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Implementation of Rooftop Solar in Qatar: Lessons Learnt from SolarCity Business and Finance Models in the U.S.

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Qatar is a country with huge potential for solar energy applications due to its reasonably high global horizontal radiation value. Further, solar energy can be used to reduce the demand on fossil-fuel generated electricity hence creating more revenues for Qatar from its natural gas resources. Currently, the residential sector consumes 57% of the total electricity consumption in Qatar. Moreover, Qatar has one of the highest electricity consumption per capita rates in the world; >15,000 kWh/year. Subsequently, at an individual level, the carbon footprint is high. It is important that we find cost effective ways to reduce dependence on fossil-fuel generated electricity as a step towards sustainable energy generation and use. Rooftop solar in the residential sector is identified a promising solution for Qatar to be sustainable in terms of energy use. The concept of using solar PV systems in homes is not a new one and has been applied in many countries. The private sector, in particular, has done a very good job in increasing the deployment of rooftop solar. However, at a corporate level, solar PV companies have to deal with a lot of economic and legal challenges. The main challenges are affordable financing and a resilient business model. One company that has managed to overcome these two challenges and become a pioneer at installing rooftop solar systems at a nationwide scale is SolarCity in the U.S. SolarCity was set up in 2006 and by 2014 it became the largest supplier and installer of rooftop solar systems in the U.S., accounted alone for one third of the residential solar market in the U.S. and had a cumulative installed capacity of 650 MW. A lot of lessons and strategies can be learnt from SolarCity's successful experience which can be used in Qatar. This research, hence, highlights the major factors behind SolarCity success and how Qatar can benefit from it in implementing rooftop solar at a large scale.

The United States is one of the biggest markets and innovations pools for the global solar industry. In fact, by the end of 2014, the U.S had the third largest installed capacity of PV (photovoltaics) globally; 6.2 GW (Brunisholz 2014). In 2014, the U.S. solar industry grew by 34% over the 2013 growth rate (SEIA 2014). This growth was mainly driven by

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the PV residential and utility sectors which both grew by 51% and 38% respectively in 2014 (SEIA 2014).

The growth and development of the U.S solar PV industry has been led by many private and public firms, the most famous among which is SolarCity. SolarCity was founded in 2006 by Elon Musk (chairman), Lyndon Rive (CEO) and Peter Rive (CTO). It is a private enterprise that sells and leases solar PV systems for homes, government agencies, universities and many other types of customers. SolarCity is now America's largest solar power provider employing more than 10,000 employees and serving nearly 217,000 customers in 18 states in the U.S. By the end of the first quarter of 2014, SolarCity has installed 26% of all PV installations in the U.S.

SolarCity's operation strategy is very simple and yet innovative. The company is based in San Mateo, California but its operations are carried by local centers in different states in the U.S. Membership in SolarCity's program starts with the customer checking through SolarCity's website whether their house is eligible for a solar installation; by considering the state which they live in and the average electricity bill. The customer contacts SolarCity's representatives in their area and schedules a site visit. During the site visit, SolarCity's engineers will assess the suitability of the house for a solar installation, the electricity consumption of the house, the average savings expected from the solar system and the financing plan. The customer, once satisfied, signs the contract with SolarCity. Usually, the whole process takes around 2 months from the first call to the time the solar system is installed on the house.

SolarCity provides three payments options for its customers; PPA (power purchase agreement), lease and My power. PPA and lease plans allow the customer to rent (or lease) the solar PV system from SolarCity for a given period (usually 20 years) and make monthly payments. However, there is a small difference between both plans in terms of how payments are made. My power scheme is an ownership program that allows the customer to purchase the solar PV system by making annual payments over a given period, at the end of which they own the solar system and its subsequent benefits (like state rebates and tax incentives). The solar lease plan is the most popular and has been chosen by over 50,000 customers (SolarCity 2015).

Financing of rooftop solar is the most difficult part in the process of solar energy deployment, especially in the residential sector. Currently, the U.S. solar industry operates on a third-party-ownership (TPO) model. In this business model, large financial institutions like banks provide the major funding for solar projects. The TPO model has been working well so far because it gives customers the opportunity to use solar electricity without bearing the heavy capital costs.

In the broad sense, solar electricity providers use one of two methods to finance their projects: Bonding: Bonding refers to the process of taking loans from large finance institutions which have the necessary liquidity to fund solar electricity projects. In finance terms; it is "the process of securitizing debt and then issuing it into the capital markets via bonds" (Travis Lowder and Michael Mendelsohn 2013). The debt provider (also known as a tax-equity holder because that provider acquires all the tax incentives from the project they are funding) also receives an interest rate from their contribution to the project; usually 5–7% in solar projects. This form of financing is the most commonly used in the solar industry. However, the major drawback of this scheme is that it largely reduces the profit margin of solar companies by taking all of their tax credits. In addition this scheme is a highly complex and illiquid one and many experts believe that it can not meet the escalating demand of the solar energy market in the U.S (Travis Lowder and Michael Mendelsohn 2013). Securitization: This is a relatively new term in the U.S solar industry and has only recently been used. Securitization is defined as "the process of transforming illiquid assets (such as cash flows from a solar lease) into tradeable instruments" (Travis Lowder and Michael Mendelsohn 2013). Securitization is a financial mechanism that allows solar companies (whether they are suppliers or installers) to have more control over the funding of their projects. Essentially, solar companies will issue asset backed notes (or securities) in the marketplace for investors to buy. An investor who purchases such an asset will be entitled to a portion of the profits generated from that asset (e.g cash flows from solar leases). This proves to have two main advantages; provide a source of low-cost financing and raise significant capital for solar companies (Travis Lowder and Michael Mendelsohn 2013, T. Alafita and J.M. Pearce 2014).

Being sustainable (in finance terms) is of high importance to U.S. solar companies especially because the ITC, which was the main driver for the growth of the solar industry, is expected to reduce from 30% to 10% by 2017 (Travis Lowder and Michael Mendelsohn 2013). This leads us to the first success factor of SolarCity which was completing the first ever securitization of rooftop solar asset in the U.S solar market in November 2013 (Ucilia Wang 2013). This marked a huge transition in the solar PV financing market. SolarCity, at that time, sold \$54.23 million worth of notes with a 4.8% interest rates. In October 2014, SolarCity further developed their securitization model and implemented the first ever direct public offering (DPO) of solar bonds (shares in SolarCity's funding) allowing normal individuals and businesses to get attractive returns on their investments in solar energy (Canales 2014). The value of the solar bonds (or shares) for 2014 was \$200 million and could be purchased for a little as \$1000 per bond with an interest rate of up to 4%. The cash flow to pay for SolarCity's bonds comes from customers' payments in their solar leases or PPA's 20-year contracts. The second success factor in SolarCity's business model is also related to financing but concerns the other competitors in the solar market. The U.S. solar market has over 5000 companies but most of them will go out of business as Lyndon Rive, SolarCity's CEO, said (Margaret Rhodes 2012). This is because the majority of these competitors, due to limited funding options, only focus one part of the solar industry chain (such as only supplying equipment or only installation). Few companies actually provide the full service of providing the equipment, installing and maintenance. Among these are SolarCity and Vivnet Solar. Both of these companies follow the TPO model and have been doing very well indeed; they are the only two national completely vertically integrated residential solar companies (Green Tech Media 2014). Being vertically integrated means working in the whole solar PV supply and operations chain.

Vertical integration benefits solar companies in two ways; it increases the profit margin and gives them "visibility into the strategies of their competitors" (Green Tech Media 2014). In 2013, SolarCity acquired Zep Solar, a solar mounting startup which was for years a major supplier of equipment for SolarCity (Eric Wesoff 2014). Zep Solar was known for its innovative grooved frame that makes mounting of solar panels much faster. Through the use of Zep Solar's technology, SolarCity was able to reduce the installation time from 2–3 days to less than one day. In addition, in 2014, SolarCity acquired Silevo, a solar technology and manufacturing company whose solar panels had a good combination of energy output and low cost. In fact, SolarCity is planning to take vertical integration in the solar industry to next levels when it announced in 2014 plans to build the U.S largest solar cells manufacturing facility in the state of New York with a capacity of more than 1GW. SolarCity views vertical integration as the best way to cut down operation cost and reduce dependence on government subsidies. This explains why in the "sunny" states like California, SolarCity is able to sell electricity at a price less than the utility but at the same time maintain profits.

A SolarCity-inspired model that can help Qatar make a transition towards mass adoption of residential rooftop solar must have five components: Government policies and agencies that encourage (through incentives) citizens to invest in solar electricity. Improve the public awareness about the benefits and technology of solar electricity. Significant investment in R&D to build local knowledge, capacity and products within the solar PV supply and operations chain. An advanced smart grid that improves solar electricity integration. Customized and innovative financial instruments and models (such as Islamic finance) which benefit from global efforts but at the same time address local challenges.

Further research in this topic requires formulating innovative business and finance models that provide an affordable and reliable source of liquidity for solar firms in order to drive the rooftop solar industry in Qatar forwards. Particularly, we need to focus on how Islamic banks and Islamic finance can support the solar industry in Qatar. We need to ensure such measures reduce the risk from the lender and borrower's perspectives and that there is a high level of confidence on solar energy technologies as a worthy investment sector.