Philippine Pseudo-Net-Metering Scheme
Results In The Double-Charging Of Consumers[1]

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Double-charging examples

To become familiar with the double-charging scheme discussed in this paper, let us start with some examples. The first two are quite obvious. The next two are a bit harder to figure out, because they involve replacing an item instead of simply returning it:

1. **Returned tomatoes:** You are at the check-out counter of a supermarket, about to pay for the items you picked from the shelves. At the last moment, you change your mind and decide to return the Baguio tomatoes. The next in line, who likes tomatoes, offers to buy them instead. The cashier, however, agrees to credit you only the wholesale price of the tomatoes. He argues that the tomatoes had been delivered from Baguio, from 250 km away, and the supermarket had paid for the transportation and other handling costs. So even if the next customer paid for the tomatoes in full, you are still billed for the same transportation and handling costs.

2. **Returned LPG tank:** You order three tanks of LPG fuel. The supplier is some distance away, so the delivery charges are substantial. You had earlier installed a biogas digester system in your backyard. It has started producing gas for your cooking range, so you now need only two, not three, tanks. However, your next-door neighbor, who needs a tank herself, agrees to buy the third tank. So when the delivery truck arrives, you ask the driver to unload two tanks only, and to bring the third to your neighbor, who pays for it in full. When you get your bill, however, it includes the delivery charge for the third tank. You ask your neighbor; she says she was also billed the same delivery charge.

3. **Replaced water**: The water from your backyard well has better quality than the water utility's supply. So you install a water pump and connect the well's output to your water system. One day, the one-way check valve which prevents your high-quality water from going out into the main supply line fails, sending your high-quality water into the mains. Your neighbor notes that her water quality has improved. Your pump's flowmeter shows that 10 m^3 of high-quality water went out. But the outward flow also caused your water meter to turn backward by 10 m^3. To avoid suspicion of meter-tampering, you talk to the water utility. Your explain that the 10 m^3 that went out must have gone to your neighbors with open taps and must have registered on their water meters. So, you explain, the utility will get paid in full for the 10 m^3 because the neighbors' will pay for it. There was no meter-tampering on your part, the utility agrees. Any water you put into their system will register on other meters, they also confirm. But their fees include the delivery cost, they explain. They have already delivered the 10 m^3 to you, even if you returned the same volume of water back, they argue. So even if the neighbors who got your high-quality water paid their bills in full,

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1 This paper uses material from some sections of my book *Crossing Over: The Energy Transition to Renewable Electricity*, which was published by the Friedrich Ebert Foundation in March 2015, and from my paper “Net Metering: The Full Story”, which was published by cleantechnica.org as a series of online pieces in September 2015. The latter, in particular, contains a full description of its origin and spread in the U.S., the complete set of arguments in favor of true net metering, and my replies to several of the important counter-arguments of contra-net-metering lobbyings. This piece focuses on the double-charging that happens under the “net-metering” scheme of Philippine utilities.

including the delivery charge, the water utility still bills you the delivery charge for the 10 m^3.

4. **Replaced electricity:** During a power outage, you run an emergency synchronous generator to keep the food in your refrigerator from spoiling. While your generator is still running, power from the mains is restored. Because you do not notice it right away, you end up sending a 5-kWh chunk of electricity into the grid, reversing your electric meter by 5 kWh. The 5-kWh chunk goes into a neighbor whose appliances are switched on, turning the latter's meter forward, also by 5 kWh, offsetting the reversal in your meter. The neighbor pays for his bill in full, which includes the 5 kWh from your generator. Your electric utility finds out about the lower meter reading and investigates for possible meter-tampering. After listening to your explanation the forward movement in your neighbor's meter offsetting the backward movement in yours, they still bill you for the various other costs associated with the 5 kWh, like transmission, distribution, system losses, meter reading charge, universal charges, etc., which your neighbor already paid for.

These cases of double-charging all involve two distinct, time-separated, but inseparable events:

1) a long-haul delivery of an item from a distant source to the first buyer, and

2) a short-hop delivery of a returned or a replacement item accompanied immediately or simultaneously by its sale to second buyer who pays for it in full.

The double-charging occurs because the recipients of both deliveries are billed the same long-haul delivery charge, although the cost of the short hop is negligible or far lower than the long haul. In terms of the check-out counter, you are billed for something you already returned and which the next buyer immediately paid for at the same price you would have paid for it.

The long-haul event starts as a simple sale, but its nature is changed by the second event; from a simple sale, it becomes one side of an offsetting exchange. In terms of the check-out counter, a sale becomes a return.

The short-hop event involves two essentially simultaneous transactions between two pairs of players. The return or replacement involves the supplier and the first buyer, turning the transaction into an exchange. The short-hop delivery involves the supplier and a second buyer, transferring liability from the first to the second buyer and extinguishg the liability of the first buyer. Again in terms of the check-out counter, when an item is returned and simultaneously bought and paid for in full by a second buyer, the first buyer owes nothing.

These two events occur at different times, because one cannot have an item delivered and in the same instant be returning or replacing it. Unless these two distinct time-separated events are seen as conceptually inseparable, like two sides of the same coin, the seeming complexity of these multi-event multi-transaction cases may confuse even suppliers themselves, who may not realize that they are in fact over-charging their customers. The complexity of the transactions also makes it easier for those who intentionally over-charge to obfuscate the issues and confuse their customers.

The problem of accounting for returns and offsetting replacements

When electric utilities enjoyed a monopoly of distributing electricity to consumers, it was unthinkable for a consumer to be sending electricity into the grid. Today, as the prices of solar panels continue to decline, more and more households and businesses are installing solar panels on their rooftops, with the potential to contribute to the grid supply, fundamentally altering the paradigm of electricity generation and distribution.

We are entering a new era when consumers can generate electricity more cheaply on their own, thanks to the continuing decline in the price of solar panels. Since the panels' output may not be enough some of the time, or more than enough at some other times, the need for the grid does not disappear. But the nature of its role changes, from merely supplying electricity to moving electricity around and balancing the surpluses and shortages. Accounting for these novel bi-directional transfers of electricity is more complicated than the earlier situation where the utility supplied all the electricity and its customers just consumed it. This simpler client/server model will increasingly be challenged by a peer-to-peer model, and buy-and-sell arrangements will be increasingly replaced by peering arrangements and peer exchanges.

In the course of accounting for these exchanges in electricity between the utilities and solar owners, avoiding either over- or under-charging is becoming a major issue. Since these exchanges are similar in form to the examples cited earlier, they are especially vulnerable to the problem of over-charging. How do utility accountants know if they are not over-charging, or under-charging, their customers? Given the complicated nature of these new arrangements, if they were not so sure themselves, it would be understandable if the accountants chose to err in favor of their own company. If, under simpler circumstances, utilities have already been involved in overcharging cases requiring billions of pesos in refunds,[2] how much more under these more complicated circumstances?

With the preceding examples in the background but with the particular context in mind of long-haul deliveries of grid electricity to solar owners some of the time and short-hop deliveries of solar electricity to the electric utility at some other times, let us look at this problem in more detail. The next table summarizes the situation:

Table 1. Accounting for energy delivered in two distinct but inseparable events

A long-haul delivery of mixed electricity		**A short-hop delivery of clean electricity**	
Distant power plants	Solar owner		Neighbors
Source description: The sources are mixed, consisting predominantly of fossil-fuelled plants, but including some renewables. The power plants may be hundreds of kilometers away from the load. Delivery of electricity requires high-voltage transmission and distribution lines	**Load description:** Solar owner generates for his own use clear renewable electrocity. However, he needs an extra supply from the grid when the sun is down or hidden by clouds, or when he has to operate loads that need more electricity than his solar panels can provide.	**Source description:** Solar owner has an extra supply when the sun is up and and his panels generate more electricity than he can use. His supply is usually highest when the sun is overhead, which coincides with the grid's peak period, when the cost of grid electricity is very high.	**Load description:** If the neighbor happens to be using a solar owner's surplus, he is probably within a hundred meters from the owner. Thus, the electricity from the solar owner does not use high-voltage transmission and distribution lines.

2 Meruenas, Mark. "CA orders Meralco to refund customers P5B in overpayments". GMA News Online. Dec. 18, 2014. http://www.gmanetwork.com/news/story/393108/money/ca-orders-meralco-to-refund-customers-p5b-in-overpayments

Event description: The solar owner is short in supply. So the utility makes a long-haul delivery of mixed electricity from distant power plants to the solar owner. In the process, the utility uses and pays for the use of long-distance high-voltage transmission lines. It also uses its own high-voltage lines, including the low-voltage 220-volt lines for the final delivery to the solar owner. The solar owner incurs a liability for the delivery, equivalent to the kWh delivered times the retail price of electricity.	**Event description:** The solar owner has a surplus of electricity. Because he is grid-connected, this surplus automatically flows out through the electric meter, to the grid. The surplus replaces some of his consumption. His surplus automatically goes into neighbors (in this analysis, we assume only one) who have some of their lights or appliances switched on. At this point, two simultaneous transactions are occurring, while this transfer of electricity is going on. (See below)
During a short-hop: The solar owner's surplus is replacing part of the delivery made under the first event, turning what would have been a sale into an exchange transaction between the solar owner and the utility. In the process, the solar owner is extinguishing his liability for the amount that he is replacing.	**During a short-hop:** The solar owner's surplus is being consumed by the neighbor, transferring to the neighbor the liability that he is extinguishing (See left)

Source: Author

As rooftop solar becomes more affordable to households and businesses, the problem of accounting for these kinds of grid exchanges will become more and more urgent.

Note that connecting a solar PV system to the grid and porting the solar surplus out does not require net metering. Like water, the physics of electricity makes it follow the path of least resistance. When it is generated in-house, the output will be consumed first by the appliances that are switched on. Any surplus that cannot be consumed at that moment will then seek other paths of less resistance—it will in effect *spill out* into the grid. On the grid, still following the path of least resistance, and because longer wires offer more resistance, the surplus will likewise go into the nearest neighbors whose lights or appliances are switched on. This flow of electrons does not care about net metering. The electrons are simply following the physics of electricity.

Can the utility keep track at all of this complex set of deliveries, offsetting replacements, exchanges, second deliveries, and transfers of liability?

It can be done simply, it turns out.

Net metering is the accounting mechanism that keeps track of the kWh throughout this complex set of transactions in a way that accurately accounts for the deliveries, exchanges, and transfers of liability that occur in the process. The mechanism turns out to be extremely simple and immediately implementable without requiring new meters or other equipment, on two conditions: 1) that the meter reverses, and 2) that the electricity going in either direction have the same price.

The origin and a short history of net metering

Net metering originated in the U.S. in 1979, when solar pioneer and architect Steven Strong put solar photovoltaic panels in his two building projects, without disconnecting the system from the grid.[3] Strong discovered that whenever he had surplus electricity, his electric meter ran backward by the same amount. This meant that he was actually contributing his surplus to the grid supply. The utility was initially unaware that this innovation was happening in their service area, because Strong "had forgotten to inform Boston Edison, the local utility, of his plan to feed excess wattage into its distribution network."

Since his meter reading reflected his net electricity consumption, he called his innovation "net metering".

Strong's innovation came just in time. Earlier, solar PV systems were always operated off the grid, for self-consumption only. Solar panels had been so expensive that they made sense only when no grid access was possible. Off-grid operation, however, required properly-sized batteries, a careful balancing of supply capacity and demand levels, a particular set of technical skills, and regular maintenance. When the batteries were fully charged, the output from the expensive solar panels went to waste; when the batteries were discharged, they had no power. These substantial requirements and limitations, on top of the high prices, prevented the widespread adoption of solar technology.

Solar panels were still very expensive in 1979, but prices have dropped enough for pioneering innovators like Strong to try them, even where grid access was available. U.S. solar advocates immediately saw the advantages of Strong's innovation over off-grid operation. In effect, Strong had discovered a novel way for solar PV systems to use the grid—as a giant battery—and a simple way to record and account for the energy exchanges that would occur. Once the system was connected to the grid, the physics of electricity and the electronics associated with solar panels ensured, round-the-clock, that the surplus in-house electricity went out to the grid when there was more than enough, and the right amount of electricity from the grid came in when the in-house supply was not enough. Net metering solved the problem of accounting for the ins and outs of electricity when the grid was used for storage, opening the door to the widespread adoption of renewable technologies, especially solar panels, as their prices continued to drop.

The early net metering policy pioneers in the U.S. were Arizona (1981), Massachusetts (1982), Minnesota (1983), Indiana and Rhode Island (1985), Idaho and Texas (1986), Maine (1987), and New Mexico and Oklahoma (1988). By 1996, net metering was in 16 U.S. states;[4] 22 by 1998,[5] and 30 states by the year 2000.[6] Strong eventually received several awards for his innovation; he was named "Hero of the Planet" by Time Magazine in 1999.[7] By 2012, 99% of all installed PV systems in the U.S. were net-metered.[8] By this time, 43 U.S. states or PUCs, including the the District of Columbia, had net metering programs.[9] South Carolina became the 44th in December

3 Bob Johnstone, *Switching to Solar: What We Can Learn from Germany's Success in Harnessing Clean Energy* (New York: Prometheus Books, 2011), p. 91.
4 Yih-huei Wan, "Net Metering Programs," NREL/SP-460-21651, December 1996, p. 1
5 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.
6 Chris Larsen, Bill Brooks and Tom Starrs, "Connecting to the Grid: A Guide to PV Interconnections Issues (3rd ed.)", 2000, p. 18.
7 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.
8 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- projects-_100010943/#axzz3Ud9FFkF9
9 Tom Tanton, "Reforming Net Metering: Providing a Bright and Equitable Future," American Legislative Exchange Council, March 2014.

2014.[10] The net metering benefits of simplicity and low cost was a major factor in the spread of rooftop solar in the U.S., and a significant factor in the ongoing U.S. shift from fossil fuels to renewables.

U.S. National Renewable Energy Laboratory (NREL) net metering researcher Yih-huei Wan offered several reasons why more and more state legislatures and public utility commissions (PUCs) were adopting net metering programs:[11]

> "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."

Net metering was successfully introduced in other countries too—Japan (1992),[12] Canada, Europe, Australia, Brazil (2006), Mexico (2007), Philippines (2008), Sri Lanka (2009), Uruguay (2010), Lebanon (2011), Argentina (2012), India (nine states as of 2014), Chile (2014), Pakistan (2015), and several other countries.

Net metering in Philippine law user is "only charged his net electricity consumption"

In the Philippines, net metering was introduced through its Renewable Energy Act of 2008, signed December of that year. The Act defines "net-metering" (most other countries spell it without the hyphen) as:

> "... a system, appropriate for distributed generation, in which a distribution grid user has a two-way connection to the grid and is only charged for his net electricity consumption and is credited for any overall contribution to the electricity grid." (Chap. I, Sec. 4, underscoring by the author)

As can be seen above, Philippine law is clear that the user should *only* be charged for his net electricity consumption. This net consumption is further defined as the user's total consumption minus his credits. Remember that the credits refer to kWh, not pesos. The "two-way connection to the grid" may be interpreted as the common bi-directional electric meter that connects the user to the grid.

The law's definition above is echoed word-for-word in the Act's Implementing Rules and Regulations (IRR), adopted by the DOE the following year, and is further elaborated on, as follows:

> "Net-metering is a consumer-based renewable energy incentive scheme, wherein

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

11 Yih-huei Wan, "Net Metering Programs," NREL/SP-460-21651, December 1996, p. 2.

12 Johnstone, p. 128.

electric power generated by an eligible on-site RE generating facility and delivered to the local distribution grid may be used to offset electric energy provided by the DU to the end-users during the applicable period." (Sec. 7, IRR, underscoring by the author).

This elaboration by the IRR further clarifies that the energy contributed by the user and credited to him may be used to offset electricity earlier delivered by the utility.

In clarifying what "net electricity consumption" meant, the country's Energy Regulatory Commission (ERC) was even more explicit in its "Rules Enabling the Net-Metering Program for Renewable Energy" adopted in May 2013.[13] It defined net-metering as:

> "a system, appropriate for distributed generation, in which a distribution grid user has a two-way connection to the grid and is only charged or credited, as the case may be, the difference between its import energy and export energy". (Art. I, Sec. 4, ERC Enabling Rules, underscoring by the author)

The ERC enabling rules also defined "import energy" as "the energy imported or received by the Qualified End-user to [sic] the Grid/Distribution System" and "export energy" as "the energy exported or delivered by the Qualified End-user to the Grid/Distribution System".[14] (Art. I, Sec. 4)

In fact, "being charged only for the net consumption" and getting credit for one's energy contribution to the grid are different ways of saying the same thing. The first one in peso terms, and the second one in kWh terms. If the credited kWh surplus cancels out a portion of the total kWh consumption, then obviously only the net consumption can be charged.

What is less obvious is that when only the net consumption is to be charged, as the law specifies, the offsetting process cancels out price considerations for the exchanged amounts. When one borrows a kilo of rice from a neighbor and returns a kilo the next day, there is no pricing issue involved.

For one to offset the other, the same reference price must apply to both sides of the exchange, and price considerations intrude only with the net of the exchange. A common reference price is a necessary condition for the mechanism to work. It turns the two transactions—an export and an equivalent import—into a fair exchange not only of equal quantities but also of equal values of electricity.

Net metering means a common reference price for the energy exchanges

That a common reference price is a necessary condition for net metering can be proved mathematically, as follows:

Let S = Solar owner's electric bill, also the utility's sales income from the solar owner, in pesos
P = retail price of electricity, pesos/kWh
Q = total quantity consumed by the solar owner, in kWh

13 http://www.erc.gov.ph/Files/Render/media/RulesEnablingTheNet-MeteringProgramForRenewableEnergy.pdf
14 To emphasize the non-monetary nature of this exchange, this paper prefers the noun/verb "port" instead of import and export. In computing hardware lingo, a port is an interface through which data passes in or out. In software, to port means to transfer software from one operating system to another. The term reflects better the non-monetary nature of exchanges occurring under net metering.

Q_N = meter reading, representing the net electricity consumption in kWh
Q_R = the offsetting replacement quantity, also the reversal in the meter, in kWh
P_X = price of the exported electricity (unknown), in pesos

Net metering rules in the Philippines and the world over require the utility to “only charge the consumer his net electricity consumption”. This rule about what the utility can charge the solar owner translates into the following constraints for the utilities:

(1) $S = P \cdot Q_N$, where the net electricity consumption $Q_N = Q - Q_R$

Suppose the utility insists on setting themselves the price P_X under which they will credit the replacement quantity to the solar owner. This intention is contrary to law, because the law is clear that the solar owner should be credited the replacement electric energy, not its equivalent value. Nonetheless, they try to solve for P_X themselves. This will be the utility equation for their sales income from the solar owner:

(2) $S = P \cdot Q - P_X \cdot Q_R$,

subject to the constraints $S = P \cdot Q_N$ and $Q_N = Q - Q_R$ which are the rules of net metering and provisions of the RE Act in the Philippines. Inserting the contraints into their sales income equation, they will get:

(3) $$\overbrace{P \cdot Q_N}^{\text{Legal requirement}} = \overbrace{\overbrace{P \cdot (Q_N + Q_R)}^{\text{Expected Sales}} - \overbrace{P_X \cdot Q_R}^{\text{Customer credit}}}^{\text{From the utility sales equation}}$$

The equation above simplifies to:

(4) $P \cdot Q_R = P_X \cdot Q_R$, and finally, to:

(5) $P = P_X$.

Let us summarize what the above exercise did: the utility wanted to set the price themselves for the replacement quantity returned by the solar owner, which is the quantity by which the electric meter reversed. The price they get, under the constraint of net metering rules, is the retail price. That is, net metering requires the prices of the exchanged quantities to be equal. Net metering means a common reference price.

This is also how net metering is in fact implemented in the U.S. where it originated, and in other parts of the world. Without a common reference price, any mechanism that calls itself “net metering” is actually pseudo-net-metering.

ERC also set a preliminary reference price” for the exchange of energy

In the same ERC enabling rules cited above, under the heading “Pricing Methodology”, the ERC also set a “preliminary reference price in net-metering agreements”, as follows:

> “In case of DUs with special programs, the applicable preliminary reference price shall be the generation charge it imposes on its regular captive market, which is based on its blended

generation cost excluding other generation adjustments.” (Art. IV, Sec. 11)

This extension, which is neither in the law nor the IRR, will contradict the RE Act and the ERC's own definition of net metering, if the ERC “reference price” is interpreted to mean the price of the outgoing energy only.

But it may still comply with the country's RE Act, if the reference price is interpreted as the price governing the exchange as a whole; that is, the price of both incoming and outgoing energy, which cancel each other out as the various definitions clearly mean, but whose monetary value may need to be recorded for accounting purposes.

In fact, there is nothing in the ERC definition that says that the reference price applies only to the outgoing but not to the incoming energy. It will actually settle the debate once and for all, if the ERC meant a common reference price for the exchanged quantities for accounting purposes, in special cases where a monetary value has to be assigned to the exchange of energy. The ERC's conditional term, “in the case of DUs with special programs”, also supports this interpretation.

This would be similar to other peering arrangements where transactions in opposite directions cancel each other out, and therefore do not have to involve a price, but may be assigned a reference price for accounting purposes.

Examples of such arrangements would include banks who borrow foreign exchange from each other, Internet hubs operated by different commercial entities who send and receive gigabits of data between each other, competing mobile phone providers who must account for incoming and outgoing connections among themselves, neighboring product suppliers who regularly borrow items from each other whenever they run out of inventory, and so on. In all these peering arrangements, essentially the same words and spirit of the RE Act apply: the exchange of equal quantities of energy, dollars, gigabits of data, minutes of talk-time, retail items, etc. offset each other and cancel each other out, presuming a common reference price; but the exchanges may specify a reference price for accounting purposes.

This is a major finding of this paper: *nowhere in the law, the IRR or the ERC enabling rules on net-metering are the electric utilities authorized to charge for the energy they deliver at a price that is different from the price of energy they take from their net-metering customers.* The law, in fact, explicitly states that the user is “credited for any overall contribution to the electricity grid” and is “only charged for his net electricity consumption”, which automatically means a common reference price.

As we show in this paper, *the arguments in favor of a common reference price for a net-metered exchange are iron-clad.*

Despite the clear language of the law and its implementing rules and regulations, as well as the equally clear definition of the term by country's energy regulatory agency, this is unfortunately not how utilities implement this accounting mechanism in the Philippines.

Pseudo-net-metering by Philippine electric utilities:

In the Philippines, contrary to the RE Act, its IRR, and the ERC enabling rules, solar-enabled net-metering customers are charged not their net but their total electricity consumption, based on the full retail price of electricity. They are not allowed to use the energy they contribute to the grid to offset their consumption. Instead, their energy contribution is first converted into pesos using the much lower generation price, and this is used to offset not their kWh consumption but their peso-denominated electric bill, which is calculated based on the much higher retail price . It is a “net billing” scheme, not net metering.

U.S. NREL researcher Yih-huei Wan recalls a similar effort in Hawaii in 1996. Hawaii also called its net billing scheme “net metering”:[15]

> “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.”

Local utilities apparently learned from Hawaii's approach. Their net billing alias “net-metering” approach is described in the DOE website by utility representative Atty. Ranulfo Ocampo, president of the Private Electricity Power Operators Association (PEPOA) and chairman of the government's National Renewable Energy Board (NREB) Subcommittee on Net-Metering, as follows:

> “Net-metering allows customers of Distribution Utilities (DUs) to install an on-site Renewable Energy (RE) facility not exceeding 100 kilowatts (kW) in capacity so they can generate electricity for their own use. 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.”[16]

Surprisingly, the author claims he picked up the net metering definition from Wikipedia. Not from Philippine renewable energy laws, rules or regulations but from Wikipedia, which is a useful starting point for gathering research leads, but not an authoritative source because anyone can change Wikipedia entries anytime.[17] Nonetheless, let us give Wikipedia the benefit of the doubt and look at its definition.

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15 Yih-huei Wan 1996, p. 7.

16 Ranulfo Ocampo. “How Net Metering Works: Understanding the Basics of Policy, Regulation and Standards”. http://www.doe.gov.ph/netmeteringguide/index.php/1-how-net-metering-works-understanding-the-basics-of-policy-regulation-and-standards. You have to click on “1. How net-metering works: Understanding the basics of policy, regulation and standards”. The same Ocampo explanation is included in the printed publication *Net-Metering Reference Guide: How to avail solar roof tops and other renewables below 100 KW in the Philippines* published by the Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry of Economics and Technology (BMWi) and apparently endorsed by the Philippine government.

17 In fact, Atty. Ocampo's Wikipedia quote cannot be found in the Wikipedia entry on Net Energy Metering. A Google search for the quote returns several sites, including “Ask A Dork – What is net metering?” and “Net Metering – Project Gutenberg Consortia Center”, which in turn attributes it to the World Heritage Encyclopedia.

This is the quote attributed by Atty. Ocampo to Wikipedia, which says very little.

> According to Wikipedia, "Net metering is an electricity policy for consumers who own renewable energy facilities (such as … solar power) which allows them to use electricity whenever needed while contributing their production to the grid."

This, on the other hand, was the full Wikipedia definition, circa November 2014:

> "**Net metering** is a service to an electric consumer under which electric energy generated by that electric consumer from an eligible on-site generating facility and delivered to the local distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period.
>
> "Net metering policies can vary significantly by country and by state or province: if net metering is available, if and how long you can keep your banked credits, and how much the credits are worth (retail/wholesale). Most net metering laws involve monthly rollover of kWh credits, a small monthly connection fee, require monthly payment of deficits (i.e. normal electric bill), and annual settlement of any residual credit. Unlike a feed-in tariff (FIT) or time of use metering (TOU), net metering can be implemented solely as an accounting procedure, and requires no special metering, or even any prior arrangement or notification.
>
> "Net metering is a policy designed to foster private investment in renewable energy. In the United States, as part of the Energy Policy Act of 2005, all public electric utilities are required to make available upon request net metering to their customers." (Underscoring by the author)

Thus, even the Wikipedia entry is consistent with the definition of net metering by Philippine laws, rules and regulations. But this is to be expected, if both definitions are based on the generally-accepted rules of net metering in the U.S. and the rest of the world.

Even lobbyists against net metering, like the Edison Electric Institute (EEI) which "represents all U.S. investor-owned electric utilities,"[18] admit as much, as can be seen in the EEI argument below against net metering:[19]

> "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." (Underscoring by the author)

Whether solar owners should get the retail price or some lower price—in the Philippine this lower price is usually the average generation cost or the "blended cost"; elsewhere, it is the avoided cost or the wholesale price—is exactly the same debate that is raging today in the U.S., where utilities have launched a campaign to roll back the gains of net metering, due to their fears that the rapid spread of "distributed generation" will undermine their monopoly status and core business model. This debate of course has been settled by the Philippine RE Act and its IRR in favor of a

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

19 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.

common reference price.

With that sufficient background of Philippine legal provisions on net metering, we can now dissect in detail, the matter of double-charging in the Philippine legal context, as it is specifically occurring today in the Philippine utilities' implementation of net metering.

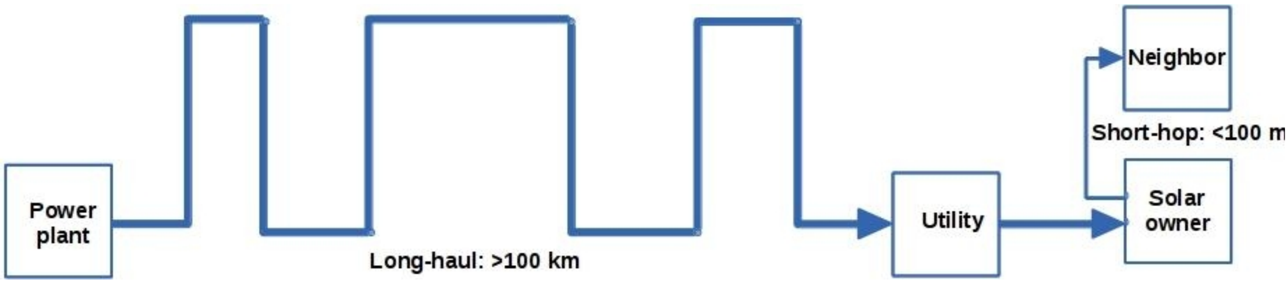
Let us go through the complex set of transactions again, when a solar owner ports his surplus out to the grid, and see how net metering, implemented with the usual bi-directional analog meter and a common reference price, accounts for everything, and how a lower price for the solar owner's surplus results in over-charging.

As explained in Table 1 and shown in Figure 1, the set of transactions consists of two time-separated but inseparable events:

First event: the long-haul

The long-haul delivery. The utility delivers electricity from distant power plants to the solar owner, turning the latter's electric meter forward, after which is it promptly consumed by the latter. This delivery is properly recorded in his electric meter. Part of this delivery is a simple sale of electricity by the utility to the solar owner. Another part, however, will be subsequently replaced by the solar surplus that will flow into the grid.

Figure 1: The two events comprising the set of net metering transactions



Source: Author

Second event: the short-hop

The offsetting replacement. When the solar owner has more electricity than he can use, his solar surplus is automatically ported to the grid. By definition—and by law in the Philippines—net metering allows the consumer to use this surplus to offset an equivalent amount in his consumption. The offset is recorded in the reverse movement of the meter's dials. The extent of the meter's reversal is the measure of both the replacement quantity and the consumed quantity that is being replaced. But for the two quantities to cancel each other out, they must have equal values too. Otherwise, the exchange will not be a fair exchange. The equality of values is a necessary condition for the import and export quantities to cancel each other out, both in kWh and in peso terms, as we proved mathematically in Equations (1)-(5).

Note very well that this exchange of quantities and values occurs at the boundary between the utility and the customer, which is the electric meter, the two-way connection of the customer to the grid. Identifying this boundary is important, because it clarifies the confusion about who owns what.

Behind the meter, everything is owned by the customer. Beyond the meter (from the customer's perspective), everything is owned by the utility. The solar owner of course owns the surplus before he ports it out. But as soon as that solar surplus passes the electric meter, reversing it, that electricity turns into utility property. This answers utility arguments that solar owners “are using utility property without paying for it.”[20]

The simultaneous sale to the neighbor. As the solar surplus reverses the first meter on its way out to the grid, it is at the same moment delivered by the utility to the neighbor, who promptly consumes it, a process that is duly recorded in the neighbor's own electric meter. Again, note that it is not the solar owner but the utility, using its own low voltage distribution lines, that delivers the now utility-owned solar surplus to the nearest neighbor.

During this short-hop delivery, it should be easy by now to imagine the offsetting replacement by the solar owner and the sale to the neighbor occurring simultaneously: the replacement reverses the solar owner's meter and, in the same moment, turns forward the neighbor's meter. The simultaneous meter movements in opposite directions duly record the actual replacement by the solar owner and the sale to the neighbor, in the process extinguishing the solar owner's liability to the utility and transfering the liability from the solar owner to the neighbor. Once the solar owner's liability is fully extinguished, it is *as if* the replaced quantity did not enter the solar owner's meter at all. *As if* electricity from a distant power plant just went through some delay along the way and during this delay was miraculously transformed from mixed to clean electricity before it was consumed by the neighbor.

Thus, using only the old bi-directional analog meter, and under net metering and its built-in common reference price, with no need for additional hardware, software or set of accounting procedures, the entire complex set of transactions are fully accounted for.

Where is the double-charging?

Any attempt on the utilities' part to change net metering's common reference price to unequal pricing in its favor will result in double-charging, specifically by billing both the solar owner and his neighbor the same long-haul delivery costs.

The mathematics of this double-charging can be shown, as follows:

Let: S_1 = sales income of the utility from the long-haul delivery
S_2 = sales income of the utility from the short-haul delivery
P = retail price of electricity
Q = total amount of electricity released by the utility for the transaction
P_{GEN} = the average generation price of electricity
P_{ETC} = all other add-on costs, that is, $P = P_{GEN} + P_{ETC}$
Q_R = the replacement amount of electricity sent back by the solar owner to the grid
Q_N = net electric meter reading of the solar owner, that is, $Q_N = Q - Q_R$

The total expected sales income of the utility for the complex set of three-way transactions

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

above is S_1+S_2, and this sum should equal P·Q. Calculating the individual S_1 and S_2, we get:

(11) Sales income from solar owner $$S_1 = \overbrace{\overbrace{(P_{GEN}+P_{ETC})}^{\text{Retail price}} \cdot \overbrace{(Q_N+Q_R)}^{\text{Utility supply}}}^{\text{Expected sales income}} - \overbrace{P_{GEN} \cdot Q_R}^{\text{Credit to solar owner}}$$

(12) Sales income from neighbor $S_2 = (P_{GEN}+P_{ETC}) \cdot Q_R$

Combining the two, we get the total sales income of the utility:

(13) $S_1+S_2 = (P_{GEN}+P_{ETC}) \cdot (Q_N + Q_R) - P_{GEN} \cdot Q_R + (P_{GEN}+P_{ETC}) \cdot Q_R$

Simplifying the above equation, we get:

(14) $S_1+S_2 = (P_{GEN}+P_{ETC}) \cdot Q_N + (P_{GEN} + 2 \cdot P_{ETC}) \cdot Q_R$

The double-charging can be seen as the multipier 2 in the non-generation charges for the solar surplus Q_R. The long-haul costs were charged not once, but twice—to the solar owner and again to the neighbor, although this cost was incurred only in the long-haul delivery but not in the short-haul delivery.

Even if the cost of the short hop were not negligible, the over-charging will not disappear. Because the short hop uses none of the high-voltage transmission lines or the distribution transformers, it will not register on the metering equipment monitoring their use. Ignoring tower and transformer costs, tranmission line costs are usually measured in pesos per kilometer. So roughly, one-thousandth the distance, one-thousandth the cost.The cost of a short, 100-meter hop—to use some typical numbers—will definitely be lower that the cost of a long 100-km haul.

The equation can be further rewritten as follows:

(15) $S_1+S_2 = P \cdot Q + P_{ETC} \cdot Q_R$

In this form, the double-charging also shows itself as an extra unearned extra income, $P_{ETC} \cdot Q_R$, over the expected income P·Q.

What about under-charging?

When utilities order a specific quantity of electricity, say Q, from power plants, they expect to earn P·Q from this amount of electricity, P being its retail price. Under net metering, it appears, they will only be earning a lower $P \cdot Q_N$. Many may believe this claim, unless they saw beyond the incomplete picture that the utilities present. The full picture includes the long-haul delivery to the solar owner, and the short-hop delivery to the neighbor who consumes the solar owner's contribution to the grid.

Going back to the equation for the utility's total sales income, let us change the solar owner's credit from $P_{GEN} \cdot Q_R$ to $P \cdot Q_R$ to enforce a common reference price, and check if any under-charging occurs:

(16) $$S_1+S_2=\overbrace{(P_{GEN}+P_{ETC})\cdot(Q_N+Q_R)-P\cdot Q_R}^{\text{Sales to solar owner}}+\overbrace{(P_{GEN}+P_{ETC})\cdot Q_R}^{\text{Sales to neighbor}}$$

Simplifying the above equation, we get:

(17) $S_1+S_2 = (P_{GEN}+P_{ETC})\cdot Q_N + (P_{GEN} + P_{ETC})\cdot Q_R$

Compare Equation (17) above to Equation (14) in the double-charging case. The multiplier 2 in the non-generation charges for the solar surplus Q_R has disappeared. The double-charging is gone.

The equation simplifies to:

(18) $S_1+S_2 = P\cdot Q$

The utility gets its expected total sales income. There is neither over-charging nor under-charging.

Triple-charging with uni-directional meters

In the Philippines, the single most alarming development in the efforts to block true net metering is the ongoing program in some utilities to replace bi-directional analog meters with uni-directional meters.[21]

The common analog meter reverses properly when power flows through it in the opposite direction. Thus, it is bi-directional and works perfectly with net metering. This kind of meter is consistent with the reference in the RE Act to a “two-way connection to the grid.”

Uni-directional meters, on the other hand, present a solid barrier to net metering, because they record consumption in the forward direction, whether power is flowing into or out of the meter. This means utilities will be charging instead of crediting solar owners who contribute their surplus to the grid, with a perverse result: the more they contribute, the higher their electric bill. This effect has actually been documented by researchers.[22]

Given the analysis in this paper of the double-charging that is already happening, uni-directional meters will lead to really bizarre cases of triple-charging.

The problem for solar owners, as long as they are grid-connected, is that their solar surplus will follow the physics of electricity and will spill out automatically, just like water seeking paths of least resistance.

The well-off can afford to pay the exorbitant fees to register for net-metering and pay for a new pair of electric meters. But low-income households cannot. So they will try size their solar panels small enough to avoid having a surplus. But they will not be able to avoid it all the time. Occasionally, when they leave for work, or if they happen in the daytime to switch off enough

21 This information was obtained confidentially from some electric utility workers.

22 Erees Queen B. Macabebe et. al., “Performance of a 3-kWp grid-tied photovoltaic system in a water refilling station” (Paper presented at the 5th International Conference on Sustainable Energy and Environment: Science, Technology and Innovation for ASEAN Green Growth, 19-21 November 2014, Bangkok, Thailand).

appliances or lights, they will have a solar surplus and this will spill out into the grid. But their uni-directional meter will register it as consumption, penalizing them severely, while the utility accumulates its undeserved earnings.

The problem is so serious that this paper's first recommendation is for the Philippine energy authorities to specifically disauthorize the use uni-directional electric meters by electric utilities.

The campaign to roll back net metering

Net metering made it extremely simple for all to generate most of their own electricity straight from the sun while staying connected from the grid. By 2012, 99% of new PV installations were net-metered.[23] Utilities unfortunately saw this "distributed generation" as a threat to their core business of sellling electricity to the public. Solar rooftops, in effect, were eroding their monopoly status. So, they started a campaign to roll back the gains of net metering.

And although net metering itself is simple in concept and implementation, the exchanges of energy themselves are truly complex. This makes it easier for those who are profiting from the over-charging to muddle the issues and confuse the public. In September 2012, U.S. utility executives met in Colorado to express concern about their "declining retail sales," "loss of customers" and "potential obsolescence," and to plan their moves against this "disruptive technology," net metering, in particular.[24] The utilities' contra-net metering campaign—others described it as the "net metering war"—was launched in 2013. As a 2013 news story put it:[25]

> "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.
>
> "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."

This campaign has already gained success in some States like Hawaii[26]. More States are considering the option.[27] Thus, the double-charging described in this paper is now being inflicted on some U.S. utility customers too. The debate will not only persist, it is bound to intensify and spill out to other countries.

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23 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- projects-_100010943/#axzz3Ud9FFkF9

24 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

25 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.

26 "PUC Approves New Programs; Ends Net Metering". Maui Now. Oct. 14, 2015. http://mauinow.com/2015/10/14/puc-approves-new-programs-ends-net-metering/

27 "16 U.S. States consider changes to net metering". *PV Magazine*. Aug. 17, 2015. http://www.pv-magazine.com/news/details/beitrag/16-us-states-consider-changes-to-net-metering_100020629/#axzz3wGrWv3Sb

There are less than 300 registered net-metering customers in the Meralco service area.[28] The paltry number attests to the solid barriers that exist in the Philippines today against net metering and solar rooftops. The success of Philippine electric utilities in undermining the net metering provisions of the RE Act might unfortunately have given all utilities the lessons they are now applying in the U.S.

This makes it even more urgent for the Philippines to correct the existing flaws in its net metering implementation.

The author first raised the double-charging issue in March 2015, in a book which contained a chapter on net metering in the Philippines.[29] Aside from private unofficial discussions initiated by the author, in which the government side usually defended the ongoing net billing arrangements, no official explanation from the government has been issued. It is time for the government to face this issue squarely.

Enabling true net metering: recommendations

To implement true net metering in the Philippines according to the spirit and letter of the Renewable Energy Act, this paper recommends:

1. that government standards on electric meters specifically exclude uni-directional meters which create a solid barrier against net metering and make triple-charging by utilities possible;

2. that the ERC, *motu propio,* review its decisions and issuances on net metering to ensure that all are consistent with the country's RE Act and its IRR as well as the ERC's own enabling rules on net metering;

3. that the DOE review its website for unofficial or official documentation on net metering which are contrary to the RE Act and its IRR, and withdraw official documents on net metering it has already published which misrepresent the net metering provisions in the country's RE Act;

4. that the NREB immediately convene a conference, open to the media and participated in by government, industry, consumers, and the non-government sector, to validate the analyses and claims of this paper, and to initiate discussions about the long-term sustainability of electric utilities and grid operators in a new era when it will often be cheaper for households and business establishments to generate electricity themselves than to buy it from the grid; and

5. that upon the confirmation of the double-charging described in this paper, the appropriate energy authorities order electric utilities in the Philippines to stop the ongoing double-charging of Philippine net-metering customers and to implement the provision in the law, the IRR and the ERC enabling rules, that the net-metering user be "only charged his net consumption," which is equivalent to a common reference price for the net-metered exchange.

The Philippines suffers from one of the highest electricity rates in the world. The positive side of this problem is that the price of renewable electricity here will beat the grid price earlier than

28 This information came from ERC Executive Director Francis C. Juan in his keynote talk at the "National Legal Conference on Renewable Energy" sponsored by the Friedrich Ebert Stiftung – Philippine Office and the Center for Renewable Electricity Strategies, and held in Manila on Oct. 22-23, 2015.

29 Roberto Verzola. *Crossing Over: The Energy Transition to Renewable Energy.* (Pasig City: Friedrich Ebert Stiftung – Philippine Office, March 2015). p. 48-50.

most other countries. This turns us into an early testing ground for policies and models that can best lead countries into the energy transition to renewables, giving the energy policy debates and experiments here—including the issues, concerns and recommendations raised in this paper—global significance.

Net metering in context

In the final analysis, the issue at hand is not net metering alone but the need to promote solar rooftops as well as clean renewables as rapidly as possible. This need is driven by the following global trends:

1. **Environmental.** Especially after the Paris climate talks in November 2015, the world has awakened to the increasingly destructive impacts of extreme weather events and other associated long-term consequences of global warming and climate change, putting on the main agenda of every country the urgent need to reduce carbon emissions and to hasten the energy transition to renewables. Other toxic pollutants among nuclear- and fossil-fuel-powered plant emissions are also a major concern.

2. **Political.** The insecurity in the global oil supply due to political instabilities in the Middle East remains a major concern, making it difficult for any oil-dependent economy to undertake long-term energy and economic planning.

3. **Economic.** The price declines in the solar and wind industry have reached the point where in service areas where the electricity rates are relatively high, solar electricity from rooftops has become the cheapest source of electricity. The approval today of any nuclear-, coal- or oil-fuelled power plant will lead to a 30- to 40-year lock-in, that will saddle the next generation with technologies that are not only harmful to health and toxic to the environment, but also increasingly more expensive.

This might also be the right time to remind ourselves, especially the utilities, why rooftop solar needs all the support we can give it. Among the renewables, rooftop solar holds the biggest promise as a clean energy source because of the following competitive edge:[30]

Largest price declines. Solar PV has shown the largest decline in prices. The general trend over the past four decades has been a 20-22% decline in PV prices for every doubling of cumulative production,[31] which translates roughly to a 9% decline per year.

Cheapest per-kWh price. In many service areas in the Philippines, rooftop solar is already the cheapest source of electricity, an unheralded milestone which former Energy Secretary Jericho Petilla noted in August 2014.[32] As solar PV prices drop, others will follow suit over the next few years. Electricity from solar rooftops avoids all transmission and distribution costs, as well as other add-ons to the grid electricity price, like metering charges, VAT and other taxes, system loss

30 This list of solar competitive advantage was taken from the author's speech before EDC engineers on January 8, 2016.

31 IRENA. *Renewable Energy Technologies: Cost Analysis Series* (Vol. 1: Power Sector). "Solar Photovoltaics". June 2012. p. 12. www.irena.org%2FDocumentDownloads%2FPublications%2FRE_Technologies_Cost_Analysis-SOLAR_PV.pdf

32 "DOE Sec. Petilla: Renewables Pave the Way to Energy Security in the Philippines," Department of Energy. http://www.doe.gov.ph/news-events/events/announcements/2473-doe-sec-petilla-renewables-pave-the-way-to-energy-security-in-the-philippines.

charges, universal charges, etc. Thus, solar rooftop electricity enjoys a built-in competitive edge over all other grid-delivered electricity. Their cheaper output also replaces expensive electricity from fossil-fuelled peaking plants, helping bring down the average cost of electricity;

Shortest implementation times. Complete solar PV systems can be bought off-the-shelf and installed in a few hours. Larger systems may take a few days. No other technology, renewable or not, approaches the short install times enjoyed by rooftop solar.

Smallest incremental investments. Solar PV investments can be done in small affordable steps, from a few watts to a few kilowatts for households and small business establishments, to a few megawatts for utility-scale solar. Potential solar owners can start small, to take advantage of the solar benefits that can already be enjoyed today, and save their larger investments for the future, while waiting further price declines and better technologies.

Most accessible to low-income households. No other technology today can do better than rooftop solar in enabling ordinary households to generate electricity themselves, instead of buying it from a monopoly. Accessibility is not only a matter of price. The sun is also more universally accessible than steady winds, steep river flows, underground heat, or biomass.

Lowest system losses. Longer wires have more resistance and larger losses. Even hydro, wind, geothermal and biomass electricity have to pass through transmission and distribution lines to reach consumers. Rooftop solar electricity has the shortest distance to travel from source to load. By reducing the burden on existing power plants, transmission lines and distribution networks, solar rooftops also delay or avoid altogether the need to invest in such infrastructure, helping keep electricity prices low.

Most reliable long-term source. The sun is the most reliable source of energy. Humanity cannot deplete it or use it up. It rises predictably every morning. Even if regularly covered by clouds, its output over a week, a month or a year can still be predicted with good accuracy. And with better weather prediction tools, our ability to predict solar output with greater certainty will improve over time. Solar panels are often the only reliable source of energy in typhoon- and flood-hit areas. They also help improve the country's energy security by relying on locally available sunlight instead of imported fuels.

Least environmental impact. Solar rooftops are the only energy source under which you can sleep soundly, without worrying about hazards to your health, safety and the environment. The health and environmental impact of solar PV manufacturing is by no means zero, but they are more easily mitigated and solved, compared to the super-massive impacts of nuclear and fossil fuels.

Clearly, we have all the reasons to provide the most favorable enabling environment for this technology. Although the supermarket does not lose anything, it will be unusual for a customer to keep picking items from the shelves, only to return it at the check-out counter for the next in line to pay for, or for a homeowner to keep sending his high-quality water into the main water supply, although he is clearly doing his neighbors a service. Given the benefits above of solar rooftops, however, the government rightly decided to encourage solar owners to keep replacing their consumption with solar electricity from their rooftops, so that not only the neighbors but also the whole country can benefit from the cleaner electricity. That is why net metering is in the RE Act.

If implemented in Philippines in the same effective manner as it has been in much of the U.S., net metering can be expected to open the floodgates to the solarization of rooftops. This will enable the general public to participate in the ongoing renewable energy transition, not just as passive buyers of electricity but as active producers themselves, engaging the utility through a peer-to-peer exchange model that has already proven itself in the information industry and is also emerging as a potential game-changer in the energy industry.

Utilities cannot beat the sun as an energy source. In many parts of the Philippines today and everywhere in the country in a few years, utilities cannot beat the rooftop solar prices either. Hopefully, most utilities will be smart enough to find a profitable way to join the effort to put solar panels on every roof in the country.

And the best way to do it, as the U.S. experience has shown, is through net metering.

Limitations of the study

This paper is a micro-level analysis of the set of transactions that occur when a solar owner's surplus goes into the grid under Philippine net metering rules. As such, it is subject to the following limitations:

1. Net metering rules in other countries may differ significantly enough from Philippine rules to invalidate the paper's analysis.

2. The paper analyzed the transactions as an offsetting exchange of energy, as specified in Philippine laws. Where rules specify that the process of sending out one's solar surplus to the grid is in fact a sale, then an entirely different microeconomic analysis is must be done to discover the true value of a) the solar surplus and b) the short-hop, if its cost is not in fact negligible. This is not as easy as it sounds. The feed-in-tariff system of Germany, started by paying the solar surplus several times retail price, because they valued solar electricity that much, at that point. Utilities want the solar surplus valued at their average generation cost, or roughly half of the retail price. This shows the range of possible values solar electricity can actually take. But utilities for pay for electricity at higher than retail, during times of peak demand, which are also the times of peak solar output. This argues for a similar higher-than-retail price for the solar surplus, especially since solar electricity can be considered a much higher quality of electricity than the mixed electricity the utilities supply. So in fact setting a reference price for solar at retail is already a compromise. This matter must be studied further in countries that want to consider net-metering transactions a sale rather than an a peer exchange. But RE Law has already made this decision for us—the price of the solar surplus must be the retail price, because the transactions are exchange of energy, not a sale.

3. To respond to another category of utility arguments against net metering requires a longer-term, business model-based and macro-level analysis that is beyond this paper's scope. The impact on profitability of the continuing occurrence of net-metered exchange transactions over the life of electric utility is a valid issue but it is distinct from the micro-level transaction-based analysis done in this paper. The concern of utilities that net metering and rooftop solar are a threat to their very survival is an issue of business models, separate from the issue of fairness of the net metering accounting mechanism. This important matter should be explored further in future studies.

[*This paper was prepared by the author for the Energy Policy and Development Program (EPDP) Conference 2016 held January 12-13, 2016 in Manila. Roberto Verzola is the Executive Director of the Center for Renewable Electricity Strategies. He may be reached at rverzola@gn.apc.org, or at 0917-811-7747*.]