

Myths and Misconceptions of Solar Energy (Part 1)

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Hugo Lucas Porta Hello, ladies and gentlemen. I'm very happy to welcome you to today's session on the first part of the solar myths. I would like to thank the International Solar Alliance and the Clean Energy Solutions Center for facilitating this webinar series. Some background for me. Before I joined Factor in 2010, I had been director for policy and finance at the International Renewable Energy Agency, IRENA. Previously, as a [inaudible] civil servant, I have been involved in many national and [inaudible] relations for the promotion of renewable energy [inaudible]. This training is part of Module 6 [inaudible] economics, [inaudible] solar energy, and focuses on debunking the solar myths. In this lecture, we will, as always, start with a brief description and definition of what solar myths are, and, afterwards, jump into the main body of the presentation. Don't forget that at the end of the presentation, you will be given the chance to test your knowledge [inaudible]. The learning objectives, which this module aims to provide, can be divided into two: an understanding of the myths and misconceptions of solar energy, and an overview of the main myths around solar energy, both solar [inaudible], or CSP, concentrated solar power, and photovoltaics.

A [inaudible] of solar energy can be primarily classified into two groups: those which may be legitimate to address, and those based on misconceptions about the technology. For the legitimate concerns, even those around energy, can support the mitigation of adverse environmental and social impacts originated from conventional energy production and consumption. It is still important to pinpoint that very large-scale deployment may also generate negative impacts on [inaudible]. Those impacts can vary significantly, not only around technology [inaudible] concentrated solar power, but also according to geographic location. [Inaudible] decentralized [inaudible]

photovoltaic installation may face more [inaudible] in controlling some impact [inaudible] those related to end-of-life treatment of equipment and components.

Misconceptions or myths. A misconception or myth is a view or an opinion made based on false understanding or interpretation of [inaudible]. The basis of this group of [inaudible] can be further distinguished between an intentional misinterpretation and intentional misinformation. An intentional misinterpretation is largely a result of knowledge gaps, which may be [inaudible] when solar energy is not communicated properly to the public due to the [inaudible] in quality or amount of information. People may believe low-quality information from unprofessional and unreliable sources, which may look relatively easy or convenient to understand [inaudible] being [inaudible] communicated in an unclear or in [inaudible] complex way to the audience so that they cannot or are not willing to take it. Misconceptions also originate from intentional misinformation, which may be provided by vested interests who create poorly rooted claims and [inaudible] that mislead scientific evidence. They may [inaudible] of evidence while not showing a full spectrum of facts. Extensive efforts for proliferating [inaudible] claims via different media can create [inaudible] imbalance inefficiently. The main body of this lecture is divided into two parts. We will begin with the myths about concentrated solar power, and continue with myths [inaudible].

Myths. Concentrated solar power is too expensive, and it will always be so. The fact is that prices for electricity produced by today's CSP plants fill the range from 12 to 16 [inaudible] per kilowatt depending on the irradiation level, and, most importantly, on the financing conditions. A remarkable cost reduction, around 50 per cent, has been achieved by CSP since 2007, with only approximately 4.5 GW installed worldwide. Compared with the current situation of wind, 350 GW, and PV 130 GW at the end of 2017, one can easily figure out the real potential for cost reduction in the next years of CSP plants. Although CSP plants are more [inaudible]-intensive than traditional fossil fuel plants, their operating costs, once connected to the grid, are low [inaudible] because sunshine is free. They will continually decrease over the coming years to the [inaudible] technology development. The result will be that cost optimization, economies of scale, and after deployment of large plants around 250 MW, are expected to further reduce the costs below [inaudible] by 2020. This means that solar thermal electricity, or concentrated solar power, will be competitive against coal and gas [inaudible] before 2025. However, as today, the cost of electricity produced by CSP plants is lower than the one generated by currently-announced nuclear power plants. In other words, concentrated solar power [inaudible] technologies are much more economically efficient compared with new fossil fuel plants from their respective [inaudible] over the lifetime of the plant.

Myth. CSP plants are an intermittent way of generating electricity. The fact is that CSP plants are today, in most cases, equipped with a heat storage system. During sunny hours, the collected solar energy is used not only to provide steam to the turbine but, also, to charge the thermal storage tank. Then, after sunset or during cloudy periods, the energy can be drawn from the storage

tank to deliver energy on demand. Normally, the solar [inaudible] on the tanks are designed to cover four to seven hours of operation, but there is already a reference plant, [inaudible] in Spain, that can produce electricity continuously during the summer season, day and night, just like [inaudible] nuclear power plants. From a system perspective, due to its [inaudible] thermal storage capability, solar thermal energy, or CSP offers significant advantage over other renewable energy sources. For the [inaudible] with biomass or natural gas [inaudible] for delivery of solar thermal electricity to markets [inaudible] operate.

Myth. CSP is not a mainstream energy source in Europe. According to the 2014 edition of International Energy Agency Technology Roadmap for CSP, the estimated production of CSP reach about 1,000 TWh by 2030 and 4,380 TWh by 2050, thus providing 4 per cent of the electricity mix in Europe, and 11 per cent of global electricity mix. In other words, this will be a significant share in the energy mix. As we have seen in the previous chapter [inaudible] 2017, the main markets concentrated solar power were Spain and the United States of America, where now new markets are moving into regions with higher number of solar hours during the year. With only 4.5 GW in 2017, CSP technologies were relatively new to other energy technologies. However, CSP has a considerable potential in [inaudible] electricity generation. In a small part of North Africa and the Middle East [inaudible] could meet the electricity demand of Europe, the Middle East, and the North African countries at the new market now for concentrated solar power, in particularly Morocco. There is also great potential for CSP plants [inaudible] in southern Europe. For example, in Spain, there exists today 50 plants with a total of 2.3 GW connected to the grid currently producing [inaudible] per year, so 50 represent already 3 per cent of electricity in Spain. Assuming an important capital contribution and the contribution of energy storage, international [inaudible] suggests that CSP could become [inaudible] competitive for [inaudible] peak loads within the current decade. [Inaudible] solar thermal electric and increase price in not only fossil fuel but also CO₂, which will bring these technologies mainstream.

Myth. Support programs for CSP deployment are expensive and inefficient for the economy of the countries. The fact is that CSP investment creates more than ten times more employment and social wealth per MW than the same investment in fossil fuel power generation. Investment in CSP plants brings high macroeconomic benefits to countries that go for it. It is high local economic content that [inaudible] CSP industry brings great contribution to the country GDP during both the construction and operation of the plants. In terms of [inaudible], the CSP industry has made the jump from manufacturing and engineering to construction [inaudible] through Europe and Asia and North America, and will continue doing so as the global CSP market is set to reach up to 150 billion [inaudible] per year according to International Energy Agency Technology Roadmap for [inaudible] power. Based on the figures estimated by the National Energy Agency, from 40 to 57 billion [inaudible] will be invested [inaudible] between 2015 and 2030, creating 275,000 to 420,000 jobs worldwide. Up to 150,000 qualifying jobs are [inaudible] alone in Europe [inaudible] covered in a wide spectrum of [inaudible] activities

related to engineering, development of financing, manufacturing of components – of reflectors, [inaudible] – construction, [inaudible] installation, and commissioning [inaudible], and also creating [inaudible] jobs.

In addition to such varied activities, the CSP industry will, in this case, also create [inaudible] jobs, research, training, transport, information and communication activities, and [inaudible]. The returns of all kinds of taxed incomes [inaudible] unemployment subsidies, [inaudible] inputs, [inaudible] CO2 emission rights [inaudible] contemplated timeframe along the lifetime of a plant higher than [inaudible], but decreasing premiums to [inaudible] prices. A report from the National Renewable Energy Laboratory estimates that investing in 100 MW of concentrated solar power generates 4,000 [inaudible] job years, plus 94 permanent jobs, and \$628 million in economic output compared to [inaudible] jobs, [inaudible] permanent jobs, and 47 million economic output for an identical investment in natural gas-fueled power plant.

Myth. CSP plants disrupt landscape. The fact: CSP power plants tend to be located at abandoned industrial sites, on rural land and in deserts to lower the impact of land use and land disturbance. Beauty is in the eye of the beholder. For [inaudible] CSP [inaudible] project, and [inaudible] in the industry [inaudible]. All this may not seem the same. All this is, again, largely a matter of [inaudible] opinion and individual taste. [Inaudible] plants are difficult to be perceived [inaudible] landscape [inaudible] and not [inaudible] over a large area. The [inaudible] CSP power plants can be seen from far away, a little similar to a lighthouse. [Inaudible] the view of [inaudible] concentrated [inaudible] is appreciated by most people.

Myth. CSP power plants need too much land. The fact is that the electricity yield of solar technologies per unit of land is in the order of magnitude of other technologies. Moreover, CSP makes great use of the [inaudible] a relatively modest amount of desert land will be enough to supply our planet with energy. According to a study performed in 2003, 2,400,000 [inaudible] per year using 1 per cent of each of the [inaudible].

Myth. CSP plants need much water. The fact is that CSP plants require less water per hectare than agricultural activities, as this was assessed in the south of Spain. Compared with conventional [inaudible] or nuclear technology, this statement does not hold true. It is true that whatever sources are often [inaudible] can be used for cooling the condenser of the steam cycle. Solar fields can be also integrated in [inaudible] thermal power plants, coal or gas, reducing immediately gas consumption and emissions [inaudible]. Moreover, solar thermal electric power [inaudible] is possible and makes sense on many sides. Solar fields can be designed with [inaudible] electricity generation [inaudible] to produce high-temperature heat to be used for industrial heating, production of synthetic fuels, [inaudible]. The combined production of electricity heat [inaudible] is of particular interest in [inaudible] where solar thermal electric can provide electricity for [inaudible] or heat for [inaudible].

Myth. CSP [inaudible] technology and, thus, not reliable. CSP plants have proven their reliability since the '80s, as the first commercial-scale application, the Solar Energy Generating System, with nine separate sites, continues to operate and produce 300 MW of installed capacity, enough to power nearly a quarter of a million homes at peak production. In other words, CSP plants have a lifetime of more than 30 years with minimum performance losses. [Inaudible] MW were installed in Spain since 2007 at 50 [inaudible] plant locations, and provide reliable electricity much preferable to the [inaudible]. The maturity and reliability of the huge [inaudible] energy since 2008 [inaudible] of evidence with daily charting, and this charting [inaudible] without any incidents. For many days during the summer 2014, solar thermal electric plants supply more than 10 per cent of the demand. On many days of the summer 2014, the total daily contribution was about 5 per cent of the demand in Spain, with the same reliability as any other conventional source. Taking into account the great potential macroeconomic benefits and the contribution of renewable energy source integration, solar thermal electric [inaudible] further support in the coming years.

CSP industry is failing – myth. The fact is that CSP industry is rather booming worldwide. Since 2010, generation of solar thermal electricity from CSP plants has grown strongly worldwide. According to International Energy Agency, the prospects for the development of CSP plants are extremely high. The forecast of CSP plant production could reach about 100 TWh by 2013, and almost 4,500 TWh at 2050 on a world level, thus, providing 4 per cent of the electricity mix in Europe and 11 per cent of global electricity mix. We have seen how in the last two years, the market has expanded from an initial ten-year phase where all the plants concentrated either in Spain or in North America, and, in the last two years, the number of countries with new CSP plants has increased in Australia, China, India, Turkey, United Arab Emirates, [inaudible] and South Africa, to mention a few. Today, the market has reached 6.2 GW.

Myth. CSP is very complex technology. The fact is that CSP power plant is not that complex, although CSP plants are like mechanical watches with many parts and components to be optimized. The electrical part of CSP plants uses common, simple conventional power generation parts and devices – just the solar field is specific.

Myth. CSP plants endanger wildlife. The fact is that there is no case about endangering wildlife at all, and the news all over the country related to bird deaths are exaggerated. However, recently, there seems to be some misleading and exaggerated news in the United States about bird deaths associated with concentrated solar power plants, especially the story about a new solar [inaudible] in California killing up to 28,000 birds per year [inaudible], which is based on a number of uncertain assumptions. In fact, the power plant reported 321 total avian fatalities between January and June 2014, in which [inaudible] were related to [inaudible], thus falling short of the estimate in those criticized [inaudible] energy [inaudible]. In 2015, [inaudible] more than 6,000 birds estimated over the course of a year. In reality, the impact of CSP or other renewable energy sources and power

generation on bird deaths has been largely overblown. So, what do these numbers mean compared to other sources of bird deaths? For example, in the U.S. every year, cats kill between 1.4 and 3.7 billion birds. Windows, nearly 1 billion. Cars, some 60 million. The [inaudible] nearly 8 million. If killing birds has to be avoided at all costs, then windows, pets, cars, and roads should be [inaudible]. Moreover, this may happen only [inaudible], which is less than 10 per cent of [inaudible] CSP power in the world, and it is not the case for power [inaudible].

Myth. Countries may be better off starting a CSP program later. The fact is that a support program for CSP would provide immediate positive returns to the economy of any given country, in terms of GDP increase, employment, and taxes, right from the starting up of the construction phase, while the first premiums will be paid some years later. [Inaudible] solar thermal electric [inaudible] association has performed simulations for different countries, which shows that their returns to the economy will be always greater than the corresponding premiums. The [inaudible] is also to be taken into consideration. The [inaudible] is the time when the support program ends and the cost of the electricity produced will be [inaudible] without necessity of repowering the unit. Besides this, there [inaudible] during the construction of the plant will be increasing with the time [inaudible] CSP programs. Therefore, an ambitious country can reach a point where new CSP plants can be deployed without any further [inaudible] support. This means that the country that has started [inaudible] earlier will be in a position [inaudible] further benefits by building the plants with [inaudible] close to 80 per cent, while others may start later the CSP program but with most of the supplies still coming from [inaudible]. Initially, such countries with [inaudible] CSP program will no doubt [inaudible] an additional [inaudible] advantage [inaudible] neighboring countries.

Myth. CSP companies, along the whole value chain, are making huge due to incentive measures – feed-in-tariffs or feed-in-premiums. The fact is that as CSP plants have high CAPEX, most of them were financed with a high leverage so that the banks are the entities that currently make most profit from the CSP deployment. [Inaudible] the companies [inaudible] investment [inaudible] for building up manufacturing units for specific CSP components [inaudible] for construction of the plants. In Spain, the profit and loss accounts of the plants [inaudible] is so very small positive results until they have to face [inaudible] cuts in the income [inaudible] of the plant [inaudible] several shortcomings [inaudible] legislation related to investment investor protection. We will now address the second part of the main body of the presentation, which is devoted to the myths about solar for the [inaudible].

Myth. The space requirement of a solar panel system is too high. The fact is that it is not necessary to provide large contiguous areas for a solar panel system. The advantage of photovoltaic solar energy is the possibility of decentralization. Roofs, house fronts, noise protection walls, canopies of traffic routes, et cetera, can be used; therefore, there are no area problems. The average household consumes about 10,400 KWh per year, and we assume 250 [inaudible] solar panel [inaudible] we can use the high and low

[inaudible] to calculate how many solar panels are needed [inaudible]. Thus, the typical home [inaudible] will need between 28 and 34 solar panels [inaudible] 100 per cent of the energy use.

Myth. The output of solar power PV system is not sufficient for the large power consumers. The fact is that with a decentralized power supply, a large number of solar PV plants provide the required power. Photovoltaic solar power can be collected [inaudible] through the power grid and then can be provided with sufficient power [inaudible].

Myth. The conditions for solar PV plants are good only in southern countries, where the sun shines sufficiently. The fact is that also in Central Europe and North America, the conditions for solar PV plants are good. Photovoltaics work both with [inaudible] and diffuse sun. Solar plants use light, not heat, to generate electricity. In fact, when the solar panels are cooler, they are better able to [inaudible] electricity. [Inaudible] is one of the leaders for solar PV capacity [inaudible].

Myth. Solar power is worthless because it only occurs when the sun shines. The fact is that solar PV systems provide electricity not only in direct sunlight but, also, from a bright sky. Even during the day, there is a high demand on the electricity grid [inaudible]. Photovoltaic solar power, which is [inaudible] utility grid [inaudible] to cover the peak loads [inaudible] heavy usage of electricity in peak consumption periods will be more expensive. It is not just a matter of replacing conventional power plants with photovoltaic solar power, but [inaudible] emissions. [Inaudible] solar power, which is fed into the grid, saves around [inaudible], depending on the country. With a [inaudible] conventional power plant, there is an energy [inaudible] renewable energy sources. Some provide [inaudible] mainly on summer days, but from the [inaudible] half of the year. Batteries and [inaudible] in the [inaudible] because the storage should [inaudible] without the sun.

Myth. Solar panels need a solar tracker system to follow the sun during the day. The fact is that the solar panels are always oriented to the sun, which coincides with the hours of higher solar radiation. Nevertheless, installing a solar tracker will increase the power output.

Myth. High environmental impact by chlorine chemistry and problems in disposal. The fact is that photovoltaic solar [inaudible] consist of nontoxic silicon, the second most widely used element on the earth's surface. Chlorine is only used when cleaning silicon. This takes place in closed cycles. The finished product, the photovoltaic solar cell, does not include chlorine compounds.

Myth. Solar PV systems cause additional electric smog. The fact is that electric smog is a collective term for high-frequency electromagnetic waves. However, electromagnetic waves are not created through direct current. Photovoltaics solar cells produce direct current, but this current is just in the solar power inverter converted into the standard alternative current. Anyone who wants to protect themselves from electromagnetic waves should [inaudible] of the solar PV system [inaudible], and, from there, the direct

current will be converted into alternative current. [Inaudible] solar PV panels [inaudible].

Myth. Photovoltaic-generated electricity is more costly than electricity generated from fossil-fueled or nuclear-powered electricity. Photovoltaics, unlike other power generation, can only survive with subsidies. The fact is that the rapid deployment of solar PV, working in combination with high learning rates – for every doubling of cumulative installed capacity PV module, costs decline by 20 to 22 per cent – has led to dramatic cost declines in the last ten years. Crystalline silicon PV module prices have fallen by more than 80 per cent since 2010, driving reductions in installed costs. Utility-scale solar PV projects can now produce electricity that is competitive with other grid supply options without financial support.

Myth. Solar cells require more energy for their production than they generate. The fact is that under the most trying conditions, it takes no more than three years of operation for solar cells to pay back the energy that goes into making them. As they will last for many decades, their energy payback is extremely short.

Myth. Solar panels will cause the roof to leak, deteriorate, or collapse. The fact is that solar panels actually protect and preserve the portion of the roof they cover. If there is ever a problem with the roof that needs to be repaired, panels can easily be removed. Most solar panels are not attached directly to the roof itself but, rather, to a mounted railing system.

Myth. Solar panels need constant maintenance. The fact is that photovoltaic solar panels are manufactured to be outdoors and withstand adverse weather conditions for many years. Its manufacture is strong, and, for this reason, the manufacturers offer guarantees of many years on the panels. Maintenance is minimal and will be limited to clean dust and dirt from the surface of the solar panel once a year, and check that the solar cables are still working.

Concluding remarks. We can now conclude that vested interest from the conventional energy companies has fed citizens with misinformation about solar energy technologies. Myths about solar energy persist due to the efforts of the conventional industry to reinforce these myths, the complexity of the topic not always easy for the citizen and the lack of a strategy from the solar industry to communicate better. Myths on solar energy are related with many aspects: reliability, economic, environmental concerns, et cetera. There are facts to debunk these myths. Fourth, [inaudible] legitimate concerns have been addressed by the solar community by applying good practices to reduce potential damages. Up to this point, we came today [inaudible] module on solar myths, and would like to thank you for your attention [inaudible] you are invited to test your understanding of the contents in the following [inaudible].