A place in the sun

Challenges and perspectives for the future of solar

Michael Liebreich, Chairman of the advisory board and founder of Bloomberg New Energy Finance, discusses solar energy with ABB Review.
This progress is not going to stop. Solar power is now seeing costs in the 6 to 8 cents/kWh range for good projects, before any subsidies. The cheapest we have seen is 5.84 cents/kWh on a project announced this year in Dubai. Solar electricity has moved from the era of 50 cents/kWh to 30 cents, to 20 cents, to 10 cents and now below even that.

Just to put those prices into perspective, what are the comparable prices for non-renewable sources?

Let us consider, for example, the United States. The price of electricity from natural gas there is low, around 6 cents/kWh; so at 8 cents/kWh, solar is not quite competitive without subsidies. But apply the investment tax credit and solar can come down to 5 cents/kWh. Solar can also help to manage the demand peak because it is almost ideally timed to meet the needs of air conditioning. But of course you still need to meet your nighttime demand, as well as demand when the weather is bad or during the winter.

Although we are talking about solar, it is also worth noting that wind energy is seeing unsubsidized prices in the United States at 4 cents/kWh – so cheaper even than gas-produced electricity.

This poses a real challenge for coal. If you’ve got a fully depreciated coal-fired power station, and you allow it to chuck out whatever pollutants it wants, then you can produce at prices of 3 or 4 cents/kWh. But as soon as you tighten that up, even if you just get rid of the SO₂ and NOₓ, coal can be 5 to 8 cents/kWh, and that is before you take into account any climate costs. But then, if you include the costs of asthma caused by coal dust and particulates, the cost of mercury, the cost of damage to roads from coal trucks and so on, coal is completely uncompetitive.

It’s a very bizarre and unstable situation that one-third of the world’s energy comes from coal, and yet the writing is absolutely on the wall for the coal sector. In the developed world we are seeing a surge of coal plant retirements, and in the developing world the build rate is dropping away. By 2030 we think we will be seeing net removal of coal generating capacity, rather than additions.

Will the cost of solar power continue to fall, and if so, what are the implications?

The 6 to 8 cents/kWh of today will continue to fall to even lower levels as the industry expands – we think it will hit 4 cents/kWh between 2030 and 2040, but it could be sooner – until we exponentially approach almost free power at the point of generation.

Of course you then have to get all that cheap, clean power to the user – at the exact time it is needed. On a system level there will have to be major changes when you look at the architecture required to integrate wind and solar power. This includes demand management, interconnections and storage. We are seeing the emergence of a completely different type of electricity system, built around flexibility. Frankly it plays to the strength of ABB to build those systems.

In terms of the total solar power that we can commercially harness, is there an upper limit?

It is very early to talk about hitting a limit as we’re still at a very low penetration of solar, less than 1 percent of global electricity. Additionally electricity is only a minority of overall power consumed. There is also transportation and heat, whether in homes, commercial property or industrial processes. Of course electricity as a whole is penetrating these other areas, but it still only accounts for less than one-third of total energy demand. So we are far from any sort of saturation in terms of what the system can absorb.

As the percentage of variable renewable power grows, my working hypothesis is that engineers are incredibly brilliant and there is no fundamental upper limit. If we keep on investing in storage, interconnection between systems and demand management, we can continue adding capacity. For example, everybody is very
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They’ve all discovered that the sun doesn’t shine at night and therefore we need batteries. Batteries will go through the same experience curve that solar has seen, but right now they are still costly → 1. So is that bad news for solar?

Well, first of all, there is a lot more electricity demand during the day than during the night. You can match a huge amount of solar power to daytime demand, and in most markets that means building out solar for many more years without having to worry about nighttime. Then, before having to add day-night storage, you can shift demand around, using demand management strategies or even thermal storage. For example, you could chill your freezers and refrigerators during the day when the sun is shining and let them coast through at night.

From the ABB perspective, when looking at cost reductions, there is so much potential that can be unlocked through looking at the whole electricity delivery chain as a system rather than as a collection of individual products. ABB is in the unique position to be able to offer the entire value chain.

Where do you see the major challenges and changes to solar power in the next decade (both technological and policy)?

The driver can no longer be green idealism and the tools to achieve it can no longer be subsidies. The motivation needs to be improved system performance, in terms of cost, pollution and resilience, and the means have to be more nuanced. The transition to a greater usage of solar electricity has to be acceptable to the pockets of consumers and of industry → 2.

If you look, for example, at the German feed-in tariffs, they sent a very clear signal and were very effective in advancing solar. The problem was that they removed price signals from the electricity market, and thus removed price as a driver of competition for developers and technology providers. What happens in such situations is that people focus on lobbying and winning business through mechanisms other than price competition. And unsurprisingly, that’s not an efficient way to do it. Ultimately it costs too much and something has to change. In Spain the reaction to this caused retroactive changes that stopped the market dead in its tracks. Even Germany is shifting to reverse auctions after it became clear high power costs were affecting Germany’s competitiveness. Everybody is still very committed to Energiewende (Energy Transition), but the initial feed-in structures are being replaced by something more economically efficient. In the United Kingdom we are introducing a contract for difference (CFD) system requiring reverse auctions – which has already proven to bring the price down.

So government subsidy and support is good at the start-up stage, but should be reduced later?

Absolutely. When solar is less than one percent of the electricity market – and I hate to say this – but if you share that extra cost over the rest of the electricity market, then it doesn’t hurt much and it doesn’t matter. But if solar advances to 3, 5 or even 12 percent, which is easily achievable in sunny countries, then you can no longer afford that level of waste.

As for industry, even if you are in a market with excessive subsidy levels, it’s always better to be a low-cost provider: It is the only way you can really control your destiny and not be at the mercy of policy changes.

If governments should not subsidize, what role should they be playing?

Their primary role should be concerned with energy security – making sure that the system doesn’t fall over – whether that’s because of technical instability or because of geopolitics. After that governments must support where necessary but not beyond. They shouldn’t try to force the incumbent energy providers to lead the transition to clean energy (but should let them do it if they want to). They should open up the market to new players and new business models. If you look at Germany, where solar has progressed most rapidly, the big utilities own 80 or 90 percent of gas, coal and nuclear, but only 5 to 10 percent of renewable energy. Why? Because incumbents didn’t have the incentive to go in and do it. You see the same in California. The utilities are responding and trying to catch up, but they are only doing it because there is a competitive threat from new players. So governments need to ensure new players have access to the market. An example is the capacity market. If you put into place a capacity mar-
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There are a number of reasons why most users will want to stay connected to the grid. The first is, I have solar panels on my own roof, but when I put the dishwasher and kettle on at the same time, I’ve got to source that power from somewhere. Retaining the connection to the grid enables me to meet those peaks – as well as those days when there is no sun – more cheaply than investing in huge amounts of storage. Second, if I have correctly sized the installation to meet my needs during the most demanding time of year, I’m going to be generating a big surplus during the rest of the year. Why not sell it? But for that I still need a wire. Third, what happens if my system fails? The grid can provide backup. Finally, if you go off grid, your system needs to be a completely self-managed mini-grid, and that’s not easy. I want my utility to help me manage it, to tell me when I need to clean my solar panels or maintain my fuel cell, and so on. So even for a well-designed system there are many services ranging from maintenance to supply security that a utility can provide. The utility can charge clients for these services, but not for bulk electricity. So what we are going to see is load defection – meaning people will seek to become autonomous in terms of energy and remove their grid connection. Is grid defection a threat to utilities? I’m not a big believer in grid defection. It will happen in some very niche situations such as very remote locations in the Australian Outback or libertarians who want to live by themselves. There are a number of reasons why most users will want to stay connected to the grid. The first is, I have solar panels on my own roof, but when I put the dishwasher and kettle on at the same time, I’ve got to source that power from somewhere. Retaining the connection to the grid enables me to meet those peaks – as well as those days when there is no sun – more cheaply than investing in huge amounts of storage. Second, if I have correctly sized the installation to meet my needs during the most demanding time of year, I’m going to be generating a big surplus during the rest of the year. Why not sell it? But for that I still need a wire. Third, what happens if my system fails? The grid can provide backup. Finally, if you go off grid, your system needs to be a completely self-managed mini-grid, and that’s not easy. I want my utility to help me manage it, to tell me when I need to clean my solar panels or maintain my fuel cell, and so on. So even for a well-designed system there are many services ranging from maintenance to supply security that a utility can provide. The utility can charge clients for these services, but not for bulk electricity. So what we are going to see is load defection – meaning people will seek to become autonomous in terms of energy and remove their grid connection. Is grid defection a threat to utilities? I’m not a big believer in grid defection. It will happen in some very niche situations such as very remote locations in the Australian Outback or libertarians who want to live by themselves. There are a number of reasons why most users will want to stay connected to the grid. The first is, I have solar panels on my own roof, but when I put the dishwasher and kettle on at the same time, I’ve got to source that power from somewhere. Retaining the connection to the grid enables me to meet those peaks – as well as those days when there is no sun – more cheaply than investing in huge amounts of storage.
don’t do this, then yes, you’ll see grid deflection.

Looking beyond the scope of solar for a moment and considering other renewable energies, be they wind, hydro, biomass, geothermal or even some of the more experimental forms such as wave and tidal power, do you see these as competitors or partners of solar?

They are very much partners. We need to recognize the value of electricity in terms of when it can be delivered. Solar is fairly readily available during the day, but leaves an important supply gap in the evening, meaning you’ve got to look at what demand it can best meet. Hydro is dispatchable. You might even be able to use pumped storage, but even if you can’t, you can collect water in a reservoir during the day and use it during the night, or during a few weeks when there’s a wind lull.

Geothermal power is very interesting where you can do it. Biogas is working quite well. Tidal power is very predictable, though expensive. Wave power is at a much earlier stage of its development. I’m skeptical about the ability to drive costs down to levels anywhere close to what we see with solar and wind. You have to put an enormous amount of concrete and steel into the sea for a relatively modest power yield.

Where do you see the main strengths of ABB in serving and advancing solar energy?

It is all about ABB’s extraordinary strength in engineering. So first of all we are talking about leading-edge components, ranging from photovoltaic inverters and low-voltage products to high-voltage direct current (HVDC) and communication equipment. ABB has huge technological competence at the product level.

Secondly, I see ABB’s competence at the system level. Whether you’re talking about load balancing, designing a mini-grid or providing other system-level services, there are relatively few players out there who are really able to deliver that. For example, startups might be very good at providing one component but will find it very difficult to provide a higher level of knowledge, reassurance and distributed services across a city, grid or multiple grids.

Utilities will change their business model from charging for electricity to charging for services.

The third element lies in the company’s reputation. One of the challenges is that the mainstream — be it the business reader of the Financial Times or the energy ministries of medium-sized countries — is not, on the whole, up-to-date about the technology and its costs. There is a knowledge lag. ABB has an exceptional role to play in reassuring policy makers and decision makers that clean energy is no longer about high-risk pioneering technology, but about robust, resilient, proven solutions.

Which is exactly what ABB Review is about and why we are producing this issue dedicated to solar.

To move on to a less mainstream topic, ABB is supporting Solar Impulse 2, a solar-powered plane attempting to fly around the world. Obviously aviation is not one of the primary fields of application of solar energy, but do you think we will ever see a commercial solar-powered flight?

Obviously solar planes are not going to be a major target market for solar technology any time soon. Solar Impulse is really an exercise in pushing the boundaries of technology and also the boundaries of human thinking by saying to people, “Look, this is possible.” And it is doing a great job.

Can it ever work as a commercial offering? Solar Impulse 2 is very slow. It is taking something like 15 hours to fly across
Every generation had to win its energy supply and we had a period where we almost forgot that.

Absolutely. We easily take energy for granted, but actually it has to be won, has to be converted, has to be delivered. Each generation has to secure its energy supply. It looks like as if are coming out of a period in which we could almost forget that fact; everything was so easy.

The new technologies are making us look afresh at how we win our energy, look afresh at our rooftops, our garbage, our insulation and so on. Energy is moving out of our deserts and ports, and into our homes and our communities. I met a chap in India who was selling solar energy to local stalls in a village market. Stallholders could for a few Rupees get an LED lightbulb and a wire back to this chap’s battery, which he was recharging every day with his solar panels. The stallholders were happy and the guy had created a good business. It was a fantastic service provision and a fantastic innovation. But actually all he had done was reinvent the electric utility.

It is also accelerating because the new technologies are building on each other. This Indian entrepreneur could only create his business because of the interaction of LED and solar. If he had tried to do it with a filament lightbulb, the solar panel would have been so huge that he wouldn’t have fit on his roof. The revolution of solar technology is going to drive the emergence of super-efficient appliances and vice versa. The Clean Energy Ministerial launched the Global Lighting and Energy Access Partnership prize (Global LEAP) for highly efficient appliances, and one of the first winners was a television set that runs on just 6 W. That’s less than a lightbulb.

Marshall McLuhan, the philosopher who coined the phrase “the medium is the message,” also said “the ‘message’ of any medium or technology is the change of scale or pace or pattern that it introduces into human affairs.” Well, it looks like solar power and these other new technologies carry an incredibly important message for us all.

Thank you for this interview and sharing your enthusiasm with us.