

The Greening of U.S.-Indian Relations:

A Review of Cooperation between the United States and India on Climate Change and Energy



NRDC Issue Paper | January 2011

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The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 1.3 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Livingston, Montana, and Beijing. Visit us at www.nrdc.org.

Acknowledgments

The authors of this report would like to thank the following individuals for their valuable assistance and input: Michael Thompson, Melissa Donnelly, Almira Moronne, Yaokun (Andy) Zhang, Carolina Herrera, Andy Gupta, and Susan Casey-Lefkowitz. We also appreciate very much the cooperation of the dozens of governmental officials and civil society leaders in both the United States and India.

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List of Abbreviations

BEE	Bureau of Energy Efficiency, India
CEPT	Center for Environmental Planning and Technology University, Ahmedabad
CSMCRI	Central Salt and Marine Chemicals Research Institute
DBT	Department of Biotechnology, India
DIREC	Delhi International Renewable Energy Conference
Ex-Im	Export Import Bank of the United States
GSEP	Global Superior Energy Performance Partnership
IOC	Indian Oil Corporation
ISGAN	International Smart Grid Action Network
LBNL	Lawrence Berkeley National Laboratory, Department of Energy, United States
MNRE	Ministry of New and Renewable Energy, India
MOEF	Ministry of Environment and Forests, India
MOP	Ministry of Power, India
MST	Ministry of Science and Technology, India
NEPA	National Environmental Protection Authority, India
NREL	National Renewable Energy Laboratory, Department of Energy, United States
OPIC	Overseas Private Investment Corporation
PACE	Partnership to Advance Clean Energy
SEAD	Super-efficient Equipment and Appliance Deployment Initiative
UNFCCC	United Nations Framework Convention on Climate Change
U.S. EPA	United States Environmental Protection Agency
USAID	United States Agency for International Development
USTDA	United States Trade and Development Agency
WTO	World Trade Organization

Executive Summary

During his November 2009 state visit to Washington, D.C., Prime Minister Dr. Manmohan Singh joined President Barack Obama in launching a Green Partnership between India and the United States to address climate change and clean energy.¹ In just one year, the Partnership has made remarkable progress. The two governments have created new relationships, structures, programs, and projects which will, in the coming years, provide a solid foundation for increased cooperation and commerce between the two nations. There has already been a sharp increase in funding for climate change and clean tech collaboration and investment. The two governments have made initial commitments of \$100 million for clean energy research and deployment in India, through the Partnership to Advance Clean Energy (PACE). The United States' Overseas Private Investment Corporation (OPIC) has announced plans to invest another \$100 million for clean energy projects in India over the next five years. There have even been indications of much larger investment funds involving the private sector and through public-private partnerships. Civil society has also been active in encouraging and supporting this Partnership.

During his visit to New Delhi in November 2010, President Obama reaffirmed with Prime Minister Singh the importance of their cooperation on climate change. They launched a Joint Clean Energy Research and Development Center and a new energy cooperation program in India. The leaders called the Green Partnership between the two democracies “indispensable.”²

This Partnership is important not only for the security of our two nations, but also for assuring a sustainable future for the world. The U.S. and India have already shown that they can provide critically-needed leadership at the international climate change negotiations.³ At Copenhagen and Cancun, Indian and U.S. officials worked together to bring the developed and developing world together.⁴ Together, the two nations are fashioning new global structures that will encourage and facilitate real action on climate change.

Findings

Over the last several months, NRDC has engaged in research on the development of the Green Partnership including extensive discussions with U.S. and Indian officials. Our key findings on the status of the Partnership are as follows:

- 1. The United States and India are building a strategic partnership on climate change and clean energy, with rapidly increased and broadened cooperation.** Top leaders, such as U.S. Secretary of State Hillary Clinton, U.S. Department of Energy Secretary Steven Chu, India's Deputy Chairperson of the Planning Commission Montek Singh Ahluwalia, and Minister of Environment and Forests Jairam Ramesh, have deepened their relationship through regular high-level meetings throughout the year. The countries have opened dialogues and created working groups on pressing issues, such as climate change negotiations, green technology innovation, and growing clean energy markets. Through these dialogues the countries have embarked on various cooperative programs on clean energy and climate change.
- 2. The United States and India have moved ahead with the creation of the Partnership to Advance Clean Energy (PACE), which is at the heart of the Green Partnership.** Both the United States and India have committed \$100 million over five years for PACE. The new PACE program launched two major efforts on research and deployment of clean technologies. First, the program has created the Clean Energy Research and Development Center, a jointly funded research center that drives collaboration among government labs, universities, and businesses to stimulate innovation in efficient buildings, solar panel technology, and second-generation biofuels. Second, the U.S. Agency for International Development (USAID) will lead a bilateral effort with U.S. and Indian partners to accelerate deployment of renewable and energy efficiency products in the Indian market, with a funding pool of nearly \$54 million.
- 3. The United States has ramped up trade missions to India on renewable and clean energy.** Both the trade missions led by the U.S. Department of Commerce and the efforts of the U.S.-India CEO Forum have connected U.S. businesses and investors with Indian entrepreneurs in the areas of energy efficiency, solar energy, and other renewable technology. The United States remains the largest investor in India. Direct U.S. investment in India's emerging markets totaled \$16 billion in 2008 and is expected to grow in the coming decade, especially in the clean energy and technologies sector.⁵
- 4. Several public and private investment groups are creating funds targeting energy efficiency and renewable energy growth.** The Overseas Private Investment Corporation is contributing \$100 million to the Global Environmental Fund's \$400 million South Asia Clean Energy Fund, 80-90 percent of which will be directed toward investments in India over a five-year period, including projects such as solar photovoltaic projects, battery innovation, and green buildings.⁶ The U.S. Trade and Development Agency announced the establishment of an Energy Cooperation Program with India, similar to its existing program with China, to promote the development of the clean energy market. These expanded financing efforts are expected to further catalyze U.S.-built renewable energy projects in India, such as solar power plants and installed wind farms. Ex-Im Bank is directing major resources to renewable energy investments in India (currently evaluating \$135 million in solar projects with a projected solar deal flow worth approximately \$2 billion).
- 5. The United States and India are leading multigovernmental efforts on clean energy.** In July 2010, at the first-ever Clean Energy Ministerial, the U.S. and India announced their joint leadership of the Super-efficient Equipment and Appliance Deployment (SEAD) initiative. SEAD is a five-year multicountry market transformation project focused on galvanizing more efficient consumer appliances, such as televisions, lights, and air conditioners, with over \$25 million in U.S. funding.⁷ The United States and India are also involved in other multicountry programs to develop best practices for smart-grids, efficient buildings, and on-line platforms to share information across partner countries.

Recommendations

Based on our analysis of U.S.-India cooperation on climate and clean energy under the Green Partnership, we make the following recommendations:

1. The United States and India should reaffirm that climate change poses a threat to the economic security of both nations and the international community.
2. The United States and India should recognize the need to continue to build U.S.-India cooperation on climate change and energy. Both should agree to refocus government efforts to ensure that the new set of interrelated projects now underway makes measurable progress over the next two years and beyond.
3. The United States and India should agree to use state-of-the art, cutting edge information and social media technologies available in both countries to make the Green Partnership a smart, responsive, efficient, and productive partnership.
4. The United States and India should reaffirm the importance of climate adaptation measures and collaboratively build both countries' capacity to adapt to climate change.
5. The United States and India should expand the existing dialogues to create specific working groups to tackle controversial finance, trade, technology transfer, and transparency issues.
6. The United States and India should discuss what additional steps our governments can take together to create a new approach to stimulate national actions and global cooperation on climate change.

CHAPTER 1

Introduction

No two countries are as well positioned today to be strategic allies as the United States and India. The relationship between both has matured beyond the old rancor, and it is clear that a strong partnership in a spectrum of fields would be of immense mutual benefit. There are common geopolitical interests, including stability in South Asia and multipolarity in Asia-Pacific. There are also significant economic interests, with both countries standing to gain from expanded bilateral trade. More than ever before, the two countries have a lot of common ground on which to build a strategic partnership. As the relationship grows stronger, it could be the true partnership of leaders required to tackle the single largest challenge the human race has faced—climate change.

Given the threat that climate change poses to the security, economies, and health of both nations, Prime Minister Dr. Manmohan Singh and President Barack Obama announced the Green Partnership at the culmination of Dr. Singh's visit to Washington D.C. in November 2009. A significant portion of the Green Partnership (Appendix B) focuses on cooperation on climate change and clean energy, and enumerates a number of bilateral initiatives including:

- A Memorandum of Understanding to Enhance Energy Security, Energy Efficiency, Clean Energy and Climate Change (Appendix C)
- Mobilization of public and private resources to support a fund or funds to invest in clean energy projects in India
- Reaffirmation of commitment to taking significant mitigation actions in support of a positive outcome at Copenhagen
- Indo-U.S. Clean Energy Research and Deployment Initiative
- Memoranda of understanding on solar energy, wind energy, and biofuels
- Technical support from the U.S. EPA to Indian efforts to establish a National Environmental Protection Authority

Since the signing of the Green Partnership, NRDC's India Initiative has analyzed and tracked its progress, as well as a number of other key bilateral activities related to climate change and energy.

The Partnership to Advance Clean Energy (PACE) has become the centerpiece of bilateral climate and energy cooperation, and the lion's share of resources—both financial and staff time—has been directed at building up this \$100 million dollar effort. PACE is creating an Indo-U.S. clean energy research and development center to promote joint breakthrough research on building energy efficiency, solar energy, and advanced second-generation biofuels. The United States Trade and Development Agency (USTDA) has launched an Energy Cooperation Program with India, similar to an existing program with China, thereby indicating India's growing prominence within the U.S. government's international efforts on climate change and clean energy. Additional government attention, including more resources such as the \$100 million dollar contribution of the Overseas Private Investment Corporation (OPIC) to the Global Environmental Facility's \$300 million dollar South Asia Clean Energy Fund, has provided a fillip to climate and energy collaboration. The United States Agency for International Development's (USAID) spending on climate and energy in India rose virtually from zero in 2007-2008 to \$14 million in 2010, and is growing to \$19 million in 2011.

President Obama's visit to New Delhi in November 2010 provided an impetus for moving forward with the Green Partnership, including key initiatives like PACE, and the visit allowed both countries to strengthen efforts that are already underway. On the whole, bilateral initiatives are moving in the right direction and have the support of key staff. However, in order to move towards a deeper relationship, both countries need to carefully examine where things stand right now and identify clear pathways and timelines for progress. This includes specific steps for all projects in order to build them to their fullest potential and start seeing some early and consistent results. In the next year, both countries must focus on direct implementation of clean energy projects that have already been launched.

CHAPTER 2

“Natural Allies”

Leaders in India and the United States are increasingly calling the two countries “natural allies.” Statements identifying the relationship between the countries as a “natural partnership” are now more frequent, both in the media as well as in policy circles. The commonality is striking:

- Both nations are vibrant democracies.
- Both are characterized by a federal system of government and immense diversity across their large geographies.
- Both have a vigilant and free press.
- Both have a politically active citizenry.
- Public life in both countries is tied together by a shared language which enables the exchange of ideas and knowledge.
- Both countries prize higher education and technical skills in their workforce.
- Both view the other as an important trade partner, with a growing business share in each others’ markets.
- Today, there over 1.6 million Indians living in the United States, comprising the country’s third-largest immigrant group.¹
- U.S.-based companies have created new jobs in India in the last decade, and at the same time Indian companies created over 60,000 new jobs in the United States in the last five years through investment and acquisition deals worth \$ 26.5 million.²

Besides the common socio-economic ties that bind them together, India and the United States have shared geopolitical interests as well. Both nations regard terrorism as their biggest national security challenge and both are carefully preparing for the emergence of China as a superpower.

In this context, efforts to strengthen bilateral ties are natural. But the benefits of a strong relationship do not end at the bilateral level. An expected consequence of improved relations is a more positive dynamic at the multilateral level. The trajectory of multilateral negotiations between the United States and India is uneven. Relations have been marked by rancor and mutual finger-pointing. In the past, India’s stance based on per-capita emissions clashed with the U.S. position that all major emitters with large aggregate emissions needed to take on emission-reduction commitments. Sharp remarks and political posturing historically dominated negotiations.

But a more cooperative working relationship emerged after Prime Minister Singh's November 2009 meeting with President Obama in Washington. In Copenhagen, moving beyond the divisive developing-developed country paradigm, President Obama and Prime Minister Singh worked to overcome differences in their positions and reach agreement on the multilateral process, while at the same time further strengthening the bilateral relationship. India and the United States continued to build on this foundation of trust and mutual respect at Cancun in 2010, where both countries' delegations worked cooperatively to bring about a well-received resolution in the form of the Cancun Agreement.

However, such exceptional moments have yet to mature into a lasting trend. International negotiations continue to be rocky, marred by the inevitable political posturing and pandering to domestic constituencies. Tensions reemerge when India takes the mantle of a developing country leader for the G-77 and when the United States rejects the Kyoto Protocol as fatally flawed. Nevertheless, decision-makers in both countries, including those involved with multilateral negotiations like the UNFCCC process, have expressed optimism that a stronger sense of partnership and trust arising out of the bilateral process will be reflected in progress at the multilateral stage as well, and that even during relatively difficult phases of multilateral negotiations, the solidity of the bilateral process will reduce adversarial sentiment. Thus, recent U.S.-India cooperation on climate and energy has an even greater significance.

CHAPTER 3

Energy Research and Deployment

Clean energy is a chief focus for U.S.-India cooperation. Energy is a key determinant of growth for both India and the United States, two of the world's four largest economies today.¹ As India's economy continues to grow 7-8 percent annually (on par and sometimes higher than Brazil, Russia, China and G20 nations), and as India is projected to overtake the United States to become the world's second-largest economy in 2050, India's need for large and sustainable energy sources will also grow exponentially.² At the same time, the U.S. economy will also need to shift its reliance toward lower carbon energy sources, in order to meet demand for rising energy consumption and maintain a robust growth rate and high quality of life while simultaneously reducing greenhouse emissions.³ A critical need for both nations is to partner on clean energy research and development by pooling technical expertise, to create new jobs and move toward a low-carbon future.

Much of the Green Partnership focuses on clean energy research and deployment. The umbrella project under the MOU to Enhance Energy Security, Energy Efficiency, Clean Energy and Climate Change, the Partnership to Advance Clean Energy (PACE), is an initiative to implement the clean energy research and deployment initiative identified in the Green Partnership. PACE has also subsumed a range of significant preexisting bilateral activities being conducted under the Solar, Wind, and Biofuels MOUs, and helped further enhance research and deployment in the three fields. This section describes the majority of bilateral and multilateral initiatives involving the United States and India on clean energy and climate change.

The Partnership to Advance Clean Energy (PACE)

Climbing energy prices and oil imports combined with increased energy demand are major drivers for clean energy innovation in India and the United States. Both countries are working to shift away from conventional energy sources and move toward low-carbon economies. India currently has over 400 million citizens who lack access to modern electricity. The Indian government and its people recognize the need to find low-carbon approaches to extend access to this vast population.⁴ The United States, on the other hand, needs to stay competitive in the clean energy race, which is fueling innovation and competition among China, Brazil and other large economies.⁵

The broad objectives of the Partnership to Advance Clean Energy (PACE) are to expand the following: the existing U.S.-India Energy Dialogue through increased bilateral engagement; joint initiatives for promoting sustainable growth; incentives for innovation and application of alternative fuels and clean energy; and capacity-building

for deployment of adaptable, affordable, and climate-friendly technologies in both countries. PACE is explicitly designed to “accelerate the transition to high performing, low emissions, and energy secure economies.”⁶

The PACE program involves a number of agencies in the United States and India and is led by a steering committee co-chaired by the joint chairs of the U.S.-India Energy Dialogue, Dr. Steven Chu (U.S. Secretary of Energy) and Dr. Montek Singh Ahluwalia (Deputy Chairperson, Planning Commission of India). (PACE was initially labeled “The Clean Energy Research and Development Initiative” in the Green Partnership agreement.)

Financing: The United States and India have agreed to a \$100 million budget for the research and development component of PACE, with both countries committing \$25 million each (\$5 million per year for the next five years). The government funding of \$50 million will be matched by at least \$50 million from nongovernment sources, through a consortium of companies and private investment entities. The privately financed component will help ensure that new technologies are quickly moved into the market.

Structure: PACE is coordinated on the U.S. side through an Interagency Task Force and on the Indian side through the existing working groups for the Energy Dialogue (see list of key staff in Appendix A). The U.S. Interagency Task Force met in New Delhi in March 2010 and discussed a bilateral framework based on multiple issues, including 1) energy efficiency; 2) renewables; 3) financing; and 4) cleaner coal. Since then, the task force has been convened through conference calls—sometimes as frequently as every two weeks. The Indian counterparts also meet at regular intervals and are convened by India’s Ministry of External Affairs and by the Planning Commission.

PACE has two complementary components: 1) PACE-R, with a research focus; and 2) PACE-D, with a deployment focus. In the United States, PACE-R is spearheaded by DOE, through the Office of Policy and International Affairs. In India, PACE-R is led by the Ministry of Science and Technology (MST) and the Planning Commission of India, through the office of Deputy Chairperson Montek Singh Ahluwalia. PACE-D is a multiagency initiative based in India and coordinated by USAID. The primary Indian counterparts are the Ministry of Power (MOP), the Ministry of New and Renewable Energy (MNRE), and the Ministry of Petroleum and Natural Gas (MOPNG).

Progress under PACE-R: During the Clean Energy Ministerial in Washington D.C., in July 2010, Energy Dialogue chairs Dr. Chu and Dr. Ahluwalia agreed on a basic framework for the establishment of a U.S.-India Joint Clean Energy Research and Development Center. The agreement to create the center was initialed on August 20, 2010, by Indian Ambassador to the United States Honorable Meera Shankar and U.S. Deputy Secretary for Energy Daniel Poneman. On November 4, 2010, U.S. Ambassador to India Timothy Roemer and Secretary of the Department of Biotechnology, Ministry of Science and Technology Dr. M.K. Bhan signed the agreement to launch the center. A public announcement about the center was made by President Barack Obama and Prime Minister Dr. Manmohan Singh during President Obama’s state visit to India in November 2010. The center will be virtual, but the Office of Policy and International Affairs (DOE) and the Indo-U.S. Science and Technology Forum (IUSSTF) will act as national secretariats for the United States and India. The research and development will take place through consortia of businesses, labs, universities, and government agencies from the United States and India respectively. The center will foster deployment of clean energy technologies and will initially focus on energy efficiency in buildings, second-generation biofuels, and solar energy. Stakeholder consultations have already taken place, in October 2010 in India and in November 2010 in the United States, and both countries are finalizing legal and administrative aspects of the center before a public opportunity announcement seeking grant proposals is made in early 2011.

Key Highlights for PACE-R:

Closer alignment of priorities

The United States and India have made significant progress in establishing the structure for cooperative research. However, both need to better define the research priority for the Clean Energy Research and Development Center. India has a greater interest in basic research and joint on-the-ground projects. This is the approach India is taking with Australia and Germany. The Indian emphasis seems to be toward large research projects aimed at significant breakthroughs in “game-changing new energy sources.” There are concerns in India that joint research of this nature is a lower priority for the United States because of intellectual property and licensing concerns. It appears that relative to India, the United States is less focused on basic research and is more enthusiastic about deployment of technologies and rapidly moving research toward the market. The United States’ reservation with basic research projects is that the work could remain in a prolonged laboratory stage and that commercialization might not occur at an optimum pace. To create clarity for U.S. and Indian stakeholders, both countries must reach a clear agreement on the research priorities.

Maximizing opportunity and providing information

Both countries need to ensure that deserving, credible and talent-rich individuals and groups have adequate opportunity to apply for the Clean Energy Research and Development Center’s grants. In order for the consortia to be productive and make the most efficient use of funds, the participants in the consortia should be leaders in their fields who have the ability to design, develop, and deliver solutions. There are concerns that information flow may not be adequate to ensure that the best and the brightest will benefit from this opportunity. There is the need for a variety of external actors such as policy experts and advocacy groups to assist or guide the creation of the consortia so that highly deserving entities with strong potential do not get left out of the process.

Progress under PACE-D: By September 29, 2010, two major bilateral agreements focused on technology deployment were signed by USAID and Indian counterparts. First, USAID and the Indian Ministry of Power (MOP) signed an Agreement on Energy Efficiency Technology Commercialization and Innovation in the amount of \$27-28 million. Second, USAID and the Ministry of New and Renewable Energy (MNRE) signed an Agreement on Renewable Energy Technology Commercialization and Innovation, also in the amount of \$27-28 million. Both these agreements center on broad-scale clean energy deployment, including financing, capacity building, and policy development. The Ministry of Power is working on revising a third agreement on coal and increasing efficiencies in coal-fired power plants. Some view advancement of coal technologies as an emissions-mitigating technology, given India’s heavy reliance on coal-based power. The scope-of-work and procurement announcement for all three agreements is scheduled for the first half of 2011.

Key Highlights for PACE-D:

Information gaps

On occasion, key Indian officials involved in implementing these agreements were not completely aware of the latest developments from the Indian side. The lapse appeared to be on the part of the coordination mechanism and not the individuals concerned. Thus, both countries need to improve internal information dissemination.

Strengthening trust

Various Indian agencies have historically had different experiences and working relationships with U.S. agencies, including USAID. For instance, USAID’s historic track record working with the Ministry of Power differs from its track record with the Ministry of New and Renewable Energy, the latter being a

newer partnership. It is important that the United States focus on building trust by listening to the needs and priorities of Indian agencies in implementing projects, with special attention to the newer, evolving relationships.

Key Highlights for PACE-R and PACE-D:

Predominance

PACE is the centerpiece of U.S.-India cooperation on climate and energy. It dwarfs all other initiatives in terms of resources (staff and money) and the attention it gets in policy circles. While this has led to some frustration among those whose projects are not under the PACE umbrella, agencies can try to use PACE's predominance as an impetus for other programs by coordinating with as many ongoing efforts as possible and even embedding them within PACE wherever possible.

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MOU for Collaboration on Solar Energy Research and Development

India is endowed with a vast potential for solar power generation, receiving nearly 5,000 kWh of solar radiation annually (4-7 kWh per square meter per day).⁷ The Indian government has announced plans to add 20 Gigawatts (GW) of installed capacity by the year 2022, making India the single most attractive market for long-term investment in solar technologies.⁸ The United States is also growing rapidly as a market for solar power, slated to overtake Germany as the largest solar market in the world, and could grow eightfold to \$8 billion by 2015.⁹ Both countries' economies can mutually benefit from cooperation in solar technology research, development, and commercialization.

The U.S.-India solar energy MOU (Appendix D) has been signed by the Solar Energy Centre, operating under MNRE, and the National Renewable Energy Laboratory (NREL), operating under DOE. The main joint activity is solar mapping for India, which has recently been completed.¹⁰ The data availability for this mapping has been a challenge. Even though the solar mapping produced is insufficient for developers to make specific solar siting decisions, it is adequate to identify certain areas as priority areas and establish a ground monitoring station. The station enables data collection to determine solar siting.

The solar energy MOU also includes building a pilot concentrated solar power (CSP) plant, identifying optimal sites for large-scale solar, and creating solar project design and finance tools for the private sector. For solar project design and finance, DOE is working with MNRE and industry associations like CII to create specialized software

for solar site development and holding workshops to teach developers how to use software tools to “prospect” for potential solar development sites. Each side is responsible for funding its own activities and has already earmarked and released its own operating expenses. Both U.S. and Indian officials are pleased with current progress under the solar energy MOU.

As part of the solar energy MOU, DOE and the national laboratories (including Lawrence Berkeley and Brookhaven) are also engaged in a number of cooperative solar activities with India. These include the following: 1) exchanging best practices and technical assistance between the Solar America Cities program and India’s Solar Cities program; 2) creating and holding workshops for Indian financial institutions to increase their comfort level with solar technologies, providing training on financial due diligence for solar projects, providing the financial institutions with the fundamentals needed to assess viability of project proposals, and potentially building industry capacity by creating an Indian equivalent of the U.S. Renewable Energy Finance Forum; 3) increasing R&D cooperation through a consortia model, where the United States will fund a consortia of U.S. industry, labs, and universities, and India will fund a similar consortia from its side; and 4) providing technical assistance to an appropriate Indian entity to establish and maintain a database of policies and incentives for renewable energy and energy efficiency, similar to the Database of State Incentives for Renewable Energy (DSIRE) model in the United States, and partnering with the Solar Energy Center (SEC) in India to test for failure mechanisms and degradation rates of photovoltaic modules recovered from storage in SEC’s outdoor testing facility.^{11, 12}

Key Highlights for Solar Energy Collaboration:

Issues of scale

Given the initial stage of activities under the solar energy MOU, India is interested in even more ambitious collaborative projects. However, an impediment to larger-scale collaboration is the relatively low level of technical assistance funds allocated to U.S. agencies to work with India. Specifically, because NREL has to spend its own money to participate in the MOU and does not receive additional Federal funding for this purpose, it has minimal incentive to undertake large-scale activities. Indian officials suggested that it would be much more productive for the Indian government to simply spend a larger amount of its own funds and hire NREL as consultants, as that would empower the Indian side to frame the scope and scale of the collaboration according to their own level of need and interest, beyond the constraints of the MOU.

Need for improved internal organization

It is unclear, even to some of the agency staff, which activities fall within the purview of the solar energy MOU and which do not. While this has not affected the quality of collaborative activities and staff commitment to implementing the projects, it might be problematic in the future for public accountability and assigning internal responsibility for performance and measurement.

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MOU for Collaboration on Wind Energy Research and Development

India has the fifth-largest installed wind power generation capacity in the world, at 10,925 megawatts (MW).¹³ The total potential of almost 45,000 MW is far from exhausted. India plans to develop 10,500 MW in the initial period from 2012-2017.¹⁴ The United States, already the world leader—along with China—with the highest installed wind capacity, will continue to see a growth in the wind turbine market, with a potential growth to \$60.9 billion by 2013.¹⁵ Because of their leading wind markets, the United States and India have immense potential for collaboration to expand their own generation markets as well as global markets.

The U.S.-India wind energy MOU (Appendix E) has been signed by the Center for Wind Energy Technology (CWET), operating under MNRE, and the National Renewable Energy Laboratory (NREL), operating under DOE. Joint activities include design, development, and deployment of low-wind-speed turbines, including design of test facilities and protocols; training of Indian scientists at the NREL; and workshops for Indian scientists at the CWET. Each side is responsible for funding its own activities and has already earmarked and released its own operating expenses. Both U.S. and Indian officials are satisfied with the progress under the wind energy MOU.

Contacts:

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MOU for Cooperation in the Development of Biofuels

India and the United States have high potential for biofuels research and development.¹⁶ In India, technological breakthroughs with biofuels could help provide energy to non-grid-connected areas and also reduce the reliance on conventional fuels in its ever-expanding automobile sector.¹⁷ In the United States, the world's second-largest automobile market and the world's highest per-capita consumer of energy, a shift towards economically and environmentally viable biofuels could fundamentally alter its greenhouse gas emissions profile. Biofuels are increasingly being viewed by scientists in both countries as a promising pathway to mitigate climate change, and collaborative research and development in this field could help both countries lead the global market in the ongoing low-carbon energy race.

The U.S.-India biofuels MOU (Appendix F) has been signed by MNRE and DOE. The objectives of the MOU include reducing reliance on fossil fuels, enhancing energy security, promoting the agricultural sector, and supporting rural development. The scope of the MOU covers the scientific, policy, and testing aspects of production, and conversion, utilization, distribution, and marketing of biofuels in a sustainable and environmentally sensitive manner, in accordance with national priorities and socio-economic development strategies and goals. Joint activities include biofuels feedstock production from non-edible oilseed production, with the involvement of local communities; collaboration on advanced conversion technologies for first-generation biofuels and emerging technologies for second-generation biofuels; development of technologies for end-use application in the transportation sector; utilization of the byproducts of biodiesel production such as oil cakes and glycerin; development of test methods, procedures and protocols, and standards and certification for different biofuels and end-use applications; promotion and facilitation of technology transfer; and joint ventures and investments in the biofuels sector in India. Each side is responsible for funding its own activities, and has already

earmarked and released its own operating expenses. Both U.S. and Indian officials are pleased with the progress being made under this MOU.

In addition to activities being undertaken under the auspices of the MOU, the U.S. Department of Energy has been engaged in a number of other cooperative biofuels-related activities with India. At the end of October 2010, DOE led a delegation of government scientists and laboratory officials to India to coincide with Biofuels India 2010 and the Delhi International Renewable Energy Conference (DIREC) 2010.^{18,19} DOE is also engaged in Jatropha development in collaboration with the Central Salt and Marine Chemicals Research Institute in Bhavnagar, Maharashtra.²⁹ Other collaborations include joint projects with the Indian Oil Corporation (IOC) to provide technical advice for biorefineries in India, including the establishment of a pilot cellulosic ethanol plant, and to explore the possibility of using lignin for biofuels production through field trials, jointly with General Motors.^{20, 21}

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CHAPTER 4

Trade and Finance

India is currently the fifteenth-largest trading partner of the United States.¹ In 2008, U.S.-India bilateral merchandise trade topped nearly \$50 billion. The United States is India's largest investment partner, with a 13 percent share. India's total inflow of direct investment from the United States was approximately \$16 billion through 2008.² In the private and public sectors of both countries, there is growing interest in trade and investment in clean energy technology, and this is expected to become a major area of growth for commercial relations between India and the United States. A number of initiatives are underway to incentivize and accelerate trade in this area.

Indo-U.S. Trade Missions

In order to galvanize the immense potential for increased U.S.-India trade in clean energy technologies, the Department of Commerce's Foreign Commercial Service (FCS) has led multiple trade missions of U.S. based business persons and investors to India.³ Recent trips have focused on clean energy, solar energy renewables, and energy efficiency, including trips led by Assistant Commerce Secretary for Trade Promotion Mr. Suresh Kumar and Deputy Assistant Secretary for Commercial Operations Ro Khanna.^{4,5} FCS organized a very large U.S. contingent at the 2010 Delhi International Renewable Energy Conference (DIREC). The FCS and its Commerce Department counterpart, Market Access and Compliance (MAC), are both active participants in PACE's ongoing efforts to strengthen public-private synergies to catalyze clean energy development.

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U.S.-India CEO Forum

Bilateral government-to-government initiatives are critical to open up new opportunities and create incentives and platforms for collaboration between countries. However, government programs alone are insufficient to fully capitalize on the massive opportunity that U.S.-India energy cooperation represents. Both the United States and India have dynamic markets, with firms and entrepreneurs who have the ability to transform the clean energy technology sector. These synergies are being harnessed through a multiplicity of private sector collaborations, but one of the most promising is the effort underway by the U.S.-India CEO Forum to fund clean energy technology projects.

At the U.S.-India CEO Forum in June 2010, the CEO chairs announced plans to create a \$1 billion private equity venture capital fund for clean energy technologies.³⁷ The CEO Forum is a corporate-driven effort, with co-chairs Honeywell and Tata Sons.⁷ In the United States, AES Corporation, Citigroup, Dow, and Honeywell are involved in the creation of the fund. In India, the Infrastructure Finance Development Corporation (IDFC), State Bank of India, and ABP India are in the lead. Although the fund announcement resurfaced before President Obama's state visit in November 2010, no significant progress has been made.⁸ While the U.S. State Department hosted the forum, neither the Indian or U.S. governments are involved in the operations of the forum.⁹

Key Highlights:

More action

Members of the U.S.-India CEO Forum need to take concrete actions to create a fund. These steps include identifying funding sources, dispersal mechanisms, a timeline for funding and project implementation, recipients of funding, etc. The forum has provided little to no public information about the fund.¹⁰ Given its leadership role in driving U.S.-India public-private partnership, the forum must increase its activity to create opportunities to capitalize on clean energy investments.

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The Overseas Private Investment Corporation (OPIC)

The Overseas Private Investment Corporation (OPIC) is an independent U.S. government agency that helps U.S. businesses invest overseas and is a key actor in driving foreign U.S. investment in clean energy. OPIC, along with the Global Environmental Fund (GEF), is creating a \$400 million South Asia Clean Energy Fund, much of which will be directed towards India. OPIC's own contribution to the fund is in the range of \$100 million. Approximately 80-90 percent of this fund is expected to be directed toward India. The fund will be disbursed over a 4-5 year timeframe, and will prioritize equity and equity-related investments in solar, wind, hydropower, biofuels, natural gas, energy efficiency, batteries and green information technologies, transportation, water, and green buildings. The fund will focus on companies that service the renewable energy value chain.¹² OPIC's loans and insurance have enabled small U.S. businesses to build solar power plants and wind turbines, and have financed start-up projects for cleaner burning bridge fuels, gas-fired plants, and biomass energy.¹² OPIC has been responsible for funding the first privately owned and operated grid-connected solar power plant in India, Awan Photo Voltaic Solar Power Plant in Punjab, owned by Azure Power.¹³ In May 2010, OPIC held a conference in New Delhi titled "Renewable Energy and Clean Technology: Accessing Opportunities in Emerging Markets," designed to identify investment opportunities in renewables and clean energy technology, including in India.¹⁴ Most recently, during President Obama's visit to India, OPIC also announced that an India-specific sub-fund for clean energy investments will be created out of the GEF-SA fund, and that the IDFC will be the India partner for the disbursement of the sub-fund.¹⁵

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The Export-Import Bank of the United States (Ex-Im Bank)

The Export-Import Bank of the United States (Ex-Im Bank) is the official export credit agency of the United States. Ex-Im Bank's mission is to assist in financing the export of U.S. goods and services to international markets. Ex-Im Bank enables U.S. small and large companies to turn export opportunities into sales that help to maintain and create U.S. jobs and contribute to a stronger national economy. In recognition that major economies like

India will be making a transition towards low-carbon development and that cleaner sources of energy will be required to fuel sustainable growth, Ex-Im Bank is directing major resources to renewable energy investments in India (currently evaluating \$135 million in solar projects with a projected solar deal flow worth approximately \$2 billion).

In July 2010, Ex-Im's board of directors approved proceeding to a full financial, technical, and environmental review of an application for financing for India's Sasan coal power plant, operated by Reliance Power Ltd. This approval was made after Ex-Im signed an MOU with Reliance to develop a 250 megawatt (MW) renewable energy facility in India.¹⁶ Previous Ex-Im grants have also been made to India, for which renewable energy projects are eligible.¹⁷

United States Trade and Development Agency (USTDA)

The U.S. Trade and Development Agency promotes economic growth in developing and middle income countries, while simultaneously helping American businesses export their products and services and create U.S. jobs. USTDA also supports U.S. policy objectives related to development and capacity building activities.¹⁸ Because combating climate change and promoting clean energy have become central to U.S. policy objectives, USTA is increasingly helping partner countries such as India expand their capacity in these areas.

USTDA has facilitated the launch of a public-private partnership with India linked to PACE, known as the Energy Cooperation Program (ECP). This is similar to the existing ECP between USTDA and China.¹⁹ The ECP seeks to catalyze and channel the resources of private sector organizations interested in the rapid scale-up of clean energy in India, including in the areas of energy efficiency, finance, smart grids, shale gas, and solar energy. Previous USTDA grants supporting alternative energy in India have included a half-million dollar grant for a feasibility study for a carbon capture and storage facility and \$600,000 for an investment analysis for a coal-to-liquid plant.²⁰

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Key Highlights for Trade and Finance Initiatives:

Need for increased commitments and delivery

Despite the positive measures described in this section, the U.S. government needs to maximize the investment opportunity presented by the clean energy sector in India. The United States should identify and mobilize significant additional funds for investment in clean energy projects in India, both from the public and private sectors. This funding should be expanded beyond research to actual start-up projects, small and medium enterprises, and clean energy entrepreneurs. These funds have to be distinct from funds directed at U.S. agencies for project coordination or implementation. Private investors in the United States should be offered incentives for investment in clean energy technology in India. The work of OPIC, Ex-Im, and USTDA is a good start, but there needs to be careful thought given to how a much larger amount of funding can be identified, approved, and disbursed in a strategic manner in India that simultaneously creates green jobs and high returns in the United States.

CHAPTER 5

Bilateral Engagement on Climate Energy

The growth of a robust collection of climate and energy initiatives between the United States and India has been accompanied by a steady drumbeat of official interaction and dialogue.¹

Since the Obama Administration took office in January 2009 in the United States and the United Progressive Alliance (UPA) coalition led by Dr. Manmohan Singh and Sonia Gandhi was reelected to power in May 2009 in India, both governments have made cooperation on climate change and clean energy a high priority. Discussions on climate change and clean energy have dominated numerous visits by high-level leaders. For example, starting with U.S. Secretary of State Hillary Clinton's visit to India in July 2009, the leaders discussed pragmatic approaches to climate change and narrowing disagreements in the lead up to the UNFCCC summit in Copenhagen.² Secretary of Energy Dr. Steven Chu traveled to India in November 2009 to advance opportunities for international clean energy cooperation and noted that India "will play a central role in the world's energy future."³ Secretary Chu emphasized that assisting India in clean-tech development is a tremendous opportunity for the United States, and that helping India move to a clean energy economy made good business sense for the United States that could lead to increased exports and job creation domestically.⁴

Several high-level Indian delegations to the United States kept up the momentum and ensured that consistent and regular progress was made in intergovernmental efforts. India's Minister of Environment and Forests Jairam Ramesh visited the United States multiple times in 2009 and 2010. Dr. Farooq Abdullah, India's Minister for New and Renewable Energy, traveled to the United States in September and October 2009, while India's Minister of Power Sushil Kumar Shinde visited in October 2010. At the Clean Energy Ministerial in Washington in July 2010, Deputy Chairperson of India's Planning Commission Dr. Montek Singh Ahluwalia and Bureau of Energy Efficiency Director Dr. Ajay Mathur led the Indian delegation in making several commitments on clean energy partnerships.

In addition to the governmental process, nongovernmental organizations and academic institutions also contributed to the strengthening of bilateral relations on climate change and clean energy. Yale University and The Energy and Resources Institute (TERI) brought together Indian and U.S. leaders at the annual Energy Partnership Summit, held in Washington D.C. in the fall of 2009 and 2010.⁵ The summits addressed a range of crucial concerns, including the role of technologies and policy in furthering energy security, opportunities for partnership, role of governments, research and deployment of climate-friendly technologies, institutional arrangements, and exchanging best practices. Forums like the Yale-TERI summits thus complemented the formal interaction and dialogue between the Indian and U.S. governments, described below.

The Bilateral Strategic Dialogue

The bilateral Strategic Dialogue was launched in July 2009 when U.S. Secretary of State Hillary Clinton visited India. Energy and climate change is listed as one of the five pillars of the dialogue.⁶ The dialogue is co-chaired by Clinton and Indian External Affairs Minister S.M. Krishna. The first meeting of the Strategic Dialogue took place in Washington D.C. from July 1-4, 2010, when both the United States and India reaffirmed their commitment to the Copenhagen accord and noted the high potential for cooperative efforts on clean energy technologies, as well as solar, renewable energy, and cleaner coal.⁷ Assistant Secretary of State for South and Central Asia Robert Blake has furthered conversations under the dialogue through official briefings and webchats.⁸

The Bilateral Climate Dialogue

The bilateral Climate Dialogue is led by Special Envoy Todd Stern from the United States and Minister of Environment and Forests Jairam Ramesh from India. In the past, discussions on climate change, specifically discussions at international negotiations regarding mitigation commitments, transparency, and climate equity, have been contentious between the United States and India. Thus, making progress in this sensitive area of international cooperation is vital to effective bilateral cooperation. Former Secretary of the Indian Ministry of Environment and Forests (MOEF) Vijay Sharma met with Todd Stern in July 2010 in Washington. Subsequently, there have been further discussions in person, on the phone, and through video conferences. These efforts have been supplemented by the visit of India's Foreign Secretary Nirupama Rao to Washington in September 2010.⁹ The relationship—which is extremely important to both bilateral and multilateral efforts on climate change—appears to be developing well. The positive progression continued at the recent Cancun discussions. Both the U.S. and Indian delegations worked productively to support India's proposal on International Consultation and Analysis (ICA) and reach agreement in Cancun.¹⁰

International funding has been one of the most controversial points for U.S. and Indian discussions on climate change over the past year. India, along with Brazil, China, and South Africa, has expressed disappointment about the United States' inability to deliver its share of the nearly \$30 billion fast-start financing under the Copenhagen Accord, even though India has relinquished its claims funds in favor of Lesser Developed Countries and the Small Island States.¹¹ Recently, in Cancun, countries made some progress by agreeing to develop an operational "Green Climate Fund" to help deploy needed resources to assist developing countries reduce emissions and adapt to the impacts of climate change. However, the real breakthrough will occur when the Green Climate Fund works to mobilize significant resources to aid developing countries in addressing climate change.

Domestically, the United States has started taking concrete steps to provide some of the funding. The United States should use the Climate Dialogue as a forum to create a better understanding with Indian officials of these new funding streams, which include the Senate Appropriations Committee recommendations for 2011, including approximately \$1.2 billion for international efforts to combat the impacts of global warming and shift towards a clean energy future.¹² Out of funds exclusively dedicated to UNFCCC operations, nearly \$7 million are likely to be approved for UNFCCC adaptation activities, \$5 million to UNFCCC clean energy activities, and \$2 million to the UNFCCC for sustainable landscapes efforts.¹³ The original FY 2011 budget requests by the U.S. administration for international climate finance total \$1.9 billion (up from the previous year's actual appropriations of \$1.3 billion).¹⁴ This includes a request for \$1 billion to the Reducing Emissions from Deforestation and Degradation (REDD+) program, pledged for the period 2010-2012. U.S. support to multilateral Climate Investment Funds (CIFs) is also projected to rise: in FY 2010, the United States delivered \$375 million to these funds, and the budget request for FY 2011 is \$635 million. The Clean Technology Fund disbursed \$300 million from the United States in FY 2010, and the FY 2011 budget request has increased to \$400 million. Similarly, the U.S. Pilot Program for Climate Resilience funded activities amounting to \$55 million in FY 2010, and is requesting \$90 million for FY 2011. The appropriations for the Least Developed Country Fund and the Special Climate Change Fund were \$50 million in FY 2010 and another \$50 million is budgeted for FY 2011. These are still, however, relatively small amounts in

comparison to what the UNFCCC and other countries have been hoping for from the United States (for instance, Japan pledged \$15 billion, half of the \$30 billion for fast-start financing).¹⁵ The Climate Dialogue should ensure that India has a comprehensive understanding of how much money the United States has given to international climate finance in FY 2010 and how much it will provide in FY 2011. Then the two sides should identify where expectations are not being met, as well as what could be done to create reasonable expectations for both sides in the next few years.

The Bilateral Energy Dialogue

Launched in May 2005, the U.S.-India Energy Dialogue is an effort to increase bilateral trade and investment in the energy economy by identifying areas of collaboration. The dialogue is presently co-chaired by U.S. Secretary of Energy Dr. Steven Chu and Deputy Chairperson of India's Planning Commission Dr. Montek Singh Ahluwalia, and is comprised of five working groups: 1) coal; 2) oil and gas; 3) power and energy efficiency; 4) new technologies and renewable energy; and 5) civil nuclear. The dialogue is driven and supervised by a steering committee whose mandate is to promote the two countries' shared vision of energy security and continued economic growth on an environmentally sustainable footing.¹⁶ Assistant Secretary for Policy and International Affairs David Sandalow has also played a strong role in moving the energy dialogue forward.

Key Highlights on the Energy Dialogue:

Need for better transparency and availability of information

The various working groups have been characterized by different levels of public information and access. The working group on coal has been most effective at making information publicly available so that interested parties and stakeholders outside government can follow and contribute to the process.¹⁷ Others have been relatively more opaque due to an absence of information on the DOE website or elsewhere on the internet. On the whole, DOE's efficacy in organizing information on U.S.-India initiatives and making them publicly accessible needs to improve across the board, but the Energy Dialogue is an area where there is a particular paucity of available information.

Staff and Funding Increase in U.S. Agencies

Various U.S. agencies that are engaged with India on climate and energy cooperation have demonstrated the increased commitment through additional staffing, often in the form of dedicated India-focused positions. The U.S. Department of Energy is preparing to hire a full-time staff member to be based on the ground in India, as is OPIC. Prior to the results of the U.S. mid-term elections in November 2010, USAID had planned to invest in 12 new Foreign Service nationals, two new civilian contractors, and two direct on-ground hires in India. While there are concerns that a shift in power in the U.S. Congress may affect the availability of resources for climate and energy related work internationally, USAID India is presently optimistic that its plans to hire new staff will continue on track and that climate and clean energy projects in India will not face cutbacks.

In terms of funding increases, the trajectory has also been positive, and is congruent with the increased prominence of U.S.-India initiatives. The most notable rise is seen for USAID's India work in the areas of climate and energy. In FY 2003, 2004, 2005, 2006, and 2007, the budget allocations for USAID's India-based environmental protection initiatives totaled approximately \$13.5 million, \$11 million, \$13.5 million, \$6.4 million, and \$7.6 million.¹⁸ Small but effective efforts were initiated, like USAID's Energy Conservation and Commercial Program (ECO-III), which catalyzed rapid progress in energy efficiency in India, both in the buildings sector and appliances.¹⁹ In FY 2008 and 2009, however, environment in India ceased to be a programmatic activity or priority for USAID, and thus money for these areas, including climate change and energy, became virtually zero.²⁰ In a significant turnaround, USAID's India FY 2010 budget included \$5 million for clean energy activities, \$5 million for sustainable landscapes, and \$4 million for adaptation, totaling \$14 million.²¹ In FY 2011, the request is for \$5 million for adaptation, \$9 million

for clean energy, and \$5 million for sustainable landscapes.²² OPIC is also increasing its India investment, with much of its \$300 million South Asia Clean Energy Fund directed towards India.²³ Overall, climate and energy funding to these agencies (for domestic and all global operations) has risen sharply. In FY 2010, funds for climate related activities disbursed through USAID, the Department of State, and the Department of Treasury are three times higher than in FY 2009, rising from \$319 million to \$1 billion.²⁴ The FY 2011 budget request raises this further to \$1.4 billion.

Key Highlights:

Inadequate Congressional support for agency activities

Despite the existing increases in Congressional appropriations for U.S. government agencies overseas, there is still a gaping need for significant additional resources to carry out India-related programs. DOE, in particular, is constrained in the scale and scope of its activities in India because of insignificant Congressional allocations for its international operations. Across agencies, officials and staff fully understand the importance to the United States of building stronger collaborations with India, and there is widespread support and commitment within the administration for engaging in a strong manner internationally, especially in key countries like India. India's rapidly expanding economy is a key market for the United States, strengthening its own economy in the process. India is also one of the most important strategic allies for the United States in terms of its goals to promote peace and security in South Asia and combat the threat of terrorism. In the larger Asia-Pacific region, India also represents a powerful presence to counterbalance growing Chinese dominance, which the United States is observing closely.²⁵ For a power-starved country like India, which has a large capacity to absorb technology and innovation, partnerships in climate and energy are among the most promising and eagerly embraced. The U.S. Congress needs to better appreciate why it is in the nation's interest to prioritize climate and energy partnerships with India and to step up its appropriations accordingly.

How this Compares to U.S. Climate and Energy Engagement with China

Over the past three decades, U.S. government agencies have responded to the growing global prominence of China by increasing their engagement with it. Conversations with agency staff indicate that China is well established within the various U.S. agencies' international programs as a priority country and continues to attract the lion's share of the resources of such programs, both in terms of funding and staff. Many U.S. agencies including DOE have a physical presence in China, with on-the-ground offices and staff.²⁶ The same is not true of India yet, although signs indicate that India is rising in the level of prominence it receives within agency work (DOE is actively working to have a full-time staff member on the ground as soon as possible).

In terms of funding, available data do not provide a clear comparison; even though the overall USAID and Department of State funding to India is higher, the difference in the amount of money identified for climate and energy work is difficult to determine (in FY 2010 China received a total of \$27 million, while India received \$126.8 million, but this aggregate is probably higher for India because of a range of developing-country initiatives including health, water and sanitation, education, etc.).²⁷

The best comparison is available through DOE website, on pages for U.S.-India cooperation and U.S.-China cooperation, respectively.^{28, 29, 30} Even though neither of the pages exhaustively lists all the bilateral activities that the department has underway in either country, a comparison supports the conclusion that there is a great deal more activity with China on climate and clean energy. Some prominent initiatives with China include:

- An ambitious 10-year U.S.-China Energy and Environment Cooperation Framework³¹
- The Ecopartnerships program involving both governments and businesses³²
- The U.S.-China protocol for cooperation in the fields of energy efficiency and renewable energy technology development and utilization

Another measure of comparison is the package of initiatives announced by President Barack Obama during his visit to China in November 2009.³³ The package comprised:

- The U.S.-China Clean Energy Research Center³⁴
- The U.S.-China Electric Vehicles Initiative³⁵
- The U.S.-China Energy Efficiency Action Plan³⁶
- The U.S.-China Renewable Energy Partnership³⁷
- Carbon Capture and Storage (CCS) demonstration projects³⁸
- A U.S.-China Shale Gas Cooperation Initiative³⁹

Taken collectively, the U.S.-India Green Partnership, along with the smaller bilateral efforts with India (many of which are described in this report), cover many of the areas addressed by the U.S.-China partnerships listed above. In terms of big announcements, however, U.S.-China cooperation seems to have an advantage. This comparative imbalance did not change significantly during President Obama's visit to India in November 2010, when fewer new large bilateral projects were announced (although two projects similar to what the United States is doing with China were included in the Indian announcements: the establishment of a Clean Energy Research and Development Center and the announcement of USTDA's new India Energy Cooperation Program).

CHAPTER 6

Key Multilateral Efforts

Super-efficient Equipment and Appliance Deployment Initiative (SEAD)

With the growth of the middle class and rise in disposable income, the Indian market is experiencing tremendous growth in the sales of appliances. Making these appliances as energy efficient as possible is thus a significant opportunity to reduce energy usage and mitigate carbon emissions. At the Clean Energy Ministerial in Washington D.C. on July 20, 2010, the United States and India announced their joint leadership of the Super-efficient Equipment and Appliance Deployment (SEAD) Initiative, a multicountry market transformation effort that also will include the private sector (originally part of Climate-REDI announced by Secretary Chu at Copenhagen).¹ SEAD's initial focus is on televisions and lighting. Funding will come from all participating countries, as well as \$76 million from the Global Environmental Facility. The United States will provide \$15 million for SEAD over the first five years. SEAD is being led by DOE in the United States and the Bureau of Energy Efficiency (BEE) in India.

Key Highlights:

Replicability

Progress under SEAD has been rapid and measurable. SEAD has been repeatedly referred to by many on both sides as one of the most successful examples of U.S.-India collaboration, and some have even described it as being more successful than any element of the formal Green Partnership. Thus, for both countries it may be worth studying SEAD's structure and operations while modeling future U.S.-India collaborative activities.

Implementation

Although the ministerial that launched SEAD was successful, in the next year the U.S. and India should work to ensure that harmonization of international appliance standards and consumer products are developed and that super-efficient appliances begin to dominate the market.

International Smart Grid Action Network (ISGAN)

A second initiative that the United States and India joined at the Clean Energy Ministerial is the International Smart Grid Action Network (ISGAN), a multilateral effort to accelerate development and deployment of smart electricity grids.² Smart grids help monitor and manage peak energy demand, reduce energy wastage and loss, improve grid efficiency, and ultimately reduce power consumption in the connected areas. For India—where over 400 million people are still not connected to the grid—smart grid technology represents the future of the electricity grid. For the United States, a transition to smart grids will also reduce the need to build more conventional coal- or oil-based power plants, and it represents a growing economic opportunity for U.S. firms specializing in this technology. The five key areas of engagement under ISGAN are as follows: 1) smart grids regulation, policy, and finance; 2) standards policy; 3) research, development, and demonstration of precompetitive technologies; 4) workforce skills and knowledge; and 5) engagement of smart grid users and consumers at all levels. The United States pledged \$4 million in 2010 for ISGAN, with additional funds expected to come from other member countries.

Global Superior Energy Performance Partnership (GSEP)

India and the United States joined other countries at the Clean Energy Ministerial to launch the Global Superior Energy Performance partnership (GSEP), an initiative to accelerate energy efficiency improvements in commercial buildings and industrial facilities.³ For India, where almost 80 percent of infrastructure that will exist in 2030 is yet to be built, the buildings sector represents both an affordable and high-impact opportunity for reducing energy usage and mitigating greenhouse gas emissions.⁴ The three major components of GSEP are 1) creation of a harmonized implementation and certification process; 2) creation of sectoral task groups to accelerate adoption of best practices through public-private partnerships; and 3) creation of cross-sectoral technology task groups to facilitate adoption of energy saving solutions such as cool roofs and combined heat and power (CHP) systems. The United States pledged \$3 million in 2010 for technical work, coordination, and information-sharing efforts under GSEP, and stated that it will leverage another \$10 million for domestic implementation. During President Obama's visit to India, he announced that companies like Marriott, Target, and Walmart, as well as Indian companies like WIPRO and Infosys, would be part of a pilot certification program under GSEP to ensure continuous energy efficiency improvements in their buildings.⁵

Clean Energy Solutions Centers

Collaborative research can accelerate technological breakthroughs and can build on ongoing work in various countries, instead of duplicating valuable time and resources. Recognizing this, Indian and U.S. representatives at the Clean Energy Ministerial entered into a multilateral partnership with other countries to establish a network of Clean Energy Solutions Centers—virtual networks with world-class online platforms to help governments of developing countries drive transformational low-carbon technologies through the sharing of best practices.⁶ The centers will be virtual clearinghouses for policy information, supporting a network of at least 100 policy and technology experts across partner countries. The United States pledged \$37 million, ClimateWorks Foundation pledged \$10 million, and additional funds will come from developed countries in the partnership.

Key Highlights for all Multilateral Efforts:

Need for additionality and coordination with bilateral efforts

The multilateral initiatives described above as well as numerous others are welcome contributions to U.S.-India climate and energy cooperation. They increase the number of forums where the two countries can engage on these issues, thereby raising the opportunities for identifying common ground and designing further collaboration. However, if this translates into merely having a multiplicity of forums to rearticulate or repackage the same existing efforts, then it only serves to waste time and valuable resources. Multilateral initiatives should be chosen wisely based on what areas are national as well as bilateral priorities in climate and clean energy. Duplication should be avoided by agency staff in both countries by ensuring that all the key players are aware of similar bilateral and multilateral partnerships, and work in tandem with counterparts responsible for similar areas.

CHAPTER 7

Recommendations

During the course of research and investigation for this report, NRDC observed clear trends across various initiatives and departments. Our investigation led us to identify several areas where the bilateral process, already off to a great start, can be further strengthened. While this report makes targeted recommendations on many of the initiatives described in previous sections, it is also an opportunity to address some cross-cutting areas for improvement. The following recommendations are the broad takeaways from our analysis:

- 1. The United States and India should reaffirm that climate change poses a threat to the economic security of both nations and the international community.** The Green Partnership is a critical element of our two nations' own commitments to constrain the emissions that are warming the earth's climate. In striving for clean energy solutions, our leaders should recognize that there is also a great economic opportunity for our two nations to cooperate so we can compete in the critical race to develop and deploy clean energy and green technologies.
- 2. The United States and India should recognize the need to continue to build U.S.-India cooperation on climate change and energy. Both should agree to refocus government efforts to ensure that the new set of interrelated projects now underway makes measurable progress over the next two years and beyond.** In moving these new projects forward, the governments should build on the successes of existing projects as a model for agency staff interaction in the future. Meaningful on-the-ground programs, such as USAID's 10-year building efficiency program ECO-III, should be a model for smart implementation of the new PACE activities. The two governments should also instruct those designing and implementing joint initiatives to ensure that the new programs and projects are aligned with each country's priorities so as to create innovation opportunities and build trust between our societies.
- 3. The United States and India should agree to use state-of-the art, cutting edge information and social media technologies available in both countries to make the Green Partnership a smart, responsive, efficient and productive partnership.** Agency heads should be directed to ensure that information about the various programs now underway and planned will be aggregated, organized, assessed, and made available to the public. This will facilitate communication and coordination among the involved government agencies, businesses, universities, and citizen groups. Creating such a mechanism for stakeholders and the public to monitor and track progress on collaborative projects could make India-U.S. joint efforts a model for the world.
- 4. The United States and India should reaffirm the importance of climate adaptation measures and should collaboratively build both countries' capacity to adapt to climate change.** Climate change is already happening and will have major impacts on both our societies. The Green Partnership called for collaborative

efforts on climate change adaptation, and now is the time to move forward in developing joint adaptation solutions. For instance, both countries should establish a “green hot line” between our nations’ public health, environmental, and emergency preparedness officials so that we can begin to cooperate in assessing and preparing for disasters related to sea-level rise, droughts, heat waves, and floods—all of which will be more frequent and severe in a warmer world.

5. **The United States and India should expand the existing dialogues to create specific working groups to tackle controversial finance, trade, technology transfer, and transparency issues.** The working groups should seek to find resolutions early on to possible points of conflict, such as the adequacy of climate change funding for India and other developing countries, the possible use of trade adjustments, trade-related intellectual property limitations, domestic content requirements, limitations on foreign investment in India on clean energy, and international review of emissions data.
6. **The United States and India should discuss what additional steps our governments can take together to create a new approach to stimulate national actions and global cooperation on climate change.** A new framework for bilateral and multilateral relationships needs to evolve. Our leaders need to work together again as they have at the recent United National Framework Convention on Climate Change (UNFCCC) conferences to stop the bickering and break the stalemate. Overall, they need to support action to combat climate change in both countries and resist pressures to ignore the problem, or to keep arguing and do nothing. This stronger, smarter, and strategic partnership holds the promise of tackling the greatest challenges to our societies.

CHAPTER 8

Conclusion

The level of cooperation between the United States and India on climate change and clean energy has advanced significantly in the last year. The credit for this progress goes not only to the two countries' leaders—who recognized climate change and energy as priorities for cooperation and as opportunities for good business and diplomacy—but also the committed governmental officials who overcame significant bureaucratic challenges to drive the process forward.

Bilateral cooperation can and should be strengthened through even better coordination within each country and between the two. Focusing on a few key efforts, instead of spreading resources thin, can bolster this effort. Improved transparency and fuller engagement with business and civil society would also be beneficial for all.

The United States and India have made a good start on their Green Partnership, moving both countries toward improved well-being and demonstrating the power of partnership in moving our world toward a low-carbon, sustainable future.

APPENDIX A

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APPENDIX B

THE WHITE HOUSE Office of the Press Secretary

FOR IMMEDIATE RELEASE

November 24, 2009

FACT SHEET: U.S.-INDIA GREEN PARTNERSHIP TO ADDRESS ENERGY SECURITY, CLIMATE CHANGE, AND FOOD SECURITY

President Barack Obama and Prime Minister Manmohan Singh launched a Green Partnership, reaffirming their countries' strong commitment to taking vigorous action to combat climate change, ensuring their mutual energy security, working towards global food security, and building a clean energy economy that will drive investment, job creation, and economic growth throughout the 21st century. Toward that end, Prime Minister Singh and President Obama agreed to strengthen U.S.-India cooperation on clean energy, climate change, and food security by launching the following initiatives:

- The two countries agreed on a comprehensive **Memorandum of Understanding to enhance cooperation on Energy Security, Energy Efficiency, Clean Energy, and Climate Change**. Through this Memorandum, both countries will work jointly to accelerate development and deployment of clean energy technologies and to strengthen cooperation on adaptation to climate change, climate science, and reducing greenhouse gas emissions from forests and land use.
- Prime Minister Singh and President Obama agreed to encourage the mobilization of public and private resources to support a fund or funds that would invest in clean energy projects in India. This represents a major step forward in U.S. - India partnerships to strengthen their economic growth and energy security, while also addressing the threat of global climate change.
- Prime Minister Singh and President Obama affirmed that the Copenhagen outcome must be comprehensive and cover mitigation, adaptation, finance, and technology. Moreover, it should reflect emission reduction targets for developed countries and nationally appropriate mitigation actions by developing countries. There should be scaled-up finance, technology, and capacity-building support. There should be full transparency as to the implementation of their mitigation commitments and appropriate processes for review. **Both leaders resolved to take significant mitigation actions and to stand by these commitments.**
- In addition, the two leaders launched an **Indo-U.S. Clean Energy Research and Deployment Initiative**, supported by U.S. and Indian government funding and private sector contributions. This new Initiative will include a Joint Research Center operating in both the United States and India to foster innovation and joint efforts to accelerate deployment of clean energy technologies. Priority areas of focus for this

Initiative may include: energy efficiency, smart grid, second-generation biofuels, and clean coal technologies including carbon capture and storage; solar energy and energy efficient building and advanced battery technologies; and sustainable transportation, wind energy, and micro-hydro power. The Initiative will allow the two governments to leverage expertise from both countries including government, private industry, and higher education to accelerate the development and deployment of new clean energy technologies. The Initiative will facilitate joint research, scientific exchanges, and sharing of proven innovation and deployment policies.

- The Initiative's work will be complemented by two **Memoranda of Understanding (MOUs) on Solar Energy and Wind Energy**. Through the MOU on Solar Energy, the U.S. National Renewable Energy Lab (NREL) will partner with India's Solar Energy Centre to develop a comprehensive nation-wide map of solar energy potential. More than two dozen U.S. and Indian cities will partner to jointly advance solar energy deployment. The MOU on Wind Energy between NREL and India's Centre for Wind Energy Technology will focus in particular on supporting efforts to develop a low-wind speed turbine technology program.
- The U.S. and India will increase cooperation on **unconventional natural gas** including on coal bed methane, natural gas hydrates, and shale gas. The two countries will also work to reduce emissions from land use, including deforestation, forest degradation, enhanced sequestration, and sustainable management of forests.
- Working with India's Ministry of Environment and Forests, the **U.S. Environmental Protection Agency will provide technical support for Indian efforts to establish a National Environmental Protection Authority** focused on creating a more effective system of environmental governance, regulation and enforcement.
- They agreed to launch a new Agriculture Dialogue and agreed on a **Memorandum of Understanding on Agricultural Cooperation and Food Security** that will set a pathway to robust cooperation between the governments in crop forecasting, management and market information; regional and global food security; science, technology, and education; nutrition; and expanding private sector investment in agriculture.
- In support of food security and climate change objectives, the U.S. National Oceanic and Atmospheric Administration will work with India's Ministry of Earth Sciences **to more accurately forecast monsoons**, and thereby reduce risks associated with climate change and to develop early warning systems to protect people and crops from the adverse effects of extreme weather.

- In support of these and other initiatives, including continuing cooperation on nuclear power, Prime Minister Singh and President Obama agreed the Governments of India and the United States will continue to engage regularly through the new U.S.-India Agriculture Dialogue, the U.S.-India Energy Dialogue and the U.S.-India Global Climate Change Dialogue.

APPENDIX C

MEMORANDUM OF UNDERSTANDING BETWEEN THE GOVERNMENT OF UNITED STATES OF AMERICA AND THE GOVERNMENT OF INDIA TO ENHANCE COOPERATION ON ENERGY SECURITY, ENERGY EFFICIENCY, CLEAN ENERGY AND CLIMATE CHANGE

Whereas the Government of the United States of America and the Government of the Republic of India (the “Participants”) have pledged to intensify collaboration on energy security, clean energy and climate change, focusing efforts on increasing energy efficiency, renewable energy, and clean energy technologies having co-benefit for climate change through the U.S.–India Energy Dialogue and the U.S.–India Bilateral Dialogue on Global Climate Change;

Whereas both Participants seek to launch a process of bilateral collaboration to support their respective efforts to achieve sustainable, climate-friendly growth through the development, deployment and, as appropriate, transfer of transformative and innovative technologies in areas of mutual interest;

Having committed to work together for energy conservation and sustainable development - to achieve energy security, mitigate the effects of climate change and safeguard the environment through both national as well as multilateral initiatives;

Recognizing that transitioning to a low-carbon economy is an opportunity to promote continued economic growth and sustainable development in all countries;

Noting the dialogue in multilateral processes such as the Major Economies Forum on Energy and Climate and its Global Partnership on climate-friendly technologies which help in understanding respective positions and advancing clean energy and collaboration in the mitigation and adaptation to climate change;

Reaffirming that both countries intend to promote the full, effective and sustained implementation of the United Nations Framework Convention on Climate Change (UNFCCC) in accordance with the Bali Action Plan. Recognizing their special role in promoting a successful and substantive outcome at the UNFCCC 15th Conference of Parties at Copenhagen in December 2009, they reaffirmed their intention to work together bilaterally and with all other countries for an agreed outcome at that meeting;

Affirming that the Copenhagen outcome must be comprehensive and cover mitigation, adaptation, finance and technology, and in accordance with the principle of common but differentiated responsibilities and respective capabilities, it should reflect emission reduction targets of developed countries and nationally appropriate mitigation actions of developing countries. There should be full transparency through appropriate processes as to the implementation of aforesaid mitigation actions. The outcome should further reflect the need for substantially scaled-up financial resources to support mitigation and adaptation in developing countries, in particular, for the poorest and most vulnerable. It should also include measures for promoting technology development, diffusion, and transfer and capacity building, including consideration of a center or a network of centers to support and stimulate climate innovation. The United States and India, consistent with their national circumstances, resolved to take significant national mitigation actions that will strengthen the world's ability to combat climate change. They resolve to stand by these commitments.

Therefore, both countries, to effectively address climate change have come to the following understanding:

OBJECTIVES

The Participants, through this Memorandum of Understanding (“MOU”), intend to expand current partnerships through increased bilateral engagement and further joint initiatives for promoting sustainable growth and increasing incentives for innovation and application of alternative fuels and clean energy as well as capacity building for deployment of adaptable, affordable and climate-friendly technologies in both countries.

The co-operation described under this MOU prioritizes, but is not limited to, the following areas for new initiatives — building on the joint projects currently under implementation — and bilateral collaborations to achieve the common goals of clean energy, energy efficiency, low-carbon growth in the pursuit of sustainable development:

PRIORITY INITIATIVES

- a. A U.S.–India Clean Energy Research and Deployment Initiative, including a Joint Research Center to foster innovation and joint efforts to accelerate deployment of clean energy technologies. Priority areas of focus for this initiative should include solar energy, energy efficiency, smart grid, unconventional natural gas, second-generation bio-fuels, and clean coal technologies including carbon capture and storage and integrated gasification and combined cycle. Other areas may include sustainable transportation, wind energy, and micro-hydro power.
- b. Increased cooperation on scaling up solar energy and energy efficient buildings and advanced battery technologies.
- c. Increased cooperation on unconventional natural gas including cooperation on coal bed methane, natural gas hydrates, and shale gas.
- d. Reducing emissions from land use, including deforestation: cooperation on forests and land use, including reducing emissions from deforestation and forest degradation and enhanced sequestration, through afforestation , conservation and sustainable management of forests.
- e. Strengthening cooperation on adaptation and climate science, including through improved ocean, weather and climate observation and prediction

capabilities, enhanced monsoon forecasts for the agricultural community, flood control, and water supply monitoring.

IMPLEMENTATION

The Participants intend to implement and monitor the provisions of this MOU through the mechanism of the existing Working Groups of the U.S.–India Energy Dialogue and the U.S.–India Global Climate Change Dialogue. The Participants may monitor implementation of this MOU in joint meetings of the Co-chairs of the Energy, Climate Change, and Economic Dialogues.

FORMS OF CO-OPERATION

In addition to identifying resources to implement this MOU, the Participants intend to encourage mobilization of public and private resources to support a fund or funds that would invest in clean energy projects in India. This represents a major step forward in U.S.–India partnerships to strengthen economic growth and energy security, while also addressing the threat of global climate change. Wherever possible, the Participants should cooperate to utilize expertise from all sectors of society including the business and academic sectors and non-governmental organizations for achieving the objectives of this MOU.

Each Participant should carry out the cooperative activities under this MOU should be carried out in accordance with its applicable laws and regulations.

Subject to their respective applicable legislation, the Participants intend to implement this MOU to ensure that they conduct Cooperative Activities in a manner consistent with this MOU.

Cooperative Activities may include the following forms:

- a. Facilitating joint research, and exchange of scientists through development, demonstration, deployment, and commercialization activities, under an appropriate written agreement;
- b. Facilitating access to financing, leveraging bilateral, multilateral and private sector funding;

- c. Facilitating policy dialogue including through scientific seminars, symposia, conferences and workshops as well as participation of experts in those activities;
- d. Public Private Partnerships (PPP); and
- e. Any other mode of cooperation jointly determined in writing by the Participants.

INTELLECTUAL PROPERTY

The treatment of intellectual property created or furnished in the course of cooperative activities in furtherance of the objectives of this MOU is to be in accordance with Annex I of the Agreement on Science and Technology Cooperation between the Government of the United States of America and the Government of the Republic of India signed October 17, 2005.

INTERPRETATION AND DISPUTE RESOLUTION

It is the intention of the Participants that this MOU not create any legally binding rights or obligations. Nothing in this MOU is intended to modify any arrangement or any other bilateral or reciprocal arrangement that the Participants may have.

COMMENCEMENT, REVISION, AND DURATION

Cooperation under this MOU is intended to commence on the date of signature and continue for a period of five years. It may be extended by mutual written consent of the Participants.

This MOU may be revised at any time by mutual written consent of the Participants.

A Participant that wishes to discontinue its participation in this MOU should endeavor to provide written notice ninety days in advance of its decision to discontinue partnership in the MOU. Discontinuation should not affect activities already underway at the time of the discontinuation.

Signed at Washington in duplicate in the English language on the twenty-fourth day of November 2009. A text in the Hindi language will be prepared and accepted at a later date.

FOR THE GOVERNMENT OF
THE UNITED STATES OF AMERICA:

Handwritten signature of Hillary Rodham Clinton in black ink.

FOR THE GOVERNMENT OF
THE REPUBLIC OF INDIA:

Handwritten signature of Anurag Kohli in black ink, with a long horizontal line underneath.

APPENDIX D

MOU Number: _____

MEMORANDUM OF UNDERSTANDING
For the Collaboration on Solar Energy Research and Development
Between
The Solar Energy Centre,
Ministry of New and Renewable Energy
Republic of India
and
The National Renewable Energy Laboratory,
United States Department of Energy

SUBJECT COOPERATION IN THE AREA OF SOLAR ENERGY

INTRODUCTION

The Solar Energy Centre (SEC), a technical institute within the Ministry of New and Renewable Energy (MNRE), Republic of India and the National Renewable Energy Laboratory (NREL), a United States Department of Energy national laboratory managed and operated by the Alliance for Sustainable Energy, LLC (hereafter "Participants") have collaborated for several years on advancing solar energy in India through assessing India's solar energy resources using well-established satellite-based techniques validated with ground measurements, and through informal exchange of researchers. The Participants' goals have historically overlapped in advancing the development and deployment of solar technologies.

Among other activities, NREL conducts research and analysis on photovoltaics (PV), concentrating solar power (CSP), integration with the electric power grid, and market transformation in support of the U.S. Department of Energy's Solar Energy Technologies Program (SETP). Understanding that the objective of the SETP is to develop cost-competitive solar systems and facilitate the technologies' acceptance in the marketplace, this collaboration intends to advance SETP goals.

The SEC also conducts research and analysis aimed at developing solar energy technologies and promoting their application through product development. The SEC is part of India's Ministry of New and Renewable Energy, the nodal ministry for all matters relating to new and renewable energy in India. This collaboration of SEC and NREL, and other entities as may be mutually determined by the Ministry of New and Renewable Energy and the U.S. Department of Energy, is designed to support the development and application of solar technologies in India.

It is the intent of the Participants to collaborate in activities that will further the assessment of solar resources across all of India, the evaluation of sites with the best technical and economic solar power producing potential, the development of project design and finance tools and promote the sharing of experiences in the Solar America Cities program and the Indian Solar Cities Programme and building of capacity across the spectrum of solar technologies. Also, the collaborative activities may include technical information exchanges related to development of a CSP plant and solar thermal and PV reliability. Collaborative activities in all these areas are of mutual interest to the Participants.

This Memorandum of Understanding (MOU) memorializes the Participants' intent to cooperate to maximize the benefit of their respective institutional interests.

Section I: Authority, Organization and Mission

1. Authority

- a. NREL is a Federally Funded Research and Development Center (FFRDC) managed and operated by the Alliance for Sustainable Energy, LLC for the United States Department of Energy under Contract No. DE-AC36-08GO28308. NREL's participation in the collaborative activities under this MOU is in accordance with the terms of the DOE contract and the DOE FFRDC sponsoring agreement.

The SEC is a specialized centre within MNRE and the SEC serves as MNRE's technical focal point for solar energy development in India.

2. Organization and Mission

- a. NREL's mission is to enhance energy efficiency and the production of renewable energy to bring clean, reliable and affordable energy technologies to the marketplace. NREL has active programs in solar energy, wind energy, ocean energy, biomass, geothermal energy, utility integration, transportation systems, energy efficiency, and energy analysis and applications.
- b. The mission of SEC is to serve as an effective interface between the Government of India and institutions, industry and user organizations for development, promotion and widespread utilization of solar energy in the country.

Section II: Scope of Cooperation and Objectives

The scope of this MOU is intended to focus on advancing solar energy in India. The objectives of the collaboration are to:

- Facilitate the development of accurate data on Indian solar energy resources as a basis for expanded solar applications.
- Transform market acceptance and implementation of solar applications in India
- Support PV and solar thermal component reliability.
- Support Indian efforts to develop a CSP pilot plant.
- Facilitate exchange of technical and market experts to advance solar energy in India.

Desired outcomes from this collaboration include:

- Facilitate the assessment of the solar resource throughout India.
- Cooperate to enhance MNRE's Solar Cities Programme.
- Facilitate the development of tools to support investment decisions on solar applications in India.
- Cooperate to identify and recommend solutions to PV and solar thermal component reliability issues.

- Increase the understanding of the scope and design of CSP plant in India.
- Enhance the capacity among Indian solar energy experts and stakeholders on technical, market and related aspects of expanded solar technologies in India.

Section III: Collaborative Activities

Collaborative activities under this MOU may include, but are not limited to, activities in the scientific and technical areas of mutual interest as described in Section II. The initial areas of focus should be to:

- **Expand the understanding of Indian solar energy resources** as the basis for development of solar energy in India. Through previous collaborative efforts between NREL, the SEC and other Indian partners (such as the Indian Meteorological Department), the solar resource in the northwestern part of India has been mapped. A main objective of the collaboration is to facilitate the extension of that assessment to the remainder of the country.
- **Identify optimal sites for large-scale solar in India** by facilitating the validation of existing solar data (high resolution, for both flat plate and concentrating collectors) for northwestern India collected over six years. Once the data are validated, the most economically viable sites in this region are to be identified based on GIS (geographic information systems) data and guided by MNRE, the SEC, and industry representatives.
- **Develop Solar Project Design and Finance Tools** that will allow industrial entities to investigate project economics for various solar project designs and financing options while drawing on incentive and resource information for that specific region.
- **Promote Bilateral Solar Cities** by drawing upon the experiences of the Solar America Cities program. NREL intends to facilitate the sharing of U.S. program structure, lessons learned and best practices with India as India implements its recently established Solar Cities Programme, and may facilitate the pairing of Indian and U.S. cities.

Also, the following additional areas of mutual collaboration may include:

- **CSP Pilot Plant.** This may include technical information exchanges in support of design and sourcing the plant, and may build on analysis conducted to identify optimal sites for a facility.
- **Solar Thermal and PV Component Reliability.** This may include the facilitation of testing of technology and devices at Indian institutions, and training on procedures and standards.

Collaboration may occur through several means, including joint technical projects, workshops, and researcher exchange.

Section IV: Source of Funding

1. The conduct of any collaborative activities mutually determined is subject to the availability of funds and staff available to the Participants. In the event that special funding is available for selected activities, the Participants may develop a separate written understanding for such activities. In such cases, the terms of funding should be mutually determined by both Participants before the commencement of activities and should be described in a separate written understanding pursuant to Section VIII below.
2. Each Participant is responsible for its own expenses for collaborative activities under this MOU, including all administrative costs, overhead expenses, labor costs, insurance costs, travel expenses and similar costs, unless a separate written understanding between the Participants provides otherwise. No exchange of funds is permitted under this MOU.

Section V: Reports, Documents and Release of Information

1. Each Participant intends to collaborate in a manner that facilitates exchanges of non-proprietary information. Subject to applicable laws and regulations, the Participants intend that information, data and reports of collaborative activities carried out under this MOU may be released by either Participant with the written concurrence of the other Participant.
2. Activities that may involve sharing of proprietary information and transfer of rights and interest in intellectual property are excluded from the purview of this MOU. In the event it becomes necessary to share proprietary information, separate written non-disclosure understandings should be put in place.

Section VI: Review of Activities

The Participants intend to review collaborative activities conducted under this MOU as a means to ascertain their effectiveness, document achievements and lessons, recognize technical personnel, and identify and plan areas for future collaboration. This review should take the form of annual, mutually determined meetings of key technical contacts and management from each Participant to discuss ongoing and future cooperation. Specific commitments developed pursuant to this MOU should be reflected in separate written understandings in accordance with Section VIII below.

Section VII: Disclaimer

Information transmitted by one Participant to the other under this MOU should be accurate to the best knowledge and belief of the transmitting Participant. Neither Participant makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, nor usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe upon privately owned rights.

Section VIII: Separate Written Understandings

Select activities derived from the collaborative activities under this MOU, including, as appropriate, details concerning financial arrangements and the allocation and protection of property rights, including intellectual property rights, should be confirmed in a separate written understanding between Participants. Such separate written understanding should include, as appropriate, a work plan, staffing requirements, cost estimates, funding sources, a plan for the adequate and effective protection of intellectual property rights and other arrangements or conditions that are not within the purview of this MOU.

Section IX: Status of the Memorandum of Understanding

This MOU does not create any legally binding obligations between the Participants. This MOU: (1) is not a contract; (2) may not be used to obligate or commit funds; and (3) may not be used as a basis for the transfer of funds.

Section X: Contacts and Changes

1. All notices, communications and coordination should involve, at a minimum, the following individuals, their successors and/or designees as follows:

- a) For the Solar Energy Centre
Dr. Bibek Bandyopadhyay, Advisor and Head
19th Milestone, Institutional Area,
Gurgaon-Faridabad Road,
Gwalpahari, Gurgaon
Tel: 0124-2579207

- b) For the National Renewable Energy Laboratory:
Dr. Dan Arvizu, Laboratory Director
Alliance for Sustainable Energy, LLC
1617 Cole Boulevard
Golden, CO 80401
Tel: 1 303 275 3016

2. The Participants recognize that implementation of the MOU may require an ongoing dialogue between the Participants and, accordingly, intend to make future changes to the MOU as technologies, policies and program goals change over time. All such changes are to be made in writing by the Participants' mutual consent.

Section XI: Commencement Date, Changes, and Discontinuation

The Participants intend to commence cooperation under this MOU upon signature. Such cooperation may continue for a period of five (5) years or until it is discontinued in writing by the Participants' mutual consent. A Participant that wishes to discontinue its participation in this MOU should endeavor to provide at least 90 days advance written notice to the other Participant.

Section XII: Miscellaneous

1. This MOU is not intended to restrict either of the Participants from participating in any activity with any other public or private organization.
2. This MOU is neither a fiscal nor a funds obligation document. Nothing in this MOU authorizes or is intended to obligate the Participants to expend, exchange, or reimburse funds, services, or supplies or transfer or receive anything of value.
3. This MOU is strictly for internal management purposes for each of the Participants. It is not legally enforceable and may not be construed to create any legal obligation on the part of either party. This MOU may not be construed to provide a private right or cause of action for or by any person or entity.
4. Each Participant should conduct the activities contemplated by this MOU in accordance with the applicable laws of its respective country, including, without limitation, export control laws.

Signed in duplicate.

Signatures

The Parties hereby initiate this MEMORANDUM OF UNDERSTANDING and acknowledge their understanding by the following signatures.

For: Solar Energy Centre:



Signature

Dr. Bibek Bandyopadhyay

Advisor and Head

Date:

Place:

For: National Renewable Energy Laboratory:

Signature

Dr. Dan Arvizu

Laboratory Director

Date:

Place:

APPENDIX E

MOU Number: _____

MEMORANDUM OF UNDERSTANDING
For the Collaboration on Wind Energy Research and Development
Between
The Centre for Wind Energy Technology,
Ministry of New and Renewable Energy
Republic of India
and
The National Renewable Energy Laboratory,
United States Department of Energy

SUBJECT COOPERATION IN THE AREA OF WIND ENERGY

INTRODUCTION

The Centre for Wind Energy Technology, an autonomous R&D institution under the Ministry of New and Renewable Energy (MNRE) of the Republic of India, and the National Renewable Energy Laboratory (NREL) a United States Department of Energy national laboratory managed and operated by the Alliance for Sustainable Energy, LLC (hereafter “Participants”) have collaborated for several years through informal exchange of researchers to support the development and deployment of wind energy technologies.

NREL's wind energy research staff and facilities at the National Wind Technology Center (NWTC) provide the wind industry with the expertise, technical support, and equipment it needs to develop successful advanced wind energy systems. NREL's wind energy research capabilities include design review and analysis; software development, modeling and analysis, systems and controls analysis, utility integration assessment; and wind resource assessment.

To make wind energy fully cost competitive and increase wind energy development, NREL researchers work in partnership with industry to develop larger, more efficient, utility-scale wind turbines for land-based and offshore installations, as well as more efficient, quieter small wind turbines for distributed applications. NREL staff independently test small wind turbines to help the wind industry provide consumers with more certified small wind turbine systems. Also, NREL collaborates with utility industry partners and provides data, analysis, and techniques to increase utility understanding of integration issues and confidence in the reliability of new wind turbines.

The Centre for Wind Energy Technology (C-WET) was established in 1999 by MNRE, the nodal ministry for matters relating to all new and renewable energy in India. C-WET serves as the MNRE technical focal point for wind power development in India, promoting and accelerating the pace of utilization of wind energy and supporting the growing wind power sector in the country. C-WET offers services and seeks to find total solutions for the major stakeholders across the entire spectrum of the wind energy sector. It supports the wind turbine industry in achieving and sustaining quality such that products of the highest quality and reliability are installed. This C-WET-NREL collaboration intends to support the development and application of wind energy technologies in India.

India has identified exploration of wind power development in regions with low-wind speeds as a priority, and it is the intent of the Participants to collaborate in advancing development of low-wind speed technologies, drawing upon the experiences of DOE's Low-Wind Speed Technology Project. Collaboration should include technical information exchanges to accelerate development of testing facilities and deployment of low-wind speed turbines in India. Indian scientists may also be invited to send delegates for NREL's Wind Energy Applications Training Symposium.

This Memorandum of Understanding (MOU) memorializes the Participants' intent to cooperate to maximize the benefit of their respective institutional interests.

Section I: Authority, Organization and Mission

1. Authority

- a. NREL is a Federally Funded Research and Development Center (FFRDC) managed and operated by the Alliance for Sustainable Energy, LLC for the United States Department of Energy under Contract No. DE-AC36-08GO28308. NREL's participation in the collaborative activities under this MOU is in accordance with the terms of the DOE contract and the DOE FFRDC sponsoring agreement.
- b. C-WET is a specialized centre within MNRE and serves as the technical focal point for wind power development in India.

2. Organization and Mission

- a. NREL's mission is to enhance energy efficiency and the production of renewable energy to bring clean, reliable and affordable energy technologies to the marketplace. NREL has active programs in solar energy, wind energy, ocean energy, biomass, geothermal energy, utility integration, transportation systems, energy efficiency, and energy analysis and applications.
- b. The mission of C-WET is to serve as an effective interface between the Government of India and institutions, industry and user organizations for development, promotion and widespread utilization of wind energy in the country.

Section II: Scope of Cooperation and Objectives

The scope of this MOU is intended to focus on advancing wind energy in India. The objectives of the collaboration are to:

- Support Indian efforts to develop a low-wind speed turbine technology program in order to facilitate deployment of these technologies.
- Facilitate exchange of technical and market experts to advance wind energy in India.
- Explore other areas for future collaboration with potential to promote enhanced deployment of wind energy in India.

Desired outcomes from this collaboration include:

- Guidance on development of Indian low-wind speed turbine test facilities.
- Enhanced capacity among Indian experts on low wind speed test procedures, equipment and protocols.
- Enhanced capacity among Indian wind energy experts and stakeholders on technical, market and related aspects of low wind speed technologies in India.

Section III: Collaborative Activities

Collaborative activities under this MOU may include, but are not limited to, activities in the scientific and technical areas of mutual interest as described in Section II. The initial areas of focus should be to:

- Invite Indian scientists to the United States for workshops and study tours on testing of low-wind speed turbines
- Provide advice and technical information exchanges regarding C-WET plans for development of test facilities for testing low-wind speed turbines and any related plans for support of India's wind industry
- Invite Indians scientists to the U.S. to participate in training of Indian researchers at NREL's Wind Energy Applications Training Symposium

Collaboration may occur through several means, including joint technical projects, workshops, and researcher exchange.

Section IV: Source of Funding

1. The conduct of any collaborative activities mutually determined is subject to the availability of funds and staff available to the Participants. In the event that special funding is available for selected activities, the Participants may develop a separate written understanding for such activities. In such cases, the terms of funding should be mutually determined by both Participants before the commencement of activities and should be described in a separate written understanding pursuant to Section VIII below.
2. Each Participant is responsible for its own expenses for collaborative activities under this MOU, including all administrative costs, overhead expenses, labor costs, insurance costs, travel expenses and similar costs, unless a separate written understanding between the Participants provides otherwise. No exchange of funds is permitted under this MOU.

Section V: Reports, Documents and Release of Information

1. Each Participant intends to collaborate in a manner that facilitates exchanges of non-proprietary information. Subject to applicable laws and regulations, the Participants intend that information, data and reports of collaborative activities carried out under this MOU may be released by either Participant with the written concurrence of the other Participant.
2. Activities that may involve sharing of proprietary information and transfer of rights and interest in intellectual property are excluded from the purview of this MOU. In the event it becomes necessary to share proprietary information, separate written non-disclosure understandings should be put in place.

Section VI: Review of Activities

The Participants intend to review collaborative activities conducted under this MOU as a means to ascertain their effectiveness, document achievements and lessons, recognize technical personnel, and identify and plan areas for future collaboration. This review should take the form of annual, mutually determined meetings of key technical contacts and management from each Participant to discuss ongoing and future cooperation. Specific commitments developed pursuant to this MOU should be reflected in separate written understandings in accordance with Section VIII below.

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Section VIII: Separate Written Understandings

Select activities derived from the collaborative activities under this MOU, including, as appropriate, details concerning financial arrangements and the allocation and protection of property rights, including intellectual property rights, should be confirmed in a separate written understanding between Participants. Such separate written understanding should include, as appropriate, a work plan, staffing requirements, cost estimates, funding sources, a plan for the adequate and effective protection of intellectual property rights, and other arrangements or conditions that are not within the purview of this MOU.

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This MOU does not create any legally binding obligations between the Participants. This MOU: (1) is not a contract; (2) may not be used to obligate or commit funds; and (3) may not be used as a basis for the transfer of funds.

Section X: Contacts and Changes

1. All notices, communications and coordination should involve, at a minimum, the following individuals, their successors and/or designees as follows:
 - a) For the Centre for Wind Energy Technology
Dr. S.Gomathinayagam
Executive Director, C-WET
Velachery - Tambaram High Road,
Pallikaranai, Chennai - 600 100
Tel: 91-44-22463982
 - b) For the National Renewable Energy Laboratory:
Dr. Dan Arvizu, Laboratory Director
Alliance for Sustainable Energy, LLC
1617 Cole Boulevard
Golden, CO 80401
Tel: 1 303 275 3016
2. The Participants recognize that implementation of the MOU may require an ongoing dialogue between the Participants and, accordingly, intend to make future changes to the MOU as technologies, policies and program goals change over time. All such changes are to be made in writing by the Participants' mutual consent.

Section XI: Commencement Date, Changes, and Discontinuation

The Participants intend to commence cooperation under this MOU upon signature. Such cooperation may continue for a period of five (5) years or until it is discontinued in writing by the

Participants' mutual consent. A Participant that wishes to discontinue its participation in this MOU should endeavor to provide at least 90 days advance written notice to the other Participant.

Section XII: Miscellaneous

1. This MOU is not intended to restrict either of the Participants from participating in any activity with any other public or private organization.
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3. This MOU is strictly for internal management purposes for each of the Participants. It is not legally enforceable and may not be construed to create any legal obligation on the part of either party. This MOU may not be construed to provide a private right or cause of action for or by any person or entity.
4. Each Participant should conduct the activities contemplated by this MOU in accordance with the applicable laws of its respective country, including, without limitation, export control laws.

Signed in duplicate.

Signatures

The Parties hereby initiate this MEMORANDUM OF UNDERSTANDING and acknowledge their understanding by the following signatures.

For Centre for Wind Energy Technology



Signature

Dr. S. Gomathinayagam

Executive Director

Date:

Place:

For: National Renewable Energy Laboratory:

Signature

Dr. Dan Arvizu

Laboratory Director

Date:

Place

APPENDIX F

MEMORANDUM OF UNDERSTANDING

BETWEEN

**THE MINISTRY OF NEW AND RENEWABLE ENERGY
OF THE REPUBLIC OF INDIA**

AND

**THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA**

ON COOPERATION IN THE DEVELOPMENT OF BIOFUELS

The Department of Energy (DOE) of the United States of America, and the Ministry of New and Renewable Energy (MNRE) of the Republic of India, hereinafter referred to as the “Participants”,

Acknowledging that developing fuels that utilize biomass resources in accordance with their national policies is an important way to significantly reduce fossil fuel consumption, enhance energy security, promote the agricultural sector, and support rural development;

Recognizing the important role played by government, industry and research entities in both countries in the area of biofuels development, and the benefits expected from their potential collaboration, in pursuit of enhancing long-term cooperation between the United States of America (hereinafter “United States”) and the Republic of India (hereinafter “India”) in the development of biofuels; and

Desiring to cooperate on the basis of equality, reciprocity and mutual benefit,

Have reached the following understanding:

1. Scope of Cooperation

The purpose of this Memorandum of Understanding (MOU) is to establish a framework of cooperation covering scientific, technical and policy aspects of production, conversion, utilization, distribution and marketing of biofuels in a sustainable and environmentally friendly manner in accordance with national priorities and socio-economic development strategies and goals.

2. Areas of Cooperation

- a. The Participants intend to develop a work plan to define the scope of their proposed collaborative activities under this MOU. The work plan may be revised as mutually determined by the Participants.
- b. Specific areas of cooperation to be included in this work plan may include, but are not limited to:
 - i. Biofuel feed-stock production based on sustainable biomass with active involvement of local communities through non-edible oil seed bearing plantations on wastelands, to include production and development of quality planting materials and high sugar containing varieties of sugarcane, sweet sorghum, sugar beet and cassava.
 - ii. Advanced conversion technologies for first generation biofuels and emerging technologies for second generation biofuels including conversion of lingo-cellulosic materials to ethanol including switch grass, crop residues, forest wastes and algae, biomass-to-liquid (BTL) fuels, bio-refineries.
 - iii. Technologies for end-use applications in the transportation sector based on a large scale centralized approach and stationary applications in rural areas and industry for motive power and electricity production based

on a decentralized approach through active community participation.

iv. Utilization of by-products of bio-diesel production processes such as oil cake and glycerin.

v. Development of test methods, procedures and protocols, standards and certification for different biofuels and end use applications.

vi. Assessment of potential and joint policy studies and business models to promote greater penetration of biofuels in various sectors.

vii. Promotion and facilitation of technology transfer, joint ventures, and investments in the biofuel sector in India.

viii. Establishment of a continuing dialogue on biofuels between the two countries including exchange of visits, information exchange and capacity building.

3. Forms of Cooperation

- a. Exchange of publicly available scientific and technical information;
- b. Organization of seminars, workshops, and other meetings on agreed topics;
- c. Exchange of scientists, engineers and other specialists, including those from industry and other non-government sectors;
- d. Visits by a Participant's specialist teams or experts to the facilities of the other Participant, and field visits to research labs, renewable energy installations and industrial sites for

technical exchanges and experience sharing on renewable energy technologies;

- e. Identification of areas/projects suitable for the possible future conduct of joint research and development, and pilot scale and demonstration projects.

4. Joint Working Group

The Participants intend to establish a Joint Working Group composed of representatives from DOE and MNRE. Each Participant is to identify a point of contact responsible for coordination. The Joint Working Group should review the work plan on an annual basis. However, when such a meeting cannot be arranged, changes to the work plan may also be made in writing by mutual determination. The Participants intend to also nominate members from concerned departments, agencies and other stakeholders in their respective countries to participate in the Joint Working Group.

5. Participating Organizations

MNRE plans to coordinate the participation of other Indian Government ministries under this MOU. The DOE plans to coordinate the participation of other United States Government agencies under this MOU, such as the United States Department of Agriculture.

6. General

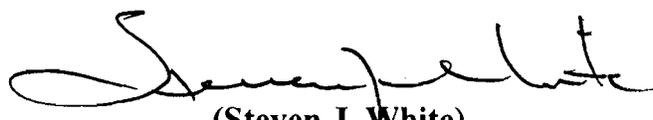
- a. Each Participant is responsible for the costs of its participation in all cooperative activities carried out under this MOU unless the Participants otherwise determined in writing. Each Participant's participation in the cooperative activities under this MOU is subject to the availability of funds, resources, and personnel and is to be conducted in accordance with the laws and regulations of that Participant's Government.

- b. This MOU does not create any legally binding obligations between the Participants.

- c. Cooperation under this MOU may commence from the date of signature. This MOU may be revised by mutual determination of the Participants in writing. A Participant should endeavor to give the other Participant at least 6 months written notice of its intention to discontinue its cooperation under the MOU and the Participants should continue to work together to conclude specific cooperative projects already in progress.

Signed at New Delhi, the 3rd day of February, 2009, in duplicate.


(Gauri Singh) 3/2/09
Joint Secretary
For the Ministry of New and
Renewable Energy of the Republic of
India


(Steven J. White)
Deputy Chief of Mission
Embassy of the United States of
America
For the Department of Energy
of the United States of America

ENDNOTES

Executive Summary

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Chapter 5

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