

Harnessing the Solar Energy Potential in Cambodia



ស៊ីឃឺអែត
Sverige

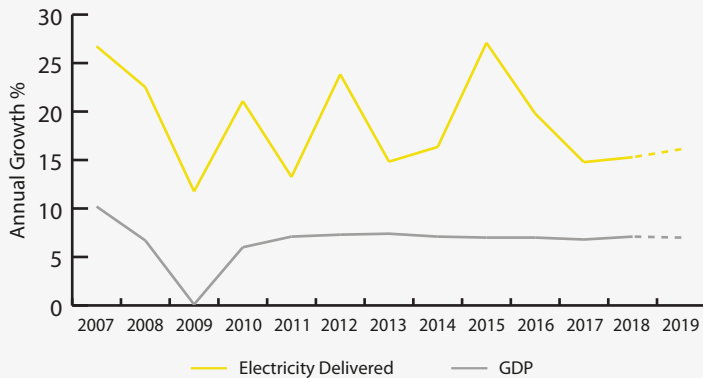


“Cambodia has strong potential for solar energy, in fact some of the most robust levels of solar irradiation that can provide the country an opportunity to meet growing electricity demands in an economical, innovative and sustainable way.”

H.E. Say Samal
Chair of the National Council for Sustainable Development
Minister of Environment

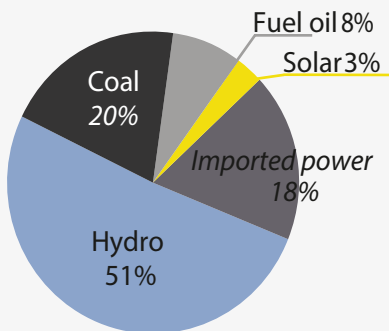
Electricity to power a rapidly growing Cambodia

Growth in Cambodia: Electricity delivered vs GDP

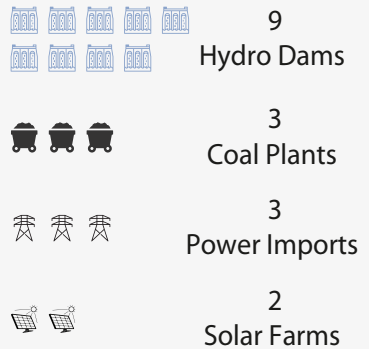


Source: EAC 2019

Current sources of power generation in Cambodia



Source: EDC Presentation, July 2019





Cambodia's economy is growing fast but its electricity demand is growing even faster

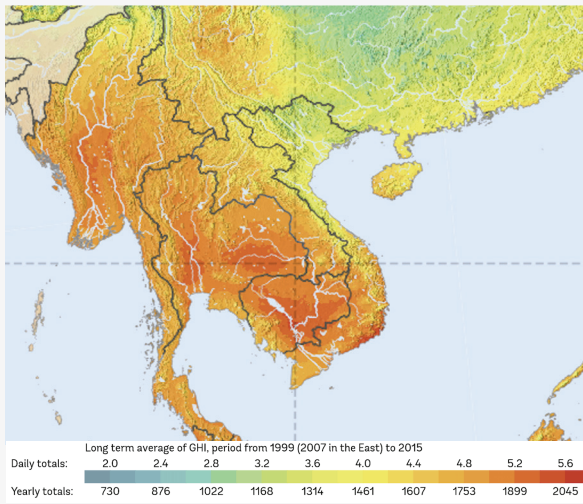
Since 2010, Cambodia's GDP has grown at an average of 7% each year, but its demand for electricity has grown even faster averaging around 20% per year. To power this growth, Cambodia has installed many new sources of electricity generation. The country had 584 MW of installed grid capacity in 2012, but by the end of 2018 it had about five times that with 2,560 MW. As trends of rapid economic and electricity growth are projected to continue far into the next decade, Cambodia must find new sources of electricity generation that are abundant, secure, affordable and environmentally sustainable.

Where does Cambodia get its electricity from today?





Cambodia's 2560 MW of installed power sources in the national grid comes from a mixture of hydropower (1330 MW, 51%), coal (505 MW, 20%), imports (450 MW, 18%) fuel oil (200 MW, 8%), and solar farms (75 MW, 3%). During the wet season, the hydropower plants can run at full capacity, but during the dry season they are unable to, as then there is less flowing water available for power generation. The Royal Government of Cambodia realizes (in the 2018 Rectangular Strategy Phase-IV) the potential for solar energy to help with meeting the increase in electricity demand and seasonal shortages in generation during the dry season. Cambodia has two 75 MW solar farms today.

Sunshine: Cambodia's abundant, free and secure resource

Levels of sunshine and installed PV capacity



Source: Solargis 2019

	 Cambodia	 Thailand	 China	 Germany
Average of Daily Global Horizontal Irradiation(GHI)	5 kWh/m ²	4.9 kWh/m ²	4.2 kWh/m ²	3 kWh/m ²
Installed on-grid solar capacity (2018)	75 MW	3,200 MW	175,000 MW	45,300 MW
	*Approved (415 MW)			
Percent of total capacity	3%	8.2%	9.2%	23%
	*Approved (14.3%)			

Source: Solargis 2019, IEA 2019, IRENA 2019

*Capacity of the solar farm projects approved as of August 2019 and based on available public information amounts to 415MW. This includes: Bavet 10MW (operating), Bavet IPP 5MW (operating), Kampong Speu 60MW (operating) + 20MW, Kampong Chhang 60MW, Kampong Chhang II 60MW, Pursat 60MW, Pursat II 30MW, Battambang 60MW, Bantey Meanchey 30MW, Svay Rieng Bavet 20MW.



Cambodia has a high potential for solar energy

The sun shines at an average of 8 hours per day in Cambodia throughout the entire year. Cambodia's recorded 'solar irradiation,' which is a measurement for solar energy received over a square meter of area, is very robust with daily averages of 5 kWh/m², peaking as high as 5.6 kWh/m² in central Cambodia. These levels are significantly higher than some of the pioneering solar nations, for instance almost double that of Germany's. This potential has been well recognized by the Royal Government of Cambodia. Just over the last year (2018-2019), many new utility-scale solar farms have been approved, for a total of 415 MW that will power the national grid within the next few years. Relative to the size of Cambodia's grid generation capacity today, this would amount to 14.3%* of installed capacity.

Sunshine is free and secure

Compared to generating electricity with traditional fossil fuel sources such as coal, which requires importing resources from neighboring countries, generating electricity from a solar plant is straightforward. Well positioned solar panels can easily and efficiently harness the sun's energy by converting sunlight into electricity. As energy from the sun is free and guaranteed daily, increasing the amount of solar generation will reduce Cambodia's reliance on importing resources and electricity from its neighbors.

*14.3% comes from EDC July 2019 presentation on current power supply: 200MW fuel oil, 1330MW of hydropower, 505MW of Coal, 450MW import high voltage. Total without solar equal 2485MW. Total solar approved is 415MW.

Solar power is affordable and easy to install



From 2008 to 2018, the price of solar panels fell from

\$3.15/W to **\$0.22/W**



In 2018, a record

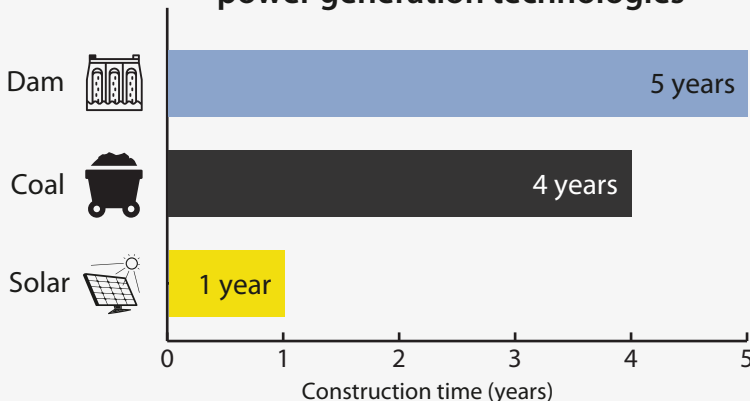
109,000 MW = 2x
of new solar was installed globally



of Vietnam's total power capacity (50,000 MW)

Source: Bloomberg 2019

Construction time for large-scale power generation technologies



Source: IEA 2017



Drop in the price of solar

The global industry for solar energy has matured over the past ten years as competition for manufacturing solar panels grew much stronger. In 2008, the price per watt of solar panels was \$3.15, and by 2018 it fell to just \$0.22. As the price continues to fall, there are more installations year after year. In 2018 alone, there was a record 109,000 MW of new solar installed globally. That amount is over double Vietnam's total electricity generation capacity, which is around 50,000 MW. Experts project that the costs of installing new large solar plants for electricity generation will drop by another 71% by 2050, attracting new investments world-wide. Solar is quickly becoming one of the cheapest available forms of electricity generation.

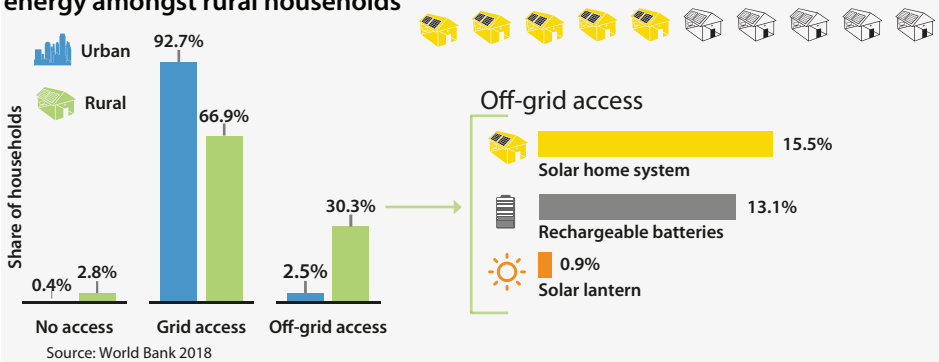
Solar panels are fast to install

The two most common power sources in Cambodia, hydropower dams and coal plants, generally take at least four to five years of construction time to start generating electricity. Compare that to the first and only solar farm in the country today, in Bavet, which took just one year from the start of installation to begin generating electricity. This is because solar panels are all similar in design and can be installed easily. Solar panels are also like puzzle pieces that can be built over time and expanded to increase the total volume of electricity they generate. These characteristics give solar power plants the flexibility to quickly expand capacity if electricity demands unexpectedly grow faster than projected.

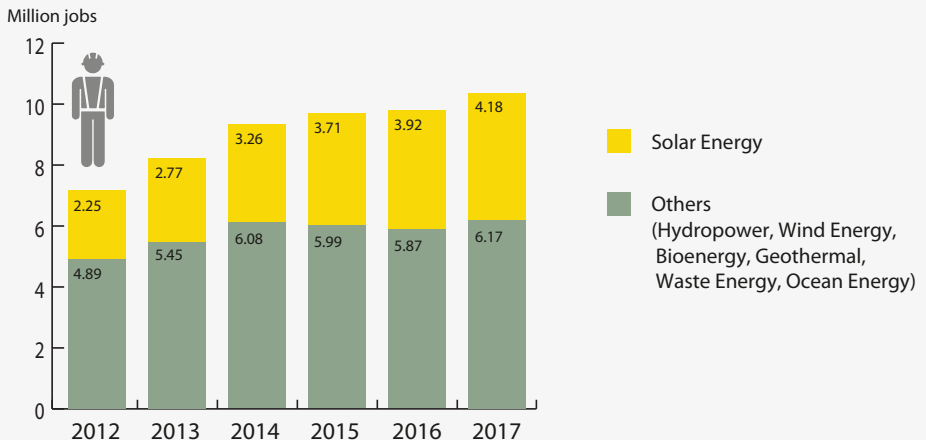
Solar energy brings power to off-grid areas and creates jobs

Off-grid solar devices are critical in closing the gap in access to energy amongst rural households

Nearly **50%** of off-grid rural households in Cambodia access electricity from solar



Global Renewable Energy Employment by Technology





Solar energy for remote communities

Solar equipment is widely accessible in Cambodia and has become an excellent solution to rural communities that live too far from the grid. With the significant drop in price, the solar home system gained popularity among consumers in remote villages. Today, more than half of Cambodia's off-grid households use solar home systems as one of their primary sources of electricity.

The Royal Government of Cambodia has targeted to electrify 70% of households with grid quality by 2030. As the price of solar home systems continues to fall year-over-year, solar energy will become a valuable component to bring reliable electricity access to remote communities in Cambodia.

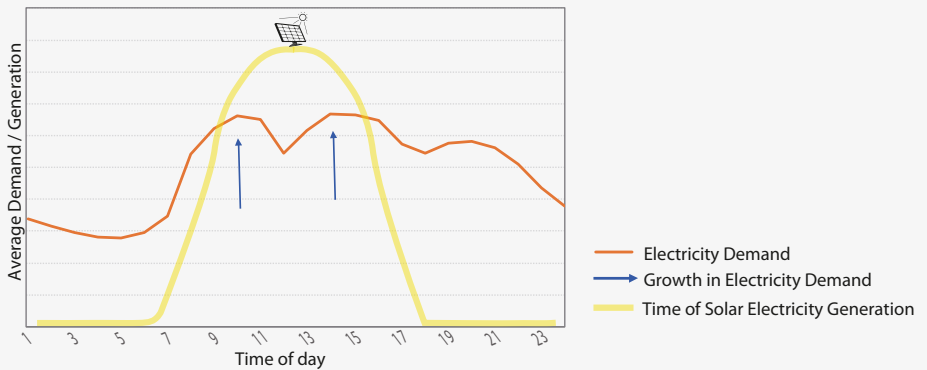
Solar brings jobs

Globally, solar energy is now the largest renewable energy job provider, bringing many new employment opportunities in the sector as it develops within a country. While employment in other renewable energy technologies have not grown much since 2012, jobs in solar energy have almost doubled since then, with the most robust growth from emerging leaders in Asia. As Cambodia continues to install renewable energy and grow the local market, it can be expected that many new jobs will be created in Cambodia's solar industry over the next decade.

Solar energy is only generated when the sun shines

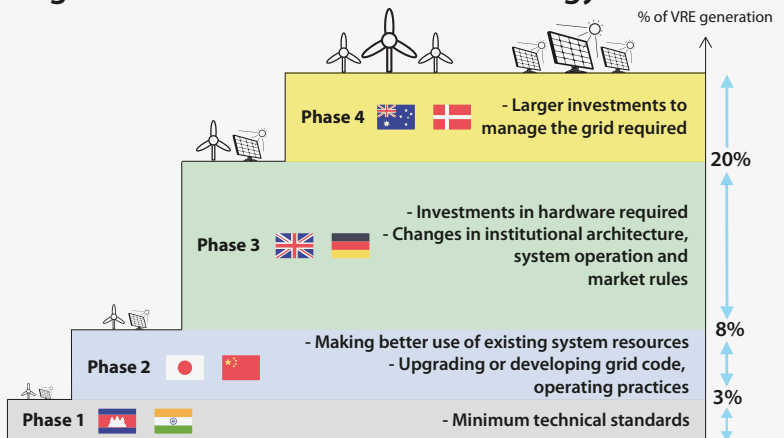


Electricity Demand Growth in Cambodia and time of solar generation



Source: EDC 2016

Integration of variable renewable energy:



Source: IRENA 2018



Source: Chip Mong

Solar responds well to Cambodia's growth in electricity demand

Solar energy can only generate electricity during the day when the sun is out. This matches perfectly with Cambodia's growth in day-time electricity demand. One great example of this is the growing use of air conditioners during the day at the hottest temperatures when the sun is out, as more Cambodians can now afford to purchase and use them. Solar energy can be used to power new growth in electricity demand.

Phases to integrate variable renewable energy

A common concern for installing solar energy into the grid used to be that it might lead to grid instability. This is because it is a form of 'variable renewable energy', which means it fluctuates according to natural conditions. For example, solar only generates energy during the day when the sun is out, and wind only generates energy when the wind is blowing. Depending on how much variable energy a national grid has installed, there are certain measures that can be taken to ensure there are no impacts on grid stability. As many countries have begun to successfully install higher amounts of variable renewable energy to the grid, 'phases' for different levels of integration have been identified, with recommended measures to take for each phase to maintain grid stability. Taking these measures will be necessary if Cambodia moves through the phases by adding higher levels of solar energy to the national grid.

Solar energy can help mitigate climate change and keep the air clean

Economic costs of climate change



By 2050, climate change could reduce Cambodia's GDP by **10%**

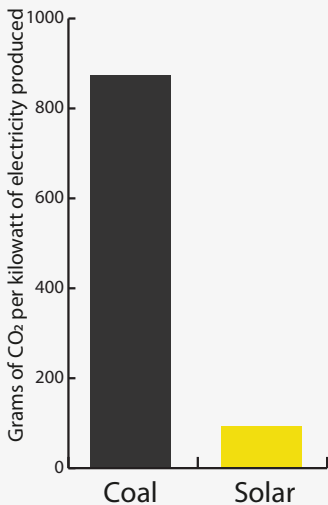


In 2050, reduced labour productivity accounts for **57%** of all loss and damage

Source: MEF & CSD, 2018



Estimated carbon footprint (coal vs solar)



Source: University of Texas; Energy Institute 2017

Global health costs of air pollution



91%

of the world's population live in places where air quality exceeds WHO guideline limits



7 million

people die every year from exposure to fine particles in polluted air (WHO)



600,000

children under 5 will die due to air pollution related illness every year (UNICEF)

Source: WHO 2019, UNICEF 2019



Climate change impacts on Cambodia

Cambodia ranks as one of the most vulnerable countries in the world to climate change, causing an increase in extreme weather events, such as floods and droughts. A recent report by the Cambodia Climate Change Alliance found that by 2050 the impacts of climate change can reduce Cambodia's total GDP by an estimated 10%. It warns that one of the most significant economic consequences will be in labor-intensive sectors, from a reduction in worker productivity with hotter temperatures. Solar energy has no direct air emissions and is well recognized as an essential component to combat climate change.

Solar and health

Currently, about 4 billion people, 92% of Asia and the Pacific's population, are exposed to levels of air pollution that pose a significant risk to their health. Air pollution, caused by burning fossil fuels and waste, is dangerous and can result in premature death, asthma, and life-long damage to respiratory and cardiovascular systems. Solar energy provides a source of energy access that can be deployed close to where people live, contributing towards keeping the local air quality clean and Cambodian people healthy.

Solar investments can be supported by derisking measures

For on-grid solar:



USD 55 million
public cost of derisking measures



USD 121 million
in economic savings over 25 years



USD 619 million
private sector investment potential

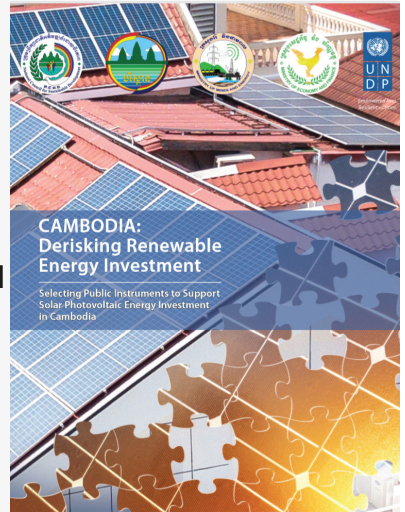


700 MW
of installed on-grid capacity

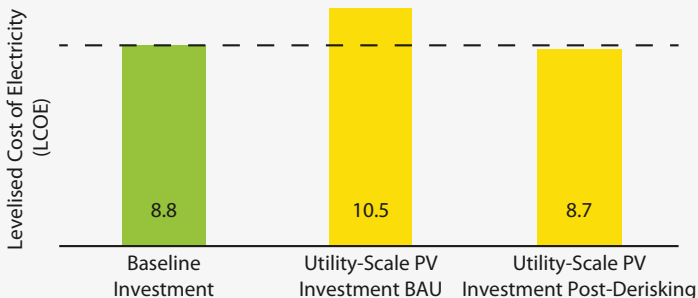


8.3 mtCO_{2e}
would be abated

Source: UNDP 2019



LCOEs for the baseline and utility-scale PV investment in Cambodia



Source: UNDP 2019



Source: ADB

Derisking measures can help reduce costs

Cambodia's De-risking Renewable Energy Investment (DREI) report identifies investment risks for solar energy and estimates their relative importance on the cost of capital. It then identifies public instruments and measures that can be taken to reduce investment risks, which lowers financing costs and thereby reduces the costs of power generation. The DREI shows that there are many cost-effective derisking measures which can be taken to support the growing solar sector in Cambodia.

Solar PV sub-sectors	Priority derisking measures
Utility-Scale PV	<ul style="list-style-type: none"> • Implement a transparent and competitive auction mechanism, with a standardized Power Purchase Agreement (PPA) • Perform grid stability studies, transparently share findings, technical support and software for grid management
Rooftop PV	<ul style="list-style-type: none"> • Expansion of regulations to low-voltage customers, including balanced solar capacity charges • Policies allowing export of power to the grid, for instance via net-metering or feed-in tariff
Solar-Battery Mini-Grids	<ul style="list-style-type: none"> • Strengthen capacities of existing government bodies/establish a government body or unit to advance/oversee/improve off-grid electrification • Implement a dual regulatory regime (comprehensive & light-touch), including license • Extend current policies on digitalization, including stronger rural cellular coverage and competitive mobile money
Solar Home Systems	<ul style="list-style-type: none"> • Develop and enforce technology guidelines/standards for solar home system equipment • Extend current policies on digitalization, including stronger rural cellular coverage and competitive mobile money