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The Fall of SunEdison – A Solar Eclipse?

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The Fall of SunEdison – A Solar Eclipse?

Abstract

In 2016, one of the largest renewable energy companies in the world, US-based SunEdison Inc., filed for bankruptcy when it couldn't service the debt it had raised to achieve aggressive growth. SunEdison had had an illustrious past; it had grown to become the largest solar installation company in the US and a global renewable energy giant. By 2016, solar power had attained grid parity in some parts of the world and solar was reaching its peak growth in the developed world. Governments from the developed world, which were boosting solar power through tax rebates and subsidies were rolling back their incentivization schemes and resorting to stricter guidelines for green project funding.. On the other hand, there was tremendous growth potential in the emerging markets where millions still lived in the dark.

By 2016, one of the most contrasting features of the solar industry was that there was little innovation and differentiation and the market was still defining its business model. The industry had gone into consolidation mode and SunEdison preferred to grow inorganically. To tap the opportunity in emerging markets and win projects, SunEdison started offering rock bottom rates.

When SunEdison's balance sheet got heavier and the company couldn't raise further debts, it decided to form subsidiaries called Yieldcos. Yieldcos were essentially energy asset holding public listed companies which assured stable dividends (from sale of electricity which the solar assets generated). Yieldcos issued shares to raise capital using which a completed solar asset was bought from its parent (SunEdison). SunEdison used the capital for further growth.

In an industry where technological innovation was rare, financial innovation became the norm. The case describes SunEdison's fall from grace. It throws light on the economics of the solar business and the need for robust sustainable finance for renewable projects.

Case

INTRODUCTION

On April 21, 2016, SunEdison Inc. (SunEdison), a global renewable energy company, filed for Chapter 11 bankruptcy protection. "Our decision to initiate a court-supervised restructuring was a difficult but important step to address our immediate liquidity issues," said Chief Executive of SunEdison, Ahmad Chatila (Ahmad). "The court process will allow us to right-size our balance sheet and reduce our debt."[1]

On the same day, the NYSE (New York Stock Exchange) announced suspension of trading in SunEdison shares. SunEdison, which had had a valuation of $10 billion in June 2015, saw its market cap eroding by 100 times in a matter of nine months, making it a penny stock unavailable for trade on the NYSE. *(Refer to Exhibit I for the Stock price chart of SunEdison and the Yieldcos)*

Over the years, SunEdison went on accumulating debt *(Refer to Exhibit II for Financials of SunEdison)*. By 2016, the company had debt to the tune of $16 billion which included debt from its subsidiaries[2], TerraForm Power Inc and TerraForm Global Inc. Its listed assets amounted to $20.7 billion dollars as of September 30, 2015. The sudden fall of SunEdison as a renewable energy major came as a shock to investors as well as analysts who until then had perceived it as an organization poised to become the world's largest renewable energy company. In June 2015, at a Senior Managers meet in Paris, Ahmad had been enthusiastic about SunEdison's growth. "By 2020," he said, "the renewable-energy startup would be worth more than $350 billion. Some day it would be as big as Apple or Google." Ahmad, who was born in Lebanon, had a degree in Electrical Engineering and was a veteran in the semiconductor industry. In 2009, he was hired as a CEO by Monsanto Electronic Materials Company (MEMC), a provider of silicon parts to the semiconductor and solar industries. In November 2009, Ahmad's first move as CEO was to acquire SunEdison for $340 million.[3]

TAKEOVER OF SUNEDISON

SunEdison was founded by energy entrepreneur Jigar Shah (Shah) in 2003 and was headquartered in Baltimore, Maryland, US. Its business model was based on a business plan Shah had worked out in 1999. The crux was "simplify solar as a service". Under this model,

1 Peg Brickley , "SunEdison Files for Chapter 11 Bankruptcy Protection ," The Wall Street Journal, 16 April 2016

2 These Subsidiaries were formed to hold energy assets and were technically called as Yeildcos.

3 Liz Hoffman ," Inside the Fall of SunEdison, Once a Darling of the Clean-Energy World ," The Wall Street Journal , April 14, 2016

organizations could sign long-term energy contracts with predictable prices without owning and operating the infrastructure to harness solar energy. After acquiring Team Solar Inc in 2006, SunEdison went on to become the largest solar installation contractor in the US.

SunEdison provided innovative financial solutions which were integrated with solar technologies, providing solar generated energy to its clients below the retail rate of electricity. For SunEdison's customers, solar meant lower energy bills, rebates, and a 30% federal investment tax credit. Hence, many firms started turning their roofs into solar roofs. But there was one barrier – the high upfront cost of solar installations. Using mechanisms like PPAs (Power Purchase Agreements), SunEdison signed long-term contracts with its clients, locking them to buy the energy generated. It financed its projects by raising funds from investment banks and mid-market banks. The investment banks got benefits like investment tax credits and an assured rate of return.[4] Such conducive policies made solar energy very competitive.

MEMC

MEMC was founded in 1959 by Monsanto Chemical Company to manufacture silicon wafers. In 1989, Hüls AG of Germany purchased MEMC. In 1995, MEMC launched an IPO and in 2001, the Texas Pacific Group acquired MEMC. MEMC kept on expanding, anticipating serving the growing electronic chip industry. But, by the late 2000s, the cyclical downswings of the chip industry had taken their toll on MEMC, and it started to report losses.

In 2009, MEMC, which had forayed into Photovoltaics (PV) manufacturing to be a part of the burgeoning solar market, wanted to be a more vertically integrated player in the industry – that is, manufacture PV cells and also install solar projects. It therefore eyed SunEdison, by then North America's largest solar services provider, with a generating capacity of 80MW. The deal worked out to be $200 million. "This acquisition will provide a third engine of growth for MEMC," said Ahmad. "MEMC will now participate in the actual development of solar power plants and commercialization of clean energy, in addition to supplying the solar and semiconductor industries with our traditional silicon wafer products."[5]

It was decided that after the deal, SunEdison would continue to operate under the same name and also retain its then CEO, Carlos Domenech (Carlos). "SunEdison has successfully built about 300 solar power plants representing approximately 80 MW of generating capacity on the rooftops and grounds of customers in the United States, Canada and Europe," Carlos said. "Our business is highly scalable and will be able to grow substantially, capitalizing on

4 Kerry A. Dolan ," Paying For Panels ," Forbes, April 16, 2007

5 "Substrate Manufacture MEMC moves into Solar," www.siliconsemiconductor.net, October 2009.

our more than 1.5 GW of pipeline, backlog and leads with a financially strong, technically sophisticated partner like MEMC, which also has a competitive cost structure in upstream materials. This combination will greatly accelerate our goal of making solar energy cost competitive with grid prices."[6]

In 2010, SunEdison bagged a project to build Europe's largest PV solar project in Rovigo, a town in northeastern Italy. The power plant had a planned capacity of 72 MW and after installation, would provide electricity to around 17000 homes. The project was co-owned by SunEdison and Banco Santander of Spain. Speaking about the projects, Carlos said, "SunEdison is focused on enabling the growth of global solar markets through strong capabilities in project finance, engineering, low-cost procurement and operations and maintenance services."[7]

By 2013, MEMC was facing stiff competition owing to falling silicon prices. It then announced a spinoff of its semiconductor business and changed its name to SunEdison Inc. Ahmad had a vision and rationale for this plan. He said, "Changing our name to SunEdison is a major milestone as this represents another step toward creating an elite, global brand that builds on a more than 50-year tradition of innovation and growth that began under the MEMC name. We strongly believe the SunEdison name provides us with broader marketplace appeal and scalability that will help us grow the company and build long-term brand equity as we look toward the next chapter."[8]

SOLAR IN EMERGING MARKETS

Continuing to grow globally, in 2011, SunEdison secured funds to set up solar plants in India, looking to make the country one of its biggest markets for solar projects. It raised $100 million to build solar plants in power-hungry states like Gujarat and Rajasthan. "We are proud of our robust history of financing solar photovoltaic projects with strong long-term returns for investors in many countries and now in India," SunEdison Managing Director (South Asia and Sub-Saharan Africa), Pashupathy Gopalan (Gopalan), had said at the time.[9]

In 2011, there were more than 30000 villages in India which had no electricity. Lack of electricity limited education and economic development. The 2011 census also indicated that around 43.2 percent Indians depended on kerosene for lighting purposes. In 2012, SunEdison launched a solar program in India called 'Eradication of Darkness'. Under the

6 "MEMC To Acquire SunEdison for US $200M ," www.renewableenergyworld.com , October 23, 2009

7 "SunEdison builds largest solar plant in Europe ," www.eetimes.com , March 23 , 2010

8 Company Press Release

9 PTI," SunEdison to get over Rs 500-cr funds for solar projects," November 18, 2011

program, it announced that it would provide electricity to 30 villages and run a pilot in one village. "By 2014, we want to be able to scale up to thousands of villages,"[10] said Gopalan. India also had a peak power deficit of 6% which was mostly met through diesel generators, especially during summers.

The South-East Asian outlook was no different. In most blacked-out and power deficit parts where there was no penetration of grid power, diesel generators were widely used and were as competitive as solar power owing to government subsidies. One of the first economical applications of solar power was replacing diesel-powered irrigation pumps. According to Gopalan, "These pumps don't have to run at night, so batteries aren't needed, keeping costs down. The total available market in India alone is 15 to 20 gigawatts, and irrigation pumping is a massive application in all of Asia and Africa."[11]

The solar potential in emerging markets came with its own set of challenges, the main challenge being lack of proper financial infrastructure. The cost structure to set up solar utility scale power projects in developing countries was more capital intensive than in the developed world owing to the high cost of setting up transmission lines and other basic infrastructure to integrate the solar output to the main grid. Such problems escalated project costs by as much as 6 times the budget of similar capacity projects in the developed world. The developing markets wanted small scale, decentralized, and roof-top solar plants where the electricity generated by solar energy could be locally consumed with minimal transmission. For large utility scale power plants, the upfront costs of setting up transmission to connect to the grid were huge and needed commitments from the local government for the signing of long-term PPAs. Hence, without PPAs and government incentives, the cost of solar was uncompetitive as compared to that of thermal power.

Also, developing countries weren't able to appreciate the long-term returns and reduction in carbon emissions unlike their developed world counterparts whose prime drive to adopt solar was to off-set carbon emissions by reducing reliance on non-renewable sources. In emerging markets, solar essentially meant lowering the supply demand gap of power by reaching areas which were either inaccessible or economically unfeasible for a grid set-up. Moreover, the scale of the project was an important aspect for investments owing to the high cost of due diligence. Hence, to attract capital, the project had to be of significant scale. Financial institutions were more willing to invest in large projects owing to low perceived credit risk. It was difficult for a remote off-grid solar project to attract capital owing to the high credit risk. There was one more inherent shortcoming of the PV-based solar system – it couldn't run

[10] Kevin Bullis , "SunEdison Turns to Big New Markets for Solar Power," MIT technology Review , June 8, 2012.

[11] Kevin Bullis , "SunEdison Turns to Big New Markets for Solar Power," MIT technology Review , June 8, 2012.

without expensive batteries when the sun went down, which meant the grid had to rely on thermal power at night.

Moreover, there were cheaper alternatives for solar, especially kerosene and diesel, which were heavily subsidized by the government. As a consequence, there was little incentive for emerging economies to adopt solar. Moreover, governments in emerging markets had to juggle with the other problems of developing economies, which led to perceived risks for investors.[12]

SOLAR IN DEVELOPED ECONOMIES

In developed economies, SunEdison had a stable substrate to grow; debt financing coupled with PPAs and rebates propelled growth. But even in developed economies, PPAs only made sense in geographies with significant solar rebate programs which could off-set the cost of capital and the high upfront investment costs. By 2014, after a decade of high growth, nations like Germany, Italy, and Greece were rolling back solar incentives. In the Czech Republic and Spain, the solar industry had suddenly come to a standstill when Feed-in-Tariffs[13] were rolled back.

Germany, which was the second biggest solar market in the world, had promoted aggressive growth in solar energy from 2010 to 2013 through its *Energiewende* (Energy Transition) policy to cut carbon emissions and eliminate dependence on nuclear energy by 2022. To boost renewable energy and protect investments, an Act was passed which required utilities to accept power from independent renewable energy generators. The independent generators were paid above market price per Kilo-Watt hour (Kwh) and their power was fed into the grid in accordance with the feed-in tariff rates decided by the regulators. This Act enhanced predictability, resulting in low-risk financing for capital-intensive renewable projects.

Energiewende boosted renewable installation in Germany and by 2014, renewable energy accounted for 27% of the electricity produced in the country. But as the market matured, installing renewable energy equipment became cheaper and there was overcapacity of combined electricity output from renewable as well as non-renewable companies, pushing down the wholesale rate of electricity. But the end consumers still had to pay higher prices due to the fixed feed-in tariff incentive contracts signed during the boom years. A 20-year

[12] The Challenges Facing Renewable Energy Developers in Emerging Markets, Chadbourne hosted a workshop for the multilateral lending and export credit agencies, http://www.chadbourne.com/Challenges_Facing_Renewable_Energy_Developers_projectfinance

[13] A feed-in tariff (FIT) is an energy supply policy that promotes the rapid deployment of renewable energy resources. An FIT offers a guarantee of payments to renewable energy developers for the electricity they produce. Payments can be composed of electricity alone or of electricity bundled with renewable energy certificates. These payments are generally awarded as long-term contracts set over a period of 15-20 years.

contract signed with an independent generator in 2009 required that he be paid 43 cents per KWh through 2020 whereas in 2014, a similar system would cost 13.7 cents per KWh.[14] Hence, mounting costs from past contracts made the administration re-structure and roll back its renewable incentive policies at a time where solar was becoming more competitive."It would be inconceivable if…the development of solar energy slows now just as it has become inexpensive,"[15] said Carsten Körnig, head of the national solar trade group BSW.

Similarly in the US, states like California where solar had boomed throughout the 2000s, were rolling back their solar incentive schemes. Without the incentive schemes, the focus was directed toward the cost structure of solar projects. By 2014, when California rolled back its solar initiative – two years ahead of schedule, the state had already surpassed its solar installation targets and incentives had dried up. Nevertheless, the industry had become mature and the cost of solar panels had dropped drastically, making the solar industry more competitive. Given the rollback of incentives, the only option left for solar companies to be competitive and undercut incumbents was to resort to operational efficiencies and innovative financial arrangements.

SOLAR INDUSTRY AND SOLAR ECONOMICS

By the end of 2015, the cumulative capacity of solar had hit the 200GW mark, which was roughly more than 1% of the world's total power consumption. It was estimated that 66GW of solar capacity would be added by the end of 2016. The world was building more solar power plants than ever because they were getting cheaper. Since 1975, the cost of installing 1MW of solar had dropped by 150 times. There was more than an 80% fall in the price of solar panels since 2010. But the industry was largely ailing from low profitability owing to the commoditized nature of the business . Without technological innovation, there was very little to differentiate between the offerings of the solar companies.

For downstream (developers and builders of solar power plants), it boiled down to winning bids by aggressive pricing, which was not sustainable. The industry was also in consolidation mode. Analysts said there were over-aggressive bids by solar power companies to win projects. Jenny Chase of BNEF (Bloomberg New Energy Finance) said in some cases, "the model is being pushed to the absolute limit". Some Indian firms were estimating

14 GreenTechMedia, "Are the Legacy Costs of Germany's Solar Feed-In Tariff Fixable? ,"

15 "Are the Legacy Costs of Germany's Solar Feed-in Tariff Fixable," www.greentechmedia.com, June 04, 2014.

development costs well below global benchmarks. "I struggle to see how they will do this without cutting corners."[16] *(Refer to Exhibits III and IV)*

As downstream struggled with profits while pursuing growth and market share, their valuations started to drop and it became difficult for them to raise more funds. So even though solar had huge potential, solar companies started going bust. Analysts called it the solar energy paradox. Solar companies had no sustainable cost advantage to continue their business, especially when tax rebates and subsidies were being rolled back. The prices were falling so fast that cost structures on which businesses were set up were quickly becoming obsolete. Such was the scenario that smaller companies seeking organic growth would not be competitive and bigger giants like SolarCity[17] and SunEdison couldn't service their debts. It was a deadlock.

SUNEDISON BUSINESS MODEL

By December 2013, SunEdison had total installed capacity of 1.3 GW through its 816 solar plants while 540 MW was under construction and 3.4 GW capacity projects were in the pipeline[18].[19] Given SunEdison's strategic shift, the upstream business (historically seen as the core of MEMC) of manufacturing solar panels now focused on internal consumption for the downstream business of solar project development. SunEdison focused on select markets across the globe, namely North America, South America, Europe, the Middle East, South Africa, India, Malaysia, Thailand, and China. Depending on the region, it deployed a different ownership model of the assets which it built. For instance, in the US, it was either the sale-leaseback[20] model or sale to a strategic buyer after completion of the project. In Europe and Canada, completed projects were sold to investors. In India and South Africa, it was a multi-year equity holding.

SunEdison used PV cell technology to generate electricity. The technology was broadly split into two categories based on application. First was utility-scale application, typically large projects with high economies of scale and high efficiencies. The second was distributed

16 "Follow The Sun," The Economist, April 16, 2016

17 SolarCity Corporation is the largest American provider of solar energy services, headquartered in San Mateo, California.

18 A solar energy system project is classified as a "pipeline" when a company has signed or awarded power purchase agreement (PPA) or other energy off-take agreements or has achieved each of the following three items: site control, an identified interconnection point with an estimate of the interconnection costs, and an executed energy off-take agreement or the determination that there is a reasonable likelihood that an energy off-take agreement will be signed. "Under construction" refers to projects in the pipeline, in various stages of completion, which are not yet operational. There can be no assurance that a pipeline will be converted into completed projects or generate revenues. (Source: SunEdison)

19 Annual report 2013

20 A leaseback is an arrangement where the seller of an asset leases back the same asset from the purchaser. Such an arrangement unlocks capital for further growth.

application, where panels were installed on roof-tops. These set-ups were less efficient owing to variation in the orientation of rooftop panels which couldn't use the full potential of the sunrays and made less economic sense than utility-scale projects. But distributed applications were less capital intensive and more profitable than utility scale projects. SunEdison's long-term objective was to make solar energy reach grid parity with traditional energy alternatives without government incentives.

SunEdison had four primary revenue streams.

- The first was sale of electricity through its typically 20-year PPAs.
- The second was REC (Renewable Energy Credits)[21], which could be sold to utilities operating on non-renewable fuel. The utilities could use these credits to off-set state mandated environmental obligations where they were required to generate a portion of their electricity through renewable sources.
- The third revenue stream was performance-based incentives (PBI) from public utilities. PBIs were based on the KWh of energy produced in a particular state by renewable energy companies.
- The fourth revenue stream was the sale of a completed solar project. For the year ended December 2012, 95% of solar energy revenue came from fully developed projects.

In the domestic US market, SunEdison had typically three types of customers:

1. Commercial customers like large retail chains (E.g. Walmart) and real estate property managing firms
2. Federal state and municipality governments
3. Utilities: For commercial customers and government, the model centered on PPAs. For utilities, it centered on PPAs and RECs

For the international market, SunEdison developed projects through strategic partners and sold them to investors or operated them through equity holdings. It also engaged in EPC (Engineering Procurement Construction) projects where revenue per KW was lower than in fully developed projects owing to exclusion of financing and other developmental activities. But EPC projects also boosted liquidity because SunEdison didn't have to handle financing and other development costs.

SunEdison used various debt financing structures to arrange long-term financing. In the US market, it sold the solar assets to third parties and then leased back the assets for an

[21] RECs are issued when one megawatt-hour (MWh) of electricity is generated and delivered to the electricity grid from a renewable energy resource — in this case, solar enegy which SunEdison generates and supplies to the grid.

extended period of time. In foreign markets, term debt financing was used and upon completion of the project, the solar assets were sold to a buyer along with the debt, freeing the balance sheet for following up on fresh projects.

Debt financing had its downside. The first was the high cost of capital which didn't make solar projects viable in contrast to their non-renewable counterparts. Second, holding on to a debt financed capital intensive asset was an organic growth restrictor. Without unloading a finished project off the balance sheet it was difficult to raise fresh debt for a new project. On the other hand, to ensure steady cash inflows through selling power, the solar asset had to be kept on the balance sheet for a longer period. But such an arrangement needed a different and more innovative type of financing with low cost of capital to make the solar projects more viable.

THE RISE OF YIELDCOS

On December 12, 2013, SunEdison announced its plans to monetize its assets through a dividend growth-oriented subsidiary. Holding solar assets was more profitable in the long run than selling them on completion. The plan was to aggregate finished projects and sell them to a subsidiary which would pay for the assets by raising equity. Such yield-based companies were popularly called Yieldcos. The proceeds of a Yieldco would then be used for funding expansion of SunEdison. The stable operational solar project would later sell electricity and generate fixed yield for its investors and promised long-term value. "So while we forgo higher short-term gross margins, giving up about $25 million in Q1 gross margins, we create higher long-term value of more than $120 million in those same projects for SunEdison shareholders," explained Ahmad on the company's first quarter 2014 conference call.

A GTM Research Solar Analyst, Corey Honeyman, said, "There are a whole other suite of risks that come with owning large utility-scale assets, which SunEdison does not have experience doing. If they were to do this without a Yieldco, a lot of the financing costs would be too prohibitive."[22]

Yieldcos provided low cost capital to solar developers who were trying to operate on a low-budget. The first Yieldco was created in 1999 and was named Brookfield Renewable Energy Partners. In 2013, there was a surge in the formation of Yieldcos. NRG yield, Hannon Armstrong, and Pattern Energy Group were some of the Yieldcos which were formed and the assets they held were mostly wind farms. Yieldcos isolated fixed energy assets and generated stable revenues from the risky project operations of their partners. This structure led to a lower perceived risk and attracted retail investors who typically wouldn't have access to private equity and debt investments. But the key challenge for Yieldcos was scale. Experts

[22] Christian Roselund, "Solar goes Public: The Rise of Yieldcos," www.pv-magazine.com, August, 2014.

familiar with such structures suggested a minimum IPO size of $150 million–$200 million and a total equity valuation of $500 million.[23]

As Corey Honeyman said, "I think both the securitizations[24] we have seen issued by SolarCity and this wave of yieldcos both represent an increasing confidence in solar as an asset class."[25] Analysts believed that Yieldcos were a sign of the solar industry's growing maturity. It was an indication that as solar became more mainstream, the cost of capital would come down.

In July 2014, SunEdison floated its first Yieldco named TerraForm Power Inc and raised $500 million. With an initial portfolio of 524 MW which was spun off from parent SunEdison, TerraForm Power had solar assets in Canada, the UK, Chile, and the US. The following year – in 2015 – SunEdison floated yet another Yieldco named Terraform Global, this time focused on emerging markets. The Yieldco was able to raise $625 million and had assets to the tune of 1406 MW in India, China, South Africa, and some South American countries. TerraForm Global was expected to generate $231 million in cash in 2016.

SUPERNOVA

It appeared that there was no stopping Ahmad. In a presentation to analysts in February 2016, he indicated that SunEdison was poised to become the world's most valuable company and added, SunEdison is the next ExxonMobil whose value is around $400bn. "That's what we're going after."

In July 2015, SunEdison through TerraForm Power went on to acquire a 90% stake in the biggest owner of Wind Energy assets in US, Invenergy. It was a $2 billion portfolio which would lead SunEdison to add 930 MW of wind energy to its portfolio. Previously, in similar deals, SunEdison with its Yieldco TerraForm Power had added 1 GW of wind assets from leading US wind developers. The move was undertaken to diversify and scale energy assets, which would lead TerraForm to own a 50:50 split in solar and wind respectively.[26]

It was the formation of Yieldcos which led SunEdison to becoming more aggressive on buying growth through debt with the objective of dropping new projects into the Yieldco portfolio. The idea was to convert high cost debt to low cost equity. At an early 2015 investor conference, SunEdison's then-chief financial officer, Brian Wuebbels (Wuebbels), told investors, "It's all about growth, creating a pipeline, feeding that pipeline into TerraForm,"[27] Additionally,

[23] Bloomberg New Energy Finance, "U.S. Solar – White Paper ," June 4, 2012

[24] Securitization is converting an illiquid asset and transforming it into a security. SolarCity had done series of securitizations of its roof-top solar installations.

[25] Christain Roselund , "Solar goes public: The rise of yieldcos ," www.pv-magazine.com,August 2014

[26] Stephan Lacey, "SunEdison's YieldCo Acquires $2 Billion of Wind Projects From Invenergy," GreenTechMedia.com , July 7, 2015

[27] "YieldCos enabled SunEdison's Debt-Fueled Acquisition Spree," www.reuters.com, April 25, 2016.

SunEdison's Yieldcos were structured differently from some of the early Yieldcos. Its Yieldcos were structured to comprise IDR (Incentive Distribution Rights), designed to channelize additional cash generated through dividends to their parent (SunEdison). The arrangement allowed SunEdison to get 50 cents per dollar for every additional dividend dollar the Yieldcos distributed above a base level dividend amount of 45 cents per share. Getting to that level quickly, Wuebbels told investors in February 2015, would require rapid expansion of the Yieldcos' holdings."In doing that, we get more cash and IDRs back to the company." [28] But rapid growth meant rapid borrowing. Within a year (September 2014 to September 2015), SunEdison's debt level had increased to $16.1 billion from $9 billion.

After setting up the Yieldcos, SunEdison's focus shifted from the distributed solar installation model, which it had started with in the US, to very large projects in emerging economies. In developing countries like India, SunEdison was bidding at record low rates. To win a 500MW project, SunEdison had made an aggressive bid of Rs.4.67 per KWh (0.06 USD). There were 28 bidders for the project. "We acknowledge that there is no doubt about these tariffs being very aggressive. The assumptions for cost of equipment, cost and other terms of finance, return expectations and presumed future benefits through securitization of assets and/or perceived premium in valuations in case of an exit are all being considered at levels that are more aggressive than what we would generally assume," said Jasmeet Khurana, associate director, consulting, Bridge to India, a boutique consultancy and knowledge provider in the Indian cleantech market.[29]

THE SUN ALSO SETS

In July 2015, SunEdison announced the acquisition of Vivint Solar, the second largest residential (distributed power) PV installer in the US, for $2.2 billion in cash, stock, and convertible notes.[30]"We are building the next generation of the biggest energy companies on earth," said Julie Blunden, SunEdison's chief strategy officer. "We're not waiting to find out who they'll be – we want it to be us."

SunEdison's shares began to slide just after the acquisition was announced. The deal price was at more than a 40% premium on Vivint's. The Vivint deal was banking on TerraForm Power to buy Vivint's portfolio of rooftop solar systems from SunEdison for about $922 million. But the deal was blocked when Appaloosa,a hedge fund which held 9.5% of TerraForm Power's shares, got a court injunction. SunEdison, in an attempt to make the deal work, later said it would cut the price paid for Vivint and reduce the asset sale to TerraForm

[28] "YieldCos enabled SunEdison's Debt-Fueled Acquisition Spree," www.reuters.com, April 25, 2016.

[29] Shailaja Sharma "SunEdison's bid brings solar power tariff to record low," www.livemint.com, November 5, 2015

[30] The Vinit Solar deal never happened owing to borrowing constraints.

Power. The deal finally didn't work due to debt constraints. SunEdison couldn't raise enough debt and Vivint also backed out from the deal. Several deals which had been announced previously also fell through. SunEdison started taking desperate measures to sell the assets to third party buyers instead of the Yieldcos to raise more capital.

In November 2015, SunEdison reported that its project pipeline had grown by 75% within a year. The company had no clear technological advantage over the incumbents but it had an interesting offering, described by Wuebbels as "Capital Innovation". "It is a story of hyper-growth fuelled by leverage," said Julien Dumoulin-Smith, an analyst at UBS. "It promised to take an infrastructure-type business and accelerate it to the growth rates we've seen in the technology sector."[31]

In November 2015, SunEdison started receiving margin calls for margin loans which it had borrowed for its takeovers. One such payment was made by channelizing funds received from TerraForm Global, which were intended as an advance payment to drop Indian solar assets in the Yieldco. SunEdison's high leverage led to investor skepticism, causing an erosion of Market Cap. The SunEdison shares, which were trading at a lifetime high of $33 in July 2015, fell to $5 by the end of 2015. SunEdison's stock price also had a shadow effect on its Yieldcos and their stock price nose-dived, eroding market cap by as much as 75%. The drop in share prices of the Yieldcos was a serious problem because it would lead to reducing the capital raised per share. The idea was to keep on issuing shares at higher valuations to buy more assets from the parent.

As more Yieldcos were being created by other solar companies, the Yieldcos started competing among themselves for the acquisition of new projects and this eventually drove up the prices of these projects.[32] Higher costs meant lower yields. The Yieldcos were offering 6% yields and it was difficult to access cheaper assets.

AFTERMATH

The ripples of SunEdison's fall were felt across the globe. After showing a promising 13-year growth, receiving around $1.5 billion of tax payers' support (combination of grants, loans, and tax credits), the $10 billion dollar company had collapsed to become a $150 million company and was liquidating its assets as quickly as possible. SunEdison had around $20 billion of debt and $16 billion of assets.

Some contrarian analysts believed that solar was being pushed too hard even though businesses and governments knew that without tax rebates, solar could not be economical.

[31] Stephen Foley and Ed Crooks , "SunEdison: Death of a Solar Star ," Financial Times, April 21, 2016

[32] Nichola Groom and Michael Erman, "Yieldcos enabled SunEdison's debt-fueled acquisition spree ," Reuters, April 25, 2016

Financial innovation to raise public money for solar companies seemed to be a vulnerable concept. For instance, a rise in interest rates by Federal Reserve made Yieldcos less lucrative. Also, a drop in oil prices made solar look less competitive. “Yieldcos were created to be financing vehicles and if they are not able to finance projects, then they are not really serving their purpose,” said Rhame Reaves Asset Management in Jersey City, New Jersey.

The fall of SunEdison raised several critical questions about the future of solar.

Is sustainable solar a financial problem or a technological one? Can solar sustain itself without tax rebates? What kind of sustainable financial solution will allow solar to reach the masses in emerging economies? Does solar need to go very slow? What kind of regulation and control are required to avoid a failure like SunEdison?

Exhibit I

Share price slump of SunEdison, Terraform Power and Terraform Global

(Prices in USD)

SunEdison

Terraform Power

Terraform Global

Source: Google finance

Exhibit II
SunEdison P & L and Balance Sheet

(In US$ Million except per share & emp data)	2014	2013	2012	2011	2010
Statement of Operations Data					
Net Sales	**2,484.4**	**2,007.6**	**2,529.9**	**2,715.5**	**2,239.2**
Gross Profit	221.9	145.3	335.6	294.9	337.1
Marketing and Administration	566.0	361.6	302.2	348.8	255.1
Research and Development	61.7	71.1	71.8	87.5	55.6
Goodwill Impairment Charges				440.5	
Restructuring (reversals) charges	(8.3)	(10.8)	(83.5)	350.7	5.3
Loss (gain) on sales / receipt of property	4.7		(31.7)		
Long-lived asset impairment charges	134.6	37.0	19.6	367.9	
Operating (loss) Income	**(536.8)**	**(313.6)**	**57.2**	**(1,300.5)**	**21.1**
Non-operating Expense	779.6	278.2	138.7	83.6	33.6
Net (loss) income att. to shareholders	(1,180.4)	(586.7)	(150.6)	(1,536.0)	34.4
Basic (loss) income per share	(4.4)	(2.5)	(0.7)	(6.7)	0.2
Diluted (loss) income per share	**(4.4)**	**(2.5)**	**(0.7)**	**(6.7)**	**0.2**
Balance Sheet Data					
Cash and cash equivalents	943.7	573.5	553.8	585.5	707.3
Cash committed for construction	130.7	258.0	27.8		
Restricted cash	270.5	143.9	113.6	162.7	62.5
Working Capital	(357.1)	495.7	324.8	449.0	453.2
Total assets	**11,499.8**	**6,680.5**	**4,745.3**	**4,881.6**	**4,611.9**
Debt	7,199.4	3,576.2	2,368.3	1,926.8	682.7
Total SunEdison stockholders' equity	232.9	232.2	575.3	737.9	2,251.7
Other Data					
Capital Expenditures	229.6	133.1	139.0	152.5	352.0
Construction of solar energy systems	1,511.0	465.3	346.9	598.1	280.1
Employees	7300	6300	5600	6400	6500

Source: Annual Report 2014- 15

Exhibit III

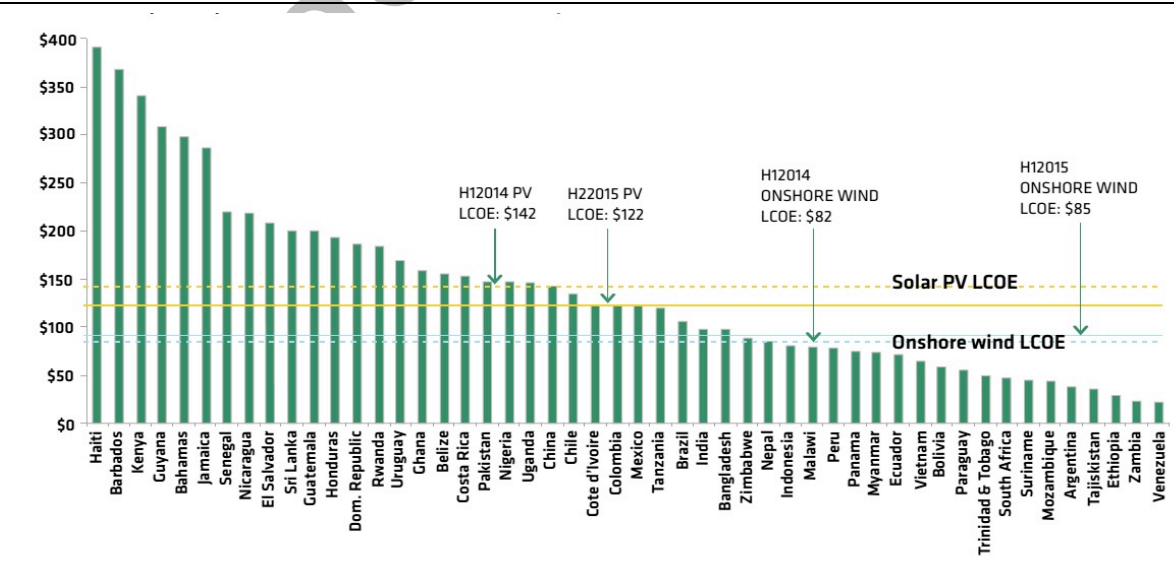
LCOE (Levelized Cost of Energy)
for Various Sources of Electricity in the US

Energy Plant Type	Lifetime Cost ¢ per Kwh
Offshore Wind	20.0
Peaker Natural Gas	18.0
Coal with CCS	14.4
PV Solar	12.5
Gas Combined Cycle with CCS	10.0
Biomass	10.0
Advanced Nuclear	9.5
Conventional Coal	9.5
Hydro-electric	8.4
Natural Gas Combined Cycle	7.5
Land-Based Wind	7.4
Geothermal	4.8
The table shows LCOE (Levelized Cost of Energy) for various sources of electricity. The information was released by U.S Energy Information Administration (EIA) in June 2015. The LCOE is calculated for a 30-year period starting for projects going online in the year 2020.	

Source: EIA

Exhibit IV

Electricity Costs in USD/MWh in Emerging Markets (Green Bars) and LCOE of Solar



Source: Bloomberg New Energy Finance

Additional Readings:

1. Robert G. Eccles and George Serafeim,"Sustainability in Financial Services Is Not About Being Green," Harvard Business Review, May 15, 2013
2. Podcast," Clean energy's dirty secret," The Economist, February 22, 2017
3. Francis O' Sullivan and Charles H. Warren, "Solar Securitization: An Innovation in Renewable Energy Finance ," An MIT Energy Initiative Working Paper, July 2016