Wide-scale Implementation of Solar Power: The Most Economic Energy Source Of All

BY:

Gary Holden

Director, GRH Strategic Ltd.

Wide-scale Implementation of Solar Power: The Most Economic Energy Source Of All

Most people think solar photovoltaic (PV) power is a great idea, but is too expensive to consider. The conventional wisdom in the energy industry is that solar PV requires subsidies from carbon taxes or carbon trading credits to be economical. Politicians and decision makers are forced to construct artificial costs (carbon penalties, feed-in tariffs etc.) to provide solar power a level playing field. This is usually justified on the basis that the added cost is simply the penalty to meeting international emissions targets. The populist view is that the use of solar power has been reliant upon political support as opposed to having pure economic justification.

The purpose of this paper is to highlight that these artificial mechanisms are not necessary; and to demonstrate that solar PV is far more economic than is conventionally acknowledged. In fact, applied in the right way, it could be the most economically viable energy source of all as once the infrastructure is in place, the energy is provided indefinitely, for free.

Much progress has been made already with a wide variety of policies to stimulate solar power deployment. For the most part, policy makers have done an excellent job in creating programs, creating incentives and building awareness. Solar power has a wide following and manufacturing costs have fallen. In many ways, the age of solar power generation is about to begin, as the price is right and the time has come for utilities and policy makers to develop the mechanisms for making solar PV panels a core part of developing the power grid.

Conventional Thinking

On October 6, 2012, the New York Times Beijing Office reported on the amount of solar power manufacturing capacity that exists in China. According to the article, approximately 30,000 MW of solar panels will be installed in 2012. The ability to manufacture panels has soared to an amazing 50,000 MW per year in China alone; and 70,000 MW per year worldwide.

Extrapolating these amounts, installed capacity world-wide could equal the electricity capacity of the United States in about 15 years. You might conclude that the human race is ready to implement a massive wide-scale deployment of solar power.

However, that was not the conclusion of the article. As is often the case, the article went on to say that with coal power costing 5 cents per kWh, the 19 cents per kWh (both in $US) needed to pay for a solar power installation makes it a poor decision. It went on to say that Chinese investors in solar power were making a big mistake as the surplus manufacturing capacity will lead to failure of those businesses; as a direct consequence of this poor economic reality. You could almost hear the sounds on wall street as another blast at renewable energy companies reverberates across the trading desks and share prices of solar companies fall to the floor.

Unfortunately, this crude economic comparison, 5 cents versus 19 cents, is a simplification that is carried out thousands of times a week in media coverage on this issue in every corner of the world. This comparison is fundamentally incorrect. For solar power to become a core part of developing the grid, we need a more accurate characterization of the true economic value.

Comparing Solar PV prices to Coal prices must consider the value of power during the day

Coal plants are a major producer of power around the world[1] and have become know as the "low cost" electricity because they most often use cheap solid fuel and operate 24 hours a day, all year round. This ability to run continuously is why coal is called "base-load" power. Competitors to coal as base-load supply include nuclear, natural gas and hydro. Solar PV, even though it uses "free" energy from the sun, is considered inferior because it cannot run 24 hours a day.

To overcome the inability to run 24 hours per day, most economic evaluations for solar PV add the cost of batteries to store the solar power during the day and deliver its energy at night. When all these costs are considered, as most have concluded, it becomes prohibitively expensive to be a seriously replacement of coal or other base-load supplies.

These comparisons are flawed on several levels. In order to adequately recognize the true value of solar power, the distinctions between solar and base-load power need to be made more transparent and understood.

To begin with, it is important to recognize that solar power and base-load power provide different functions and both are necessary to meet the changing demand for electricity over the 24 hour period.

From a power pool perspective, base-load power is a resource with fluctuating value, as electricity prices change hourly to reflect the balance of supply and demand. Generally speaking, prices spike as the balance tightens in late afternoon and drop when the balance relaxes during the night. This can become an economic disadvantage to owners of base-load plants as most of the production receives low prices. In most markets, base-load plants will dump their power into the market at night and will accept a price that only covers their *variable operating costs*. This is referred to as "must run" as cooling off and starting up again it is not an option for technical reasons.

There are even times when the pool price of electricity drops below the variable costs of base-load plants when the system is in a position of extreme surplus. This is an indication there are too many base-load facilities on the grid for the level of demand at night. Some pools even allow generators to bid prices below zero, which means base-load generators effectively buy the right to run. In Texas, one energy retailer has de-

[1] Coal is the dominant source of power generation in Germany, USA, China, Canada (Alberta), Australia to name a few. In the US, coal has historically provided more than 50% of the supply.

faulted to offering night time power for <u>free</u> in a retail energy contract; reflecting this exact phenomenon in offers to customers.

In the United States and Canada, some power pools will dump their night time power into adjacent power pools at low prices in order to keep base-load plants operating. Pools that can turn off power plants at night take advantage of this cheaper source of power.[2]

What this means is when considering the low value of base-load power during the night, the allocation of value for plants that produce power on-peak takes on a different meaning. This really means that the so-called 5 cent per kWh coal plant is worth about 8 cents during the day and in the order of 2 cents once the sun goes down. Solar power, inherently a day time only generator, should be valued accordingly in any economic evaluation.

To make matters worse, coal plants are often located a considerable distance from the demand. Long distance transmission of electricity adds quite a penalty; especially on the margin. Depending how far away the marginal generation is, there are transmission line losses to factor in that get exacerbated during the peak period when lines are loaded up. Those can be dramatic since marginal transmissions losses are twice as large as average transmission losses[3]. It would not be unusual in a 10,000 MW system, to have two 400 MW coal plants simply running to replace the transmission losses. A 10% to 20% penalty for on-peak coal power is quite common which adds to the value of solar PV at solar would be inherently located to offset such penalties.

Combining these effects, the economics of Solar PV should be compared to the 8 to 9 cents per kWh day time value of power from a coal plant not the 24 hour average of 5 cents per kWh. This would be a more fair comparison and start the process of recognizing solar power in a more positive light.

But that is only the beginning.

Solar PV has been financially handicapped

In order to develop a 5 cent cost for coal power, you need to apply many years of utility strength and monopoly advantage to the equation. In many developed nations, the so-called 5 cents is only possible because utilities have a historic regulatory pact that ensures long-term access to cheap capital through guaranteed

---

[2] Alberta (Canada) will routinely dump night time power in British Columbia as BC has the ability to curtail its hydro dams, use the cheap coal power at night and release the dams during the higher valued part of the day. In many cases it actually sells on-peak power to the United States for a profit; essentially converting cheap coal power into economic gain by storing the energy in its hydro system not unlike a large battery.

[3] Losses increase exponentially with flow so that each additional megawatt transmitted on a line results in an increasing loss rate. In particular, marginal losses as a function of power flow equals: Marginal Losses = 2 * Resistance * Flow / Voltage^2 or 2 * Average Losses. Therefore, we should observe that losses increase as more power is transmitted over longer distances and marginal losses are exactly twice average losses. Therefore, if the average losses at some point in time on the system is 5 percent and the quantity transmitted were increased slightly, 10 percent of the incremental flow would be lost. *Source: Dr. David Patton, Phd expert witness in transmission costs for NY PUD.*

physical franchises, captive customers, flow through cost escalations and protection from capital variances. Other markets built the infrastructure as a government department and used the government's balance sheet to access the same low cost capital. Either way, the 5 cent power, to be very clear, would be much more expensive without this advantage.

Creating this "regulatory bargain" was intentional and very, very smart. It created lower cost power almost everywhere around the world. If not built by governments, this power was built by investor-owned utilities that leveraged the regulated monopoly status into low-cost debt, produced blue chip dividends and, at the same time, produced power that everyone could afford. In virtually all cases, it produced a global competitive advantage that persists today.

Whether it was hydro, coal or nuclear power, these advantages fed economies and created super competitors that has had the unintended consequence of deterring new entrants with new ideas. Being a new entrant, solar is on the losing side of that equation. When we refer to 19 cents ($US) for solar power, we are assuming a customer must go out and find a local contractor, pay a retail margin on the panel (most likely built and shipped from China) and get a "good payback" of, say, five years. This means the panel has an interposing profiteer (to cover the myriad of risks the contractor might face) and a cost of capital of over 20 percent to satisfy the economic requirements of the typical homeowner. Somehow we expect this equation to compete with a utility who could flow through the capital cost and rent their balance sheet out to captive customers for about 7%, or lower. Solar PV is inherently financially handicapped in any comparison with utility generated power.

Looking at this from the other side, if the coal plant were facing similar costs of capital and construction risks, coal would likely face in the order of a 50% rise in the capital part of the cost equation.[4] The utility financing advantage is a big factor in assessing economics of solar power.

We would then be calling coal plants 8 cents per kWh instead of 5 cents. If solar received the same advantages and utilities made solar a consistent part of their regulatory submissions, they would require considerably less than 19 cents per kWh for an solar PV installation. The result would be in the 13 cent range if all regulatory advantages came to bear. Perhaps even lower, if the installation has some economies of scale that an individual home owner would never enjoy.

It might be time to give solar the same advantages that coal, nuclear and hydro enjoyed so many years ago.

Combining the three issues, 1) time of day valuation of power, 2) marginal transmission losses and 3) a utility financing advantage, we would now be comparing solar PV at 13 cents to a coal plant's day time value of 9 cents.

[4] The Capital component of coal plant economics is the most dominant variable and often represents 70% of the cost of coal power. A shift in the cost of weighted average cost of capital from 6% to 9% would cause a rise of approximately 50% in this component; depreciation would also be higher if the plant carried t[1]he risk of capital overruns as the absolute capital cost would be likely higher.

Coal, Hydro, Nuclear and Wind are not getting any cheaper

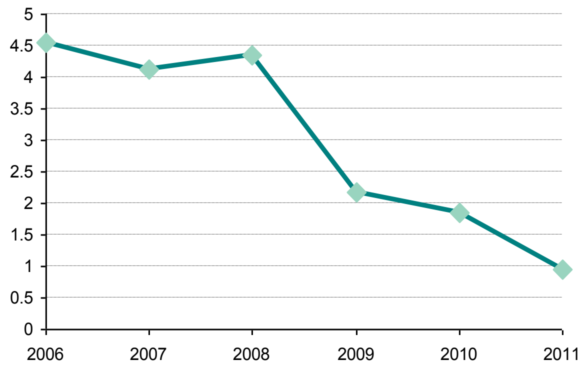
Trends are important in these matters. The longer trend of future generation costs is an important consideration; and it makes the case even more compelling. Coal power is not really 5 cents any more. Coal plants are being retired all over the world and they are not being replaced with new coal plants. New coal plants are not anywhere near 5 cents. The "5 cent number" was always a blend of historic assets, cheaper coal mines, depreciated equipment; costs that are no longer available.

Steel costs, mitigation of mercury, better particulate control, harder-to-get-at mines and modern labour costs are all the reasons. Recent announcements of coal plants are more in the order of 8 to 12 cents per kWh. This would put day time coal energy at a value of 14 cents and night time at around 4 cents per kWh.

Nuclear is even more expensive than that, and wind, based on steel and labour costs, are also rising; and they need gas generation firming to make them a reliable base-load source.

Solar, on the other hand, is dropping in price. Prices have dropped by more than 60% since 2006 which is having a material impact on the installed cost per kW. Prices for the panels have fallen so much that installation costs are now the greatest component of the overall cost. Solar power is now more a function of labour costs than the photovoltaic material costs.

Prices for Chinese PV Si solar panels [5]



In a world where solar PV becomes a part of utility planning, there will be the need for massive expansion of solar power companies willing to install and commission the large volume of panels required.

On-peak temperatures are presenting new problems to power grid planning

In most parts of the world, the entire electricity utility value chain is geared to address the hottest day of the year, or, more importantly, the hottest day in 50 years. Utility planners, transmission companies and distribu-

[5] source: Re-considering the Economics of Photovoltaic Power by Morgan Baziliana,b, IjeomaOnyejia, Michael Liebreichc, Ian MacGilld, Jennifer Chasec, Jigar Shahe, Dolf Gielenf, Doug Arentg, Doug Landfearh, and Shi Zhengrongi

tion utilities are well experienced at determining the incremental cost of a unit of reliability based on a 1-in-50 year hot day. This is for good reason too. There have been crisis events related to hot weather and the associated spikes in air conditioning demand.

This was never more evident than during the heat wave of 2012 as air conditioning demand set a new peak and local utilities all over the US suffered the embarrassment of being caught short as compressors sucked more juice than any other time in history.[6] You can bet utility executives all over the country were called upon to submit expansion plans of the entire network to ensure it will not happen again. New peaking plants, new transmission lines, new distribution lines and more transformer capacity everywhere. Regulatory hearings will be reminded repeatedly of the heat wave and, under the trump heading of "system reliability" the money will be allocated, spent and butter spread across everyone's power bill.

In the city of Auckland, New Zealand, they had a meltdown of transmission lines in 1998 related to excessive air conditioning demand coincident with a line failure. Having a robust array of solar PV in the downtown core could have made a meaningful difference on that set of conditions.

With a warming planet, the 1-in-50 assumption is increasingly tested. Some say changing weather patterns have pushed reliability risks to be more like 1-in-30 or 1-in-20 year events. Recent reports that in the first few years of the 21st century, the global air temperature has just reached its 330 straight month above the 20th century average.[7] This is quite alarming as high temperature has emerged as a serious problem for utility grid planners and restoring the system back to historic reliability levels will be very, very expensive.

In the United States, it is estimated that about 100,000 MW of generation is dedicated to serving air conditioning in office buildings, shopping malls and homes. It is now likely that an incremental horsepower of compressor capacity is the single most expensive thing utilities have to build for.

To add a brand new air conditioner in downtown Phoenix for example, the incremental costs would include the proportional cost of a new coal plant, the cost of a new transmission line, the cost of an expansion of the distribution system, as well as the cost of new capacity at the local substation. As you can imagine these costs have been going up all of the time as the cost of steel, wood, copper and lead have outstripped inflation over the past couple of decades.

These escalating costs, and the growing cooling demand, and have become a major issue in future utility planning as power prices are rising more quickly than ever before and solar PV must now become a part of the solution from a power grid planning perspective.

---

[6] Extreme temperatures have claimed many lives and caused much economic harm. The summer 2012 North American heat wave led to more than 82 heat-related deaths across the US and Canada. This long-lived, straight-line wind and its thunderstorms cut electrical power to 3.7 million customers.

[7] August 2012 was the fourth-warmest August globally since 1880 and the 330th consecutive month in which temperatures worldwide were above the 20th-century average, according to the US National Data Center. Bloomberg September 2012

Every grid has different conditions and specifications, but roughly speaking, incremental transmission and distribution capacity has ballooned to between 4 and 6 times more expensive than the historic costs. For example, in a geographically spread area, where the transmission and distribution assets have been evolving since the 1940s (and have an average life index of about 25 years), with modest population density, the transmission costs would be approximately 2 to 4 cents per kWh. Distribution costs would be similar; producing a range of 4 to 8 cents per kWh for the historic costs.

If the cost of new transmission and distribution costs, at 4 to 6 times the cost of historic assets, are ascribed to incremental air conditioning demand, then a new air conditioning load should be charged between 16 cents per kWh and 48 cents per kWh. Clearly, our regulatory mechanisms would never separate and charge such incremental costs to new loads, as it would be prohibitive and socially unacceptable. However, it is quite valid to consider such costs in making decisions on alternatives. Cutting back on air conditioning is not an option in a warming climate so we must find the lowest cost way to expand the grid.

Solar PV has a unique correlation to peak electricity demand

Which brings us to the most important part of the discussion. Solar PV's unique ability to generate power exactly when the grid is stressed with high temperatures makes it a very powerful tool in supplying energy with zero variable cost at exactly the time when the power grid is stressed the most. Surprisingly, the notion of correlation has not become part of the utility discussion relating to solar power. Factoring in this advantage changes the economic comparison substantially. In fact, this correlation, when added to the previously stated factors, makes solar PV the most economic energy source we know of.

For the sake of argument, if you assume a standard normal distribution of outcomes around the LOWER side of the cost range, we would expect a utility to declare the cost of serving incremental air conditioning demand of (minus one standard deviation) 10 cents per kWh up to (plus one standard deviation) 22 cents per kWh. In other words, utilities should be prepared to offer incentives up to this range to avoid adding to the air conditioning demand. Needless to say, solar power, being one hundred percent correlated to air conditioning demand, deserves similar economic entitlement. To complete the math, if utility supported Solar PV can be installed for 13 cents per kWh, and receive a value benefit of offsetting air conditioning of 10 to 22 cents, then solar PV has an actual net cost of *negative 9 cents to plus 3 cents per kWh*.

If you have trouble believing this assertion, walk into your local utility and ask them if 50% of all the air conditioning disappeared permanently overnight, how long would it be until you need to expand the grid? Furthermore what impact would it have on the on-peak price of power? In most cases, you'll then have the answer as it will likely be for an extended period of time and this change in demand would provide a lot of capacity for the city to grow and on-peak pool prices would fall dramatically.

The surprising part of this analysis is, that even if you are reluctant to deal with incremental costs and prefer to stay in the realm of average costs, the average transmission and distribution cost would still create a credit for solar between 5 and 10 cents per kWh. In most cases, you could ignore the distribution component and it would not matter; it would still be highly compelling.

The comparison would then become: base-load coal's daytime value of 8 cents per kWh and utility financed solar PV at 13 cents less a credit of 5 cents. Resulting in *approximately 8 cents for both.*

This makes sense in another way as, roughly speaking, a new double-circuit 220 kV transmission line contains enough steel and aluminum alloy to build the frames and support structures of 4 million solar panels; enough to put 10 panels on every house in a city the size of Auckland.[8]

Why not simply use Feed-in-tariffs or other political solutions?

Many countries have chosen the mechanism known as feed-in tariffs (FITs) as a proxy for the net benefits solar produces to a grid. This is where a posted buy-back price is offered to stimulate solar PV embedded within the distribution grid. These tariffs were initially set to reflect the cost of solar panels for consumers and have been adjusted downward over time. Many jurisdictions have also included the perceived cost of CO_2 in the FIT. As a result, FITs have resulted in very high prices offered to solar power owners[9] for excess power, making the choice very appealing. Not surprisingly, this has lead to rapid deployment in those regions.

Germany has been leading the way, as more than 28,000 MW have been installed under this program; equal to as much as the rest of the world combined. Germany's leadership almost single handedly brought the cost of solar power down across the planet; and perhaps they might be the smartest utility regime of all.[10] They have received much criticism for the high cost to German society however. Critics have claimed the FITs have been way over valued as they have been slow to react to changing costs of PV panels.

The underlying problem with FITs is simply they are set up to provide the lowest cost. They are assuming the most inefficient financing possible and they struggle to consistently seek the lowest cost supplier. Contractors had many windfall opportunities as the offer was so compelling to homeowners that costs became secondary. Furthermore, from a utility planning perspective they are essentially randomly located as the tariff is made available to everyone regardless of the contribution to the grid.

Sometimes people will worry about stranded costs. FITs have been accused of making historic investments in distribution or transmission costs redundant. Counter arguments that FITs have released capacity for future growth have been effective however as most utilities are wrestling with expansion of their grids and freeing up capacity is a benefit not a detriment.

---

[8] 220 kV towers for a 500 km line spaced 450 m apart uses in the order of 55 million lbs. of steel and 4.4 million lbs. of aluminum alloy; Auckland has approximately 450,000 homes; a single solar panel use about 15 lbs. of steel.

[9] Sometimes 10 times higher than grid priced power.

[10] In fact, FITs are offered in over 50 jurisdictions now at a wide variety of prices and are still widely criticized as unnecessary subsidization. The political pressure against such charges will likely mean they cannot be sustained.

FITs are also often sold as part of a countries commitment to international emissions reductions. It could be observed that these commitments are highly political and inherently unsustainable.

It is Not A Matter of "If"; It is a Matter of "How Much"

For solar PV to become wide-spread and sustainable, it must be done on the basis of economic rationale. Fortunately, solar PV is inherently economic. The economic benefits are such that there is no requirement to consider CO_2. A reduction in CO_2 is just a by-product of making the economic decision. If done as part of the utility grid management there is no particular requirement for elaborate smart meters. If installed with utility economics in mind, there is no particular requirement for special power buy-back contracts with customers. Simply a requirement to add the capacity in an efficient, utility based model that gives regard to location and size. Simple and starkly effective.

The question is really a matter of how much do we need.

If the City of Auckland were to track its air conditioning demand, they would discover that the ramp up and winding down of air conditioning, is partly correlated to the degree to which the sun is shining, partly related to the absolute temperature and partly from internal sources.

Air conditioning engineers refer to this as Solar Radiation Gain (SRG). [11] The ratio of SRG to the other solar loads is what is needed to establish the unique amount of solar power required, as each city or town has a "finger print" that identifies the degree to which their own weather patterns are correlated to the SRG.

Phoenix is different to Auckland and Auckland is different to London. It is easily discoverable exactly how much SRG "swings" and puts demand on the electricity grid. If downtown Auckland has 300 MW of installed air conditioners then Auckland needs in the order 240 MW of that amount in solar panels within its grid. Phoenix on the other hand may need 2000 MW. Each target for the economic amount will vary quite widely across the globe, but in all cases the amount is significant.

In virtually all cities, every flat industrial rooftop, every sloping office building and every house is a potential site for making the grid more cost effective.

Not everyone understands this phenomenon. In Peter Lang's 2009 paper analyzing options for the Australian National Electricity Market, called "Solar Power Realities", he states that solar power's intermittent production requires battery storage to be an effective contributor to the grid; which a view that is widely held.

However, if the solar PV is offsetting air conditioning, which essentially converts the demand profile to the equivalent of a mild, overcast day, storage is not needed as every kWh is instantaneously consumed. This renders the concept of battery storage moot. In effect, the *correlation* is the equivalent of storage. As a

[11] "In addition to SRG, Conduction Heat Gain (CHG)" and "Internal Loads" make up the balance of the solar loads. SRG and CHG are also correlated based on humidity and altitude. Certain climates have higher correlation between SRG and CHG than others. In non-equatorial climates, where the relationship between the SRG and CHG is high, the portion of SRG ranges from 0% at night to 15% during cloudy periods to up to 80% during blazing sunshine.

point of interest, Australia's NEM has approximately 3,000 MW of air conditioning demand contributing to the peak set in June-July-August. Roughly 30 million standard sized panels worth.

For colder climates, the principles are the same except the winter presents additional challenges. Some of these regions have a summer peak, driven by air conditioning, and a winter peak driven by heating systems kicking in after the sun sets. These utilities must develop two pronged strategies to reduce infrastructure costs. Augmenting solar power with district energy systems or commercial cogeneration will reduce both summer and winter peaks; retaining the economic value associated with avoided infrastructure costs.

In all regions, regardless of weather patterns, would benefit from solar PV embedded in the network.

What is required to Make It Happen

For the most part, all it would take is the will of the utility and its regulatory body. However, this will be an uphill battle in most regions of the world. Utilities will not naturally cooperate as it would require considerable restructuring of time honored process. Building transmission and distribution in large increments is conventional and challenging enough. Adding the option of embedding solar panels inside networks, essentially as a network device, will not be accepted easily.

Having said that, in regulated markets, all it would take is for the regulator to request that the distribution utility file its aggregate air conditioning load and its incremental and average cost of serving that load. Once the "finger print" is known, the regulator and utilities can jointly choose from a number of business models to execute a plan. It is likely the distribution utility in partnership with solar installation companies could rapidly deploy the needed capacity.

In deregulated markets, distribution companies could feasibly partner with energy retailing companies as well. The boards of directors of distribution companies could chose to implement solar to simply drive down costs. Energy revenues from the wholesale pool could be used to offset the capital costs.

These business models could include offering owners of rooftops a "rent" to accommodate the panels as opposed to building owners owning the panels directly; not unlike the way transmission companies rent space for transmission towers. This rental agreement could be in conjunction with an energy contract or be completely independent of one. It would not matter and would depend upon the circumstances and desires of the rooftop owner.

From a technology point of view a simple meter to measure the output is all that is needed.

Simple, effective and very economic. With the capital cost rolled into the charges for transmission and distribution, historic decisions in infrastructure are preserved and the solar devices produce low cost power, lower the overall cost of the network and create future capacity for expansion.

Why is this not happening?

If the economic compulsion of putting solar power to offset air conditioning load is this strong, why is it not happening? Why are there not utilities all over the world planning to integrate solar panels on industrial rooftops, hockey arenas, schools, warehouses, roadsides and parks as we speak?

For starters, the rules of electricity development do not allow it. In fully deregulated markets, wholesale market participation is distinct and forced to be separated from transmission and distribution development. Integrated thinking is simply "not allowed" in the conventional sense. Creating synergy between transmission companies and energy companies would require some creative thought to subvert the rule structure.

In markets where wire is rate-of-return regulated and wholesale/retail energy is competitive, it would require a regulator that is open to economic flows across the boundaries established to keep things tidy.

In fully regulated markets, where all decisions are under the purview of a single regulator, it should be as straight forward as putting together the case. But even in this situation, it does not happen. If solar happens at all, it is under the overriding justification that their is a responsibility to protecting the world from global warming.

Perhaps the real reason is that conventional analytical processes have inadvertently erected barriers. Transmission companies and departments are assigned the responsibility of building transmission lines; not to think of ways to reduce them. Generation companies and departments are trained to build what they know and to optimize government subsidies where they are offered. Transmission companies do not get any economic value from generation plants and vice versa. Saving infrastructure costs are only of passing interest to a generator. In fact, perversely, generators spend enormous lobbying effort ensuring that infrastructure is overbuilt, unconstrained and stretched to every corner of the landscape as that proposition maximizes the optionality of choice.

Other parts of the value chain try to bridge the institutional barriers. Metering people continue to build more elaborate solutions in an attempt to stitch these complexities into a coherent package as demand side behaviors are factored in. Peak reduction is considered the job of the metering departments as the problem is assigned to the "customer-side" of the things. Each challenge in the value chain is discreetly identified, analyzed and resolved. Not surprisingly, the notion of integrated solutions is spoken of but rarely implemented.

Finally, and perhaps the biggest reason, is that the traditional methods are so ingrained that utilities generally do not have the incentives. Minimizing capital is contrary to the fiduciary duty of a company who's primary goal is to earn a return on capital. Companies with this mandate, are better off with carbon taxes and external instruments as drivers. This removes the contradiction.

One thing we know for sure is that utilities have an endless wealth of engineering talent and the competency to solve complex problems. If this juggernaut was liberated with new regulatory guidelines, the propagation of solar PV will serve to lower electricity costs <u>and</u> our carbon footprint. Easier said than done, to be sure.

Conclusion

Solar power is getting cheaper all the time and if intelligently applied in its proper role, it is far and away the most economic energy source we have now. To discover the amount of economic solar power that is appropriate will require a step change in willingness on the part of regulators, utilities, and politicians to implement, but it will be well worth it. If approached in an effective way, there is no need to trade carbon, add feed-in tariffs or institute carbon taxes to see solar power be deployed on a large scale. On the contrary in fact, as this option obviate the need for such policies.

With solar PV firmly entrenched in a "retail" model, utilities will have to get more involved for this to happen. As was the case in the 1920s and 1930s, when utilities all over the world took on the challenge to make electricity ubiquitous, it is time for them to take on the challenge of making that same system lower cost and more green. If you consider that the original goal of regulatory bodies was to encourage decisions for the common good, society is a big winner if solar PV becomes a key ingredient in utility planning. The resulting PV proliferation would accelerate the decline in panel manufacturing costs. Jobs would be created in a new industry where installation of the technology would require engineers, technicians and hands-on-deck in the field.

Consumers would have lower cost power as peak power prices decline; shrinking the day-night subsidy coal currently enjoys. With coal power on the decline, electricity planners would turn to marrying wind farms and gas turbine plants to meet base load demand. The excess manufacturing capacity in China will be more in demand as the US alone could economically deploy 80,000 MW of solar to offset correlated air conditioning demand. Nuclear power would be put far on the back burner.

Finally, a sigh of relief would spread through legislatures everywhere as policy makers can finally abandon the notion that carbon taxation is the key to saving the planet.

<u>The Last Word</u>: As many solar advocates point out, outside of the initial manufacturing process, solar power consumes no fuel; so it clearly will help conserve diminishing fuel resources for future generations. If solar power were deployed to match air conditioning demand as a standard part of utility planning, worldwide installations would quickly exceed 500,000 MW in total - or roughly the equivalent of 1500 coal fired power plants.

Those who believe the solar industry has run its course may be surprised. Solar companies that reduce their costs, develop value propositions to target the needs of particular segments, and strategically navigate the evolving regulatory landscape can position themselves to reap significant rewards in the coming years.

McKinsey Report: 2011 - Darkest before Dawn

About the Author

Gary Holden has been involved in power and gas utility for over 25 years. He was the CEO of TransAlta New Zealand during the 1990's and was CEO/President of AltaGas and ENMAX Corporation in Canada from 2001 to 2011. He has experience in vertically integrated utilities, managing Canada's largest coal power fleet, implementing retail energy programs in NZ and Canada and has developed district energy, wind and solar power. He is a former director of Climate Change Central, Climate Change Emissions Management Corporation and EnSource Energy Corporation. Mr. Holden resides in New Zealand and provides strategic management consulting for energy and retail operations in NZ and Australia. He has been recognized as one of Canada's Top 40 under 40 in 1996, runner-up for New Zealand CEO of the Year in 1998 and was Consumer Choice Awards Business-person of the year in 2009.