Solar Power's Rise and Promise for Inclusive Green Growth

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Abstract

Time was when solar energy was facilely dismissed as impractical, space–intensive, inefficient and pricey. In recent years, however, innovations in technology, regulation, and financing have resulted in remarkable efficiency improvements and price reductions, thereby reversing the skepticism about this renewable energy (RE) source.

In this paper, we explore how this has happened, to what extent photovoltaic solar technology has been accepted around the world, and what might be its potential for inclusive green growth. We find that adoption of both on-grid and off-grid solar systems have been widespread and are rapidly increasing. Particularly noteworthy is the utilization of small-scale individual or distributed off-grid solar home systems (SHS) in remote and underserved areas in the developing world, including East Africa and South Asia. It appears that the Philippines has been a relative latecomer. Data show that solar power's "installed" capacity remains a tiny fraction of all RE sources (that also include hydro, geothermal, wind, biomass, and ocean). Moreover, such capacity is mostly for on-grid; limited thus far has been installed for off-grid SHS. We conclude with the paper's main points and possible implications for policy and research

Introduction

Not too long ago, solar power was facilely dismissed as impractical, space-intensive, inefficient and expensive. In terms of social desirability, it was generally regarded a cellar-dweller among the various renewable sources. The costliness of solar energy in the Philippines is reflected in the range of government-approved feed-in-tariff (FIT) rates, namely, P9.68 per kilowatt hour (later reduced to P8.69/kWh) for solar, P8.53/kWh for wind, P6.63/kWh for biomass, and P5.90/kWh for hydro. Economists generally appear to be not too sanguine about renewable energy (RE), solar in particular, owing to its perceived inefficiency.

On June 16, 2014, the Foundation for Economic Freedom (FEF) in the Philippines opposed the Department of Energy's (DOE) plan to increase the installation target for solar energy from 50 megawatts (MW) to 500 MW, ostensibly to ramp up reserves for the 2015 and 2016 summer months. FEF pointed out the added burden imposed on consumers to the great advantage of solar energy developers, financiers, and foreign equipment suppliers. Qualifying their opposition, they added: "We ... are not against renewable energy *per se*, but against the obscene prices that must be borne by the Filipino consumers due to the exorbitant FiT rates and duration (20 years) given to developers".

The World Wide Fund for Nature (WWF-Philippines) has taken the contrarian stance, concurring with DOE's move to scale up solar energy capacity and arguing that it will make power cheaper in the long run. They say that while FEF claims new solar projects will add P0.32 per kWh to consumers' electricity bills, their own energy experts reckon the added cost to be a maximum of P0.05/kWh for the additional 450 MW of solar plants. Which implies that a household with an average monthly bill of 300 kWh would pay only P15 more per month for clean and green energy.

It appears that skepticism or unease about solar power lingers in the Philippines and probably elsewhere as well. More empirical research and policy discussion seem called for. Meanwhile, there's much to learn from the international literature and field experience for raising the level of policy discourse.

Strides in solar energy

Time was when solar energy was quite unappealing to consumers and producers of electricity as solar panels were deemed highly inefficient and costly. In recent years, however, with rapid technological advance, solar power has become increasingly attractive and a promising source of electricity. The earlier skepticism about solar power has, indeed, made a turnaround, according to physicists and

solar experts[1]. While today solar power accounts for less than one percent of global energy supply, it is growing faster than any other source, averaging 50 percent yearly over the past six years. Annual installations of photovoltaic (PV) panels shot up from under 0.3 gigawatts (GW) in 2000 to 45 GW in 2014 – which can electrify upward of 7.4 million homes in a developed country like the United States, for example.

The surge in the viability of solar power, according to the solar expert authors, can be explained by innovations in regulation, industry, technology, and financing. It no longer needs public subsidies to be price-competitive vis-à-vis such traditional energy sources as coal, natural gas, and nuclear power. The International Energy Agency (IEA), which used to be lukewarm, if not altogether skeptical, about solar power, posits an upbeat forecast of solar energy becoming the single largest source of power by 2050, accounting for as much as 27 percent of electricity worldwide. When that happens, the consequences will be profound and the benefits widespread. Electricity will reach far-flung off-grid villages in developing countries which have never tasted what it means to have light or heat on demand.

Roughly two billion people worldwide lack electricity, and nearly three billion rely on such dirty fuels as firewood and animal dung for cooking and heating[2]. Almost 90 percent of those suffering from energy poverty are in South Asia and sub-Saharan Africa. Facing this huge challenge, governments realize that building energy infrastructure such as large power plants and transmission lines takes decades. Fortunately, with the plummeting price of solar panels, companies are working with local banks for financing and servicing arrangements suited for the rural poor, which typically entail small up-front costs, affordable monthly payments, and reliable maintenance agreements.

Solar power and green energy revolution

The East Africa region is arguably a global leader in adopting new business models for solar home systems (SHS) commercialization[3]. Being the most practical least-cost approach to provide basic electricity services (e.g., lighting and mobile-phone charging), SHS could with little difficulty be applied to developing countries for dispersed off-grid homes in far-flung villages.

Bangladesh, where the use of solar PV panels has risen sharply, is now known to have the world's fastest solar home system SHS coverage rate, thanks to microcredit financing facility, whereby households make a down payment and amortize the balance in tranches[4]. The SHS program in Bangladesh started in 2003 and in a few years, 50,000 units per month were being installed. While about three million rural households had been covered by early 2014, no more than 10 percent of off-grid households have been reached by the system. Likewise, an Indian company (SELCO) has sold and maintains two million SHS in India also facilitated by financing tailored to poor households[2].

Besides solar energy for individual or "distributed" small-scale power such as SHS at 5W-100W-peak scale, the adoption of large-scale grid-connected PV panels has markedly scaled up in the last five years owing to a steep drop in international module prices[3] from about US$6 per Watt-peak (Wp) five years ago to around US$1/Wp currently. Many countries (e.g., Australia, Germany, Italy, Portugal, Spain, and the Southwestern U.S.) have therefore dropped FIT subsidies. In African countries much poorer than the Philippines and Sri Lanka, there are tens of MWs of grid-connected PV panels installed by private companies that seem to be profiting even without a FIT subsidy.

China as well is undergoing a green-energy revolution, and solar power is figuring palpably[5]. In 2014, electricity generated by renewable sources (water, wind and solar) increased 20 percent, with solar power generation alone rising a spectacular 175 percent. Solar power also beat nuclear energy in terms of new power created – an additional 17.43 terawatt-hours versus 14.70 terawatt-hours from nuclear sources.

Power storage challenge

A key challenge is the inability of PV modules to harness energy from the sun at night or on cloudy days. The obvious solution is battery storage. Studies by the U.S. Western Electricity Coordinating Council suggest that better ways to store energy could reduce waste by about 18 percent and boost the efficiency of electricity use by up to 11 percent. Better energy-storage methods would also make it easier to deliver electricity to remote and neglected rural areas. Research and development in storage technology have of late resulted in significant price reductions. Battery costs have already fallen by about 70 percent over the last five years, prompting some companies, like SolarCity in the U.S., to pack solar panels with

batteries[1]. In another 10 years or so, the price could fall further by 70 percent due to improvements in technology and manufacturing.

The company that created powerful batteries for cars in the U.S. has already begun in April 2015 to manufacture batteries for homes, according to Tesla chairman and CEO Elon Musk. Tesla Powerwall is a rechargeable lithium-ion battery, a cost-effective device that stores electricity charged from solar panels or when utility rates are low. It is seen as a threat to distribution utilities in the U.S. (or locally, e.g., Manila Electric Company), as it has the potential for consumers to untether from the grid[8]. Experts regard this as a game changer, a major breakthrough in the formidable challenge of reliable RE storage.

Multiple Powerwalls can also be linked together for homes or institutions with larger energy requirements. Further, a recent initial breakthrough made by Professors Wang Changan of Beijing's Tsinghua University and MIT's Li Ju through their work on nanoparticles is shown to extend lifetimes of lithium-ion batteries up to four times[9].

Energizing the poor

Infrastructure -- both physical and human -- is, by definition, a *sine qua non* for development. Transportation, electric power, and water, in addition to human capital, undergird human activity -- indeed, life itself -- for it to prosper[10].

Roughly 2 billion people worldwide lack electricity, and nearly 3 billion rely on such dirty fuels as firewood and animal dung for cooking and heating, according to the World Bank[2]. Almost 90 percent of those suffering from energy poverty are in South Asia and sub-Saharan Africa.

The Philippines is by no means free from energy poverty especially in rural areas and its remote countryside which are home to the majority of the poor in the Philippines. Given the country's thin power reserves, any shortfall events, caused by plant shutdowns due to accidents, planned maintenance, or weather-related disturbances, always adversely affect the poor first in both rural and urban areas. Mindanao usually has negative reserves throughout most of the year, Visayas' situation remains highly precarious, while Luzon's is also no source of comfort.

Renewable energy projects in a number of developing countries have demonstrated that solar power, among other REs, can directly contribute to poverty uplift by supplying the electricity needed for starting businesses and generating jobs[11]. As well, electricity facilitates many household chores, mobile-phone charging, use of radio, etc. Moreover, it enables children to study at night, thereby motivating them to continue schooling. Bezner states: "Providing access to electricity will allow hospitals to keep life-saving refrigerated vaccines on hand, allow students and entrepreneurs to continue their work after dark, and ensure that families do not need to rely on dangerous and costly kerosene-powered lamps"[12].

Rural electrification in Misamis Oriental province in the southern Philippines has engendered social and economic investments resulting in marked pick-ups in agricultural, business, and industrial productivity; employment opportunities; health and medical services; and educational facilities[13]. Higher household incomes and increased opportunities for saving and investment have likely reduced children's value to parents as productive and old-age-security assets, thereby motivating family planning to limit the number and spacing of children.

Research points to evidence on the pivotal link of electricity to the welfare of the poor. But the costs involved in connecting to the power grid and regularly paying for utilization often deter poor households and keep them without electricity[14]. Now, with individual or distributed off-grid small SHS and affordable financing modalities for installation and eventual ownership, energizing the poor is well within reach. This is demonstrated by the experience in Bangladesh reputed to have the world's fastest SHS coverage rate, which has significantly lifted living standards and reduced poverty especially in previously lagging regions[4]. Poverty reduction can be hastened if rural electrification is complemented by, inter alia, roads and schools made in key locations to maximize distributive and multiplier effects[14].

Conclusions and implications for policy and research

International literature and field experience reveal that the erstwhile skepticism about solar energy has made a sharp turnaround. Solar power is fast becoming a leader among REs owing to innovations in technology, regulation, financing and industry, resulting in steeply falling prices. It is warmly welcomed by developed countries particularly concerned about climate change, on the one hand, and by developing countries still having to deal with energy poverty, on the other.

Adoption of large on-grid solar photovoltaic (PV) systems is perceptibly becoming commonplace in the developed world, and so is that of small or distributed off-grid solar home systems (SHS) particularly suited for remote and often neglected villages in developing countries. Mini-grids, as well, either connected to or unconnected from the main grid are becoming widely used. The dramatic rise in the viability and acceptance of solar power has led the previously lukewarm International Energy Agency (IEA) to make an upbeat forecast of solar energy becoming the single largest source of power by 2050, accounting for 27 percent of electricity worldwide.

The rise and promise of solar power seem indisputable. There are a few policy implications that may be worth considering.

One, to hasten the development/installation and adoption of solar technology, particularly distributed off-grid SHS for the thousands of marginalized households throughout the country. There is also ample room for larger on-grid systems, in lieu of the justifiably much loathed heavily-polluting coal-fired plants, to address the country's energy deficits.

Two, to critically review and rationalize the operative FIT system toward greater equity and fairness between power producers/distributors and consumers.

Three, to establish a good data collection system for solar power development/production and use, including data to enable assessments of impacts on, *inter alia* economic growth, employment, poverty reduction, and greenhouse gas emissions.

Fourth, an initial research project could probably already be carried out to gauge, for instance, how satisfied are households and institutions using solar PV technology in terms of its efficacy, cost savings, and general impact on households' living standards or institutions' operations.

Finally, a comparative benefit-cost analysis of the various renewable energy sources would be in order.

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