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Understanding the Expanding Global Solar Industry

Introduction

Solar Photo Voltaic (PV) is the smallest but also the fastest-growing segment of the global electricity generation market. By the end of 2014, solar PV accounted for about 3% of total global installed capacity and just over 1% of total generation. Installations have grown tenfold since 2006 and will grow by another 25% this year. These high growth rates are almost certain to continue. In many countries, including the United States, solar already represents the largest source of new annual generating capacity.

Technological advances in solar cell design, materials, concentrators, trackers and power management equipment continue to improve the efficiency of solar technologies. This, combined with new manufacturing processes and production scale, has dramatically reduced the equipment costs for power producers.

Average installation costs for the industry have fallen from $15 per watt in 2007 to under $3.50 per watt last year. Some recent large, ground-mount utility-scale projects are coming in as low as $1.25 per watt.

The dramatic drop in installed costs has reduced the levelized cost of electricity production (i.e. per kWh cost) to levels in many regions that are competitive with traditional forms of electricity generation like coal and natural gas.

These improving economics are converging with increasing global electricity demand, depreciating existing plant and growing concerns over the pollution caused by conventional fossil generation. Historically low interest rates, and an insatiable demand for yield are also making it easier to finance solar capacity expansion.

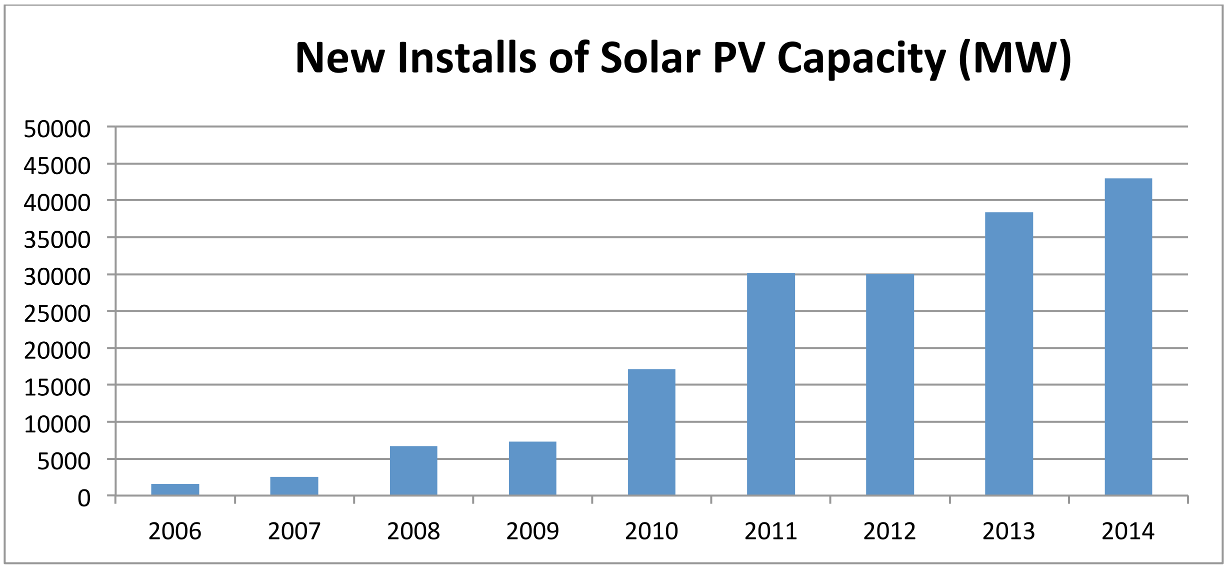
Solar PV presents one of the most exciting growth industries available to investors today. Further, geographic and political biases have created a sector filled with mispriced securities of which informed investors are able to take advantage.

This report outlines these observations in greater detail.

1) Market Size and Development

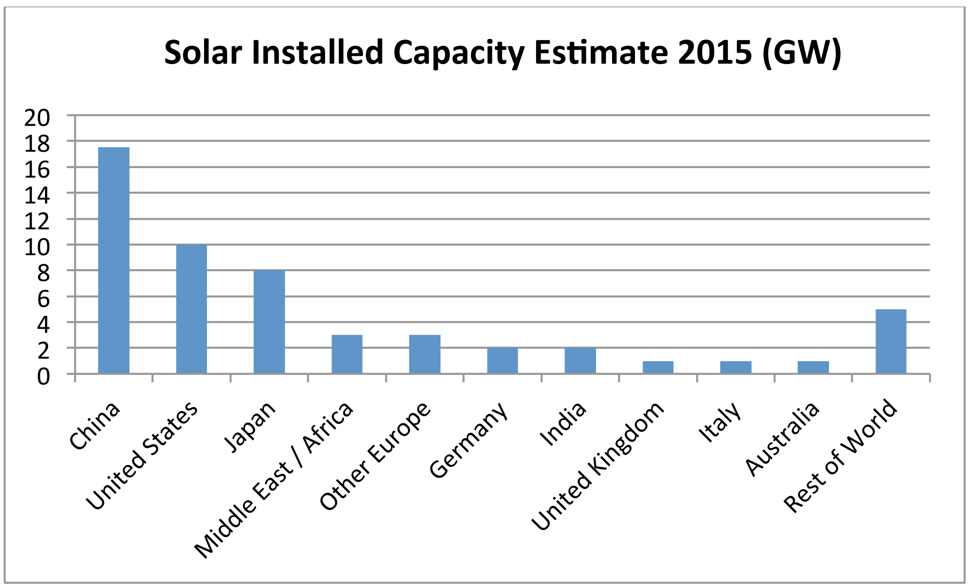
Solar PV electricity is the smallest yet fastest-growing segment of the electricity generation market.

- End of 2014 total installed solar PV capacity was 186 GW
    i. This is equal to approximately 3% of total global installed capacity of 5,250 GW
- 2014 solar PV generation was 262 TWh
    i. This is just slightly higher than 1% of total global electricity demand of 23,000 TWh
    ii. Capacity factors in solar are in the low 20s are a little more than half that of wind capacity and about one third the average capacity factors across all generation types



- Installations have grown tenfold since their small base in 2006
- Average cost per Watt installed has fallen from more than $15 in 2007 to approximately $3.50 in 2014
- Market growth has plateaued twice: in 2009 during the global financial crisis and in 2012 as European governments accelerated the reduction of subsidies or removed them entirely
    i. Europe has gone from more than half of the global solar market as recently as 2011 to less than 15% in 2014

- Looking forward, expectation is for as much as 60 GW in 2015, good for more than 25% growth
    i. China is officially targeting 17 GW for 2015
        1. Didn't make their 14 GW target in 2014, are putting more efforts into streamlining approvals and FIT payments
    ii. US is in a rush to beat Investment Tax Credit (ITC – 30% rebate on capital costs) with expiration at end of 2016
    iii. UK big push in Q1 2015 due to subsidy step-down
    iv. High growth in many emerging markets off a small base
    v. Possible slowdown in Japan, Ontario
- Global market is dominated by three jurisdictions, China, United States, and Japan, all with important policy incentives in place
    i. These three countries expected to be between 60%-70% of global volume



- Market is roughly 50/50 between large utility-scale ground-mount projects (1 MW and higher) and smaller commercial / residential rooftop
    i. Expectation is for a shift to larger share for small rooftop over large ground-mount in coming years
    ii. Residential rooftop takes longer to scale up, but easier to integrate into the grid
    iii. China's challenges in meeting installation targets primarily related to slow scaling in distributed small installations
- In the longer term, the growing trend to distributed energy, the predictability of solar power, and the best road map for cost declines among all power generation types should make solar the largest new generation market for decades to come

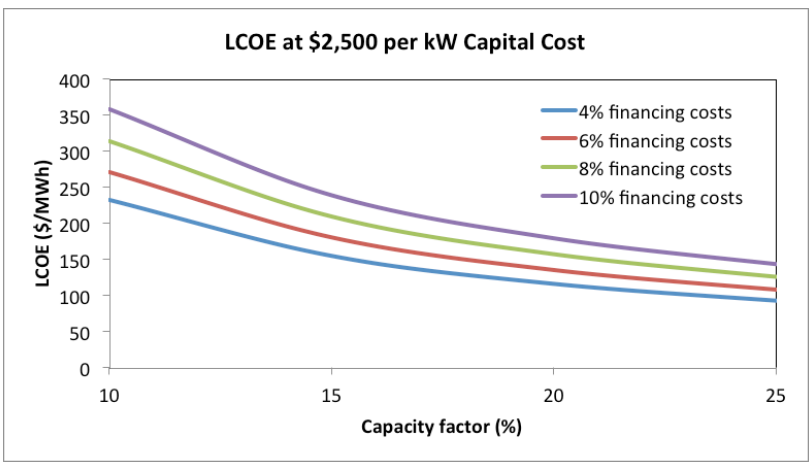
2) Solar PV Capital and Levelized Costs and Economics

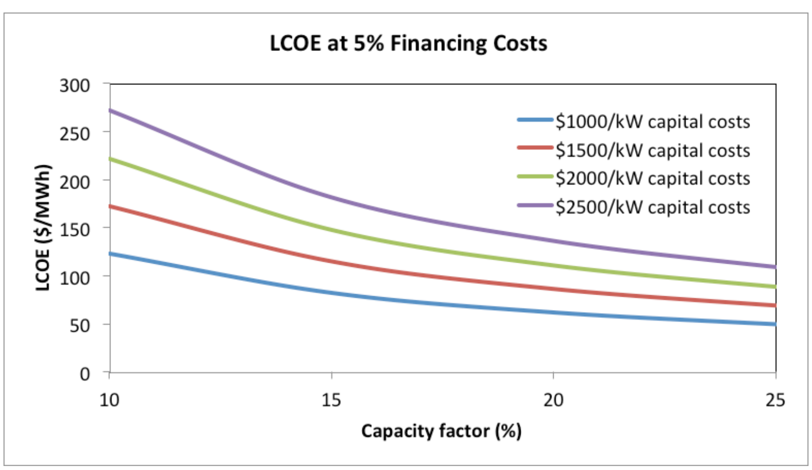
Solar costs are primarily up-front capital costs, and are often quoted as such: the cost per Watt of installed power. To compare with other forms of generation, costs per kilowatt hour need to be estimated, the majority of which are the amortized costs of capital but also include operations and maintenance expenses. The result of this estimation is called the levelized cost of energy (LCOE). Below we discuss hard capital costs and estimated LCOE, and further discuss sensitivity of LCOE to certain assumptions.

- Per Watt average costs of new installation have fallen from $15 in 2007 to under $3.50 in 2014
- Current estimates of installed costs are $2-$5 per Watt for small rooftop and $1.25 - $2.50 per Watt for larger ground-mount utility-scale projects
- Some current data points:
    i. SolarCity model residential installation shows total cost of $21k for 6.4 kW system
        1. $3.28 per Watt, including sales and marketing
        2. Likely at low end of $2-$5 per Watt range for small rooftop before sales and marketing since they have scale advantages
    ii. Vivint Solar (similar model to Solar City) has installed costs of $3.21 per Watt in most recent quarter
        1. $2.32 per Watt installation
        2. $0.89 S,G&A
    iii. Small rooftop hard costs (before sales and marketing costs) can be as low as $1.50 in developing markets
    iv. Enel Green Power Carrera Pinto in Chile, 97 MW at $180, roughly $1.90 per Watt
    v. Boralex building 10 MW in France for Euro 11m (Euro 1.10 per Watt)
    vi. Carbon Free financing of 63-project, 18 MW portfolio $85m ($CAD $4.70 per Watt)
        1. Small projects, Metis cooperation, are factors behind coming in at the high end of the range
    vii. Kyocera-led consortium in Japan building 92 MW for Yen 35 billion (slightly more than $3 per Watt)
    viii. China Minsheng New Energy planning 20 GW in China over five years, at total investment of 200b CNY ($32.35b USD, $1.60 per Watt)

- **Installed Costs Breakdown**
    i. Chinese module prices $0.525-$0.575 per Watt at point of shipping
    ii. With margins in high teens / low twenties (were lower through overcapacity in 2010-2013) module costs are $0.425-$0.50
        1. Cell is roughly half the cost
            a. Of this polysilicon raw material is $0.08-$0.10
        2. Balance is solar glass, backing, and connections
    iii. Inverter is $0.13-$0.14 per Watt at scale, higher for small residential
    iv. Balance of system (labour, mounting, tracking, connection to grid, and wiring) ranges widely depending on scale and labour rates from $0.50 per Watt to $3.00 or more for retail in developed markets
- **Levelized Costs of Electricity (LCOE) for solar**
    i. With the dramatic drop in installed costs in recent years (largely driven by scale and intensifying competition), the levelized cost of electricity (i.e. per kWh cost) has fallen to levels that are much more competitive with other alternative forms of electricity generation
    ii. Some contract bid data points:
        1. 2014 Texas project bid at $0.05 per kWh (maybe $0.07 before ITC subsidy)
        2. 2014 New Mexico project at $0.058 per kWh ($0.085 before subsidy)
        3. First Solar bid 500 MW in India at $0.0875 per kWh (with escalation factor)
        4. Brazilian auction in November 2014 average $0.089 per kWh
        5. Winning bids in Dubai, January 2015, came in below $0.06 per kWh (bid by Saudi company ACWA)
        6. Boralex French project Euro 0.085 per kWh
        7. Residential contracts signed by SolarCity and Vivint are in the $0.15 per kWh range, with escalation of 1.5% typical
    iii. LCOE depends on a number of assumptions, the most critical being capacity factor, cost of capital, and maintenance costs
    iv. $0.06 per kWh (as seen in Dubai bid) requires roughly the following:
        1. Installed cost of $1,250 per kW (low end of observed installations)
        2. Capacity factor of 25% (high end of observed performance)
        3. Maintenance costs of $20 per kW per year
        4. Cost of capital of 6%
            a. Weighted average cost of capital, includes equity
            b. Thin levered equity returns implicit at recently observed low bid rates
        5. 20-year contract lifetime
        6. No escalation factor in prices, no deterioration in performance
    v. Sensitivity to installed costs, capital costs, and capacity factors are in [charts below]

1. Low cost of capital is a major boon to solar, as difference between 4% and 10% cost of capital is more than 50% at low installed costs, higher for more expensive projects
2. Escalation factors of 1.5%-2% can add 5%-10% to LCOE
3. Typical degradation is 2-3% in first year, 0.5% thereafter
    a. 80% of rated performance at year 20 is guaranteed by manufacturers
    b. Adds 2-3% to LCOE
4. Capacity factors in non-desert locations (like Germany, Japan, UK, China, where much of the global installation has been to date) are significantly lower, ranging from 13%-18%
5. Higher insolation in desert regions somewhat offset by heat-related efficiency loss (roughly 0.5% per degree Celsius) and higher maintenance to clean in dusty environment





3) Global Solar Incentive Schemes

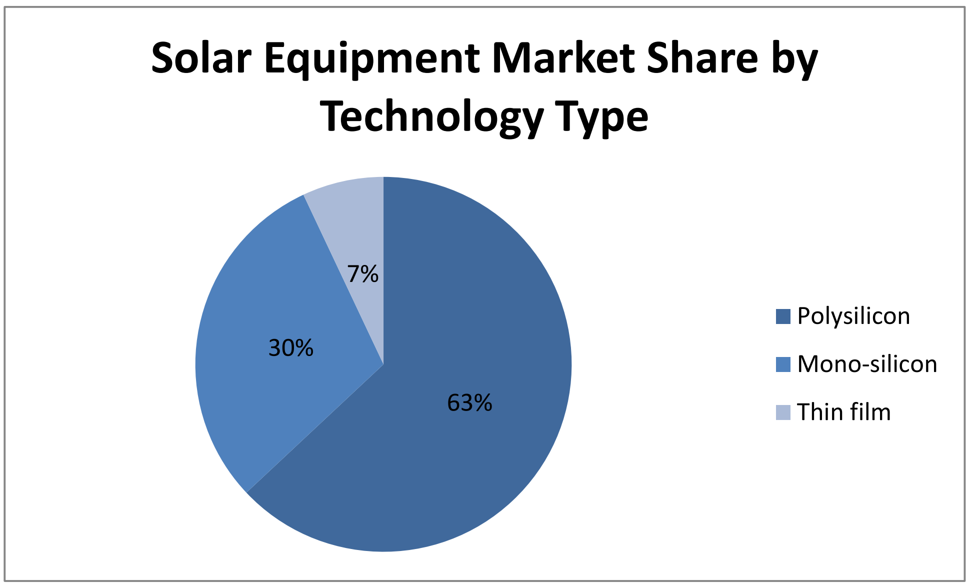
Government subsidies have been critical to the development of the solar industry, but are less important today as solar is better able to compete directly with conventional forms of electricity. Incentive schemes were generally put in place to encourage renewable energy development and often to support the development of domestic solar industry technology. The most important incentives in place today are in the two largest solar markets: the Investment Tax Credit (ITC) in the U.S. and the Chinese Feed-in-Tariff (FIT)

- Incentive schemes really took off with the German FIT, launched in 2004
- Many other jurisdictions have followed Germany's lead, especially in Europe at first, then migrating to some North American States and Provinces, Japan, and China
- United States in the past mostly been driven by Renewable Portfolio Standards (RPS) that require utilities to meet a threshold for percentage renewable generation by a target date (e.g. 20% by 2020)
    - **i.** Many States with RPS in place have created tradable credit systems to facilitate most efficient means of achieving the mandated target
- However, since 2009, the ITC has been the critical driver of U.S. solar development, offering a very generous 30% of capital costs rebate on commissioning
- After Germany, other European FITs (Spain, Italy, United Kingdom) had surprisingly rapid take-up and were abandoned after relatively short period in place
    - i. Even with attractive economics at market prices, backlash from FIT-driven goldrushes in Spain and Italy have led to greatly reduced new solar installations in Southern Europe.

Country / Region	Incentive Type	Incentive Price	Expiry / Review	Other Notes
China	FIT	1 Yuan (~$0.15) per kWh	Unknown	In place since 2013, payments only really started late 2014 Paid by central govt, concern with slow payment terms (6-9 mo)
United States	Mixed (State by State) Federal ITC	ITC 30% of qualifying project costs	ITC expires end of 2016	States dominated by RPS, and credit trading systems to attain RPS Hawaii, New Jersey, California most attractive Some small FITs (Michigan, Texas, New York) with limited impact
Japan	FIT	Up to $0.50 per kWh (small) Current $0.23 per kWh large	Regular review	At present, moratorium on further approvals due to unexpected high take-up Best rates in the world Enough already approved for record year in 2015, 2016 likely much less
UK	Generation credits (ROCs)	~$0.07 GBp per kWh	Expired March 31, 2015	ROCs generated a lot of development Moving to auction system, much lower prices
Canada	Mixed (provincial)	Ontario small $0.28-$0.35 per kWh	Biannual review	Large (>500kW) no longer FIT eligible, revert to auction process Other provinces award by bidding process
Germany	FIT	Small E0.129 Mid E0.089 Large auction	Regular review and decrement	Large systems (>10MW) have capped price of E0.11 per kWh, all-in FIT is in addition to market price
Australia	Mixed (State by State)	FITs low ($0.10 per kWh)		Credit system oversupplied due to retail eligibility, halted large scale development 2013-2015

4) Solar Technology Market Share, Players and Development

Solar is still a relatively young industry with developing technologies that are continuing to change. Most of the market is based on an active layer that is made from a silicon-based semiconductor. Other semiconductor materials are also possible, some more efficient and more expensive (e.g. gallium arsenide), some the opposite (e.g. thin film, using cadmium telluride). Multi-junction solar cells can be made with layers of different semiconductor materials to capture more of the light spectrum. Within the silicon segment, there are different approaches to crystal growth, with mono-silicon the more expensive and more efficient in comparison to poly-silicon. The dominant technology today is the simplest and cheapest – polysilicon.



- **Multi-crystalline silicon 63%**
    i. Standard p-type 35%, advanced 30%
        1. Advanced includes double-screen-printing, ion-implanting, selective emitters, wrap-through variants, and rear-surface passivation, bifacial, multi-junction
    ii. Largest players all Chinese: Yingli, Trina, Jinko, Canadian Solar, JA Solar, Renesola, and between them account for about 1/3 of total market, half of multi-crystalline (poly) market
- **Thin film (mostly CdTe – Cadmium Telluride) 7%** (First Solar and Solar Frontier are 95% of this)
    i. Solar Frontier is Japan-based CIGS (copper indium gallium selenide), about 1 GW
    ii. First Solar restarting idled lines, 728 MW expansion 14-15
    iii. Thin film losing share, was 12% in 2009

- **Mono-crystalline silicon 30%**
    1. Standard p-type 14%, advanced 10%
    2. N-type 6%
- **Mono- vs. polysilicon vs. thin film**
    1. Mono-silicon most efficient, highest cost
        1. Consistent orientation of crystals allows for highest energy harvest, efficiencies of 18%-20%+ delivered
        2. More costly and energy intensive, LCOE generally higher than polysilicon
            1. SunPower only major module manufacturer that does not discuss its costs per Watt
        3. Preferred for some rooftop applications, anywhere where maximum power is desired from limited space
        4. Wacker claims shift to mono in coming decade
        5. SunPower largest mono producer
    2. Polysilicon is less efficient, lowest cost
        1. Poly efficiencies delivered are in the high teens, 15-19%
        2. Chinese producers are mostly poly
            1. JA Solar and Yingli only Chinese tier 1 with some mono
        3. Costs for large poly-silicon module producers are now in the low $0.40 per Watt and dropping 5% per year
    3. Thin film is least efficient, equivalent (or higher) cost to poly
        1. Many materials for film, CdTe, CIGS, a-Si (amorphous silicon)
            1. Cadmium Telluride faces limitations in supply of tellurium and toxicity of cadmium
        2. Thin film efficiencies range from below 10% to 15% depending on material
            1. First Solar claiming efficiencies over 16% on its best lines today, and for the whole company by the end of 2015
            2. Company also claims an energy-density advantage in hot, humid climates where thin film performs better
        3. First Solar dominates this market with CdTe technology
            1. 90% of sales are in the United States, large utility projects benefitting from ITC grant
            2. Puts global competitiveness of First Solar technology in some question, despite company claims
        4. Hanergy Thin Film is a murky Chinese, Hong Kong-listed company with a crazy market value that claims to produce a-Si solar modules

5) Technology Advances and Prospects

Although solar is becoming a large-scale, low-cost commodity manufacturing industry, there is still significant technological development opportunity and potential for differentiation. Numerous technologies promise the ability to absorb more light and thereby increase efficiencies closer to the theoretical maximum. New materials can make use of parts of the light spectrum not captured by silicon, and increase theoretical maximum efficiencies. Opportunities exist to improve the manufacturing processes through in-line measurement and testing. As solar grows into a larger industry, the ability to enter the market with new technologies will become more challenging. There is something of a 'Catch-22' for aspiring new entrants: you can't get scale unless you are low cost, but you can only have low costs if you have scale.

- Current technology advances in the lab and early application are commonly referred to as 'third generation'
- Technologies are generally focused on reducing reflectivity of solar cells; increasing light absorption in solar cells; reducing 'recombination' of electron and 'hole' couple that would close the electricity producing circuit; reducing the amount of materials (silicon, glass) required in modules; improving efficiency and yields in the production processes
- Polysilicon production
    - i. Polysilicon makes up as much as 20% of module cost and is primarily made using an expensive and energy-intensive Siemens process to convert metallurgical grade polysilicon to solar-grade (highly purified) poly
    - ii. Fluidized bed reactor (FBR) technology is used by REC in Norway and now by SunEdison / Samsung JV in Korea
        1. SunEdison claims can cut poly costs per module by more than 50% to $0.05 per Watt peak by 2016
- Wafer / crystal creation and sawing
    - i. Standard advances in reduced wafer thickness and increased wafer surface area steadily increase yields and reduce costs
        1. Benefit somewhat offset by fragility of thin silicon wafers and loss due to breakage
    - ii. Multi-wire cutting

- Cell / module advances
    i. N-type silicon cell design
        1. While all cells have elements of p-type and n-type layers (to create poles for electron and its 'hole' duality) increasing the size of the n-type relative to the p-type can improve efficiency
            a. P-type is boron-doped and is subject to light-induced degradation within weeks of panel installation
            b. N-type has historically had lower yields and higher costs
        2. SunPower and Panasonic are leaders in existing n-type production
        3. Confluence and Solaicx are active in developing lower-cost n-type solutions
    ii. Two-sided (bifacial) cell designs
        1. Adding glass and cells to the back of a module (which is otherwise metal) allows for harvesting of extra light from reflection (albedo), and can make tracking systems more efficient in gathering the maximum light from the sun's path
        2. Meyer-Burger and SCHMID, both out of Germany, claim that yields can be improved 30% or more for an incremental module cost of only $0.10 per Watt
            a. This depends on optimal lab-type conditions and cost estimates have not been proven at scale
    iii. Multi- or hetero-junction
        1. Hetero-junction cells combine layers of different semiconductor materials with properties that are able to harvest different wavelengths of light:
            a. Standard silicon mostly harvests in the infrared spectrum
            b. Gallium arsenide, amorphous silicon, silver, other materials can harvest ultraviolet, invisible light-energy
        2. Hetero-junction designs boost the theoretical maximum efficiency of solar cells to something higher than 40%
            a. This is at the vanguard of scientific research into solar cell improvements
            b. Still very high cost, not yet commercial
        3. Toronto-based Morgan Solar combines more expensive, high efficiency solar cell materials with concentrating optics so less of the material needs to be used
            a. A 4cm x 4cm optic uses a 1mm x 1mm cell
            b. System requires dual-axis tracking to ensure the concentrating optic functions at maximum efficiency
            c. Company promises costs that are competitive with polysilicon (and potentially better when balance of system advantages of

higher efficiency are included), but is not manufacturing at scale yet

- Balance of System advances
    i. Tracking systems
        1. Tracking systems allow panel orientation to be gradually changed (on one or two axes) to maintain perpendicular aspect to the sun and maximize light harvesting
        2. Tracking systems are commonly used in large-scale ground mount applications, less common on rooftops where space requirements or logistics don't allow for it
        3. Single-axis tracking can add 15%-30% to cell efficiency for as little as $0.15 per Watt additional cost, depending on latitude and insolation of location
            a. There is also higher expense to maintain the moving parts / motors
        4. Dual axis adds another 5%-10% over the single axis system in efficiency, but for the same cost, cost benefit is much lower
        5. Overall, tracking systems are less attractive as module costs have come down much faster than tracking costs, making it cheaper to add modules than tracking where space allows
    ii. Concentrated PV (CPV)
        1. Concentrated PV uses mirrors or lenses to focus sunlight from a wider area on to a smaller PV cell
        2. Was conceived when silicon cells were expensive and reducing area required was a key to cost reduction
        3. With much cheaper silicon cells today, the benefits of reduced PV cell area required are not enough to compensate for the extra costs (design, installation, focus depth, materials)
        4. CPV accounts for less than 1% of global market, mostly in United States and Europe, and very little has been added in the past few years
        5. Morgan Solar (mentioned earlier) promises a more economic CPV design that doesn't require mirrors or extra focus depth and uses inexpensive materials
            a. Have yet to prove their technology at scale after nearly a decade of development
    iii. Inverters / power electronics
        1. Inverters are required to convert the DC power generated by solar arrays into AC power needed to access the grid
        2. Central (string) inverters convert the power collected from a large array of solar modules, set up in series

a. They optimize power based on the lowest-producing cell, so that shading of one cell can bring down the output of an entire array
b. They run at high voltage, with higher resistance losses, and greater safety requirements

3. Central inverters cost $0.12-$0.18 per Watt (at scale), having fallen nearly as rapidly in price as solar modules
4. Micro-inverters (one inverter per panel) or module-level power optimizers cost more but can theoretically get the maximum power out of every cell, increasing overall yield
    a. Enphase primary supplier of micro-inverters, SolarEdge primary supplier of power optimizers
        i. Sparq, private Canadian company is developing micro-inverters that control four panels instead of one, saving costs over micro-inverters with, they claim, little loss in efficiency
    b. Between the two micro-inverters are cheaper since power optimizers still require a central inverter, but micro-inverters need to be calibrated to the requirements of different electric grid specifications
    c. Cost of both technologies around $0.30 per Watt, roughly double the cost of central inverters alone
    d. Technology providers promise power increases of up to 25%, but real world outcomes have been in the low-mid single digits
        i. $0.20 premium per Watt for yield increase of 5% is not economic
    e. Module-level power electronics today account for a very small fraction of the market, mostly in US applications
        i. Most of this is encouraged / sold through by installers that have an incentive to maximize the bill to the customer regardless of the resulting yield
    f. Future expansion will require more definitive demonstrations of the gains; technological improvements; and the emergence of larger, more dependable suppliers

- Efficiency / process advances
    i. Improved process measurement and control
        1. No in-line measurement available for wafer / cell production
        2. Variable raw material inputs and furnace performance leads to 5%-25% cells outside spec limits and >10% of cells down-rated for performance and sold at loss-making discount
        3. In-line analysis of cell / wafer performance factors can improve efficiency, isolate furnace problems, reduce loss and waste

6) Market Observations

The market for valuing solar companies has had to process several dramatic changes in the past few years. Many solar equipment producers have 'vertically integrated', meaning they have entered the business of solar farm development and operations. Financial reports and valuations are more complicated due to the mixture of different business models. Related to this vertical integration has been the emergence of yieldcos. With their limited reinvestment, yieldcos have questionable long term sustainability, and their set up as captive to manufacturing parent companies raises questions of conflict of interest. Finally, the market in the past several years has shifted dramatically from one of overcapacity to one where supply is tight. We believe that potential returns to commodity module producers (mostly China-based) are higher than appreciated by the market, and we offer some thoughts below on the case for investing in Chinese suppliers.

- Vertical integration makes company analysis more challenging, puts consolidation in play
    - i. Upstream producers of cells and modules in the US began to get into the business of developing utility-scale and commercial projects in 2012
        1. Helped secure a distribution channel for production in an oversupplied market
        2. Also took advantage of attractive subsidies available for development of solar generation assets, particularly the US ITC
    - ii. First Solar was the first company to make this move, followed by MEMC who purchased SunEdison
        1. MEMC since renamed itself SunEdison and shed much of its upstream production activities
    - iii. SunEdison had global development operations and became heavily acquisitive in the late 2014/2015 period, helping to spur interest in global development assets
    - iv. China-based market leaders in module production have development businesses, primarily in China, but also around the world, except in the U.S. where local players have too large an advantage
    - v. In the U.S., residential rooftop developer / facilitator, SolarCity, has taken vertical integration in the other direction, buying a start-up module maker Silevo, and now building a factory in Buffalo New York with intended capacity of 1 GW
        1. Unusual expansion into 'commodity' part of the value chain
        2. Heavily subsidized by the NY State govt, basically covering entire $750m capital cost and providing tax breaks as well
        3. SolarCity commits to minimum employment levels for 5-year period
    - vi. Numerous complications to financial models/analysis from vertical integration

        1. Modules produced for in-house development are not booked as revenue even as the costs of capacity they use are absorbed, making financial performance look worse than reality
        2. Sale/leaseback transactions, used by SUNE, SCTY and others lead to high debts (without recourse to the parent) and only gradual revenue recognition with payments even though cash has been received from financier
    vii. Consolidation has been active, led by American companies with high valuations
        1. SunEdison has been the biggest acquirer, expanding into wind and other renewable generation with FirstWind acquisition, then more global assets, and most recently into residential rooftop by acquiring Vivint Solar, #2 to SolarCity, for $2.2b
        2. Canadian Solar followed SunEdison's lead in buying ReCurrent energy from Japan's Sharp for approximately $1b
        3. SolarCity has made one relatively large acquisition (aforementioned Silevo) and several smaller ones (Mexican developer)

- 'Yieldco' model has driven much of the growth in the past year, model may be misunderstood
    i. Concept started by conventional utility NRG with NRG Yield, owning both conventional (gas) and renewable assets
        1. The concept is for developers of new generating assets to focus on the development business, leaving the operations and cash flow harvesting of developed assets to a new subsidiary company (the yieldco)
        2. These companies have promised to pay out virtually all cash generation to investors (hence the 'yieldco') with little cash retained for asset renewal or growth
        3. As yieldcos have also promised growth to investors, they have depended on market access to finance new acquisitions, generally of more properties developed / acquired by the parent development company
        4. Parent companies get a captive channel for 'dropping down' their developed assets (at fair market prices?), valuation credit for their minority shares in the yieldco, as well as dividends received
    ii. The concept was quickly adopted by renewable industry, with yieldcos spun from SunEdison (Terraform, Terraform Global), First Solar and SunPower (together 8point3), NexEra (NextEra Energy Partners), and Abengoa (Abengoa Yield) all launched since late 2014
    iii. Canadian Solar preparing for yieldco launch in late 2015, other Chinese solar developers musing about the possibility
        1. Chinese, and all developing world, assets have been considered not 'yieldco ready' as they are not bankable with long-term financing,

making it more difficult to secure stable predictable cash flows that can be paid to investors

iv. Yieldcos accounted for nearly half of all solar financings in the first half of 2015, taking advantage of their low cost of capital

v. Cost of capital advantage driven by the apparent security of long-lived assets and contracts, and by the income offered

    1. Treated like a utility, since power generation (and in some cases transmission) is their business

vi. However, unlike utilities, yieldcos pay out nearly all their cash available for distribution, leaving very little for maintenance, capital refurbishment or growth

    1. Yieldcos depend on regular access to capital markets to fund growth and even eventually to replace capital necessary to maintain distributions

vii. There is also a reasonable concern of conflict of interest as most yieldcos are set up as controlled companies by a parent that is channeling all of its development assets through the yieldco

    1. Parents have greater economic incentive to transfer development assets at higher vs. lower price

viii. Yieldcos initially launched with yields comparable to utilities, as low as 3% in some cases, but yields have gone much higher (doubled or more) with a reassessment of the model, led by SunEdison / Terraform, the largest in the space

    1. With no replacement of depreciating capital, an argument can be made that at a minimum, yields in the 8%-10% range (investment payback of 10-12 years) should be demanded by investors

- Strong bias against Chinese production and development assets evident in market valuations

    i. There is a bifurcation evident in market valuations, with Chinese upstream producers carrying significantly lower valuations than U.S. based producers and developers (see attached table at the end of this section for metrics of different sub-groups of the solar sector)

    ii. Although China accounts for more than 75% of global production, and U.S. development companies enjoy relatively high valuations based on high growth prospects, Chinese producers are not given credit for the growth

        1. Multiples among U.S.-listed top tier Chinese module producers (Jinko Solar, Trina Solar, JA Solar, Canadian Solar and Yingli) are 5-8x P/E and less than 5x EV/EBITDA

            a. Many of these companies have downstream development assets that are not included in financials and, contrary to the U.S. examples, not recognized in valuations

    iii. After several years of excess capacity due to rapid expansion in China, some rationalization there (bankruptcy of SunTech, LDK, debt distress at Yingli) has led to more tempered capacity growth at the same time as improving economics has boosted demand

iv. The result is a tight capacity environment in 2015 and at least through 2016 as well
    1. Post-2016 U.S. ITC demand is a question mark but with aggressive targets for growth in China, India and the Middle East, strong mid-term growth is likely

v. With factories at full utilization and pricing stabilizing, Chinese tier 1 producers have seen gross margins rise to over 20% from mid-teens in 2014 – as recently as 2012 they were negative

vi. Market growth of 25% plus with expanding margins and operating leverage is driving very high earnings growth, yet P/E is in the single digits

vii. The market case against Chinese solar producers is listed below, (our rebuttal follows each point):
    1. Solar modules are a low-margin commodity business
        a. True, but scale is important in this business, reducing the ability of new entrants to compete
        b. There is also some technological differentiation
        c. Market growth is strong, suppliers are more rational, and margins are rising
    2. Chinese accounting is suspect, with a history of fraud in North American-listed Chinese companies
        a. All tier one Chinese producers have observable business, with their products sold and installed all around the world
        b. All have multinational 'big four' auditors
    3. History of bankruptcy among Chinese solar manufacturers
        a. Not all manufacturers are the same: LDK and SunTech grew capacity too fast with too much debt. Today Yingli may be in the same situation, with debt/EBITDA greater than 6x while Trina, Jinko, JASO have debt/EBITA of 3 or less
        b. Bankruptcy also happens in Western solar market, such as Solyndra, and is a possibility with SunEdison and its $11 billion of debt
    4. Chinese economy in crisis, sources of finance vulnerable, government slow to pay Feed-in- Tariff
        a. True, Chinese module producers have begun getting into downstream solar development, which requires finance. However, these developments are a smaller part of their business than more highly-valued American peers
        b. Economic crisis and instability is everywhere, arguably as much in America (with its enormous debt and deficits) as anywhere else

    c. China has imperative to invest in renewable energy given its local pollution issues and invests more in infrastructure than any other country in the world (they have the savings, capital formation, and cheap labour to do so)
    d. Slow payment terms make cash flows slightly less attractive, but given the imperative and how much government has staked on renewable energy we judge non-payment risk as very low

5. Tariffs and technology edge for Western producers will lead to market share losses
    a. Despite tariffs in U.S. and Europe, Chinese modules remain competitive and hold high market shares (albeit lower than in the rest of the world)
    b. Tariffs raise prices in the country that imposes them, raising electricity prices for consumers (i.e. solar buying utilities, residents, and businesses)
    c. U.S. is subsidizing their own producers (SolarCity has a $750m plant in Buffalo basically fully funded)
    d. Technology edge is unclear but Chinese companies are setting records for efficiency in polysilicon even as SunPower does so in mono-silicon and First Solar does so in thin film
    e. The low market shares for SunPower and First Solar outside of the United States indicates a lack of competitiveness without tariff protection