Clean Energy in Asia: Challenges and Opportunities for the United States

Joanna I. Lewis, Ph.D.
Associate Professor, Science Technology and International Affairs Program
Edmund A. Walsh School of Foreign Service
Georgetown University

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The Role of Renewable Energy in Meeting 21st Century Energy Demand in Asia

Developing countries are the engine for growth in energy demand in the 21st century. India, China and Southeast Asia together account for 60% of the projected future energy demand globally through 2040.[1] While China has been the driver of global growth of the past two decades, due to the rapid economic and population growth expected across Southeast Asia, its projected growth in energy demand will be twice as large as China's over the next two decades, representing one-tenth of the rise in global demand.[2]

Growing global energy demand will require significant investments in new energy infrastructure, and most of this investment will be in renewable energy. Around $7.8 trillion is projected to be invested in renewable power worldwide through 2040 in technologies including onshore and offshore wind; utility-scale, rooftop and distributed solar; and hydropower. Renewable energy in fact comprises the bulk of the investment that is projected to be spent across the entire power sector, compared with $2.1 trillion to be invested in fossil fuels, mainly in emerging economies.[3] BP projects that two-thirds of new power generation will come from renewables over the next two decades.[4] Developing economies committed $177 billion to renewables last year, up 20% from the prior year; this is even larger than the $103 billion in developed countries, where investment was actually down 19%.[5] Last year marked the largest shift towards renewable energy investment in developing countries that we have seen yet. In the Indo-Pacific alone, investment totaled $168.9 billion.[6]

The directions that Asia's energy growth takes are driven by a variety of national and regional concerns including economic development and job creation, energy security, electricity access, air quality and public health, and climate change mitigation. Asia's energy future will be both green and brown. Asia will make up half of global growth in natural gas, 60% of the rise in wind and solar photovoltaics, more than 80% of the increase in oil, and more than 100% of the growth in coal and nuclear.[7]

In Southeast Asia in particular, renewable energy is expected to play an increasingly important role. The declining cost of renewables globally also presents new options for off-grid

applications, which can increase energy access and reduce reliance on costly diesel generators in remote areas. The International Energy Agency (IEA) projects that by 2040 renewables will account for the largest share of installed capacity in Southeast Asia at around 40%, but will still lag behind coal in terms of share of total electricity generation.[8] Even high efficiency supercritical or ultra-supercritical coal plants will put these countries on a high carbon energy development pathway. But if its growing economies continue to rely on fossil fuels and do not leapfrog to advanced, cleaner technologies, emerging Asia will lock in a commitment to future carbon emissions that will crush global climate efforts. As we have been warned by the most recent IPCC report, power generation systems will need to reach net zero carbon emissions around 2050 to stabilize global emissions and avoid the most dangerous climate impacts.[9] While much focus has rightfully been on China's power system as the largest source of current emissions, for plants that are in the pipeline (meaning planned but not yet built), other developing countries, particularly throughout emerging Asia, will be far a more important source of emissions in the coming decades.

Opportunities to Shape Asia's Clean Energy Future

There are two key opportunities to shape Asia's clean energy future: (1) by shaping the source and nature of investments in Asia's growing energy infrastructure, and (2) by shaping the types of energy technologies that are deployed. Currently, the country playing the biggest role in shaping the energy future of its Asian neighbors, is China.

China has emerged as the largest single provider of overseas infrastructure investment in the world, and particularly in Asia. Many of these investments are motivated by China's Belt and Road Initiative (BRI). China does not provide official numbers for outbound energy infrastructure investments, but estimates suggest that, since 2000, China's two state-run policy banks (the China Development Bank and the China Export-Import Bank) may have provided between $150-250 billion in global energy infrastructure financing, of which approximately half stayed within Asia.[10] An increasing amount of that funding is being directed toward Southeast Asia to meet the region's growing infrastructure needs, including energy infrastructure.

China has been dominating the sales of coal plants abroad since the early 2000s. While China actually exports far more solar panels around the world than any other country, this deployment is not evenly distributed across the world.[11] Developing countries tend to want coal plants, not just because they are being sold inexpensively, but because they represent a tried and true model of development that they want to replicate. The vision for technology leapfrogging is like the model we saw in cell phones, where many developing countries leapfrogged over the use of landlines and straight towards mobile phones, allowing access to the internet and financial services even in remote locations. In clean energy this is not always being achieved, because the countries that industrialized first and are already transitioning to clean energy technologies still want to export their polluting technologies elsewhere. For example, we see that even China, still the largest coal user in the world, has put in place very stringent environmental regulations to reduce domestic air pollution, and has established the world's largest carbon market. As a result, there are reports that they are shutting down some of their dirtier, less efficient coal plants before end of their useful life, and exporting these dismantled plants to countries in Southeast Asia.

China is not alone in financing coal-fired power plants overseas. Japanese, Korean, French, and German banks are currently the major sources of finance for coal-fired power plants around the world, but China is beginning to catch up with and will potentially surpass Japan as the region's largest foreign direct investor and component provider.[12] One study estimates that Chinese firms are involved in the construction, ownership, or financing of at least 16% of all coal-fired power stations under development outside China.[13] Chinese energy companies have strong national support and domestic policies that favor them and their overseas investments; they can outbid competitors and provide power plant projects at a lower cost. This access to cheaper labor, materials, and financing has helped China become a leading investor in overseas coal plant development. Of all the power capacity additions in Asia involving Chinese corporations, 68 percent of operating capacity and 77 percent of under-construction capacity is in coal.[14] Most of this coal power finance is concentrated in South Asia and Southeast Asia, with the largest markets in India, Indonesia, and Vietnam.[15]

This goes against the vision for a clean energy figure that many governments are putting forward. For example, many emerging Asian countries have pledged aggressive renewable energy targets as part of their Paris Agreement commitments that if met could lead to many gigawatts of renewable power being built in these countries. [16] In addition, there are significant risks to an extensive reliance on coal given the rising environmental and social costs. Around the world, coal plants are increasingly at risk of becoming stranded assets and a frequent target of public protests.[17] Despite the risks, Chinese coal plant development is on a growth trajectory due to the pull from poorer nations that seek the cheapest options for energy finance, as well as the desire for Chinese companies to expand their markets overseas.

In contrast, almost all of the multilateral development banks have been restricting coal plant investments due to environmental concerns. The World Bank pledged in 2010 to stop investments in coal, and more recently in oil and gas as well. The Asian Development Bank (ADB) has not funded any coal plants since 2013. Even the China-led Asia Infrastructure Investment Bank (AIIB) has an aggressive energy sector strategy guiding its investments with very restrictive language about supporting coal and oil investments.

It is clear from the trends described above that the source of investment matters in shaping energy technology decisions. And a lack of American investment will leave these technology decisions to China, Japan, and others in the region.

Challenges and Opportunities for U.S. Companies

There are major opportunities to expand U.S. involvement in both technology and investment decisions in emerging Asia. To understand these opportunities, we must understand the political economy of low carbon technology development.

Now a $332 billion-dollar industry globally, the political economy of renewable energy around the world is becoming increasingly consistent.[18] Many countries have identified renewable energy as a strategic industry for promoting economic development.[19] Because the social benefit

of reducing greenhouse gas emissions is not generally reflected in cost structures, the deployment of socially desirable technologies is not always immediately economically profitable. As a result, governments use policy tools to adjust relative prices to encourage the adoption of alternative energy technologies through subsidies or other forms of public support. [20]

To garner such support, the political rationale for renewable energy, namely carbon mitigation, is increasingly being directly linked to the economic rationale, namely job creation and technological leadership. While the carbon mitigation benefits of renewable energy may be global, economic development impacts are a benefit of renewable energy utilization that can be captured locally. For governments to justify extending the costs associated with renewable energy to ratepayers they must also make the case for other direct economic benefits from promoting renewables, such as job creation and long-term economic competitiveness. As a result, countries have increasingly been using protectionist policies to encourage domestic manufacturing for renewable energy and raise barriers to foreign entry into domestic markets. Not all countries are well positioned to become competitive exporters of the same green technologies, but if industrial policies can help create competitive domestic manufacturers, there may be direct domestic economic benefits. There may be global benefits as well; new market entrants can lead to more competition in the sector, and encourage further technological innovation.[21]

Governments around the world have prioritized the development of renewable energy technologies with a range of policies and incentives. As the manufacturing and use of these technologies has grown rapidly in recent years, national leaders have shifted. The emergence of several rapidly industrializing economies in these industries has led to an increasingly globalized supply chain, and consequently an increase in the international trade of renewable energy technologies. It is therefore not surprising that trade-related disputes have also increased, both via the World Trade Organization (WTO) and domestic trade remedy channels. [22]

Perhaps no country has used industrial policy to promote renewable energy as effectively, and as controversially, as China.[23] China's policies to promote renewable energy have long included mandates and incentives to support the development of domestic technologies and industries. While some elements of these policies, such as local content requirements, are unduly protectionist, others are far less controversial, such as R&D support, technology certification and quality control programs, and fiscal or other tax-related incentives. The Chinese government has identified several renewable energy industries as strategic national priorities for science and technology (S&T) investment, and established a constant and increasing stream of government support for R&D and technology demonstration. Other forms of industry support have been given through more informal channels, such as low interest loans or other favorable loan terms given by central and local governments and state-controlled banks, low-cost land grants, or expedited permitting.

China's renewable energy growth over the past decade has been extremely impressive, particularly considering many of the challenges the country faces in this sector. Much of the country has mediocre renewable energy resources, and the geographic distribution of these resources is not well matched with where demand is located. Energy technology that has primarily been domestically developed has far less demonstration experience than that of other

countries, and in many cases is still struggling to catch up to the technological performance achievements of comparable technology made by other countries. In addition, renewable energy project siting has frequently been inefficient, resulting in lower capacity factors. Inexperienced operation and maintenance (O&M) and poor forecasting only increases obstacles to achieving high-performance renewable energy facilities.[24]

While renewable energy has been growing quite rapidly over the last decade in China, key technologies are facing serious obstacles. Continued curtailment of wind and solar power and consolidation among technology manufacturers has affected the growth of the industry. While widespread curtailment of wind and solar power is in part a technical issue driven by insufficient peak capacity, distribution congestion and transmission capacity limits, political and institutional factors play an even larger role. Curtailment is also caused by the incentive structure created by fragmented transmission authorities and local taxation structures, as well as the way electricity is priced in a still predominately state-regulated power sector. [25]

There has been a lot of attention rightfully placed on intellectual property theft by China, and at least one high profile case related to IP theft in China's wind power sector. However, research supports the finding that most of the IPR that Chinese companies have acquired in the clean energy space has been obtained legally. Most studies of the Chinese wind and solar industries have not found any significant obstacles to accessing advanced technologies and intellectual property through licensing, mergers, or research partnerships with foreign firms. There have been some examples of foreign firms not wanting to give up key elements of their proprietary technology due to concerns about IP protection and competition, most prevalently in the wind industry, but also in the solar industry particularly for second generation technologies. There have not been any major barriers to increasing manufacturing scale locally due to China's strong manufacturing base and skilled workforce. [26]

The larger challenge for China has been the development of a healthy innovation system that provides multiple layers of support for innovative activity including by fostering access to global learning networks. The tension between the state-led push for indigenous or independent innovation and the needs of Chinese firms to catch-up to global counterparts using international collaborations in innovation has to some extent hurt Chinese firms. In addition, protectionism and barriers to market entry and to trade by foreign technology firms are still widespread, and it is unlikely this will change. This prevents innovation that can happen through international collaborations, as well as through competition. This is one reason that many Chinese solar firms and increasingly wind firms have developed R&D centers abroad. [27]

If China's first major clean energy technology successes were in wind and solar, their next big success is poised to be in energy storage. Energy storage technologies represent a $620 billion investment opportunity over the next two decades.[28] While China is still in the early stages of energy storage deployment and utilization, its companies are already among the world's top energy storage technology manufacturers.[29] At the end of 2017, the Chinese government released a 10-year plan for developing a domestic energy storage industry for two key purposes: (1) to support battery manufacturing for its already massive electric vehicle manufacturing enterprise; and 2) to help with the serious grid challenges related to integrating substantial amounts of wind and solar power into the grid.[30]

It is projected that energy storage deployments will grow thirteenfold over the next six years. Last year's deployments already made up more than half of the total amount of storage deployed in the past five years. This growth likely will be concentrated in the United States and China, which together are projected to account for over half of global deployments by 2024.[31] In the United States, the States are currently taking the primary leadership role in supporting energy storage deployment, with California, New York and Massachusetts all having mandates. Big U.S. utility-scale solar projects are also adopting storage, including projects in Hawaii, Texas, Minnesota and Colorado.

But China is becoming the market to watch. It has made bold commitments for electric vehicles that are driving its dominance in battery technologies. Its 2018 New Energy Vehicle (NEV) mandate includes a target for 4.6 million electric vehicles by 2020, and a plan to eventually ban cars with traditional internal combustion engines. This single policy has had ripple effects across the globe. Within 48 hours of China's announcing this target, General Motors and Ford announced major electric vehicle initiatives.[32] This is a great example of how a strong, clear policy signal can push businesses to drive technology deployment efforts even further, leading to what has been called an "ambition loop."[33] Government leaders likewise should build on corporate commitments and implement policies and targets that will further incentivize these efforts.

The United States should not stand by and let China use its state-directed industrial policy to dominate the energy technologies of the future. As one Detroit publication states, "The U.S. auto industry risks becoming an isolated technical backwater while China surges into the global lead in a technology its government has targeted as a key to leadership for the 21st Century."[34] The market for electric vehicles, batteries and other energy storage applications is massive, and the opportunities for American technology companies and investors are significant. Tesla is completing construction on its third "Gigafactory" in Shanghai. (Gigafactory 1 is in Reno, Nevada; Gigafactory 2 in Buffalo, New York.) The massive electric car production facility was constructed in months in the middle of a muddy field. Many in the United States called Tesla's two-year timeframe from construction to production in Shanghai not feasible, but it looks like they will meet this schedule. [35] China can use state intervention to make things move quickly. And they obviously saw a major opportunity from being the first Tesla factory outside the United States.

Recommendations for U.S. Policy and Engagement in the Region

The transition to a low carbon economy is already underway, and the United States is currently a leader in the development of the next generation of energy technology industries. American companies are leading the world in making solar photovoltaics cheaper with more efficient materials as well as flexible solar cells; in developing advanced biochemical and renewable fuels; in developing solar thermal technologies to operate conventional steam turbines; and in developing smart grid technologies to allow for intelligent energy systems that can shift and reduce demand.[36] We are leading in developing efficient building materials, lighting, and energy management software. We are also leading in the soft, technical skills needed to plan for and

design low carbon energy systems. These industries are creating domestic jobs, and are generating new innovation with spillover effects across the economy.[37]

For all countries, the transition to cleaner sources of energy is not just about climate change; this transition will lead to the creation of new, globally competitive industries. For all countries, the low carbon transition is an economic issue, a competitiveness issue, and a public health issue—not "just" an environmental issue. And this transition does not have to come at the expense of economic growth. As global carbon emissions growth slows, economic growth has increased. In the United States, air quality has improved dramatically over the past two decades, even as the economy has expanded. [38]

Now is the time to double down on programs that are accelerating the clean energy transition, ensuring we do not fall behind in innovating the core technologies of the future. The U.S. government has established several sophisticated programs that are directly supporting U.S. energy entrepreneurs. Programs like the Advanced Research Projects Agency (ARPA–E) and Cyclotron Road target early-stage, high-impact energy technologies with the potential to radically improve economic prosperity, national security, and environmental well-being.[39] These innovative programs are being emulated by many other countries around the world. At the subnational level, many U.S. states have been promoting aggressive clean energy policies and developing smarter, more efficient ways to manage power systems. These incentives are creating new job opportunities ranging from installation and manufacturing jobs to high tech jobs. In California, employment in advanced energy technologies grew six times faster than overall employment growth last year.[40]

The United States has been engaging with numerous Indo-Pacific nations on clean energy, natural resources, and climate change; engagement with some countries including China and India spans several decades. In many cases, this engagement has directly benefited U.S. companies, and led to fruitful technology partnerships with researchers at U.S. universities and national laboratories.[41] This cooperation has also played a crucial role in expanding global action on energy and climate change.

In addition, global linkages can spur innovation. The United States benefits from collaboration with other countries, including China: the largest clean energy market in the world. Should the United States decrease its involvement in such efforts, it risks its own technology industries and research community becoming more isolated. The United States is innovative because of its global linkages and partnerships, not in spite of them.

We should launch new bilateral collaboration in emerging Asia. Existing collaborations with China (CERC) and India (PACE-R) have revealed characteristics of effective bilateral collaboration, including an *a priori* intellectual property framework, joint work-planning, and integration of public and private capital and institutions. Now the United States has an opportunity to launch new collaborations that improve on existing initiatives. For example, in addition to R&D, international technology collaborations should also target industrial-scale demonstration projects that consolidate individual research projects and provide more scope for joint patent filings. Moreover, the funding and prioritization schemes should be even more flexible to adapt to changing needs.

Given the scale of investment that will be directed at the energy sector in Asia in the coming decades, the U.S. Government should partner with the private sector to design and pilot a finance facility for clean energy technology projects in emerging markets. The goal of the facility would be to develop a self-sustaining, replicable and scalable fund that requires decreasing amounts of concessionary capital over time as the risks associated with investment in this space are better understood and quantified. In addition, conventional energy infrastructure has traditionally consisted of large, centralized fixed assets developed using well established project financing structures and instruments, while many of the most promising sources of clean energy are harnessed using smaller scale, distributed facilities. Therefore, the government should look to lay a key role in establishing and incentivizing means of capital aggregation for next generation distributed renewables and low carbon technologies. Such efforts can help to counter Chinese dominated investment in Asia's energy infrastructure.

As existing multilateral agencies like the World Bank are moving away from financing polluting energy sources such as coal, China has emerged as an important alternative source of finance that has yet to enact strict lending guidelines on the environment, particularly in the context of its expansive Belt and Road Initiative. The U.S. should directly, bilaterally engage in expanded dialogue with China on how the two countries can work together to ensure that development finance institutions do not undermine global decarbonization efforts. Commonly agreed safeguards should be developed to promote green over brown investments, particularly in emerging and developing economies in the Indo-Pacific.

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