DOWNLOAD PDF AMERICAS SOLAR POTENTIAL

Chapter 1 : Solar Power Today and its Potential for the Future | HuffPost

America's Solar Energy Potential Every hour, the sun radiates more energy onto the earth than the entire human population uses in one whole year. The technology required to harness the power of the sun is available now.

The future Introduction Central America is rich in renewable energy resources and there exists tremendous opportunity to harness this potential. The region has a total installed generation capacity of 12GW. As a whole, Central American countries generated 43TWh in Encouragingly, despite the range of fossil fuel options now available, the region is continuing to expand its use of renewable energy, a trend that is in the global interest as well as the economic, social, and environmental interest of Central American countries. The opportunity Today, the electricity matrix of the Central American region is divided mostly between hydropower 30 per cent large hydro, plus 12 per cent small hydro and oil and diesel 38 per cent. However, concerns about dependence on oil, the environment and energy security have forced the region to develop other renewable resources. Central America has the largest share of renewables 56 per cent and the most diverse mixture of renewable generation, composed of biomass, geothermal, wind, and hydro. Potential The falling prices of renewables, their abundance in the region, and fit with a hydro-dependent electricity matrix indicates that the development of renewable energy is an attractive option for meeting growing regional energy demand and for providing energy security at a competitive cost. Moreover, the declining costs of wind and solar equipment have made those technologies cost competitive in several markets in the region; this is especially true of those countries which depend on imported fossil fuels for power or have high electricity tariffs, like Nicaragua and Honduras. In view of the increasingly favourable policies, incentives, and political support that have been introduced in the last five years, Central America has the potential to meet per cent of its electricity needs with renewable energy. Existing regional wind power installations currently use less than one per cent of the available resource potential, even according to conservative estimates, and most Central American countries boast two to three times the annual solar radiation of world solar energy leaders such as Germany and Italy. Geothermal Most of the geothermal potential in Central America has not been exploited. Studies vary widely in estimates of regional geothermal resources and range from 2,â€"13,MW across about 50 different sites. Wind In Central America, wind has been harnessed to produce energy at utility scale. The total installed capacity of wind power in the region reached MW in and slightly more than 38 per cent of the wind power capacity was installed in alone. However, these trends do not reflect the entire region. The regional interest in wind energy is expanding rapidly. The three countries mentioned above are currently installing and operating new plants. Panama, an ambitious newcomer, has licensed more than MW of wind capacity, which amount to a staggering 39 per cent of the installed generation capacity in Solar Solar energy in the region is in early stages, especially when it comes to market development. The first mid-scale photovoltaic power plant by regional standards is in Costa Rica, which has a 1MW plant that began operations in November In turn, a solar power plant of 1. Each facility will produce enough energy to provide electricity to over 1, households. Countries in the region have issued ambitious policy statements that show a political will for the further advancement of renewables. There are a variety of regulatory measures in place to ensure that renewable energy continues to grow. For example, five of the seven Central American countries have established tendering procedures and three have adopted clean energy policies. All countries except Nicaragua have adopted a biofuel mandate and Guatemala and Nicaragua have begun to experiment with feed-in tariffs. Most countries in the region have concrete policy mechanisms in place for advancing renewables. Tax incentives to reduce costs, stimulate investment and increase the competitive advantage of renewable energy sources are the most common, but the region also has positive experience in tendering for renewable energy projects. Newer mechanisms, such as net metering, feed-in tariffs 1 , and renewable energy production laws are just getting off the ground in Costa Rica, Guatemala, and Panama. Governmental structure The structure of Central American energy institutions has changed dramatically since reforms in the s created new independent regulatory agencies, unbundled and privatised large state-owned utilities, and established competitive electricity markets in most countries with the exception of Costa Rica and Honduras. Although new agencies initially faced obstacles connected with their lack of maturity, countries have developed stronger, more independent institutions over the years. Official estimates are for the expansion to be completed by the end of , although most experts in the region say that this timeline is unlikely. Current efforts to strengthen electricity integration in Central America through SIEPAC and to streamline regional electricity regulation through the MER can benefit from international best practices for scaling up renewable energy through regional interconnection. They also established a regional electricity market and a regulatory commission. To reinforce this interconnection and to enable access to North American and South American markets, a Mexico-Guatemala interconnection was completed and a Colombia-Panama interconnection is under construction. Central America experienced a wave of market liberalisation reforms in the s, during which El Salvador, Guatemala, Nicaragua, and Panama liberalised their entire electricity markets, unbundled their vertically integrated utilities, and opened areas of generation, transmission, and distribution to private competition. Honduras and Costa Rica preserved their vertically integrated utilities, which are state-owned and operate as a single buyer. Infrastructure challenges can present major concerns for developing any energy project in Central America, renewable or otherwise. Whether these challenges are perceived or real, they are often cited as particularly concerning for renewable energy deployment, increasing the risks and costs associated with renewable investments and, in extreme cases, preventing a prospective project from being developed. The distribution of renewables often means that existing grid networks must be extended to account for new factors, such as suitable project siting in resource-rich zones, and the need to manage intermittent generation. Across the region, the capacity of countries to finance new projects with local and international funds varies widely. Panama, for example, has both a very healthy internal savings rate and a high level of foreign direct investment FDI , whereas El Salvador has the weakest performance in both areas. This is consistent with the performance of investments in the power sectors of these countries. Nicaragua has negative internal savings, but a very high rate of FDI, while Guatemala and Honduras have modest but positive rates in both areas. The major obstacle to integrating sustainability policies into the operations of financial institutions remains the lack of understanding of the risks and opportunities of renewable energy and a failure to address these with the right financial products. Having said that, the ability and willingness of commercial banks to fund renewable energy projects has increased significantly in recent years. Loans cover up to 90 per cent of project costs, with costs for audits built in, as well as an associated partial loan guarantee programme for energy equipment which can enable larger-scale project financing. In the past decade, Central America has improved development policies and regulatory frameworks to promote renewable energy, despite challenges in some countries in relation to the overall investment climate. We can see that increasing policy support, such as the use of energy auctions, has already led to growth in renewable energy capacity in Costa Rica, Guatemala and Panama. A further development may be solar energy: There are enormous opportunities for future renewable energy development in the region, and domestic and international investors will be increasingly willing to harvest these opportunities if the remaining technical, market, finance, and social barriers can be removed. However, to achieve their full clean energy potential, Central American countries will have to assess and document their renewables endowment, communicate broadly the potential of these assets, and create the necessary financial and political mechanisms for supporting them.

Chapter 2 : The Way Forward for Renewable Energy in Central America | Worldwatch Institute

Concentrating solar power (CSP) is the other method for capturing energy from the sun, and seven southwestern states have the technical potential and land area to site enough CSP to supply more than four times the current U.S. annual electricity demand. 1.

The report focuses on the status of renewable energy technologies in Central America and analyzes the conditions for their advancement in the future. It identifies important knowledge and information gaps and evaluates key finance and policy barriers, making suggestions for how to overcome both. Central America, long a frontrunner in hydropower and geothermal energy, is exploring its potential for expanding these technologies in a more sustainable manner while also developing other renewable energy resources such as wind, solar, biofuels, and agricultural waste. Still, as the economies of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama expand, use of fossil fuels is on the rise, while the use of fuelwood, primarily for cooking, continues to be unsustainably high. Across the region, an estimated 7 million people still have limited or no access to electricity services. Renewables are the only convincing and affordable solution to provide underserved communities that are far from existing grids with access to modern energy services. The urgent challenge for the region is to build on past successes and avoid locking in economically, socially, and environmentally costly fossil fuels for decades to come. The potentials for renewables are enormous: Solar and biomass have enormous potentials throughout the region. Despite their sustainable energy ambitions and policy statements, the seven countries of Central America have been unable to comprehensively design, synchronize, and implement the program of work necessary to promote sustainable energy solutions to their full potential. The full costs and benefits to society of specific energy development options remain unclear. What is evident, however, is that the region pays an enormous socioeconomic price for its reliance on fuelwood and imported fossil fuels. Most Central American countries have been able to greatly improve their investment climate for sustainable energy. Still, powerful financial barriers remain, ranging from the unavailability of capital and the lack of human expertise, to investment insecurity and costly administrative processes. Most countries in the region have concrete policy mechanisms in place for advancing renewables. To support this transition, we suggest four areas for improvement in knowledge and communication as well as four areas for improvement in finance and policy: Addressing knowledge and communication barriers: Produce additional, detailed assessments of renewable resource potentials in the region and make them publicly available; Assess renewable resource technical potentials against existing and future electricity load curves, and harvest renewable resources in tandem with energy efficiency and smart grid solutions, via an integrated energy planning approach; Assess and communicate widely the full socioeconomic impacts of different energy scenarios, including impacts on local economies and job creation; and Increase efforts to support national and regional renewable energy research; boost public awareness of renewables; and strengthen the related knowledge and human resource capacities of the government, banking, and private industry sectors. Addressing finance and policy barriers: Mainstream renewable energy policies and goals among the diverse government agencies; Evaluate existing policy instruments related to renewables and, where necessary, refine the policy mix; Streamline administrative processes for developing new renewable energy projects and make them less costly and time intensive; and Establish clear indicators for measuring, evaluating, and reporting progress on renewable energy policies and investment environments. Central America can power its economies in large part with renewable energy sources, helping the region to address some of its most pressing development challenges. What is needed now is the continued, collaborative effort of researchers, governments, and the private sector to help realize this goal.

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Chapter 3 : America's Solar Energy Potential | a4architect

Consider the solar energy potential of one acre of land. There are 43, square feet in an acre. Divide the number of square feet in one acre by 9 (the number of square feet in one square yard) and you find that there are 4, square yards in one acre of land.

In Morocco, expansion of a giant solar power plant near the city of Ourzazate will soon increase its capacity to megawatts. Solar energy has been slower to arrive in West Africa, but growth is underway. Zagtouli now delivers 30 megawatts to the national power grid. Charlotte Aubin, founder and director of Greenwish, a renewable energy company, was closely involved. She helped create the first Independent Power Producer, or IPP, with money from Senegalese investors and an international fund backed by three European governments. How is that possible? The more people want a product, the cheaper it gets. Led by investment from the United States and China, the industry has been rapidly scaling up. Production costs have come down as a result. Coulibaly says he has seen the price of a solar panel reduced by more than percent in Maliâ€¦ in only twelve years. Something else has changed too in the region: Until recently, independent power producers like Air Com and the Greenwish project could not exist. The law simply prohibited it. Senegal lifted the ban on non-state power production in ; Mali did it in , while Burkina Faso legalized IPPs only last year. Senegal now has four solar power stations. Burkina Faso is building two more. South Africa and Morocco have dozens each. And the list is getting longer: At nighttime, an estimated million Africans still use candles and kerosene lamps to light their homes. How do you get all those millions connected? Charlotte Aubin has an idea that would use existing structures â€" telephone towers. Companies like Air Com in Mali build small local grids, tailor-made for the communities they serve. Coulibaly says we make an estimate of the electricity needs of a particular village â€" now and in the future. And then we build an independent local solar-powered grid based on those estimates. But for private power producers and small independent off-grid networks, the future looks bright.

Chapter 4 : Solar Energy and Energy Independence

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The technology required to harness the power of the sun is available now. Solar power alone could provide all of the energy Americans consume â€" there is no shortage of solar energy. The following paragraphs will give you the information you need to prove this to yourself and others. You do not need advanced math skills to follow and perform the arithmetic examples shown below. Anyone who can balance a checkbook or calculate the total square feet of floor space in his or her home, and understand why an area measuring 10 yards by 10 yards equals square yards, can perform the following arithmetic examples and prove that American energy independence could be achieved with solar energy alone. On average, and particularly in the Sunbelt regions of the Southwestern United States, every square meter area exposed to direct sunlight will receive about 1 kilowatt-hour per hour of solar energy. Scientists like to measure things using the metric system. However, most Americans are unfamiliar with the metric system. Europeans use the metric system. It is easier for Americans to think in square feet and square yards because feet and yards are common lengths in the United States. So, for the sake of clarity and because this is written for an American audience, all measurements will be converted from meters to yards. A simple calculation can accomplish the conversion from square meters to square yards. A square yard is Prove this by multiplying The answer is nine the number of square feet in a square yard. If you perform the calculation you will see that the answer is slightly less than the whole number 9 but close enough for our purpose. Using this conversion, we can say that a square yard of land in direct sunlight receives x This calculation can also be used in reverse to convert yards to meters, simply divide by. Every square yard of land, if exposed to direct sunlight, receives about watts of solar energy [NOTE: In round numbers, a one square yard area will receive about watt-hours 5 kilowatt -hours per day of solar energy. Another way to obtain this result would be to take the 6 kilowatt-hours per meter explained above in the third paragraph and apply the conversion calculation 6 x Americans can assume, at least in the Sunbelt regions of the southwestern United States, that every square yard of land exposed to direct sunlight will receive about 5 kilowatt-hours per day of solar energy. With the above information in mind, perform the following exercise: Measure an area ten yards long and ten yards wide. That would be thirty feet by thirty feet. Take a good look at the size of it. You are looking at an area covering square yards. If that area were in direct sunlight all day it would receive about 5 x kilowatt-hours per day of solar energy. Now go look at your home electric bill. Your electric company calculates your home electric bill based on how many kilowatt-hours of electrical energy you use. Find the total amount of electricity that you have been billed for given in kilowatt-hours. The amount of kilowatt-hours on your bill is for an entire month. If your home is a typical residential electric customer, you and your family consume between and kilowatt-hours of electricity per month. Compare the quantity of electric energy your home consumed in one month with the quantity of energy the sun gives freely to a square yard area exposed to direct sunlight. One hundred square yards of sunshine provides as much energy in 1 to 2 days as an average family uses in an entire month! Technology accomplishes the conversion of solar energy to electricity. Several different technologies are used; perhaps the one that most people have heard of is the solar panel, made from photovoltaic cells called PV. For a detailed explanation of photovoltaic cells there is a very good article on the Internet located at: Conversion of one form of energy to another always causes a loss of energy. In other words, the new form of energy will be less than the original. Efficiency is the word scientists use to describe the difference in power resulting from the conversion of one form of energy to another. The same thing is true of gasoline in your car. Solar panels PV covering an area ten yards by ten yards square yards or square feet would produce x. Seventy-five kilowatt-hours per day is a lot of electricity for a single-family home. If part of the electricity is stored in a home battery, or is used to electrolyze water for producing hydrogen gas, and the gas is stored for use by a fuel cell when needed, then square yards covered with solar panels would provide an average family with energy independence. Most detached family homes have more than square yards square feet of roof, or that much space around their homes where solar panels could be installed. In the Southwest, if you look at any commercial or industrial park, or any typical mall or supermarket you will see that most of the buildings have flat roofs. Those roofs require insulation to lower the cost of air conditioning on hot days. If those roofs where covered with solar panels the sun would provide electricity for the air conditioning and save businesses millions of dollars per month that would otherwise be paid to the utility companies. Unlike photovoltaic cells, CSP uses mirrors to concentrate the sunlight on a focal point, which magnifies the suns heat. Similar to holding a magnifying glass in the sun, focusing the light onto a piece of paper until the paper catches on fire. CSP technology has more than one form. Troughs, dishes and towers are the different forms available today. A CSP dish or tower looks like a modern glass sculpture and contributes aesthetically to the landscape. CSP systems can achieve 30 percent efficiency, or about twice the efficiency of standard photovoltaic cells 2 x. Large Concentrating Solar Power plants create the thermal energy equivalent to conventional fossil fuel power plants. After the sun sets, CSP plants generate electricity from cost-effective thermal storage , providing hour service to the power grid. Consider the solar energy potential of one acre of land. There are 43, square feet in an acre. Divide the number of square feet in one acre by 9 the number of square feet in one square yard and you find that there are 4, square yards in one acre of land. A CSP dish, tower, or trough receiving an acre of sunshine would yield about 1. One acre has enough solar energy potential to yield 7. Each thousand kilowatts is one million watts. A million watts is a megawatt. Consider the solar energy potential of one square mile of land. A square mile is acres. One square mile of sunshine has the potential of providing acres x 7. Ten thousand square miles is a plot of land miles long by miles wide. Multiply acres by 10, square miles equals 6,, acres. With a yield of 7. What does this mean? The entire State of California uses about 50, megawatt-hours of electricity per hour at peak time, and much less during off-peak hours:

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Chapter 5 : Renewable energy in the United States - Wikipedia

Solar brightfields, solar arrays built upon landfills or contaminated land, are a fast-growing segment of the U.S. solar industry with the power to unlock gigawatts of clean energy potential and.

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In a practical application, not all of the land area will be used. This is because of unfavorable terrain and the need for service roads and land for plant facilities. And, the solar collectors must be individually positioned for optimal orientation to the angle of sunlight and given enough space between collectors to prevent a collector from casting a shadow on adjacent collectors; the result is unused space between the collectors. For these reasons, actual electricity production will be less than the numbers shown in the examples. However, the desert regions of the southwestern United States will easily produce 7 hours of productive sunlight per day, and often exceed 1 kilowatt of solar energy per square meter, so in that respect the above calculations are conservative. Lake Mead, behind Hoover Dam, covers more than square miles. Given an area the size of Lake Mead, for the production of electricity from solar energy, California would be energy independent. CSP plants seem to use a lot of land, but in reality, they use less land than hydroelectric dams for generating an equivalent electricity output, if the size of the lake behind the dam is considered. The same is true for coal plants. A CSP plant will not use any more land than a coal power plant if the amount of land required for mining and excavation of the coal is taken into consideration. If the sunshine radiating on the surface of an area miles wide by miles long would provide all of the electricity that America needs, every day, why would Americans hesitate to use it? One million soldiers trained in this area using tanks, artillery and aircraft. The desert is very resilient, there is little evidence today of injury to the desert ecosystem. The system would only be needed until fusion energy, or something like it, is developed, then the land would be returned to nature in the care of the public parks service. Time, sand and the desert wind would gradually remove all evidence of technologies brief occupancy. In the meantime, the lizards, turtles, snakes and scorpions would hide and sleep in the shade under the giant mirrors and troughs. The reason why solar energy has not been development on a large scale is the cost. Not the cost of sunshine, that is free. Private investors resist putting their money into solar energy projects because of the high upfront capital investment required for plant and equipment. The initial investment is what causes the price per kilowatt-hour for electricity from solar energy to be higher than the price of electricity generated from natural gas or coal. The estimated kilowatt-hour rates assigned to solar energy are not based on the cost of electricity generation, they are based on the cost of the investment capital and the requirement to earn a return on investment, or pay back the loan for the investment. Remember, the solar fuel is free.

Chapter 6 : RE-Powering America's Land | US EPA

FILE - People stand next to solar panels of the solar energy power plant in Zagtouli, near Ouagadougou, Burkina Faso, Nov. 29, , on its inauguration day.

Chapter 7 : Renewable energy in Latin America: Central America | Global law firm | Norton Rose Fulbright

It's understandable if the megawatt solar project that recently broke ground outside Annapolis didn't garner national attention. After all, 12, megawatts of new solar will go online across the United States in

Chapter 8 : Solar Power Could Provide 10 Percent of U.S. Electricity by

Solar Maps. These solar maps provide average daily total solar resource information on grid cells. Learn how the maps were made.. If you have difficulty accessing these maps because of a disability, contact the Geospatial Data Science Team.

Chapter 9 : West Africa Taps Solar Energy Potential

Describes how contaminated lands, landfills, and mine sites can be reused as renewable energy installations. Also supplies best practices, tools and resources for screening properties for renewable energy potential.