

Mission: **Not yet ac**

**California has made ample progress in deve
yet plenty of work remains to be done**

Although California is a leader compared to the rest of the nation in terms of promoting solar, installers and system owners in the state still face obstacles and uncertainties.

From interconnection hurdles to incentives to the issues involved with integrating lots of new solar capacity into the grid, California needs to deal with the challenges presented by its successes and build on them to fulfill its vast potential.




California

Accomplished

Managing solar,



Where the action is: The California Independent System Operator (CAISO), which oversees the state grid, faces the challenge of incorporating California's growing solar capacity. The control room in Folsom is pictured here.

Jim McIntosh knows about pressure. During much of the energy crisis of 2000 and 2001, McIntosh was the director of operations at the California Independent System Operator (CAISO), the wholesale transmission grid operator, which meant that McIntosh had the unenviable task of going before the TV cameras to explain why millions of customers faced rolling blackouts – power outages that were hugely disruptive to businesses and were even blamed for a number of deaths. McIntosh also had to field calls from then-Governor Gray Davis's office and the White House, which presumably weren't friendly chats about family and sports.

So when McIntosh says something energy-related is going to »present challenges,« he's probably not indulging in hyperbole. And that is exactly the phrase McIntosh, who is now execu-

tive advisor for operations at CAISO, uses when he characterizes the hurdles in integrating large amounts of photovoltaic (PV) and other solar-generated electricity into the grid. Thus far, he says, the peak amount of solar fed into the high-voltage CAISO grid was 514 MW, which happened this past June. But things are changing fast. »I expect to have another 200 MW before the end of the year, and the next year it jumps and I get another 500 MW.« McIntosh notes that »it's a considerable jump to 1,000 to 1,500 MW of additional solar,« however, »It's coming in at a fairly rapid clip.«

Beyond all that, there's a lot more waiting in the wings: McIntosh says there's a total of 10 GW of solar projects at various stages of development in the interconnection queue. And there could be more. If interconnection requests to the lower-voltage distribution grids run by the investor-owned utilities (IOUs) are included, there are between 70 and 80 GW of solar projects at some level of gestation in California – this in a state where peak electricity demand is in the 50 GW range.

Perhaps more than anything else, the challenge facing McIntosh and

the CAISO is symbolic of the progress California has made in creating a robust solar market. But it also points to some of the very real challenges California confronts as it moves into the future – dilemmas that include not only interconnection but the shape and size of procurement and incentive programs, permitting, financing and a host of other nettlesome issues that need to be addressed for the Golden State to live up to its name. »Our big problem is managing success,« says Adam Browning, executive director of the advocacy group Vote Solar, referring to the burgeoning interconnection queue. »It shows there is an incredible appetite to sell solar here.«

But translating that appetite and enthusiasm for solar and other renewables

– which is reflected in the state’s newly elevated 33-percent Renewable Portfolio Standard (RPS) and Governor Jerry Brown’s goal of installing 12 GW of in-state renewable distributed generation projects – will be an ongoing struggle. It’s a struggle that frequently pits entrenched interests with divergent goals against one another. To get a handle on the hurdles ahead for California’s solar market, PHOTON spoke with developers, policymakers, regulators, advocates and utilities. What we heard was enthusiasm about the progress the state has made, as well as acknowledgement that much work remains.

Solar benefits, befuddles the grid

This past summer McIntosh received a taste of some of the benefits and prob-

lems involved with incorporating large amounts of solar into CAISO’s grid. On the positive side, the amount of solar already available helps him provide the energy he needs to meet the increased power demand that comes in the morning as people wake up and turn on their hair dryers and televisions and get ready for work – a time McIntosh terms his »morning pull.« As the sun rises, he says, solar fields around the state crank up and increase their output in a way that nicely follows rising demand. »As the solar penetration levels get higher, the fact that it does follow the load curve should help us in the morning pulls,« he says.

But the dilemma for McIntosh – whose ultimate responsibility is keeping the lights on – comes from the fact

The researcher

The future can’t come fast enough for Yi Cui. He left his native China to get a Ph.D. in chemistry at Harvard University, then moved to California for postdoctoral work and joined the faculty at Stanford University – all by age 30.

Yi specializes in using nanotechnology to develop miniature electronics. He replaces the wafer as a building block for his devices with a structure called a nanowire. The nanowire uses a fraction of the material required to perform the same function with a wafer. Four years ago, his research yielded an interesting improvement in lithium-ion battery storage devices. Yi replaced graphite with silicon nanowires for the anode, the storage component that sends current into the device, resulting in an increase of the charge capacity. The number of cycles

achieved with this material, however, was quite low.

More recently, Yi has published articles on the advantages of nanowire solar cells. He says nanowire structure may not push efficiency limits higher than wafer-based or thin-film cells, but the structure can dramatically lower costs by reducing the quantity and quality of material needed to achieve the same results. Nanowires also open the possibility of building solar cells on cheap, everyday surfaces like aluminum foil.

Yi’s research techniques are totally outside the box. He and Stanford professor Michael McGehee are using textile manufacturing concepts to spin tiny threads of copper and silver to see who can get better results using nanowires to improve light absorption on a cell, in place of indium-tin oxide. McGehee is using silver. Yi favors copper. »I would say the silver nano-



source: Stanford University (rendering by PHOTON)

wires work a little better right now,« McGehee says.

This work has won Yi some high-profile admirers, including Dick Swanson, a former Stanford faculty member and founder of the cell maker SunPower Corp. »To me, it’s exactly the kind of thing that should be going on in a university,« says Swanson. »It’s just a wonderful contribution to the industry.« *mh*

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that solar, like wind, is intermittent, a lesson that was hammered home over the July 4 weekend this summer. On July 3, McIntosh says there was a 65-percent loss in power from solar in less than an hour as monsoonal clouds hovered over some of the bigger solar plants in southeast California. For now, since there's still relatively little solar on the grid, finding enough power elsewhere to compensate for that quick energy drop isn't hard. »It's not a big deal when it's just 500 MW,« he says. »But if you look at the penetration levels, I've got 10,000 MW out there on the books.« In other words, the more intermittent power CAISO integrates, the more scrambling McIntosh has to do. »The physics of keeping the grid reliable

and keeping 60 cycles (60 Hz) is that if one of these goes down, I have to have another plant go up.«

That is why CAISO is working with utilities on forecasting solar output with the hope that more precise predictions are possible. Forecasting is complicated, McIntosh noted, because water vapor in the air and clouds impact electric generation. At the same time, CAISO is probing the use of batteries and combined-cycle units as a way to add predictability to solar and wind power delivery. McIntosh predicts the cost for so-called load following services and spinning reserves, which ensure electricity at times when the power supply and demand are out of balance, will double from \$200 to \$400 million in the next 2 to 3 years.

So much demand, or not enough?

For those eager to see solar make up a much bigger part of the energy mix in California, it's hard to call grid integration a problem; or if it is, it's a very good one to have. But two important questions emerge once you understand how many solar projects are at some point of development in the state. What does it mean for future PV demand? And what will it take to move projects from the signed-contract stage to actual construction and operation?

The question of demand is of growing interest, as global PV companies look to California as a market that might fill the gap created by less robust growth in Europe. Those looking to California for salvation, though, should keep this in mind: whether it's 10 GW or 80 GW

The Governor

Jerry Brown took a lot of flack for idealism during his first tenure as governor of California. His time in office overlapped partly with Jimmy Carter's presidency, in the era following the 1973 oil crisis, which is remembered as the first time the US attempted to implement renewable energy.

Brown took office in 1975 and two years later, signed into law California's first tax incentive for rooftop solar power. When he retook office this year, it helped settle the concerns of the solar industry in California, which feared losing the 2020 renewable energy portfolio standard that Governor Arnold Schwarzenegger had increased to 33 percent by executive order but hadn't yet pushed through the Legislature. This year, Brown signed it into law.

In 2010, it was Brown who, as Attorney General of California, sued

mortgage giants Fannie Mae and Freddie Mac for shutting down Property Assessed Clean Energy (PACE) financing programs, which promised to significantly increase residential solar development throughout the US. Brown's 2010 gubernatorial election campaign included a Clean Energy Jobs plan with the promise of 20 GW of new renewable energy, a pledge that included rooftop and large-scale solar, renewable energy transmission, storage, and a feed-in tariff program among its targets.

In his earlier terms, Brown was given the moniker »Moonbeam,« meant to deride his new-age California style. During his recent campaign, Brown took ownership of the name, telling The New York Times it meant he was »creative and not hidebound to the status quo.«

In terms of renewable energy, Brown does have big ideas, not least of which is a target of 12 GW of local distributed renewable energy. For Schwarzenegger,



Jerry Brown, past and current governor of California.

it took pounding a fist on the table to get solar policy passed in this state. With a weak economy, reduced state revenues and a more fractious Legislature, Brown faces a tougher test in turning his green energy plans into reality. But if he succeeds, he could leave an even greater legacy of green power in the Golden State. *mb*

source: Matt Swales / dep images GmbH (rendering by PHOTON)



of total projects seeking interconnection, only 15 GW to 17 GW of renewables (not all solar) will be required to reach the state's 33-percent RPS by 2020. »For the next mid-decade, we have made most, if not all of the commitments we need to make,« says Aaron Johnson, director of renewable energy policy and strategy for Pacific Gas & Electric Co. (PG&E). »We are playing a game of musical chairs and there are a lot fewer chairs than there are players and projects.«

That may sound dispiriting to some, but observers of the California solar market also know that signed contracts by no means equal built PV systems. »It's still challenging to go from a piece of paper to generating energy,« says Mike Marelli, Southern California Edison's director of contract origination and analysis, who noted that his utility had 5 GW of solar under contract at last count, half of it PV and half solar thermal, although more PV has been added since then.

Fixing some of the challenges to advancing solar from the contract stage to getting financed and built will be essential. There is widespread agreement that interconnection is among the most significant stumbling blocks, if not the biggest impediment. Recognizing the problem, the California Public Utilities Commission (CPUC) has fast-tracked a reform effort to restructure what's known as Rule 21, which governs interconnection. The utilities and CAISO, meanwhile,

say they've been overwhelmed with the number of interconnection requests they've received. Not having requests processed quickly and transparently, and not receiving information about where it's possible to hook up to the grid and how much upgrades might cost, can leave developers in a tough situation. »It can take 1 or 2 years to get an interconnection study back, which is way too long for a small project,« says Ted Ko, associate executive director of the Clean Coalition, a group that advocates for European-style feed-in-tariff programs and other reforms to boost renewable energy. »If you're a 50 MW project, it won't kill you, but if you're a 1 MW project it will,« says Ko. »And if it comes back with \$500,000 in upgrades, you just go home.«

Permitting for residential and commercial projects in California is also a roadblock. »Permitting is very expensive and the rules are inconsistent. Ultimately, we need to get to a standard set of rules and fees across jurisdictions,« says Jonathan Bass, director of communications for SolarCity, the largest residential integrator in the state. »As a first step, if we could just get every jurisdiction to publish and adhere to its own rules, it would make a big difference.«

It's not a whole lot better for developers of larger projects, especially when it involves dealing with state agencies to obtain approval to build. »Between the Department of Fish and Game and a number of other state



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Wine and watts: In the future, California may be as well known for producing solar power as it is for producing wine.

departments, sometimes there is uncertainty about who takes the lead,« says Arno Harris, president of Recurrent Energy, which develops solar projects 20 MW and smaller. »The first part of the process and cycles in the middle of the process can be negotiations between those agencies about whose authority it falls under. And those kinds of things feel like a waste of time.«

To remedy this situation, efforts are underway to streamline permitting, including the Desert Renewable Energy Conservation Plan, an effort by state and federal wildlife agencies to speed the construction of projects that meet certain requirements.

The right programs?

No discussion about the future of the California solar market would be

complete without an examination of procurement and incentive programs. Even though the utilities insist that they've already signed up plenty of renewable projects to meet their mandate under the RPS, it seems clear that the attrition rate remains high and continued procurements will be necessary. This will be especially true if Gov. Brown continues to insist that the 33-percent mark is a floor and not a ceiling when it comes to a clean energy target.

For Adam Browning of Vote Solar the mixture of procurement programs – which include the California Solar Initiative (CSI), the Renewable Auction Mechanism (RAM) and a feed-in tariff – is a real strength. »My point has been that through diversity we have robustness,« he says. In

fact, Browning says he has been invited to places like Spain, which was seeking advice on rebuilding its solar market after a badly designed feed-in-tariff program failed. »The point is that there is real danger to rely on a single program. What you like to see are different programs providing different benefits.«

Others see a need for new programs and reforms to existing ones. Matt Cheney, the CEO of CleanPath Ventures, a solar investment and development company, says there is a real danger to procurement programs that rely on a bidding process to boost competition and lower prices – a mechanism that is part the RAM and is also used to award contracts among those who respond to requests for offers from the utilities. »There is no downside in

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solar for companies to lob in pricing they themselves know is too low with respect to the marketplace,« Cheney says. He calls this a »race to the bottom,« which he says can be deceiving because it convinces policymakers and others that they're driving the installed cost for solar down when, in fact, it's just an illusion. »They will have a successful auction, but the actual delivery of what they thought they were contracting into may not be possible,« says Cheney.

For Cheney, more emphasis needs to be put on the track record of companies submitting bids and more severe penalties if they can't deliver on their proposals. For others, like Ted Ko, California will remain short of its clean energy goals until it adopts the sort of

feed-in tariff that has helped Germany become the leading solar market in the world. Ko and his organization are advocating for feed-in tariffs through the implementation of Senate Bill 32 (SB 32), which established a feed-in tariff with a cap of 750 MW for projects 3 MW and smaller. In particular, the Clean Coalition is pushing for pricing by the CPUC that follows the organization's interpretation of a ruling from the Federal Energy Regulatory Commission (FERC), which the coalition says allows states great latitude in determining what is known as avoided cost. That is the rate utilities must pay for the electricity it purchases from certain facilities.

In California's past, avoided cost was based on electricity generated

from a gas-fired power plant. But Ko says the FERC ruling changes that. »Our contention is that if you can determine the market price for 3 MW and under renewables, that is your avoided cost.« A successful SB 32 feed-in tariff, says Ko, could be drastically expanded beyond the initial 750 MW.

Looming debates

Policy impacting residential and commercial PV systems, meanwhile, may pose some of the biggest challenges in the years ahead.

It won't be long, for example, before California has installed enough net-metered solar – the mechanism allowing solar producers to sell excess energy generated – to reach the state's current cap on paying for electricity

The entrepreneur

Jack West is building a market for his solar mounting system like an auto racing pit crew. At trade shows and in private meetings with potential business partners, his team performs full-scale time trials to compare the speed of installation for his module-integrated Zep Solar system against any competitor's rail-based racking system. They have also posted a video of the time trial on Zep Solar's website. This is the PV equivalent of match race, against any challenger.

»For us it's great because we win all the time,« says Daniel Flanigan, the Zep Solar vice president of marketing.

West pursued a risky business model when he introduced the Zep technology last year at Solar Power International. The heart of the system is a module frame with a deep groove that connects small

metal parts holding the modules to one another and to the roof. The product design is clever because it reduces the material to a bare minimum. But it's risky because it makes Zep dependent on module manufacturers for access to consumers. If panel producers don't attach Zep-compatible frames during the assembly process, Zep is shut out of the market.

Initially, Zep had to work hard to create demand for the product. Like many solar manufacturers, Zep used a power-point presentation to show the value for potential partners. It also compiled case studies of existing installations. But what could be more effective – or more fun – than a showdown at high noon on a sloped shingle roof?

Almost a year after launching the Zep system, West has signed 7 module licensees, including industry heavyweights such as Trina Solar and Yingli



source: Zep Solar, Inc. (rendering by PHOTON)

Solar. Zep is also getting ready to announce its first deal with a national PV system integrator. Flanigan wouldn't divulge the name of the integrator, but he says the company witnessed an installation race against a competitor's racking system. Zep won. Announcement of a contract with the national integrator will signal they also won the prize. *mh*

If only everything was as **predictable**

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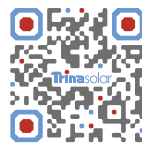
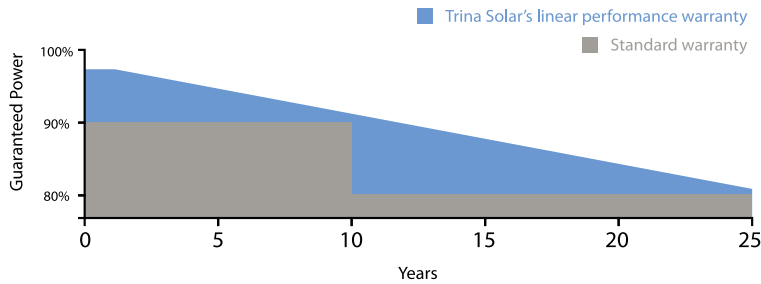
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from this source, which is 5 percent of aggregate peak demand for each IOU. Installation companies want the cap removed. »The caps are arbitrary numbers and should be eliminated, or at a minimum, raised to 10 percent. This is probably the most obvious thing holding solar potential back,« says SolarCity's Bass.

But that position bumps up against the utilities' insistence that net-meter customers pay their fair share for the benefits of the grid. »We are going to need to address the issue of who pays for the distribution system and the pipes and wires side of the business because solar customers do not,« says Aaron Johnson of PG&E. »It's not clear

where the tipping point is, but at some point we simply can't do it.«

Also to be determined is what comes after the CSI program, if anything, to incentivize solar installations. Bass says a modest incentive would be sufficient to allow solar to stay at or below retail parity. But what any incentive might look like in the future is a mystery. Melicia Charles, who heads up the solar program at the CPUC, says the post-CSI world is very much on their radar. »Right now, no hard decisions have been made,« she says. »It remains to be seen whether solar can continue at the pace it's going without subsidies. And the further question is if we continue the program, would it have the

same structure as now? Would it be up-front rebates or PBI (performance based incentives)? And if they're lower subsidies, what would they be?«

Clearly, this is not a time for California to sit on its laurels and congratulate itself for a job well done. But many share the view of Carla Peterman, a commissioner at the California Energy Commission, appointed earlier this year by Gov. Brown. »I'm optimistic. The challenges we face are the result of our success and we need to work on those and talk more about non-upfront cost barriers,« she says. »And now that costs are dropping, it's show time to see how we fit all of this solar into a system not made for it.« Chris Warren

The Analyst

For someone who makes a direct case for going solar, Andy Black took a roundabout path from his first inspiration – a solar-powered fan on the outhouse of his family's summer cabin in eastern Canada – to his current career in the solar industry. He earned an electrical engineering degree, had an »unfortunate« stint in the computer chip industry, did volunteer work and took a whole lot of solar classes before, gradually, developing a sales tool that formed the backbone for his own company, OnGrid Solar, and the material behind the courses he now teaches on the financial case for going solar.

The sales tool grew organically – as did Black's career – alongside the California solar market. Black started his first full-time solar position as a salesperson for an installation company back in 2001 and he didn't like the stories other salespeople were telling their customers.

He compiled a list of 13 disingenuous things told to potential clients.

Among the most egregious tactics, he recalls, was encouraging California homeowners to claim they had home businesses in order to get tax benefits, or telling customers they would get certain credits on their electric bills, although solar system owners were ineligible for the credits.

Black put his engineering background to use in building a sales tool that could make the case for solar without the smoke and mirrors or outright deception. He wrote articles to help dispel myths, and pretty soon he was teaching classes. He still teaches with Solar Energy International (SEI) and the Solar Living Institute.

Black believes California has done just about everything right to stimulate the solar market, with forward-thinking policy and declining subsidies. But photovoltaic technology hasn't hit the »tipping point,« where it outgrows skepticism. »We can get through that more quickly if we



Andy Black has built his career as a financial analyst making the case for solar.

don't make up stories about how to sell it,« he says. »Stick to the facts.«

One of those facts: this financial analyst doesn't have a photovoltaic system on the San Jose townhouse where he lives. It wouldn't save him any money, since his electric bills are about \$25 monthly. »It absolutely makes no financial sense,« says Black. He's thinking about it anyway. *mb*