China hopes to boost FDI it will have to mitigate barriers … regarding contract enforcement, regulation, and project approval."[39]

Ken Newcombe of Climate Change Capital has cited consistent statistics that 25% of new powerplants now being built in China are coal fired units with capacities less than 250 Mw, about one-quarter the size of a modern and efficient powerplant. These powerplants, he observes, are often built by municipal governments, using boilers produced by Chinese manufacturers, and on average achieve efficiencies less than 25%.[40] Going from 25% to 40% efficiency would reduce coal use by 37% for the same amount of electricity generation.

A study of the Chinese cement industry also finds that a continued dependence on outdated technology leads to higher greenhouse gas emissions, inferior product quality, and resource

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[38] Allen Blackman and Xun Wu, "FDI in China's Power Sector," RFF DP 98-50.

[39] Allen Blackman and Xun Wu, "FDI in China's Power Sector," RFF DP 98-50.

[40] In comments at a Resources for the Future workshop on "The Economics of Climate Change: Understanding Transatlantic Differences," March 2, 2006.

waste.[41] They find that China's massive increase in cement output was realized through the establishment a fragmented industry, totally dominated by small-scale, low-capacity, and low-tech rural enterprises. Their study also makes the kinds of technology comparisons needed to identify areas where economic technology is not being utilized in China due to institutional choices that lead to inefficient use of resources. They cite data showing that the average energy intensity (in kJ per kg output) of all kinds of kilns in China is considerably higher that of advanced kilns in the U.S, some 23% for precalciner kilns, and 63% for vertical shaft kilns. [42]

The authors also make the interesting point that although the need for technology transfer into cement production is clear, much of the required technical capacity and competence to bridge this need already exists within China itself. They point out that Chinese institutes for industrial design and research maintain contacts with leading cement-equipment suppliers outside China, and that Chinese technical capacity is not significantly behind the state of the art. Thus, they conclude that barriers to cross-border sharing of technology are not the main concern. Instead, it appears that the cement industry is an example of how state-directed investment has led to a structure of industry with inadequate size and antiquated technology, and how the availability of state-directed financing and other preferences for inefficient enterprises prevents their being weeded out by competition.

2.5. THE IMPORTANCE OF TECHNOLOGY TRANSFER

Technologies that offer lower CO_2 intensity have largely been developed in the industrial countries. Therefore technology transfer, which occurs largely through foreign direct investment, is required to replace carbon-intensive technology. The substantial difference in technology between the installed base of capital in China and India and new investment in OECD economies can only be eradicated by new investment that replaces existing capital with new equipment. Given China's high rate of growth, the contribution of the existing capital stock to emissions will become a smaller and smaller share of total emissions over time. But with normal depreciation rates, there will remain substantial opportunities to reduce emission by replacement of existing capital with new investment. This process should improve productivity across the board, since most studies agree that existing facilities have neither the technology nor the scale to be competitive in a modern economy. Accelerating replacement therefore requires an understanding of why capacity that is already out of date and uncompetitive in a global market remains in use in China and India.

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[41] Nordqvist, J. and L.J. Nilsson (2001) "Prospect for Industrial Technology in Chinese Cement Industry," Vol 2. Proceedings of the 2001 ACEEE Summer Study on Energy Efficiency in Industry.

[42] Zhu S.L. (2000) "Greenhouse Emission from Cement Industry and its Reduction Counter measures (in Chinese)," Beijing: Energy Research Institute.

New investment in China and India also appears to lag technology in use in the OECD. In India, it appears that there is little difference between new and existing investment, but China's opening of its economy does appear to be providing benefits in the form of more advanced technology. Nevertheless, China's new investment closes only half the technology gap observed between the energy intensity of its existing capital stock and that of the United States.

Each year's accumulation of capital based on technologies that produce uneconomically high levels of greenhouse gas emissions will lock those emissions in place for decades. Therefore, bringing technology embodied in new investment up to levels now competitive on a global scale will provide immediate and growing reductions in emissions relative to the base case.

We have developed some order-of-magnitude estimates of how large a difference removing the technology gap in new investment and accelerating replacement of the existing stock of equipment in China and India could make.

2.5.1. Emission Reductions Achievable by Closing the Technology Gap Are Large

Technology transfer and increased investment have the potential for achieving large reductions in emissions. The potential from bringing the emissions intensity of developing countries up to that currently associated with new investment in the United States is comparable to what could be achieved by the Kyoto Protocol (See Table 2). These are near term opportunities, from changing the nature of current investment and accelerating replacement of the existing capital stock. Moreover, if achieved through transfer of economic technologies it is likely that these emission reductions will be accompanied by overall economic benefits for the countries involved.

Table 2: Greenhouse Gas Emission Reductions Achievable Through Technology Transfer and Increased Investment

	To 2012 (MMTCE)	**To 2017 (MMTCE)**
Adopt US technology for new investment in China and India	**2600**	**5200**
Adopt US technology with accelerated replacement in China and India	**4200**	**7700**
Adopt continuously improving technology with accelerated replacement in China and India	**5000**	**9800**
EU under Kyoto Protocol (without hot air)	***600***	***1400***
All Annex B countries under Kyoto Protocol (including US and hot air)	***2800***	***7300***

The potential emission reductions estimated in Table 2 are derived from a study my colleagues and I performed using a model of economic growth based on the idea of "embodied technical progress." In the first case, we assumed that in 2005 new investment in China and India immediately moves to the level of technology observed in the United States, and calculate the resulting reduction in cumulative carbon emissions through 2012 and 2017. This is the technology transfer case. In the second case, we assume that policies to stimulate foreign direct investment accelerate the replacement of the oldest capital with new equipment, giving even larger savings. In the third case, we assume that the new technology continues to improve over time, as it will if policies to stimulate R&D into less emissions-intensive technologies are also put in place. It can be seen that even the least aggressive of these policies has potential for emissions reductions as large as possible if all countries (including the U.S.) achieved exactly the emission reductions required to meet their Kyoto Protocol targets.

2.5.2. Leapfrogging Technology Offers Little Additional Gain

It is also important to note that given the large difference between emission intensities of China and India and the U.S., and the relatively small remaining distance between the U.S. and Japan, most of the emission reductions achievable through technology transfer can be achieved by moving from current to U.S. technology. Going beyond this in the next decade or so, by pushing developing countries to adopt technology not currently economic even in the United States, entails rapidly increasing costs and smaller emission reductions.[43]

2.5.3. How Institutional Failures Account for the Technology Gap

The critical question for policy design is why do these differences in technology exist – are the observed differences in technology an appropriate response to differences in resource endowments, or are they unfortunate consequences of lacking the institutions required for efficient resource use and technology transfer? Evidence we discuss below strongly supports the latter view, that technology differences are attributable to institutional failures.

The United States has a free and efficient set of markets, whose operations lead to cost-effective choices about energy use – in the sense that investments to save energy, or use less

[43] The potential for emissions reduction through technology transfer is discussed in P. Bernstein, W. David Montgomery and S. D. Tuladhar, "Potential for Reducing Carbon Emissions from Non-Annex B Countries through Changes in Technology." Accepted for publication, *Energy Economics*. 2006.

coal and more renewable energy, are made up to the point at which the cost of any additional investment would be greater than the market value of energy saved.[44]

The critical question about the technology gap is whether China and India should also be assumed to be making the most cost-effective choices of energy technology, so that improvements in their emissions intensity can only come at a cost. As Figure 4 revealed, new investment in China and other developing countries clearly does not incorporate world-class technology. Do these differences in technology arise from the efficient functioning of well-developed markets, or are they caused by a lag in institutional and market development?

One theory holds that China and India are already making optimal choices, (including energy technologies), given their supplies of labor, capital, energy and other factors of production. Under this theory, in order to slow emissions growth in developing countries, it is necessary to undertake costly measures to restrict energy use or deploy expensive renewable energy technologies to replace fossil fuels. If these countries are already using energy optimally, given their resource endowments, then any change will entail a cost, just as it does in advanced, free market economies. These changes in patterns of energy use will occur only if forced by a policy regime that limits or penalizes GHG emissions.

This is the fundamental idea behind the notion that the way forward under the Kyoto Protocol is for developing countries to agree to emission limits and participation in the international emission-trading system. Such a system would shift some the burden of paying for emission reductions in developing countries to the developed countries that would buy permits from them. But the cost of meeting emission caps would remain, and developing countries doubt that adequate compensation for restraint on growth will be provided, since the required scale far exceeds current aid budgets and the willingness of developed countries to make large-scale wealth transfers. They also rightly perceive that this system will systematically slow their industrial development and put their future well-being at the mercy of the developed countries' willingness to continue these transfers.

The alternative theory is that China and India are not making optimal choices in energy supply and use because of the lack of adequate institutions to support an efficient market, so that it would be possible to involve these countries in a process of improving their well-being, while simultaneously reducing their GHG emissions. We have already discussed the strong evidence from a variety of sources that developing-country markets do not function as freely and effectively as those in the developed countries of the world, and that lack of

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[44] Cameron, L.J., H.L. Foster, and W.D. Montgomery (1997) "The Economics of Energy Conservation Strategies to Reduce Greenhouse Gas Emissions," Energy Studies Review; and Jacoby, H. D. (1998) "The Uses and Misuses of Technology Development As a Component of Climate Policy," MIT Joint Program on the Science and Policy of Global Change, Report 43.

economic freedom is a major reason why they remain poor and underdeveloped. There is also very strong evidence that the level of institutional development in China and India explains why their energy use and carbon emissions per dollar of output are so much higher than they would be if technology already economic for use in the United States were used in China and India.

If this is the case, then cooperative efforts move forward on institutional reform can be highly effective in reducing greenhouse gas emissions, as well. The following analysis examines in detail the nature of institutional failings in China and India, and their connection with excessive levels of energy use and greenhouse gas emissions.

A third possibility suggested by some observers is that China, at least, is already on a par technologically with the United States in its new investments. This view is based in part on anecdotal evidence about, for example, powerplants built in China by global engineering firms such as Siemens, and partly by reliance on Purchasing Power Parity measures of GDP. The anecdotal evidence is in fact consistent with the observation that most new investment in China lags in technology, because FDI of the type that brings world class technology is a very small share of either total FDI or total investment in China. The reliance on PPP measures in international comparisons of technology is inappropriate for two reasons. First, it is generally accepted that PPP data on China contains gross inaccuracies, so that it greatly overvalues China's GDP.[45] Second, international comparisons of technology require indices of physical output relative to energy and other inputs, while PPP measures are designed to compare economic wellbeing by evaluating differences in the cost of consumer goods purchased by households. A measure that is accurate for the latter could be grossly inaccurate for technology comparisons. At most, a correction to MER-based measures to account for the overvaluation of the Yuan might be appropriate.

Nevertheless, the MER versus PPP debate has become sufficiently heated that it is important to develop reliable and accepted indicators of differences in technology.[46] The ideal procedure would be to calculate sector specific energy intensities for comparing technology, based on the best available comparable indicators of physical output. As discussed above, information that is available at the sectoral level confirms the picture that emerges at the national level using emissions intensity comparisons based on GDP calculated based on MER. We recommend such studies as part of the Partnership's agenda to promote institutional reform.

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[45] See Appendix A for a discussion of why PPP-based measures of energy intensity are likely to be misleading.

[46] Castles I., and D. Henderson (2003a): The IPCC Emission Scenarios: An Economic-Statistical Critique, *Energy & Environment* 14 2-3, pp. 159-185; and Nordhaus, W. D.: 2005. 'Alternative measures of output in global economic-environmental models: purchasing power parity or market exchange rates?' IPCC Expert Meeting on Emissions Scenarios, US-EPA, Washington D.C.

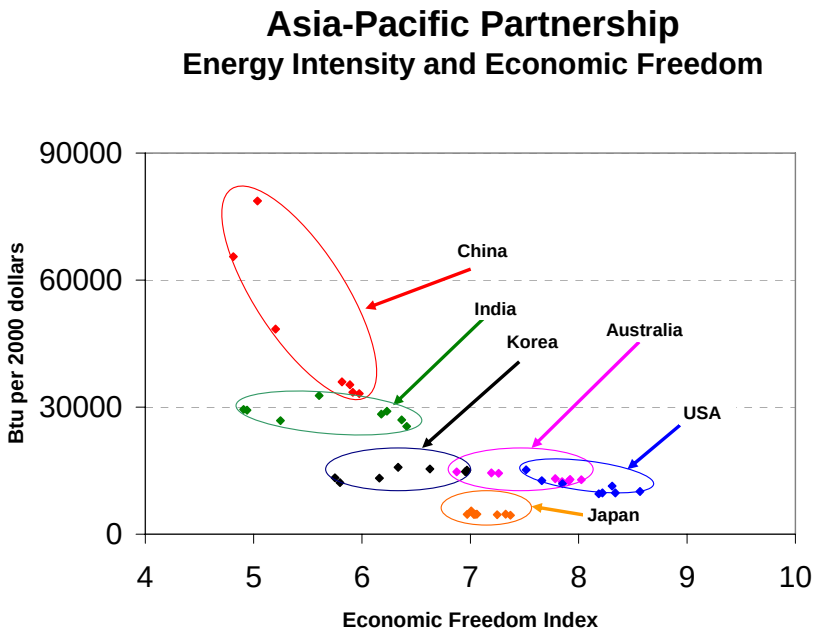
2.6. Econometric Evidence on the Relationship Between Institutional Factors and Energy Intensity

2.6.1. Economic Freedom and Energy Intensity in the Asia Pacific Partnership

Figure 5 illustrates how scores on economic freedom and energy intensity of the members of the Asia-Pacific Partnership have evolved over time. We can see that for each country, progress toward greater economic freedom is associated with lower energy intensity, and that countries with higher scores on economic freedom tend to have lower energy intensity than countries with lower scores. China and India, despite some progress over time, remain in the region with low scores on economic freedom and high energy intensity. The relationship between economic freedom and energy intensity for these two countries, however, is quite clear, with China's progress thus far in institutional reform being accompanied by dramatic improvement in energy intensity. The relationship is clear for India as well, but not as strong. This is due to India's combination of a strong democracy with a powerful bureaucracy and subsidized power sector, so that an aggregate economic freedom index does not accurately characterize the investment climate that matters for energy intensity. The other partners occupy the region with high scores on economic freedom and low energy intensity.

We explore next how cross-sectional data allows us to quantify the relationship between economic freedom and energy intensity, and to conclude that the association seen for China and India and across countries is not accidental.

Figure 5: Energy Intensity and Economic Freedom 1980 - 2003



Although an increasing number of studies have focused on the relationship between economic freedom and growth, very few have explored sector specific implications of economic freedom. The overall rankings of economic freedom are based on detailed analysis of a large number of components of economic freedom, including 38 different categories. This provides a wealth of information on very specific aspects of governance, market institutions, and rule of law that relate directly to the quality of the investment climate, obstacles to technology transfer, and incentives for inefficient energy use. Only one other study has addressed the relationship between greenhouse gas emissions and an aggregate index of economic freedom.[47]

In order to determine the relation of economic freedom and energy intensity, we have analyzed the relationship between specific institutional characteristics and energy intensity using a panel data approach.

2.6.2. Data

The measure of economic freedom comes from the Economic Freedom of the World, published by The Frasier Institute (Economic Freedom of the World, 2005 dataset). The dataset provides detailed economic freedom scores from 1970 to 2000 in 5 years interval. Economic freedom scores are available on an annual basis from year 2000. The latest dataset (for year 2003) provides data on 127 countries for five broad economic freedom groups (1: Size of Government: Expenditures, Taxes, and Enterprises; 2: Legal Structure and Security of Property Rights; 3: Access to Sound Money; 4: Freedom to Trade Internationally; and 5: Regulation of Credit, Labor, and Business) and 38 detailed sub-groups. A brief discussion of the subcomponents is provided in Appendix C. The index is scored from a low score of 0 to a highest achievable score of 10. A low score would indicate that the country is deprived of economic freedom. For example, in 2003 Myanmar had the lowest score of 2.8 while Hong Kong had the highest score with 8.7.

Energy intensity (total primary energy consumption per dollar of GDP measured in Btu per 2000 U.S. dollars using market exchange rates) data was collected from the Energy Information Administration. Data on energy intensity is available on an annual basis from 1980 onwards. Data for year 2003 is available for 167 countries with the lowest energy intensity of 1598 Btu per 2000 U.S. dollars for the country of Chad and Tajikistan having the highest energy intensity of 198203 Btu per 2000 U.S. dollars using market exchange rates.

[47] Carlsson and other studied the relationship of CO_2 emissions and economic freedom. Carlsson, F. and Lundstrom S. (2001), "Political and Economic Freedom and the Environment: The Case of CO_2 Emissions," Department of Economic, Goteborg University, Sweden

All other macro economic data were collected from the World Development Indicator (2001 and 2005) published by the World Bank.

The pooled energy and economic freedom dataset consists of 838 observations. The dataset includes 25 high incomes, 45 middle income and 21 low income countries (see Appendix-B for the list of countries by income level in the sample).[48] The descriptive statistics for energy intensity and the five major sub-components of the economic freedom index are shown in Table-3.

Table 3: Descriptive Statistics of Energy use per GDP and major subcomponents of Economic Freedom of the World Index

Description	Variable	Obs	Mean	Std. Dev.	Min	Max
Energy Intensity	nrggdp	838	17732	18650	1599	208677
Size of Government: Expenditures, Taxes, and Enterprises	gsize	874	5.6	1.6	1.2	9.7
Legal Structure and Security of Property Rights	legals	874	5.5	1.9	1.0	9.6
Access to Sound Money	smony	874	7.2	2.1	0.1	9.8
Freedom to Trade Internationally	frdtr	874	6.6	1.5	1.7	9.8
Regulation of Credit, Labor, and Business	regul	874	5.7	1.0	2.5	8.8

2.6.3. Model Specification

In this paper we develop several different regression models of energy intensity and economic freedom. We assume that energy intensity is a linear function of economic freedom or its subcomponents. In order to control for the economic structure, we use the shares of services and agriculture in GDP. We also control for income level by grouping the countries into low, middle, and high income countries as defined by the World Bank, and estimate a "fixed effects" model to isolate the influence of institutional factors.

[48] High-income economies are those in which 1999 GNI per capita was $9,266 or more. Middle-income economies are those in which 1999 GNI per capita was between $755 and $9,265. Low-income economies are those in which 1999 GNI per capita was $755 or less.

We have used the following three regression models and its variations to build relationship of economic freedom and energy intensity:

$$nrggdp_{i,t} = \alpha_i + efw_{i,t}$$

$$nrggdp_{i,t} = \alpha_i + gsize_{i,t} + legals_{i,t} + smony_{i,t} + frdtr_{i,t} + regul_i$$

$$nrggdp_{i,t} = \alpha_i + iprop_{i,t} + accap_{i,t} + burea_{i,t} + gsize_{i,t} + srvsh_{i,t} + agrsh_{i,t} + dlow_i + dmid_i + dhigh_i$$

where dependent variable *nrggdp* represent energy intensity for country *i* and at time *t*, and independent variables *gsize, legals, smony, frdtr,* and *regul* are the five subcomponets of economic freedom index. *Iprop, accap,* and *burea* are very specific factors (level of protection of intellectual property, access of citizens to foreign capital markets and access to domestic capital, time involved with government bureaucracy) contributing to the economic freedom index. The control dependent variables are share of services values added as a percent of GDP (*srvsh*) and share of agriculture values added as a percent of GDP (*agrsh). Dlow, dmid,* and *dhigh* are indicator variables where the value is one if the country is low, middle, or high income country respectively.

The regression results for the relation between economic freedom, its sub-components, and energy intensity are shown in Table-4. The first regression (Model-A1) suggests that economic freedom is statistically significant, though by itself the aggregate index does not explain a large percentage of the variation in energy intensity. However, the explanatory power does increase when the subcomponents of the economic freedom is taken separately. In Model-A2 we expand the overall economic freedom and include the five sub-components of the economic freedom. All sub-components of the economic freedom except freedom to trade internationally variable (*frdtr)* are statistically significant and of the correct sign. The regression result (Model-A2) suggests that more reliance on personal choices and market *(gsize),* strong rule of law and limitations on exercise of government power (*legals),* sound macro-economic conditions *(smony),* and less restrictive regulation of credit and labor markets *(regul)* lead to improvement in energy intensity on average.[49]

[49] The subcomponent that measures restraints that affects international exchange *(frdtr)* contributes to an increase in energy intensity. Since the current sample is dominated by middle and low income countries, the positive sign on the coefficient on *frdtr* might indication that countries in the sample are not replacing capital with better technologies.

Table 4: Energy Intensity Regression Results

Variable		Model-A1	Model-A2
Constant		36603.0	40048.0
		(3539)*	(3968)*
Economic Freedom of the World Index	efw	-3068	
		(566)*	
Size of Government: Expenditures, Taxes, and Enterprises	gsize		-786
			(457)**
Legal Structure and Security of Property Rights	legals		-722.0
			(452)
	smony		-1030.0
Access to Sound Money			(389)*
	frdtr		2999
Freedom to Trade Internationally			(607)*
	regul		-4600
Regulation of Credit, Labor, and Business			(484)*
Number of Observation		839	838
R-squared		0.03	0.09

Standard errors in parenthesis
* Significant at 1%, ** significant at 10%

The regression result for overall economic freedom with control variables that take into account the heterogeneous economic structure of the countries in our sample (Model-B1-Model-B4) and income level effects are shown in Table 5 (Model-B5). The explanatory power increases as a result of including the control variables vis-à-vis the result where economic and income levels are not controlled for (Model-B1).

Table 5: Energy Intensity Regression Results

Variable		Model-B1	Model-B2	Model-B3	Model-B4	Model-C1
Constant		36603.0	39805.0	74573.0	70351.0	52607.0
		(3539)*	(4092)*	(6167)*	(6172)*	(7162)*
Economic Freedom of the World Index	**efw**	-3068	-4210.0	-5435.0	-5581.0	-4136.0
		(566)*	(862)*	(849)*	(840)*	(885)*
Services share of GDP	**srvsh**		74	-277	-208	-162
			(71)	(83)*	(84)*	(83)**
Agriculture share of GDP	**agrsh**			-526	-497	-566
				(71)*	(71)*	(89)*
Population	**pop**				19	18
					(5)*	(4)*
Dummy - low income	**dlow**					10645
						(3145)*
Dummy - middle income	**dmid**					9493
						(2011)*
Dummy - high income	**dhigh**					–
Number of Observation		839	736	736	736	736
R-squared		0.03	0.04	0.11	0.13	0.16

Standard errors in parenthesis
* Significant at 1%, ** significant at 5%

Aggregate economic freedom is formulated by averaging all of the 38 subcomponents, but many of these measure aspects of governance or human rights that may not be important in explaining the variation in the energy intensity.[50] A simple averaging method to derive the economic freedom score will under-emphasize important variables while over-emphasizing irrelevant variables, and will therefore weaken the association between the aggregate score and energy intensity. In order to address this, we include as explanatory variables scores on aspects of economic freedom that we can identify from the literature and a priori reasoning as having a direct connection to energy intensity.

The existence of a relationship between institutions and the amount of energy used – and emissions released – per dollar of output is consistent with economic theory and borne out by studies of the investment climate and growth process in China and India.

The rule of law has long been considered a prerequisite of sustained economic growth, because sustained economic growth depends on the enforcement of long term contracts, international trade, and financial investments. This is only possible in a stable framework of commercial law that protects investors and creditors rights.[51] Lack of protection for

[50] The low explanatory power of a regression in which the overall economic freedom is regressed against energy intensity (Model-A1is consistent with the hypothesis that only some of the components of the freedom index affect energy intensity.

[51] Dam, K. (2006) "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" John M. Olin Law & Economics Working Paper No. 275, January 2006.

intellectual property, inadequate or nonexistent enforcement of long term contracts, and bureaucratic delay and corruption are commonly mentioned problems in China and India, as well as in many other developing countries.

Inadequate legal institutions also help to explain the technology gap, because of the key role that foreign direct investment plays in technology transfer. If the institutional framework discourages multinational companies from capital investments that embody the best world-scale technology, productivity will lag and energy as well as other resources will be used less efficiently. Failure to protect intellectual property, in particular, will lead to unwillingness to license technology as well as discouraging use of advanced technologies in the course of direct investment.

In general, it is to be expected that the lack of a market-oriented investment climate hinders technology transfer, by discouraging foreign direct investment and use of most advanced technology adopted elsewhere. Moreover, distortions in energy pricing due to price controls and subsidies administered through state enterprises can be expected to prevent adoption and diffusion of technology that is economic in regions with free markets.

Inadequate infrastructure, including human capital as well as transportation, electric power, water and other physical infrastructure can also discourage FDI and frustrate deployment and use of advanced energy technologies.

Based on our a priori expectation that these institutional factors will be associated with differences in energy intensity, we included scores on protection of intellectual property, access to citizens to foreign capital markets, time with government bureaucracy, and size of the government as explanatory variables.

In each case, a higher score indicates performance more consistent with basic notions of economic freedom. Thus a higher score on "time for government bureaucracy" indicates *less* time spent dealing with government agencies, and a higher score on "size of government" indicates a *smaller* role of state run enterprises in the economy.

We used pooled data on these scores from the Economic Freedom of the World study for 1990 – 2005. Using these specific factors together with control variables for economic structure and income level significantly increases the explanatory power (Model-D4).[52] In model D1 only the energy intensity related variables are regressed, while in D2 we test for group fixed effects. The coefficients on the income dummies are not significant and hence

[52] We pick from the list of economic freedom subcomponents those that best reflect market imperfections that would be expected to discourage use and transfer of economically efficient technologies and hence be most likely to cause differences in energy intensity.

with specialized subcomponents there is no difference in the variation in energy intensity. However, when we control for economic structure the explanatory power increases and moreover if the income dummies are also included (Model-D4) the results indicate that 38% of the energy intensity is variation can be explained by the control variables. In addition, based on these results, we can say that the energy intensity differs by income level with specialized subcomponents.

2.6.4. Results of the Statistical Analysis

The detailed results are reported in Table-6

Table 6: Energy Intensity Regression Results

Variable		Model-D1	Model-D2	Model-D3	Model-D4
Constant		105439	102759	150636	164021
		(8132)*	(8489)*	(11576)*	(12625)*
Protection of intellectual property	iprop	-2640	-1974.0	-4739.0	-4323.0
		(720)*	(997)*	(889)*	(1040)*
Access of citizens to foreign capital markets/foreign access to domestic capital	accap	-4194	-4164	-4124	-4006
		(967)*	(970)*	(1059)*	(1038)*
Time with government bureacracy	burea	-2520	-2394.0	-2847	-2348
		(907)*	(929)*	(948)*	(947)*
Size of government	gsize	-3832	-3893.0	-4505.0	-4184
		(732)*	(742)*	(799)*	(805)*
Services share of GDP	srvsh			-335	-338
				(156)**	(157)**
Argriculture share of GDP	agrsh			-960	-1490
				(184)*	(226)*
Dummy - low income	dlow				
Dummy - middle income	dmid		594.0		-17326.0
			(3314)		(4333)*
Dummy - high income	dhigh		-3636.0		-21275.0
			(5306)		(6340)*
Number of Observation		381	381	345	345
R-squared		0.27	0.27	0.35	0.38

Standard errors in parenthesis

* Significant at 1%, ** significant at 5%

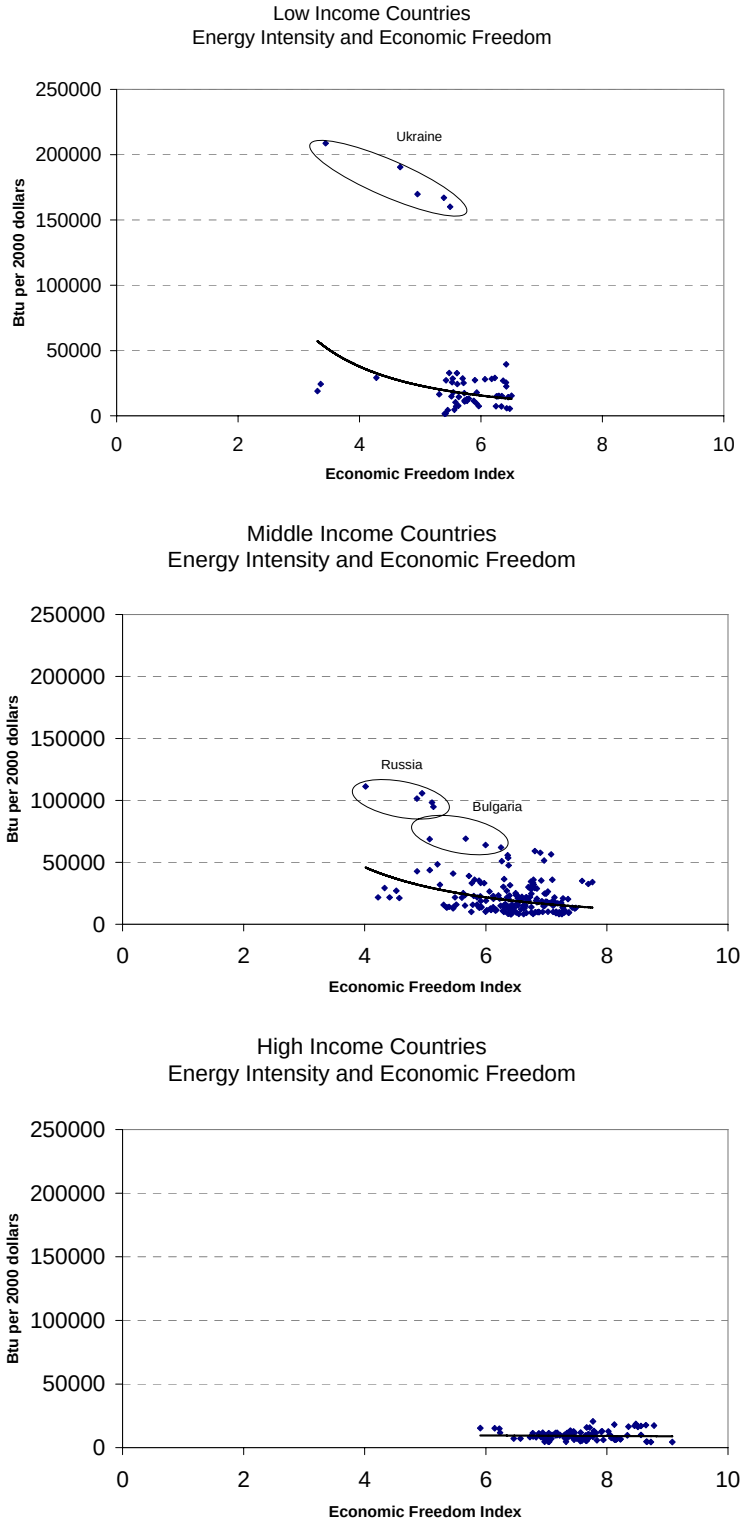
Taken by itself, the aggregate economic freedom index explains only a small share of differences in energy intensity. Components of the freedom index most closely related in principle to efficient use of energy and technology transfer do explain a significant share of the variation. However, some of the influence of these institutional factors is obscured by the different effect of economic freedom on emissions in the lowest income countries. In the initial stages of economic growth brought about by greater economic freedom, rapid industrialization leads to increasing emissions per dollar of output. This is the situation of the poorest countries, as they emerge from subsistence agriculture and local production into a market economy. The ability of energy related institutional factors to explain energy intensity becomes quite large when we control for income level and economic structure.

Moreover, we see that the coefficients on the energy-related institutional variables become larger when we control for economic structure and income level, indicating a larger quantitative impact of institutional reform on energy intensity than would be predicted without controlling for structure and income level.

Results for the income groupings also reveal what has been called an "environmental Kuznets curve." The negative sign indicates that mid and high income countries have lower energy intensity than average for all countries, and other things being equal, the energy intensity for high-income countries is lower than for mid-income. This implies that even if they have the same scores on components of economic freedom, and identical industry structure, a mid-income country will have lower energy intensity than a low-income country, and a high-income country will have lower energy intensity than a mid-income country. This suggests that the process of growth itself, which is stimulated by economic freedom, leads to lower energy intensity and emissions intensity.

We observe this relationship in the data. Figure 6 contains three panels, which plot the relationship between the overall index of economic freedom and energy intensity for each of the three groups of countries (the countries included in each group are listed in Appendix B). It can be seen that for the lowest income group higher scores on economic freedom are associated with greater energy intensity, while for middle and high income groups we observe that the higher scores on economic freedom are associated with lower energy intensity.

Figure 6: Overall Index of Economic Freedom and Energy Intensity 1980 - 2003



2.7. How Improved Markets Lead to Lower Emissions and Higher Growth

Institutional reform can be expected to increase the productive potential of a lagging economy by improving the efficiency of resource use based on technologies currently available, and by facilitating transfer of more advanced technology. When these changes occur, the result can be expected to be both improved material standards of living and reduction in energy use and greenhouse gas emissions. This is illustrated in Figure 7:

Figure 7: How Efficiency and Technology Improve Growth and Emissions Intensity

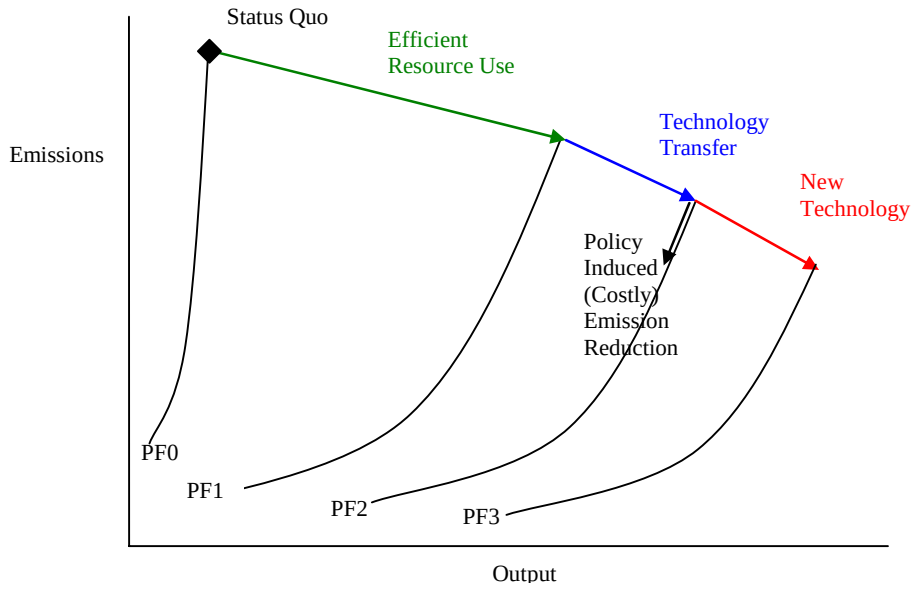


Figure 7 depicts the tradeoff between emissions reduction and provision of needed goods and services to the population of a developing country. Each of the curves PF0 to PF3 represents a "production frontier" or the combinations of marketed economic output and greenhouse gas emissions that are possible given the institutional character of the country. These slope downward to the left, indicating that for any given institutional setup a country can only achieve lower emissions by sacrificing some economic output. PF0 represents the choices available to a country with low economic freedom, markets with distorted and subsidized prices, and an unfavorable investment climate. The level of output and emissions in such a country is represented by the "status quo" point. We assume that in such a country, with no policies in place to limit greenhouse gas emissions, the maximum amount of output possible with the existing institutions, prevailing technology, labor force, and endowment of capital is being produced, with no regard to limiting greenhouse gas emissions. It would be necessary for this country to give up output to get lower emissions, and indeed to reduce income from low to even lower levels.

If in such an economy price distortions were removed, so that all domestic resources were used more efficiently with the prevailing technology, it would be possible to get more output from the same labor force and capital stock. At the same time, energy would be used more efficiently, automatically reducing greenhouse gas emissions. Thus, even if nothing were done to limit emissions, more output would be possible and emissions (compared to the baseline) would be likely to decrease. This movement from PF0 to PF1 depicts the economic gains and emission reductions possible by correcting pricing distortions and subsidies, explicit and implicit.

If in addition the investment climate were improved, so that foreign direct investment led to a larger capital stock and to improved technology, an additional increase in output possible with existing labor force and natural resources would be achieved. Since these technologies almost all use energy more efficiently, likely emissions would fall as well even with no policies in place to reduce emissions. This movement from PF1 to PF2 illustrates the economic gains and emission reductions possible with an improved investment climate.

With higher income attributable to creation of efficient markets and technology transfer, such a country might also choose to begin adopting policies that reduced the amount of output available for consumption in order to achieve additional emission reductions. This policy choice is represented by an arrow pointing downward to the left, indicating a reduction in emissions is achieved at a cost in foregone consumption.

Finally, appropriate R&D can provide new technologies that move the production frontier further to the right, to PF3. If this R&D provides productivity enhancing and emission reducing technologies, than again it is possible to gain both increases in output and reductions in emissions.

2.8. The Institutional Environment in China and India and the Technology Gap

A number of studies have addressed aspects of the investment climate and the progress of institutional reform in China and India. These studies reveal some of the areas in which institutional reform would have direct and predictable effects on greenhouse gas emissions, as well as contributing to growth in overall productivity and incomes.

2.8.1. Why the "Investment Climate" and FDI Matter For Greenhouse Gas Emissions

Foreign Direct Investment (FDI) can play an important role in bringing the level of technology to that of the developed countries. In addition, FDI can be a source of improved and cleaner technology, which would improve energy efficiency and contribute in the reduction of emissions. In light of these relationships and findings, the challenge for China and India is not only to attract FDI but to ensure that FDI brings with it improved technology is imported to help address the energy efficiency problem.

China

China has been the largest recipient of FDI in recent times and has made significant improvements in its energy intensity. However, despite its continued improvement in energy efficiency and high levels of FDI, analysis of macroeconomic data suggests that technology embodied in new investment in China is not at the same level as in the developed countries.[53] This apparent paradox is resolved by research showing that FDI flows to China have come primarily from other Asian countries, and have not as a result embodied the type of technological advances that would accompany FDI from OECD countries. An extraordinary 95 percent of the FDI in China is directed to small-scale firms.[54] These small firms, primarily competing for the domestic market, would not require or use high technology in their production processes. Studies by Zhang and Karen Fisher-Vanden have shown that decrease in the energy intensity in China is primarily due to shift in the structure of the Chinese economy. [55]

Huang et al. observe that increases in FDI have come from local Chinese firms seeking investment rather than foreign firms seeking opportunities on their own.[56] This is in part attributable to the more favorable treatment of foreign firms in terms of levies, availability of bank financing, and paper work. The same authors have argued that the surge of FDI to China is due to a lack of financial capital in China. This agrees with the findings of Dam and others that the lack of legal protections for creditors makes financial investment in the private sector excessively risky, while funds flowing from the Chinese state banking system are largely "directed lending" to state owned enterprises.

The fragmented market of China and distortions in its economic and financial system are also seen a disincentive for better technology transfer and absorption. Huang provides a rather different perspective on the Chinese FDI inflow. He argues that an "economic litmus test is

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[53] Bernstein, P., W.D. Montgomery, and S.D. Tuladhar (2005), "Potential For Reducing Carbon Emissions from Non-Annex B Countries through Changes in Technology," forthcoming in Energy Economics.

[54] Di, W. (2006) "Pollution Abatement Cost Savings and FDI Inflows to Polluting Sectors in China", University of Texas at Dallas, School of Social Sciences.

[55] Zhang (1997) points out that the shift in the structure of economies from energy- intensive to less-energy-intensive caused real energy intensity to decline over the past two decades. K Fisher-Vanden, G. Jefferson, M. Jingkui, and X. Jiany "Technological Innovation and Diffusion in Transition Economies: The case of China" (2003) suggest that the main reasons for improvement in energy use in China are increasing energy prices, research and development expenditures, reform in the ownership structure of the enterprise, and structural shifts at the industrial level. It should be noted that the structural shift and other drivers are initiated through FDI.

[56] Huang, Y. and W. DI (2003) "A Tale of Two Provinces: The Institutional Environment and Foreign Ownership in China".

not whether a country can attract a lot of FDI but whether it has a business environment that nurtures entrepreneurship, supports healthy competition and is relatively free of heavy-handed political intervention."[57] Case studies have also shown the lack of technology transfer in FDI in China, and all conclude that "the reasons for these potentials [positive spillover of technology] not being fully realized are institutional barriers." [58]

India

Past protectionist regimes in India limited the ability of the Indian economy to attract FDI. Over the past decade, the inflow of FDI into India has increased steadily; however, much of it has come in the information technology (IT) service areas where the private sector initiative has been vibrant. Other sectors, such as power, energy, and manufacturing still lack investment. With its economic growth shackled by government regulation, corruption and a deteriorating infrastructure, India uses far more energy, and releases far more greenhouse gas emissions, per dollar of GDP than any developed country and more than most developing countries.

India lags far behind other middle income developing countries in attracting FDI, because of its inhospitable investment climate. [59] For example, in India it takes 11 different procedures and 89 days in average to set up a business. Registering property has to follow 6 procedures and requires 67 days. Enforcing a contract takes more than a year (425 days) and requires more than 40 different procedures.[60] China has almost the same bureaucratic hurdles, far larger than Australia, as seen in the figure below from the World Bank.

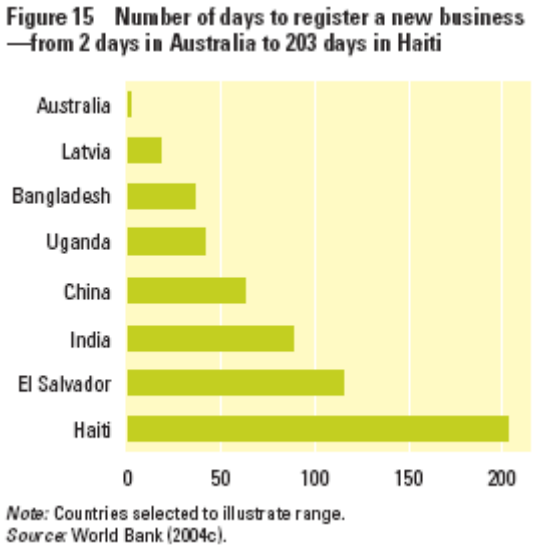
[57] Huang, Y. What China could learn from India's slow and quiet rise, Financial Times, 27 January 2006.

[58] As cited in Di, W. (2006) "Pollution Abatement Cost Savings and FDI Inflows to Polluting Sectors in China", University of Texas at Dallas, School of Social Sciences.

[59] India's foreign direct investment (FDI) over the past four years (2000-2003) has averaged about $3.3 billion per year. As a percentage of gross fixed capital formation, this amounts to about only 3.1 percent, which is much below the developing country average of about 12 percent. The low level of total value of FDI (the current market value of FDI holdings) in India (5.4 percent of GDP) compared to the average for all developing economies (31.4 percent of GDP) is also a reflection of the inadequate conditions of the investment climate (World Investment Report, 2004).

[60] The World Bank, *Doing Business 2005*.

Figure 8: Number of Days to Register a New Business



2.8.2. Need for infrastructure can frustrate deployment and use of advanced energy technologies

The World Bank's recent report on the investment climate in India attributes what the World Bank characterizes as India's low rate of investment and productivity growth relative to China and other developing countries to India's investment climate The poor state of infrastructure, especially transport and power generation, is cited as the most important negative aspect of the investment climate. Both transport and power generation and transmission are largely closed to foreign investment, and dominated by State enterprises and social policy. Lack of transportation infrastructure adds to inventory costs because of unreliable and slow shipments as well as raising costs of moving goods.

To keep pace with the current economic development in China, China will need extraordinary level of infrastructure investment. It is estimated that over the periods 2006-2010, China will need to spend $132 billion annually (6.9% of GDP) for infrastructure expenditure.[61] On a sectoral level, infrastructure expenditure on electricity sector alone will be over $72 billion annually.[62] Historically external donor financing has been minimum and the possible source of such financing can only be possible with private investment which very much hinges on the investment climate.

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[61] "Connecting East Asia: A New Framework for Infrastructure" Asian Development Bank, Japan Bank for International Cooperation, and The World Bank, 2005. The total investment includes $88 and $44 billion for investment and maintenance expenditure respectively.

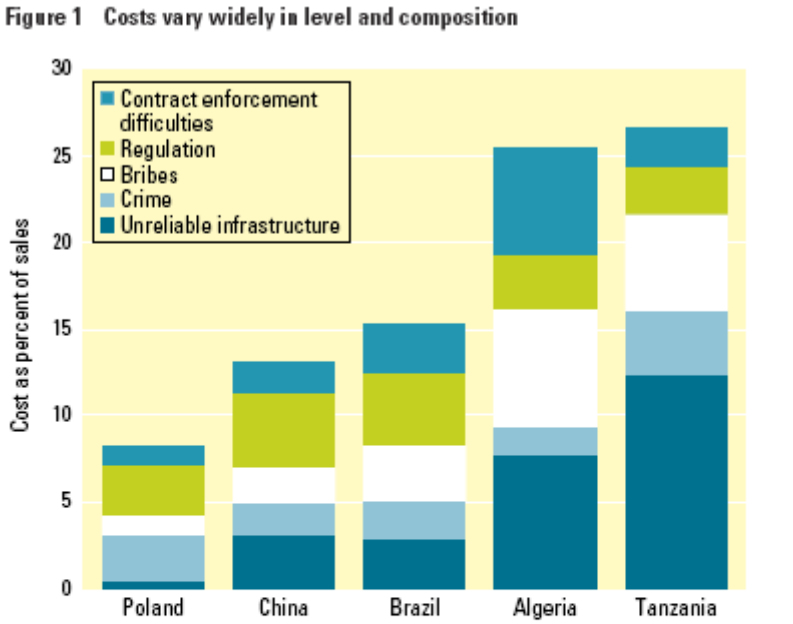
[62] Fay, M. and T. Yepes (2003) "Expenditure on Infrastructure in East Asia Region, 2006-2010," The World Bank.

India's electric power industry is insolvent and unable to add generating capacity fast enough to meet demand, leading to unreliable supply and power shortages, due to excessive subsidies and price controls that hold revenues below cost and make financing for capacity expansion unavailable. Due to unreliability of the electric system, 60% of industry does its own generation. The inefficiency of small scale generation is likely a large part of the reason for high energy use per dollar of output, and for its continuation. This is particularly a problem for high value added and technology intensive industries, whose growth would help to lower energy intensity. The World Bank sees this lack of infrastructure as the most significant problem with the investment climate, and it leads directly to inefficient energy use as well as discouraging FDI.[63]

[63] Asian Development Bank, News Release, No. 188/04, Asian Development Bank, 2004.; and Montgomery, W.D. and S. D. Tuladhar 92005) "Impact of Economic Liberalization on GHG Emission trends in India," Climate Policy Center.

2.8.3. Why rule of law matters

Figure 9: Additional Costs and Obstacles



Note: The survey asked registered firms to report values either in monetary terms, directly as a share of sales, or in terms of time. "Contract enforcement difficulties" captures the share of inputs that are below agreed-upon quality (weighted by material inputs in total sales) and overdue payments (as a share of total payments, using an interest rate of 10 percent for the average length of overdue payments). "Regulation" captures management time spent dealing with officials (weighted by the cost of management compensation to total sales), and the gap in actual employment relative to desired levels due to regulatory costs associated with hiring and firing workers (weighted by total labor costs in sales). "Bribes" are the total costs of bribes as a share of sales. "Crime " is the sum of losses due to theft, security costs, and protection payments (as a share of sales). "Unreliable infrastructure" includes sales lost due to interruptions in power and telecommunications and due to the loss or damage of goods in transit. Countries selected to illustrate range.
Source: World Bank Investment Climate Surveys.

China

Figure 9 characterizes some of the obstacles to investment associated with China's rule of law that have been identified by the World Bank. Roger Bate captures the importance of legal institutions well in an essay on the relationship between China's massive problems of water supply and water quality and the lack of anything resembling property rights in water in China. He comments that "As Russia is discovering, it's not possible to throw off the shackles of communism and then confine yourself to the bits of capitalism that appeal to the current oligarchs. Success will require the discipline of the market as much as the opportunity and growth it brings, and growth without responsibility is not sustainable."[64]

[64] Roger Bate, "China from Red to Green," American Enterprise Institute, March 2, 2006.

Kenneth Dam comments that when China embarked on creating a market economy in 1978 it had no legal system in the Western sense, let alone property law. The distance that China has come since that point is truly remarkable, and responsible in no small part for its high rates of economic growth. Nevertheless, significant issues with the rule of law, protection of intellectual property, and enforcement of contracts remain. The deficiencies appear as much in the administration of justice as in substantive law.

Dam states that "In 2004 the President of the Supreme People's Court conceded that the difficulty of executing civil and commercial judgments has become a major 'chronic ailment' often leading to chaos in the enforcement process." According to his statement, "China's courts lack the authority and stature to command obedience to their decisions, especially where such decisions affect other government branches and officials."[65] Professor Dam's review of the state of Chinese law concludes that in many ways substantive law – the laws written on the books – is reasonable, but local enforcement suffers from lack of resources and expertise, bias in favor of local parties with no independent national source of review, and a tendency to make judgments as ordered or suggested by local government officials.

The credit system in China particularly suffers from a lack of substantive law. Despite a huge financial sector, China has no law protecting secured creditors and faces substantial ideological opposition to creating such a law, that would put lenders rights above, for example, those of workers. This legal lacuna makes financial intermediation virtually impossible for the private sector, so that there is almost no flow of bank loans or access to bond markets for any but state owned enterprises.[66]

Lack of protection for intellectual property is a prominent and well known failing of the rule of law in China, which has been a haven for piracy of copyrighted material and source of concern about copying of proprietary technology and processes. As a condition of its accession to the WTO, China agreed to address issues in intellectual property but widespread concerns remain. Intellectual property law has been the topic of repeated discussions between the United States and China, and is a central issue in the recent review of U.S. trade policy toward China.

China has shown concern about some aspects of enforcement of intellectual property, but largely in regard to counterfeit products, especially pharmaceuticals, that are a real menace to the Chinese population. The number of IP infringement cases in China that have been

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[65] Kenneth W. Dam "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" John M. Olin Law & Economics Working Paper No. 275 (2D Series) The Law School, The University of Chicago, January 2006.

[66] Nicholas R. Lardy, When Will China's Financial System Meet China's Needs. In How Far Across the River? Chinese Policy Reform at the Millennium, ed. Nicholas C. Hope, Dennis Tao Yang, and Mu Yang Li, 67–96. Stanford: Stanford University Press. 2003.

brought is quite small and will remain small as long as financial damages awarded for IP violation remain only ceremonial and a token basis. Beijing Central Press Union Technology paid a paltry amount of $9600 as a fine for pirating 59,000 Windows XP CDs. Defendant, Beijing Metals and Minerals Import and Export Co., paid a fine of $20,000 for attempting to export imitation Nike clothing in violation of trademark agreement.[67] There is also hope that as China develops its own capability for scientific and technological discover, it will become concerned about defending its own property and become part of the global system of protection of intellectual property. There have been some positive signs of local firms engaging in protecting their interests. A local Chinese maker of USB flash memory, Netax Technology Co., was awarded $120,000 where the defendant Huaqi and Fuguanghi was accused of patent infringement.[68]

At present, however, there are disturbing signs of unwillingness to provide such protections to the intellectual property of foreign investors in China. The Wall Street Journal, for example, reports that "China's long-awaited antimonopoly law probably will create more obstacles to foreign companies' access to its booming economy, people familiar with the law's evolution say. Western companies' most pressing concern is that the law could allow trumped-up antitrust charges to chip away at their profitable patents. That fear is based on the latest known draft of the law, which prohibits the abuse of intellectual-property rights but doesn't describe how regulators should interpret such offenses." Quoting a Chinese law professor, the Journal continues "The finer points of antitrust law and intellectual-property rights -- a patent is essentially a legal monopoly -- aren't dealt with in the planned law, and China has almost no expertise in this area."[69]

India

Corruption and regulation are rated as the next most negative parts of the investment climate, following the disastrous state of the power grid, with labor and land market restrictions also important. These are found to be greater problems for resource industries. All these factors frustrate attempts to move 60% of India's population out of agriculture into other sectors.

Administration of justice is also mentioned by the World Bank as a significant negative in the investment climate, with lengthy judicial processes and little confidence in the

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[67] Cox, A. and K. Sepetys (2006) "Intellectual Property Rights Protection in China: Litigation, Economic Damages, and Case Strategies," in Economic Approaches to Intellectual Property: Policy, Litigation, and Management, eds. Gregory K. Leonard and Lauren J. Stiroh.

[68] Ibid.

[69] China antitrust law worries foreign interests --- Western firms fear policies could target profitable patents By Adam Cohen 26 January 2006 The Wall Street Journal Europe.

predictability or fairness of results. Also, the Gujarat government's unilateral decision to revise the power purchase agreements of five independent power producers sends a clear signal of the lack of contract enforcement and will adversely impact investor confidence (Godbole 2004)[70].

2.8.4. Why energy subsidies and price controls matter

At a sectoral level, the state of Indian electricity sector provides a vivid reminder of how detached the sector is from adopting free market principles and the extent of distortions. Excessive energy subsidies have historically been a part of the state governments' policy program and continue to be pervasive in the state governments' operations. Subsidies for coal and petroleum products are substantial, and are significant in encouraging uneconomic use of these fuels.[71]

The length to which the state governments in India have gone to create distortions in the energy price (electricity price) is quite remarkable, and is one of the primary reason India faces total absence of investment in the power sector and chronic shortage of power in India.

In the energy sector, the largest impact has been the abandonment of full privatization of the state-owned petroleum sector. The frustration of the private sector against excessive government meddling in private sector affairs and the slow pace of the economic reform is well summarized by a notable Indian business as "What we [India] are doing is a lot of back-stepping and rolling back…sometimes policy is being compromised to an extent where it has no strength or is ineffective."[72]

In the power sector, national and state policies are in conflict with, at present, the states appearing to be winning. The infamous Dabhol project that was to establish two gas-fired units of 2000 MW of generating capacity with an initial cost of $2 billion would have been the largest ever foreign direct investment in India. However, tariff disputes with the state electricity board of Maharastra along with other obstacles ultimately killed the project even

[70] Godbole, M. (2004), Power Sector Reforms: No Takers, Economic and Political Weekly.

[71] Larson and Shah (1992) estimated the total energy subsidy to coal and petroleum product was in excess of $2.7 billions of dollars resulting in a welfare cost of about $190 millions of dollars. Recent figures of the total figure suggest that the economic services (includes energy and industry) received more than 80 percent of the total subsidy in 2003-2004. The relative share of energy and industry and mineral sectors in total subsidy for the fiscal year 2004 was 4 percent and 14 percent respectively. The total subsidy amounts to 4 percent of the GDP in fiscal year 2004.

[72] An interview of Ratan Tata, Chairman of Tata Group, cited in "Indian business chief hits at minister," September 2005, Financial Times.

when India was in dire need of power. With the current reform-minded political outlook, the State of Maharastra has announced the revival of the Dabhol project.[73]

While reforms in the electric utilities sector under the Electricity Act of 2003 are continuing, states are moving in the opposite direction by introducing further, extreme subsidies. In 2005, the newly elected Chief Minister of Andhra Pradesh decided to distribute power for free for agricultural users. Subsequent to the decision by Andhra Pradesh, a state that was a model for energy sector and other reforms, Tamil Nadu, included hut dwellers along with agricultural consumers as free power recipient and reduced tariffs significantly. Another state, Maharashtra, has also introduced free power (at the same time it is attempting to revive Dabhol!). These state-level decisions, that are counter to the national goal of rationalization of tariffs (Electricity Act 2003), have added millions of dollars to the state budget, diminished incentives for efficient energy use, and caused further deterioration in the investment climate.

2.8.5. Why state direction of investment matters

India's large state enterprises and State Electricity Boards are insulated from the market forces that promote efficiency.[74] Many domestic industries are protected and offered favored financing which allows them to continue using inefficient technology and practices without losing out to international competition. There are also restrictions on technology imports, designed to protect domestic industries, and restrictions on FDI that prevent technology transfer. Energy price regulations encourage inefficient energy use, and lack of infrastructure limits the available skills for using new technology.

As one example, more than 21 percent of the government revenue in India derives from public-sector operation. This is part of the reason for the low level of inward FDI growth in India compared to other transition countries that have adopted economic liberalization.

In China, much of the economy remains dominated by enterprises at least partially owned by the state, which are in turn financed by state owned banks that direct financing based on decisions of the central government rather than based on anticipated profitability and

[73] Reineberg, H.H. (2006), "India's Electricity Sector in Transition: Can Its Giant Goals Be Met?", The Electricity Journal, vol. 19, Issue 1.

[74] Indian state-owned enterprises have a long history of being in the "red" as a result of inefficient operation in addition to political interferences in its operation. The financial burden that state owned enterprises have to bear goes beyond its own operation and control. Financial Times (September 2005) notes that "The majority state-owned oil group's finances have also been hit by the requirement that it help state oil refiners and retailers to shoulder the burden of losses caused by the government's refusal to pass on the full weight of oil price rises to consumers, who enjoy massive subsidies on household fuels and kerosene."

creditworthiness. China has fallen behind compared to India on institutional reform as a result of a sense of complacency over the past decade.[75]

2.8.6. Institutional Change is A Prerequisite for Success In All Other Partnership Objectives

Financing and building projects based on advanced energy technologies, or that require substantial capital investments to improve energy efficiency, is an uphill battle when the investment climate and energy pricing are not favorable. Without fundamental economic reform reductions in emissions intensity requires policies and programs that will be costly and have limited effects; with fundamental economic reform emissions intensity will fall as a consequence of improved technology, more efficient investment, and enhanced economic growth. The technology gap is so large in the case of China and India that emission reductions from moving to technology economic in the United States are about 8 times as large as the additional gains possible by moving to an emissions intensity half that of the United States, characteristic for example of Japan. [76]

Without remedies for the fundamental institutional problems existing in China and India, the continuation of two unfortunate current conditions can be expected:

- A hostile economic environment will prevent the technology that might be introduced through demonstration projects supported by the Partnership from spreading throughout the economy

- Lowering emissions overall will remain costly, because without new technology emission reductions will require diverting resources that could otherwise be used for growth

If remedies are found for fundamental institutional problems, two kinds of results can be expected:

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[75] "The resilience of the state sector is a result of vast, powerful vested interests, powerful because so many of the remaining state enterprises are essentially wholly-owned subsidiaries of government agencies.

State monopolies and oligopolies retain tremendous power to keel competitors from entering their sectors. For example, Chalco, the sole supplier of domestic alumina in China has defended its monopoly by refusing to grant potential rivals licenses for the technology need to refine China's peculiar low-grade bauxite." Financial Times, 28 February 2006, "Challenging change: why an ever fiercer battle hinders China's march to the market."

[76] The potential for emissions reduction through technology transfer is discussed in P. Bernstein, W. David Montgomery and S. D. Tuladhar, "Potential for Reducing Carbon Emissions from Non-Annex B Countries through Changes in Technology." Accepted for publication, *Energy Economics*. 2006.

- There will be much better prospects for demonstration projects that transfer economic technologies and enhanced potential for positive spillover effects

- The root causes of both poverty and high carbon intensity will be addressed together.

2.9. What Might the Future Look Like Without Fundamental Institutional Change

2.9.1. Sustained Economic Growth Is Unlikely Without Continued Institutional Change

Neither China nor India can expect sustained economic growth without continued economic reforms. Thus the Partnership starts with a tremendous advantage when it addresses institutional reforms that will facilitate technology transfer and reduced greenhouse gas emissions, because addressing institutional issues is critical to the highest priority of both countries.

Moreover, both countries have already begun the process of institutional reform, and their current rates of economic growth were made possible by those reforms. Thus examining how the reform process has taken place thus far, and where problems remain, can provide some guidance on how the Partnership could most effectively promote further reforms that would close the technology gap. In this regard, it appears that the situations of China and India are very different.

India

India has democratic political institutions and many of the institutional prerequisites for efficiently functioning markets, so that even though India has lagged China in the transition to a market economy in recent years, remedies for present deficiencies in the investment climate are apparent.

India benefits, as did the Asian Tigers, from a set of civil and legal institutions that were successfully transplanted a very long time ago. In the case of India, the heritage of British rule created legal and governmental institutions that are in need of reform, but do not need to be created from scratch. In addition, India has a highly educated professional and technical class, creating a strong comparative advantage in the export of highly-valued services. These advantages are counterbalanced at present, by India's lag in starting on the process of creating a fully open market economy, and the stalled process of reform that leaves India even behind China in key respects. Notorious problems in the organization and regulation of India's power sector make unreliable electricity supply a serious constraint on growth, and

continued regulatory burdens and associated corruption limit FDI and productivity growth.[77] However, it has been suggested India's open and democratic institutions, and its successful creation of a civil society where differences can be addressed openly and resolved peacefully through the political process, gives it the most important preconditions for sustained growth.[78]

China

Experts generally agree that China started with no legal foundation for market institutions, and none of the legal framework that India inherited from British rule, when Deng Shao-Ping started the movement toward a market economy almost 30 years ago. Although China has made much progress in liberating market forces, it still faces serious risks to its economic future without continued institutional change.[79] An economic collapse would slow growth in China's greenhouse gas emissions, but a low emissions scenario based on a collapse of Chinese economic growth is not attractive for China or the rest of the world.

For China, basic institutional reform is not just a way to avoid wasteful practices in the supply and use of energy. Many scholars and commentators see continued and much deeper reform necessary to maintain China's economic growth. Kenneth Dam asked the question of whether China's indisputably low scores on all measures of the "rule of law" provides an exception to the generalization that the rule of law is a prerequisite for growth. He concludes that by creating the beginnings of a market economy, China has been able to achieve rapid but by no means spectacular growth in the last 20 years, but that its growth thus far has been driven by massive investment and rapid growth in the industrial labor force, with relatively little productivity improvement. [80]

Growth cannot be sustained forever by continued accumulation of capital and increases in the labor force, especially given China's population policies that are eroding the labor force. Achieving sustained growth required productivity growth, which is brought about through technology improvement that will only occur with an improved investment climate. Moreover, according to Dam the experience of the Asian financial crisis – during which the

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[77] India: Investment Climate Assessment 2004: Improving Manufacturing Competitiveness, Finance and Private Sector Development Unit, South Asia Region, The World Bank.

[78] Bhagwati, J., February 28, 2006, Indian Lessons, article in Wall Street Journal.

[79] This is consistent with the finding of Rodrik that "The onset of economic growth does not require deep and extensive institutional reform." but "Sustaining high growth in the face of adverse circumstances requires ever stronger institutions." Dani Rodrik,. Understanding Economic Policy Reform. Journal of Economic Literature 34:9–41. 1996.

[80] Kenneth W. Dam "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" John M. Olin Law & Economics Working Paper No. 275 (2D Series) The Law School, The University of Chicago, January 2006.

newly industrializing economies of Asia fell back from growth rates more rapid than China's to rates of growth that have remained well below China's – reveals that rule of law is also crucial to managing stresses when they appear. Prasad and Rajan reach similar conclusions about the need for much more rapid reform in the financial sector: "at its present stage of development, certain aspects of the incremental approach could pose significant risks to the Chinese economy. Notwithstanding the constraints that still exist due to deficiencies in policy and institutional frameworks, and the overhang of various legacy problems, there may now be few alternatives to bolder and more concerted reforms in order to maintain high growth and economic stability."[81]

Some time ago Paul Krugman pointed out that "Asian growth, like that of the Soviet Union in its high-growth era, seems to be driven by extraordinary growth in inputs like labor and capital rather than by gains in efficiency."[82] That comment appears to remain true of China today. China's high rate of investment compared to GDP (43% compared to an OECD average of 21% in 2003)[83] and high ratio of capital investment to resulting output (estimated to be 5, compared to 2 – 3 in the OECD) suggest that growth has been driven by large and increasingly wasteful capital investment. Current statistics are also consistent with the hypothesis that despite reforms, Chinese investment and economic growth is still driven by state directed investment priorities. Prasad and Rajan confirm this conclusion, stating that: "…the investment boom in recent years has been fueled by cheap credit and overoptimistic expectations of future demand growth in sectors that are doing well at present."[84]

The private sector in China still has little access to bank lending or a corporate bond market, since the current state of institutional reform leaves most savings intermediated by state-owned financial institutions that direct lending to state-owned enterprises. An OECD study found that the growing private sector in China had higher total productivity than the state-owned sector, even though the state sector was much more heavily capitalized than the private sector. [85] Another implication of this comparison is that a large share of the

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81 Eswar S. Prasad and Raghuram G. Rajan, "Modernizing China's Growth Paradigm," IMF Policy Discussion Paper, PDP/06/3.

82 Paul Krugman, The Myth of Asia's Miracle. Foreign Affairs 73(6): 62–78. 1994.

83 OECD Factbook 2006 - Economic, Environmental and Social Statistics 2006; and Goldstein, M. (2004) "Adjusting China's Exchange Rate Policies," Institute for International Economics, Paper presented at the International Monetary Fund's seminar on China's Foreign Exchange System, Dalian, China, May 26-27, 2004.

84 Eswar S. Prasad and Raghuram G. Rajan, "Modernizing China's Growth Paradigm," IMF Policy Discussion Paper, PDP/06/3.

85 Organization for Economic Cooperation and Development. OECD Economic Survey: China. Paris: OECD. 2005.

investment in the state sector was wasteful, a situation that can be tolerated during a period of massive saving and investment but not forever.

Dam sees the Chinese economy as still pervaded by what he calls "crony capitalism" and "state directed investment." Others see a "two-track" system, in which a modern and growing portion of the economy is being supported by effective institutional reform and opening to foreign investment, while the remainder of the economy – largely in the Chinese interior – remains largely untouched by those reforms and correspondingly stagnant and inefficient.

"Crony capitalism," in China's case involving transfer of ownership of formerly state owned corporations, with continuing state-directed investment, to a group of oligarchs drawn from former managers and party hierarchy, appears to be prevalent and associated with wasteful and inefficient investment, as well as abuse of minority shareholders by management. Crony capitalism and wasteful investment, coupled with slow growth in total factor productivity, suggest that the Chinese story is one of missed opportunities – to grow at rates comparable to the successful Asian Tigers at the same stage of growth, and to maintain growth rates when the absorption of underutilized labor and massive capital investment are no longer possible.

China also faces growing demographic challenges exacerbated by lack of attention to public and social services (retirement and medical care in particular) in the transition away from the old communist model. These challenges are likely to reduce the growth in labor supply and the abundant savings that made high and even wasteful investment possible, and increase the need for productivity-improving technology to maintain economic growth. China also faces severe negative externalities for growth arising from its failure to provide public goods and regulate pollution.[86]

Considering all these factors, Dam's conclusion seems inescapable that "Whether China can avoid a growth slowdown therefore depends in substantial measure, as the experience of China's Asian neighbors suggests, on whether it can successfully address institutional issues, including Rule of Law issues." The good news, he points out, is "The fact that Chinese

[86] The Economist devoted a special issue to China's reform tasks Balancing Act: A Survey of China March 25, 2006 and emphasized the challenges China's leadership faces from the pressures in rural areas for definitions of property rights in land to protect farmers from land seizures by local governments, concerns about the creation of "an oligarchy of a wealthy elite controlling the country's resources, as in Russia," lack of health care and benefits for migrant laborers who form the majority of the labor force in cities, and a broad opposition to reform of property law based on concern about losing China's socialist model.

leaders and thinkers have expressed an interest in Douglass North and his work suggests that they know that their institutions are not sufficiently strong for indefinite sustained growth." [87]

2.9.2. Efforts to Reduce Greenhouse Gas Emissions Will Be Difficult and Costly Without Fundamental Institutional Change[88]

Economic models that have been used to analyze the costs of a global agreement on a cap and trade system for all countries have for the most part assumed that markets work as efficiently in countries like China and India as they do in the United States or other advanced economies. These studies also generally find that there will be substantial cost savings from extending emission trading from the Annex B countries to include all developing countries. These cost savings do not come about because of technology transfer or improved productivity, but because the modelers assume that marginal costs of reducing emissions are zero when a country has adopted no emission caps, and that marginal costs rise as emission caps become more binding. Thus in a scenario in which only Annex B countries agree on emission caps, there are unexploited gains from trade between countries with caps – in which the marginal cost of emission reduction may be as high as $100 per ton – and countries like China and India where the marginal cost is assumed to be zero. Extending the emission trading system to include China and India will result in a single worldwide price of carbon, which will be less than that established under Annex B trading but clearly greater than zero.[89]

Problems with establishing an international emissions trading system

The difficulty with this picture is that international emission trading alone does not transfer technology or create emission reductions within a country. Without institutional reform, China and India will remain unable to exploit the latest western technology broadly throughout their economies. Distortions that prevent adoption of technologies that are already economic even in countries that do not put a price on carbon, such as the United States, will also be obstacles to any efficient response to the incentives that international emission trading is supposed to provide. The various economic models that appear to show abundant cheap abatement opportunities in Asia do not take account of this reality.

Moreover, offering to pay for emission reductions – which is what the basic country to country emission trading system created under the Kyoto Protocol involves -- creates

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[87] Kenneth W. Dam "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" John M. Olin Law & Economics Working Paper No. 275 (2D Series) The Law School, The University of Chicago, January 2006.

[88] We are grateful to Lee Lane for suggesting this line of thought.

[89] See, for example, Bernstein, Montgomery, and Rutherford, op. cit.

perverse incentives. To participate in emission trading, a country must agree to some form of a cap on emissions. In negotiating this cap, China and India have every reason to exaggerate their indifference to climate change. Similarly they have every reason to inflate their baseline emissions. With their opaque institutions, there is every likelihood that they would be able to negotiate a cap based on an emissions baseline considerably higher than realistic projections of emissions, which would thereby lead to payments for 'anyway tons' or even for tons that were induced by the prospect of receiving payments for abatement. All this will degrade the cost-effectiveness of expenditures by Annex B countries on these supposedly cheap tons.

Under the Framework Convention and Kyoto Protocol, each country chooses its own policy measures. If China and India were to adopt market mechanisms like taxes, such measures could not be expected to bring about cost-effective actions to reduce emissions, given the flawed market institutions that characterize so much of the Chinese and Indian economies. The record of Chinese state-owned enterprises (SOEs) gives little reason to believe they would respond in an economically efficient manner to a tax on their carbon emissions. Based on past history, the imposition of an emission tax could simply lead to more borrowing from state-owned banks to cover the increased losses of the state-owned power plants and manufacturers. The lack of central government control over local governments (that own many SOEs) could in any event make it impossible to enforce restrictions on emissions from SOE's. In India, the prevalence of protection from competition and corruptions suggests that protected sectors would be less likely to abate, than they would be to pass on the cost of an emission tax or pay larger bribes to escape the tax.

Heller and Shukla[90] have pointed out the difficulties of transplanting a market-based set of climate policy institutions to China and India under their present institutional setting. But if China and India respond instead with command-and-control central planning directives (and that is what the Heller-Shukla approach amounts to) the resulting investment will also be very inefficient, based on experience throughout the world as well as the track record of China and India's current institutions. There is little reason to believe that government-imposed choices will be more efficient and effective in managing greenhouse gas emissions in China and India than they have been in managing those economies overall.

The relation between economic freedom and greenhouse gas emissions challenges the basic and almost universally accepted assumption that bringing China and India into a global emission trading system will substantially reduce the cost of achieving global reductions in greenhouse gas emissions. If we consider the institutional inefficiency of the Chinese and Indian economies and the institutional problems of trying to pay states to abate, there will not be great supply of low cost emission credits coming from those countries. With fundamental

[90] Thomas Heller and P.R. Shukla: Development and Climate: Engaging Developing Countries, in Beyond Kyoto: Advancing the International effort against climate change, Pew Center on Climate Change, pp. 111 -140.

institutional reform, substantial reductions in emissions below current forecasts are likely whether or not China and India become part of an international emission trading system. Without fundamental institutional reform, their emission reductions are likely to be costly and limited.

2.10. Opportunities to Reconcile Growth and Climate Objectives

The great opportunity for the Partnership is to join an ongoing dialogue on institutional reform in China, which is now underway because of a shared understanding of the benefits of institutional reform for the Chinese economy and the commitments made by China in its WTO accession protocol.[91] Climate objectives can become a constructive part of this dialogue, by suggesting areas where institutional change would contribute to improved environmental quality and reduced greenhouse gas emission as well as foster conditions favorable to sustained economic growth. This is a far less confrontational approach than insistence, as the European Union appears to believe is necessary, that China and India take on obligations to cap and reduce emissions that would be very costly given its current level of institutional development and technology.

There is one more possibility. Should China or India fail to achieve fundamental institutional change, and as a result their growth stalls, then the high emission scenarios envisioned by the IPCC become highly unlikely even if that country were to continue using energy very inefficiently. Thus in a sense the problem of growth in emissions from developing countries may solve itself: either those countries will achieve free market institutions and move toward much lower carbon intensities, or they will stall in economic growth and halt their emissions growth as well. The Kaya Identity finds that either improvement in emissions intensity or a reduction in economic growth serves equally well to slow the growth in emissions. Thus reducing risks of growing greenhouse gas emissions may not be a particularly important reason for pressing China and India on fundamental economic reform; the prospect of the two most populous nations of the world failing to achieve decent standards of living is.

[91] World Trade OrganizationWt/L/432 November 2001 (01-5996) Accession of the People's Republic of China, Decision of 10 November 2001.

3. HOW CAN THE ASIA PACIFIC PARTNERSHIP BRING ABOUT INSTITUTIONAL CHANGE?

In the first half of this essay we have attempted to establish that institutional reform should be the highest priority of the Asia Pacific Partnership. This conclusion is supported first by evidence of a large gap in energy technology between China and India, and the rest of the partnership. This evidence comes from data on national and, to a limited extent, sectoral energy intensities which support inferences about the level of technology embodied in new investment. We also drew on research on institutional obstacles to economic growth to identify a number of areas in which China and India lack a market oriented investment climate and other institutions that support efficient markets, and described how these deficiencies are likely to be causes of the technology gap.

This analysis provides strong indications that China and India lag far behind the US, Japan and Australia in technology, even in new investment, and that this lag and resulting high levels of greenhouse gas emissions are attributable to failings in legal, political and market institutions. There is also strong evidence that remedies for these failings would contribute to economic growth. However, much more detailed understanding of the opportunities for institutional reform and improved technology is required as a basis for an action plan, and a consensus on such an understanding is required to reach agreement on actual steps to be taken by members of the Partnership. This requires serious research and detailed analysis of data that do not now appear to be available in the published literature.

Although it is clear that there is a relationship between institutions, economic growth, and greenhouse gas emissions, there is no general formula that can be applied to identify the specific institutional failures responsible for high emissions per unit of output in a specific country. Cross-country comparisons are helpful in suggesting areas where reform may make a difference, but they are not sufficient to identify and prioritize reforms that will have the most beneficial effects on technology transfer and greenhouse gas emissions in China and India. In the following section, we describe the most important areas where additional information is required to identify needed reforms and quantify their potential benefits. In the subsequent section we discuss how a process for conducting this research and developing proposals for reform could be designed, and desirable roles for experts, governments, and the private sector. In the final section we propose a specific process under which the Partnership could move forward on an agenda of institutional reform.

3.1. WHAT ARE THE KEY QUESTIONS THAT NEED TO BE ANSWERED?

Answers to four key questions would provide a basis on which the Partnership could move forward on an agenda of institutional reform:

- How can cost-effective opportunities for improving energy efficiency and reducing carbon emissions in each country be identified?
- What types of institutional reform are most pressing in each country?
- How can institutional change be brought about?
- How large are the potential emission reductions and enhanced prospects for economic growth that could be achieved through institutional reform?

Industry by industry comparison of technology between target country and global practice

In order to identify cost-effective opportunities for reducing carbon emissions it is necessary to begin with an industry-by-industry and sector-by-sector assessment of the technologies currently embodied in new investment in China and India, and comparison to the technologies embodied in new investment in other Partnership countries. The ultimate objective would be to characterize the technical efficiency of various technologies, in terms of energy and other resources required to produce a unit of physical output, in order to cut through the mysteries of properly valuing GDP or value added in a particular industry. This technology assessment needs to be complemented by an economic analysis of whether the technologies adopted in other Partnership countries would also be economic for China and India, assuming free market and unsubsidized pricing of energy and other inputs.

Assessment of how pricing distortions affect technology adoption

A second critical need is to understand the extent to which energy prices are distorted by taxes, subsidies and the operations of state enterprises in China and India. Some examples are abundantly clear, as in the provision of free electricity to agricultural and other users in some states in India. In other cases this is not an easy task, because price controls are not always as explicit as India's policies to provide free electricity. In particular, when energy services are provided by state-owned enterprises, various direct and cross-subsidies can be concealed by the flow of government funds to cover operating losses.

State owned enterprises and technology

A similarly difficult task is to understand, especially in China, how the organization and incentives for state-owned enterprises affect the choice of technology. A starting point could be comparison of the technologies embodied in new investment by state-owned enterprises, those embodied in new investment by private domestic firms, and those embodied in Foreign Direct Investment. Existing studies comparing the technologies adopted by domestic enterprises and those by foreign investors in the power sector provide an example of the nature of such studies and their usefulness. In addition, it would be important to understand the extent to which there are competitive forces at work to lead state-owned enterprises to

use resources, including energy, efficiently, or whether access to directed lending from state owned banking institutions to cover losses effectively insulates managers of state owned enterprises from the consequences of their decisions.

Protected and regulated industries

Where China's reforms have lagged in defining certain key property rights, such as the rights of creditors, India's have lagged in removing protection from domestic industries. When protection and regulation eliminate competition, as in the case of India's industries that are reserved for small-scale firms, the discipline of the market that leads to efficient use of resources may be missing. The continued flow of funds from state owned financial institutions in China into partially or wholly state owned enterprises, despite nonperforming loans and continuing negative cash flow, provides a similar insulation from competition that would drive to more efficient use of energy resources and search for superior technology. The prevalence and implications of this type of protection needs to be investigated. Moreover, state owned enterprises in the energy sector can be used to provide concealed as well as explicit subsidies in the form of energy prices below long run marginal cost. Such subsidies need to be found and quantified.

Infrastructure and human capital

Adequate infrastructure and a qualified technical workforce are important aspects of the investment climate that influence decisions about FDI and the possibility of technology transfer. Identification of needs in these areas would also useful to defining roles that could be played by governments of other Partners, since investment in infrastructure and human capital is less exclusively the province of the host country than fundamental legal reform, for example.

Other aspects of the investment climate

As a general matter, we have seen that a lack of appropriate legal institutions, protection of intellectual property, burdensome bureaucracy and corruption are impediments to foreign direct investment. Specific case studies of how these factors now affect decisions about technology transfer are needed to assess where the most useful reforms would be.

For example, in China, there is strong evidence that high energy use per dollar of output in agriculture is connected with the fact that farmers cannot own the land they cultivate under China's property laws. Thus, there is no incentive to invest in productivity-improving capital or technology, so that energy as well as other inputs are used at much higher levels than in the United States.

Property rights and long term contracts may also play a role in discouraging what should be highly profitable investments in methane capture. If property rights in leaking methane from

coal mines or solid waste are not well defined and enforceable at law, investors in methane capture projects will have little assurance of being able to earn continued returns over the life of the investments.

Bureaucracy can serve to keep out competition to local generators, thus allowing uneconomic technologies chosen for municipally-owned power generation to keep competition and supplies from more efficient units out of their local markets.

Nature of FDI and technology transfer

Greater understanding of the contribution of FDI is also required. Basic data about the sources, destinations, and technology level of FDI need to be developed. The example of Di's work on the sources and destinations of FDI – from other Asian economies to small-scale enterprises – shows how critical detailed understanding of FDI is to the design of policy. Her work suggests, for example, that increasing the amount of FDI may have little affect on the level of energy technology, but that opening areas of the economy now dominated by state-owned enterprises to FDI could.

Embodied technological progress is not the only route through which productivity improvements and increases in energy efficiency find their way into the economy. Fisher Vanden, for example, estimates that about half of the technical progress in China is embodied in new capital equipment, and about half is not. Better understanding of this macroeconomic phenomenon can help to understand how much could be accomplished by stimulating FDI and new investment, which is directly related to embodied technical progress. Different policies could be required to stimulate greater technical progress of the disembodied variety.

How can institutional reform be brought about?

Our review of the literature and evidence on the relationship between institutions and emissions intensity has important implications for designing an approach to institutional reform through the Asia Pacific Partnership. It suggests that institutional reform in China and India is a prerequisite to achieving improvement in emissions intensity through technology transfer and more efficient markets. However, history and recent developments in China and India make it clear that reform will be incremental, so that an information gathering and research phase to identify the most important and productive reforms is necessary. From the beginning, Deng Xiaoping called his reform strategy "crossing the river by feeling for stones." For many reasons, including both a general cultural inclination and the need to work through, past or around political, ideological and bureaucratic obstacles,

reform proceeded in small steps addressing legal issues when required to make economic reform possible.[92]

It is particularly challenging to design ways in which Australia, Japan, and the United States can make needed reforms more likely to happen in countries like China and India. Such reforms are clearly the prerogative of each sovereign country. However, China and India have clear interests in encouraging investment, gaining access to the world financial system, and acquiring new technology that can sustain productivity improvement and growth. This creates internal incentives for China and India to be interested in continued reform, as they clearly are. If incremental reforms are likely to occur where the greatest need is perceived, one important role of the APP is to make that need and the benefits of changes in energy-related institutions apparent.

Even if Australia, Japan and the United States had no other policy instruments available to them, creating a process which achieves consensus on the benefits to be gained from specific reforms would go a long way toward creating incentives for reform. However, there are a number of specific policy instruments available.

What needs to be done to facilitate reform:

Some questions may need to be addressed outside the APP process, because they are relevant to the U.S. (and other advanced countries) approach to China and India. On the other hand, the central governments of both countries also have an interest in understanding the answers. The most obvious is how and where the relevant decisions about economic policy and institutions are made. In both China and India, state and regional governments appear to be largely responsible for creating policies and maintaining institutions that contribute to wasteful energy use and excessive greenhouse gas emissions.

Where will the opposition come from?

One important benefit of understanding how and where decisions are made is that it will help to understand who benefits from the current and expected state of affairs. The current debates about economic policy and further reform in both China and India provide a great deal of material on what factions within the government and what interests within the larger economy and society favor and oppose reform. They suggest a broad ideological set of issues, having to do with abandonment of the socialist program, and also concern about the consequences of what Kenneth Dam has labeled "crony capitalism" – the enrichment of a

[92] Dam, K.W. (2006) "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" The Law School, The University of Chicago, John M. Olin Law & Economics Working Paper No. 275.

small oligarchy while leaving much of the population outside the benefits that economic freedom should supply.

Other opposition to reform can be expected, given current commentary on China, from the new managers and owners of partially privatized state enterprises that still benefit from state-directed loans and a general lack of law ensuring proper corporate governance. Likewise, regional governments now have considerable fiscal and policy autonomy in China, and use it to form business enterprises that are then protected by a judicial system that is largely run locally. Since farmers have no property rights in their land, use of rural land for economic development has deprived farmers of their livelihood with no compensation, and creates resentment of the opening of markets.[93] Efforts to strengthen the rule of law would disrupt these arrangements, and reforms would be resisted unless at a minimum they were accompanied by other fiscal and budgetary changes to make local governments financially sound and able to compensate employees adequately.

For example, in current negotiations about the new Chinese antitrust law a chapter forbidding the abuse of government power to restrict competition was reportedly dropped during a review of the law by China's State Council.[94] The chapter would have given the central government a way to ensure that local governments did not use their powers to favor local businesses over those from different towns, provinces or countries. Kenneth Dam has also identified this local preference as a pervasive problem in the legal system. The difficulty of getting this logical provision included in the new antitrust law is evidence of the power of the local governments over reform.

India has similar political issues, as the erratic pace of reform after elections demonstrates, and in particular faces a great challenge of establishing efficient pricing of energy in the face of widespread poverty and an expectation of free government services. However, identifying these issues may suggest a role for the advanced countries. For example, one way to encourage reform of electricity pricing might be to devote official development assistance and loans from multilateral institutions to providing income supplements to those now targeted by free electricity. This could neutralize the reaction to higher electricity prices, and the assistance could be phased out as the power industry recovers and begins supplying reliable and efficient power.

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[93] The Wall Street Journal reports opposition to reform from all these sources: "In some ways, the 63-year old Mr. Hu faces a more complex situation than his predecessors, as China becomes more like the U.S., with a greater tolerance of dissenting views and organized interest groups. Resistance to some market-oriented changes is mostly driven by special interests such as disenfranchised farmers, private businessmen, and ministries trying to hold on to their powers." Kathy Chen "Amid Tension with the US, China faces protectionism at home." WSJ Friday March 31, p. A8.

[94] Cohen, A. 2006 World Economic Forum: China antitrust law worries foreign interests --- Western firms fear policies could target profitable patents, article in The Wall Street Journal Europe.

Finally, the industrial members of the partnership need to understand what leverage they have to bring about change. This leverage can include carrots and sticks, as well as persuasion. The types of leverage are the same as those contemplated or exercised in current dialogues, including discussions of nuclear power with India and in the U.S. review of trade policy toward China which incorporates mention of a number of punitive measures.[95]

Quantification of the potential benefits of continued reform

It may be desirable to quantify the potential benefits of continued reform in China and India, as part of the process of developing a consensus in favor of specific reforms. This quantification would start with data on the magnitude of the technology gap at an industry and sectoral level. Comparison of emissions intensities at a detailed sectoral level can quantify the technology gap. The second step in quantification is to identify the types of technology that would be embodied in FDI, and the kinds of technology that would be adopted by domestic concerns if institutional barriers were removed. These estimates would provide a basis for estimating how the emissions intensity of new investment would change after successful reform of key institutions. Finally, using data on the rate of investment expected in the future with ongoing reform, it would be possible to estimate how rapidly the overall emissions intensity of China and India would converge to that of the more advanced members of the Partnership. From this point, it would be straightforward to estimate total emissions under different growth scenarios, and the impact of institutional reform on those emissions.

3.2. ROLES IN THE PROCESS

Experts, the private sector, and governments all have key roles to play in the Asia Pacific Partnership, if it is to be successful in bringing about fundamental institutional reform.

Experts

The studies that we outlined in the previous section clearly require expert inputs, in order to design research that will provide reliable information, to guide the participants in interpreting that information, and in devising ways to quantify effects and benefits of institutional reform. The subject of institutional reform in economic growth is one that has been studied with care by the profession, and that expertise should be brought to bear in the process. It is particularly important that these experts be disinterested, and serve as a resource for the working group rather than advocates of their own designs for climate change policy.

[95] US Trade Representative, Review of China Policy.

Some examples of research that suggest insights that would be valuable in the process by scholars whose objectivity and expertise are unquestionable are: David Victor[96] and Tom Heller's[97] work on policy reform and technology in China; Scott Barrett's work on international agreements[98]; Dale Jorgenson and colleagues with their studies of the Chinese economy;[99] Kenneth Dam's institutional and rule of law perspective on economic growth;[100] Karen Fisher-Vanden's studies on Chinese sectoral energy intensities[101]; Yasheng Huang's work supporting bold institutional reforms in China to keep up with India[102]; Tarun Khanna's studies comparing and contrasting different development approaches;[103] and Jagdish Bhagwati's analysis of economic and political freedom in India's sustained development.

Private Sector

There are important roles for the private sector in a process of incremental reform. These roles include helping to identify the most important opportunities for technology transfer and the institutional reforms needed to make them possible, as well as being the source of the actual investments and technologies that are desired by China and India. The expectation of greater flows of investment and technology from the private sector is likely to be the most

96 "The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming" (Princeton University Press, April 2001), "Technological Innovation and Economic Performance" (Princeton University Press, January 2002, co-edited with Benn Steil and Richard Nelson).

97 "Greenhouse Gas Implications in Large Scale Infrastructure Investments in Developing Countries: Examples from China and India," Program on Energy and Sustainable Development Working Paper #54, CESP Stanford, March 2006; and "Baseline for carbon emissions in the Indian and Chinese power sectors: implications for international carbon trading," CESP Stanford, January 2005.

98 Environment and Statecraft: The Strategy of Environmental Treaty-Making, Oxford University Press, 2003.

99 "China's Economic Growth and Carbon Emissions," in M. B. McElroy, C. P. Nielsen, and P. Lydon (eds.), Energizing China, Cambridge, Harvard University Press, 1998 (with M. S. Ho and D. H. Perkins), pp. 301-342; "Why Has the Energy-Output Ratio Fallen in China?" Energy Journal, Vol. 20, No. 3, July 1999 (with R. Garbaccio and M.S. Ho), pp. 63-91. Econometrics 3, ch. 4, pp. 151-178; and "Controlling Carbon Emissions in China," *Environment and Development*, Vol 2, part 4, October 1999 (with R. Garbaccio and M. S. Ho), pp. 493-518. Econometrics 3, ch. 11, pp. 361-392.

100 Dam, K.W. (2006) "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" The Law School, The University of Chicago, John M. Olin Law & Economics Working Paper No. 275.

101 Fisher-Vanden, K. et al. (2002), "What is driving China's decline in energy intensity."

102 Selling China, Cambridge University Press, 2003.

103 "China and India: The race to growth. India's entrepreneurial advantage" and "It's India Above China in New World Order" 2003.

important factor making institutional change sufficiently attractive to lead to action by the host country.

The first key contribution that businesses can make is in helping to identify what types of institutional reform are most needed to make lower carbon technologies viable in the market and to remove disincentives for the transfer of those technologies. Businesses that have been involved in investment and technology transfer need to describe the problems. It is clear from our survey that different countries and different industries within a country will face different problems. Surveys and indices of the rule of law, the investment climate and the level of economic freedom provide a helpful picture, but they are not designed to shed light on energy technology and cannot prioritize reforms that will make a difference to FDI and technology transfer most likely to reduce emissions intensity.

Businesses that are, or have been, active in China and India have the most direct experience on what institutional, legal and other practices are discouraging investment and technology transfer. Identification of problems and proposals for what would be an improved investment climate need to originate with the businesses that make the decisions on investment and technology. This seems obvious, but when a government-to-government initiative is developed and staffed, there is a natural tendency to turn to studies done by government agencies and contractors rather than asking those who have actually tried to do business and apply technology in China and India. In the Partnership there is an opportunity to bypass the usual route of task forces and studies, and to involve the international business community directly in the diagnosis of needs for institutional reform. It may be that business needs to volunteer for this role rather than waiting to be asked, by recounting the history of their past ventures and the lessons they have learned.

There is also evidence that fundamental institutional reform can be brought about by dealings between the Chinese government and the private sector. Professor Ruoying Chen describes a case in which the desire of the Chinese government to sell non-performing loans to American hedge funds led to adoption of important changes in laws, once the Chinese government realized that the hedge funds would not consider the transaction without those changes. She also suggests that continued interactions with foreign investors will be an important impetus to continued reform.

> *"I worked on these NPL deals, the non-performing loans. The banks have huge NPLs. So at the beginning, the government really started to thinking about how to deal with these things. You can simply write them off and then give capital to the banks. That's one way to do it. The government did. On the other hand, the government still wants to make some gains out of these non-performing assets, so they introduced the foreigners, the funds, all of these hedge funds in Wall Street, to go into there, to purchase them to try to work out. And then they realized that if you have to--if you want to do these deals, you had to make certain change through a law, through your court*

system, to your regulatory system of foreign exchange, the company, the whole company law and drive them by market demands. In order to do the deal the government started various initiatives across different ministries and also the courts to work out a certain rule to make some small steps to change the law which later brings back bigger steps. For example, now the privatization of the banks, they went to Hong Kong, to get listed as strategic investors from the West in order to make improvements. So sometimes these reforms really go hand in hand. And in working with the market, with the private sectors, the mentality, the information, the incentives that officials have, again, will also be affected. So as long as this interaction keeps going, I think it will bring more change to the political and legal forum."[104]

Governments

The countries in which institutional reform leading to reduced emissions intensity would make the most difference to global emissions are India and China. The countries with an interest in promoting that reform as part of their commitment to global climate policy are Australia, Japan and the United States.

Korea occupies an interesting intermediate role. It has clearly achieved the status of a middle income country, and its rankings in most aspects of rule of law, investment climate and economic freedom are quite similar to the other OECD countries. Moreover, Korea has a much more advanced technology base, and its emissions per dollar of output are much nearer those of the OECD countries than China and Japan. Yet Korea has not taken on the same commitments under the UNFCCC as Australia, Japan and the United States. In many ways, Korea stands as an example of how institutional reform can make transfer of technology and improved emissions intensity possible, and its greatest contribution to the process may be in providing insights into how that came about.

There will always be a perception that institutional reform will create winners and losers, and will therefore be opposed by interests that want to preserve the status quo because of perceived or actual benefits. Dealing with this opposition is a fundamentally political process that must occur within China and India, but other members of the Asia-Pacific Partnership can play a role by providing incentives and support for change.

Even if the private sector in the advanced countries has to be the source of the investments and technologies that China and India desire, there may be a role for incentives, resources and funding to be supplied by Australia, Japan and the United States. For example, if China or India were to embark on a process of legal reform to protect secured credit, the advanced

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[104] Brookings Institution Policy Briefing China's Economic Development and Legal Reform: Financial Markets and Corporate Governance, March 9, 2006.

country governments might provide temporary, appropriate credit insurance to assure private investors that they are protected while the host country designs and proves out its reforms. It would be important to keep this kind of incentive specifically targeted to particular reforms, and temporary.

The recent review of U.S. trade policy toward China suggests another, potentially more confrontational and dangerous role for governments. The U.S. committed in that review to a number of actions related to this process:

> The Administration will step-up efforts to promote regulatory reform in China, in place of subsidies and administrative measures and policies that distort resource allocation and trade flows, including: (1) deepening and expanding the State Department's high-level dialogue with China's economic planners regarding structural reform; (2) broadening and intensifying assessment of subsidies in China and continuing pressure on the Chinese government to comply with its subsidy-related obligations under the WTO, including making a full WTO subsidies notification (expected early 2006); (3) expanding USDA-led initiatives to improve China's transparency and compliance with its SPS obligations under the WTO; and (4) giving intensive attention to China's development of standards and of an anti-monopoly law. [105]

Some types of institutional reform that would be very good for China and India in the long run, such as normal protection for intellectual property, are also connected to other ongoing negotiations. For example, in its accession protocol to the WTO China made commitments to various types of institutional reform. This suggests that there may be other remedies available should China or India fail to make progress in some directions. Given the difficulties that both central governments have in keeping regional governments in line, such external pressures might not be unwelcome.

Studies of China, in particular, also suggest that there is a lack of capability for accomplishing certain types of institutional reform, in particular in the administration of justice and in local government. Secondment of staff from U.S. agencies or from private businesses to serve in the court system or in local governments as professional staff might provide welcome resources.

Governments can also serve a role of consolidating private sector responses and making the consequences of reform, or lack of reform, clear. China and India frequently want something from the private sector, in the form of investments and application of advanced

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[105] *U.S.-China Trade Relations: Entering a New Phase of Greater Accountability and Enforcement*, Top-to-Bottom Review, Office of the U.S. Trade Representative, February 2006.

technology. There is a clear history of reform being undertaken in order to get a deal desired by governments done. One role for Australian, Japanese and U.S. governments could be to coordinate private sector positions on key issues, to make it clear to China what it will take by way of institutional reform to achieve the private sector responses they want, and possibly to provide additional incentives for private sector action.

One area where such inducements might be required is in assuring the credibility of reforms promised by China and India. For example, if China were to commit to an effective antitrust law, uncertainties about the enforcement of the law might remain and chill technology transfer. To deal with this, the United States government might use funds authorized by the Energy Policy Act of 2005 to offer intellectual property insurance for a transition period until the performance of Chinese antitrust law was demonstrated. A consequence of failure of enforcement of the antitrust law would be termination of the insurance for new investments, and a resulting halt in the flow of technology.

Did someone mention NGO's?

Designing an effective approach to institutional reform is an ambitious task, but it can be broken down into steps. It is also a difficult enough task that limiting participation is highly important. The term stakeholder needs to be interpreted very strictly – those with direct experience with doing business in APP countries and a direct interest in the outcomes – as does the term expert – an objective and disinterested party able to analyze the facts and not associated with a particular environmental or technology position or agenda.

One of the greatest challenges for the Partnership will be to keep this process focused on fundamental economic reform, and prevent it from wandering off into pork barrel projects or Green fantasies and public relations gambits about promoting uneconomic technologies. In this regard, participation of both business and environmental NGO's with specific agendas should be limited or prohibited, because of the critical importance of focusing on institutional reforms that will lead to change in the real business environment.

4. A PROPOSED APPROACH TO INSTITUTIONAL REFORM

If there is to be progress on institutional reform, at minimum the key actors or stakeholders -- concerned businesses, other groups with influence on opinion and policy in China and India (including local and regional governments), and national governments -- must agree on the nature and scope of the problems and on reforms required to address the problems. In this they will need to be assisted by experts and analysts, but the key consensus must be among those with a stake in the outcomes and an ability to influence them.

There are four parts to the proposal. The first three form a research and consensus building process, based on the need for a shared understanding of economic possibilities and institutional barriers.

1. Characterize the investment climate and opportunities to reduce greenhouse gas emissions through growth-enhancing institutional reform.

2. Develop proposals for specific institutional reforms, together with estimates of what they could achieve by way of emission reductions.

3. Understand obstacles to change, and in particular to the proposed reforms.

The final step is to reach agreement on a process that will involve the governments included in the Partnership, identifying concrete actions that each will take to bring about institutional reforms and achieve the identified benefits for climate and economic growth.

4.1. STEP 1: CHARACTERIZE THE INVESTMENT CLIMATE

Agreement on the state of the investment climate must be reached between host governments, involved businesses and the United States government, before discussions about needed reforms can be productive. This suggests that the first step could be to task a group of experts and representatives from the international business community and the APP governments to characterize the investment climate.

Several proximate objectives could be defined for such a working group of experts and stakeholders. One objective should be to analyze industry by industry how much energy use and emissions can be reduced by moving technology to the level of advanced countries. The second objective should be to determine what institutional factors stand in the way of increasing FDI and technology transfer and eliminating the uneconomic use of energy.

The working group will likely need to reach an agreement on a methodology for achieving these objectives. To reach agreement on conclusions, it would be helpful if the group were to determine in advance how to gather information on the scope of the problem and how to

analyze it. Achieving consensus across stakeholders and countries on the basic facts about the current investment climate and the role of FDI in promoting technology transfer will go a long way toward developing support for reforms.

One contribution that Australia, Japan and the United States could make is in the form of funding for serious research on the investment climate, the level of technology embodied in new investment, the role of FDI and potential energy savings from technology transfer, and the nature and impacts of pricing distortions on energy supply, demand and greenhouse gas emissions in China and India. Even before an agenda for institutional reform is drawn up, these studies could begin the process of making a case to governments on the need for reform and its likely benefits. Multilateral institutions like the World Bank may also have a role in such studies, as shown by the Bank's useful and perceptive study of the investment climate in India.

4.2. STEP 2: CREATE PROPOSALS FOR CHANGE AND QUANTIFY THEIR IMPACT

The goal should be to develop proposals sufficiently broad and specific to create a receptive investment climate, to foster technology transfer and to provide correct market signals for energy efficiency. As we have discussed, commentary on China and India suggests a number of areas in which there appear to be institutional deficiencies directly connected to wasteful energy use, disincentives for technology transfer, and resulting high greenhouse gas emissions.

A major role for Australia, Japan and the United States governments in this step should be providing funding for serious research issues that would underpin proposals for reform. Two areas of research that could increase understanding of the need for reform would be on elucidating the direct consequences of proposed reforms for energy efficiency and the benefits of a market based investment climate for the overall process of economic growth.

It would be important to ensure that proposals include actions by all parties, so that they are broadly perceived as equitable and cooperative. In this step in particular, opinions of international businesses on how much change is needed to create a receptive investment climate should be included.

Unless managed carefully, any proposal for reform is in danger of causing the country in which reform is needed to resent being told what to do. This risk needs to be managed through a process that reaches consensus on proposed reforms and avoids any suggestion that the reforms are being imposed. Therefore, it is necessary that all proposals represent a consensus of experts and stakeholders in the host country and the international business community. In order to avoid causing resentment and resistance, it could be very helpful if proposals originated from the private sector or from developing country participants, rather than government representatives. Experience in China, in particular, suggests that the

government's desire to make a deal has led to incremental reform based on requirements stated by private investors. Whatever a developing country's opinion of multinational corporations and investment banks might be, those businesses are not afflicted by the geopolitical burden that governments bear.

4.3. STEP 3: OBSTACLES TO REFORM

No matter how clear the benefits of free market institutions for economic growth may be, the process of institutional change is not conflict free. In both China and India there are fundamental political and philosophical debates underway about the directions those economies are taking, and substantial economic, political and bureaucratic influences opposed to change. In both countries, progress is underway, and engagement between their governments and investors from the private sector seems to be a feasible path to additional, incremental reform. Discussions about how to remove obstacles to needed reforms may, in contrast, require government to government discussions.

Indeed, it is helpful to keep in mind that there are two types of "obstacle" or "barriers" to address. One set of barriers includes the institutional shortcomings that discourage FDI, technology transfer, and efficient use of energy resources. The other set of obstacles are those that prevent or slow the pace of beneficial institutional change. Identifying institutional shortcomings and recommending solutions is an area in which the private sector likely has the best information and clear incentives to make an effort to identify and push need change. Identifying obstacles to reform and potential ways to remove those obstacles is much more a public good, and one in which governments must take the lead.

The discussion of barriers to change could start by taking up proposals from the consensus process followed in Steps 1 and 2. The focus of the discussions would be on the political and historical circumstances that lead to the aspects of current investment climate that are addressed by reform proposals, with a view to identifying the interests that benefit from the status quo and would oppose change. Although these discussions would need to be between governments, continued involvement of business would be needed to ensure that focus is maintained on reforms that will matter.

Some examples of barriers from China and India that our review has already identified include:

- Local government fiscal autonomy combined with lack of resources for local government
- Lack of independent judicial review and dependence of judges on local governments

- Ideology
- Beneficiaries "crony capitalism"
- Political interests that favor redistribution

As cited by Dam with reference to China, this opposition to change will be difficult to overcome because all of the interests and positions are deep rooted: "A key problem faced by the current Chinese leadership is created in large measure by recent Chinese political, economic, and ideological history, which has left the leadership to face a multitude of stumbling blocks, ranging from underperforming state-owned industrial and financial enterprises to state bureaucracies and local governments that enjoy de facto autonomy in many spheres and that therefore have strong incentives to resist change."[106]

There may need to be additional, and potentially costly, action to reduce opposition to institutional reform. In addition, some of the barriers may be due to lack of resources, experience or capability – as in the design of business law. Discussion of potential methods of removing barriers to institutional change in which Australia, Japan and the United States could assist should be on the agenda. Equally important is also need for the developed partners of the Partnership to recognize and willingness to address policy reforms of their own to facilitate this transition. For example, putting a more accepting attitude toward foreign direct investment into the United States on the agenda might create a great deal more interest in reaching a deal.

4.3.1. Potential pitfalls

There are a number of potential pitfalls that may be encountered if this process were to begin. They include:

Too many separate agendas: it is important to keep the process focused on fundamental institutional reforms that have a direct bearing on technology transfer relevant to energy or to incentives for the efficient use of energy. Inclusion of advocates for specific technologies, whether they be renewable, wind, biomass, or nuclear, could shift the focus irretrievably into searching for ways to foster use of those technologies rather than remedy underlying institutional problems and let technology choices be made based on the resulting free market economics. Inclusion of environmental and anti-globalization NGO's could have disastrous consequences, by introducing a continuing debate about the basic assumption of the process that greater openness and economic freedom is beneficial.

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[106] Dam, K. (2006) "China As a Test Case: Is the Rule of Law Essential for Economic Growth?" John M. Olin Law & Economics Working Paper No. 275, January 2006.

Too little role for private businesses who have "seen the elephant:"[107] the key to success is not an outstanding set of studies by the experts, but identification of real world opportunities and barriers. Private sector knowledge of technologies that can make it on their own in the global marketplace and experience with institutional obstacles to doing profitable business in China and India is the essential foundation of the approach.

Back to project finance: The temptation for project developers and beneficiaries participating in the process to get together to figure out what they can get the US (or Japan or Australia) to pay for, rather than staying focused on institutional reform.

Preaching: The possibility of causing the process to break down entirely if China and India perceive a condescending attitude or excessively ambitious (outsider) proposals for reform.

4.4. STEP 4: AGREE TO A PLAN

Although proposals should emerge from a consensus process with heavy private sector participation, only governments can agree on a plan for moving forward. However, any plan will have very asymmetric roles for China or India, on the one hand, and Australia, Japan or the United States on the other. Reforms can only be carried out by a national government, though other governments may be able to provide technical assistance, incentives, or rewards. Given that reform will be both difficult and incremental, the plan needs to be embedded in a process rather than a single agreement.

The decision to reform and implementation of reforms must be undertaken by the government of China or India. Given the less than total control that either central government has over governments in the states and provinces, as well as the formidable power of bureaucracies in both countries to resist change, an agreement to reform will not necessarily lead to implementation of reforms. The clear difficulty of implementing even well-designed reforms to which the central government is committed, taken together with the complexity of understanding current institutions and creating proposals for incremental reform, suggests that a process and not a single agreement is required.

In broad outline, the process could have the following elements.

China and India could:

- Participate in the consensus process of identifying needed reforms and developing proposals

[107] Old soldiers in the U.S. Civil War coined a phrase for green troops who survived their first taste of battle: "He has seen the elephant." The phrase may go back to Alexander the Great and his battles in India.

- Design institutional changes
- Address barriers to reform

The United States and other advanced economies could provide:

- Technical assistance and funding for the consensus process and associated studies
- Technical assistance and resources to assist in the design and implementation of reform
- Financial inducements and linkage to other negotiable issues to help generate sufficient support for reforms within China and India
- Appropriate responses if counterproductive policies are adopted, such as the new Chinese antitrust policy mentioned unfavorably in the US Trade Representative's review of China policy
- Incentives and risk-sharing to international businesses to encourage investment and technology transfer during the transition to a better investment climate in China and India

Business must remain involved in all stages to keep focus on realistic and sufficient action.

To be successful, the negotiating process will need to bring forth a sufficient set of offers from each party to bring about meaningful changes in institutions with significant and quantifiable effects on greenhouse gas emissions. These offers would be embodied in an agreement on actions to be taken by all parties, and a framework under which actions would be monitored and additional steps could be agreed.

This is the place where the current efforts of the Partnership's taskforces to identify technologies and investments that have profit potential and could reduce emissions would become most useful. These investments would become in a way the reward to China and India for progress on institutional reform. The voluntary nature of private sector actions in the Partnership underscores the need for institutional reform to turn these potentially profitable investments into real projects.

This recommendation follows a long line of recommendations that to be successful climate negotiations need to follow the pledge and review model rather than the targets and

timetables model.[108] The pledge and review model deals directly with the unenforceability of future targets in an agreement among sovereign nations, and provides incentives to carry out promised actions by providing credible consequences for failure to do so.

The Marshall Plan is a good example of such a process: Europe pledged various actions with the money provided by the U.S., and when it made good on those pledges the program was extended and broadened. Exactly the same could be undertaken by the members of the Asia Pacific Partnership. Future actions by Australia, Japan and the United States desired by China and India would be contingent on success in implementing near term reforms agreed in the process.

[108] David Victor, Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming, The Princeton University Press (2001); David Victor, et al., The Implementation and the Effectiveness of International Environmental Commitments (Cambridge, MA: MIT Press) 1998; Scott Barrett, Environment and Statecraft: The Strategy of Environmental Treaty-Making, Oxford University Press, 2003; Thomas Schelling, Some Economics of Global Warming, American Economic Review 82: 1-14.

APPENDIX A: PPP VERSUS MER

PPP measures make China's GDP more than twice as large as measures based on market exchange rates, so that if PPP measures were used, much of the technology gap would disappear. In general, PPP measures are accepted as superior to measures based on market exchange rates (MER) for purposes of international comparisons of the standard of living. But it is not true that PPP measures are better for all purposes, and in particular there is no reason to believe that PPP based measures of energy/GDP ratios are superior to MER based measures for international comparisons of technology in the case of China and India.

Professor Richard Cooper has provided an informative critique of the use of PPP measures for any purpose other than international comparisons of economic welfare. First, he argues that it is incorrect in theory to use PPP in measuring GDP. Location is one part of the cost and value of commodities. In calculating any country's GDP, expenditures on a particular good are calculated using the actual, and likely different, prices observed at different locations. This is done because resources need to be used to transport goods, different amounts of resources may be required to produce the same good in different locations, and the same good will be valued differently in different locations. This information is required to calculate GDP properly, and is lost by valuing Chinese or Indian consumption goods at U.S. prices. Second, he argues that PPP measures are generally based on out-of-date information and are highly subjective, especially for developing countries. The nature of domestically produced goods that comprise a large share of consumer expenditures, such as food, housing and transportation, is radically different between developing and developed countries. Third, absent specific regulatory interventions, prices of traded and non-traded good will be equalized by trade, so that PPP measures will converge to MER measures.[109]

Kenneth Dam agrees that the PPP measure of Chinese GDP is widely recognized to be unreliable in general and points out further reasons why it is clearly biased upward: "In any event and even if one can trust Chinese economic statistics for GDP in Chinese currency, we have every reason to be skeptical of the PPP figures for Chinese GDP. Citing a number of technical but crucial defects in China's collection of the requisite underlying information, a 1994 World Bank report stated that '[t]here is no reliable PPP estimate of China's PPP.' The report further concluded that some PPP approximations probably overstated China's PPP GDP per capita and that in any event those approximations varied at the time from $1,000 to $3,000. Albert Keidel, who prepared the World Bank report, recently reaffirmed the inadequacy of those approximations, stating:

[109] Prepared Statement of Richard N. Cooper: Chinese Economic and Budgetary Prospects. In Compilation of Hearings Held Before the U.S.-China Security Review Commission. 107th Congress, First and Second Sessions. 791–796.

"China's PPP is really unknown. We have no statistics on what the purchasing power parity measure of China's GDP should be…. And so we're looking at a Chinese economy that in PPP terms is much smaller, in my mind, than the numbers that are usually used." [110]

Dam also cites the general convergence of PPP and MER measures that are to be expected in the course of economic growth, and discusses concerns that even measured in local currency Chinese GDP may be overstated.[111]

Even an accurate PPP-based measure of aggregate GDP is likely to produce a highly distorted comparison of the state of energy-using technology, because it is based on prices of consumer goods and services that are generally lower in PPP terms in developing countries than in developed countries. For most energy-intensive industries that produce internationally traded goods whose prices are arbitraged by international trade, the more accurate procedure is to compare output levels based on MERs rather than on aggregate PPP indices that are heavily weighted toward prices of consumer goods and services. As a result, using an aggregate PPP index to convert GDP from rupees to dollars will lead to an implicit overestimate of the output of energy intensive sectors that are responsible for most emissions, and therefore will underestimate differences in energy intensity. Thus on balance using GDP measured at MER in calculating emissions intensity provides a better representation of the underlying energy technology better than using GDP based on PPP. At most, a correction to the standard MER measure of GEP to eliminate the effects of Chinese policies that cause the Yuan to be overvalued would be appropriate.

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[110] Albert Keidel, "China In The Global Economy: Prospects and Challenges," IMF Economic Forum, Washington, DC., October 19, 2004

[111] Kenneth W. Dam "China As a Test Case: Is the Rule of Law Essential for Economic Growth? "

John M. Olin Law & Economics Working Paper No. 275 (2D Series) The Law School, The University of Chicago, January 2006.

APPENDIX B: COUNTRIES REPRESENTED IN THE SAMPLE

Countries Represented in the sample

SNo.	Country code	Country name
1	AUS	Australia
2	AUT	Austria
3	BEL	Belgium
4	CAN	Canada
5	DEU	Germany
6	DNK	Denmark
7	ESP	Spain
8	FIN	Finland
9	FRA	France
10	GBR	United Kingdom
11	GRC	Greece
12	HKG	Hong Kong China
13	IRL	Ireland
14	ISL	Iceland
15	ITA	Italy
16	JPN	Japan
17	LUX	Luxembourg
18	NLD	Netherlands
19	NOR	Norway
20	NZL	New Zealand
21	PRT	Portugal
22	SGP	Singapore
23	SVN	Slovenia
24	SWE	Sweden
25	USA	United States

SNo.	Country code	Country name
1	ARG	Argentina
2	BGR	Bulgaria
3	BOL	Bolivia
4	BRA	Brazil
5	BWA	Botswana
6	CHL	Chile
7	CHN	China
8	COL	Colombia
9	CRI	Costa Rica
10	CZE	Czech Republic
11	DOM	Dominican Republic
12	DZA	Algeria
13	ECU	Ecuador
14	EGY	Egypt Arab Rep.
15	EST	Estonia
16	GTM	Guatemala
17	HND	Honduras
18	HRV	Croatia
19	HUN	Hungary
20	JAM	Jamaica
21	JOR	Jordan
22	KOR	Korea Rep.
23	LKA	Sri Lanka
24	LTU	Lithuania
25	LVA	Latvia
26	MAR	Morocco
27	MEX	Mexico
28	MUS	Mauritius
29	MYS	Malaysia
30	NAM	Namibia
31	PAN	Panama
32	PER	Peru
33	PHL	Philippines
34	POL	Poland
35	PRY	Paraguay
36	ROM	Romania
37	RUS	Russian Federation
38	SLV	El Salvador
39	THA	Thailand
40	TTO	Trinidad and Tobago
41	TUN	Tunisia
42	TUR	Turkey
43	URY	Uruguay
44	VEN	Venezuela RB
45	ZAF	South Africa

SNo.	Country code	Country name
1	BGD	Bangladesh
2	CMR	Cameroon
3	GEO	Georgia
4	HTI	Haiti
5	IDN	Indonesia
6	IND	India
7	KEN	Kenya
8	MDG	Madagascar
9	MLI	Mali
10	MOZ	Mozambique
11	MWI	Malawi
12	NGA	Nigeria
13	NIC	Nicaragua
14	PAK	Pakistan
15	SEN	Senegal
16	TCD	Chad
17	TZA	Tanzania
18	UGA	Uganda
19	UKR	Ukraine
20	VNM	Vietnam
21	ZWE	Zimbabwe

APPENDIX-B1: ECONOMIC FREEDOM, ENERGY INTENSITY, AND CARBON INTENSITY FOR HIGH INCOME COUNTRIES IN THE SAMPLE.

High-income economies are those in which 1999 GNI per capita was $9,266 or more, based on World Development Indicators 2001, The World Bank.

Energy Intensity in Btu per 2000 U.S. Dollars Using Market Exchange Rates. **Carbon Intensity** in Metric Tons Carbon Equivalent per Thousand 2000 U.S. Dollars Using Market Exchange Rates.

SNo.	Country code	Country	Economic Freedom Index	Energy Intensity	Carbon Intensity
1	AUS	Australia	7.85	12383	0.248
2	AUT	Austria	7.69	7434	0.101
3	BEL	Belgium	7.37	11465	0.164
4	CAN	Canada	8.03	17863	0.217
5	DEU	Germany	7.46	7545	0.122
6	DNK	Denmark	7.66	5435	0.098
7	ESP	Spain	7.16	10217	0.153
8	FIN	Finland	7.65	9654	0.117
9	FRA	France	6.91	8269	0.082
10	GBR	United Kingdom	8.15	6427	0.101
11	GRC	Greece	6.88	11125	0.222
12	HKG	Hong Kong China	8.69	4995	0.100
13	IRL	Ireland	7.87	5476	0.100
14	ISL	Iceland	7.71	15907	0.094
15	ITA	Italy	6.57	7235	0.115
16	JPN	Japan	7.25	4605	0.068
17	LUX	Luxembourg	7.77	8637	0.144
18	NLD	Netherlands	7.74	10766	0.190
19	NOR	Norway	7.30	10212	0.070
20	NZL	New Zealand	8.23	15212	0.182
21	PRT	Portugal	7.15	10421	0.158
22	SGP	Singapore	8.48	18727	0.345
23	SVN	Slovenia	6.26	14806	0.218
24	SWE	Sweden	7.33	8294	0.061
25	USA	United States	8.19	9521	0.152

APPENDIX-B2: ECONOMIC FREEDOM, ENERGY INTENSITY, AND CARBON INTENSITY FOR MIDDLE INCOME COUNTRIES IN THE SAMPLE.

Middle-income economies are those in which 1999 GNI per capita was between $755 and $9,265, based on World Development Indicators 2001, The World Bank.

Energy Intensity in Btu per 2000 U.S. Dollars Using Market Exchange Rates. **Carbon Intensity** in Metric Tons Carbon Equivalent per Thousand 2000 U.S. Dollars Using Market Exchange Rates.

SNo.	Country code	Country	Economic Freedom Index	Energy Intensity	Carbon Intensity
1	ARG	Argentina	5.76	10130	0.134
2	BGR	Bulgaria	6.25	61988	0.978
3	BOL	Bolivia	6.53	20893	0.329
4	BRA	Brazil	5.93	13944	0.151
5	BWA	Botswana	7.16	9014	0.180
6	CHL	Chile	7.43	13449	0.179
7	CHN	China	5.97	33175	0.704
8	COL	Colombia	5.46	12824	0.158
9	CRI	Costa Rica	7.38	9632	0.084
10	CZE	Czech Republic	6.85	28903	0.508
11	DOM	Dominican Republic	6.31	13675	0.247
12	DZA	Algeria	4.57	21246	0.367
13	ECU	Ecuador	5.86	21728	0.361
14	EGY	Egypt Arab Rep.	6.12	22925	0.364
15	EST	Estonia	7.76	34095	0.763
16	GTM	Guatemala	6.55	8436	0.138
17	HND	Honduras	6.53	15334	0.250
18	HRV	Croatia	6.00	18967	0.289
19	HUN	Hungary	7.37	20804	0.308
20	JAM	Jamaica	6.92	18422	0.369
21	JOR	Jordan	6.97	24873	0.463
22	KOR	Korea Rep.	6.96	14739	0.219
23	LKA	Sri Lanka	6.16	11064	0.178
24	LTU	Lithuania	6.75	30890	0.366
25	LVA	Latvia	6.85	17711	0.236
26	MAR	Morocco	6.08	12877	0.239
27	MEX	Mexico	6.45	11619	0.189
28	MUS	Mauritius	7.03	10222	0.198
29	MYS	Malaysia	6.52	23267	0.389
30	NAM	Namibia	6.75	13924	0.173
31	PAN	Panama	7.25	16002	0.281
32	PER	Peru	6.85	9823	0.128
33	PHL	Philippines	6.65	14407	0.226
34	POL	Poland	6.13	20564	0.440
35	PRY	Paraguay	6.37	53562	0.122
36	ROM	Romania	5.72	39108	0.635
37	RUS	Russian Federation	5.14	94774	1.429
38	SLV	El Salvador	7.21	8578	0.115
39	THA	Thailand	6.60	22158	0.378
40	TTO	Trinidad and Tobago	6.81	59130	0.984
41	TUN	Tunisia	6.30	15632	0.265
42	TUR	Turkey	5.86	15922	0.266
43	URY	Uruguay	6.75	9532	0.086
44	VEN	Venezuela RB	4.33	29326	0.386
45	ZAF	South Africa	6.92	35348	0.809

APPENDIX-B3: ECONOMIC FREEDOM, ENERGY INTENSITY, AND CARBON INTENSITY FOR LOW INCOME COUNTRIES IN THE SAMPLE.

Low-income economies are those in which 1999 GNI per capita was $755 or less, based on World Development Indicators 2001, The World Bank.

Energy Intensity in Btu per 2000 U.S. Dollars Using Market Exchange Rates. **Carbon Intensity** in Metric Tons Carbon Equivalent per Thousand 2000 U.S. Dollars Using Market Exchange Rates.

SNo.	Country code	Country	Economic Freedom Index	Energy Intensity	Carbon Intensity
1	BGD	Bangladesh	5.73	11680	0.185
2	CMR	Cameroon	5.59	7282	0.162
3	GEO	Georgia	6.42	39448	0.290
4	HTI	Haiti	5.89	7400	0.130
5	IDN	Indonesia	6.07	28041	0.516
6	IND	India	6.41	25460	0.507
7	KEN	Kenya	6.50	15366	0.221
8	MDG	Madagascar	5.93	9378	0.155
9	MLI	Mali	5.56	4735	0.052
10	MOZ	Mozambique	5.48	32820	0.093
11	MWI	Malawi	5.52	14836	0.132
12	NGA	Nigeria	5.93	17858	0.462
13	NIC	Nicaragua	6.30	15285	0.260
14	PAK	Pakistan	5.61	24403	0.364
15	SEN	Senegal	5.77	12835	0.243
16	TCD	Chad	5.40	1599	0.030
17	TZA	Tanzania	6.34	7208	0.089
18	UGA	Uganda	6.48	5538	0.059
19	UKR	Ukraine	5.49	160112	2.414
20	VNM	Vietnam	5.53	25715	0.435
21	ZWE	Zimbabwe	3.32	16693	0.267

APPENDIX-C: DESCRIPTION OF COMPONENTS OF THE ECONOMIC FREEDOM OF THE WORLD INDEX

The Economic Freedom of the World (EFW) Index is made of 38 distinct sub-components aggregated into five key areas. We provide a brief note on each of the areas and sub-components.

1: Size of Government: Expenditures, Taxes, and Enterprises

A. General government consumption spending as a percentage of total consumption.

Large share of government spending in total suggests dominating role for the public sector in decision process and hence crowds out individual and private decision making capability leading to weakening of overall economic freedom.

B. Transfers and subsidies as a percentage of GDP.

Increase in transfer from one section of the economy (productive agent or sector) to provide subsidies to another (usually unproductive or protective sector) discourages productive member of the society. In addition, increase subsidies distorts price in the market all leading to negative impact in doing business.

C. Government enterprises and investment as a percentage of GDP.

Increase role of public sector in the real sectors of the economy, especially in developing countries, often operate with a different sets of rules and regulations. These provide implicit distortion in the market. For example, gross inefficiencies in the operation of State Electricity Boards in India resulting in gross financial mismanagement. Also, larger than life role of state enterprises in China is a sore point in the building a true market oriented economy.

D. Top marginal tax rate (and income threshold to which it applies).

i. Top marginal income tax rate (and income threshold at which it applies)

ii. Top marginal income and payroll tax rate (and income threshold at which it applies)

Large top marginal tax rate and payroll tax rate and income threshold at which it applies means that investors get to keep less of their earning and hence discourage further growth in the economy. Lower tax rate and payroll tax results in higher score of economic freedom.

2: Legal Structure and Security of Property Rights

A. Judicial independence: the judiciary is independent and not subject to interference by the government or parties in disputes.

Protection of one's right is a fundamental need for any economic advancement. As important as it is necessary to have adequate laws, it is equally important to have the protectors of the law to be impartial and objective. Government influence on judicial proceedings/outcomes only bread negative investment climate.

B. Impartial courts: A trusted legal framework exists for private businesses to challenge the legality of government actions or regulation.

Impartial courts provide level playing fields for investors in an event of business arbitration or judgment.

C. Protection of intellectual property.

For innovation to take place and flourish, one has to be recognized for innovation. This can only be guaranteed if there is strong protection of intellectual property right. Such protection rewards the innovators financially to pay for the idea and investment. In an environment where there is no such protection there will be no incentive for any form of innovation. Innovation in India and China in the form of international patent is significantly less than in the US because of weak protection laws and enforcement.

D. Military interference in rule of law and the political process.

Without having a strong rule of law, society basically stagnates. Moreover, military interference in the basic rule of law will not invite any form of investment. The low score of Myanmar indicates the long reach of the military interferences in the overall governance of the country.

E. Integrity of the legal system.

It is impossible to maintain and grow business in an environment where the legal system can be manipulated. Corrupt legal system unfortunately is pervasive in least developing countries and their low scores reflect this fact.

3: Access to Sound Money

A. Average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years

Excess money supply fuels inflation and hence is adversely impacts new investments.

B. Standard inflation variability in the last five years.

If is important to have a stable macro economic condition to provide stability in the business environment. Certainly in macro economic condition leads to having one less aspect of uncertainly investors have to deal in its planning process. High variability in inflation will withhold investment and lower the score of economic freedom.

C. Recent inflation rate.

Inflation is fueled by national government printing money to support consumption and hence devalue investment in real terms. It is natural for countries with high inflation rate to have less conducive investment climate. High inflation countries will tend to have low score.

D. Freedom to own foreign currency bank accounts domestically and abroad.

In an age of globalization, international firms need to have the flexibility to move international currency in and out as required. Such flexibility can only occur if there is full convertibility of national current and capital account. Restriction of convertibility discourages foreign direct investment. Comparison of foreign direct investment between China and India indicates that restrictive currency repatriation regulation in India contributed to low level of foreign direct investment in the past decade.

4: Freedom to Trade Internationally

A. Taxes on international trade.

i. Revenue from taxes on international trade as a percentage of exports plus imports.

ii. Mean tariff rate.

iii. Standard deviation of tariff rates.

High tax rate especially international trade does not provide incentives to attract new investment. High tax means that profit earners get less to keep for its shareholders and investment. There are plenty of examples, such as in Shanghai region and Ghuangdon provinces in China, where countries have established Export Promotion Zones or Special Economic Zones with zero tax facilities. Such establishments have greatly attracted foreign direct investment in China.

B. Regulatory trade barriers.

i. Hidden import barriers: No barriers other than published tariffs and quotas.

ii. Costs of importing: the combined effect of import tariffs, license fees, bank fees, and the time required for administrative red-tape raises costs of importing equipment by (10 = 10% or less; 0 = more than 50%).

Regulatory barriers such as production quantity restrictions and price restrictions all add to decreasing economic freedom that retard growth. Prior to the opening of the Indian economy (early 1980s), "License Raj" in India was notorious for its trade barriers and red-tapism that all lead to economic isolation resulting in meager economic growth. Relaxation of regulatory trade barriers promotes economic freedom and growth.

C. Actual size of trade sector compared to expected size.

Performance expectation in trade matters in promoting economic freedom.

D. Difference between official exchange rate and black market rate.

Improper valuation of national currency all lead to non-market based pricing. Under such distorted exchange regime does not add to economic freedom.

E. International capital market controls

i. Access of citizens to foreign capital markets and foreign access to domestic capital markets.

ii. Restrictions on the freedom of citizens to engage in capital market exchange with foreigners—index of capital controls among 13 IMF categories.

Freedom raise money for investment should have no boundaries if investment is to increase. Unrestrictive capital market provides gains to trading entities and hence lesser is the control higher will be the score.

5: Regulation of Credit, Labor, and Business

A. Credit Market Regulations

i. Ownership of banks: percentage of deposits held in privately owned banks.

ii. Competition: domestic banks face competition from foreign banks.

iii. Extension of credit: percentage of credit extended to private sector.

iv. Avoidance of interest rate controls and regulations that lead to negative real interest rates.

v. Interest rate controls: interest rate controls on bank deposits and/or loans are freely determined by the market.

Barriers in any form impede freedom to trade and hence reduce economic freedom. The ability to apply, qualify and repay credit requires that the rules and regulation are efficient, transparent and hassle free. More competition in the banking sector leads to better credit rates for investors and hence is beneficial. Barriers to entry for foreign banks and other forms of restriction such as interest rate control reduce economic freedom. In the name of providing easy access to finances, developing countries have adopted directed targeted lending (bank are directed by the respective governments to provide loans to priority sectors of the economy) which distorts the banking operation away from market oriented operation.

B. Labor Market Regulations

i. Impact of minimum wage: the minimum wage, set by law, has little impact on wages because it is too low or not obeyed.

ii. Hiring and firing practices: hiring and firing practices of companies are determined by private contract.

iii. Share of labor force whose wages are set by centralized collective bargaining.

iv. Unemployment Benefits: the unemployment benefits system preserves the incentive to work.

v. Use of conscripts to obtain military personnel

Artificial setting of regulation on the labor market

Proper labor regulations are there to protect the labor as well as the employer. However, if the labor law is in favor of either one of the party then it impedes in the operation of effective management of a business. Laws that determine remunerations and benefits should be based on market principles and should be consistent without overly burdening on cost of doing business. Excessive labor market regulations decrease economic freedom.

C. Business Regulations

i. Price controls: extent to which businesses are free to set their own prices.

ii. Administrative conditions and new businesses: administrative procedures are an important obstacle to starting a new business.

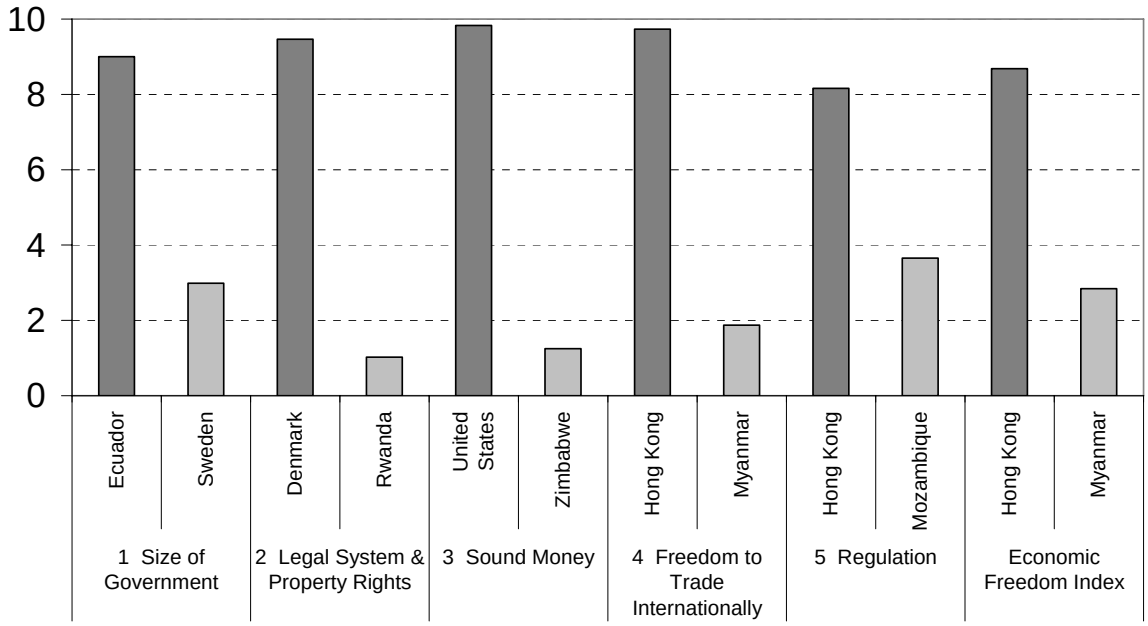
iii. Time with government bureaucracy: senior management spends a substantial amount of time dealing with government bureaucracy.

iv. Starting a new business: starting a new business is generally easy.

v. Irregular payments: irregular, additional payments connected with import and export permits, business licenses, exchange controls, tax assessments, police protection, or loan applications are very rare.

Regulations are formulated to facilitate and build a conducive climate. These ensure that rights to operate a business are conducted without additional cost. Price control, tedious bureaucracy paper work, and rent seeking activities all adds to cost of doing business. These all add to reduce economic freedom.

Maximum and Minimum Score for
Areas of Economic Freedom Index (2003)



APPENDIX-D: ASIA PACIFIC PARTNERSHIP ECONOMIC FREEDOM INDEX AND ENERGY INTENSITY

Asia Pacific Partnership: Energy Intensity

(Btu per 2000 dollars using market exchange rates)

	1980	1985	1990	1995	2000	2001	2002	2003
Australia	14737	14487	14391	13121	12848	12947	12553	12383
China		78693	65522	48418	35973	35259	33488	33175
India	26805	29270	29447	32729	29030	28337	26965	25460
Japan	5508	4733	4450	4690	4703	4683	4667	4605
South Korea	13317	12185	13213	15777	15388	15102	14762	14739
United States	15174	12629	11901	11361	10081	9758	9737	9521

Asia Pacific Partnership: Economic Freedom of the World Index

	1980	1985	1990	1995	2000	2001	2002	2003
Australia	6.88	7.19	7.26	7.78	8.03	7.92	7.91	7.85
China		5.04	4.81	5.20	5.82	5.89	5.91	5.97
India	5.25	4.94	4.91	5.61	6.23	6.18	6.37	6.41
Japan	7.01	7.06	7.37	7.03	7.33	7.04	6.97	7.25
South Korea	5.75	5.80	6.16	6.33	6.63	6.97	6.95	6.96
United States	7.52	7.66	7.85	8.31	8.57	8.34	8.22	8.19