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Task Force on Energy for Sustainable Development
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Summary Report

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INTRODUCTION

The achievement of sustainable development, defined as "meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs," is dependent upon the ability of government actors, private corporations, citizens, and non-governmental organizations to address the world's increasing demand for energy.[1] Increased access to energy services is linked to development for the purposes of economic growth, improved educational opportunities, and basic household operations. Yet, while the benefits of increased energy access are apparent, the potential adverse effects on the local and global environment pose several challenges to policymakers.

The United Nations Commission on Sustainable Development (UNCSD or CSD), established by the General Assembly in December 1992 in order to follow up on the United Nations Conference on Environment and Development (UNCED), has chosen to focus on energy for sustainable development in its 2006/2007 cycle.[2] The Ninth Session of the CSD in 2001 also focused on energy as one of its major themes, and there, countries agreed that "stronger emphasis should be placed on the development, implementation, and transfer of cleaner, more efficient technologies and that urgent action is required to further develop and expand the role of alternative energy sources."[3] Specifically, the Johannesburg Plan of Implementation (JPOI), adopted at the World Summit on Sustainable Development in 2002, calls for several efforts to address "energy

[1] Brundtland Report of the World Commission on Environment and Development, U.N. General Assembly, A/42/427, 4 August 1987, Annex "Our Common Future." Available http://www.are.admin.ch/are/en/nachhaltig/international_uno/unterseite02330/

[2] UN Department of Economic and Social Affairs (UNDESA), Division for Sustainable Development (SD), "CSD-11: Multi-Year Programme of Work for CSD: 2004/2005 to 2016/2017," Page updated 3 August 2005, Available http://www.un.org/esa/sustdev/csd/csd11/CSD_mulityear_prog_work.htm)

[3] UNDESA, SD, "Issues: Energy for Sustainable Development," Page Updated 3 February 2006, Available http://www.un.org/esa/sustdev/sdissues/energy/enr.htm

in the context of sustainable development."[4] These JPOI calls for action include improving access to energy services that are "reliable, affordable, economically viable, socially acceptable, and environmentally sound;" increasing the use of renewable energy sources; "developing advanced, cleaner, more efficient, and cost-effective energy technologies;" and accelerating the "development, dissemination, and deployment of affordable and cleaner energy efficiency and energy conservation technologies."[5]

Consistent with these calls to action, the Princeton University Undergraduate Task Force on Energy for Sustainable Development attempts to address the question of how to increase access to sustainable sources of energy. In so doing, the Task Force analyzes several issues related to energy generation, energy efficiency, energy services in difficult-to-reach areas, and the implementation of renewable energy incentives and financing.

The Task Force is led by Professor Denise Mauzerall, and is composed of eight third-year public policy students, as well as one fourth-year "commissioner," in the Woodrow Wilson School of Public and International Affairs at Princeton University. For a semester of directed, intense study, each of the Task Force members tackled a specific issue related to generation, efficiency, development, or implementation, and compiled an individual report analyzing his or her specific issue.

As its geographic focus, the Task Force examined three countries that will have a significant effect on energy consumption trends and the resultant environmental effects of energy consumption: India, China, and the United States of America. Each country is at a different stage of economic development: in 2005, the US total GDP (purchasing power

[4] Ibid.
[5] UNDESA, SD, Johannesburg Plan of Implementation (JPOI), Adopted 2002, Available http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf

parity, hereafter PPP) was US$12.41 trillion and per capita GDP was US$42,000; China's total GDP (PPP) was US$8.182 trillion and per capita GDP was US$6,300; India's total GDP (PPP) was US$3.699 trillion and per capita GDP was US$3,400.[6] According to the UN's composite Human Development Index, the US ranks 8th; China ranks 94th, and India ranks 127th.[7] In addition, each country currently produces and consumes large and growing amounts of energy. With global electricity production at 16.5 trillion kWh in 2003, India produced 0.557 trillion kWh that same year; China produced 2.19 trillion kWh in 2004; and the U.S. produced 3.892 trillion kWh in 2003.[8]

Population growth and/or economic development are expected to contribute to the rise of energy production and consumption in each of these countries as well as throughout the globe. Between 2002 and 2025, electricity generation will likely come close to doubling, from 14.3 trillion kWh in 2002 to 26.0 trillion kWh in 2025.[9] Since the growing demand for energy services is an issue that affects policymakers in many countries, the diverse array of technologies and policies available in the three case study countries present opportunities for the discovery of overarching concerns, goals, successes, and failures.

The final in-depth report of each individual Task Force member presents findings and policy recommendations on their respective individual topic. Summaries of these reports were presented at a side-event of CSD-14 on May 12, 2006 at the United Nations in New York City. These individual reports follow this summary, which discusses

[6] Central Intelligence Agency (CIA), *The World Factbook*, updated May 2006, Available http://www.cia.gov/cia/publications/factbook/index.html
[7] United Nations Development Programme, *Human Development Report 2004*, "The Human Development Index," Available http://hdr.undp.org/docs/statistics/indices/hdi_2004.pdf
[8] CIA, 2006
[9] Energy Information Administration (EIA), *International Energy Outlook 2005*, #:DOE/EIA-0484(2005), Washington, DC, July 2005. Available http://www.eia.doe.gov/oiaf/ieo/index.html. Hereafter EIA, *IEO 2005*

current trends in energy demand and environmental repercussions, provides summaries of individual reports, and concludes with broad recommendations determined by the members of the Task Force.

CURRENT TRENDS IN ENERGY DEMAND AND ENVIRONMENTAL REPERCUSSIONS

Assessments of global energy demand forecast significant increases over the next two decades. According to the Energy Information Administration (EIA), global energy demand is predicted to increase by fifty-seven percent over the 2002-2025 time period (Figure 1).[10] Much of this growth will come from "emerging Asia," including India and China, where the predicted increase in energy demand by 2025 is more than a doubling of 2002 levels.[11]

Fossil fuels are the traditional and predominant source of energy, and forecasts predict their continued predominance (Figure 2). In 2025, oil is expected to maintain its position as the dominant source of energy, "with its share of total world energy consumption declining only slightly, from thirty-nine percent in 2002 to thirty-eight percent in 2025."[12] This continued demand for oil is consistent with the anticipated growth in the transport sector, which is expected to account for sixty percent of the predicted fifty-three percent increase in global oil demand.[13] Coal and natural gas demand are also forecast to increase as more areas of the world gain access to electricity. India and China both are home to large reserves of coal, and together, "account for 87

[10] EIA, *IEO 2005*
[11] ibid.
[12] ibid.
[13] ibid.

percent of the projected rise in coal use in the emerging economies region and 72 percent of the *total* world increase in coal demand over [2002-2005]."[14]

Figure 1. World Marketed Energy Consumption, 1970-2025.[15]

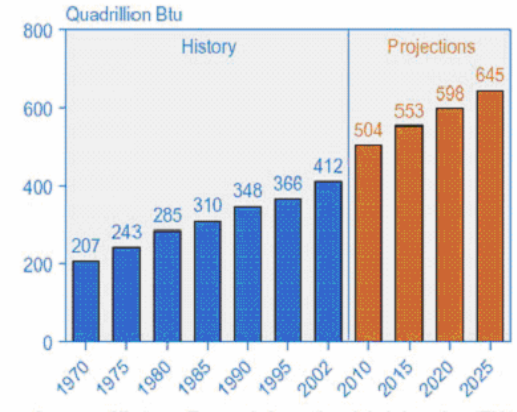
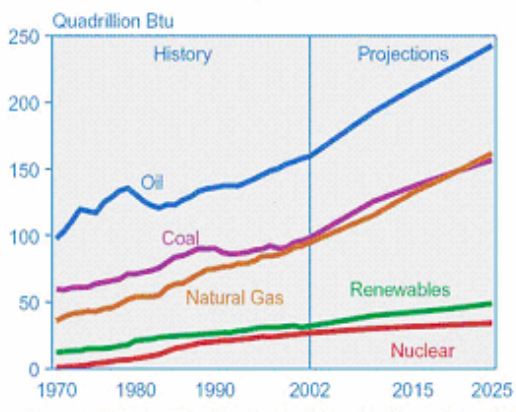


Figure 2. World Marketed Energy Use by Fuel Type, 1970-2025.[16]



Renewable energy sources are only expected to hold an eight percent share of world energy consumption from 2002-2025, as growth in demand for natural gas and coal is projected to be more rapid than that of renewable sources.[17]

With the persistence of trends in the global fuel mix over the next twenty years, individual citizens, lawmakers, and other concerned parties can expect significant environmental damage at both the local and global levels if concerted efforts to avoid such repercussions are not taken. Locally, fossil fuel combustion can lead to deteriorating air quality with further implications for ecological systems and human

[14] ibid.
[15] Energy Information Administration (EIA), *International Energy Outlook 2005*, #:DOE/EIA-0484(2005), Washington, DC, July 2005. Figure 7, Available http://www.eia.doe.gov/oiaf/ieo/figure_7.html Figure Sources : History – EIA *International Energy Annual 2002*. DOE/EIA-0219(2002) Washington, DC, March 2004, web site www.eia.doe.gov/iea/. Projections – EIA, System for the Analysis of Global Energy Markets (2005)
[16] Energy Information Administration (EIA), *International Energy Outlook 2005*, #:DOE/EIA-0484(2005), Washington, DC: July 2005. Figure 8, Available http://www.eia.doe.gov/oiaf/ieo/figure_8.html Figure Sources : History – EIA *International Energy Annual 2002*. DOE/EIA-0219(2002) Washington, DC, March 2004, web site www.eia.doe.gov/iea/. Projections – EIA, System for the Analysis of Global Energy Markets (2005)
[17] EIA, *IEO 2005*

health. The pollutants from fossil fuel combustion include sulfur dioxide and nitrogen oxides, which both are precursors to acid rain, and particulate matter, which has been linked to increased cases of and complications from respiratory illnesses like asthma and increased numbers of premature mortalities.[18]

Fossil fuel combustion results in the emissions of greenhouse gases that globally accelerate climate change.[19] Greenhouse gases affect climate by absorbing infrared wavelengths of radiation and preventing radiation of heat from the earth's surface to space. Carbon dioxide absorbs strongly in the infrared and is an increasingly abundant greenhouse gas in the atmosphere. It is the single most important anthropogenic (emitted by humans) greenhouse gas in the atmosphere. Greater concentrations of greenhouse gases mean greater average global temperatures; a rapid increase in the average global temperature will cause disruptions in the climate system. These disruptions may be both positive and negative, although scientists anticipate the negative effects to outweigh the benefits. Expected negative effects, according to the Intergovernmental Panel on Climate Change (IPCC), are:

- A general reduction in potential crop yields in most tropical and sub-tropical regions for most projected increases in temperature
- A general reduction, with some variation, in potential crop yields in most regions in mid-latitudes for increases in annual-average temperature of more than a few °C
- Decreased water availability for populations in many water-scarce regions, particularly in the sub-tropics
- An increase in the number of people exposed to vector-borne (e.g., malaria) and water-borne diseases (e.g., cholera), and an increase in heat stress mortality
- A widespread increase in the risk of flooding for many human settlements (tens of millions of inhabitants in settlements studied) from both increased heavy precipitation events and sea-level rise

[18] EPA, "Acid Rain," Fact Sheet. Available http://www.epa.gov/acidrain/index.html, Last updated on Thursday, March 2nd, 2006. Accessed 10 May 2006. See Also Shaw, Jonathan. "Clearing the Air: How epidemiology, engineering, and experiment finger fine particles as airborne killers" Harvard Magazine, May-June 2005, pp. 28-35.

[19] The analysis from this paragraph is drawn from Lee Kump, James Kasting, and Robert Crane, The Earth System, Second Edition, Upper Saddle River, NJ: Pearson Education, Inc, 2004.

- Increased energy demand for space cooling due to higher summer temperatures.[20]

Predicted beneficial effects according to the IPCC include:

- Increased potential crop yields in some regions at mid-latitudes for increases in temperature of less than a few °C
- A potential increase in global timber supply from appropriately managed forests
- Increased water availability for populations in some water-scarce regions
- Reduced winter mortality in mid- and high-latitudes
- Reduced energy demand for space heating due to higher winter temperatures.[21]

However, the effects of climate change are most likely to be adverse in the developing countries, which are also the least likely to have the resources necessary to adapt to such effects as rising sea levels, increased incidences of vector-borne disease, and reduced agricultural yields.[22] Current trends in total and per capita carbon emissions globally and in the three focus countries are presented below in Figures 3 and 4.

At the same time, it is true that reliance on traditional and pre-industrial sources of energy, such as wood-burning cook stoves and other forms of biomass combustion, can result in negative health effects.[23] Nearly two million children each year die from respiratory infections resulting from indoor air pollution and poor ventilation.[24] According to a 2006 UN Report, "indoor air pollution has larger health effects than urban

[20] IPCC, Impacts, Adaptation, and Vulnerability: Summary for Policymakers, http://www.grida.no/climate/ipcc_tar/wg2/008.htm#25. Because climate change is expected to cause an increase in extreme events, dry areas will become drier and wet areas may experience more intense precipitation. Water-borne diseases and vector-borne diseases will increase because the extent of tropical climate areas will increase with the trend of warming.

[21] Ibid. Note that many of these benefits will disproportionately help already developed countries, such as the United States and Europe. Countries located in the low-latitudes, which are almost all developing countries, will suffer from sea-level rise, increased disease, and higher risks from extreme weather events. Moreover, there is "high confidence that developing countries will be more vulnerable to climate change than developed countries, and medium confidence that climate change would exacerbate income inequalities within and between countries." See IPCC, Climate Change 2001: Working Group II: Impacts, Adaptation, and Vulnerability, Chapter 19, Executive Summary Available: http://www.grida.no/climate/ipcc_tar/wg2/658.htm

[22] IPCC, 2001

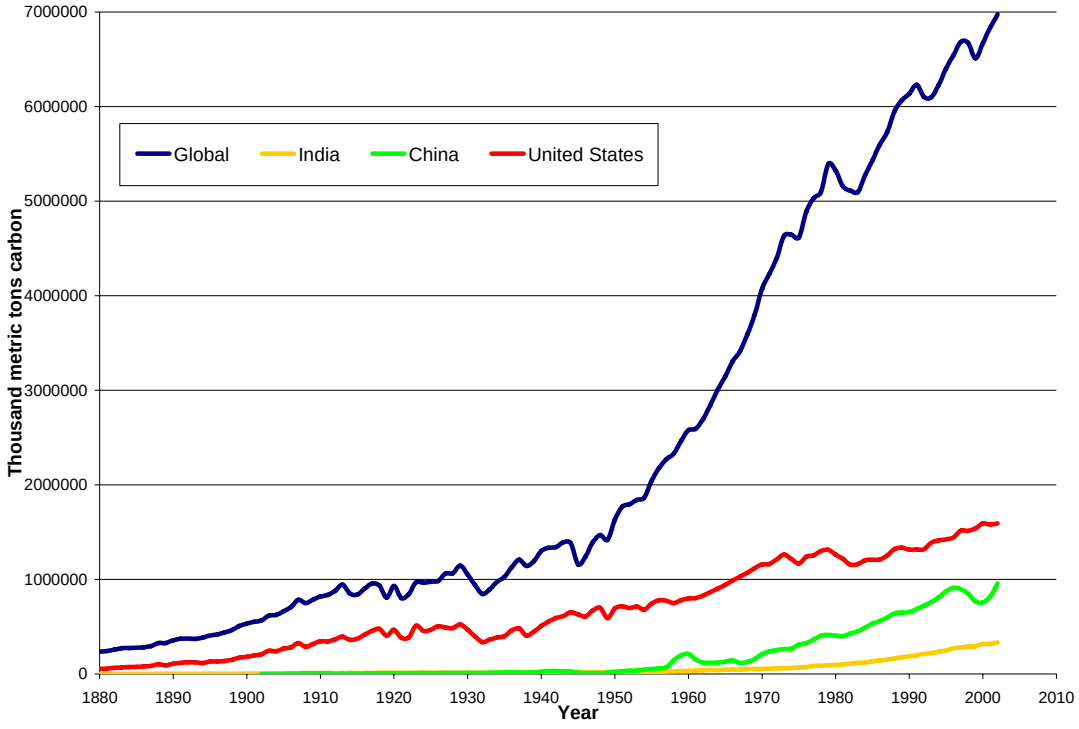
[23] UNDESA, *Trends in Sustainable Development*, 2006, Available http://www.un.org/esa/sustdev/publications/trends2006/index.htm

[24] Ibid.

air pollution [due to industrial activity, electricity generation, and transportation] by a large margin."[25]

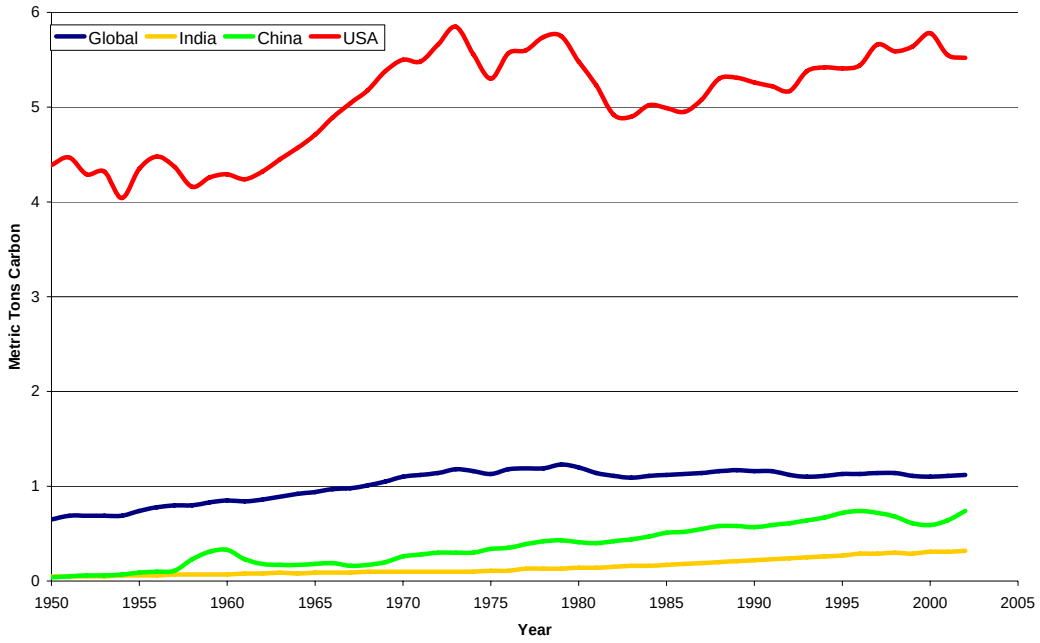
Inhibiting the modernization of energy services to the more than two billion people without electricity is clearly not the goal of sustainable development. Rather, policymakers and industry should implement available types of renewable energy sources, such as wind power or photovoltaic (PV) solar panels or small hydroelectric power plants. These forms of energy generation result in negligible amounts of air pollutants in lifecycle calculations, and during operation, emit no air pollutants or greenhouse gases. Additionally, efforts to control the emissions from fossil-fuel based energy would allow countries like India and China to utilize their existing natural resources with reduced impacts on air quality, human health, and climate change.

Figure 3.
Total Carbon Emissions from FF Combustion and Cement Production, 1880-2002.[26]



[25] Ibid.
[26] Figure created from data available at http://cdiac.ornl.gov/ftp/trends/emissions

Figure 4. Per Capita Carbon Emissions, 1950-2002.[27]



The Task Force papers proceed from the following objectives – to reduce the negative effects of fossil-fuel based energy sources, to increase the use of renewable energy sources, and overall, to improve access to energy services globally. First, the papers examine specific types of energy generation: one renewable and one adapting the use of coal. Michael Treadow analyzes the existing options and projected developments in wind energy. W. Ulysses Fowler appraises advanced coal gasification technologies and the feasibility of decarbonizing coal. Second, the papers look at ways to increase the efficiency of energy use so as to increase access to users without necessarily increasing emissions. Ben Steiner explores fuel efficiency in private vehicles and Nikki Laffel reviews the methods by which public transportation can provide gains in transport efficiency. Andrew Turco investigates methods by which efficiency in buildings, from construction to operation, can be achieved. Third, the papers discuss the extension of

[27] ibid

energy services to difficult-to-reach areas in the context of development. Antonio Lacayo surveys the opportunities for providing energy services to rural areas, and David Schaengold proposes distributed generation as a means of electrifying urban slums. Fourth, the papers determine methods by which the implementation of improved energy services might be accomplished via governmental regulation and financing options. Sabina Sequeira proposes the use of mandated market systems. My presentation, developed from my senior thesis, argues for the reform of public international financing institutions, such as the Export-Import Bank of the United States, to promote the growth and dissemination of renewable energy technologies.

PAPER SUMMARIES

"Wind Power: A Clean and Renewable Supplement to the World's Energy Mix"

Wind power harbors the potential to become a key contributor to the world's energy supply in years to come. Not only is it inexhaustible and free, but in comparison to fossil fuel sources, its environmental footprint is negligible. The major technical hurdles to wind power's growth relate to its remoteness and variability, but neither is an obstacle too great to be overcome. In many places, wind-generated electricity is already cost-competitive with traditional energy sources, and in those where it is not, capital investment is needed to prime the wind industry for competition. This paper reviews the background and technical aspects of wind power, examines the economic side of wind power, argues for general strategies that governments could use to create incentives for growth in the wind industry, and examines China as a case study. The final

recommendations focus on ensuring fair grid access, taking advantage of offshore wind potential, and enacting economic measures to foster the industry's growth.

"STRENGTHENING SECURITY, HEALTH, AND ENVIRONMENT: Towards a Sustainable Coal-based Development Strategy for China"

In the next 30 years, 1400 GW of new electricity generation capacity is expected to be constructed worldwide. If all of this new generation capacity utilized coal, it would produce over its lifetime emissions of carbon dioxide 40% greater than total fossil carbon emissions from 1750 to the present. To avoid these emissions and the resulting impacts, it is imperative to develop new sources of decarbonized electricity. Integrated coal gasification and carbon capture and storage offers one of the most promising routes to decarbonized fossil fuel resources, since coal is abundant and secure and gasification is commercially viable. As such, coal gasification could play a significant role in increasing global supplies of decarbonized energy in the near and long term. However, several obstacles to implementation remain, especially in China and India where the most significant electricity growth will occur. China holds a position of special importance due to its extensive coal reserves and massive energy requirements, which together could transform China into the largest global carbon emitter within the next two decades. Both China and the world have much to gain by avoiding this outcome and instead developing China's energy system along an alternative trajectory based on advanced coal technologies. This paper examines barriers to the widespread implementation of coal gasification, including environmental policy, institutional capabilities, intellectual property rights protection, investment and trade rules, and finance and economics. The

policy recommendations argue for the enforcement of existing environmental regulations and promulgation of tougher ones, the reform of the innovation process, the strengthening of intellectual property rights protection, the continuing liberalization of foreign investment, and the development of gasification-based electricity generation demonstration projects.

"Achieving Vehicle Fuel Efficiency: The CAFE Standards and Beyond"

Automobile fuel efficiency is one of the few issues in the greater global warming debate where stricter regulations are politically feasible because of the convergence of other policy goals. In particular, the United States' massive reliance on foreign oil and the coming crunch of global oil supplies have politicians concerned about energy security calling for increased fuel efficiency regulation. In addition, environmentalists have long sought more efficient vehicles and there is also a growing awareness among segments of the population of the threats caused by increased greenhouse gas emissions. Fuel efficiency is also one of the few areas in the climate change debate where the government has a history of regulation that can easily be relied upon as a basis for a new standard. Finally, the transportation sector accounts for 20% of carbon dioxide emissions in the US, so an increase in automobile fuel efficiency would significantly affect carbon concentration in the atmosphere. This paper identifies the current fuel efficiency situation in the United States and in China, and argues for policies that push for higher standards in both countries. Three policies are advocated. First, fuel efficiency standards in both countries should be increased to 36 mpg by 2015. This should be a fleet wide standard with tradable credits so improvements can occur at least cost. Second, though

politically difficult to achieve in both the United States and China, a higher gas tax would curtail unnecessary driving and reduce fuel consumption while raising automobile fuel efficiency. This is the most economically efficient option. Finally, both nations should implement a feebate system that subsidizes high efficiency vehicles with taxes raised on low emissions ones, eliminating market failure by bring total gasoline lifecycle costs to the forefront.

"Promoting Public Transportation for Sustainable Development"

This policy proposal addresses the issue of public transportation as a means for sustainable development. Transportation is an issue that needs to be addressed because it has two deleterious effects on the environment. One is the effect of vehicle carbon dioxide, $CO_{2,}$ emissions on climate change and the second stems from other vehicle emissions that cause air pollution leading to negative health effects. These two issues warrant the conclusion that transportation needs to be monitored. Policies can be instituted to mitigate these negative consequences. This report focuses its policy recommendations on promoting public transportation as a means for environmental sustainability. The idea is that increased use of public transportation will lessen the demand for private transportation thereby lowering the number of vehicles on the road and thus lessening global vehicle emissions.

"Laying the Foundation for a More Energy Efficient Future: Reducing Climate Change through Green Building"

Buildings are huge energy consumers. Residential and commercial buildings account for 39% of total energy use in the US, meaning that reductions in buildings' energy demand could result in a great drop in the need for carbon-emitting power plant production of electricity. Additionally, peak electricity loads, which tend to determine the number of power plants needed and which sometimes requiring older, dirtier plants to come back online, are usually determined by the demand for lighting and cooling of buildings. Residential electricity use per capita has been increasing since the 1980's, and US energy consumption, as a whole, is expected to continue growing due to the creation of more commercial floor space, the continued increase in the use of electric appliances in residential buildings, and expanding industrial output. Essentially, decreasing energy demand from buildings could greatly reduce energy production and its accompanying carbon emissions. As things stand now, however, builders usually care more about cutting their own initial capital costs than about long term efficiency, so inefficient building stock tends to get cemented into the building infrastructure. Even the construction of buildings themselves account for about one-third of total industrial energy use.

The incorporation of cleaner, more energy efficient buildings is extremely important to address now rather than later because buildings, unlike cars for example, have a very long life time. Building infrastructure that is invested in now is very difficult to change, so, if efficiency isn't incorporated at construction, it will be very difficult to improve in this area in the future. Office space in the US is expected to increase between

one and two percent per year in the coming future, so there is potential to make an impact. This paper looks at the ways that energy efficiency can be increased in the construction and operation of buildings. After examining the technologies available, the paper argues for a carbon tax with revenues used to subsidize geothermal heating systems, financial incentives for the construction of energy efficient buildings, more stringent renewable energy requirements for large buildings, better labeling of energy life-cycle costs, and the use of Type II partnerships to provide resources and an organizing framework for further collaboration on building efficiency.

"Off-Grid Energy in Rural India: Policy Recommendations for Effective UN Projects"

Rural areas in developing countries suffer significantly from energy scarcity, forcing people to rely on traditional biomass as their primary energy source. The current approach of the government of India to solve this problem focuses on extending the electricity grid, which fails to attend the real needs of poor people and is too expensive. This paper discusses the potential use of off-grid energy technologies, like improved cooking stoves, biogas digesters, and micro hydropower, as an alternative for grid extension. This is followed by four policy recommendations to ensure that UN rural energy projects are effective in complementing the government of India's efforts and attending the basic energy needs of the most poor in rural India. These recommendations are: to provide micro-credit and consulting for the promotion of off-grid renewable energy technologies (RETs); to focus on alleviating women's energy needs, particularly cooking; to include capacity building in energy projects by creating partnerships with the

community and providing technical assistance; and to financially support local entrepreneurs who could either benefit from energy access or supply their communities with energy services.

"Clean Distributed Generation for Slum Electrification"

Approximately half of the world's urban poor do not have access to electricity. Usually, those without access to electricity in cities live in slums, informal urban settlements that typically enclose some of the worst standards of living in the world. While electricity is in principle available in many of these slums because of the prevalence of black-market "companies" that pilfer electricity from power lines neighboring the slum, such electricity is unsafe both to those who use it and those who provide it, and expensive, sometimes more expensive than market-rate electricity.

This paper describes the barriers preventing electricity from being brought to the slums in the traditional manner, despite high demand and a willingness on the part of many slum-dwellers to pay market-rate prices for electricity. Specifically, these fall into three main types: sociological factors, infrastructural barriers, and economic barriers. Then, the paper argues for the use of clean distributed generation technologies to electrify slum areas in the Indian city of Mumbai. A combination of solar cells and wind turbines could provide electricity for individual dwellings or a group of dwellings cheaply, and unambiguously raise the standard of living for those connected. Mumbai's two seasons, a monsoon season with strong westerly winds, and a dry season with abundant sunlight, make it climatologically perfectly suited for photovoltaic cells and wind turbines.

Policy recommendations advocate that micro-credit agencies with experience in the slums be employed to give partial-loans/partial-grants to local entrepreneurs, who should be given the freedom to experiment with different strategies for payment and the number of households connected to a single plant. In addition, government programs could channel funding for partial grants from money already allocated to development projects in the slums. Finally, the utility companies can be used as a capital source for the micro-credit agencies, since they stand to profit financially by slum electrification.

"Renewable Portfolio Standards, Feed-In Tariffs, and Tendering: Instituting Effective Mandated Market Policies in China"

The growth of China's population and demand for energy will result in large installments of fossil-fuel powered energy projects unless greater efforts to rapidly replace carbon-based fuels with renewable energy technologies are adopted. This paper discusses the challenge to the rapid expansion of renewable energy in China: RETs are characterized by high initial capital costs, compared to carbon-based sources of energy, resulting in low initial profit margins for producers. Its proposed solution is the implementation of mandated market share policies, which require that a certain quantity or proportion of a country's energy be generated from renewable energy sources by instituting a purchase obligation or creating strong incentives for renewable energy at some point along the energy supply chain. Three particular polices are discussed: renewable portfolio standards, feed-in tariffs, and tendering. In the context of China's energy needs, each policy is analyzed, and recommendations are made to develop an effective mandated market system with the help of various state and non-state actors.

"Exporting Sustainability: A Proposal to Reduce the Climate Impact of the Export-Import Bank of the United States" (Thesis available online)

One important mechanism that has not been given much attention in the policy discussion of climate change is the financing of projects in developing countries that emit large quantities of greenhouse gases. When financial flows from developed countries support inefficient, greenhouse gas-intensive projects in developing countries, the emissions constitute a source of leakage. Although the emissions are financed by developed countries, they are not counted in climate mitigation arrangements. Export credit agencies (ECAs) are financing organizations whose purpose is to promote exports. Often, they are publicly supported and operate under the governments of developed nations. The Export-Import Bank of the United States is one such ECA, and its effect on international trade is significant. Each year, it authorizes billions of dollars in the form of loans, guarantees, and insurance to facilitate export transactions. A fairly significant amount of this support is disbursed to projects that emit significant amounts of greenhouse gases: roughly one-third of financing is for power projects alone. Other exports, such as those for transportation, heavy industry, and fossil-fuel extraction, also receive significant support. The resulting emissions would place the Export-Import Bank, if it were a country, among the world's top ten contributors to greenhouse gas emissions.

Reducing the Bank's emissions therefore has the potential to mitigate global climate change. This thesis further argues that taming the Bank's emissions is politically strategic given several facts: first, the Bank historically has shown leadership in pressing

other export credit agencies to adopt agreements that promote international public goods; second, the Bank is well-suited to engage developing countries and at the same time its policies do not have the potential to significantly disrupt the U.S. economy; third, if the Bank's emissions are not regulated, they represent a significant source of carbon leakage. For the purposes of this presentation, it is argued that the Bank should consider reforming its financing policies to give greater support for renewable energy technology exports.

CONCLUSION

The Task Force acknowledges that no silver bullet exists to resolve the tension between need for increased energy services and the concern for preserving environmental quality. Rather, opportunities should be taken advantage of where they arise. The overall recommendations fall under four such areas of opportunity, and could be considered general recommendations that extend beyond the case studies of India, China, and the U.S.

For energy generation, the Task Force recommends:

- Promoting advanced technology to decarbonize fossil fuels;
- Increasing the proportion of energy generated from renewable sources;
- Internalizing all costs associated with energy generation.

For energy efficiency, the Task Force recommends:

- Internalizing the costs of energy inefficiency;
- Promoting green building, from construction to operation;
- Reforming and raising fuel efficiency standards;
- Improving public transportation services.

In providing energy services to difficult-to-reach areas, the Task Force recommends:

- Financing renewable technologies that facilitate electricity generation and cooking fuels close to end-users in slums and rural areas;
- Focusing on women and capacity-building projects for community empowerment;
- Using micro-credit to support local entrepreneurs who could either benefit from energy access or supply their communities with energy services.

In implementing renewable energy technologies, the Task Force recommends:

- The use of mandated market systems where the appropriate administrative infrastructure exists;
- The use of existing public financing institutions to provide incentives for renewable energy exports.

In our research, we have found the issues surrounding energy and sustainable development to be complex and engaging. At the same time, we remember that providing energy to the world's population is about improving people's lives, and we are encouraged that so many opportunities abound for accomplishing this goal. It is our hope that this analysis will contribute to that end, and that further similar efforts will continue to seek out and find the ways that work.

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