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Issues Potentially Confronting solar and clean energy in 2012

Given dramatic declines among solar companies 2008-2011 even as the new installations of solar power have been expanding greatly worldwide, it's worth asking, what happened? It's curious to see so many solar firms going under in 2011, and likely 2012, even as many gigawatts of new solar are being installed ever more widely.

Clean energy more broadly has been in a downturn, but it has been sharpest, most prominent in solar. Some problems as we'll see here are vexing to solar. They include overcapacity, lack of profit and lost margins, zero pricing power, and subsidy cuts.

And more widely influential for clean energy too has been massive *risk aversion* globally. At a macro-level there's sharp "to'ing and fro'ing" in sentiments, most lately all to 'risk-off' (safety is the most crucial and volatile assets are loathed).

Risk-off indeed overshadowed 2011. It spiked too – shunning not just equities but assets of many kinds. Hence this particularly subsidy-dependent, volatile sector was especially undesirable – solar undisputedly *not* a place to be for long periods.

In a fright-filled 2011 of meltdown fears, what perhaps went up most was correlation. That's to say nearly everything went down. First Greece imploded, then came anticipated fears about Spain, Italy. It felt as if most all asset types outside a few singular classes like say Gold, or the very safest Bonds, fell hard and nearly in unison.

2H 2011's swoon swamped even more modest non-correlation clean energy had at times seemed to show before. Yes this certainly is a very risky, thus volatile sector. Still, 2009 & 2010 had by comparison, often shown relatively rather less severe moves. Back then a tighter band generally didn't move downwards much more than say -30% at bottoms, nor up over say +40% at tops in a recent two-years that ended at 2010.

2H 2011 however pushed cleantech down severely. Risk-on days can & did engender a few large jumps up, say with ECO up by +4%, or even +8% in a day such as October.

By year-end renewable energy broadly had fallen terrifically. And other than a few cases of acute solar-specific news like a CEO departing a large firm (see below), it has been macro-level events that have caused these broad and rather aching drops here.

So events within solar arguably weren't the only catalyst for many one-day big losses in 2011. Conversely solar news alone wasn't the only reason for a few robust one-day gains. One might argue macro-factors were the major factors behind big changes in 2H & 2011. For instance at times it seemed Greece's debt might, *potentially*, perhaps *possibly* just begin to be addressed – a firewall built to prevent spread to Spain, France, Italy – and then clean energy (clearly solar) jumped notably on those rare-day events.

In brief hours of relief when it appeared Eurozone debt *might* be contained, one saw short 'melt-ups' prominent in solar and across clean energy. Importantly however that positive sentiment with its big echoes for clean energy couldn't be maintained.

A result was dramatic uncertainty of early 1H 2011, accelerating in 2H. Downturn extended, it got worse in latter 2011. (Or one may perhaps make a case against a backdrop of major & prominent secular bear there were brief cyclical moves. And huge volatility along with great downward moves is what one sees at the start of 2012).

In sum arguably 2 different factors punished clean energy down over latter 2011. These were 1) vast overcapacity in solar that is greatly hammering most all shares there globally – and 2) macroeconomic despair over global debt with only brief rays of hope & bits of hope did bring leaps in clean energy but without any real follow-through.

In part too very low valuations in solar if looking at P/E, price/book perhaps played a role catalyzing jumps of briefest 4% or 8% in a day in October. In context then of post a very-long-4- years fall 2008-2011, short run-ups were feasible. Years prior to 2008 however, the drivers upwards for gains then in clean energy often had been very different.

History might imply that like in other areas clean energy *may* potentially, possibly, 'regress to mean' back upwards if given return of risk appetite. That's when the so-called 'animal spirits' are once again present or at least nearer past (robust) levels. It may not happen, solar might stay depressed for years, but it is a consideration.

So October's spurt of gains might have been just brief return to risk-on & reward.

Appetite for risk is important. Note then all the desire for risk has been utterly thrashed from 2008 onwards. Investors of 2011 mainly were seeking just any return *of* investment -- hardly any return *on* investment. That plus overcapacity here was fantastically bearish for risk-laden clean-energy as one sector among many (most safer) options.

Let's turn now to the issues specific to solar that led to today's aggressive deflation here. Most notable of all has been low-cost, China-based firms in the PV (photovoltaic) solar value chain, that have brought about great challenges to traditional pricing power.

Yes, deflation can bring price bargains to buyers in the long term. But nearer term it can mean havoc for manufacturers' stability, & so for sellers' profitability. And as this year was beginning some great pressure was notably already on the highest-quality Tier 1 solar names struggling as 2011 just began to unfold.

We'll look again at a sample big upstream Tier 1 maker of polysilicon & wafers, key ingredients in typical PV panels. Like so many names of the past few years this is a China-based firm yet it trades on U.S. markets. Manufacturing polysilicon, (poly) & the wafers for crystalline silicon (c-Si) panels, it runs complex plant with process expertise in a technological capital-demanding system – not just on brute capex.

First though here's a quick review below of manufacturing of poly & wafers upstream which is used as noted for making common kinds of solar PV panels. (See i.e. Solar Industry, p. 80, Oct. 2011 for details on processes).

Today's common PV is based on purified silicon (Si) and this Si may account for some ½ the cost of making PV cells, so it's major. Si, atomic number 14 is 2nd most prevalent element on the planet and so is not hard to get at. But ... putting it into suitably pure form at lowest cost is thorny, and where much competition now is focused.

Unlike oil found certain places (not always convenient), Si is abundant. But like hydrogen (H), the most abundant element in the solar system, Si isn't found sitting alone. Rather it's reactive and so has already been combined with other elements like with oxygen, as say sand or rock. Think of hydrogen (H) and that too is everywhere but only in combined form like with oxygen so bound up as ubiquitous H₂O or simply water.

Converting Si source material to desired elemental, sufficiently pure Si for solar is where \$\$ costs come in. Cheapest is metallurgical refined silicon (MG-Si) @ 'just' 98% pure, to alloy some metals. But MG-Si can't be used for solar PV; the iron impurities are too high and must be <1 part per million for PV. Other impurities like phosphorus must be even less for Si is to have the desired electrical and mechanical traits for PV.

Solar Si for panels must be at least 99.9999% pure known as 'six nines' or 6N - called 'SG-Si'. For using Si in semiconductor wafers — those ubiquitous chips in Electronic devices — it has to be much purer still at 99.999999% or 9N and that's called 'EG-Si'.

For a positive note these solar panels made of Si last a very very long time. Importantly Si isn't toxic. It's well understood from semiconductor manufacturing. Indeed in a recent past the Si for making PV often just came from cast-off, surplus 9N EG-Si left over from making integrated circuits. But that 9N EG-Si was purer than is needed: there's only a small gain when going from 6N to 9N while the costs go much higher.

Hence one possibility ahead to lower costs may be dedicated manufacturing processes for 6N grade, SG-Si solar silicon. Instead poly production now uses a process that's 9N.

So attempts have been made to upgrade MG to 6N, or to blend it with 9N Si to lower PV costs, but so far that hasn't proven highly workable or effective.

As a side note the cheap MG-Si made easily by electrolysis costs only a few dollars/kg to produce. That needs only 12 kWh of electricity to make each kg of MG-Si poly. (Side note: we make twice that power here on our roof or about 24 kWh/day *from the sun*, see <http://wildershares.com/solar.php>).

The 9N (Siemens) process is both costly and energy-intensive. It needs some 200 kWh for each kg of poly, and that's some 16x more energy-consumptive than MG-Si. Toxic chemicals are used too in a very complex process so there's much room for improvement. The 4 steps for producing poly common now are:

- 1st *Hydrochlorination; using silicon tetrachlorosilane (STC) & hydrogen to make TCS;
- 2nd *Distilling the TCS (or SiH₄) in high purity feedstock, then applied in deposition of poly;
- 3rd *Depositing poly by vaporized gas onto rods that cool; and lastly to push down prices,
- 4th *Recovery of vented gas as mixed chlorosilanes, to be re-used.

Clearly companies today in c-Si solar that make the poly, to ingots, wafers, cells, modules and panels all need costly equipment. That, plus complexity were once key barriers to entry. Importantly however that major barrier has lately been overturned.

In just a few years China has greatly ramped its PV capacity poly to panels. Abundance is now key. From near zero, there's now fierce competition among entrants & dramatically lower prices at factory gate. By 2011, China c-Si panels were nearly interchangeable commodities coming from Tier 1, higher-quality names from China.

Rather than innovate or differentiate, a model at firms is to *drive down prices*. Lowest costs may come from big, co-located, manufacturers cranking out inexpensive product. The entire c-Si solar landscape has changed and in very short time.

As a result as 2011 started to unfold, c-Si *module prices* (for PV panels) had reached lows near \$1.25/watt. Good for PV buyers, hard on sellers' margins. Yet it didn't end there. China producers had cheap capital, labor, land & strong government support; they also benefited from low taxes & co-locating. (There are also few regulations there, but that has been a *short-term 'gain' only* & is not real - since it means horrible pollution).

Think of that sample big firm able to push down its poly & wafer prices hard over 2011. Being vertically integrated in making poly & wafers it could set the bar. Wafer prices @\$0.50/W early 2011, soon gave way. Few competitors could profitably sell at \$0.50/W – and their costs had to be lower to profit – so a down trend was hard on all (with 156x156 mm multi PV wafers growing ever closer to just a \$1.00 spot price).

Helpfully the overall PV *demand* was growing. China for example grew past a 1 GW-sized market in 2011, bigger for 2012/13. New demand *might* help bring some hoped for price stabilization but even if orders picked-up, the vast extra capacity would be very tough to wring out. Overcapacity had simply grown too immense by 2011.

Stepping back a hope early 2H was if poly was near \$50/kg, wafers \$0.50/W, modules \$1.25/Watt, there might be brief margin stability, good for many. That may mean desired clarity in pricing, from poly to panels. For pricing see e.g. <http://pvinsights.com>

But that hoped-for price stability did not materialize in 1H or 2H as they unfolded.

Dynamism (downwards) ruled. Module prices went to [\\$1.20/watt](#) - further down by Q3 to \$1.13/W. By Q4 in late October, they were at \$1.09/watt. Late December just \$0.96/W. Hard to show any profits let alone any possible share gains at those price levels.

Data from analysts illuminates. For an example part of that poly/wafer firm made 12,000 MT of poly in 2011, up 11% from near 11,000 MT in 2H 2010. Its production costs moved well down too over Q3 2011, to just \$22/kg, or down -8% from \$24 q/q.

Wafer production was growing. Q3 2011 it was 2GW, vs 1.2GW in 2H of 2010. Processing costs went down to \$0.22/W (-17% q/q, -24% y/y). They also felt poly production costs could go down towards \$20/kg(!). Again, hardly allows bottom line *profit*. And if poly *prices* went nearer \$20/kg, the much higher costs at most firms were untenable.

Think of 1-2 years ago with poly priced nearer \$60. A question was if it might go to \$50/kg - yet prices have moved (far) lower. China was then sourcing some poly from overseas like the U.S., but global overcapacity meant nobody was making great profit in PV.

Price drops have continued. For rapidity of change some 6 years ago poly was nearer to \$100/kg. 5 years ago China production still was puny as a severe poly shortage emerged; prices rose to near \$300/kg and in 2008 they grew to \$350 and were even higher(!).

A few years ago near 95% of China's poly demand was met by imports. So China's domestic poly manufacture ramp since has come with great alacrity. By early 2011 prices worldwide in solar were plummeting, overcapacity becoming immense.

Over 2011 seminal poly prices touched new lows. That in turn helped push down the costs for PV makers downstream: they could buy their c-Si ingots, wafers, cells, or modules at bargain spot prices to finish out and sell finished PV panels.

Note too the alternative PV technologies or business models that assumed high poly costs (like string ribbon in U.S.— or thin film CIGS cylinders) saw business models fall apart over 2011. Their c-Si competition was getting far less expensive by latter 2011.

Margins were miniscule or worse (charges soon filed of dumping). If costs couldn't be pushed down, to ramp output meant bigger losses or another option was to lower utilization rates, but that only slowed losses in hopes of prices stabilizing.

Downstream PV makers were vexed. Those with contracts to buy poly at the fixed prices (nearer \$50) agreed upon months before were suffering. Rather than enjoying cheap spot poly <\$45 that their competitors were finding advantageous — they were in a bind since they agreed had to source the poly under fixed contract.

By late October 2011 average poly prices had dropped again to just \$39(!).

Problematically for the margins at companies making PV from poly at costs near \$50, poly spot prices continued to give way in an amazing 2011. By mid year it was clear any hoped-for (even moderate) stabilization in poly pricing wouldn't soon materialize.

China producers in particular were setting a price bar poly to panels ever lower.

Significant pricing drops came weekly. In Q4 poly dropped most since June, as October prices fell -5.8% in one week, dropping -6.1% the next week. After being well above \$40 during much of Q3, by October 2011 it was touching below \$40/kg.

Early-November poly fell further. Some China manufacturers sold at \$35/kg, or ½ where poly prices had been start of the 2011 year! Wafers too that may need only 5 ½-6 grams of poly apiece were priced down at just 40 cents/watt. And the *costs* to make these wafers had dropped some places to 17 cents/watt; the wafers soon were priced \$0.33/watt. Meanwhile lowest *costs* to make poly was dropping to near \$21/kg.

Poly prices fell again -8% a week; by December, the spot *prices* for poly were just \$29 (or \$20 for poorer, 2nd grade poly). Modules became 95 cents/W on average, or 75 cents at the lower end for poorer-grade c-Si, a new and unprecedented price.

Two camps emerged. Many poly producers shuttered capacity given prices. Scaling-back, they sought to rein in costs as prices declined – hoping less supply too might help to bring better pricing. Several companies cancelled planned expansions for 2012.

Another camp expanded. One China supplier announced new poly production to 55,000 tonnes/year. It aimed to be a leading low-cost supplier, surviving among fewer producers. Indeed the top 6 suppliers alone of cells/modules had already gone from being roughly around $\frac{1}{4}$ of the market in 2Q 2010, to just over $\frac{1}{2}$ a year later, 2Q 2011.

The world's very largest poly supplier (based in U.S.) announced an expansion by 28% for 2012 from a new plant in Tennessee. That decision, though, was made during higher poly prices and locked them into a commitment, despite falling prices.

Meantime the poly producers who'd signed long-term contracts had renegotiated. Better that, than see customers failing due to competitive disadvantage. Sourcing poly at near \$50 actually worked in nobody's favor. Contracts were remade.

It recalls a bind corn-ethanol biofuel producers were in as corn feedstock prices fell years back, aiding competitors who could buy at spot prices. Then, the locked-in names failed. What works well in rising prices, may not work the other way round.

Here, downstream PV makers buying at spot prices without contracts benefitted, as did the lowest-cost vertical integrators given falling rates. A scenario either of stable, or of slightly ascending prices would have instead favored those with fixed contracts.

China's relentless cost reductions continued. Their c-Si modules sold at near 20% less than U.S.-built c-Si PV – on razor thin margins. And China's past poor-quality issues too were being addressed among its own formidable Tier 1 PV competition.

During all this China firms, like those globally, were *all hard hit* by lower shares in 2011. Indeed this had gone on now for 4 years. Huge loan & credit facilities available in China were often much more \$\$\$ than was needed, yet that it could be borrowed was impactful. Obtaining loans for more capacity wouldn't be too hard, if desired, in China.

So module pricing in 2H saw little respite. Buyers hoped for still lower figures, manufacturers for stable ones, but the 'buyers were winning'. Plus PV demand growth by now wasn't as robust as some had hoped, near 6.5% Q/q & moved up only some in Q3. Plus now the macroeconomic risk was hammering earnings per share & new Q4 demand. An unfolding 2H daily brought about an ever more-gloomy picture.

On excess capacity, Average Selling Prices (ASPs) <\$1.20 pained. Earlier a few sellers had hoped in Q2 to see ASP floors near \$1.10/watt for modules in 2012, and \$0.95 in 2013 for some stabilization – but industry foresaw ASPs could go (much) lower still.

Helpfully in a few places expansion was being reined in, the capacity rationalized a bit. With consolidation the capacity might perhaps be a bit sopped up. On the other hand some firms weren't resting. One estimate by a pro-growth camp predicted that 2010-2015 PV Si output might grow 3.5 fold, for compound annual growth of 28%.

China's new demand was also set against relative weaker demand ahead other places including from Italy, compared to go-go growth near 7 GW in 2011. Subsidies were much less affordable given debt. Germany's blistering PV growth too was dropping.

Perhaps weakness some regions could be partially offset by growth elsewhere. A new Feed In Tariff ('FIT' below) in Japan post-Fukushima Daichi, could be net positive, along with demand from China, and from the U.S., India, Australia, and many other places.

One estimate saw roughly 22 GW added global PV capacity. Frontier areas too like in Namibia were predicted to emerge and they were aiming for a new 1 GW. A few growing nations generally outside of Europe were also adding PV quickly.

Europe had pockets of growth. French smaller installations grew as distributed generation (DG) and *measured on per capita* basis, France's total installed capacity was growing near California's rates, ahead of the wider U.S. That put it at roughly twice the new PV capacity of the U.S., but again only if measured on per person basis.

Measuring on that kW/per capita, 60 million people of France had 1.47 GW (DC) capacity in 1H 2011, or 0.25 kW/person. California, strongest State in U.S. had 1.17 GW for its 40 million, a bit better at 0.29 kW/person. But look more broadly at all the USA; 300 million had roughly 3 GW installed & grid connected PV in 2011, 'just' 0.11 kW/person. (Other places like New Jersey were growing strong in commercial PV). For more U.S. stats see <http://www.seia.org/galleries/pdf/SMI-Q2-2011-ES.pdf>

U.S. installed likely in 2011 something near twice the PV of 2010 according to Solar Energy Industries Assn. It's estimated France put in about 1.3 GW new solar PV in 2011.

So PV growth had broadened from just Germany of past, to worldwide. 20 countries were expected to each install >100 MW solar in 2011, vs. just 13 countries in 2010.

In 2011 the top 10 PV markets were Germany, Italy, U.S., China, Japan, France, Australia, India, Spain, Canada. Lately too Asian markets, and Czech Republic grew fast.

The U.S. wasn't stopping. Grid connected PV placed in Q2 2011 grew 69% vs. Q2 a year prior. So U.S. clearly had a place in the leaders pack. Globally the U.S. share of worldwide PV installations was at 5.1% in 2010 (down just a bit from 6.0% in 2009).

But with slowdowns ahead for Germany & Italy, the U.S. has room for growth. Consider non-sunny Germany. Its solar insolation is like Maine; thus most of the U.S. is far sunnier even in places like New Jersey so there's pretty staggering room to grow.

Look a bit at leader Germany. Its longtime pole position can't be maintained. For instance 2011 installations were robust near 5 GW of PV (much at end of year). But visibly on the horizon that main past driver, a German FIT, will soon fade.

First 9 months of 2011, about 3½ GW of solar was put in according to their Federal agency the Bundesnetagentur. It estimated close to 2 GW may be placed just in Q4.

But with a FIT cut Jan. 1, it seems a perennial hope of retail grid parity there may be roughly starting to be reached - undercutting past need. The new FIT at 'just' say 18 & 24 Eurocents/kWh could be nearer to retail German electricity costs.

So as Germany's FIT declines, PV is no longer a money-spinner. But it can shield against high household electricity costs & hedge against rising rates. If simply about the best power choice, then as noted even (lesser-subsidized) PV may still win out.

Note Germany's prices like California, are dear at retail. For example the San Diego peak electricity rates are nearer 27 cents/ kWh here with PV & Time of Use (TOU) metering, see http://wildershires.com/pdf/SDGEDR-SES_rates_in_the_2000s.pdf

Take a look at California's renewable energy. The GW+ the State may have in 2012 is substantial, its total PV capacity greater than 6 next-best States put together. Large projects may in theory (probably much too optimistically) add near 7 GW solar by 2015. All that from solar can put it near ½ the goal of getting 12 GW by ALL renewables by 2020. And California has its excellent solar resources (insolation) for more growth.

NASA for instance has rated Los Angeles 5.4 kWh/m²/day, trailing only Honolulu at 5.9. Better than sunny Las Vegas (5.3), Phoenix (5.3), or Miami (5.2) while major areas like San Francisco Bay Area (away from coast) are favorable at 5.0. It's now the cash-strapped budget (like rest of the U.S.) that is a key concern for PV subsidies.

But don't let numbers mislead. Solar is still a *miniscule* part of the mix. Geothermal made about 20% of State renewable energy in 2010, Wind 10%, solar just around 1.5%. Big hydro is a far larger presence. So growth rates sound high given the start from basically zero, but the absolute figures are definitely still dismal today.

Consider too P/E ratios in solar. Once high, seen on Wall Street as a growth area, solar P/Es were 25x+. However they've moved far down. China's solars dropped to near 2x in a 2008 trough and have come down in 2H 2010 near some 5. (Their P/B multiple averages too in 2011 went from 1.4x, to 0.4x in Q3, dropping about 2/3rd).

For China's c-Si notably, we've seen P/Es in Q3 at 5, 4, under 3(!). An obtuse nature of China-firms, questions over reporting (not necessarily solar) can make for muddier waters. That adds a kind of tax here pushing down valuations, and P/E (& P/B) relative to more transparent equities. Murkier numbers, or using reverse shell corps may depress values in very uncertain times like these since a great financial collapse of 2008.

Other items briefly merit mention. A severe poly shortage of 2007 is gone. Yet for a small example, sourcing low-iron glass for PV may become an issue ahead. Transmittance comes into play with higher-iron content. (See e.g., [Solar Industry Magazine](#)).

Reducing silver content in PV metallization pastes too is at play in driving down materials use and reducing marginal costs. Silver prices (like gold) have jumped of late.

That's important because in a silicon PV cell a 2nd highest cost can be metallization paste. As silver costs doubled in a year, formulizations are needed that may reduce silver-use by say, 30% by 2015. Getting the silver paste usage down to <150 mg per wafer while not sacrificing functionality or longevity or efficiency, would be notable.

Minor metals too have importance in thin film & related areas and so consider Indium, like gallium from producing zinc, lead, copper, iron ores. Notably it is major in manufacture of thin films like CIGS, synthesis of semiconductor copper indium gallium selenium. Strategic Indium today comes mainly from (wait for it, wait for it) China. For more on the salient mineral production statistics for here in the U.S. see for instance <http://minerals.usgs.gov/minerals/pubs/commodity/indium/mcs-2011-indiu.pdf>

Thin film PV is less costly, but less efficient than c-Si. So with sharply lower c-Si costs it's critical thin film PV retain access to cheap materials as a price-lead erodes.

Thin film priced say \$0.75/watt in Q3 has a price advantage over silicon PV @\$1.20/watt, but it is less of a lead than before. Thin film is great & economical: it's also U.S.-made for American jobs. And yet more efficient, long-lived c-Si going <\$1.10/watt is increasingly hard on its heels especially if the room available for installing panels is limited.

As indium prices rose significantly in 2011 it's important to reclaim metals & avoid waste. As we've seen with Rare Earths, say Lanthanides it's possible to see strategic metal bottlenecks come from China, who fixes export levels even for rather pervasive elements that aren't truly very rare. Plus even very abundant lowest-cost materials may present challenges if solar of all kinds scales up to new levels.

EVA (ethylene vinyl acetate) used in PV is used in many other uses. Once/if global economies do return to growth, there may be competition for even simple materials. So as PV makers push down *all* costs, every input arguably warrants new attention.

Clearly there's a great deal going on in diverse facets of solar's value chain, many balls in the air. Besides poly to panels, there's balance of system (BOS) like Inverters where pain is also severe. In Q2 revenues in this space fell y/y only about 1%. Yet this was on sharp price declines as inverter shipments grew some +40% in Q2. For all 1H after the strong gains of Q2, shipments in the first 6 months reached near 10 GW to July.

So despite near 20 GW total shipments in 2011, strong inverter price declines have meant less revenue overall. Unlike PV with 'like vs. like' (PV getting less costly to make) a trend in inverters has been towards less costly designs. Previously the 3 string inverters like in our 1st system here are being replaced in a simpler product mix. This is especially prevalent in entry markets like China & India, as bottom-line costs are crucial.

We do emphasize ECO 'can and does at times drop like a rock,' something amply shown in 2011 and the past 4 years given solar. And oil was near \$100 in Q4; while pricey oil may perhaps have had some correlation with gains in ECO in past, here it meant nothing.

In sum, solar today still is dismally miniscule as a percentage of all energy produced overall. It is expanding fast, yet from near zero. Profits have fallen hard, overcapacity dominates and expectations are of more failures in 2012. Lastly macro-environment debt in the Eurozone and fragility that mattered little to clean energy at start of 2011, mattered greatly by year end – probably more so than solar-specific events. As markets have gone to risk-off, animal spirits are gone, this risk asset has plummeted.

Positive Side of U.S. Solar Exports, Or at Least a Few Possible Rays of Sunlight...

Not to be solely pessimistic about all the solar-arena, we note that despite sharp stock drops in 2011, the U.S. was actually a *Net Exporter in total* in solar products in 2010.

Overall value of U.S.-made solar exports totaled \$5.6 billion. This was mostly poly (as PV feedstock) at \$2.5 billion, and capital equipment for PV fabrication at some \$1.4 billion.

Mainly our exports went to China, Germany, as expected. And our internal, domestic PV *installation* growth here in the U.S. was growing too from 435 megawatts installed in 2009 – to very roughly well over 1,000 MW (1GW) installed in the U.S. in recent 2011.

Our *imported* solar products in 2010 were valued at estimated \$3.7 billion. Much of that as expected was bringing in some \$2.4 billion worth of finished panels. China and Mexico were 2 leading sources of panels assembled overseas; these trade figures come from a recent joint study by GTM Research and Solar Energy Industries Assn.

We thus see a net win in exports mostly due to Poly & PV Capital Equipment to make poly, cells, panels, etc. Interestingly we're a net *Exporter* here to China and this trade *surplus* is estimated at roughly \$250 million. But whether the U.S. continues to win such niches in a supply chain – or if low-cost nations (China) grab more market share here -- exporting as they did finished cells & modules, is yet to be seen.

Certainly U.S. solar roof installs emplaced here are by nature downstream, local. We can remain 'king' here, and yet there's so much more value across the solar chain.

For example a bearish sign for the U.S. is as installations grow in c-Si PV, it may tip a balance *against* domestic industry. The U.S. importantly leads in *thin film* solar – but no longer in the more common c-Si panels now coming from China etc.

Sales may flatten upstream in U.S.-made poly & capital machinery (to rationalize supply/demand) as Average Sales Price (ASP) goes down <\$1/w for China products. Yes we still produce lots of poly here. But with our panel manufacturers gone, it isn't surprising U.S. net exports poly to overseas panel makers (not really a good thing). Moreover poly isn't used only for PV; some percent may go to semiconductors. Solar data can thus look better than they truly are, if some poly is used outside of solar PV.

How long we stay an exporter of PV machinery too is unknown. Certainly Asia does not lag ability to replicate fabrication processes first designed here. There's unique intellectual property (IP) here too, especially for newer *thin film* PV, and U.S. firms may arguably be better able to maintain a present lead in that unique IP. But globally Tier 1 c-Si PV is becoming a commodity with any small technological lead hard to keep unique.

In sum if & when capacity is rationalized, prices stabilize, demand better meets supply, arguably there *may be* potential earnings + share price growth. Where in the solar value chain this might be strong is unknowable today (part of a case for an Index as a basket of equities). So the situation is in flux. There is today curiously, much PV installation growth - along with tremendous losses priced into solar companies.

New Japanese Feed In Tariff (FIT); also China's FIT, for Demand-led Growth:

So yes, there can be glimmers of hope for growing solar installations. That could mean that sentiment for equities need not only be entirely bearish; it doesn't only have to be ever-greater hits to ever-dwindling margins. Thus one possible reason for maybe just a bit of hopeful sentiment in future could be Japan's new Feed In Tariff (FIT).

Effective in a few months' time, mid-2012, a FIT in Japan can advance installations of solar, wind, & geothermal there. After Fukushima where METI's promises of utmost nuclear safety were clearly not met, their public sentiment needs little explanation. Lacking domestic fossil fuels, their decision to adopt this FIT makes sense.

Goals include going from a near 5GW total solar installed end of this year, to some 28GW solar by 2020. A FIT is key to stimulating installations at 3GW/year clip (This may help wring excess in PV, but beware 'dumping' margins from China, and trade war).

Unlike Germany or China with wind power installations, or say Iceland's geothermal power, there is today relatively little present on/offshore wind power – or geothermal now in Japan that operates 2 separate grids, one for East and one for West. Those Japan grids are at 50 HZ and 60 HZ and so do not interchange power.

That renewable deficit may change. Unlike the Ministry of Economy, Trade & Industry (METI) as a powerful voice directing development of energy as mostly nuclear generation and coal for instance, the future may be different.

Natural gas may figure more prominently in future in Japan. So too wind and solar. Land use issues may stymie growth in geothermal which could be robust baseload power like is nuclear, coal, oil, & natural gas. Yet the renewables that lag today in Japan are likely to grow. They could even surpass the big rates of installation from say, Italy.

Or think (again) of China. Besides fantastic manufacturing growth in finished c-Si for export, there's growing demand to install domestic solar & wind power. We note China too recently adopted a FIT although unsurprisingly it pays less at maybe 18 cents/kWh for solar mainly as cheaper domestic PV, than the Japan solar FIT at 50 cents.

Yet even a temporary China FIT may catalyze growth. In 2010 China installed near 19GW of wind turbines, about 3 times that installed in the U.S. (a growth area too). China's wind stalled in 2011 with many turbines not connected to grid & low voltage ride through power issues (below), but given the 2 new FITs, that growth may resume.

For instance Japan's wind FIT may amount to some 25 cents per kWh. That's quite high. Wind produces power more inexpensively than does solar (which usefully works at peak demand periods), so normally wind doesn't get such steep help. That said Japan's wind on & offshore like its solar resources, are so far being little used.

A Japanese solar FIT near 50 cents/kWh might ramp its installations especially steeply. FITs for Japan & China may help stimulate demand-led *installation* growth too. On the other hand sparser short-term hope exists for *profit* growth in c-Si solar very near term, when great excess capacity still exists with loss of pricing power.

A key problem here is global solar demand at say 25 GW in 2012, is swamped by global capacity at 30-40+ GW. Even with big reductions in price, demand can't yet catch supply. Chinese credit facilities offering some \$43 billion to their alternative energy industries since 2009 altered matters - as have over 300 cell and module manufacturers.

Perhaps there *may* be a bit of sunlight for solar earning revisions farther ahead if/when a macro-environment improves, credit flows on better demand, debt is eased, there's write-down of excess inventory, poly/module prices are more predictable, capacity is rationalized to demand, consolidations are finished and uncertainties over subsidy cuts get resolved, then things can be rosier. And yet yes, that all sounds quite thorny!

End of Q4 came then with solar firms failing, ongoing debt, price declines ahead, and risks of disorderly unwinding high. Yet that was also widely foreseen, so expected, which helps. Some Tier 1 names are still firm, but with consolidation and failures far from complete, doubtless there will be much solar turmoil in store ahead for 2012

Having been asked many times how it is solar installations worldwide can grow so quickly – while solar stocks are plummeting – it is hoped the info above hopefully helps explain such a curious and dismal outcome for the valuations of companies themselves.

The nature too of solar has changed dramatically the past few years as seen for instance in ECO components. From exactly zero China-based solar names in the Index (and the solar sector) early in the millennium, there has been a dramatic shift.

To wit by 2010, China's PV manufacturers had grown global market share to almost half (45%) from 36% a year before. By 2011 it's over ½. U.S. PV makers by contrast fell from 58% to 17% the same period. It's no longer c-Si PV, but in thin film where the U.S. retains its core dominance. Likewise Germany went from 18% to 8% market share.

One domestic response from firms based in the United States (and Europe) has been to create joint ventures that marry U.S. or European innovation with China capabilities to force down costs greatly. Those JVs however have so far had mixed results. But solar product is improving, and it is getting less costly to boot.

Consider on a positive note long-lived c-Si. Many PV makers in 2011 extended Warranties, strengthening them. Given the past problems with China's PV (like its wind turbines, something seen too in India's wind turbines) that arguably was a wise move.

25-year warranties guaranteeing 90% performance year 1, 80% next 13 years were bolstered. One Norway-based firm debuted a linear power output warranty. Rather than guarantee in big steps (down to 80%) over decades, it starts with a base of >97% output in year 1, and that output can decline no more than 0.7% per year.

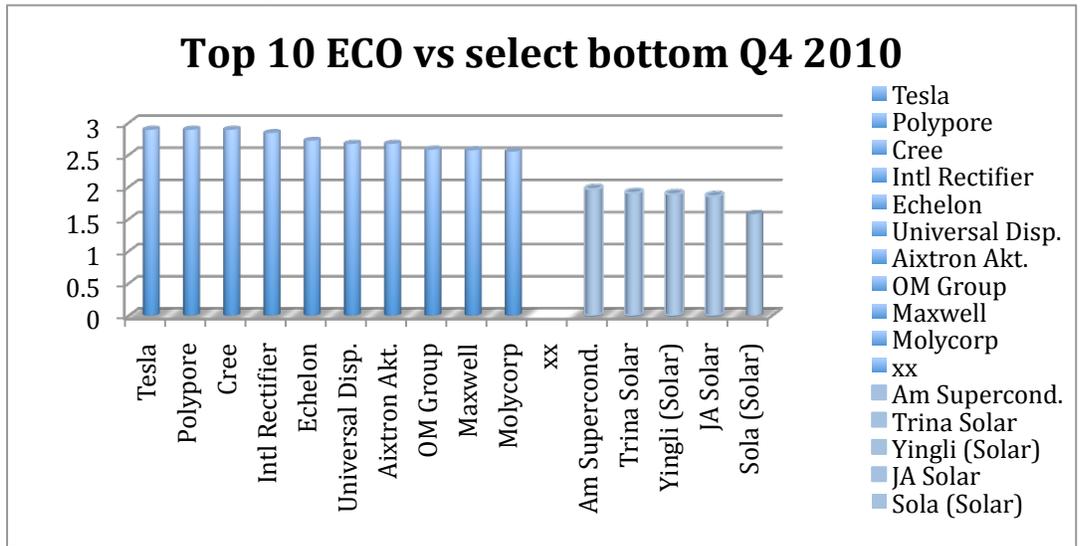
After 25 years its panels must perform at levels greater than 80.2%. With that change two China-based names soon offered similar guarantees over 25 years. And just to note we've monitored our own PV's performance nearly a decade here. This is 3.8 kW monocrystalline PV & passive 3 string inverter, plus separate 2.8 polycrystalline PV & other inverter. Live output can be seen, degradation over time is slight: <http://www.wildershires.com/solar.php>
For 2003, <http://wildershires.com/pdf/monopvgraphs.pdf>

Energy Storage, Energy Conversion, Energy Delivery & Conservation

Stepping back the clean energy names in ECO Index differed – at times noticeably – from just solar (as found say by an independent Solar index) in 2010 & 2011.

Let’s take a quick look at what 1st drove ECO higher late 2010 – then led it in down March - June 2011. This can be seen to some degree in component weights captured 2 weeks before end of each Quarter. They reflect 10 weeks of moves from co-equal weights within each Sector of ECO at the start of every Quarter.

We’ve noted some areas of ECO outside solar (and wind) did much ‘better’ late 2010. Indeed that is clearly a case when one looks at the ECO Top 10 from Q4 2010 below:



Tops in Q4 2010 above were diverse assorted pure-plays in *other* areas of clean energy. They include an electric carmaker; maker of advanced Li battery membranes; LED manufacturer; a maker of energy-saving chips; designer of networks for energy savings; a builder of organic LEDs; fabricator of deposition tools for LEDs & efficient displays; producer of cobalt and Li-ion precursors; ultracapacitor manufacturer; producer of rare earths as strategic elements for e.g. EVs, electric motors, wind turbines, lighting etc.

The above mainly were in 3 (of 6) ECO sectors, Energy Conversion (@ 2.17% each to start Q4); Energy Storage (2.12%); and Energy Delivery & Conservation (co-weighted 2.37%).

Observe here too that Renewable Energy Harvesting was largely absent from the top ECO performers in late 4th Quarter of 2010: that’s where solar & wind mostly reside.

Interestingly look too at a Bottom 5; removing any under 1.0% (*banded stocks <\$50M in market cap so minor weightings omitted below) we there see 5 of 10, or fully half there (the ‘losers’) are either solar or wind. Below is a table for all names that were fully-weighted (>\$200M) and are seen here near the end of Q4:

ECO Index; Past Q4 2010 Components & Weights on 12/15/2010:

| Company Name | Symbol | % Weight |
|------------------------|--------|----------|
| Tesla Motors | TSLA | 2.89% |
| Polypore International | PPO | 2.89% |
| Cree | CREE | 2.89% |

| | | |
|---------------------------------|-------|-------|
| International Rectifier | IRF | 2.84% |
| Echelon | ELON | 2.72% |
| Universal Display | PANL | 2.67% |
| Aixtron Aktiengesellschaft | AIXG | 2.67% |
| Om Group | OMG | 2.58% |
| Maxwell Technologies | MXWL | 2.57% |
| Molycorp | MCP | 2.55% |
| Applied Materials | AMAT | 2.54% |
| Satcon Technology | SATC | 2.45% |
| Ener1 Inc | HEV | 2.34% |
| GT Solar International | SOLR | 2.32% |
| Quanta Services | PWR | 2.31% |
| Zoltek Cos | ZOLT | 2.26% |
| Rubicon Technology | RBCN | 2.24% |
| Sunpower | SPWRA | 2.20% |
| Advanced Battery Tech | ABAT | 2.20% |
| STR Holdings | STRI | 2.19% |
| Ormat Technologies | ORA | 2.17% |
| Sociedad Quimica y Minera SA | SQM | 2.16% |
| Canadian Solar | CSIQ | 2.15% |
| Energy Conversion Devices | ENER | 2.13% |
| MEMC Electronic Materials | WFR | 2.10% |
| Itron | ITRI | 2.09% |
| Amerigon | ARGN | 2.06% |
| First Solar | FSLR | 2.04% |
| Suntech Power Holdings Ltd | STP | 2.04% |
| Cosan Ltd | CZZ | 2.02% |
| Idacorp | IDA | 1.98% |
| CPFL Energia S.A. | CPL | 1.97% |
| American Superconductor | AMSC | 1.97% |
| Air Products & Chem | APD | 1.96% |
| Calpine | CPN | 1.94% |
| A123 Systems | AONE | 1.91% |
| Trina Solar Ltd | TSL | 1.91% |
| Yingli Green Energy Holding Ltd | YGE | 1.89% |
| Green Plains Renewable Energy | GPRE | 1.89% |
| JA Solar Holdings Ltd | JASO | 1.86% |

(banded stocks not shown)

Two observations come from above. One is the Top 10 had No pure-plays in Solar, nor in Wind. Latter 2010 didn't favor those themes. Secondly what were favored then were i.e. electric vehicles, efficiency, advanced batteries, and materials broadly in clean energy – and those did not fit into any one, specific, single narrow theme.

For anyone interested in more on the electric vehicle (EV) and powering it from solar PV, or from 'regular Utility' grid power from the wall, we post this new PV+EV Report, http://www.wildershares.com/pdf/solarsense_v1.2.pdf

Now let's consider what may have contributed to *declines* in March-June 2011. A glance at ECO's Bottom 10 components late Q2 2011 can be pretty telling. As seen June 16, 2011, the 5 bottom performers in ECO from April 1 - to late June in descending order of Worst / to the 'Not-Quite Worst' were:

| | | |
|-------------------------|------|-------|
| AMERICAN SUPERCONDUCTOR | AMSC | 0.81% |
| ADVANCED BATTERY | ABAT | 0.81% |
| ENER1 | HEV | 1.12% |

| | | |
|----------------------|------|-------|
| CHINA MING YANG WIND | MY | 1.30% |
| SATCON INTL. | SATC | 1.34% |
| ----- | | |

Their individual stories reflect what happened to bottom 5 – each unique to it, so not pervasive through its sector. First with equally forceful falls to 0.81% weight were both American Superconductor (AMSC) that started Q2 @2.00% in Energy Conversion Sector -- and a battery firm (ABAT) that started Q2 @2.00% in the Energy Storage Sector.

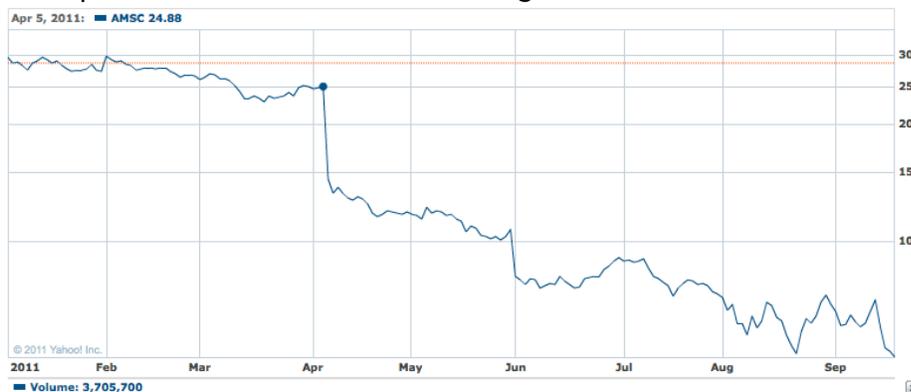
In a nutshell AMSC was once a prominent high-flyer in wind. In ECO early as when it was just \$5, to late 2009 when it reached around \$40/share that had a noticeable gain. Over 7 years its shares had grown some 8-fold for some robust upside volatility.

AMSC over years had moved strongly into wind power, specifically into power converters that are fundamental to converting variable turbine outputs, adjusting for pitch and yaw, the tremendous frequency variability etc. Its unique software (and hardware) became crucial intellectual property and a vital key to preserving its value.

A company-specific risk was they grew over those years while relying greatly on one (now big) wind turbine-building customer based in China. It became 70-75% of their revenues any particular Quarter. That China wind company had grown up fast alongside AMSC and it became in time one global leader in large wind turbines.

So when that key customer suddenly started to reject ordered components from AMSC, claiming issues of quality control etc and began to source from a subsidiary (of itself), valuations of AMSC dropped precipitously April through June 2011.

From \$25/share early April, valuations dropped to some \$8 mid-June as it began to unfold. Here below is a Chart for this 2011 period where an April-June fall is seen alongside a few subsequent months to show the bleeding did not end there:

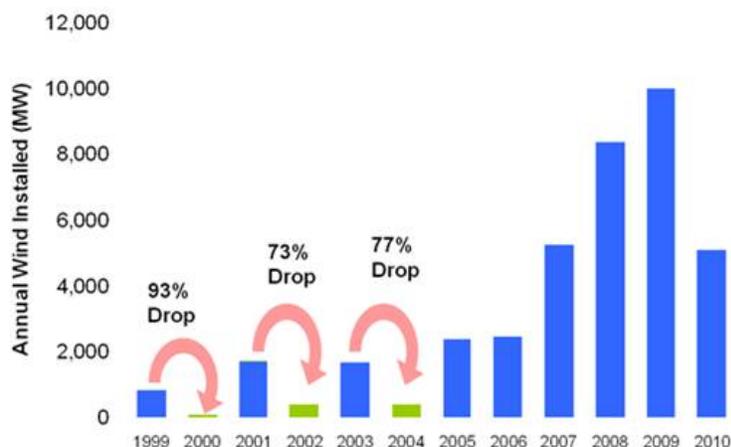


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There were also broader issues facing the wind industry. At a time when subsidies of all kinds for renewables have been under fire including the U.S.'s 1603 Treasury Cash Grants program, wind is clearly no sure thing. This is made worse by a threat the critical Production Tax Credit (PTC) won't be renewed in future. With a PTC, U.S. based facilities producing domestic world components have grown over 10 fold.

But when the PTC is allowed to lapse even a year, as happened before, wind’s growth has stumbled very badly in the following year after each occurrence. For an example of this see the Chart below from AWEA, on the Impact of a PTC lapse:

Historic Impact of PTC Expiration on Annual Wind Installation



Source: AWEA

Moving on, another sample great fall in ECO April-June 2011 was a small, highly obtuse and speculative China based pure play in batteries & electric bikes. Second-worst fall of Q2 it sits outside solar & wind, so wouldn’t be in a themed Index there. (That name had ended Q2 at below the threshold size and so not eligible for ECO start of Q3).

It began Q2 near \$2 - and fell dramatically 2nd Quarter ending < ½ the value where it began the period. In its case that was not an over-reliance on a single customer – but rather perhaps action by ‘shorts’ that impacted it. Lack of transparency made matters worse. Valuations were difficult for such an obtuse, speculative China symbol.

Third down list of Q2 bottoms was a pure-play in a volatile advanced battery/ emerging electric vehicles part of the clean energy space. It began 2nd Quarter near \$3.0 amid thin hopes a partner’s rehashed car platform previously used in (failed) attempts to launch an EV, could this time be maybe made sellable with its batteries.

The small firm notably staked a great deal of future success – or failure – on a tiny Norwegian carmaker. When that manufacturer failed, it simply decimated this symbol. A bit like in the solar too as was discussed above, there is today great over-capacity present among the extant and potential battery makers for EVs in 2012, crushing crucial margins of potential sellers of batteries for future EVs.

So a few battery makers *may* do well while most fail. In short there’s huge risk & possibility for great falls (or some gain) in EV batteries ahead. As this 3rd component was just a bit >\$200M at rebalance to start Q2, it had begun co-equal weighted in its sector and ended Q2 at only just above \$1, or well down below.



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4th down a list of Q2 ‘losers’ was a wind pure play that began Q2 near \$10: it (MY) reached down near \$5 mid-June Q2. Why? (We Chart performance to mid-Q4 2011 below showing that its fall too didn’t end at Q2’s finish - but it did jump last week of December).

In Q1 things had certainly started rather brighter for this newly listed, China-based wind manufacturer. Briefly its total revenues had grown 39% from Q1 2010, to \$213M.

Net income was up near 60% that period; gross margin up 26% vs. 21%, and this name was trading roughly 5.7x its earnings estimates for 2011. But Q1 2011 also marked its high-water point, after that matters became much more challenging.

Several factors came into play, including new competition making it very tough to grow revenues. And like solar, the ASPs of its units was declining, so low-cost manufacturers including those here from India (unlike with solar) endured tiny margins.

P/E’s in this space also dropped considerably, especially for China based symbols. Here below in blue, it drops hard from April 1, 2011 vs tracker for a wind index in red:



google.com

Despite the plunge at that China wind firm, a far better relative story was seen in a wider Global Wind Index (in red, above), including its much better Q2 period April-June.

Factors facing MY included a new tough bar in regulatory approval at wind farms in China. Yet against that backdrop China’s total installed wind capacity reached some 44 GW in 2010, and added some 60% more. But all was not rosy for wind in China in 1H 2011.

Few regulations, bad management & quality control meant turbines were often cut off from grid -- due to voltage sags, etc. Just in February 2011, 598 turbines at 16 farms were disconnected. Lacking low-voltage ride through (LVRT) capability a result was Chinese regulators created 18 new technical standards for wind. It was important too that the local LVRT technology didn’t violate foreign-owned Intellectual Property (IP).

By summer this name missed earnings estimates by a large amount, at \$217M in revenues. Market share was near 9% so it's no tiny player in wind, yet it was gaining only some new orders and that alone was not enough. (Other firms there did much better).

After a boom 2008 a number of wind firms had entered the field in China. That pushed down prices; a wind blade dropped in cost from \$1,000/kW in 2008, to ½ that in 2011. Not as steep as the drops in solar for PV poly etc, yet a great decline nonetheless. During this price war quality was hit in wind – more so than at the Tier 1 Solar PV manufacturers that were using highly-rated upstream fabrication machinery.

Early statistics reveal some 16 wind turbine generator sets in China either collapsed, or caught fire 2009 to mid-2011(!). Not a good record. That was on top of issues over respect given to foreign-owned (non-Chinese) IP. Through it all these wind makers saw tough competition as margins dropped despite new orders. Demand was there (though patchy) and some high-quality names in China did much better even as this one lagged.

Some of the strongest China names clearly gained mid-2011, and it later climbed a bit in October on announcing it was approved to receive up to \$5 billion backing from state-owned China Development Bank. It noted too it had robust LVRT capability, and owned that IP. But still the bottom line was hurting: Q3 2011 saw profits down 43% even as revenues gained (to RMB1.9 billion, from RMB1.49 billion in Q3 2010).

For purposes of its U.S.-exchange traded shares, Q3 2011 earnings were \$16.1 million (RMB102.7 million) or 13 cents per share - RMB0.82 per share. A year prior it had been RMB1.70 share so this company was not generally headed in a positive way.

Higher costs were cited in declining Q3 profits including income tax expenses and lease fees. For all 2011, it anticipated wind projects might make 1,800 MW - 2,000 MW.

Out of curiosity let's take a look at what some 'well-performing' wind names did mid-2011 in worldwide (mainly outside U.S.) WilderHill New Energy Global Innovation Index (NEX). That has many wind components that are mostly based outside the U.S.

Looking at its strong Wind Sector (RWD) performers during Q2, when wind in NEX did well (especially vs laggards in solar - rather like AMSC & MY did poorly), we see that wind names there in NEX's top ½ in the middle part of June included:

| NEX Wind components, top ½ on 6/16/11 | Country | Currency | Weight | Sector |
|--|----------------|-----------------|---------------|---------------|
| EDF Energies Nouvelles SA | FR | EUR | 1.63 % | RWD |
| Iberdrola Renovables S.A. | ES | EUR | 1.53 % | RWD |
| China Longyuan Power Group Corp. Ltd. | HK | HKD | 1.46 % | RWD |
| Acciona S.A. | ES | EUR | 1.42 % | RWD |
| China Suntien Green Energy Corp Ltd | HK | HKD | 1.39 % | RWD |
| EDP Renovaveis S/A | PT | EUR | 1.37 % | RWD |
| China Datang Corp Renewable Power | HK | HKD | 1.37 % | RWD |
| Gamesa Corporacion Tecnologica S.A. | ES | EUR | 1.32 % | RWD |
| China WindPower Group Ltd. | HK | HKD | 1.29 % | RWD |

Top here was 4 China names on Hong Kong exchange, these gainers offsetting Wind losing names 3rd Quarter. To round out wind a bit, take a quick look at the U.S.

It's easy to recall when wind here in the U.S. comprised well under 1% of our total electricity supply. Note then it had reached over 3% in 2011, some 44 GW of cumulative capacity. In context here of the American overall energy appetite (total pie) also growing over this period, the relative growth in wind has been rather a lot.

Here in the U.S., 8.4 GW (8,400 MW) of wind was in construction in 2011. After peak 2008, this represents a bump up again of projects in 2011 after a weakened past 2 years. Some 1,200 MW was being built in California. 800 MW added in Oregon, 700 MW in Oklahoma and Iowa, and another 600 MW in Illinois, Kansas, and Washington.

In just Q3 Colorado was biggest @500 MW new capacity, Oklahoma was putting in 130 MW, Minnesota, West Virginia, and Texas each putting in about 100 MW. These numbers are still minuscule compared to say one large natural gas-fired plant at maybe 500 MW. But, turbine growth is scaling up from scratch, and this fuel resource is abundant & free -- though it must be stressed too wind is intermittent to its great downside.

In Q3 the U.S. installed about 1,200 MW new capacity overall, due largely as noted to a Production Tax Credit. That new 1.2 GW compares to 670 MW put in over 2010, according to the American Wind Energy Assn. for a 75% gain over one year. Looking back to merely a decade ago, wind capacity is now 20 fold greater than then(!).

On the other hand, other governments are playing to win in wind (& solar) and they've been growing much faster. Germany & China are two examples. Nominally 'Communist' China made an enormous commitment to growing clean tech, far more than here. For instance the U.S. PTC is hardly assured an annual renewal, and tools like a national FIT or RPS are just ignored. By contrast China supports its wind -- and solar to much larger RMB/\$ degree and with clearer long term commitments, than the U.S.

America invented many of these technologies but has lost that lead to China, Germany etc in innumerable technological areas. Partly this is because other governments have spotlighted strategic domestic growth of clean tech in order to grow jobs, reduce reliance on foreign sources of energy, and help clean fouled local environments.

To sum about 9% of our electricity today comes from renewable sources -- yet that's mainly from big hydro with limited growth. Indeed most is just still from big hydropower, wood, & biofuels (ethanol from corn); look for growth other than there.

U.S. wind reaching 3% of our total is becoming 'real'. While solar is far punier, it is growing very fast (say 30% y/y) and has the greatest potential of all, long term.

A decade and a half or so from now, from basically scratch, some 6% of U.S. new installed capacity might be solar. That would be tremendous growth in the period. And while many hurdles remain this may still arguably surprise to upside, if grid parity is reached more and more places. That's especially so once need for PV subsidies is past and each inexpensive solar panel installation makes sense in its own right.

This concludes excerpts of a review of the clean energy sector and so ECO in Q4 2011.
