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PROJECT ON U.S. LEADERSHIP
IN DEVELOPMENT

Energy and Development Trends

THE ROLE OF RAPIDLY EMERGING COUNTRIES



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Center for Strategic and International Studies
1800 K Street, N.W., Washington, D.C. 20006
Tel: (202) 887-0200
Fax: (202) 775-3199
Web: www.csis.org



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ENERGY AND DEVELOPMENT TRENDS: THE ROLE OF RAPIDLY EMERGING COUNTRIES

Sarah O. Ladislaw

Introduction

One of the least understood but potentially important trends in the energy field is how emerging economies' development priorities are shaping energy markets. Emerging economies are expected to make up the bulk of growth in demand for energy in the coming decades, with countries outside the Organisation for Economic Co-operation and Development (OECD) accounting for 83 percent of expected growth in energy demand between 2008 and 2035.¹ As the global centers of expansion, these countries will increasingly influence how new energy markets evolve—commercial frameworks, technology sharing and development, regulations, and preferences for fuels and technologies that meet their societies' needs. Many of these countries have integrated new notions of sustainable development—driven by concerns about local pollution, energy security, climate change, and social development—that are likely to bring about energy systems different from U.S. or European models of energy infrastructure and use.

These development frameworks also influence how companies compete and succeed in these markets by influencing technology decisions, efficiency or local pollution regulations, local rules about content, interaction with state-dominated sectors, and the dynamics of markets and physical infrastructure. Moreover, the influence these development policies have on the investments and strategies of energy companies and energy markets can materially impact investment and technology trends available to other developing countries. This influence can happen in several ways. In some cases the policies are driving down the cost of traditionally more expensive energy technologies. These countries also serve as models for energy development in lesser developing countries, and, in some cases, are using less-developed markets as platforms for their own technology ventures. Many global energy companies are using new business ventures and strategies to help these countries meet their wider development goals while fulfilling their basic energy needs—though many face challenges. These strategies and experiences can open up opportunities for bringing energy to new areas in other countries. U.S. development efforts might gain useful insights through a survey of how Brazil, China, and India view meeting their energy needs within their development agenda, how companies are involved in these ventures, and what models could be useful for countries developing their systems.

1. Calculations were based on data from the U.S. Energy Information Administration (EIA), *International Energy Outlook 2011*, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=IEO2011&subject=0-IEO2011&table=1-IEO2011®ion=0-0&cases=Reference-0504a_1630.

The remainder of this paper will evaluate the role of rapidly emerging developing economies in energy development trends and will recommend how the development programs of the United States, along with the international donor community, should shift to capitalize on these trends. Preliminary analysis shows the following:

- Major emerging developing economies are reshaping energy markets by growing demand in ways that impact the energy economics of other developing countries;
- Countries like China are driving down the cost of energy technologies through domestic policy support, research and development, and manufacturing incentives and prowess that can make these technologies more affordable for other developing countries or donor organizations that finance energy assets;
- Given the resource profiles, policy priorities, and economic and commercial structures, these countries can introduce new energy models (like distributed generation) and new business ventures that attract companies looking to access these major new markets and can be exported as models for other developing countries; and
- As growing political and economic voices on the international stage, these major economies are becoming engaged in south-south trade and foreign direct investment in energy sectors around the world.

While the international and U.S. development communities focus on alleviating energy poverty and promoting climate-friendly technology, keeping an eye on how the vast majority of energy investment in these major developing economies can present new strategic opportunities to advance shared development goals is important. This paper recommends prioritizing current and future energy development as it relates to how large developing economies will impact development trends by:

- Prioritizing energy development partnerships with large developing economies;
- Encouraging private-sector input about new business ventures that can serve as models of public-private partnership; and
- Establishing linkages between technology advancement and development.

Background: Energy, Development, and Investment

Energy is critical to any modern and growing society. Energy heats, cools, and lights our homes and businesses, powers our factories, fuels our cars, and increasingly underpins the fabric of societal communication through modern technology. Governments have traditionally given priority to providing affordable and reliable energy to their constituents in order to fuel economic growth and greater societal well-being. To have a properly functioning energy sector requires combining regulatory and financial incentives to ensure adequate supplies and the necessary infrastructure to deliver those supplies to consumers. Countries around the world employ various models for enabling this type of activity with varying degrees of success. Countries differ, for instance, in the level of government control over investment, the appropriate role for the private sector, or the level of market-oriented pricing policies that can also determine private-sector interest. As the world population grows closer to the 9 billion people anticipated by the United Nations in 2050, the struggle to provide continued access to affordable energy and increase access to those who lack

energy becomes more intense. How developing countries provide adequate energy is of growing importance to their development needs, but also to how those activities impact world markets.

Rapidly emerging developing countries are the prime destination for new flows of energy investment and private-sector activity. Emerging economies are expected to make up the bulk of growth in energy demand in the coming decades. Between 2008 and 2035 non-OECD economies are expected to make up 83 percent of energy demand growth. Together, China, India, and Brazil account for 55 percent of overall growth. China is by far the biggest share, accounting for nearly 40 percent, with India and Brazil farther behind at 11 percent and 5 percent, respectively. The contours of the demand growth are shown in Annex 1.² In contrast, non-OECD demand growth in the rest of the world (outside Brazil, China, and India) accounts for 28 percent of the world total.

Meeting these energy needs requires a great deal of investment in all energy sectors and across the entire value chain. According to projections from the International Energy Agency (IEA) about \$38 trillion dollars in energy supply infrastructure will be required worldwide between 2011 and 2035—about 1.4 percent of GDP on average to 2035 (see Table 1). Nearly 63 percent of the supply-side energy investment between 2011 and 2035 will take place in non-OECD economies, with China requiring \$5.8 trillion, or 15 percent of the world total. India and Brazil comprise a smaller but still important share at \$2.2 and \$2 trillion, respectively.

Table 1. Cumulative Investment in Energy Supply Infrastructure in New Policy Scenario, 2011–2035 (\$ billion, in 2010 dollars)

| | Coal | Oil | Gas | Power | Biofuels | Total |
|-------------------------|-------|-------|--------|--------|----------|--------|
| OECD | 175 | 2,703 | 23,756 | 6,897 | 216 | 13,746 |
| Non-OECD | 934 | 7,027 | 5,661 | 9,986 | 136 | 23,744 |
| China | 647 | 510 | 638 | 3,968 | 31 | 5,794 |
| India | 87 | 203 | 266 | 1,631 | 16 | 2,203 |
| Latin America | 32 | 1,971 | 609 | 718 | 68 | 3,399 |
| Brazil | 0 | 1,379 | 165 | 404 | 61 | 2,009 |
| Interregional transport | 55 | 2,680 | 80 | - | 4 | 407 |
| World | 1,164 | 9,997 | 9,497 | 16,883 | 356 | 37,897 |

Source: IEA/OECD, *World Energy Outlook 2011*, pp. 96–98.

These figures represent only the investments necessary to create much-needed infrastructure for energy supply and not the total household or end-use expenditures (infrastructure, installation, and services) that must also take place over this period. While the vast majority of energy investment in developing countries takes place in large rapidly emerging economies and on conven-

2. Figures in this paragraph were calculated using data from EIA, *International Energy Outlook 2011*, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=IEO2011&subject=0-IEO2011&table=1-IEO2011®ion=0-0&cases=Reference-0504a_1630.

tional energy sources, the strategic focus of most U.S. government and multilateral development programs is on energy access and the promotion of clean energy.

Current Government-Led Activities and Initiatives

The international donor community currently spends about \$4 billion on energy-related development.³ Energy has long been an important area of investment for development programs because of the improved health and well-being provided by energy services, as well as the potential for increased economic activity. In recent years the development community has been increasingly driven by goals to alleviate energy poverty—those set forth by the UN Millennium Development Goals, as well as the clean-energy and climate goals driven by increasing global concern over the anticipated impacts of climate change.⁴

Energy Poverty and Access

Approximately 1.3 billion people—20 percent of the world population—lack access to electricity and nearly 2.7 billion people—40 percent of the world population—continue to rely on traditional biomass to meet their daily energy needs, such as cooking, lighting, and heating (see Table 2). Without new policies and initiatives, these numbers barely change by 2030, staying at 1 billion and 2.7 billion respectively.⁵ Nearly 84 percent of the people without access to electricity live in rural areas. This magnitude of reliance on traditional biomass is estimated to lead to 1.5 million premature deaths per year, or over 4,000 deaths per day, by 2030.

The international development community has set numerous goals to improve energy poverty around the world. For example, while there is no specific energy target in the UN Millennium Development Goals, the United Nations has declared 2012 to be the International Year of Sustainable Energy for All, and energy poverty will be a major theme at the UN Conference on Sustainable Development in Rio de Janeiro, Brazil, in June 2012.⁶ According to estimates done by the International Energy Agency, to provide universal access to modern energy services by 2030 would require cumulative investment of \$1 trillion, on average \$48 billion per year. This is less than 3 percent of projected energy investments over that period, but more than five times the level of investment in energy access on a per annum basis compared to 2009.⁷

3. This is a very difficult figure to determine because many institutions do not break out energy-specific investment from broader investment categories like climate change, economic development, and infrastructure, nor do they aggregate investment that could count as assistance. The number provided here is based on OECD overseas development assistance in the energy category (as tracked by the OECD statistics found at <http://stats.oecd.org/Index.aspx>). A more exhaustive and systematic review of energy and development spending is needed.

4. While the Millennium Development Goals (MDGs) do not explicitly focus on energy poverty and access, subsequent work has highlighted the importance of energy to achieving the broader MDGs of ending poverty and hunger and environmental sustainability. More information on the MDGs can be found at <http://www.un.org/millenniumgoals/>.

5. IEA/OECD, *World Energy Outlook 2011*.

6. For more information on both initiatives visit <http://www.sustainableenergyforall.org/> and <http://www.uncsd2012.org/rio20/>.

7. IIEA/OECD, *World Energy Outlook 2011*.

Table 2. Access to Electricity and Dependence on Traditional Biomass for Fuel in 2009
(millions)

| | Number of people lacking access to electricity | Number of people relying on the traditional use of biomass for cooking |
|-----------------------|--|--|
| Africa | 587 | 657 |
| Sub-Saharan Africa | 586 | 653 |
| Developing Asia | 676 | 1,920 |
| China | 8 | 423 |
| India | 289 | 836 |
| Other Asia | 379 | 661 |
| Latin America | 30 | 85 |
| Developing countries* | 1,314 | 2,662 |
| World** | 1,317 | 2,662 |

Source: IEA/OECD, *World Energy Outlook 2011*, pp. 478–480.

*Includes Middle East countries.

**Includes OECD and Eastern Europe/Eurasia.

While access to energy is not sufficient for development, it is one of several necessary preconditions for sustainable growth and development.⁸ Greater access to modern energy requires supportive commercial and regulatory frameworks that enable the sustainable use of affordable and reliable energy supplies. These enabling environments require the presence of other factors that contribute to sustainable economic growth and the existence of cost-effective energy resources and technologies. Cooperation among local governments, aid organizations, and the private sector is often essential to bringing the key components together and creating new opportunities for growth and development.

Governments, the United Nations, and multilateral development agencies are all involved in projects and programs to alleviate energy poverty or provide more reliable and sustained access to energy for areas that currently rely on basic biomass for cooking, lighting, and heating. Most recently, the UN declared 2012 the Year of Sustainable Energy for All, with three main goals:

- Ensure universal access to modern energy services;
- Reduce global energy intensity by 40 percent; and⁹
- Increase renewable energy use globally to 30 percent.

Member governments are all contributing to the UN agenda by looking for ways to steer their development initiatives toward these shared goals. Many of the ongoing activities in this area focus on bringing electricity to rural communities and clean cooking fuels to those using traditional biomass (Box 1).

8. C. Kirubi, A. Jacobson, D.M. Kammen, and E. Mills, “Community-based Electric Micro-grids Can Contribute to Rural Development: Evidence from Kenya,” *World Development* 37, no. 7 (2009): 1208–21, <http://rael.berkeley.edu/sites/default/files/Kirubi%202009-%20Community-Based%20Electric%20Micro-Grids%20Can%20Contribute%20Rural%20Development,%20Evidence%20from%20Kenya.pdf>.

9. Energy intensity in this context refers to the amount of energy required to generate a unit of GDP on an economy-wide basis.

Box 1. Role of Private Sector in Addressing Energy Poverty and Access

The private sector is involved through a variety of public–private partnerships at the regional, bilateral, and global development assistance level. Two notable partnerships focus on creating market opportunities for the private sector on the electric power and clean cooking fuel sectors.

Global Sustainable Electricity Partnership (E8)—A nonprofit international organization, made up of major electricity companies from around the world. The group's mission is to provide input on global electricity within the international framework and to promote sustainable energy development through projects in the electricity sector, as well as human capacity building in developing and emerging nations worldwide.*

Global Alliance for Clean Cookstoves—Public-private initiatives launched by the UN Development Programme and ample support from the U.S. government with the goal to “save lives, improve livelihoods, empower women, and combat climate change by creating a thriving global market for clean and efficient household cooking solutions.”*

* For more information on these initiatives, visit www.globalelectricity.org and www.cleancookstoves.org.

Energy, Development, and Climate Change

A recent trend within international energy development is to ensure that objectives and projects simultaneously advance economic growth while also (1) not contributing to global climate change and (2) helping to build societies that are more resilient to the impacts of climate change. Development that mitigates the impact of economic growth on climate includes placing a priority on clean energy technology (energy sources that do not emit high level of greenhouse gases, most notably carbon dioxide) and improving land-use and forestry practices. For building climate-resilient societies, on the other hand, development aid goes toward building economic activities that contribute to industries, infrastructure, and technology that will help make the most vulnerable societies better able to adapt to a changing environment. Many development institutions adopted an approach to make sure that all development assistance took climate change into consideration (rather than massively reprogramming funds toward climate-specific initiatives).

This strategy has, however, had an impact on the development communities' perspective on funding carbon-based energy projects (oil, coal, or natural gas), which are typically less expensive than low-carbon energy alternatives.¹⁰ (See Box 2.) The United States has done so through launching the Global Climate Change Initiative, whereas major development banks are developing or have already released development plans that include development goals with clean energy or climate change in mind. This strategic shift has been highly controversial. Many in the development community believe that spending funds on more expensive energy projects is a poor use of resources. Others believe that investing in energy sources that exacerbate climate change merely replaces one development challenge today with challenges down the road for which society is

10. See Catherine Mitchell et al., “Policy, Financing and Implementation,” in *Renewable Energy Sources and Climate Change Mitigation: Special Report of the Intergovernmental Panel on Climate Change*, ed. Ottmar Edenhofer et al. (New York: Cambridge University Press, 2012), http://srren.ipcc-wg3.de/report/IPCC_SR-REN_Full_Report.pdf.

Box 2. World Bank's Controversial Energy Strategy

In 2009, the World Bank embarked on creating an internal strategy guide to investing in energy. Creating the strategy included preparing technical support papers and consultations with external and donor countries. The strategy included the following three goals:

1. Expand energy access to between 65 million and 80 million people by 2020;
2. Increase the share of clean energy projects in its energy-lending portfolio to at least 75 percent by 2015; and
3. Eliminate lending for constructing new coal-fired power plants in middle-income countries.

The controversy stems from the third goal and, perhaps by extension, the prioritization of so-called clean energy. Many developing countries asserted that developed countries were wasting limited resources by spending them on more expensive clean-energy projects. The Bank tried to work out a method for determining how to navigate this divide, but in the end the controversy was so great that the strategy has not been released.

woefully unprepared. This development-focused financing does help bolster the market for clean-energy technologies and, perhaps more importantly, develop innovative strategies and applications especially in distributed generation.

Much of this trend was predicated on the belief that significant increases in international financing would be available to assist developing countries close the cost gap between higher-priced clean energy resources and conventional energy sources. Within global climate negotiations there has been a widespread push for developing countries to include strategies for both adaptation to and mitigation of global climate change. For many countries this means making sure that low-cost development of high-carbon and often less expensive fuels does not prevail over clean-energy technologies and sources. To support these efforts, the international community (both public and private sector) was to deliver significant new funds for developing countries to adjust. The future for large funding of clean-energy projects is uncertain. Despite a pledge of \$30 billion in “fast-start financing” between 2010 and 2012 and \$100 billion per year by 2020, only about a third of the actual money has materialized and the task of achieving the longer-term financing goal seems increasingly unlikely (Box 3). International development banks and major developed economies have, nonetheless, tried to steer existing funding toward meeting climate-friendly development goals.

Box 3. The Promise of Climate Finance

Estimates of how much additional investment is needed to cover the incremental cost of low-carbon energy technologies and funds for adapting to climate change in developing countries vary widely, with no one accepted view. The climate-change negotiations in Copenhagen, Denmark, in 2010 reached a political agreement for developed economies to deliver \$30 billion in fast-start climate financing between 2010 and 2012 and \$100 billion per year by 2020. The longer-term financing goal is subject to a great deal of deliberation and disagreement as negotiators work to resolve details of how to raise this money, what mixture of private versus public funds to include, how to spend the funds (the mechanisms, decisionmaking authority, categories of funding, prioritization of recipient countries and categories, etc), and how to ensure accountability and transparency. The first part of this dilemma, where the money will come from, seems the most daunting—generating enough revenue seems more and more unlikely, and without funds there is little sense arguing about the other details.

Meanwhile, even the fast-start financing has proven controversial, with many developing countries accusing developed countries of not fulfilling their commitments. A recent report by Bloomberg New Energy Finance estimated that countries have pledged \$27.3 billion of the \$30 billion target, but estimates are that only \$11.3 has actual been delivered. In addition, not all of the money has been new (instead, existing or reprogrammed funds were used) and most of the funds have gone to nonforestry-related mitigation (as opposed to adaptation).^{*} These shortfalls have caused controversy and tension among negotiating countries and eroded confidence in the ability to deliver on the arguably more important and more complicated longer-term financing promises.

^{*} Bloomberg New Energy Finance, “Have Developed Nations Broken Their Promise on \$30 Billion ‘Fast-Start’ Finance?” White Paper, September 5, 2011.

Impact of Energy Investment in Rapidly Emerging Developing Economies

Rapidly emerging developing economies craft their economic growth, societal development, and energy strategies based on factors that balance their political and economic structures and aspirations and the evolving needs of growing and changing populations. Brazil, China, and India are widely recognized as some of the largest, fastest growing developing economies in the world. Their relative economic size, recent growth trends, and future growth potential have put them at the forefront for strategic analysis in a variety of areas, such as international politics, global economic trends, and regional and international security, among many others. These countries have been particularly influential in current energy markets and also in shaping beliefs about future energy trends. A key question for any long-range analysis of energy and development trends is whether or not these countries follow traditional energy and development pathways experienced by today’s developed economies.

Several key areas of energy and development policymaking in these countries stand out as being potentially different from the priorities of today’s developed country during the current stage of development in rapidly emerging economies. These themes include a focus on environmental sustainability, requirements to include local content, concern over energy security, a desire

to reduce local pollution and associated health effects, and long-range strategic plans to develop their own technologies and increase their standing as providers of value-added goods and services and eventually sources of innovation. Table 3 summarizes the headline energy and development priorities in China, India, and Brazil.

■ ***Reshaping energy markets through demand***

Large developing countries like Brazil, India, and China are large enough energy consumers to significantly impact global and regional energy markets. China, the largest of the three economies by far, is now arguably the global or regional marginal price setter in oil, coal, and natural gas markets. For example, surges in Chinese oil demand have played a large role in run-ups in oil price since 2004—both extremely large and sustained, and more constrained and temporary price spikes. Most recently, the drive to close down old and inefficient coal-fired power plants by the end of 2010 in accordance with the 11th Five-Year Plan caused an unexpected increase in global oil demand as diesel fuel replaced coal-based generation toward the end of the year. Chinese energy demand has similar effects in Asian natural gas markets—now the highest price natural gas in the world—and coal markets, which are so tight in Asia that U.S. coal producers have been exporting coal to help fill demand, raising coal prices in the United States.

Table 3. Headline Energy and Development Policies and Priorities*

| China | India | Brazil |
|---|---|---|
| Energy-intensity reduction targets | Measures to increase energy access | Carbon emissions reduction targets |
| Carbon-intensity reduction targets | Carbon-intensity reduction targets | Energy-efficiency targets |
| Energy-efficiency policies (industry, buildings, vehicles, and others) | Energy-efficiency incentives, standards, and pilot trading system | Biofuels expansion, both domestic and international |
| Non-fossil fuel share of overall consumption targets | Solar targets (solar mission) | Pre-salt and other offshore oil and gas development |
| Hydro, nuclear, solar, wind, and gas targets | Levy on coal to fund national clean energy fund | Renewables targets in context of power generation diversification |
| Extension of ultra-high-voltage transmission lines and grid connections | Renewable energy standards and incentives | Energy R&D support |
| High-speed rail and alternative fuel vehicle targets | Oil and gas domestic production and import objectives | |
| Oil and gas domestic production and import objectives | International natural-resource investment | |
| International natural-resource investment | Energy R&D support | |
| energy R&D support | | |

* This table is not exhaustive, nor does it describe in detail the policies and implementation mechanisms or evaluate success. It is meant to illustrate priorities and, in some cases, desired outcomes and drivers.

India's impact on global oil markets is much less extreme than China's but, in the coming decades, will be just as great as its economy continues to grow and its population increases much more rapidly. India is also a major energy importer, with demand needs already shaping regional trade and energy. Similarly, Brazil's economy shapes a great deal of regional energy trade and investment in Latin America (though regional energy integration is a continuing challenge). Brazil has the added benefit of vast natural resources (biomass, oil, natural gas, and others) that might surpass the current needs of its population, traditionally giving them considerable flexibility.

The ability of these countries to shape energy markets might impact the options for lesser-developed economies. For example, demand for oil has driven the price and availability of oil for power generation or transportation beyond affordability for other developing economies. Countries dependent on oil imports suffer economic consequences as oil prices drive ever higher and volatility is the norm. These countries, in turn, look to development agencies to find and support alternative sources of energy to meet their needs. As demand for coal and natural gas increases, some regions will be at least temporarily constrained for resources, causing the same problem.

On the other hand, China, India, and Brazil are increasingly important markets for renewable energy as well. Brazil is already the second-largest ethanol producer in the world and deserves a great deal of credit for advancing models of biomass for power generation and biofuels for transportation as viable commercial alternatives to conventional hydrocarbon-based fuels. As of 2009, China has been the largest investment destination for renewable energy and energy efficiency in the world for two years running.¹¹ For these much smaller markets of renewable energy, this growth is important for sustaining and advancing the viability of the technologies and companies that bring these energy resources to bear. As will be explored further in the next section, vibrant markets for these resources drive down the cost of technologies, create new models for deployment, and extend their reach into more countries.

■ ***Driving down cost of technologies***

Large developing economies have played a role in driving down the cost of energy technologies. China is the most notable example, as its ability to “localize” technologies and mass-produce them quickly and cheaply has been applied, as a matter of policy, across a variety of energy technologies. Key examples of this include Chinese production of super-critical and ultra-super-critical coal-fired power plants, nuclear power plants, wind power turbines, solar photovoltaic systems, and others.¹² Notably, China has been widely criticized by both industry and government for some of its policies and practices involved in “localization,” as well as the ultimate quality of the technology it produces. This ability to reduce the cost of the technol-

11. Angus McCrone et al., *Global Trends in Renewable Energy Investment 2011* (Nairobi: UN Environment Programme), <http://www.fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2011>.

12. Xiaomei Tan and Deborah Seligsohn, *Scaling Up Low-Carbon Technology Deployment: Lessons from China* (Washington, D.C.: World Resources Institute, 2010), http://pdf.wri.org/scaling_up_low_carbon_technology_deployment.pdf; UN Environment Programme, “Global Investments in Green Energy Up Nearly a Third to \$211 billion,” <http://bnef.com/PressReleases/view/158>; Presentation by Kate Jackson, senior vice president and chief technology officer for Westinghouse Electric Company, “Energy Opportunities and Challenges: Clean Energy, Nuclear Energy,” http://csis.org/files/attachments/102610_KJackson_0.pdf, at CSIS event on Implications of a Secure, Low-Carbon Pathway in China, October 26, 2010.

ogy, however, has been transformative for energy deployment in China and for certain energy markets. Solar photovoltaic, for example, has experienced one of the most rapid growths in history due to the combination of strong market-pull incentives (like feed-in-tariffs in Europe, particularly Germany), a well-supplied polysilicon market, and the reduction of costs achieved by Chinese manufacturers due to the Chinese government incentives to produce and export solar panels.

The key to deployment of renewable and other advanced energy technologies to a wider range of developing economies is bringing down the cost (in addition to providing the proper commercial investment frameworks). To the extent that large developing countries serve as key drivers toward reducing technology costs, and to the extent those cost reductions can be exported or duplicated elsewhere, it will create greater opportunities for other developing economies.

■ *Introducing new models of energy systems*

Brazil has the longest-standing example of an alternative energy model that continues to be of great interest, although hard to duplicate, in many parts of the world. Brazil's experience growing a domestic transportation system that fully incorporates biofuels and petroleum-based fuels is an impressive story of cooperation among the government, industry, and civil society, driven by a concern over growing reliance on imported oil and a recognition of the country's vast biomass resources. Today Brazil is the second-largest ethanol producer in the world, all gasoline in Brazil contains 20 percent to 25 percent ethanol, and nearly half of the cars in Brazil are flex-fuel vehicles (capable of running on 100 percent ethanol or a blend of ethanol and gasoline).¹³ Brazilian facilities for ethanol production continue to be some of the most efficient in the world, able to use the sugarcane waste for power generation and to switch between production of sugar or ethanol based on market conditions. A combination of Brazil's unique climate, its long-sustained policy incentives, and the unique level of coordination among key private-sector elements, like the state-run oil company Petrobras, car companies, and ethanol producers, has made Brazil's biofuels program hard to duplicate. However, its success can also largely be credited for the impetus of many other biofuel policies around the world.

India also provides several examples of how the development needs and priorities are driving new business ventures and models supported by government policies and microfinance. One of the big challenges for bringing electric power to rural communities in India is the lack of cost-effective ways of extending grid connections to the communities or providing viable utility-scale power generation given the smallness of the market. Many of these communities traditionally focus on costly and heavily subsidized diesel power generation. Recently, companies have experienced some success with distributed power generation, using either solar water heaters or biomass gasification plants to service households, industries, or rural communities.¹⁴ This proliferation of off-grid energy companies is driven by indigenous entrepreneurial opportunities, government support through grants, corporate strategies for social responsibility, multilateral development assistance, access to microfinance, and identification of new technology and market opportunities. In one example, telecommunications growth in India is very

13. U.S. Energy Information Administration (EIA), "Brazil Country Analysis Brief," January 2011, <http://www.eia.gov/countries/cab.cfm?fips=BR>.

14. Conversation with Bharat Bhushan Agrawal, Bloomberg New Energy Finance, on September 15, 2011.

strong, and the need for consistent and reliable electric power to run telecommunications towers is key (India currently has a 12 percent deficit in electric power, with most towers relying on diesel back-ups to cover for the shortfall). Industry is now pressuring the government to provide incentives to cover the up-front incremental cost of solar photovoltaic units on towers to provide a longer-term solution. According to some estimates, the solar photovoltaic units are now cost-competitive to diesel generation in some places.¹⁵

While these new models require specific circumstances or government support, they are models for development in other communities that are being duplicated where possible. It is important to keep track of when new models or business ventures take place and study the enabling environment and the potential for repeat or improved deployment in other contexts.

■ *Financing their own development and technology export*

South-south financial flows—money going from developing countries (rather than from developed countries) to developing countries—are having a large impact on development financing. Between 2009 and 2010 China’s two largest development banks invested more money in other developing countries than the World Bank.¹⁶ Other major developing economies, like Brazil, Russia, and India, have spent less money, but they have fast-developing investment strategies for many resource-rich parts of the world—Africa being a particular focus for both China and Brazil, though their investment portfolios differ dramatically.

For China, one of the main drivers of its strategy of foreign investment is the country’s growing demand for a wide variety of natural resources, including energy. Thus, one of the most notable and widely studied trends in Chinese foreign investment has been its acquisition of natural resources in other countries. These acquisitions have been accomplished through direct investment, purchases of assets, or a combination of government guarantees in exchange for development assistance or infrastructure investment in countries where the state plays a strong role in the natural-resource and energy sectors. Proponents of this trend view additional Chinese investment as a much-needed influx of capital to meet the growing demands of society and a smart idea for an ever-increasingly resource-dependent China. Critics of this trend are concerned about the countries in which China chooses to invest (some of them subject to sanctions, such as Iran, or politically complicated places like Sudan), where developed countries try to manage the balance between their diplomatic or foreign-policy goals and commercial investments. India and Brazil also exploit international energy resources but do not employ the same type and scale of strategy that China has and therefore avoid much of the controversy. Brazil, China, and India also seek to build markets for their domestically created energy technologies and services.

Recommendations

The trends in energy development among rapidly emerging economies do not conclusively point to one specific program or set of programs that the U.S. government or international donor community should create or dismantle in order to increase its overall effectiveness. Instead, the clear message from exploring these trends is the need to strategically refocus on the powerful actors and interesting new opportunities that should be harnessed to make the most of global energy and

15. Ibid.

16. Tan and Seligsohn, *Scaling Up Low-Carbon Technology Deployment*.

development potential. In many ways, the U.S. and international development programs, and certainly the international energy community, are aware of the important impact of major emerging developing countries on global energy markets. But it is not always as clear what to do about the emergent trends in terms of altering development priorities or strategies. The U.S. government has recently been very consistent in prioritizing engagement with these countries to ensure complementary energy policy priorities—development of low-carbon sources, energy efficiency, energy security, and so forth. Three key recommendations aim to prioritize existing and future activities as they relate to the impact that large developing economies will have on development trends.

1. Prioritize Development Partnerships with Large Developing Countries

Major developing economies like Brazil, China, and India (and possibly others) should be regarded as partners in global efforts to develop energy. Their domestic and international energy and development policies are at least as influential as U.S. policies and activities. The partnership should include aligning development priorities and coordinating mechanisms for technology sharing. USAID recently started this type of engagement with China on a broader basis, although its strategy is still being developed and it is too early to determine success. The United States and other developed donor countries should find ways to build on their experience in the development sector, as well as learn from the new approaches and models employed by these countries. Also, they should harness the new enthusiasm, capital, perspective, and expertise being brought to bear by these countries.

2. Encourage Private-Sector Input on New Business Ventures

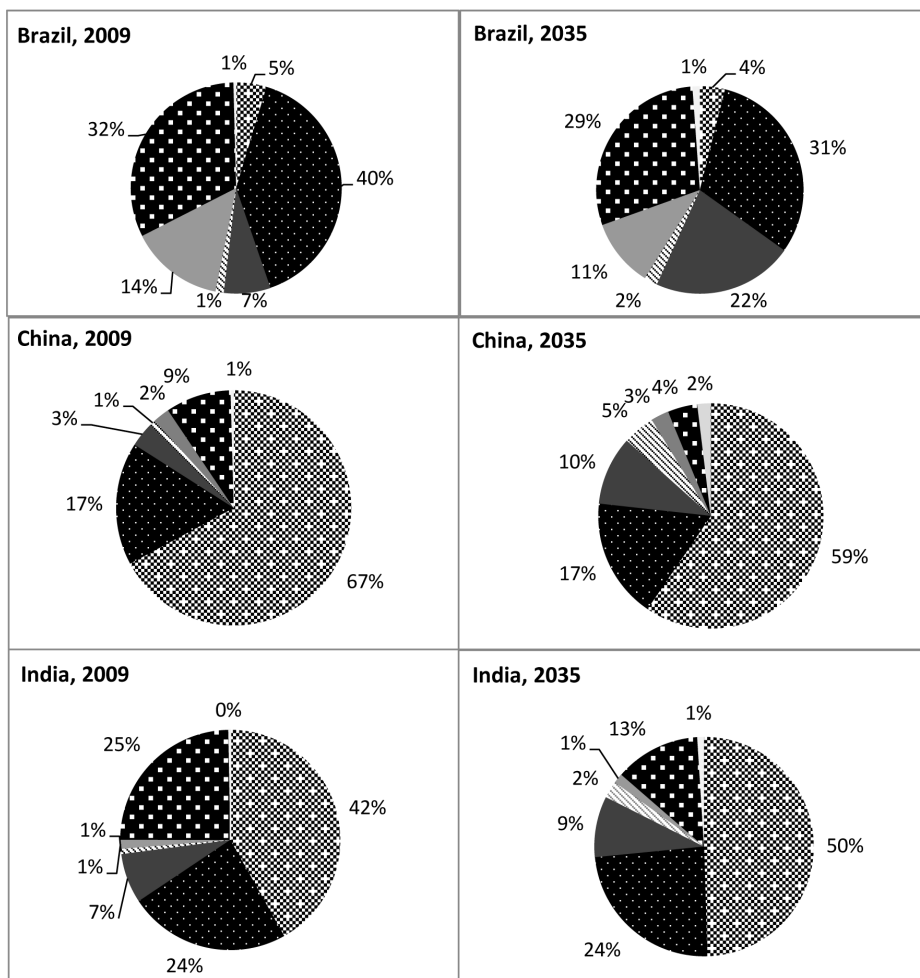
Clearly the private sector, in cooperation with state-run energy agencies and companies, will remain the major investors in energy development around the world. More of this investment should be driven to places where development needs are most acute. To that end, understanding the ever-evolving landscape in which these private-sector enterprises are working is important, as is understanding how to adjust projects, policies, incentives, and initiatives to keep pace with the new business realities and cultivate new ventures. In some instances, less definitional rigidity in some development goals may be necessary, along with more strategic insights about where investments can and should be made for greatest impact.

3. Establish Linkages between Technology Advancement and Development

New and improved energy technologies are emerging all the time, with clear global economic, environmental, and social benefits. In the energy sector, technology development is critical to ensuring the most efficient and effective use of increasingly scarce energy and other natural resources. Global technology development and deployment have a mixed record of success but, in some circumstances, are worth further exploration. Removing barriers to technology trade and acquisition and ensuring the proper commercial frameworks for their adoption remain critically important to growing opportunities for these markets.

ANNEX

Contours of Demand Growth by Fuel for Brazil, China, and India, 2009 and 2035
 (Figures based on International Energy Agency's *World Energy Outlook 2011* Current Policy Scenario)



Note: this table is not exhaustive, nor does it describe in detail the policies and implementation mechanisms or evaluate success. It is meant to illustrate priorities and, in some cases, desired outcomes and drivers.





ABOUT THE AUTHOR

Sarah Ladislaw is a senior fellow in the Energy and National Security Program at CSIS, where she concentrates on global climate change issues, energy and geopolitics in the Western Hemisphere, energy security, renewable energy technology, and sustainable development. She manages several of the program's activities on secure, low-carbon pathways, focusing mainly on the United States, Europe, and Asia. She also managed the CSIS end of a partnership on energy security and climate change with the World Resources Institute. She was involved with CSIS's work on the geopolitics portion of the National Petroleum Council's 2007 study and the CSIS Smart Power Commission in 2008, focusing particularly on energy security and climate issues. Her current focus is on the geopolitics of clean energy (renewable, nuclear, and natural gas), energy trends in China, geopolitics of energy in Latin America, U.S. energy and climate change policy, the private-sector role in energy and development, and carbon management strategies and technologies. She is also an adjunct professor teaching an energy security course at the George Washington University's graduate program in international affairs.

Prior to joining CSIS in 2007, Ladislaw was with the U.S. Department of Energy focusing on energy relations with Canada, Mexico, Brazil, Colombia, Venezuela, as well as other Western Hemisphere energy issues.

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INTERNATIONAL STUDIES

1800 K Street, NW | Washington, DC 20006
Tel: (202) 887-0200 | Fax: (202) 775-3199
E-mail: books@csis.org | Web: www.csis.org

