

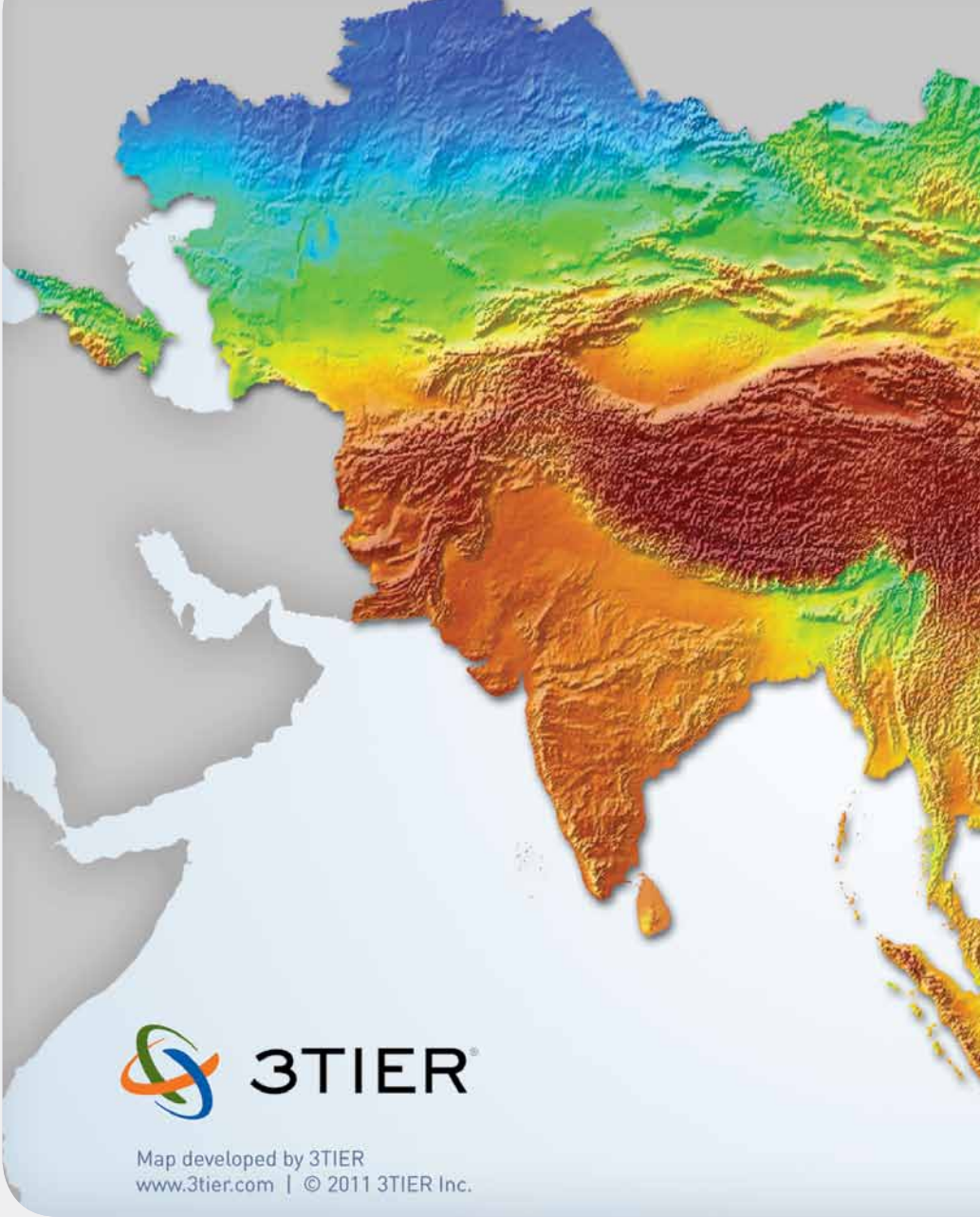
The background of the cover is a close-up, low-angle shot of a solar panel array. The panels are tilted, and the grid lines of the cells create a strong sense of perspective, leading the eye towards a bright sun in the upper right corner. The sky is a deep blue with some light clouds. The overall tone is clean, modern, and focused on renewable energy.

ADB

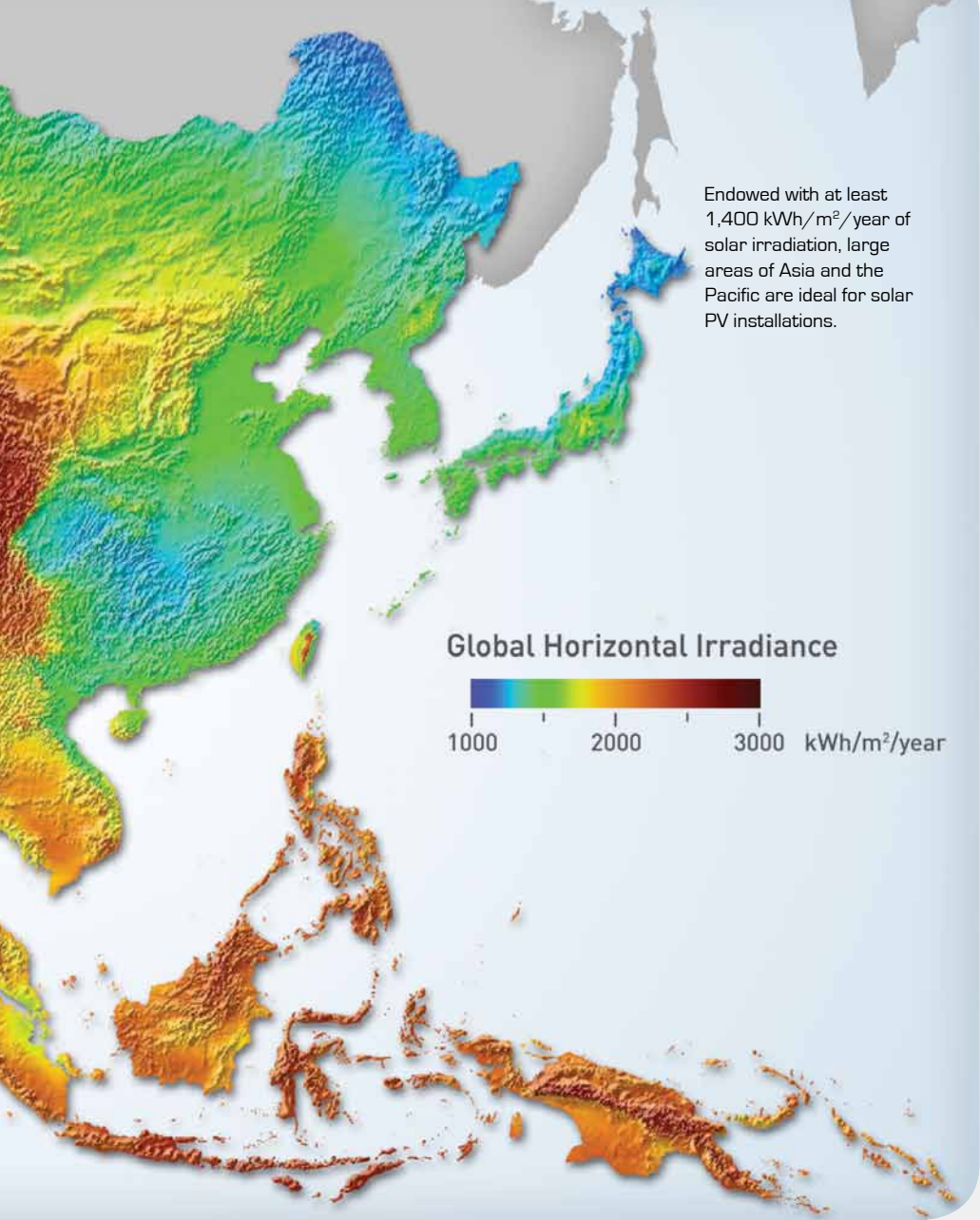
Asia Solar Energy Initiative

Affordable Solar Power for Asia and the Pacific

Asian Development Bank



The Asia Solar Energy Initiative: Affordable Solar Power for Asia and the Pacific



The largest solar photovoltaic (PV) power plant in Asia lies on the plains of Lop Buri, Thailand, and is set to begin generating 73 megawatts (MW) of clean, renewable electricity in 2011, enough to power 70,000 homes. Solar PV panels lining the roof of the modern railway station of the Shanghai Hongqiao Airport in the People's Republic of China (PRC) have transformed the building into an energy producer. Solar parks are being developed in India, solar resource mapping is under way in Uzbekistan, and large-scale solar projects are under design in the Philippines—all part of a major drive by the Asia Solar Energy Initiative (ASEI) to tap the region's abundant solar energy.



In Uzbekistan, where ASEI was launched in 2010, ADB's solar energy development team and government officials stand in front of one of the world's two largest solar furnaces.

A major effort by the Asian Development Bank (ADB) to identify and develop large capacity solar projects, ASEI comes under the umbrella of ADB's Clean Energy Program. Promoting the availability and use of clean energy is one of ADB's highest priorities.

At the launch of ASEI in Tashkent, Uzbekistan, in May 2010, ADB President Haruhiko Kuroda said, "The world has a high stake in Asia. With the most populous and dynamic economies in the world, this region is key to stabilizing the global climate, while driving global growth. Asian leadership is critical and ADB stands ready to assist. I urge all of us to use every means at our disposal to create a greener, more sustainable future."

Committed to achieving 3,000 MW of new solar electricity generation and associated smart grid projects by 2013, ADB plans to provide up to \$2.25 billion in financing for solar projects under ASEI, and expects to leverage an additional \$6.75 billion in solar power investments over the same period.

Solar Solutions

The International Energy Agency estimates that solar energy could make up as much as a quarter of the world's total electricity production by 2050. With an estimated 900 million people in Asia still lacking access to electricity, most beyond the reach of grid development and centralized generation, localized solar plants are a viable solution.

The distributed power generation potential of large-scale solar systems can help sustainably meet the challenge of supplying affordable clean energy to Asia's large and growing population. A number of countries with far-flung islands, such as Indonesia, Maldives, the Philippines, and others in the Pacific region, have very high costs for electricity and solar energy is a feasible way to replace their expensive fossil fuels.

Asia is witnessing the emergence of some of the largest solar promotion programs globally, such as the National Solar Mission in India, the Golden Sun program of the PRC, and Thailand's Small Power Producer scheme for renewable energy. If these programs are able to achieve the scale envisaged, they have the potential to create a huge wave of demand which, in turn, will spur innovation, efficiency in production, and cost reduction in solar energy applications, consequently increasing the competitiveness of solar energy against traditional and alternative energy sources around the world.

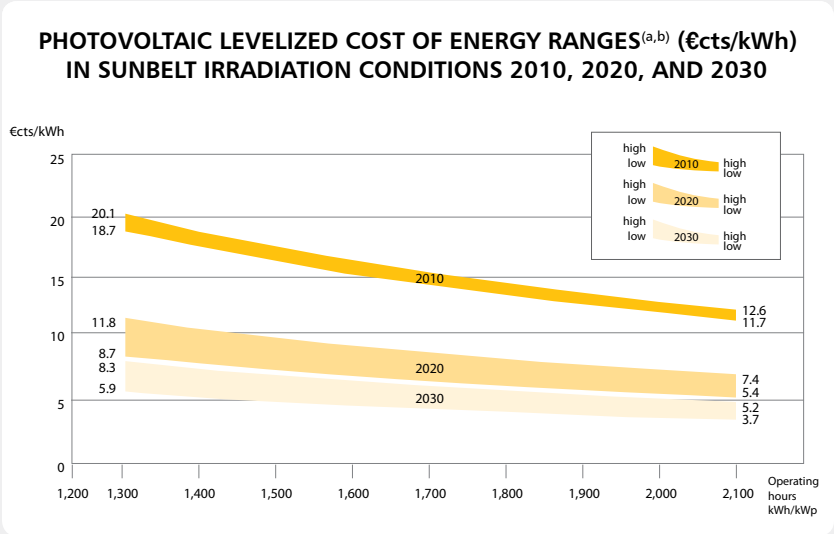
Many developing countries in the region have ideal conditions for harnessing solar power, but as Seethapathy Chander, Chair of the Energy Community of Practice at ADB explains, the steep up-front costs of solar projects, high borrowing costs, and the lack of access to long-term capital are stalling solar energy growth. ASEI plans to overcome these constraints by boosting the development of enough grid-scale projects so that the cost of solar electricity to consumers will reach "grid parity" much sooner,



A mat weaver in Vanuatu works by the light of a rechargeable solar lamp (Photo by REEEP).

matching the price consumers pay for electricity generated by conventional carbon-intensive and polluting fossil fuels, such as coal.

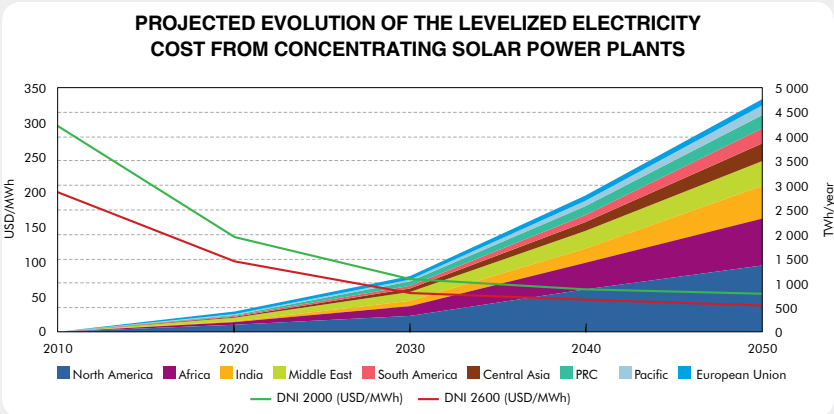
ASEI aims to accelerate the downward trend in the cost of solar energy. The following figures show the current trends for PV (below) and concentrating solar power (bottom), in terms of the projected levelized cost of energy (LCOE).



kWh = kilowatt-hour.

- ^a Turnkey photovoltaic (PV) systems > 1 megawatt-peak (MWp); 85% performance ratio; lifetime until 2020 is 25 years and after 2020, 30 years; operation and maintenance (O&M) costs 1.5% of Capex; Debt financing with weighted average cost of capital (WACC): 6.4%; System Price 2010: €2,800/kWp (kilowatt-peak).
- ^b Low and high levelized cost of energy (LCOE) correspond, respectively, with the lowest and highest turnkey system price within the price range.

Figure by ARE/ASIF/EPIA.



DNI = direct normal irradiance, PRC = People's Republic of China.

Figure by IEA.

The transfer of manufacturing of solar components to low-cost production facilities in Asia and improvements in the technology are also helping to lower start-up costs. “By 2014 to 2015, we should get very near grid parity for solar power across Asia,” says Chander.

ASEI is helping to create an enabling environment in the region for solar-generated electricity to become increasingly competitive with the retail rate from mainstream networks that are presently dominated by fossil fuel sources. This allows developing countries to strengthen their energy security and benefit from the economic activities contributed by local solar manufacturing and associated industries. In addition to catalyzing large-scale grid applications, the region will also benefit from improved social, rural, and livelihood development enabled by decentralized solar power generation for remote and rural communities.

ASEI: Three Interlinked Components

Through discussions with stakeholders and industry experts, and drawing on ADB’s long experience in project management, policy, energy, and finance, ASEI was designed as three interlinked components—knowledge management, project development, and innovative finance.



The shift of solar manufacturing facilities to low-cost plants in Asia, like this one producing PV components in the PRC, has dramatically reduced the cost of solar technology.

Knowledge Management: Asia Solar Energy Forum

ASEI includes the Asia Solar Energy Forum (ASEF), a key international knowledge-sharing arena that brings together private sector companies, government representatives, and other stakeholders to share knowledge, develop partnerships, discuss new solar power proposals and incentive mechanisms, and organize major conferences on solar energy. ASEF



also provides a regional platform to synthesize and analyze the various technology trends, market breakthroughs, measurement and modeling techniques, and smart grid and storage solutions piloted and scaled up in the region, thereby promoting a more effective and efficient solar development program.

ASEF is designed as a nonprofit independent, nonpartisan, nonpolitical institution interlinking with knowledge hubs globally to facilitate solar energy technology transfer to Asia and the Pacific. The forum is a member-supported society with members from countries, utilities,

ADB President Kuroda opened ASEF's first meeting in Manila on 5–6 July 2010, which saw enthusiastic networking among peers and intense engagement between project developers, equipment manufacturers, lenders and government officials.





financiers, manufacturers, and other stakeholders in solar energy. ASEF's primary objectives center on knowledge sharing and consultations, policy and regulatory framework development, and capacity development for local stakeholders.

Rising Interest in ASEF

ASEF's first meeting was held on 5–6 July 2010 in Manila, the Philippines, and brought together more than 200 policy makers and solar energy-related professionals from 34 countries with enthusiastic networking among peers, and intense engagement between project developers, equipment manufacturers, lenders, and government officials. More than 300 delegates from 38 countries attended the second meeting of the ASEF in Tokyo, Japan, on 1–2 December 2010. Both meetings paved the way for the establishment of ASEF as a nonprofit knowledge society.

The second meeting of ASEF in Tokyo on 1–2 December 2010 featured solar projects of the ASEI, and brought together over 300 delegates to discuss technology trends, production capacities, market barriers, risk management strategies, resource modeling techniques, and emerging trends in smart grid and storage technologies.



Project Development: ASEI's 3 GW Challenge

To stimulate development and prove large solar plants are a viable, clean energy alternative, ASEI made an ambitious commitment, at its inception in 2010, to increase the amount of new solar power generation in the region to 3 gigawatts (GW) by 2013, a sixfold increase.

3 GW Progress

The first projects supported under the ASEI are two private sector-led solar PV electricity generation projects (a 73 MW project and a 44.5 MW project) in Central Thailand. Through the Asia Pacific Carbon Fund,



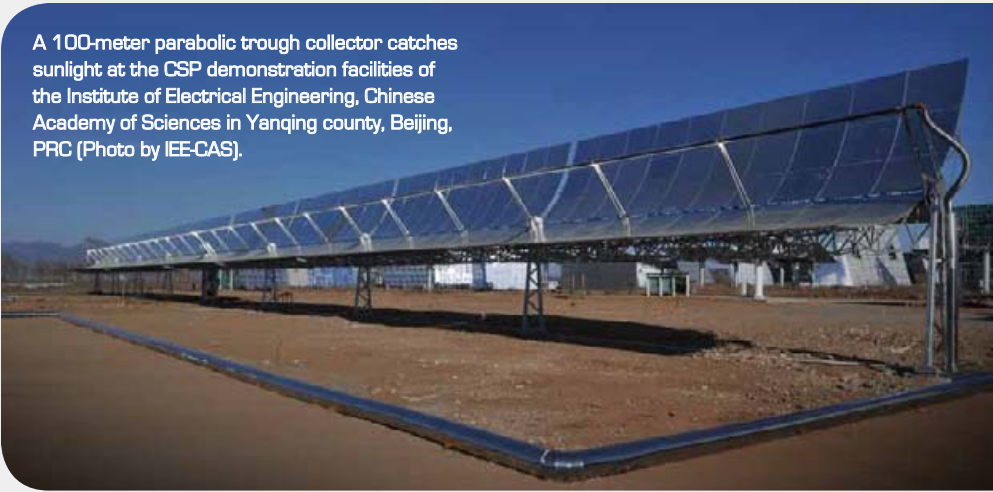
From left: At Lop Buri, Thailand, the largest PV solar power plant in Asia can produce up to 73 megawatts (MW) of electricity, enough to power 70,000 homes; With an installed capacity of 2.2 MW, this building integrated solar project uses PV elements as integral parts of the roof for Wuhan City's railway station in Hebei Province, PRC (Photo by CECEP Solar); Aligned with its Energy for All initiative, ADB has provided solar home PV systems in Bhutan, bringing electricity to rural communities for the first time.

ADB is also involved in two 10 MW solar PV power plants and 10.7 MW of building integrated PV projects in the PRC. A 1.5 MW pilot concentrating solar power (CSP) plant has also been implemented near Beijing in the PRC. Various other potential projects are under consideration, and several developing member country (DMC) governments already have ongoing programs to attract investments in solar power generation. Overall, the targeted projects are expected to demonstrate and model the feasibility and sustainability of various types of public and private solar generation projects.

Projects Under Consideration

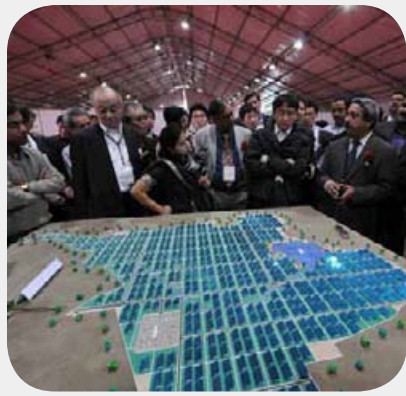
- Four demonstration CSP projects in the PRC—50 MW in each of four provinces
- Private, large-scale PV and solar thermal projects under concessions in five provinces in the PRC, in collaboration with state utilities and private distribution companies
- Solar power transmission project in Gujarat, India, that will enable about 500 MW of solar power generation capacity to be connected to the grid
- Several projects enabling the implementation of grid-connected solar power in India via the public–private partnership route
- A 5 MW grid-connected solar PV demonstration project and two off-grid, solar–wind hybrid plants (0.5 MW–1 MW) in Bangladesh
- Various technical assistance activities to enable solar energy development in Uzbekistan, such as solar resource mapping and assessment; establishment of a solar energy regional center; and development of policies, regulations, and technical codes and standards

A 100-meter parabolic trough collector catches sunlight at the CSP demonstration facilities of the Institute of Electrical Engineering, Chinese Academy of Sciences in Yanqing county, Beijing, PRC (Photo by IEE-CAS).



- Solar energy projects in the Philippines in collaboration with the Clean Technology Fund under the Climate Investment Funds administered by the World Bank

Assistance is being provided for the identification, development, and implementation of 3 GW of solar generation and associated smart grid projects. Most countries in the region lack data on solar resources, not only critical for choosing the best locations for solar installations but also for potential investors. To boost project development, ASEI is making considerable investments in systems for generating and gathering solar irradiation data—using satellite-based images and measurements from ground stations—in DMCs.



Young girls (left) in traditional dress at the site of the 2,000-hectare Gujarat Solar Park at Charanka Village, Gujarat, India. A scale model of the project (right) was shown at the International Workshop on Solar Park and Smart City Development, held from 12–14 January 2011 and co-sponsored by ADB and the Government of Gujarat.

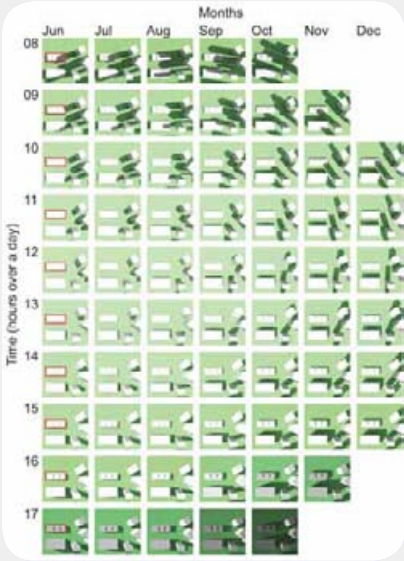
Based on the identification of probable high potential sites and proper solar resource data, assistance is provided for inviting bids from the private sector to develop bankable solar energy projects. Large areas of land are required to build utility-scale projects, and the most suitable are desert or degraded regions that cannot be used for growing food or forests.

ADB's Rooftop Solar Power Plant

To develop expertise within ADB and a suitable model for implementation of distributed solar power generation, ADB is installing a 567-kilowatt (kW) capacity solar PV power project on the roof of ADB's Headquarters in Manila. The winning bidder has been selected through international competitive bidding and the contract initialed. A Philippines-PRC joint venture firm has committed to supplying 623,000-kilowatt-hour electricity annually (about 4% of the present annual consumption) for 15 years. The project will also demonstrate other advantages of solar systems that function efficiently at ambient temperatures and pressures, create no noise, and can be installed in a modular manner.



Providing all the energy needed by the parking building, solar panels at the top of the multistory car park of ADB Headquarters in Manila, Philippines, demonstrate the distributed generation potential of solar PV in urban settings.

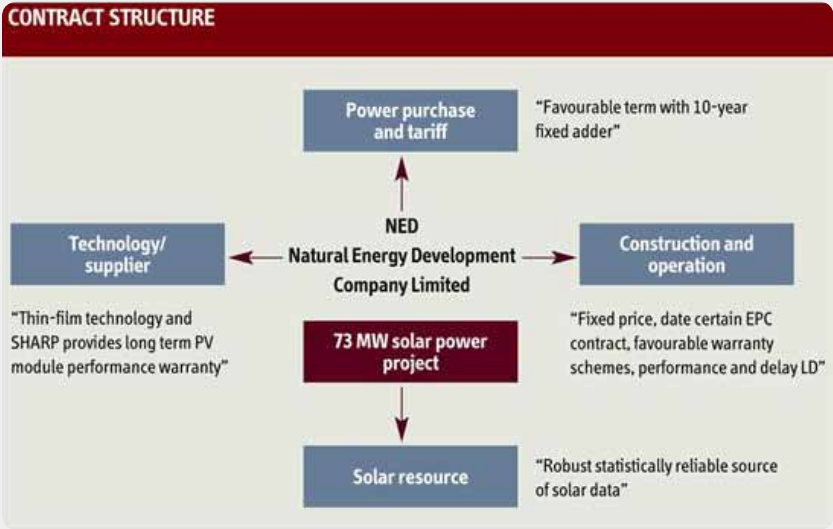


Shading analysis of the ADB block helps estimate the daily and seasonal energy output that can be expected from the solar rooftop PV system. ADB's rooftop is marked in red (Shading analysis by Solar Energy Research Institute of Singapore; Fraunhofer ISE).

The plant will also pioneer independent power producer-type development of solar energy for rooftop applications across the region. In tropical countries, such as those in South Asia and Southeast Asia, solar PV's generation profile closely parallels electricity demand, with its maximum output coming in the early afternoon of hot summer days when air-conditioning is at its peak. The roofs of large homes and commercial and industrial buildings provide ideal locations for the installation of power generation equipment to help improve energy security.

Innovative Finance: Asia Accelerated Solar Energy Development Fund

For large-scale solar energy projects to be implemented swiftly in Asia and the Pacific, financing solutions to mitigate risks and buy down the initial high technology adoption cost of solar power generation projects are critical. ASEI's Asia Accelerated Solar Energy Development Fund



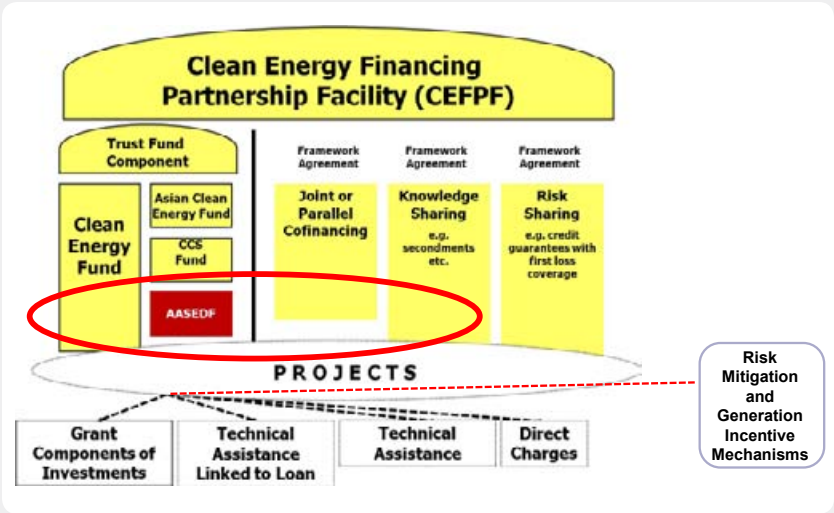
While conventional gas-fired projects in Thailand require contingency funds of only \$15,000–\$20,000 per MW installed capacity, solar projects require up to \$200,000 per MW. Apart from providing an 18-year loan, ADB also provided \$2 million from its Clean Energy Financing Partnership Facility to cover contingency costs arising from using thin-film PV technology on a large scale, allowing the project to close the financing on a non-recourse basis (Contract Structure by Thomson Reuters).

(AASEDF) is designed to fulfill that role. The AASEDF boosts solar energy growth in the region through private sector participation by keeping transaction and opportunity costs low while solar technology remains at the pre-commercial stage. Ultimately, such support helps unburden the end-consumers of the initial high cost of solar power.

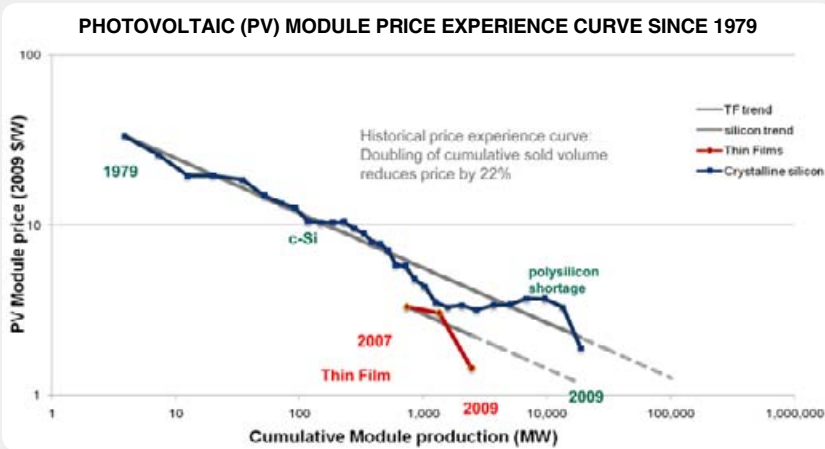
“With energy demand projected to almost double in Asia and the Pacific by 2030, there is an urgent need for innovative ways to generate power while, at the same time, reducing greenhouse gas emissions. Sustainable solar energy can be the clean power of the future if there are appropriate incentive and financing mechanisms in place,” said ADB Managing Director General Rajat Nag.

To supplement its direct financing, ADB is raising \$500 million in AASEDF resources from its community of financing partners. This specialized fund will help “buy down” the high up-front capital costs of solar energy, create innovative guarantee instruments, and implement preparatory works for attracting private sector investments.

Lacking an operating track record, solar energy development is presently an unknown technology to most commercial banks in the region. Since solar projects typically need finance of about 15–18 years, ASEI



The Asia Accelerated Solar Energy Development Fund (AASEDF) under ADB’s Clean Energy Financing Partnership Facility helps finance project preparation, mitigate risks, and provide generation incentives for solar energy projects.



As shown in this graph, increasing scales of solar energy utilization is accompanied by declining costs of production, and is one of the reasons that solar PV is the fastest-growing power generation technology [Figure by European Commission-JRC].

is helping to convince banks to lend. By securing such long-term loans, investors should see returns after 4–5 years. Such innovative financing arranged by ADB for Thailand’s 73 MW solar PV project at Lop Buri won two international awards in 2010.

The AASEDF promotes private sector investments not only by keeping transaction costs low for the sector but also by offering risk mitigation and generation incentives to promote solar energy development that are not readily available from other general purpose funds. The ground-breaking AASEDF is structured as a multidonor trust fund under the Clean Energy Financing Partnership Facility administered by ADB. It is available to support projects in all DMCs and is open to support and contributions from government agencies, international organizations, bilateral funding agencies, the private sector, and civil society organizations.

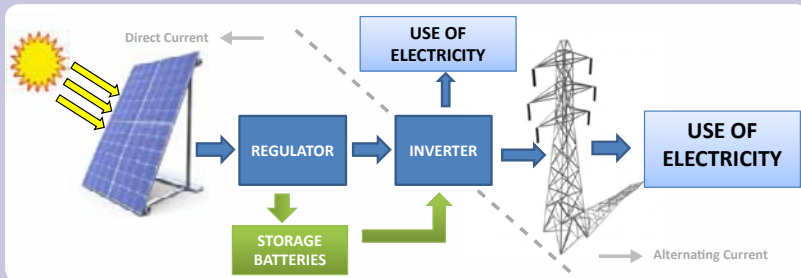
While all of ADB’s DMCs are eligible for support, the AASEDF will prioritize projects in large markets that accelerate the deployment of large solar generation capacity and cost reduction that would contribute significantly to lowering costs, consequently making solar technology affordable to many more markets. There will be two key conditions for AASEDF support. First, the host country government shares a part of the cost of transition projects by way of fiscal or tax incentives with project developers, or by announcing adequate feed-in tariffs. Second, the procurement process (for selection of project developers or purchase of solar equipment) is open to all ADB member countries.

Understanding Solar Technology

There are two widely used technologies for converting sunlight into electricity—photovoltaic (PV) and concentrating solar power (CSP).

According to the Renewable Energy Policy Network for the 21st Century, solar PV is the fastest-growing power generation technology globally and is used in more than 100 countries. PV uses solar cells made of semiconductors to convert solar energy directly into electricity. PV advantages include modular construction, which allows grid connection to occur in stages.

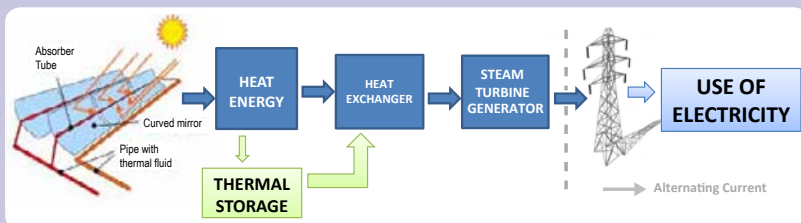
PV conversion is the direct conversion of sunlight into electricity with no intervening heat engine. PV solar systems require few on-site staff and can be operated remotely, with washing PV panels as the main maintenance. Electricity storage is still problematic so power can only be utilized during daylight hours. PV generates direct current (DC), which must be converted to alternating current (AC) to be compatible with electricity grids.



PV technology uses solar panels to convert solar irradiation directly into electricity.

CSP technology uses mirrors to focus solar energy to produce heat, which is used to produce electricity through a conventional steam turbine. CSP has higher operating costs than PV systems but power generation is highly predictable. CSP systems can include thermal storage, enabling electricity to be provided around the clock.

Integrated Solar Combined Cycle (ISCC) power plants use two sources of energy—solar and gas (fossil fuel)—to produce electricity. This hybrid system lowers the use of fossil fuels and reduces the cost of the solar energy plant by using the same power block (steam turbine).



CSP technology concentrates the sun's energy to produce heat, which is transformed into electricity through a conventional steam turbine.

Helping Bring Solar Power to Other Developing Regions

ASEI can serve as a model for other developing regions with high solar potential, such as northern Africa, Latin America, and the Caribbean. As President Kuroda said at the Second ASEF Meeting in Tokyo in December 2010, “Ultimately, realizing the region’s solar energy potential will help trigger a wave of innovation, efficiency improvements, and scale that can accelerate the diffusion of solar energy technologies and thus help it achieve grid parity with the other sources of energy worldwide.”

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IMAGE CONTRIBUTORS

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Asia Solar Energy Initiative: Affordable Solar Power for Asia and the Pacific

Home to the most populous and dynamic economies in the world, Asia and the Pacific is critical to stabilizing the global climate while sustaining economic growth. The Asia Solar Energy Initiative of the Asian Development Bank helps enable solar-generated electricity to compete with the retail rate from mainstream networks currently dominated by fossil fuel sources. Consequently, developing countries benefit economically from local solar manufacturing and associated industries while strengthening their energy security. Progressively, the region will gain not only from large-scale solar energy grid applications but also from decentralized solar power generation for remote and rural communities across the region.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.8 billion people who live on less than \$2 a day, with 903 million struggling on less than \$1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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