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Maximizing the Value Chain: Solar Jobs

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Webinar Presenter

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Hugo Lucas Porta Hello, ladies and gentlemen. I'm very happy to work with you to today's session on maximizing the value chain in particular in how to maximize jobs, employment and the value chains for solar technologies. I would like to thank the International Solar Alliance and the Clean Energy Solutions Center who facilitates this webinar series. A few words about Factor: It's an international consulting firm advising public and private actors from climate change, sustainable energy to _____ strategy. About myself: Before I joined with Factor in 2010, I have been Director for Knowledge Policy and Finance at the International Renewable Energy Agency (IRENA). I was responsible there for all the work in socioeconomics of renewable energies. I learned then how to estimate and how to maximize employment in the value chains of renewables including solar.

The lecture of today about matching the value chains of solar is part of the Model 6 on socioeconomic aspects of solar. In this lecture of today we will start with a brief definition of the model of the value chain and, after a while, jump into the main body of the presentation. Don't forget at the end of the presentation you will be given the chance to test your knowledge with a little quiz. The learning objective, which this model aims to provide, can be divided into three parts. First we will see a brief overview of employment in the solar sector.

This is followed by a detailed description of the structure and relevance of the solar PV Value Chain. Finally, we will talk about the opportunities for policy makers to maximize the value chain and to create jobs.

On the model for the value chain, I would like to give you an overview of the concept. A value chain is a tool for strategic analysis for manufacturing (or service) organization as a system, made up of subsystems each with inputs, transformation processes and outputs. It encompasses all the values processes in both in the production of goods and services around material to deliver a product and it’s based on the notion of value added at each state of the production. The tool can be a great help in analysis of such a global industry as solar photovoltaics. They are ______ to understand the graphical distribution of different production activities, their interconnections and interdependences and, ultimately, a decision making adjusting new markets for expansion.

The main body of the presentation is divided into 4 parts. First of all we will learn about the development of the employment in the solar market in the last years, followed by the general structure and relevance of the solar value chain. Later we will see a presentation of ways to maximize the value chain from a production and a strategic perspective and opportunities for ______ makers in setting then enabling environment to maximize jobs locally. As you can see in the side as part of the International Renewable Energy Agency (IRENA), renewable energy offers a 10.3 million direct and indirect jobs in 2000 … at the end of 2017. Solar photovoltaic contributed the biggest share with 3.4 million jobs, solar, heating and cooling and concentrated solar power are relatively small in comparison with 800,000 and 34,000 jobs respectively.

Globally the solar PV industry had another banner year in 2017 with record installs of 94 gigawatts up from 73 gigawatts in 2016, significant new job creation. China, India, the United States and Japan were the most important markets, followed by Turkey, Australia and the Republic of Korea. Employment increased by 8.7 per cent to approach 3.37 million jobs in 2017. A key feature of the solar PV landscape is that jobs remaining highly concentrated in a small number of countries. This can be attributed to the fact that the bulk of manufacturing takes place in relatively few countries and domestic markets vary enormously in size.

The top five countries led by China account for 90 per cent of the solar PV jobs worldwide. Of the leaders shown in the diagram, 8 are Asian and overall else here is home of almost 3 million solar jobs. This represents 88 per cent of the global total followed by North America’s with 7 per cent and Europe with 3 per cent. Reflecting its unchallenged status as the leading producer of PV equipment on the world’s largest installation market, China, accounted for about 2/3 of the PV employment worldwide or 72.2 million jobs. Job gains were once again strongest in the installation segment, which now accounts for 36 per cent of China’s PV jobs. Likewise strong growth in new capacity addition boosted the employment in India to an estimated 164,000 jobs.

By contrast European PV employment continues its downward slide, reflecting limited domestic installation markets and a lack of competitive difference among European model manufacturers. Revised estimates indicate an 8 per cent decrease, 99,000 jobs across the European Union in 2016. More surprisingly, US employment fell as well for this time to about 233,000 jobs. Japan’s slowing pace caused employment to fall from 302,000 in 2016 to an estimated 272,000 jobs 2017. As deployment of solar PV continues to expand, more and more countries will benefit from job creation along the supply chain, primarily in installation, operation and maintenance. Available information for 2017 shows a decline in major solar heating and cooling markets, including China, Brazil and India.

Expert estimates that global employment in the sector stood at 800,000 jobs in 2017, a 2.6 decrease from the previous estimate. Estimates for China suggest that employment declined from the previous year. The country has long been the clear leader in the deployment of solar heating and cooling and still accounts for 83 per cent of the total jobs in the sector. The Top 5 countries account for 94 per cent of all jobs. Of the Top 10, 4 countries are from Asia and another 4 countries are from Europe. Employment in the European Union is thought to have declined slightly in 2017 to 34,000 jobs.

The Brazilian market declined as well for the second year in a row by 3 per cent, in 2017. IRENA's employ factor factor-based estimates suggest that country's employment in this sector fell slightly to about 42,000 jobs. Turkey has an estimate of 16,000 people working in this sector. In the United States the employment was estimated for 12,000 jobs in 2017. For India, where annual installations have fluctuated in recent years, the employment calculation suggest that the country have had some 17,000 in 2017, when 1.5 million square meters of collector area was added into the market. As in past years, China continued to have the largest number of people employed in renewable energy, accounting for 43 per cent of the world total. The number climbed from 3.6 million jobs in 2016 to 3.8 million jobs in 2017, a growth of 5 per cent.

This was entirely due to the continued expansion of the solar PV sector. Employment in solar water heating declined and remained essentially uncaged in other renewable energy sectors. Solar PV employment was estimated at 2.2 million jobs, an expansion of 13 per cent of the previous year. Of these jobs, almost 1.4 million were in manufacturing. Following the record solar PV installations in 2017 some 792,000 people were working in the construction and installation segment, 25 per cent more than the previous year. Employment in the Chinese solar water eating industry continued its down trend.

After 2.8 drop in 2017, employment in the sector stood at 670,000 jobs. The United States experienced its first job loss in the solar sector since 2010 when the Solar Jobs Census first began tracking employment. The number of solar jobs fell by 9,800 or 3.8 per cent to about 250,000. Most of the loss took pace in the installation segment, affected by a 22-percent reduction in new-capacity addition, particularly of utility-scale plants. The contracts between 2016 and 2017 is sick by the fact that installation in 2016 was driven higher by expectation that a 30 per cent federal investment tax credit might expire.

Policy uncertainties in states such as California, Massachusetts and Nevada have had an impact. The installation segment of the value chain generates more than half of all US solar jobs. Manufacturing accounts for a fairly small 15 per cent of employment. More than 95percnet of solar panels are imported. Project development represents another 14 per cent of jobs, sales and distribution 12 per cent, and the rest is in research and development, government and other activities.

In January of 2018, in response to a trade petition filed by two manufacturers, the US government imposed import tariffs for modules and cells at the rate of 30 per cent to decline to 15 per cent over 4 years. An initial analysis suggested that that the tariffs may reduce installations by 11 per cent over the next 5 years. In India, new solar installation reached a record of 96 gigawatts in 2017, effectively doubling the total install base of the technology in the country. Employment in solar PV increased by 36 per cent to reach 164,000 jobs of which 92,000 were in on-grid application. IRENA estimates that the construction and installation segment of the value chain accounts for 46 per cent of these jobs with operation and maintenance and manufacturing representing 35 per cent and 19 per cent, respectively.

Manufacturing of solar PV modules is limited, given the availability of inexpensive imports, mostly from China. The market share of domestic firms decreased by 13 per cent to 7 per cent from 2015-2017. As of September 2017, the average price of imported modules was USD 0.4/W, compared with the USD 1.4/W for domestic products and a large of the existing manufacturing capacity stands idle. Since solar PV has the largest market share regarding solar jobs, we will also focus this sector in the following slides of the solar value chain. The value chain of photovoltaic is considerably complex and involves of different professions required to create a utility-of-scale PV Solar System, however the real junior star once the solar cells module has been produced.

The manufacturing process captures only the upstream part of the value chain while most of the activities happen in the downstream part. It involves the project planning, implementation and use phases, including decommission. The project planning phase is very important. It includes area planning, system preparation, operational module, applying for approval for the use of land and considering different financial options. Once this has been done comes the implementation phase in which the offshore construction process takes place. The system is getting verified and installed.

The last part of the downstream value chain is the use phase, which involves a complex socio-technical configuration, which involves operation and maintenance activities as well as different adjustments and negotiations derived from the property relations around the PV solar plan, it's positioning within the industry and the markets, negotiation with local authorities and communities and how the plan will be operated and the energy produced will be distributed and used in an even local social components. In terms of project planning, the use phase involves consideration of political and country risk. Similarly to any other industry, the photovoltaics value chain can be broken down into several specific types of organization (suppliers, operators, consulting firms) that actually operate the values processes involved in the value chain. First there is a whole series of products that are required to be a PV solar system. Thus the following pleasure must be active on the market: Suppliers of the manufacturing equipment, suppliers of the raw material for wafer cells and module production, producers of crystalline silicone, producers for silicon wafers and ingots, et cetera.

In terms of services, there are financial, legal, consulting and testing services that go through the whole value chain as these services may be required at each stage. One can also include different activities such as education of the personnel, the publishing and PR efforts to promote solar energy as well as government relations services to obtain approval, subsidies and support grants. When it comes to actual phases of the chains, there are several necessary services as well: Wholesale distribution, project planning and development, design, engineering and construction, operations and maintenance services. In an ideal market environment, all these activities can be performed by different organizations that enter contractual relations with each other. In reality however firms tend to optimize their cost structures by reducing the transaction cost. There are several of doing so.

They can form a cluster, by concentrating related and interdependent activity in one region. For example silicon, wafer and modules production or diversify their processes. While there is a significant number of companies that focus exclusively on solar electricity or renewable energies, many newcomers and large corporations for whom solar is one market of many. Also most companies are partially vertically integrated in order to capture more stable value. As the whole industry develops, vertical integration becomes more feasible; however no group covers the whole value chain today.

Whilst there are many highly-specialized companies upstream, like Q-Cells or RSI Silicon, and in the more service-oriented downstream segment. So part of the body of the presentation we have seen or talked about the solar market and the concept of the solar value chain, we will now look at the possibilities to maximize the value chains and how to conduct these opportunities as a policy maintenance. First of all we will consider the possibility to increase the value from a production perspective. One possibility to do this is technology differentiation. To avoid having to compete just on price, firms must offer a product that is technologically different.

Whilst there are there are many distinguishing features, the one number to beat is efficiency as measured in $/kWp followed closely by the module efficiency measured in kWp/m^2. This is so important because a 1-percent point efficient increase in the cell results in an additional yield of 6 per cent. In addition it brings down requirements for area and electrical components. Also technologies study is possible to maximize value. The technologies that are installed today may not be the technologies of tomorrow.

For instance with the sharp drop in polysilicon prices some of the thin-film technologies no longer look as appealing as they did a year ago. As a mitigation strategy, we will expect alternative technologies to be present in any company’s product portfolio. Another possibility is to increase product quality and certification and this will help to gain value, too. The presence of module certification from independent bodies such as TÜV is no longer a distinguishing feature. It is in fact a quasi-license to operate.

Another possibility is production capability as an important factor. It is essential that production can be scaled up to significant levels. For the new technologies, like new thin-film photovoltaic material, the capability of ramping up production very quickly is crucial. Otherwise the new product will not make a difference. Another point is the cost structure. How well a company can control costs is one of the most important factors, especially in an industry that sees an ever-growing number of new entrants.

Silicon manufacturers with access to cheap energy, for instance, have a distinct competitive advantage as 85 per cent of the energy needed to build module is used in producing. Other cost advantage comes from economies of scale and supply contract at low-pricing level. Vertical integration will increase the value. In order to be able to capture more value and to mitigate the inherent risks of the supply chain, it is crucial to either integrate vertically or build a strong partnership with others in the value chain. Financial strength is important and to have the value creation and increasing. Whilst this is fairly obvious, a strong balance sheet is required not only to weather a downturn but also to finance growth.

Finally branding plays an important role. Success is determined by how well a company can communicate the value it creates for customers, its brand strength and access to distribution channels. Now we will see the issue of maximizing the value chain from a monistic point of view. Solar PV energy deployment has risen steadily for new 2 decades, from less than 9 gigawatts installed capacity in 20007 to more than 290 gigawatts in 2016. IRENA estimates that achieving the energy transition in the G20 countries will require communitive investment in the solar sector of about $3,630 billion by 2030 and $6,610 billion by 2050. Such investment can create value and result in economic benefits, including income generation and job creation.

The solar PV sector employed 3.1 people at the end of 2016, mainly in China, Japan, the United States, Bangladesh and India. Furthermore IRENA estimates that the solar sector could support around 9 million jobs in 2050. Some studies in the literature have analyzed the impacts of solar employment on the economy. They project that the solar industry will generate nearly 6.6 billion gross value added euros with a cumulative installed capacity of almost 139 gigawatts in distributed and large-scale installation and employ more than 136,000 people in Europe by 2020. With a total at 229,000 person days needed to develop a solar PV plant of 50 megawatts, labor requirements vary across the value chain. People working on operation and maintenance are needed through all the project lifetime and therefore represent the bulk of the labor requirements, 56 per cent of the total.

Equipment manufacturing, 22 per cent, and installation and grid connection, 17 per cent, also requires significant labor inputs. A greater number of jobs are in the downstream segment. Downstream employment has grown over time while upstream has remained stagnant. For example in Japan manufacturing jobs nearly doubled from 2002-2011 while those in services and other segments increased by 3.5 times. Similarly it has been estimated that for every firm in the German solar industry that manufacture solar PV modules, six other firms are created along the solar PV value chain.

In Europe 83 per cent of the impact on jobs and growth value added respectively 2014 was linked to downstream activities. A part of the value creation is the monitoring of existing costs. The total cost of a utility-scale ground-mounted solar system can be divided into 3 categories: The cost of modules, the cost of inverters and the balance of system costs. In 2015, balance of system costs were the major cost component of solar projects, accounting for about 60 per cent of total cost. Modules accounted for 30 per cent and inverters, 10 per cent. Hardware costs other than modules and inverters including cabling, racking and mounting, safety and security, grid connection and monitoring and control.

Installation costs involve construction and electrical installation and health and safety inspections. Soft costs include those related to financing, permitting, system and engineering design. Balance of system costs vary significantly across countries. Soft costs and installation costs constitute a large percentage of total costs in many countries, suggesting opportunities of value creation beyond the manufacturing of the main components. [Singing] You can see there is a strong correlation between jobs created and gross value added in the activities of the value chain.

In the United States for example the effects on job support are gross value added of the current market condition are visible in downstream activities where a decrease of more than 66 per cent in the gross value added and job support is observed between 2008 and 2016. For upstream activities, the effects are of the same order of magnitude with a decrease of 62 per cent over the same period. This stems from economies of scale and the learning curve, which affect upstream manufacturing activities more than downstream services activities. On the other hand downstream activities are more labor intensive. The price decline of solar products is mainly caused by increased efficiency and experience in the PV industry.

These cost reductions are partly the effect of more competition and of a more globalized production chain. Although a lower unit cost and increased efficiency of modules make solar PV systems more attractive, it also means less material and therefore labor for the same installed capacity. In addition, the gross value added decreases due to a lower unit cost, which can mean lower revenues per megawatt installed.

In the last part of the main body of the presentation now we are considering the different opportunities for increasing the value creation along the value chain. In the next slides we will have a view of the different parts of the solar value chain and which possibility assists to create for maximized value: Project planning, procurement, manufacturing, installation, reconnection, operational maintenance and the commission. Planning a 15 megawatt solar PV panel requires an estimated 2,120 per cent base of labor. Project development activities accounts for about 59 per cent of this labor, 1,250 person-days, followed by site selection, 17 per cent, engineering, 12 per cent, and feasibility analysis, another 12 per cent. Almost 40 per cent of the total person-days needed are for legal, energy regulation, real estate and taxation experts, indicating the importance of the knowledge of the local context.

While some of these needs can be fulfilled by foreign experts, they offer considerable opportunities for domestic employment. About 24 per cent of the total labor requires engineers, environmental experts and health experts and safety experts. These professionals can be hired from abroad on a temporary basis or skills could be developed domestically as part of the education and training policies designed to meet future needs in human resources. Manufacturing the main component of 50 megawatt solar PV plant requires 50,225 person-days. The production of solar cells requires much work.

Solar modules need another 21 per cent of the total person-days, followed by inverters, 17 per cent and solar trackers and structures, 14 per cent. Although building a domestic manufacturing capacity for solar has the potential to increase income and employment, realizing its value-creation potential requires the existence of and access to subcomponents, some highly specialized and raw materials. Maximizing value creation from the development of a domestic PV industry relies on leveraging capacities in other industries, such as glass, aluminum, silicon and semiconductors, in order to improve and provide expertise, raw materials and intermediary products for the manufacturing of components. The raw materials needed differ according to the PV technology. Two technologies dominate the market: Crystalline silicon and thin film.

[Sneezing, nose blowing and other non-verbal human-generated sounds]

Installing and connecting a 50 megawatt solar plant takes about 39,380 person-days of labor. The most labor-intensive activity is site preparation and civil works, which accounts for more than half of the total. This activity is always sourced domestically, creating many opportunities for employment especially for low-to-medium skilled workers. Assembling equipment accounts for 24 per cent of the total labor needed, followed by cabling and grid connection, 16 per cent, and commissioning site selection, 4 per cent. The installation and grid connection phases offer good opportunities for value creation, particularly where existing resources: Equipment, labor, and expertise can be leveraged. Around 90 per cent of the person-days required construction workers and technical personnel most of whom are available domestically.

The second most prevalent occupation for the phase are civil engineers and foreperson, which account for about 6 per cent of the total work. Operating and maintaining of a 50 megawatt solar PV plant requires an average of 13,560 person-days for every of the lifetime of the facility. Close to 86 per cent of the maintenance or 40 per cent of the labor is needed for operations. A skilled workforce with solid knowledge about solar PV plant operations make up the majority of the human resources needed. Maintenance requires construction workers for about 5,300 person-days per-year or 48 per cent of the total operation and maintenance.

Out of 1,900 person-days per-year required for operation, more than 1,100 are highly-skilled operators with specific skills. Similarly about 19 per cent of occupations needed for the solar plant operation and maintenance consists of technical personnel, between 9,950 and 13,400 person-days per-year. Another 15 per cent are highly-skilled engineers. It takes about 5,150 person-days to decommission a 50 megawatt solar PV plant. The most labor-intensive activity is dismantling the project, which requires 3,060 person-days, 60 per cent of the total. Disposing of equipment and clearing the site requires 1,220 and 890 person-days, respectively, 21 and 17 per cent of the total. Those activities can be commonly handled locally.

Technical and construction workers perform 73 per cent of all decommissioning work. The second most-needed occupations in this phase are truck drivers and crane operators, who account for 14 per cent of the total work. Last but not least as I've shown it previously, developing countries are more affected by the shortage of education and training and resources. One of the fastest-growing markets in the solar sector is the off-grid sector both solar home system and _____. As analyzed by the International Renewable Energy Agency (IRENA), the solar off-grid sector has a great potential to create ______ and _____ jobs and, of course, in these jobs created, you, too, the improvement of the economy when it is powered.

All of the challenges, the Alliance Rural Electrification have created platform to advertise jobs in the off-grid sector. Concluding remark: In this last part we will come to our conclusion of the most common and important information, which we have collected today in this presentation. Several forces define the socioeconomic impasse of the PV industry; the most significant are _____ of capacity/efficiency gains in manufacturing and services and _____ _____. Opportunities for domestic value creation can be created at each segment of the value chain, in the form of jobs and income generation for enterprises, operating in the country. Opportunities for leveraging local labor markets and existing industries can be identified to maximize domestic value.

So as usual you can have now a small quiz to test the knowledge of the lecture today. Thank you very much.