Net metering opens the floodgates to solar rooftops and other renewables

by Roberto Verzola

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Net metering is one of the most effective methods of encouraging the rapid deployment of distributed renewable energy (RE) generation. Net metering is even better than feed-in-tariffs (FIT), the current darling of the RE industry, if the FIT rate is lower than the retail price of electricity.

How it all began

The world's first net-metered connections occurred in 1979, in the U.S. state of Massachusetts, when 28-year old architect and solar pioneer Steven Strong put solar photovoltaic (PV) panels in his two building projects, a 270-unit apartment complex called Granite Place with a 5-kWp system added on, and a Department of Energy-funded solar house called the Carlisle House with a PV system integral to its design.[1] The story of Strong's innovation is told by Bob Johnstone is his book *Switching to Solar*:[2]

> "The Carlisle House as it was called featured passive solar heating . . . plus 126 solar electric panels capable of generating a whopping 7.3 kilowatts mounted on its southern-facing roof. More accurately, the PV panels *were* the roof. . . .
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> "The Carlisle House was designed to draw utility power from the grid when necessary. Conversely, when the solar cells were turning out more power than the house could use, the excess power would be fed back to the utility. A small meter mounted on the wall of the dining room told the story in kilowatts. When the utility power was drawn it ran forward. But when the PV was pumping out excess power, it ran backward. . . ."

The curious thing about Strong's innovation is that "he had forgotten to inform Boston Edison, the local utility, of his plan to feed excess wattage into its distribution network." *The electric utility was unaware that net metering was already happening.* The potential was there all along. Strong was just the first to discover and use it. Johnstone continues Strong's story:[3]

> "Strong mentioned his concern to the building's co-owner, a developer of Irish descent named Peter O'Connell. The latter did not hesitate. He asked Strong whether the solar system was ready to turn on. On being informed that it was, O'Connell simply threw the switch. Nothing went bang, everything worked as planned.

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1 Bob Johnstone, *Switching to Solar: What We Can Learn from Germany's Success in Harnessing Clean Energy* (New York: Prometheus Books, 2011), p. 91.

2 Ibid., p. 91-92.

3 Ibid., p. 92-93.

“In June 1979 . . . O'Connell invited Carter to attend the grand opening of Granite Place that September. Once the president had accepted, the developer invited various local dignitaries including the governor, the state energy secretary, and senior executives from Boston Edison. But Carter had to cancel at the last minute, sending Denis Hayes as replacement. In his speech, the director of the Solar Energy Research Institute conferred his blessing on the utility for allowing power from the building's PV panels to be fed into its grid. The state energy secretary said essentially the same thing. When the utility executives' turn to speak came, they had little choice but to praise the project, too. Interconnection was, for the moment at least, no longer an issue.

“. . . power companies were delighted to bask in the positive publicity that flowed from being seen supportive of renewable energy. This was especially welcome at a time when so much bad publicity was associated with the shutting down of malfunctioning nuclear plants like Boston Edison's Pilgrim power station on Cape Cod Bay. In 1983, the utility commissioned Strong to build a solar-powered energy-efficient house in Brookline, Massachusetts. Impact 2000, as the house was dubbed, subsequently became the subject of a series on public television, a wonderful PR coup for the power company.”

Figure 1. Steven Strong discovered net metering

That was how the discovery called net metering got to an auspicious start. Soon, solar and wind pioneers throughout the U.S. were connecting their setup to the grid too. Strong eventually won a number of awards for his solar work. The U.S. Department of Housing and Urban Development granted him a $156,000 award for Granite Place; Time Magazine named him environmental “Hero of the Planet” in 1999; the American Solar Energy Society gave Strong the society's highest honor---the Charles Greeley Abbot Award---for “achievement in the advancement of solar energy applications” in 2001.[4]

Net metering means parity pricing

Net metering was a very simple yet powerful idea: a single meter that ran forward when power flowed from the grid into the house, and backward when power flowed the other way. By default, the price of incoming power was the same as the price of outgoing power. This was called parity pricing.

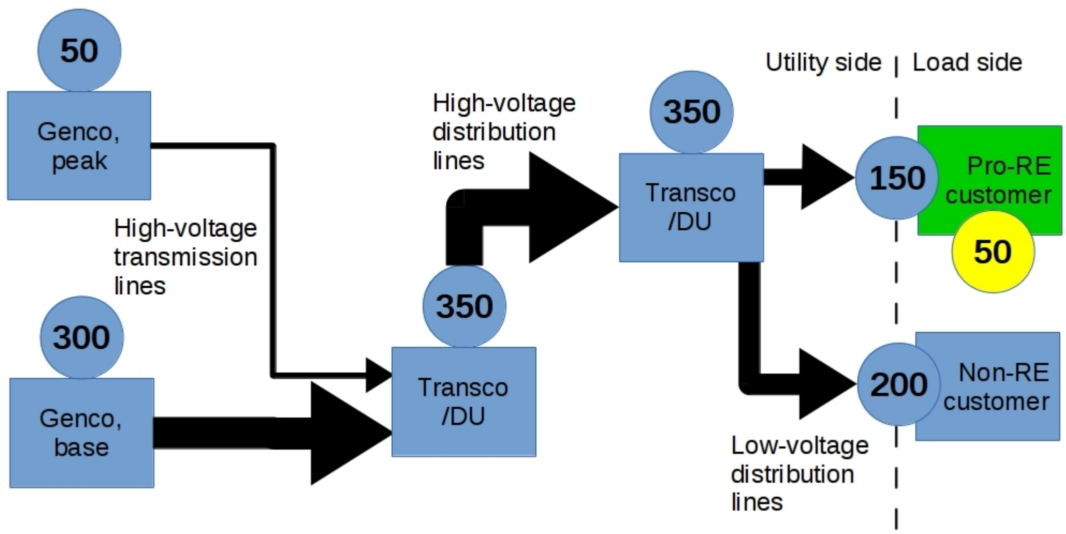
Let us see what happens under the net metering scheme. Let us start with a pro-RE consumer who has not installed solar panels on his rooftop yet. Assume that he and a neighbor each consume 200 kWh, for a total of 400 kWh of electricity per month. Assume further that 300 kWh of this is produced by a base-load generating company (genco) and 100 kWh by a peaking genco. These 400 kWh are distributed by a transmission company (transco) and a distribution utility (DU).

Suppose the pro-RE customer then installs enough solar panels to generate 50 kWh in a month, all of it for self-consumption; there is no surplus to export. Now, he needs only 150 kWh from the grid. The

4 Marvin Goldberg, “Something old and something new in commercial solar energy”, August 23, 2009, http://www.examiner.com/article/something-old-and-something-new-commercial-solar-energy.

peaking genco now needs to produce only 50 kWh, reducing the total output of the two gencos to 350 kWh per month. This also reduces to 350 kWh the total electricity carried by the transco and the DU. The peaking genco and the transco/DU have lost some market due to self-generation by one of their customers. But this is no different from the market they lose when a customer decides to save on electricity by turning their air-conditioning units off more often. (See Figure 2.)

Figure 2. Solar PV output for own use only



On the gain side, the genco that reduces output now emits less greenhouse gases and local pollution, which is beneficial to society as a whole. In addition, the reduced output from the peaking genco, whose price is invariably higher than average, also brings down the average generation cost of grid electricity, a benefit enjoyed by all DU ratepayers in the form of a lower retail price for electricity.

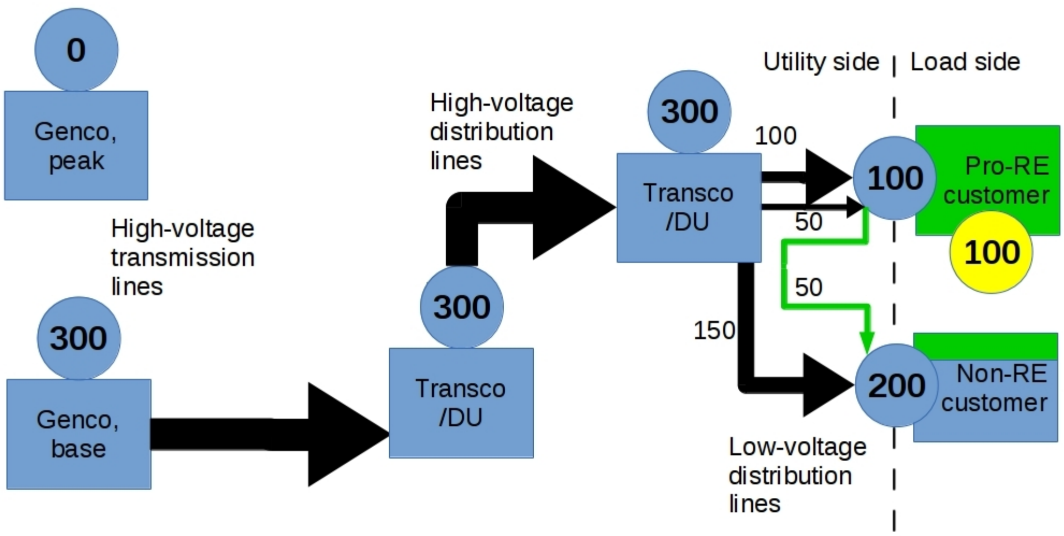
Now suppose the pro-RE customer increases his RE output further to 100 kWh. However, he could only use 50 kWh. So the other 50 kWh, his surplus, automatically goes out to the grid.

A similar situation happens if you use a water pump to introduce an extra 50 gallons into your piping system. Assuming all your pipes are already full of water, all your taps are closed, and there is no check valve to prevent water from flowing out, your 50-gallon surplus will go out through your water meter seeking a path of least resistance—an open tap. As the surplus goes out into the distribution pipes outside, the meter rotates backward reversing your water consumption by 50 gallons. Those 50 gallons will eventually register on the meters of the nearest neighbors with open taps. Did the meter reversal cause any loss to the water utility? No, because an equivalent forward movement occurred in the meter of your neighbor with the open tap. The liability extinguished when your water meter reversed was simply transferred to your neighbor.

Similarly, the exported solar surplus is consumed by the nearest neighbor with some appliances turned on and this registers on the neighbor's meter. (In reality, the surplus might be split among several neighbors. For simpler exposition, we are assuming one neighbor only.) Although he imported 150 kWh from the grid, his meter has reversed by the amount of his export. Thus, his meter reading—his net energy consumption— is now only 100 kWh. His neighbor still consumed 200 kWh for the month, but 50 kWh of this is now clean, renewable electricity.

Because any exported surplus registers on the neighbor's meter, this fully extinguishes his liability for an amount equivalent to his export, and transfers the liability to the neighbor. In effect, the RE exporter received 50 kWh of non-renewable electricity from the utility and replaced it with 50 kWh of renewable electricity, which the utility delivered to his neighbor. The reversal of the electric meter reflects this transfer of liability perfectly, making net metering the simplest way to account for everything. This is a very important point missed by most who argue against net metering: any reverse movement in the exporting meter registers as a forward movement in the neighbor's meter. Thus the DU does not lose anything in the process. The liability is simply transferred from the RE exporter to his neighbor. (See Figure 3.)

Figure 3. Solar PV Surplus used by neighbor



Another useful analogy for those who have a hard time understanding the net metering pricing issue is to consider a similar situation with LPG tanks. Suppose you order three LPG tanks from a distant supplier that charges a high delivery fee per tank (due to the distance). When the tanks arrive though, you have just started operating a backyard biogas digester. Thus you now only need two instead of three tanks. So you make arrangements with your next-door neighbor, for him to get the third tank instead. He will of course pay for both the tank and the delivery charge. Thus, you simply transferred liability for the third tank to your neighbor, and the supplier did not lose anything in the transaction.

Under net metering, there was no need to install any new utility equipment or to adopt any change in its billing and accounting procedures. The scheme was simplicity itself, making it accessible to even low-income consumers who could only afford very small-scale PV systems. All they need are solar panels and a special “grid-tie” inverter that can sync with the grid. No batteries needed.

Furthermore, the government did not have to provide any subsidy for the net metering scheme at all. It just needed to make sure that the gencos, transcos and DUs affected did not put up artificial barriers to make it difficult for pro-RE consumers to send their surplus out to the grid and use the scheme.

Net metering encourages pro-RE electricity consumers to spend their own money to set up PV systems even without government subsidy. In turn, these solar PV owners bring the following benefits to other electricity consumers and to society as a whole:

1) they help phase out fossil fuel-based generating plants that cause local air and water pollution, emit climate-changing greenhouse gases, and displace local communities;

2) they replace electricity generated from expensive peaking plants with cheaper electricity, and therefore help bring down the average cost of electricity;

3) by consuming electricity at source, they reduce system losses which can help bring down further the average cost of electricity in utilities that pass on system losses to their ratepayers;

4) they generate electricity without putting any additional load on existing high-voltage transmission and distribution lines or requiring the construction of new ones;

5) they help improve the country's energy security by relying on locally available sunlight instead of imported fuels;

That is a lot of benefit, considering the relatively small effort required from government in mandating its implementation. Net metering does not need any government subsidy. But it needs the government to keep utilities off the backs of rooftop solar owners and small wind turbine owners.

The idea spread gradually in the 1980s. In 1981, the Arizona Corporation Commission approved net metering below 100 kW, the first among U.S. public utility commissions (PUC) to do so.[5] The next year, the Massachusetts PUC followed suit. In 1983, Minnesota became the first U.S. state to enact a net metering law. More state PUCs and legislatures followed suit: the Indiana and Rhode Island PUCs in 1985, the Idaho and Texas PUCs in 1986, the Maine PUC in 1987, and the New Mexico and Oklahoma commissions in 1988.[6]

By this time, however, utilities had turned hostile. They now saw net metering as a threat to their business model. Closing ranks, they would henceforth lobby strongly against the scheme and find various ways to undermine it even if it was adopted as policy. The battle lines were being drawn.

Japan, an early adopter

By the 1990s the net metering idea had crossed the Pacific. In June 1990, Japan's Ministry of International Trade and Industry (MITI) announced highly simplified regulations for residential PVs that wanted a grid connection. The Japanese Federation of Electric Power Companies volunteered to introduce a net metering program based on parity pricing by 1992. The first to take advantage of the new program was a Sanyo engineer and solar researcher, Yukinori Kuwano, who connected a 2-kW PV system to the grid in July 1992.[7] Net metering would eventually be tried in Canada, Europe, Australia, Brazil (2006), Mexico (2007), Sri Lanka (2009), Uruguay (2010), Lebanon (2011), Argentina (2012), India (nine states as of 2014), Chile (2014), Pakistan (2015), and several other countries. Germany would pioneer another successful approach, the feed-in-tariff.

5 Chris Larsen, Bill Brooks and Tom Starrs, “Connecting to the Grid: A Guide to PV Interconnections Issues (3rd ed.)”, 2000, p. 18.
6 Yih-huei Wan, “Net Metering Programs,” NREL/SP-460-21651, December 1996, p. 1-3.
7 Johnstone, p. 128.

At this point though, outside of pioneering Minnesota, net metering in the U.S. was still a matter of regulatory process or mostly a do-it-yourself effort. It took root or not depending on the whims of local utilities or the openness of regulatory commissions to innovative ideas. However, things were about to change. Let us hear this time Johnstone's story about legal researcher Thomas Starrs:

> “As a student researching the causes of the 'wind-rush,' the sudden surge of investment in wind energy in California during the early eighties, Tom Starrs had what he modestly described as 'a minor epiphany.' Namely, that the main driver for investment in renewable energies had virtually nothing to do with any recent advances in the technology. Rather, it was energy *policy* that played the most important role. Investment in wind had been rooted in the tax breaks that state and federal law had made available to developers . . . .
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> “Armed with this insight, in December 1992 Starrs invited himself to a meeting of the Photovoltaics for Utilities Group (PV4U) in Stuart, [Florida]. . . . Starrs stood up and introduced himself. He explained that he was a graduate student at the University of California at Berkeley looking for a meaty topic into which to sink his teeth. 'I sat down, and this guy literally in front of me, who I didn't know, had never seen before, leaned back in his chair, and sort of whispered out of the corner of his mouth—“net metering!”
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> “Starrs had no idea what the stranger meant. Nor that this was Steven Strong, the architect who . . . had the previous decade designed and built the world's first grid-connected solar electric house and who by now probably had more experience with PV-powered houses than anyone else in the US. When the session was over Starrs got together with Strong. The latter explained what he meant by the term 'net metering.' The basic idea was simplicity itself. It exploits the fact that the rotating aluminum disk on the garden-variety electric meter used to track the number of kilowatts a household consumes in a given period—usually a month—has the ability to spin backward as well as forward. This ability meant that net metering of solar electricity could be introduced for residential customers with no change to the existing equipment.
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> “Net metering is essentially an accounting mechanism based on parity pricing: any excess electricity generated by photovoltaics (or other form of generation) flows out to the grid. It is automatically credited to the customer at the same—that is, retail—rate as electricity flowing in from the grid. The meter spins backward, effectively erasing a portion of the total charged. 'Net' simply means the final figure read out at the end of the billing period. Starrs was entranced by the concept. It seemed to him that net metering was the obvious way to simplify the often-byzantine process of connecting small systems to the grid. Also, to provide an answer to a complex question: What is the value of electricity generated and delivered within the distribution system? As Starrs knew from his work on the policy arena, it pays to keep things simple.
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> “Starrs wrote the first-ever paper on net metering. In June 1994, he presented the concept at an American Solar Energy Society conference in San Jose, California. The paper caused quite a stir. ' . . . Afterward I was just barraged with questions and business cards. That's when it hit me that, for whatever reason, this issue really resonated with people.' ”

Six months later, at the 1994 First World Conference on Photovoltaic Energy Conversion in Hawaii of the Institute of Electrical and Electronics Engineers (IEEE), with some 900 attendees, a working group was formed to propose net metering as a policy option for government. Their target: the California state legislature. When the group considered who should draft the bill, “the heads of the other six or seven people around the table all immediately swiveled to look at me,” Starrs relates. So, with two other colleagues, he ended up writing the draft legislation that will require utilities to accept the scheme. To make the bill more palatable, Starrs' draft described net metering not as a sale of electricity from the solar rooftop owner to the utility but an exchange of energy. His drafting team also formulated “a set of rules that would simplify the process of interconnecting these systems in a way that more or less eliminated the utilities' project-specific discretion over the interconnection.” As Johnstone described it:[8]

> “The proposal was that, so long as the PV system's inverter—the device that converts continuous direct current output by the panels to alternating current in sync with the grid—met certain technical specifications, then the utility would be obliged to accept that inverter as the interface. The power company would not retain the ability to impose any additional requirements regarding interconnection. There was legal precedent for this argument. For decades AT&T had battled in the courts to maintain its monopoly on what equipment customers could plug into their wall socket. The phone company argued that interconnection of telephones made by anybody other than its manufacturing arm, Western Electric, would compromise the stability and reliability of its network. Starrs had studied the epic anti-trust telecoms lawsuit in grad school. He knew how eventually the regulator had ruled that any manufacturer willing to meet certain standard specifications could make and sell devices to the consumer.”

To make a long story short, Starrs' draft passed the California legislature unanimously in 1995, and California became the second state to do so after Minnesota.[9] In the lobbying process, however, the local utilities still managed to limit the law's impact. Only installations of 10 kW or lower could participate in the scheme, and an overall system cap was set at 0.1% of the local utilities' peak demand.

Net metering researcher Yih-huei Wan of the U.S. National Renewable Energy Laboratory (NREL) identified the following reasons why net metering programs were subsequently adopted by more state legislatures and public utility commissions:[10]

> “The main objective for states implementing net metering programs is to encourage private investment in renewable energy resources. Other goals include stimulating local economic growth, diversifying energy resources, and improving the environment. The appeal of net metering arises from its simplicity: the use of a single, existing electric meter for customers with small generating facilities. After the program is implemented, no regulatory interaction or supervision is needed. As a policy option, it makes renewable energy technologies more economically attractive without requiring public funding. Net metering also addresses a perceived equity issue of utilities gaining an unfair advantage over customers by paying customers only avoided cost but charging them retail price of electricity.”

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8 Johnstone, p. 119.

9 Yih-huei Wan, “Net Metering Programs,” NREL/SP-460-21651, December 1996, p. 2.

10 Ibid., p. 2.

Supposedly following California's lead, Hawaii also enacted a net metering statute in June 1996, but with a different outcome. NREL researcher Yih-huei Wan tells the sad story:[11]

> "Hawaii's net energy metering law mandates the use of two meters (one to record total consumption and the other to record total generation). Customer generators are billed for the electricity they use at the utility retail rate, and the utility credits the customer generators for the electricity they generate at a rate determined by the PUC based on the utility's incremental cost of energy. This requirement prevents the customers from using generation to offset their own consumption, thus denying customers the most important benefit of net metering. . . . Therefore, it is more appropriate to classify the Hawaii net metering law as a simultaneous purchase and sale agreement for small customer-owned generators rather than a net metering law."

Net metering spreads

Despite stiffening opposition from utilities, some 16 U.S. states had a net metering program by 1996,[12] going up further to 22 U.S. states by 1998. Of the 22, six enacted net metering laws, 14 established net metering programs via public utility commissions and the regulatory process, and utilities in two states implemented a net metering program voluntarily.[13] In 2000, the number had gone up to 30.[14]

In 2001, California RE advocates managed to pass a temporary measure raising the maximum size allowed for net metering from 10 kW to 1 MW, opening the scheme to larger structures and business establishments. The measure would end August 2002. A major legislative fight ensued, with solar advocates trying to extend the measure, and utilities trying to stop its extension. The measure was extended, but utility lobbyists managed to insert deal-breaking amendments. Net metering credits for large-scale solar producers were reduced by up to 50%. Customers were required to install an additional meter, at the customers' expense, unnecessarily complicating the scheme, as well as making it more expensive. An enthusiastic businessman who was also an environmentalist, Fred Adelman, submitted his net metering application for a 30-kW system immediately, on the day the 10-kW cap was lifted. He received an email from PG&E requiring that before he could connect to the grid, an engineering impact study would have to be performed at the customer's expense. Nothing happened for a month. When Adelman called PG&E to follow up, he was informed that he would be charged $605,000 because the company would have to upgrade their local distribution network first. Adelman eventually got the charges reduced to $11,000, but only after a long and costly legal battle.[15] In short, even with a net metering law passed, hostile utilities continued to sabotage the program.

The year 2012 was a watershed: that year, 99% of all installed PV systems in the U.S. were net-metered.[16] The trickle of do-it-yourself citizens who now had the means to generate their own

11 Yih-huei Wan 1996, p. 7.
12 Ibid., p. 1.
13 Yih-huei Wan and H. James Green, "Current Experience with Net Metering Programs", Presented at WindPower '98 Bakersfield, CA USA, April 27-May 1, 1998, p. 3.
14 Larsen et al., p. 18.
15 Johnstone, p. 219-220.
16 Vera von Kreuzbruck, "US: 99% of installed PV systems in 2012 were net-metered projects", *PV Magazine*, April 17, 2013. http://www.pv-magazine.com/news/details/beitrag/us—99-of-installed-pv-systems-in-2012-were-net-metered-

power was turning into a flood. In September 2012, alarmed U.S. electric utility executives gathered in Colorado and agreed that distributed generation (DG) in general and net metering in particular was a “disruptive technology” that threatened their centralized business model with “declining retail sales,” “loss of customers” and “potential obsolescence.” They decided to launch a major effort to stem the tide. Their main target: net metering and its parity pricing feature.[17]

The “net metering war”, as some accounts put it, began in earnest in 2013. By this time, there were net metering programs in 43 U.S. states and the District of Columbia.[18] South Carolina became the 44th in December 2014.[19] Where net metering is not mandated by law or the regulators, utilities usually credit those who send their surplus to the grid the avoided cost of the exported electricity, which is usually lower than retail price.[20] The battles, however, continued to rage. As a 2013 news story put it:[21]

> “The fate of rooftop solar net metering—the credit homeowners get for putting kilowatt-hours on the grid—is being fought in states across the country . . . . Utility companies, which make their money selling electricity from centralized power plants, have sought or are seeking to limit the payments for the distributed generation coming from thousands of solar panels.
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> “The Edison Electric Institute, which represents investor-owned utilities, has identified distributed generation as a potentially 'disruptive technology' that could compete with utility companies . . . . “In state after state, utility companies are seeking to change net-metering programs.”

Utilities against net metering

The utilities' main target has been the parity pricing scheme behind net metering. They argue against it in a number of ways. Edison Electric Institute (EEI), which “represents all U.S. investor-owned electric utilities,”[22] uses the following argument:[23]

> “Because of the way that net metering policies originally were designed, net-metered customers often are credited for the power they sell to electric companies, usually at the full retail electricity rate, even though it would cost less for the companies to produce the electricity themselves or to buy the power on the wholesale market from other electricity providers.

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17 Joby Warrick, “Utilities wage campaign against rooftop solar”, Washington Post, March 7, 2015, http://www.washingtonpost.com/national/health-science/utilities-sensing-threat-put-squeeze-on-booming-solar-roof-industry/2015/03/07/2d916f88-c1c9-11e4-ad5c-3b8ce89f1b89_story.html

18 Tom Tanton, “Reforming Net Metering: Providing a Bright and Equitable Future,” American Legislative Exchange Council, March 2014.

19 http://www.solarserver.com/solar-magazine/solar-news/current/2014/kw51/south-carolina-becomes-44th-us-state-with-solar-pv-net-metering.html

20 Yih-huei Wan and Green, p. 1.

21 Mark Jaffe, “Rooftop solar net metering is being fought across U.S.” The Denver Post, September 1, 2013, http://www.denverpost.com/business/ci_23986631/rooftop-solar-net-metering-is-being-fought-across.

22 http://www.eei.org/ about/members/Pages/default.aspx

23 Edison Electric Institute, “Straight Talk About Net Metering.” http://www.eei.org/issuesandpolicy/generation/NetMetering/Documents/Straight%20Talk%20About%20Net%20Metering.pdf, p. 2-3.

> "Many energy experts agree that net-metered customers should be compensated at the wholesale price for the electricity they produce, similar to other electricity providers. This reflects the fact that electric companies buying this power still must incur the costs of delivering the power to their customers, including the costs of maintaining the poles, wires, meters, and other infrastructurers required to deliver a reliable supply of electricity."

Thus, EEI argues, net-metered customers should be credited only for the wholesale price (what we call in the Philippines the average generation charge or the "blended cost" of electricity), not the retail price of electricity. Net-metered customers, EEI insists, must still pay for the "cost of transporting and delivering the electricity through the electric grid to reach a customer."[24]

The simple answer to the EEI argument is that the liability for these transport and delivery costs have been transferred to the neighbors who used the exported surplus, because this surplus registered on their meters. Thus, all the costs which EEI claims are being avoided by their net-metered customers are actually being paid by other customers who used the surplus. If this seems confusing, imagine again our analogy with the LPG tanks. The owner of the backyard biogas digester returns one of the three tanks he ordered, pays only for two, and asks his neighbor to pay for the third instead. The neighbor, accepting this transfer of liability, agrees to pay for the tank as well as its delivery charge. So everything is fully paid for.

EEI, on the other hand, wants to credit the customer who returned the third tank only the cost of the tank's contents, and to bill him—and the neighbor as well—the delivery charge for the same tank. The EEI position will in fact result in *double-charging*. If you want to be polite, call it a *hidden subsidy*.

Another vocal critic of net metering is the American Legislative Exchange Council. ALEC uses an interesting analogy to support its position against net metering:[25]

> "Imagine you have a home vegetable garden and have had a very good year and a bumper crop of tomatoes. Do you consider it somehow appropriate for you to send those tomatoes down your local grocery store and expect to sell them to the grocer at the same price that he sells to the public? How would that help him pay his rent, and maintenance and heating bills for the store? The taxpayer has already paid you to grow tomatoes. Why, you have even made the grocer pay to have the tomatoes carried from your house to his store. Won't this arrangement raise the cost of tomatoes and other groceries to other shoppers? Well, that's exactly what net metering does. It forces the grocer—the utility—to buy a wholesale product at retail prices."

The ALEC analogy is faulty because it is incomplete. A full analogy would involve you ordering, say, 30 kilos of tomatoes from your grocer (which your grocer perhaps imported out of state), delivered to your doorstep, for which the grocer charges you the retail price that covers all the grocer's costs, including the transport of the tomatoes from another state to the grocer, plus of course the cost of home delivery, the grocer's profits, government taxes and so on. As the ALEC analogy says, you have a bumper crop of tomatoes. So you accept only 20 kilos of the delivered tomatoes. But your next-door

24 Ibid.
25 Tanton, p. i.

neighbor, who also wants tomatoes, agrees to get the other 10 kilos. So your grocer's delivery service brings the 10 kilos to your neighbor instead, which your neighbor pays for in full. As for the 20 kilos which were delivered to you, you also paid for them of course—in full. Clearly, the grocer was in fact fully paid for his 30 kilos of tomatoes.

ALEC is arguing that your refund should only cover the wholesale price; you should still pay for inter-state transport, delivery charges to your home, the grocer's profit, and government taxes for the 10 kilos you returned, although your next-door neighbor already paid for them. ALEC is trying to justify the double-charging that is currently being inflicted by U.S. utilities on non-net-metered solar PV owners, who are sending their surplus to the grid to be used by their neighbors but are getting credit only for the wholesale cost of electricity.

Whether it involves electricity, water, tomatoes or LPG, crediting only the wholesale and not the full retail price of returned items that were absorbed and fully paid for by neighbors is double-charging. If you are at the grocery checkout counter, and you decide to return an item you just paid for, and which the next person on the line agrees to buy for its full price, you have the right to demand a full refund.

ALEC further claims that net metering advocates "miss the fact that they are using utility property without paying for it." ALEC is apparently referring to the fact that the net-metered surplus passes through utility-owned posts and wires on its way to the neighbor.

Our reply: The boundary between utility and customer property is the electric meter. It is the equivalent of the grocer's checkout counter. While the "dirty" 50 kWh was travelling on transmission and distribution lines, it was the property of the utility. As soon as it passed the customer's electric meter, turning it forward, it became customer property. And as soon as the net-metered customer's 50-kWh solar surplus passed his electric meter and reversed it on the way out, that 50 kWh became utility property. The ownership change occurs at the electric meter, like the ownership change that occurs at the checkout counter. ALEC is wrong to claim that solar rooftop owners "are using utility property without paying for it." It is the utility, as the new owner of the 50-kWh solar surplus, which used its own posts and wires to deliver the surplus to the next-door neighbor. And since this 50 kWh will register on the neighbor's meter, the utility will get fully paid to the last dollar for its service.

The utilities' perspective

Finally, for the sake of argument, let us accept the utilities' perspective, that the 50 kWh that goes into the net-metered customer on one hand, and the 50-kWh surplus exported by the same customer, should *not* count as a single transaction involving a simple transfer of liability, like returning an item that is then paid for by another customer, but should be treated as two completely separate transactions.

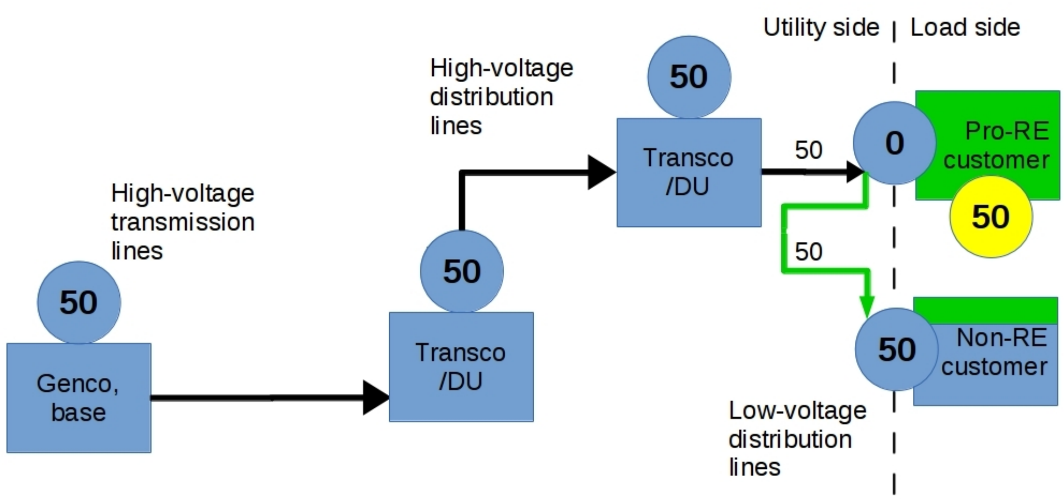
Let us accept that the 50-kWh consumption by a customer can be treated and metered separately from his 50-kWh surplus that he exports to his neighbor. In such a case, utilities are now in a position to price exported surpluses separately from regular electric meter readings. The utility still bills the solar customer the full retail price of his 50-kWh consumption. When the customer subsequently exports his 50-kWh surplus to a neighbor, the utility also bills the neighbor the same full retail price of 50 kWh for the exported surplus. The question now is: what value should be assigned to that solar surplus? How should it be priced? EEI, ALEC and their allies are proposing to price it below retail. They want to deduct the cost of transmission, distribution, etc. and keep these for themselves, and then credit the exporter of the surplus for what remains, what they call the “wholesale price” of electricity. Very roughly, this means half of the retail price will go to them, and half to the exporter of the surplus.

What is wrong with this scenario? At least two things:

1. Let us trace the path of the 50 kWh once more. At the genco, the 50 kWh passes through several transformers as it is stepped up in voltage and sent through the transco's very-high-voltage transmission lines. At the end of the final transmission line, the chunk passes through more transformers to make it more suitable for the DU's high-voltage distribution lines. Eventually, the chunk is stepped down further in voltage and until it is suitable for the DU's low-voltage lines that serve residential and commercial neighborhoods. Throughut this process, the chunk accumulates charges representing the added-value of the hundreds of kilometers of those transmission and distribution lines. Finally, the 50-kWh chunk reaches the customer's premises and is promptly consumed. This 50-kWh transaction registers as a forward movement on the meters of the genco, the utility, and the customer.

When the sun is high in the sky, on cloudless days, the solar rooftop customer generates a surplus of 50 kWh, so it goes out to the grid. Under net metering it will simply reverse his meter back to zero. But the utilities want it metered separately so that they can assign a lower price to this outgoing surplus. As soon as it is metered, the solar surplus is on the grid, owned by the utility. (See Figure 4.)

Figure 4. The solar surplus and the equivalent amount that it replaced



Electricity follows the path of least resistance, and the longer the wire, the greater the resistance. Thus this surplus is delivered from the net-metered customer to his nearest neighbors who have some appliances turned on, a distance in the order of a hundred meters or less. (We assume one neighbor only, for simplicity.) This neighbor-to-neighbor transfer of surplus *avoids* the cost of moving electricity from the gencos to the consumer, a distance in the order of hundreds of kilometers. It avoids the costs of going through high-voltage transmission and distribution lines, transformers, and their associated supervisory control and data acquisition systems. One-thousandth the distance roughly means one-thousandth the cost. Thus we can say that the cost of this neighbor-to-neighbor transfer, like returning an item and asking a delivery service to bring the item to a next-door neighbor who will pay for it instead, is *negligible*. It is *too cheap to matter*. Yet, the DU will charge the neighbor the full delivery fee for this chunk, as if it had delivered the surplus from a distant generating plant through the utility's high-voltage lines and transformers, to the neighbor.

The cost of that neighbor-to-neighbor transfer is “negligible”, but it is not zero. So, not charging for it is still a loss to the utility, isn't it? Far from it. Rather than recover this negligible amount from the neighbor, the utility actually has better options. First, there are carbon markets which are bound to grow as global warming and climate change take their inevitable toll. Distributing carbon-free electricity commands value in these markets. Also, most utilities are required to distribute some renewable electricity, under what are usually called renewable portfolio standards (RPS). Utilities may be subject to fines if they don't meet their RPS obligations. Utilities that are over-quota can sell their surplus to those that are under-quota. Hence, moving a net-metered customer's surplus to a neighbor is again worth money to utilities. In fact, in a market where prices will be set by much larger chunks of renewable electricity distributed on the grid over hundreds of kilometers from wind and solar farms, it will be worth much more than its actual cost.

Should the utilities then spare the neighbor of these transmission, distribution and other charges? If they did, it would be a windfall to the neighbor, who is expecting—and willing—to pay the full retail price for his meter reading.

We argue that this added-value belongs neither to the utility nor to the neighbor. Who invested the money to generate renewable electricity at the point of use, bypassing the expensive transmission and distribution system of the grid? Who displaced 50 kWh of conventional electricity, resulting in less greenhouse gases, less energy insecurity, less local pollution and less displacement of local communities? Who avoided electricity from expensive peaking plants, thereby bringing the average cost of electricity down? For these things, we have the RE-adopters to thank for. They created all these added values; they should get the credit for the neighbor's potential windfall.

2. Let us now consider the actual value of the solar surplus itself. U.S. utilities would value it at roughly the same rate as the average generation price, about half the retail price, the utilities keeping the balance. Yet, utilities themselves pay a range of prices for other types of electricity that they buy. During peak hours, they regularly pay *higher than retail* for electricity coming from oil- or natural gas-fired plants, *not* the retail price minus delivery and other charges. Solar surpluses typically occur when the sun is shining brightly high in the sky, when demand for electricity is high and utilities buy electricity from peaking plants at prices higher than the retail price. This peak-hour price is what utilities usually avoid when they are taking surpluses from solar rooftops. If solar surpluses are to be paid the avoided price of electricity, should not solar surpluses be paid higher than retail rates too?

In fact in many countries that implement feed-in-tariffs, solar electricity (and other clean renewables) *are* bought at higher than retail prices, because their societies value these types of electricity more: they don't cause health problems, displace communities, poison the environment, warm the globe and change the climate, deplete non-renewable resources, and so on. They also create more jobs, rely on local resources, enhance energy security, ease regional and global tensions around contested oil reserves, and do not cause nuclear proliferation. The debate instead in these countries is: how much higher than the retail price do clean renewables deserve?

Thus, parity pricing for renewables is already the middle ground between, on one hand, those who believe they should be valued higher than retail as most feed-in-tariff implementations do and, on the other hand, those who think they should be priced lower than retail as many utilities insist. Anti-net metering lobbyists do not want a compromise. They want their unreasonably extreme position to prevail. To make this happen, they have been calling parity pricing a “subsidy” for renewables. We have already explained earlier why this is not a subsidy at all: crediting the net-metered customer the full retail price for his surplus is no different from crediting a customer at a grocery checkout counter the full retail price for an item he is returning, knowing that the next customer on the line is willing to pay for it, also at the full retail price.

Now, let us face the issue of subsidies squarely. We have shown that parity pricing under net metering is no subsidy. This does not mean that we do not want subsidies for renewables. Not all subsidies are bad. Subsidies are a valid option for governments to encourage things to move in a desired direction, or to support important efforts that cannot otherwise take off the ground or cannot do so fast enough. Subsidies to renewables belong to this category. Renewables will help improve our energy security especially under worst-case scenarios like peak oil. Renewables also reduce pollution and mitigate climate change. Solar panels on rooftops do not displace communities, poison them, or cause nuclear proliferation.

Historically in the energy sector, however, the biggest subsidies have been enjoyed by the nuclear and fossil-fuel industries. G20 governments, for instance, continue to subsidize fossil-fuel exploration to the tune of $88 billion per year, more than twice what the top 20 private companies are spending.[26] A report of the U.S. Energy Information Administration released on March 12, 2015 shows that in 2013, the electricity sectors which received direct subsidies from the U.S. federal government included: fossil-fuel ($4.1 billion); nuclear ($1.7 billion); transmission and distribution ($1.2 billion); solar ($5.3 billion); wind ($5.9 billion).[27] The U.S. EIA emphasizes that their report does not include all subsidies. In addition to money from governments, producers of dirty electricity enjoy hidden subsidies too. By externalizing large parts of their costs, fossil-fuel-based generating plants (and think-tanks that they fund) enjoy enormous hidden subsidies that are eventually paid for by local communities and the general public in the form of health costs, social costs, environmental costs and costs from climate-related disasters. The utilities' demand for impact studies, one-time “net-metering” charges, recurring “meter-reading” charges, etc. from their net-metered customers are not only artificial barriers against distributed renewables. They are also hidden subsidies for the utilities themselves.

In summary, under the scenario implementing what the utilities want, they will be overcharging the neighbor with imaginary transmission and distribution costs which were never incurred. They will also be underpaying net-metered customers for their high-value surplus. The result: hidden subsidies for the utilities. The various costs can be more properly assigned and fairly calculated of course. But this will then complicate things a lot, requiring additional metering equipment and major changes in billing and accounting procedures. In the end, we will end up with something that is very much like a full transfer of liability from the owner of surplus to his neighbor. And this can be implemented very simply if we accept for billing purposes the readings from meters that reverse when power flows in the opposite direction. In short, we will end up with something very much like net metering.

Finally, we offer another hypothetical case as the final test whether net metering causes losses to the utility or not: Someone runs a diesel-fuelled synchronous generator (one that can sync with the grid).

26 Roberto Savio, “Climate Change Continues, Impervious to Official Declarations”, *Other News*, March 19, 2015.

27 U.S. Energy Information Administration, “Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013”, March 12, 2015. http://www.eia.gov/analysis/requests/subsidy/.

Due to an accidental connection, it ends up sending out 50 kWh into the grid, reversing the careless owner's meter by 50 kWh. The 50 kWh go into a neighbor whose appliances are on, turning the latter's meter forward by the same amount. The neighbor pays the utility for the 50 kWh added to his meter.

Here is the test: Is anyone else due any other payment? Specifically, did the accident cause the utility to subsidize the careless owner? Perhaps some unpaid transmission, distribution and other costs associated with 50 kWh of electricity?

Let us check all three perspectives. The neighbor's perspective: He paid for 50 kWh which he actually consumed as reflected in his meter reading. So he has no problem. The neighbor's payment, however, goes not to the careless generator owner who actually supplied the 50 kWh, but to the utility whose 50 kWh was erased from the meter. The utility's perspective: The neighbor's payment fully covers the lost income from the 50 kWh that the careless customer had already consumed but accidentally erased from his meter. So the utility should have no problem either. The careless owner's perspective: Diesel is expensive. The retail price of the 50 kWh he extinguished when he reversed his meter is less than the cost of electricity from the diesel generator, so he is not happy with the accident. It is clear, however, that he got no subsidy from the utility when he reversed his meter. He owes nothing to the utility or to his neighbor. A utility claim to recover a “subsidy” would be spurious and will not prosper.

When you come to think of it, whether the export of 50 kWh was accidental or not is in fact irrevelant. If the careless owner intentionally generated more surplus and sent it out to the grid, we can go through the analysis once more, and the result will be the same: he would not owe anything to the utility or his neighbor. He would be losing money of course, but this is his own business, not the utility's. However, if the cost of electricity from the generator were cheaper than retail (as it would be if he used rooftop solar panels), he would be saving money. Then he would want to do it again and again.

Thus, net metering encourages more private investments in solar panels and other low-cost renewables---something that even small-players and low-income families can participate in---without without any subsidy from the government or the utility.

The anti-net-metering Institute for Electric Innovation (IEI) makes a big case out of their finding that an increasing number of solar rooftops are being leased. Because of this, IEI says, the delivery charges that they want to credit to the utilities are going mostly to solar leasing companies.[28]

IEI has inadvertently revealed the true problem with private utilities. It is called *envy*. The utilities are envious that money which can be going to them are now going to solar leasing companies instead. They are envious that renewables now seem to get more subsidies than they get. The solution is in fact simple: the utilities can compete with solar leasing companies and themselves offer similar services to their customers. Consumers can then decide, in true market fashion, whether to lease from the utility or from any of the competing solar leasing companies.

Utilities have been treating customers as captive clients who have no choice but to passively obey whatever terms the utilities dictate, just like mainframe computer and landline operators did in the past. They are so used to treating customers this way that under net metering, they get a persistent feeling that they are “losing” something. Of course they are, but it is not something they are entitled to. They

28 Institute for Electric Innovation, “Net Energy Metering: Subsidy Issues and Regulatory Solutions” (Issue Brief), September 2014, p. 4.

are losing the competition in a freer market; they are losing customers and market share.

Low-cost solar panels on rooftops and small-scale wind turbines are permanently changing the rules of the game. Net metering will minimize transaction costs, remove barriers to entry, and make it truly easy for low-income families and other small-scale players to join. Users of electricity can now empower themselves, in more ways than one. Utilities cannot stop them anymore. Like operators of mainframes and landlines, utility operators must learn to adjust to the new realities and accept their reduced role in the future: at night, or when there is not enough sun or wind, or when there is too much sun or wind.

When they go to the government whining that they should be compensated for their "losses" under net metering, they are basically asking for more subsidies.

The Philippine case

In the Philippines, small-scale renewables (100 kW or lower) are allowed to connect to the grid under a scheme which the government also calls "net-metering".

Here is how our Department of Energy defines its "net-metering" scheme:[29]

> "Any electricity generated that is not consumed by the customer is automatically exported to the DU's distribution system. The DU then gives a peso credit for the excess electricity received equivalent to the DU's blended generation cost, excluding other generation adjustments, and deducts the credits earned to the customer's electric bill."

The Philippine scheme, like Hawaii's 1996 scheme, is clearly not net metering as the rest of the world understands and implements the term. It authorizes local utilities to credit the consumer not the retail price but the much lower average generation cost of electricity. The most essential element of net metering—parity pricing—is missing. This Philippine-style "net-metering" is exactly what U.S. utilities are lobbying for today.

The Philippine definition, by the way, was written by the president of the Philippine Electric Plant Owners Association. Drafted by a utility representative, the rules clearly reflect the utilities' unfriendly attitude towards customers who generate their own electricity. EEI, ALEC and their U.S. utility funders will envy their Philippine counterparts for the ease with which the latter have so easily managed to sneak in the same double-charging scheme that the former want imposed on all U.S. utility customers.

Compared to the 44 U.S. states that already have true net metering in place, the Philippines has a long way to go before the floodgates to solar rooftops and other low-cost renewables are fully opened.

March 23, 2015

29 http://www.doe.gov.ph/netmeteringguide/index.php/1-how-net-metering-works-understanding-the-basics-of-policy-regulation-and-standards