

# Solar & Alternate Energy

## The Competitive Solar Landscape (Includes Conf Call Transcript)

### Equities

Americas  
Electric Utilities

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### Evaluating the solar outlook amidst an increasingly competitive outlook

We held our latest conf call with Martin Meyers, co-founder and head of the consulting services at Photon (Solar) Consulting. Mr. Meyers articulates a view of growing competition following years of substantial growth in the solar, noting a ~50% compound volume growth 2004 – 2009, and ~40% 2009 – 2014. He estimates the global PV markets at ~56GW in 2015, growing to 65GW in 2017, and up to 72GW in 2019. Mr. Meyers' primary focus argues the bulk of value will be extracted from downstream developers (~\$10-11 Bn of value) this year vs. the ~\$1 Bn in operating profit extracted by upstream players, with pressures on both despite volume growth.

### Worried about the utility 'pushback': a limiting factor on growth function

According to Martin, when PV penetration in any market approaches ~5%, the operational, economic and financing impacts on the centralized electricity system becomes large enough to cause strong pushback, which can negatively impact annual installation volumes. We see several of these key reforms (CA and AZ) to take effect in 2017/18, exacerbating potential solar boom-bust from ITC expiration/step-down.

### Financial engineering should provide significant incremental value

Mr. Meyers highlighted on the call that value in the PV sector now is driven by energy finance, not by advances in technology. As PV electricity approaches grid price in a growing number of markets, the largest cost savings for PV system costs can potentially come from reducing the cost of financing the system. For a typical system, Photon estimates that reducing the discount rate by ~100 basis points will have the same impact on levelized life cost of electricity from that system as would have been achieved by reducing the cost of that system by 8 to 10c/Watt.

### Declining module prices maybe a lesser driver of value now vs the past

Average module costs in 2009 was north of \$2/Watt for US panels, falling to 70c/Watt this year and projected to 51c/Watt by 2019 according to Photon. For the Chinese players, prices have declined from ~\$1.70/Watt in 2009 falling to ~61c/Watt in 2015 and by 2019 to ~48c/Watt. According to Mr. Meyers while the 'experience curve' can drive down prices significantly, the rate of cost reduction now is much slower than experienced earlier having extracted much of the easy low-cost manufacturing gains.

### The C&I segment represents the biggest untapped opportunity

Mr. Meyers highlighted the small (non-Fortune 1000) C&I segment as one of the biggest unmet segment opportunities. The rate structures for these end customers often include a significant demand charge; so PV (potentially along with storage) can impact those demand charges significantly, and have a disproportionate impact on the electricity bill for those end customers. Growth in the commercial segment has really not taken off the way it has for resi; but we expect this is set to change with string growth over the 2015-17 period, particularly with improving financing opportunities. We highlight SCTY recently announced a \$1 billion fund for its plans for more than 300 MW of new commercial solar projects, including battery storage systems, over the next two years. Sungevity (mostly so far focusing on residential installations too) recently partnered with Sol Systems which finances commercial-scale solar projects. Vivint has also announced intentions to potentially partner up to enter the C&I segment as well. Also this year, Apple announced a \$848mn 25 year agreement to buy output from First Solar's California Flats project; while 180 target stores announced agreements to install solar panels on their sites through a deal with Greenskies Renewable Energy. We think this trend will strengthen over the coming months.

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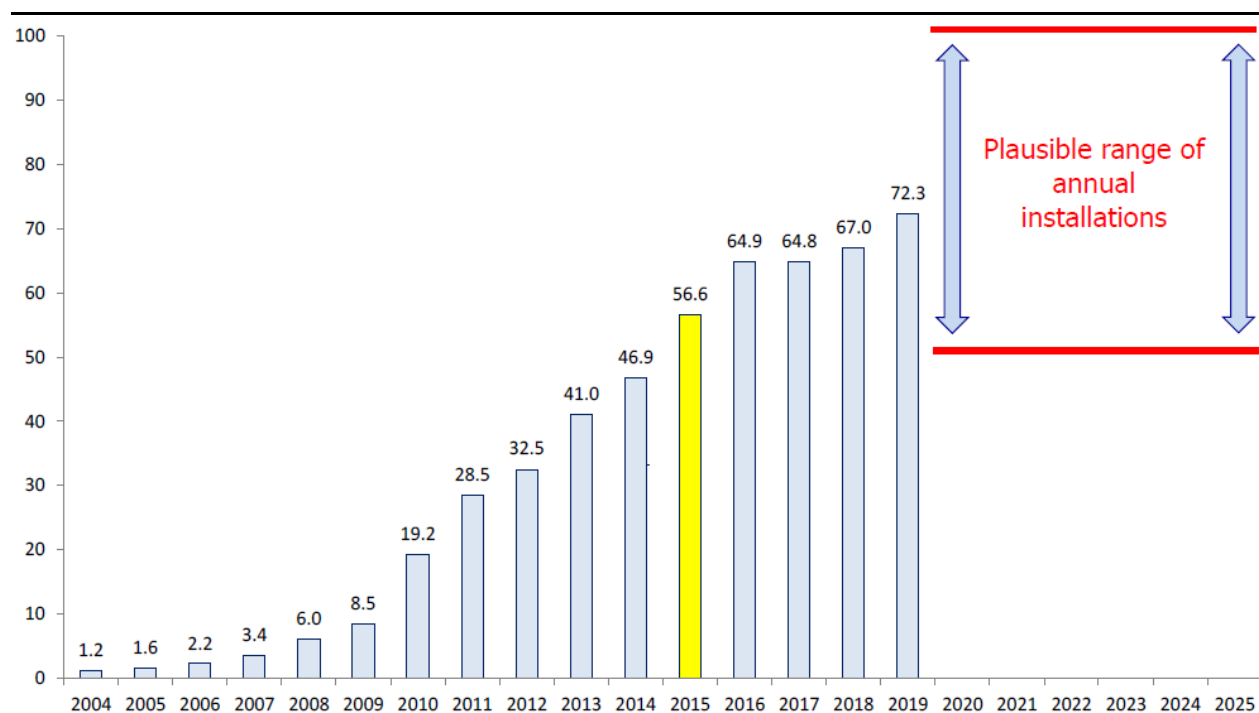
## What about US installment projections? 7.8+ GW this year

In the US, Photon expects over 7.8 GW in 2015, reaching close to 10 GW next year. Then, factoring in the impact of declining ITC, they expect closer to 7 GW by 2017 and a further decline to about 6 gigawatts in 2018 factoring in a certain degree of saturation in California; heading back towards 7 GW by 2019. California is still a large chunk of the US markets. In the nationwide numbers above, PHOTON estimates California to account for ~3.5 GW in 2015, rising to 4 GW in 2016; but then below 2GW in 2017 and even further down to about 1GW in 2018.

## Summarizing Global installation volume forecasts by PHOTON

In the chart below, global PV installations volume growth slows down over the 2015-2019 period compared to the past. Estimated ~56GW in 2015, 65%GW in 2017, 72GW in 2019; and significant variability on forecasts beyond - PHOTON expects annual installations at 50-100GW beyond 2020.

**Figure 1: PV Installation Volume Forecasts** (*preliminary estimates from PHOTON Consulting*)



Source: PHOTON Consulting presentation slides used on the UBS Conference call

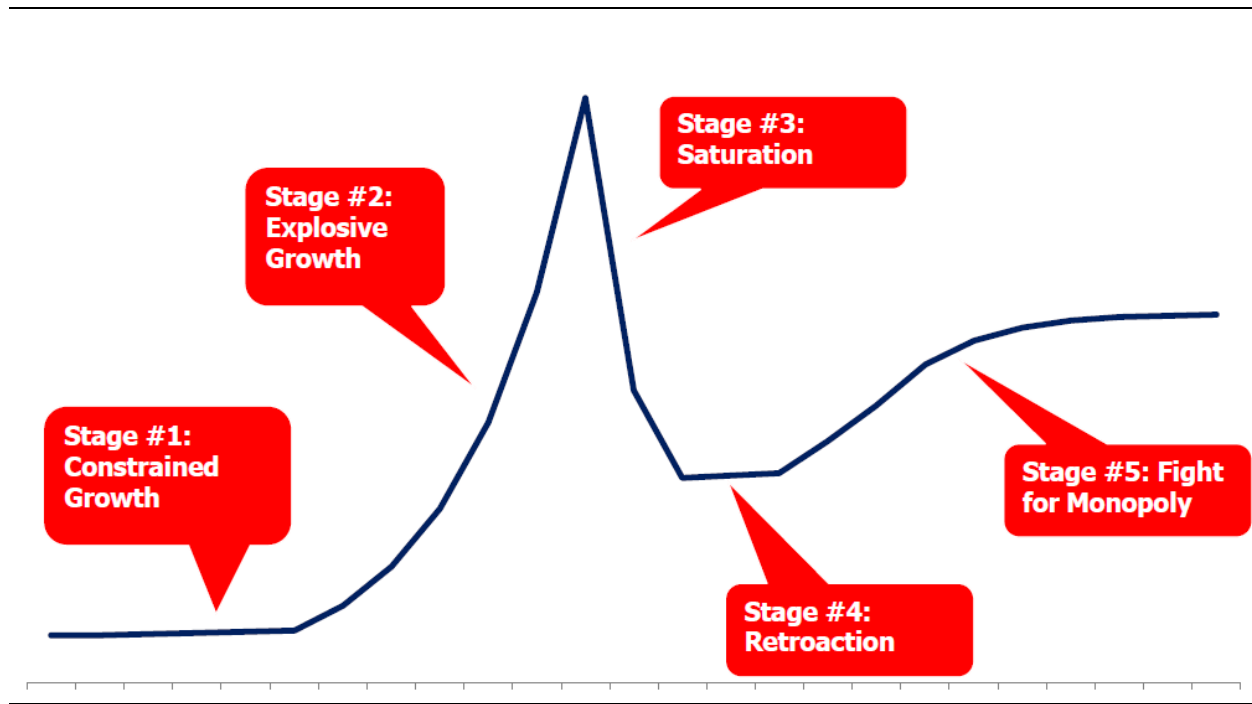
## A macro look at how the market may evolve

In the chart below we show PHOTON's "five stages of PV market evolution". The first stage of constrained growth is the stage where the IRR spread is too low to drive volume. The IRR spread is the difference between system IRR and the associated discount rate for that system. PHOTON concludes that when this IRR spread reaches a threshold of about 100 to 200 basis points, demand growth becomes price elastic and volume growth speeds up. At this point we enter stage 2 in the chart below (this state of affairs is seen consistently across several markets now).

The dip in the cycle happens when PV penetration increases and reaches the 5% threshold in terms of grid connected electricity generation. Given the impact such

levels of penetration have on operational, economic and financing impacts on the centralized electricity system – PHOTON holds that policy makers at this stage will start to take put in place polices that squeeze value away from owners of PV systems. The last stage is the 'fight for monopoly' characterized by a trend where solar cos will try to deepen and entrench relationships with the customers and their value-chain partners in attempts to grow their market share.

**Figure 2: PHOTON Consulting's 'Stages of PV market evolution'**



Source: PHOTON Consulting presentation slides used on the UBS Conference call

# Conference Call on Global Solar Competitive Trends

*We present below highlights from our call with Martin Meyers, co-founder and head of the consulting services at Photon Consulting - a solar industry research and consulting group based out of Boston, MA. The call focused on the growing competitive trends in the sector as well as impacts from panel manufacturers moving into the developer space.*

*Comments on the sector have been edited for clarity. Let us know if you would like to see slides used on the call.*

Replay of the call is available until 5/12, using the following call details:

Toll Free: 800 633 8284

Toll: +1 402 977 9140

Passcode: 21767669

Julien Dumoulin Smith: Good afternoon everyone. I appreciate you taking the time on a busy day here; today we are hosting a call with PHOTON Consulting to discuss competitive trends in the sector, stemming across various parts of the industry - and hopefully trying to tie together some of those trends.

Speaking today from PHOTON is Martin Meyers, who is the co-founder and head of the consulting services over there. So with that let me turn it over to Martin to kick things off. Thank you for taking some time Martin, what are we looking at today?

Martin Meyers: We're looking at a very dynamic sector that continues to have enormous opportunities for value capture; and also a lot of risks as the sector changes in the core.

And it's useful to remember that this year we're **expecting total installation volume in the order of 55 gigawatts of solar-generation capacity**. If you look back to five years ago we were still in the single digits annual gigawatts. This sector has scaled massively and the impacts are very significant across geographies and the opportunities to both gain value and also the risks to some of the existing players are very high.

And it's also becoming much more impactful to many of you on the call that are active in the utilities space.

I'd like to cover five topics quickly today and then look forward to having a really good interaction with you addressing any questions as they come in to Julien or directly over the phone. And our topics are really as follows. First this is an energy finance sector, not a technology-driven sector.

Secondly local PV installation markets move through five very predictable stages. And I'm going to take you through those. And we believe that that makes what seems to be a very wild market from demand side actually one that's very amenable to analysis.

The third point is that **a series of factors is leading to significant slowdown in growth volume**. We've already seen that in the last two years, those of you who are watching are aware of that. I'm talking globally now. Despite the fact that in some markets we still have explosive growth taking place. And so we'll talk through some of the implications of that.

And then the last two points are really about what it's going to take to survive and thrive in this rapidly changing markets and that really connects to lining up strong value propositions with supply-chain partners and getting those aligned into relationships all the way through to end customers in high-value markets.

The title for the Solar Annual Report that we just released is 'The Hunger Games'. Many of you are familiar with that story and that's really about winner take all or survival only of a small number. And so that's why we've chosen that theme as the headline of our report because we believe that there will be significant casualties as the sector evolves over the next five years.

So starting with that first point - **buying a PV System is really like purchasing 25 years of electricity upfront in a lump sum**; at least the financing of doing that. As PV electricity now is at or below grid price in a growing number of markets, really the **strongest leverage point on further reducing PV is actually by reducing discount rates, the cost of financing the system**.

Just to give you an example on that if you take a typical system these days reducing the discount rate for that

system by about 100 basis points it will have the same impact on levelized life cost of electricity for that system as reducing the cost of that system by 8 to 10-tenths a watt; so lots of leverage by reducing discount rate.

**And so financing innovation is the biggest opportunity area for value capture.** And just one way to put some numbers on that, when we look at the operating profit pool for solar manufacturing this year and for solar system development this year, we're looking at about a billion dollars of **operating profit in manufacturing**; something like **\$10 or \$11 billion** in system development.

But if you look what we call the **financing scrub pool** (taking the value of this year's total installations and then looking at the value of the spread between system IRR and discount rate over the 25 year life of those systems) - you're looking at a pool of **\$180 billion**. So it's way more than 10 times as big as the annual operating profit pools.

And so that's where the value is. Meanwhile PV technology is really barely changed over the last 30 years. We've seen costs come down a lot over the last 10 years, but that's really just experience curve effects. And today non-module costs in a system on average represent something like 2/3 of the total system cost. And even more for residential systems.

And the biggest opportunities lie in the system cost reduction on the soft cost side of things - so customer acquisition costs, installation costs, administrative costs. So technology it's important to have competitive technology but it's definitely not the path to value capture.

So that's our definitional approach to this sector. When we think about installation markets - we've now been researching PV demand for well over a decade across dozens of solar markets and segments. And based on this broad and deep data set we've developed and fine-tuned a framework that enables very accurate prediction of the ebbs and flows of feeding installation volume.

And at the core of this analytical framework are two metrics. One is an accelerator and drives really fast growth. And the other is a brake that can slow growth down.

So the first of these metrics, **the accelerator, is what we call IRR spread**. It's the difference between a system IRR and the associated discount rate for that system. And what we found out across multiple markets and segments over the last 10 plus years of our studying this sector is that **when this IRR spread reaches a threshold of about 100 to 200 basis points, we get very price elastic demand growth - so very, very fast volume growth.** *And we've seen this now consistently across markets and segments.*

Second metric, **the brake, is PV penetration** (specifically grid-connected PV electricity generation) - so volume of electricity generated as a share of the total electricity consumption in that territory.

And **when penetration approached 5% we start to see a range of operational, economic and financing impacts on the centralized electricity system that results in very strong pushback.** Now this doesn't lead to an end in PV installations necessarily. But it typically significantly reduced volume in that annual installation volumes. And it puts a real cap on volume growth going forward.

And so we can map these metrics onto the five stages of PV market evolution; which start from constrained when IRR spread is too low to drive volume to explosive growth when spreads reach and pass that threshold of 100 to 200 basis points above discount rate.

Then saturation on penetration reaches the 5% threshold I described earlier. Then retroaction when policy makers start to take actions to claw back value from owners of existing and particularly very large PV systems, a phenomenon that we've seen now across multiple markets.

And then finally the fight for monopoly which we describe in The Hunger Games, our recently released report in which PV companies have to develop these

strong relationships within the customers and their value-chain partners to gain local market share.

Now this is really important. We're spending more time talking about this fight for monopoly because a growing number of large, rich and active electricity markets are now saturated for PV - for example Germany, Italy and Spain. Or will be saturating within the next five years; California, Chile and Japan and South Africa, the U.K. and others.

And so the consequence of this is the third point that I highlighted that volume growth is slowing. The sector experienced close to 50% compound volume growth 2004 - 2009; about 40% 2009 - 2014 with that rate slowing already in the end of that period. And we're expecting only 9% volume growth from 2014 to 2019.

Now part of that is inevitably the result of just the law of large numbers. You can't continue exponential growth forever. But it's also because a growing number of these significant markets, some of which I listed earlier, are approaching saturation. And so within the next five years if not a little bit beyond that there's a real potential for hitting a peak in annual PV installation volume.

And so potential to create and capture value is shifting very much from being part of that wave of growth to now building business models that enable capture of some of that big and financing spread pool that I described earlier.

And if you look out 2020, 2025 you know there's a lot of uncertainty. Volumes are still influenced by decisions by policy makers, by utilities on how they respond to this rapid penetration. There are certainly ways to smooth and there are other ways that we took wilder swings. But we really believe that there's a range of somewhere between 50 and 100 gigawatts per year of installation - that's somewhat sustainable in that timeframe.



**So we're at 55 odd gigawatts this year. We expect to be in the mid-70s by 2018 - 2019. And going forward we're expecting some ups and downs over the five years after that.**

So then in this world of uncertain volume growth, capturing value for solar players really is going to depend on an ability to align end-customer relationships in very specifically targeted markets and segments with the full group of participants in the value chain. So it doesn't mean that a company has to do everything, but they need value-chain partners that together have a business eco system that is really oriented to value capture.

The fact that there is this potential for value capture is highlighted by the fact that our amplifier, our spread on a global-weighted average basis over the next five years is between 500 and 550 basis points. That's a lot of potential value across - call it 55 to 70 plus gigawatts of installation volume per year.

But getting all the players aligned, the interests aligned is what's key and in doing that right has changed a lot as the sector has evolved. And the list of players involved includes customers, system financiers, developers and solar EPCs, manufacturers, capital equipment companies and the suppliers, materials, consumables that go into solar manufacturing.

And solar companies that have the capability and a track record to establish and maintain a business model like this - it's really a key for value capture, particularly in light of the rapid evolution in local markets. And evolving understanding of solar system risk profiles like financiers and shifting supply and demand balances.

An example of a company that's transformed itself over the last five years and of its business model is Con Edison which of course not that many years ago was really an incumbent polysilicon and wafer supplier, and today has completely transformed itself, and really does almost no solar-related manufacturing anymore.

So that takes me to the last point which is the **end game for solar companies. In our view that involves establishing a sustainable market position in high value electricity markets and segments.** And this is really a topic in our Solar Annual Report, recently released, that we called The Hunger Games as I mentioned earlier.

And in this report we describe nine key weapons that companies will wield as they play this - as they struggle in this fight for a dominant position in local markets. So they need cost leadership but that's certainly not enough. They need financing capabilities and they could do a good job of identifying prioritizing where they play. They have to line up a value proposition throughout the supply chain as was described.

They have to focus their sales and marketing very specifically to grow market share in local markets. They have to be prepared for the impact of saturation that we described earlier. And then defend their local electricity market power so that it's seen as being in the interests of the broader participants in that electricity market including end customers.

They have to **upsell and cross sell associated products and services** and they have to complete and continue to repeat this cycle across the portfolio of markets. It says volume growth slows down as we described earlier and as competition intensifies companies that are successful at yielding these weapons will be positioned for sustainable value capture while companies that fail to adopt to the requirements of this new set of armaments will struggle to capture value and eventually face the prospect of exit from the sector or even death.

So let me stop there and I look forward to entering into a period of discussion with you. Julien?

Julien Dumoulin Smith: Great, excellent. Thank you Martin. When you look at that total profit you started describing here, what margin compression are you thinking about over the forecast period? Can you talk about putting dollars behind that as you think about the next wave and how that plays out?

Martin Meyers: Sure. It's interesting. You see very little in percentage terms; the changes can be meaningful because they're so low. But let me just go down to the manufacturing side - we've got operating profit margins that are as low as mid-single digits. So this year I mentioned about a billion dollars of operating costs if pooled. That's about **a 3% operating profit margin.**

It could reach as high as \$2 or \$3 billion. But really heading back down by 2018, '19 as we expect utilization rates to fall and cost-based competition to increase; meanwhile on the system development side, profit pool more in the \$10 billion range. **So there is some narrowing of the margins there as competition intensifies and as some of the higher margin markets get squeezed down. Japan is a really good example of that.**

But meanwhile the size of the financing spread pool stage really very significant because the total revenue pool every year for systems being sold is relatively stable. And as I said earlier, **on average for the sector as a whole the spread between system IRR and discount rate is going to be in the 500 to 550 basis points range.**

So certainly **over this next five years it will be difficult for manufacturing on its own to capture much value** there. We're really into dynamics in the sector for undifferentiated players that looks a lot like other low differentiating manufacturing sectors. Really tough to get I guess more than a at best cost of capital returns.

There is **somewhat better opportunity in the system development side.** But with a lot more pressure there. And then the **big opportunity really is in getting the right portfolio systems in the hands of the right providers of financing;** that like in a

world with really low yields, twenty-five year assets with 25 year asset lives and call it 6, 7, 8% yield and modest risk or knowable risk - looks pretty hot compared to a lot of other potential investments.

Julien Dumoulin Smith: Got it. And then maybe following up here - let me just clarify. So as you think about the development pool, isn't one of the drivers of value back to the developers the fact that the cost structure on the manufacturing side continues to decline? So perhaps they thought about locking a PPA, but through the course of the development cycle the cost-structure itself is somewhat dynamic and they benefit from some of that margin expansion with lower costs than what they'd initially contemplated.

Is that one of the drivers you think to the disproportionate value proposition and the downstream opportunity? Or what are the drivers? Why is it still a profitable segment and what are the drivers prospectively that you're seeing in the downstream side.

Martin Meyers: Sure. **Our view of cost going forward matches very nicely to a continuation of the experience per related reductions in cost.**

And for the period when the sector was growing way above 50% compound the annual or half 50% and the sector was very young. **Experience curves can drive phenomenal cost reductions.** But now we're in a very different environment where as I mentioned earlier we're at single digit compound growth and potential for actual year-on-year declines in some years. And maybe we'll have more years of history behind us. So **the rate of cost reduction is really much, much lower.**

All the cost numbers that we share include all appropriate overheads so they're true all end costs. So cash costs, depreciation costs at the plant level, all SG&A, all corporate costs and on a global weighted average basis those costs and we've been talking 2009 as one starting point.

So back **in 2009 that was at above \$2 a watt. That cost by this year is falling below 70 cents a watt.**

**And we expect to reach about 51 cents a watt. And for the Chinese players that have really been the drivers of cost reduction, let's say from \$1.70-ish a watt in 2009 falling to about 61 cents a watt this year and by 2019 about 48 cents a watt.**

So it's slowing. And then of course lighter price doesn't follow cost exactly. We do see swings in manufacturing margins. They're modest. We do expect by 2018-19 margins on the manufacturing side will be a little weaker again. So that gives you the picture on cost.

Now, on those developers who were able to benefit from expectation of very significant declines in the purchase price of modules from when they make commitments to actually when they signed their contracts to when they actually had the procurement - this is the old Dell computer days when they were able to have high-priced microprocessors sitting in inventory because of their business model which was manufacture and ship to the end customer with no inventory sitting in between compared to the other retailers.

And they could count on that because the cost of their components were falling all the time. If we switch that and think about solar rate of decline in price and cost is slowed significantly and so to the **degree that that was a big driver value in the past less so going forward.**

And then I would add that there have certainly been some pickups in procurement prices as a result of policy changes. Such as the trade disputes between the EU and China; or between the United States and China.

Julien Dumoulin Smith: Thanks Martin. So if I heard you right, you're expecting more or *significantly less of a cost-structure decline amongst the Chinese*. It's hard to ask why but perhaps if I can ask why the slow down?

Martin Meyers: Yes so I say that the sector has gone through a series of important drivers of cost reduction. And say from the mid-2000s through to 2007, '08, '09 we saw whole shifts in manufacturing from primarily the EU and to a

lesser degree other western countries to China which have lower prices for a lot of factors.

So that is point number one. Point number two is that scale really expanded. So first that enabled existing suppliers to start to reduce price. And the second thing is that China itself started to attract new domestic Chinese suppliers to provide a lot of input.

It's worth taking a step back to remember that if you think of from from polysilicon to a completed module that's ready to go out into the field and be installed in a system - there's a processing cost involved in turning that polysilicon into a module.

*And particularly if you go back 2007, 2008, 2009 more than half of that cost was actually all the stuff that you brought either as a consumable or as a material to put into that module. So I'm talking about solar blasts, encapsulate, framing junction box back at the front of that process that we were talking about crucibles, about, about silicon carbide, about silver paste etc.*

And what's happened is that for many of these as the sector has scaled the competition to supply these materials has gone way up - much, much tighter competition. We've also moved to much lower cost location for manufacturing. And in places where there was a lot of government support that enabled very rapid construction of facilities and to provide financing to buy the manufacturing capacity.

That's when we've seen scaling up, which enabled the crisis in the first instance to drop for a lot of these components. And then more recently we've seen much more intense competition among those suppliers especially as sector buying slows down and sector buying growth slows down and gets much, much harder to maintain a preferred price position.

So it's not about technical innovation. We expect to see small continuing incremental improvements in technology that will improve performance that will help support modest cost reduction. But not much.

Julien Dumoulin Smith: All right. I have a question on saturation: you described this concept a little bit earlier. Can you be a little bit more specific in describing what you mean by this saturation concept?

Martin Meyers: Sure. So what tends to happen is that when the economics for solar become attractive enough you get very fast what we call explosive growth. And what's **really interesting about solar penetration into a grid-connected system is that the impact of solar on the economics and hence the finance-ability of the centralized electricity system are way out of proportion to its volume metric penetration.**

That's because a significant amount of solar is going to go out through highest priced and highest value, highest margin customers in a utility service area. And so we've done a series of analyses across market from using some system value modeling where we model prices and costs and margins and volume by end customer segment in centralized electricity systems.

And our conclusion is that **by the time you reach 5% PV penetration that can drive as much as a 15% impact on revenue for the incumbent centralized electricity system. And as much as a 50% reduction in operating profit;** which for a utility structure that typically has a pretty significant debt burden on its balance sheet.

When operating cash flows fall by 50% that has very meaningful impacts on finance-ability in the system. And so what we've seen across market after market after market is that as PV penetration is measured by the revolving of PV electricity as a share of the total electricity consumption in a system; when that approached 5% somewhere a little before or a little after 5% we start to get very noticeable impacts.

It can be not only on what I just described but also significantly driving down wholesale electricity prices like we've seen in Germany for example. And you have very big pushback from the utility companies typically to start, and then from regulators and policy makers to

make sure that the integrity, operational integrity of the electricity system is maintained.

And so that leads to changes in policy that will almost always lead from a peak year significant reductions in annual installation volume probably for a year or two. And then typically some continuation of installations going forward but at much lower rates and typically controlled by a set of rules that reduces, effectively takes away that risk of operational system failure.

And so it's important we believe it's a really critical component because we've seen now in just market after market that when the economics are attractive you get exponential volume growth and the **exponential volume growth of solar is not sustainable with the centralized electricity system**. And so pushback will happen. And we can just walk through the series of European markets that we've seen that in.

We're starting to see the first signs of that in Japan since October of last year. You know other markets are absolutely facing the prospect of that for that challenge.

Julien Dumoulin Smith: So what other markets outside of Japan are seeing that compression? In terms of the saturation point, where you're seeing pressure - basically what you're saying is that in markets that have higher penetration you're seeing the margins come down. You're seeing pushback. Presumably in lower subsidies to drive development of solar, right? I think that's somewhat of the punchline you're getting us to?

Martin Meyers: So that can certainly be the case although it's also worth remembering that in a number of these markets you don't need incentives in order to drive significant volume. The great irony of the market in Japan is that the last things they really needed to drive fast installation volume growth was a Feed-In Tariff. That market was set to grow very significantly based purely on unincentivized net metering economics.

But if we take a step back and just look at markets we're expecting that they're going to peak and then have to decline over the next five years just a sampling



of those - Australia, Chile, California, Japan, South Africa, the U.K. - that's just spread geographically.

And a point that's really important to note here is one of the topics where we get some real pushback from clients is to say well there are these huge markets outside the OECD – the usual suspects where there can be a ton of installation volume growth. China – the world's biggest market by volume is likely to hit in the order of 15 gigawatts.

You know, how much more can that market grow? Just maintaining that volume year-over-year for five years is already quite something. India another market that has grown and has enormous growth potential and we build that into our outlook. But really when you take a look, we're currently modeling explicitly in our installation volume outlooks at 32 individual markets.

And those 32 markets represent 89% of global grid connect electricity consumption. There are real limits on how big those PV markets can get. It won't take that long to hit 5% threshold in those markets either.

Julien Dumoulin Smith: Right. Excellent. And then just to dig down here, two questions out of that. Of those markets that you didn't discuss which ones are the fastest growing within the 32 markets? What are not those that are slowing down?

And then separately on the U.S. we're getting a question here given the ITC expiration how much do you actually think the U.S. shrinks in terms of total megawatt penetration rate? So I'd be curious, what's your expectation for U.S. installations '15, '16 and then pro forma for '17, '18?

Martin Meyers: Right. So some examples of very fast growing markets - let me start with the U.S. market. We have many conversations with clients that say we'd like to enter the U.S. market and our answer is always that there is no U.S. market as such.

There are I don't know how many scores of utility service areas and many different sets of regulatory rules. And so right now California still represents a very big share of the total installation volume for the United States. And so the potential for growth in the United States overall you really need to look at it by individual state level.

And so if we take a look at the **United States as a whole, this year we're looking at something over 7.8 gigawatts reaching close to 10 gigawatts next year. Then given the impact of the ITC declining closer to 7 gigawatts by 2017 and then with the impact of California saturating as we expect thrown in a further decline to about 6 gigawatts in 2018 and then heading back towards 7 gigawatts by 2019.**

So still a very strong, market's still one of the bigger markets globally.

Julien Dumoulin Smith: How much does California make up in your mind then? And then just to hit that one since you bring it up explicitly here - and given our U.S. oriented caller base - how much of that 7 to 6 gigawatts is California in your mind?

Martin Meyers: So **California is about 3-1/2 gigawatts this year rising to 4 gigawatts next year then below 2 in 2017 and down to about 1 in 2018.**

Julien Dumoulin Smith: Very interesting. And maybe let's talk about residential margins versus the utilities account, right. So you've talked about the potential for compression and I'd be curious where do you see the most compression in the margin profile and what do you estimate it as being today?

So you talk about the profit pool. How do you estimate profits? Have you thought about this on a return profile basis? Like where were the return profiles of residential and utility scale headed? We keep hearing the residential side is the greatest downside; the margin

compression just given a rolling back of their metering subsidies domestically. I'd be curious to hear your view on that.

Martin Meyers: Sure. We believe that in a way the most important driver is IRR spread. Let me just pull up California for us here.

Julien Dumoulin Smith: Or perhaps not necessarily limit it to California but what about the thought process relating to just residential versus utility scale in general? In terms of the margin spread that you see.

Martin Meyers: Right. So it's really important to remember there's a big difference between the installer and what their margin is; and the system developer and solar EPC. The model for getting the project initiated and constructed is really very different for a 100 megawatt utility system than it is for a 7000 or 8000 watt residential rooftop system.

And so I guess what I'd say is that a first key point is that IRR spreads are extremely attractive in California in particular for residential systems. And they're among the highest that we model. And the flip side of that is that on the field it is much more competitive. And because you're now pricing against often competitive options or negotiated PPA pricing, it's much, much more difficult to capture significant value.

Whereas for a system going into the California residential where you've got really high electricity prices, the system IRR's really high. And this is why we mentioned earlier how important it is for companies to build a strong market presence. They have really low unit customer acquisition costs. And they can afford to make a lot more margin at a given price than a new entrant that's struggling and has much higher unit to acquisition, customer acquisition costs.

I'd also highlight that there's been even in the news a lot recently about solar companies raising significant amounts of financing to address the commercial and industrial segment. And we've been talking to clients for the last three years, I would say about the importance of the commercial industrial segment and have been

working with clients building out business models in the commercial industrial segment across different geographies globally.

And we believe that **one of the biggest unmet segment opportunities is in the small C&I segment** - where it's not easy for a provider of financing to assess credit risk of end customers, but there's tremendous value opportunity. And so solar companies that figure out the way to line up financing to serve that segment - of course its many sub-segments within the smaller C&I segment too - there's an enormous opportunity there.

**The rate structures for these end customers very often include a significant demand charge. And the right about of PV perhaps with a little bit of storage added can very significantly impact the demand charge and so have a disproportionate impact on the electricity bill that those end customers face.**

So it's a non-trivial problem, to get a really well-oiled machine of evaluating the right customer sub-segments and then going to those customers with a good value proposition and lining up the financing to support the PV and PV plus storage that goes into those end customers.

And we're seeing and now increasingly hearing publically about companies beginning to tap this segment – such as GE's comments about their goal to build a 750 megawatts of distributed commercial volume by 2017 if my memory serves me right. So this opportunity is being seen and has potentially very significant impacts. There is a lot of value opportunity for the end customers; and also for the financiers and developers and installers that are serving that end customer. And also, I should add, for the suppliers of hardware because you're able to get a few extra cents a lot typically.

You're going into these systems and a few cents a watt actually is a very significant impact in terms of operating profit margins for these beleaguered manufacturers. And the flip side of that is big declines in demand

charges can have very significant impacts on utility revenue and operating profit.

Julien Dumoulin Smith: Got you. Here's a question coming from another email here. So statement - increasingly the industry relies on remote solar systems delivering electricity at normal pricing where a high LMP drives demand. You finance these projects with a synthetic hedge. We've seen this in the wind industry for instance. Apple's deal with First Solar is an instance of this, but there are countless others, like Ikea and Google.

So just to go back to something in terms of the nominal market size, any thoughts around this quasi DG C&I opportunity in the context of your numbers? I suppose implicitly there's going to be some skepticism about the decline in profile in the C&I and overall U.S. penetration that this questioner is asking.

Martin Meyers: So I think the high profile large volume deals that we're seeing get lots of headlines. And can move very significant volumes. Our conviction based on our work in the field is that the bigger value opportunity is really **finding that section of C&I that's not Fortune 1000 end customers that has where it's a significant addressable market opportunity.**

It can be very meaningful to a solar company's bottom line and meaningful volume. And it also has much better prospects for building market power locally so that you have a sustainable position that can remain.

External Questioner: This has been a terrific call. Question on your saturation point where you talked about 5% causing various changes - policy etc. I'm curious what your reaction is on the wind side - I think the analogy is comparable. We're seeing wind in the wind corridors of the United States reach about 10 to 15% off off-peak generation already.

What's your reaction there because people are still forecasting even more wind penetration? Or do you see

that basically peaking now and potential policy changes that will limit growth of that renewable asset off peak?

Martin Meyers:

Sure. So we always talk to clients about the importance of the distinction here. You know, like the distinction between generation technology and energy architecture. So wind definitely has very significant penetration in certain geographies in the United States and in other parts of the world; essentially always operating on the wholesale side of the meter.

The big **distinction with solar and why it can have such a large impact is because solar directly attacks the highest value customers in a centralized system**. That's why solar can have such a disproportionate impact on the economics.

And so I think it's important to make that distinction, notwithstanding that it's true that our penetration of solar and wind are both increasing - both of which are non-dispatchable and have almost zero marginal costs. And really do a number on so this takes us into the world of market design because it can drive wholesale electricity prices flat or even negative as many of you have experienced.

But what makes solar so different is that it has a significant volume moves into serving residential and commercial or industrial end customers. It has a very, very different set of impacts on the economics of the centralized electricity systems, basically taking away demand and disproportionately taking away revenue from that system.

Julien Dumoulin Smith:

Great. Well it being the top of the hour here I think we'll call it a day. But thank you very much Martin and the team at PHOTON for taking the time. Thank you all for listening.

Martin Meyers:

Thanks all.

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Risks for Utilities and Independent Power Producers (IPPs) primarily relate to volatile commodity prices for power, natural gas, and coal. Risks to IPPs also stem from load variability, and operational risk in running these facilities. Rising coal and, to a certain extent, uranium prices could pressure margins as the fuel hedges roll off Competitive Integrations. Further, IPPs face declining revenues as in the money power and gas hedges roll off. Other non-regulated risks include weather and for some, foreign currency risk, which again must be diligently accounted in the company's risk management operations. Major external factors, which affect our valuation, are environmental risks. Environmental capex could escalate if stricter emission standards are implemented. We believe a nuclear accident or a change in the Nuclear Regulatory Commission/Environment Protection Agency regulations could have a negative impact on our estimates. Risks for regulated utilities include the uncertainty around the composition of state regulatory Commissions, adverse regulatory changes, unfavorable weather conditions, variance from normal population growth, and changes in customer mix. Changes in macroeconomic factors will affect customer additions/subtractions and usage patterns.

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12-Month Rating	Definition	Coverage <sup>1</sup>	IB Services <sup>2</sup>
Buy	FSR is > 6% above the MRA.	45%	37%
Neutral	FSR is between -6% and 6% of the MRA.	43%	33%
Sell	FSR is > 6% below the MRA.	12%	20%
Short-Term Rating	Definition	Coverage <sup>3</sup>	IB Services <sup>4</sup>
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	less than 1%	less than 1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	less than 1%	less than 1%

Source: UBS. Rating allocations are as of 31 March 2015.

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