BEFORE THE
PUBLIC SERVICE COMMISSION OF WISCONSIN

Joint Application of Wisconsin Electric Power
Company and Wisconsin Gas LLC, both d/b/a
WE Energies, to Conduct a Biennial Review of
Costs and Rates - Test Year 2015 Rates

REBUTTAL TESTIMONY OF ASHLEY C. BROWN
ON BEHALF OF WISCONSIN ELECTRIC POWER COMPANY

Q. Please state your name, occupation, and address

A. My name is Ashley C. Brown. I am Executive Director of the Harvard Electricity Policy Group (HEPG) at the John F. Kennedy School of Government, at Harvard University. HEPG is a “think tank” on electricity policy, including pricing, market rules, regulation, environmental and social considerations. HEPG, as an institution, never takes a position on policy matters, so my testimony today represents solely my opinion, and not that of the HEPG or any other organization with which I may be affiliated.

Q. Please describe your professional qualifications.

A. I am an attorney licensed to practice law in Massachusetts, Ohio, and the District of Columbia.

I served 10 years as a Commissioner of the Public Utilities Commission of Ohio (1983-1993), where I was appointed and re-appointed by Democratic Governor Richard Celeste. I also served as a member of the NARUC Executive Committee and as Chair of the NARUC Committee on Electricity. I was a member of the Advisory Board of the Electric Power Research Institute. I was also appointed by the U.S. Environmental
Protection Agency as a member of the Advisory Committee on Implementation of the Clean Air Act Amendments of 1990. I am also a past member of the Boards of Directors of the National Regulatory Research Institute and the Center for Clean Air Policy.

I have served on the Boards of Oglethorpe Power Corporation, Entegra Power Group, and e-Curve, and as Chair of the Municipal Light Advisory Board in Belmont, MA.

I serve on the Editorial Advisory Board of the *Electricity Journal*.

I have been at Harvard continuously since 1993. During that time I have also been Senior Consultant at the firm of RCG/Hagler, Bailly, Inc. and have been Of Counsel to the law firms of Dewey & LeBoeuf and Greenberg Traurig. I have also taught in training programs for regulators at Michigan State University, University of Florida, and New Mexico State University (the three NARUC sanctioned training programs for regulators), as well as at Harvard, the European Union School of Regulation, and a number of other universities throughout the world. I have advised the World Bank and the Inter-American Development Banks on energy regulation, and have advised governments and regulators in more than 25 countries around the world, including Brazil, Argentina, South Africa, Costa Rica, Zambia, Tanzania, Namibia, Mozambique, Hungary, Ukraine, Russia, India, Bangladesh, Saudi Arabia, Indonesia, and The Philippines. I have written numerous journal articles and chapters in books on electricity markets and regulation, and am co-author of the World Bank’s *Handbook for Evaluating Infrastructure Regulation*.

I hold a B.S. from Bowling Green State University, an M.A. from the University of Cincinnati, and a J.D. from the University of Dayton. I have also completed all work, except for the dissertation, on a Ph.D. from New York University. My current CV is provided as Ex.-WEPCO/WG-Brown-1.
Q. Have you previously testified before the Wisconsin Public Service Commission?

A. No. I have testified, however, before FERC and various state commissions, as well as before Congressional and state legislative committees.

Q. On whose behalf do you offer your testimony?

A. On behalf of Wisconsin Electric Power Company (WE).

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to assess the value of distributed (DG) solar photovoltaics (PV) and appropriate pricing for its value and output. In the course of my testimony I will address various points made in the direct testimony of RENEW/ELPC witnesses Gilliam, Rabago and Vickerman; MMSD witness Cicchetti; TASC witnesses Hornby and Friedman; and Commission Staff witness Singletary.

In particular, I will address the argument advanced explicitly or implicitly by witnesses Gilliam, Vickerman, Cicchetti, Hornby and Singletary that retail net metering is an equitable way to compensate customers who own DG. (Direct-RENEW-Gilliam-15-16; Direct-RENEW-Vickerman-3-4, 6-7, 10-18, 20-31, 33-34; Direct-MMSD-Cicchetti-23-24; Direct-TASC-Hornby-3-4, 8-10, 14-28; and Direct-PSC-Singletary-13-24, 36.) I will also address the argument advanced by witnesses Gilliam, Rabago and Hornby in favor of a “value of solar” approach to compensating solar PV DG customers. (Direct-RENEW-Gilliam-6-10, 15-16; Direct-RENEW-Rabago-44-50; Direct-TASC-Hornby-10-13.)

Q. What conclusions do you reach in your testimony?

A. My conclusions are that retail net metering and “value of solar” are severely flawed schemes for pricing solar PV DG. Net metering overvalues the energy produced as well
as the installed capacity, is very heavily cross-subsidized by non-solar customers, and is
socially regressive in that it transfers wealth from less affluent to more affluent
consumers. The "value of solar" approach promulgated by solar advocates like witnesses
Gilliam, Rabago, and Hornby artificially inflate the benefits of solar PV DG and discount
the costs. I also conclude that WE’s proposal is a very reasonable, market-based system
for pricing solar PV DG, and that the proposals for demand and fixed charges as applied
to solar PV DG hosts are reasonable ways to rectify the cross-subsidies in net metering.

Net metering and the value of energy and other attributes of distributed solar PV.

Q. Do you see value in distributed solar PV?

A. Yes, I do. Solar PV has some very real benefits and long-term potential. The marginal
costs of producing this energy are zero. If one looks at environmental externalities, then
the carbon emissions from the actual process of producing this energy itself, without
taking the secondary effects into consideration, are also zero. Significantly, the costs of
installing solar PV have declined in recent years, adding to the potential long term
attractiveness of solar. Those are very real benefits that would be valuable to capture. In
its current, most common configuration, however, it has some drawbacks that inhibit it
from capturing its full value. Solar PV is intermittent and thus requires backup from
other generators and cannot be relied on to be available when called upon to produce
energy. Thus, its energy value is entirely dependent on when it is produced and its
capacity value is, at best, marginal. To fully develop the resource, therefore, it is
imperative to provide pricing that will allow solar PV DG to fulfill its potential, by
linking itself to storage, more efficient forms of catching the sun’s energy, or other types
of generation (e.g. wind) that complement its availability. Thus, it is critical that prices

REBUTTAL-WEPCO/WG-BROWN-4
be set in such a fashion as to provide incentives for productivity and reliability and not to subsidize it at a decidedly low degree of optimization. Solar has huge potential, but to attain it, it needs to receive the price signals to fully exploit its capabilities.

To fully assess the value of solar, one would need to look at the resource in all of its dimensions, not simply the costs and environmental effects derived from the energy-producing process itself. It is also critical to think of pricing in the context of establishing incentives for technological improvements that would increase its efficiency.

Solar PV's present value, on a stand-alone basis, is very limited because of its intermittent nature and its uncertain availability.

Q. Are you saying that the prices paid for distributed solar PV should be the result of an analysis of all the criteria and ascribing empirical value to them to establish prices?

A. No, I am not saying that at all. What I am saying is that many in the solar industry have come to recognize that retail net metering (NEM) is, in the age of smart grid and more sophisticated technology, no longer a defensible method for pricing solar DG. Having recognized the inevitable demise of a pricing system that favors their resource through cross-subsidization by other customers, many solar advocates have shifted to an argument that pricing should be based on consideration of the “value of solar.” While I do not subscribe to that point of view, I recognize that the argument is being made and a regulatory forum, such as this, has an obligation to provide a fair hearing for those who call for a “value of solar” based pricing system, so it seems appropriate to respond to the arguments being advanced. I will, however, focus heavily on net metering (NEM) because that is the historical status quo in Wisconsin which WE has proposed to change,
and which many of the solar interveners, by attacking WE’s proposal and offering no
alternative of their own, are effectively trying to defend.

Q. How do you define net metering (NEM)?

A. To begin, I would note that I use the terms "net metering," "retail net metering" and
"NEM" interchangeably and synonymously. What I mean is that the meters run forward
when solar PV DG customers are purchasing energy from the grid. When those
customers produce energy and consume it on premises, the meter simply stops, and when
the customer produces more energy than is consumed on premises, the meter runs
backwards. Thus the solar PV DG customer pays full retail value for all energy taken off
the grid, pays nothing for energy or distribution when self-consuming energy produced
on premises, and is paid the fully delivered retail price for all energy exported into the
system. At the end of whatever period is specified, the meter is read and the customer
either pays the net balance due, or the utility pays the customer for excess energy
delivered. The reconciliation is made without regard to when energy is produced or
consumed. This is how transactions between owners of DG and utilities have
traditionally been handled, and is the scheme which the intervenors in this case would
like to maintain.

Some call this arrangement retail net metering, and that is what I am referring to when I
say net metering or NEM. There are other forms of net metering such as wholesale net
metering, where exports into the system are compensated at the wholesale price -- often
LMP -- and certain of WE’s tariffs have been so structured. There are other variations as
well, but for purposes of my testimony, when I use the terms NEM or net metering I am
referring to the retail variety.
Q. What is the "value of solar"?
A. There are, conceptually, four possible approaches to pricing solar PV DG. One is to set the price to reflect the market clearing price in the wholesale market at the time the energy is produced. That is a market approach. A second approach would be a cost-based approach, where the price is set based on a review of the costs or according to standard costing methodology. A third approach would be, as I already discussed, net metering. Finally, a fourth approach would be to administratively derive a “value of solar” based on analysis of avoided costs and whatever else the evaluators believe to be worthy of measure. As you will see, while I do not believe this fourth approach to be appropriate, I do think that analysis of the criteria its advocates believe are important should be conducted and evaluated -- not to set the price, but simply to establish the context for evaluating the reasonableness of the pricing methodology approved.

Q. When you say that you do not subscribe to the point of view that distributed solar prices should be established by assessment of the “value of solar,” what exactly do you mean?
A. Optimally, prices for electricity are determined by a competitive market or derived from cost-based regulation, and thus are essentially subjected to an external discipline that should result in efficient resource decisions devoid of arbitrary or “official” preferences. Subjective consideration of the “value” of particular technologies and where they may rank in the merit order of “social desirability,” as proposed by certain of the intervenors’ witnesses, effectively removes the discipline that is more likely to produce efficient results. (See, e.g., Direct-RENEW-Gilliam-6-10; 15-16; Direct-RENEW-Rabago-44-50).

Whereas both the marketplace and transparent cost-based regulation are likely to produce
coherent pricing that allows us to enjoy a degree of comfort knowing that efficient
performance will likely lead to productivity, subjective consideration of soft criteria, like
“value of solar,” are a step away from coherence and reasonable predictability.

Q. Are you saying that economic efficiency should be the sole basis for resource selections?
A. I am saying that economics is critical, and that efficiency is of vital importance. I am
also aware and certainly agree that there are other economic values, besides efficiency,
especially those that go beyond short term efficiency. It is also obvious that many people
believe that other, non-economic factors need to be considered. Certainly the fairness of
the impact on customers also needs to be factored into any decisions. There has, for
many years, been a running debate in electricity regulation as to whether externalities
ought to be factored into regulatory decisions. I do not, for purposes of this testimony,
intend to join in that debate. Similarly, I do not want to express any point of view as to
what is permissible or not permissible under applicable law.

I would also suggest two things about consideration of externalities. If they are to be
considered, then all relevant ones deserve attention, as opposed to “cherry picking” the
issues to best protect a particular interest. Secondly, if the Commission believes that non-
economic objectives should be factored into its decision, then it would be wise to
prescribe the ways of attaining them that are the most efficient from an economic point of
view.

Q. If one were to assess all of the criteria that need to be considered, what would they be?
A. There are a number of them that are quite important in the full valuation of solar PV.
One would begin, of course, by looking at the cost of producing energy. Beyond that, the
criteria would include availability/capacity, reliability, energy value, impact on system
operations and dispatch, transmission costs and effects, distribution costs and effects and
hedge value. Solar proponents often phrase these issues in terms of avoided costs.

While, as you will see in my testimony, I do not agree that many of the costs identified
are actually avoided, I have no problem examining the claims in the context of whether
costs are avoided. In addition to those dimensions, there are also the following: degree
of subsidization and cross-subsidization, efficiency considerations, impact on alternative
technologies, market price impact, reliability, and social effects including the
environmental and customer class impacts. There is also the issue of whether distributed
solar PV enhances the level of competition in the industry, or whether anything WE has
proposed would deny the solar industry its right to compete.

In the interests of full disclosure I draw many of the criteria from the writings of RENEW
witness Rabago. While I do not agree with the value of solar approach to setting rates for
solar PV DG, I generally believe that the criteria he has identified, and, in fact, testified to
in this proceeding are among the ones that one should contemplate if one follows that
approach. I was, however, disappointed that in his testimony, Mr. Rabago simply lists
the criteria and does absolutely no analysis to demonstrate that the actual facts justify his
assertions. He provides a laundry list of “benefits” he asserts WE fails to consider, but
offers absolutely no insight into why anyone would think solar PV DG offers any of the
benefits he enumerates. (Direct-RENEW-Rabago-46). He also claims that solar PV DG
offsets “expensive peak generation,” but provides absolutely no data to back up his claim,
and, as my testimony will demonstrate, that assertion is generally wrong. (Direct-
RENEW-Rabago-13). In fact, solar PV DG production is, as a general rule, not
coincident with peak. As my testimony will point out, the evidence is compelling that
solar PV DG offers few, if any, of the benefits Mr. Rabago claims, and in some cases, the purported benefits are in fact detriments. I would also note that The Alliance for Solar Choice witness Hornby also calls for an assessment of the cost and benefits of what he calls “customer owned generation” (Direct-TASC-Hornby-10-13), a sometime accurate, but often inaccurate description of facilities that are often, in many jurisdictions, owned by large solar companies that “lease” them to property owners.

Q. Does net energy metering (NEM) capture all of those values?

A. It most decidedly does not. NEM, as practiced, significantly over-values distributed solar generation. In terms of the values enumerated earlier in my testimony, solar PV DG does the following:

1. Creates a cross-subsidy from non-solar to solar customers;
2. Fails to reflect the inefficiency of small scale solar PV relative to other forms of generation, including alternative renewable resources;
3. Constitutes price discrimination in favor of an inefficient resource;
4. Significantly overvalues both the capacity and reliability value of solar PV DG;
5. Adversely impacts the degree of competitiveness in the industry;
6. Artificially inflates the transmission value of solar PV DG;
7. Fails to account for the fact that the value of energy varies widely depending on when it is actually produced;
8. Distorts price signals for energy efficiency;
9. Causes socially regressive economic impact;
10. Assumes system benefits from solar PV DG that, in fact, may not exist;
11. Overvalues its contribution to carbon reduction; and
12. Vastly inflates its value as a fuel hedge.

Q. If NEM fails to capture those values, why has it become the prevalent form of tariff for solar DG in the U.S. today?

A. It was never developed as part of a fully and deliberatively reasoned pricing policy. NEM was simply never a conscious policy decision. It is basically a default product of two no longer relevant considerations, one practical and the other technological. The practical reason is that distributed generation had such an insignificant presence in the market that its economic impact was marginal at best. Thus, no one was seriously concerned about “getting the prices right.” The second, technological reason is that the meters most commonly deployed, especially at residential premises, until recently have had very little capability other than to run forward, backward, and stop. Thus, for technical reasons, NEM was simple to implement and administer, and, as a practical matter, given the paucity of DG, there was no compelling reason to go to the trouble of remedying a clearly defective pricing regime. Many states, however -- some of which Mr. Vickerman notes at page 9 in his testimony -- have recognized the problems with NEM, but seeing no alternatives to it, put in place production caps to limit any harm caused by a clearly deficient pricing regime.

Retail net metering sets up unfair and counterproductive cross-subsidies.

Q. Beyond failing to capture the values you mentioned, are there other problems with NEM?

A. Yes. Under NEM, when DG providers export energy into the system, consumers are required to pay them full retail rates for a wholesale product. What everyone agrees upon is that solar PV DG provides an energy value, although there is considerable disagreement about what that value is. Solar proponents argue that it has a capacity value
as well. I believe that value, if it exists at all, is minimal, but solely for purposes of answering this question I will assume some level of capacity value. Both energy and capacity are wholesale products and should be compensated as such. While, as I will discuss later in my testimony, there may well be reasons to treat DG differently from wholesale generation for transmission purposes, there is, absent a solar host leaving the grid, absolutely no reason to discriminate between wholesale and DG producers in regard to the fixed costs of the distribution system and its operations. Indeed, no solar industry witness in this proceeding even makes any claim about solar providers providing distribution services. Under NEM, however, solar PV DG providers are compensated at full retail prices for what they provide. That includes the not-insignificant cost of services that they, indisputably, do not provide, including distribution costs, administrative and back office operations. There simply can be no justification for forcing consumers to pay a provider for service they not only do not provide, but, in fact, have no capability to provide. Solar PV DG producers remain connected to the grid, and are fully reliant upon it in the many hours of the day when solar energy is not available. Under NEM, that solar PV DG producer is excused from paying his/her share of the costs of the distribution system when energy is being produced on premises. If the costs of the distribution system were variable with energy production, that would be sensible, but they are not. Distribution costs are fixed, and do not vary with energy production or consumption. Thus, excusing solar PV DG customers from paying for their own distribution costs at the time their solar units are functioning has no justification in either policy or economics. Making matters worse, the costs solar PV DG providers do not pay under NEM are either reallocated to
non-solar customers or have to be absorbed by the utility. Both outcomes are unacceptable and unjustifiable. There simply is no reason why solar PV DG customers should receive free backup service compliments of either their neighbors or the utility.

Q. Is that the cross-subsidy you referred to in your testimony earlier?

A. Yes, that is part of it.

Q. Beyond what you have already testified to, what other cross-subsidies are embodied in NEM?

A. Another cross-subsidy relates to the intermittent nature of solar energy. No utility with an obligation to serve, such as WE, can be fully reliant on the availability of solar when it is needed. While I will explain more about that in subsequent testimony, suffice it to say that this gives rise to two types of cross-subsidy. The first arises when the distributor relies on the availability of solar for making day-ahead purchases, and the other arises when it does not do so. When it does rely on the availability of solar and it turns out that solar energy is not available when called upon, the utility is compelled to purchase replacement energy in the spot market at the marginal cost, which is almost certainly higher than the price of the solar energy on whose availability it had relied. In notable contrast to what happens in the wholesale market when a supplier who is relied upon fails to deliver, those incremental costs have to be borne by the utility, which passes them on to all customers, as opposed to being borne by the specific solar PV DG customer whose failure to deliver caused the costs to be incurred. If the distributor, in recognition of solar’s intermittency, instead chooses to hedge against the risk of solar’s unavailability, the cost of the hedge is likewise passed on to all
customers rather than simply those whose supply unpredictability caused the cost to be incurred.

Both of these forms of cross-subsidy violate a bedrock principle of regulation -- that costs should be allocated to the cost causer. The function of that principle, of course, is to provide price signals to improve performance, but NEM fails to provide such signals and essentially holds solar PV DG providers harmless for their own very low capacity factors and inefficient performance.

Q. Are NEM cross-subsidies helpful to the solar PV DG industry?

A. Yes. In the short term they constitute a wealth transfer from WE's non-solar customers to the solar industry. In the long term, however, they are actually harmful to solar energy because NEM provides absolutely no incentive to improve the performance of a generating resource that, among renewables, already ranks last in efficiency and in cost effectiveness for reducing carbon emissions. In effect, the solar industry is putting its short-term profits ahead of the long-term value of solar energy. If they prevail in seeking to maintain NEM, that victory will be short-lived, because markets, both regulated and unregulated, do not prop up inefficient resources over the long term.

Q. Do the WE proposals address the cross-subsidy issues?

A. Yes they do, in two ways. First, the fixed charges being proposed for solar PV DG customers will compel them to pay more of the distribution costs they currently avoid under NEM whenever they are producing energy. By requiring solar customers to pay all of their share of customer related fixed costs, the non-solar ratepayers will no longer have those costs re-allocated to them.
Second, the demand charge will end the cross-subsidy inherent in socializing the costs of
hedging against the unreliability of solar PV, or the alternative of incurring the costs
associated with buying energy at the marginal cost when solar panels are not producing
what is required.

It is also noteworthy that, if adopted, WE’s proposal on these two issues will adhere to
the regulatory principle that the cost causer pays for those costs he/she causes to be
incurred.

Q. How effective is NEM for providing appropriate price signals?

A. It is woefully ineffective. Electricity prices can be quite volatile over the course of every
day, and, of course, vary seasonally as well. Rather than reflecting those prices, NEM
simply treats all energy the same regardless of the time during which it is produced. For
example, it fails to differentiate between energy produced on peak and off peak. It pays
off-peak solar PV DG a price that is averaged with on-peak prices, thus effectively over-
valuing the energy. Conversely, if solar PV DG were actually produced on peak, NEM
would average that price with off-peak prices, thus undervaluing the energy. Any form
of dynamic pricing, ranging from time of use to real time, could address this issue with
more precision than flat, averaged prices. Interestingly, under the first scenario, cross-
subsidies would be paid to solar producers, while, in the second scenario, solar producers
would be cross-subsidizing the other ratepayers. In short, the price signal, and the
efficiency that would flow from that, is completely lost.

Q. Do you agree with the solar witnesses that, if adopted, WE’s proposals will harm the
profitability of the solar PV DG industry?
A. They may, but if solar producers improve their efficiency, these changes may actually improve the industry's profitability. After all, under the WE proposal, if solar units produce on peak, they will be better compensated than if they are off peak, so their financial performance will be driven in large part by their efficiency as producers.

As a matter of public policy, however, I believe that the solar witnesses' core argument is very flawed. What they are seeking is a pricing regime that has, at its core, the assurance of profitability for them, without regard to productivity or efficiency. NEM accomplishes that for them. Their self-serving reasoning reminds me of Charles Wilson, the former Chairman of General Motors, later Secretary of Defense, who once famously stated: “What’s good for General Motors is good for the country.”

The argument being made about the industry’s profitability is flawed on several counts. Indeed, it is directly contrary to some bedrock principles of regulation and ratemaking. First, seeking a pricing regime that locks in guaranteed profits, as NEM does, violates a fundamental principle of regulation, namely that profits are not guaranteed but are earned by performance. It also violates another key regulatory principle that pricing should include balanced and symmetrical incentives for improvements in productivity and efficiency, which NEM decidedly lacks. Finally, regulation needs to seek a balance between the consumer interest and the industry interest, and NEM is very heavily skewed against non-solar customers and in favor of the solar industry.

Q. What about the argument that what WE is proposing would be unfair because it changes the rules on solar PV DG in the middle of the game?

A. My view is that the solar PV DG industry is not only not regulated; it does not want to be. Indeed, it seeks the best of both worlds: low risk and high profits. It seeks that status by
attempting to shield its profits from regulatory oversight while manipulating the
regulatory process to extract those profits from a largely captive customer base (which
includes both solar and non-solar customers who are compelled to pay NEM prices).

Given the perch of the industry in both regulated and unregulated aspects of business, it
should come as no surprise that the laws, rules, and tariffs do sometimes change. Indeed,
economic conditions and technology change, so it is simply unreasonable to expect rules
that last for eternity.

In the specific context of NEM, however, it is simply disingenuous to suggest that
proposals such as the ones made by WE in this proceeding are unexpected and
unanticipated. NEM was, as noted, never a thoroughly reasoned policy derived from a
public deliberation, but was simply a default policy that was convenient and
inconsequential at the time of implementation. It should surprise no one that once
dynamic or time-sensitive pricing came into existence, and once solar PV DG achieved
substantial levels of market penetration, changes regarding NEM would be on the table.

Moreover, Wisconsin is hardly the only state where this issue is on the table. It is being
debated in many regulatory forums, not only in the U.S., but in various jurisdictions
around the world. Most importantly, for reasons already noted, subsidies and cross-
subsidies such as NEM are almost always designed for short-term purposes and rarely
last forever. Finally, as the chart from Lazard found on page 23 of my testimony
demonstrates, the market is already aware of the high cost of solar DG PV, so investors
have almost certainly already factored the risk associated with high costs into their
expectations from the industry. The solar industry's surprise at WE's proposal is
reminiscent of Claude Raines in the film Casablanca, expressing complete shock that
gambling was occurring at Rick’s Place. No one can ever have any reasonable expectation that a pricing regime providing an above-market price for a less efficient product is sustainable.

Q. Do you agree with Alliance for Solar witness Hornby that imposing demand and facilities charges on solar PV DG hosts is unfairly discriminatory (Direct-TASC-Hornby-14)?

A. No. It is not unfairly discriminatory at all. Solar hosts, and I use that term to generically encompass both owners and lessees of solar panels, have very unique characteristics. They are users of the distribution system, either as active users or passive users (i.e., reliability backup), depending on when their panels are generating energy. They also depend on the system to deliver their excess output for sale. Under NEM they do not, however, pay for the service the grid provides them when they are self-consuming their own energy production. Moreover, under NEM, they are paid as if they were providing distribution services even though they provide no such service. Those are a very unique set of characteristics that I do not believe are shared by any other class of customers, and that justify the imposition of a facilities charge on them that may not be imposed on a different class of customer. Indeed, the failure to recognize that solar hosts are a different type of customer, as is implicit in NEM, imposes more costs on non-solar customers and is, in fact, discriminatory as to those customers because it forces them to pay costs which they did not cause to be incurred.

In regard to the demand charge, again solar PV DG customers are unique. They are intermittent and somewhat unpredictable generators of energy, but the utility has an open ended obligation to serve them. The utility will have to buy energy at the marginal cost to serve solar hosts when they fail to generate their own supply, or it will have to hedge
against that contingency. Either way, those costs are caused entirely by the nature of
solar PV DG and are entirely attributable to the hosts of those facilities. It is hardly
discrimination to compel a customer to pay for costs he/she caused to be incurred.

Q. Aren't the cross-subsidies needed to promote the growth of renewable energy?
A. One can debate this point, but nothing in what I am saying, or in what WE is proposing,
would remove the tax credits and other government-sanctioned or sponsored subsidies.
Thus, nothing in this case will reduce the amount of direct subsidy that flows into solar
energy. The issue in this case is whether the value of a highly inefficient cross-subsidy
inherent in NEM is outweighed by the misguided price signals, regressive social
implications, unfair cost-shifting, transgressions against some bedrock principles of
regulation, and other adverse effects of NEM. As my testimony progresses, it will
become evident that I believe that NEM as currently designed has many more negative
than positive effects. Thus, even if there were a case for cross-subsidizing solar PV DG,
and I am not convinced that there is, NEM is not the proper vehicle for it.

Q. Why do you say that?
A. The fact that conscious subsidies and/or cross-subsidies are designed to promote a
particular technology raises two key issues. Many would argue that the government,
including regulators, should not be picking winners and losers in the marketplace. While
I generally agree with that premise, I can see circumstances where, for policy reasons,
government might want to provide support for a socially and economically desirable
technology and/or assist it to get past the commercialization hump. That leads inexorably
to the second, and, more relevant issue, concerning solar PV DG: namely, that subsidies
and cross-subsidies for those purposes, especially the latter, need to be designed as near-
term boosts rather than a permanent crutch. In other words, the subsidy/cross-subsidy should be designed to serve as both a stimulus for the designated technology and an incentive to the producers and vendors of the technology to become more efficient. In the case of solar PV DG, that means to attain grid parity with other resources. The objective is to assist a technology to achieve commercial viability. The problem with NEM, of course, is that it is effectively an indefinite crutch, with absolutely no built-in incentive to increase efficiency and/or to achieve grid parity. In effect it requires non-solar customers to pay more for the least efficient renewable resource in common use and provide the solar industry with no economic incentive to improve its productivity or availability or wean itself off dependence on the cross-subsidy. It is particularly telling that most of the solar witnesses in this case treat NEM as a form of entitlement, since it existed at the time some of the solar investments were made. In essence, they are demanding a permanent, assured revenue stream from captive customers to support their market position without having to improve their productivity or efficiency. The reason why solar PV DG vendors and providers cling to cross-subsidies is because they find more comfort in receiving substantial cross-subsidies than they do in the prospect of becoming competitive. Solar PV DG is the most expensive form of generation widely used today. The chart that follows illustrates that point:
Q. Why should NEM be revisited now?

A. We now have pricing methods that are more capable of measuring DG production as well as consumption on a more dynamic basis. In addition, solar DG market penetration has dramatically increased to the point that it can no longer be dismissed as marginal, so appropriate pricing is now a non-trivial issue. In addition, we now have very precise, location-specific energy and transmission price signals that provide a very transparent market price by which one can measure the economic value of distributed generation.

These new developments, plus the fact that NEM was put in place on a default basis, mean that it is now time for a full-blown policy consideration of the most appropriate pricing policy for distributed generation.

Q. Are there reasons to discard retail NEM as you have defined it above in favor of the sorts of policies WE has proposed?
A. Yes. There are very compelling reasons to do so.

Q. Please enumerate the reasons why NEM should be discarded.

A. The answer to this is quite simple. For all of the reasons I have noted, NEM pricing results in large cross-subsidies, offers no incentives for efficiency -- indeed, may even provide disincentives to invest in efficiency improvements -- and results in consumers paying energy prices for solar PV DG that are far in excess of its market value and not even subject to cost-based oversight. Moreover, its raison d'être -- inability to more accurately price solar PV DG facilities and low market penetration by solar energy -- no longer exists. Solar energy is penetrating the market in greater numbers and is likely to continue to do so. Secondly, more sophisticated pricing enables us to measure solar energy and customer behavior on a much more efficient, dynamic basis. The fundamental reality is that NEM utterly and completely fails to capture the value of the product being priced.

At the risk of being a bit repetitive, it is worth emphasizing just how imperfect NEM actually is. The price of electric energy is not constant. Wholesale markets reflect that reality. Net metering and many forms of incentives do not reflect the values established by the market. Rather, a net metering regime relieves the solar panel host of any obligation to pay for the costs of the distribution system when energy is being produced, even though he/she remains reliant on it and, when the meter runs backwards, is effectively paid the full retail price for energy exported from the customer’s premises. As a point of illustration, see below for a funding mechanism for residential customers presented by DTE Energy to the Michigan Public Service Commission. According to
DTE, the 3 cent per kWh difference between the net metering credit and the unrecovered fixed utilities cost represents a differential that non-participating customers must pay.

Under NEM, compensation at retail rates is not cost-reflective because net metering means that solar DG energy exported into the distribution network is compensated at the full bundled retail rate on an averaged basis rather than at a price based on the unbundled cost of producing the energy at the actual time of production. Thus, it does not reflect the obvious fact that the energy has greater value at peak demand than it does off peak. It is a deeply flawed value proposition from an economic point of view. The fact is that the wholesale market produces hour-by-hour prices that provide generators (renewable and non-renewable alike) and consumers with important price signals that reflect real-time values. Both generators and demand responders are compensated according to those real-time prices. Solar DG-produced energy, by contrast, is compensated on a basis that lacks a foundation in either market or cost. The compensation is out of market because it is a
flat price regardless of when it is produced. It is hard to avoid the conclusion that on an
economic basis, the net meter-derived price paid for solar DG energy completely misses
the value of solar during most hours of the day. In fact, that failure is famously
illustrated by the following California ISO Duck Curve:

As is dramatically illustrated in the graph, enticed by a number of factors, not the least of
which is net metering, substantial investment in the growth of solar capacity in the
Golden State has enormously magnified the need for additional fossil plants, operating on
a ramping basis, to compensate for the drop off in solar production at peak. In that
context, the absence of any meaningful signal to make solar more efficient (e.g. linking it
with storage) is simply something that can no longer be tolerated.\(^1\) While Wisconsin’s situation is not identical to California’s, it would be pure folly for the state not to learn the lesson of what has gone wrong in other jurisdictions and adopt a remedy before finding itself in a similar dilemma.

Not coincidentally, the charts from both the California and New England ISOs (found further below in my testimony), as well as that from DTE, which is in the MISO, illustrate the wisdom of compensating Solar PV DG at LMP, so its price accurately reflects its value at the time of actual production and avoids requiring non-solar customers to pay prices for energy that far exceed its value.

Contrary to the intervenors’ claims, the solar industry’s positions are anti-competitive.

Q. Does distributed solar PV increase the level of competition in the industry?

A. This is one of the most interesting arguments put forward by many of the proponents of solar PV. In theory, new actors and new technology in the marketplace should increase efficiency and thereby boost competition. That, however, can only occur when market prices prevail, or, where market imperfections require regulatory oversight, when cost-based regulated prices are designed to provide appropriate incentives for productivity gains. Were such a pricing regime in place, my answer would be yes, but, in the context of NEM, the answer is absolutely not. In fact, NEM reduces the competitiveness of the market.

What the solar industry is seeking in this proceeding, and in others like it around the country, is not the right to compete, but rather the right to be compensated at arbitrarily high levels justified not by market or costs, but by the highly inflated price derived from

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\(^1\) For further discussion of the implications of the duck curve, see *What the duck curve tells us about managing a green grid*, Ex.-WEPCO/WG-Brown-2.
net metering, a primitive and unsophisticated relic of the age of dumb prices. The effect of the *status quo*, net metering, is to require consumers to pay a higher price for a designated technology, distributed solar PV, and provide less market opportunity for other, more efficient producers. Stated succinctly, the solar PV industry could play a constructive role in increasing the level of competition, but to do that they would have to increase their productivity and give up their demands for prices substantially higher than those earned by their more efficient competitors.

Q. How have the other parties to this proceeding addressed this competitiveness issue?

A. This perverse view of competition is well articulated by Sunvest Solar’s witness, Neumann, as well as RENEW Wisconsin’s witness, Vickerman, who suggests that the Commission’s primary criteria for evaluating the merits of WE’s proposal should be how profitable it will be for their industry. They contend that the proper price is not the result of market forces, or even of cost-based analysis, but rather is whatever price protects their desired margin -- a conclusion they reach by focusing on what is lucrative for the subset of market participants they represent. Indeed, Vickerman actually complains that WE’s proposal does not include recognition of the fact that older solar installations may be less efficient, as if a competitive market would give special dispensation to a market participant for its own inefficiency. (Direct-RENEW-Vickerman-14). The lack of competitive balance in the arguments is also well illustrated by RENEW witness Rabago, who extols the virtues of the economies of scale in solar panel production even as he denies that central station generation shares such virtues. (Direct-RENEW-Rabago-13). Curiously, Mr. Rabago also fails to mention that the economies of scale in energy
production at central stations (including large-scale solar stations) are completely absent in the small-scale solar PV DG installations he is promoting.

One other aspect of the anti-competitive nature of net metering is seen in the fact that wholesale generators do not obtain any guarantee of purchase of either their capacity or their energy without actually delivering energy when called upon to do so. If they fail to deliver, under most capacity arrangements, they must cover the marginal costs of replacing what they failed to deliver. They obviously receive no energy payments unless they actually produce energy, and all payments to them are disciplined by competition, or in the absence of a competitive market, by a cost-based price. While it is also true that solar PV DG providers are not paid unless they deliver energy, in notable contrast to the wholesale market, solar PV DG producers on NEM tariffs are compensated at levels that include capacity, energy, distribution costs, and all other aspects of retail service, even though the product they deliver guarantees no level of capacity and provides absolutely no distribution service whatsoever. Moreover, it is not subject to competitive market forces or cost-based regulatory oversight. Indeed, it is not even subject to the “avoided cost” standard articulated for renewable energy under PURPA. In short, the risk-reward symmetry applied to solar PV DG is low-risk, high-reward, as opposed to the more symmetrical arrangements to which wholesale generators are subject.

Q. Has WE, in this proceeding, proposed anything that would deny the solar industry the right to compete?

A. No. In fact, the WE proposal would make the market far more competitive and would produce far more value for consumers. Nothing being proposed by WE in this proceeding would deprive solar generators of the right to compete. In fact, quite the
opposite is the case. What WE has proposed would enable solar PV to participate in the market on a fair, relatively level, and open basis. First, WE will continue to purchase any energy produced by distributed solar that is in excess of what is required on the premises of the solar host. In fact, this would provide some competitive advantage to solar PV DG because it would provide an assurance of purchase without asking for a reciprocal commitment of guaranteed delivery. Second, it proposes to pay all energy producers, large or small, central or distributed, the market price, namely the locational marginal cost. In other words, it allows the market-clearing locational price for all generators, which has the advantage of bundling both transmission costs or savings and energy costs. It is a rather level playing field for all generators, with a slight advantage to solar PV DG because, again, it assures purchase without assured delivery.

Placing a Value on Solar PV DG

Q. How do you respond to the intervenors' testimony on pricing, particularly Mr. Rabago’s testimony (Direct-RENEW-Rabago-44-50)?

A. Needless to say, pricing is of critical importance. I intend to address that, but in the context of tangible, enumerated values. I say that because there are efforts in some places to attach a subjective value to solar and then derive prices from that value. I do not share that point of view. I think it is best to derive prices from the values established by either costs or market, not ephemeral and subjective considerations. For that reason it is useful to analyze all of those considerations, so that all of the claims being made can be fairly analyzed. As I have noted, however, my view on NEM is clear: it produces very poor price signals, forces consumers to pay prices that exceed the value they receive, and has been overtaken by events and technology.
Q. How do you assess the availability/capacity value of distributed solar PV?

A. The capacity value of a generating asset is derived from its availability to produce energy when called upon to do so. If a generator is not available when needed, it has little or no capacity value. By its very nature, solar DG on its own, without its own backup capacity (e.g. storage), can only produce energy intermittently. It is completely dependent on sunshine in good atmospheric conditions. Unless sunshine is guaranteed at all times at which solar DG is called upon to produce, it cannot be relied upon to be available when needed. Moreover, even if all days were reliably sunny, the energy derived from the sun is only accessible at certain times of the day. In many jurisdictions, the presence and potency of sunshine is not coincident with peak demand. Frequently, for example, solar DG capacity is greatest in the early afternoon, while peak demand occurs later in the afternoon or in early evening). Two charts illustrating the lack of coincidence of solar production and peak demand in New England may be found below. They are derived from a 2013 Update on Solar PV and Other DSG in New England prepared by ISO New England, and illustrate that the facile assumptions made by RENEW witness Rabago (Direct-RENEW-Rabago-13, 46) (i.e., that solar benefits include near-term reductions in peak generation) are precisely that.
These two charts dramatically demonstrate that on the days chosen as representative of summer and winter in New England, solar PV is completely absent during the winter peak, reaches its peak production as peak demand is rising in the summertime, and drops off dramatically during almost the entire plateau period when demand is at peak. It should also be noted that on the days chosen, the sun was shining. The graph, of course, would look very different on cloudy days when solar production is virtually nil. Given this reality, it is very difficult to attach any credibility to Mr. Rabago’s assertion of reductions at peak, or to attach much capacity value to solar PV.

Another graph, from EPRI, reveals the same thing on a national level:
As noted earlier in my testimony, providers of capacity in the wholesale market may also have availability issues. In their case, however, if they are not available when called upon to produce, they are typically obligated to either provide replacement energy or to pay the marginal cost of energy that they failed to deliver. Unless a similar obligation is imposed on solar DG providers, the capacity value of solar DG is reduced even further. Good pricing policy would suggest that DG prices should be fully reflective of the value of the type of capacity that is actually provided. As currently implemented, net metering does not adequately reflect how the capacity availability measures up to demand. Additionally, solar DG remains connected to the grid, and the value of the grid should not
be underestimated. An unplanned system of rooftop solar photovoltaics is more difficult to administer than the grid that is in place. Further, solar DG may be installed in places that are inefficient, generating electricity at particularly unhelpful times of day. Determining the actual capacity value of solar DG is a fact-specific question that should consider capacity availability resulting from timing of generation and less than optimal placement of photovoltaics.

Q. What about the availability and reliability value of solar PV?

A. Many solar advocates assert that solar DG enhances overall reliability because the units are small and widely distributed, but close to load, and not reliant on the high voltage transmission system. It is argued that they are less impacted by disasters and weather disturbances. These claims are highly speculative and, for the reasons I will explain, not necessarily accurate. It would be a mistake to simply assume that solar DG improves reliability.

Solar DG is subject to disaster as much as any other installation. Strong winds, for example, can harm rooftop solar as much as any other facility connected or not connected to the grid. Cloudy conditions can disrupt solar output while not affecting anything else on the grid.

Solar DG has more reliability benefit in some places than others. In Brazil, for instance, a system that relies on large hydro plants with large storage reservoirs, solar has considerable long-term reliability value because whenever it generates energy it conserves water in the reservoirs, thereby adding to the reliability of the system. However, in a thermal dominated system like MISO, where there is little or no storage, reliability has to be measured on more of a real-time basis. Therefore, solar’s
intermittency makes it unable to assure its availability when called upon to deliver energy. Indeed, it is far more likely that a thermal unit will have to provide reliability to back up a solar unit than the other way around.

It is also important to examine rooftop solar reliability issues in two contexts: that of the individual customer and that of the system as a whole. Solar vendors, as part of their sales pitch, claim that reliability is increased for a customer with a rooftop solar unit because on-site generation provides the possibility of maintaining electric power when the surrounding grid is down. When the sun is shining, this claim is likely to be true. Conversely, without the sun, the claim has no validity. That argument, however, only applies to the solar host. During a system outage the power inverter, an electronic device or circuitry that converts direct current to alternating current, is automatically switched off to prevent the backflow of live energy onto the system. That is a universal protocol to prevent line workers from encountering live voltage they do not anticipate. Thus, if a solar DG unit is functioning properly, when the grid goes down, the solar DG customer’s inverter will also go down, making it impossible to export energy. If the solar DG unit is not functioning properly, then the unit may be exporting, but will do so at a considerable risk to public safety and to workers trying to restore service. The result, of course, is that the solar panel provides virtually no reliability to anyone other than perhaps to the solar host. There are virtually no reliability benefits for the system in Wisconsin, and therefore no basis for calculating a payment for such service.

Q. Please continue.

A. Attributing reliability benefits to an intermittent resource is a stretch. By definition, intermittent resources are supplemental to baseload units. The only possible exceptions
to that are, as noted above, where there are individual reliability benefits or where the availability of the unit is coincident with peak demand. Absent those circumstances, and absent storage, it is almost certainly the case that the system provides reliability for solar DG, rather than the other way around. That is particularly ironic given that in the context of net metering, solar DG hosts do not pay for that service while generating electric energy, and collect payments for distribution service they rely upon rather than provide. Indeed, from a reliability perspective, net metering is truly perverse because non-solar customers pay solar DG providers for reliability benefits that solar DG does not provide them, while solar DG customers do not pay for the reliability benefits they actually do receive.

From an investment perspective, solar DG pricing methods like NEM, which redirects distribution revenues from utilities to solar PV providers who offer no distribution services, are detrimental to reliability because they deprive utilities of the revenue needed to maintain high levels of service. For utilities, the diversion of funds leaves them with the Hobson’s choice of either delaying maintenance and/or needed investment, or seeking additional funds -- in effect, a cross-subsidy from non-solar DG users. It is also relevant to reliability to note that the prevalence of intermittent resources on the grid, including solar DG, may well cause new, cleaner, and more efficient generation to appear less attractive to investors. Over the long term, that effect could lead to reliability problems associated with inadequate generating capacity, especially at times of peak demand.

Q. Does distributed solar PV avoid transmission costs?
A. DG advocates assert that there are real transmission savings are achieved through the deployment of DG, especially in systems that use locational marginal cost pricing
(“LMP”). (See, e.g., Direct-RENEW-Vickerman-28). The argument is that by producing energy at the distribution level, less transmission service will be required, thereby reducing or deferring the need for new transmission facilities. It is also often contended that DG will reduce congestion costs, and perhaps even provide some ancillary services. All of that is theoretically possible, but certainly not uniformly or even inevitably true. Of course it is true that DG, absent any adverse, indirect effect DG might have on the operations of the high voltage grid, does not incur any transmission costs in bringing its energy to market. However, that is quite different than asserting that DG provides actual transmission savings. In fact, it would be incorrect to simply conclude that solar DG will achieve transmission savings. It is possible that there could be transmission savings associated with solar DG deployment, but that can only be ascertained on a fact- and location-specific basis. Such savings would most likely be derived from reducing congestion or providing ancillary service of some kind. It is also theoretically possible, but highly unlikely, that massive deployment of solar DG will eliminate (or, more likely, defer) the need to build new transmission facilities. However, for a variety of reasons including the complexities of transmission planning, the time horizons involved, the complex interactions of multiple parties, and economies of scale in building transmission, it is improbable that solar PV actually saves any investment in transmission capacity. Indeed, a mere glance at the California ISO duck graph showing the need for ramping capacity to make up for the intermittent availability of solar PV DG is almost a prima facie case for believing that the opposite is true and that solar PV DG may cause a need for more transmission to be built. Regardless, it is virtually impossible to demonstrate
that solar DG will obviate the need for transmission, much less quantify the cost savings associated with this purported benefit.

Of course, there is a simple way to calculate any actual transmission savings, and that is by compensating solar DG providers in the organized markets at the locational marginal cost of electricity at their location. That compensation model would have the benefit of capturing both the energy value and the demonstrable transmission value of solar DG.

Absent that formulation, efforts to calculate actual transmission savings would be a difficult task indeed. It is, of course, important to note that WE has proposed to do exactly that.

Q. Does distributed solar PV DG avoid distribution costs?

A. No. It is more likely that solar PV DG will cause more costs than it saves. That is because these generation sources could change voltage flows in ways that will require adjustments and maintenance. It will also inevitably increase transaction costs for the utility to execute interconnection agreements and do the billing for an inherently more complicated transaction than simply supplying energy to a customer. It is impossible, unless perhaps when a solar PV DG host leaves the grid, to envision a circumstance where solar PV DG would effectuate distribution savings.

Regarding distribution line losses, DG offers value only to DG providers when they consume what they produce because any DG output exported to the system is subject to the same line loss calculations that any other generator experiences. If there were locational prices on the distribution system, there might be line loss benefits that could be captured by DG but, since those price signals do not exist, the argument is purely academic.
Q. Is there a fuel hedge value associated with distributed solar PV?

A. The theory advanced by some solar proponents is that because the marginal cost of solar is zero, it serves as a hedge against price volatility. In theory that might make sense. In reality, however, solar is an intermittent resource that cannot serve as a meaningful hedge unless such zero-cost energy is both sufficiently and timely produced. Thus, solar PV is the equivalent of a risky counter party whose financial position renders him incapable of assuring payment when required. Moreover, the value of a hedge depends on the amount of money the purchaser of the hedge is obliged to pay and the size and probability of the price he/she seeks to avoid paying. With a NEM system (or the high-priced “value of solar” approach that solar advocates seek), the price paid is highly likely to exceed the fuel price most utilities would hedge against. In short, the argument ventures into the realm of the absurd. It amounts to: Pay me a fixed price that is higher than the price you want to avoid, in order to avoid price volatility.

Effects of solar PV DG on other renewable resources.

Q. How does the efficiency of distributed solar PV compare with other renewables?

A. Not well. Since 2008, as the chart below from the Energy Information Agency points out, solar PV has had the lowest capacity factor of any commonly used renewable energy resource in the U.S. It is also worth noting that while the overall costs of installing solar panels has declined (as noted above), the productivity of solar PV has remained constant at consistently low levels.
Q. What about the claim that solar PV DG reduces carbon emissions?

A. The stark reality of solar PV's combination of high prices and poor capacity factor carries over into the cost of reducing carbon emissions. An interesting dialogue occurred recently between Charles Frank, an economist at Brookings, and Amory Lovins of the Rocky Mountain Institute. Their dialogue, while contentious on many points, reflects similar views on the realities depicted in the EIA chart. (Exs.-WEPCO/WG-Brown-3, 4, 5). Frank analyzed five generation resources by their cost effectiveness in reducing carbon and concluded that nuclear and natural gas, followed by hydro, wind, and solar were, in that order, the most cost-effective types of generators for reducing carbon. Lovins took issue with Frank for using outdated data and for not looking at energy efficiency. He also argued that nuclear ranked last in cost effectiveness, and expressed some reservations about the ranking of natural gas. What is significant, however, is that among renewable resources, Lovins concurred with Frank that solar is the least efficient
renewable resource for reducing carbon.² Thus, in the view of both men -- who hold quite divergent views on how best to reduce carbon emissions -- not only is solar PV DG expensive, it is the least cost-effective renewable resource for reducing carbon emissions.

Q. What is the impact on other renewable resources of the higher-than-market prices paid for distributed solar PV?

A. Net metering is completely inconsistent with pricing policy applied to other forms of electricity generation, including non-DG renewables. All wholesale generators, renewable and otherwise, have to incorporate transmission and distribution costs into the price of energy delivered to customers. As I discuss elsewhere in my testimony, it is true that transmission issues play out differently for distributed generation than for wholesale generation. Since DG, by definition, does not rely on transmission capacity, although DG might impact congestion costs in various ways, wholesale energy’s delivered cost reflects transmission capacity costs while DG’s does not. Thus, any competitive advantage for DG on that score is quite natural. Under the net metering scheme, DG providers also do not have to incorporate distribution costs into their end product, and that results in a serious economic distortion of the generation market. In fact, as noted elsewhere in my testimony, solar PV DG providers under NEM are actually paid for delivering their energy even though they provide no such service. Wholesale generators, unlike their DG counterparts, enjoy no such comparable enrichment for service they do not provide. The effect of NEM’s highly inefficient and non-cost-reflective rates is to distort market prices in ways that reward inefficiency and will likely deprive the wholesale markets of price signals that enable construction of new, highly efficient

² For the sake of completeness, I've included two blog posts by Frank in which he addresses some of the points made by Lovins. (Ex.-WEPCO/WG-Brown-6, 7). As Frank puts it, though, even after addressing Lovins' criticisms, "Wind continues to rank number four and solar ranks number five by a large margin." (Ex.-WEPCO/WG-Brown-6).
generation. In addition, at a critical mass, artificially elevated solar DG prices are highly likely to create distortions and inefficiencies in the capacity and energy prices found within organized markets.

An environment with two parallel pricing regimes, one market- or cost-based, and the other an arbitrary one neither market- nor cost-based, is simply economically incoherent and unsustainable. WE has recognized that and proposes a more coherent and sustainable pricing regime that effectively—indeed, elegantly—bridges the gap between DG and wholesale generation by using LMP as the common denominator that provides universally coherent price signals.

The overall effect of net metering is to increase the prices consumers pay for energy overall, without any assurance of any long-term benefit in the form of increased efficiency. Solar DG is artificially elevated to a preferential position above more-efficient, larger scale generation, including renewables. The disparity in treatment between solar DG and other forms of energy suggests that net metering is not only preemption bait (as further discussed below); it is fundamentally anti-competitive as well. Indeed, it compels consumers to both cross-subsidize less efficient producers and to pay higher prices than necessary for energy.

Q. Please expand on your concerns about the effect of NEM pricing on other renewables.

A. Large-scale bulk power renewables (e.g. large-scale wind and solar farms, geothermal), are put at a particular disadvantage by NEM pricing of solar PV DG independent of costs or market for three basic reasons. First, large-scale renewables are more efficient and more cost-effective than DG, yet net metering provides a subsidy to the less efficient form of generation. In fact, solar DG providers are compensated for the energy they
export at a price that can range from two to six times the market price for energy.

Second, in those states with renewable portfolio standards (“RPS”), the entry of a critical mass of non-cost-justified solar DG units into the market could have the effect of driving more efficient, large-scale renewables out of a fair share of the RPS market. Third, as noted above, for renewables purchased in the wholesale market, the price paid by consumers reflects all of the transmission and distribution network costs incurred in delivering the energy. It is assumed for DG that there are no transmission costs. The effect, in a competitive market, is to bias the market to incentivize highly inefficient small-scale solar to the detriment of less costly larger-scale solar. Because locational costs are not factored into the price the solar DG user is paid, such compensation is likely to lead to poor locational decisions of the sort that we see in Germany. The ultimate result is higher costs than necessary to keep the system reliable and stable.

In a similar vein, even if renewables have a salutary impact environmentally, one must look at DG PV in the context of how its attributes compare with those of other renewables (e.g. utility-scale solar, wind, small hydro, geothermal). Capacity factor is one attribute that may be used for such a comparison; it is the ratio of actual output to the maximum potential output of a particular energy generator over a period of time.

Q. How would you compare solar PV DG with other renewables?

A. An environmental analysis should include an examination of the least-cost, most efficient ways to get to the desired results. Problematically, the preferential pricing of DG generally, as opposed to non-DG forms of renewables, may lead to distortions that favor DG over larger-scale, usually more efficient, and less costly forms of non-emitting generation that will achieve more environmental benefits at lower cost. Results such as
that cannot be justified on the basis of externalities, which are no different between DG and larger-scale renewables. Indeed, it could well be argued that overpayments for DG have the effect of squeezing more efficient forms of renewable energy out of RPS markets by using preferential pricing to grab a disproportionate share of the RPS market.

In the long run, of course, the inherent favoritism in pricing DG over other renewable energy sources does not bode well for the future of renewables. Discrimination in favor of inefficient resources on a long-term basis is almost never sustainable. The inevitable backlash in the marketplace has the potential to sweep away public support for renewable energy, an outcome no one concerned about the environment would want. One of the most notable ironies emanating from the use of net metering to price solar DG is that it will almost certainly lead to changes in retail pricing that will undermine the promotion of energy efficiency. The reason for this is that as solar DG becomes more widely deployed, utilities and their regulators will likely become increasingly concerned with the diminution of revenues required to support the distribution system that is caused by the use of net metering.

Additionally, when solar DG is being self-consumed at the host premises, no revenues are being paid by that host to the utility for providing what essentially amounts to a battery to supplement their self-generation. Since the costs of the distribution are essentially fixed and not variable with the use of “behind the meter” generation, net metering results in a delta of revenue that is either made up for by non-solar customers or constitutes a loss for the utility. Neither outcome is likely to be satisfactory to either the utility or the regulators. Inevitably there will be ratemaking consequences.
Q. Is there a possibility of the states being preempted by the federal government because of inconsistent pricing regimes for DG and wholesale generation pricing?

A. Yes, unfortunately, there is. Because of the economic distortions caused by NEM, there are some who are calling for DG to be under the control of the Federal Energy Regulatory Commission (“FERC”) rather than state public utilities commissions' jurisdiction (see, for example: David B. Raskin, *The Regulatory Challenge of Distributed Generation*, 4 Harv. Bus. L. Rev. Online 38 (2013). (Ex.-WEPCO/WG-Brown-8)).

Unless states begin to remedy the price distortions inherent in net metering, it would be surprising if many aggrieved wholesale generators did not seek relief from FERC. In a somewhat analogous situation where New Jersey and Maryland sought to use state subsidies/mandates to support the construction of new power plants in order to manipulate and/or bypass the PJM capacity market, the FERC, in a decision (135 FERC 61,022, April 12, 2011) which was later affirmed by the Third Circuit Court of Appeals (New Jersey Board of Public Utilities et al. v. FERC, 744 F.3d 74 (2014)), struck down the state program by preemption. State Commissions that continue to prop up a net metering regime with no basis in either market-based pricing or cost-of-service regulation may well discover the prospect of preemption hanging over them. As a former state regulator myself, I am not generally well disposed toward preemption, but while still serving on the Ohio Commission, I came to recognize the likelihood of that outcome if we continued in a direction that put us on a collision course with federal regulators.

Further foreshadowing preemption are several other examples of state net metering programs running contrary to federal pricing regimes. First, the Public Utility Regulatory Policies Act (“PURPA”) places an avoided cost ceiling on power purchases; net metering
evades that ceiling. Under net metering arrangements, not only are purchases of excess power mandated at levels well in excess of avoided costs, but they also include a cross-subsidy from non-solar customers for the distribution costs of solar DG providers. Bulk power renewables are subject to all of the rules of the wholesale market, which may include such costs as congestion costs, ancillary services, penalties for no availability, and others. Under net metering, solar DG providers are subject to none of these disciplines. In addition, I have heard wholesale renewable generators complain angrily that the arbitrarily high prices paid under net metering have the effect of attracting enough solar DG providers to fill up the RPS market, so that they are being effectively squeezed out of the portfolio entirely. What is particularly ironic about this is that, as noted elsewhere in my testimony, distributed, small-scale solar is the least efficient form of commonly used renewable energy sources in the U.S. All of these factors indicate that an increasing number of parties are likely to be motivated to ask FERC to preempt net metering and other state-mandated regimes that allow for unreasonably discriminatory and anti-competitive pricing.

Q. Does distributed solar PV DG have the effect of driving down other generating costs?
A. This argument, which is made by RENEW witness Rabago, is a variation of the flawed fuel hedge argument. (Direct-RENEW-Rabago-46). It is in fact reminiscent of a vegetarian who demands to be paid by carnivores for not eating meat, because by reducing demand for meat, he is providing a service to them by driving down meat’s price.

Given that solar PV DG is, as previously demonstrated, the least efficient and most expensive form of commonly used generation in the U.S., this argument is, like the fuel
hedge argument, premised on the assumption that one should pay a very high price to avoid having to pay for a less expensive product.

On both a theoretical and practical level, this is not a serious argument.

Q. Does distributed solar PV have a positive environmental footprint?

A. Despite the widespread notion that solar energy is green, this is actually quite a complicated question. Expectations of environmental externality benefits may be the biggest motivator for supporting and subsidizing solar DG. Proponents of solar DG note that solar has zero carbon or other harmful emissions from the process of producing energy. Additionally, solar proponents contend, to the extent that wide deployment of solar PV avoids the need to invest in technologies that do have carbon and other undesirable emissions, there is an environmental benefit that avoids the social costs associated with pollution. In the absence of legal limits on relevant emissions such costs, solar advocates correctly point out, are not captured in the internalized costs of the competing technologies. Therefore, solar advocates suggest that regulators and policy makers should take these external social costs into consideration in setting prices for various forms of energy.

The use of external social costs, as opposed to solely the internalized economics of various forms of energy, is a controversial subject. Many oppose the use of externalities as a factor in pricing because it distorts the market and necessitates social judgments economic regulators may not be empowered to make. In the views of such opponents, the only externalities that ought to be incorporated into pricing are those that are internalized by legal mandate. Proponents of incorporating externalities into rates, on the other hand, contend that doing so is the only way to accurately reflect all social costs.
They also contend that factoring in environmental externalities is a form of insurance against future regulatory requirements. My purpose in testifying is not to debate the inclusion of non-mandated externalities in pricing, but rather to acknowledge that the debate exists, and address the positions advanced by those who favor inclusion of externalities. While this testimony takes no position as to the merits of incorporating externalities into ratemaking, on the assumption that at least some regulators and policymakers will look at externalities for purposes of measuring the value of solar PV, it will address how externalities ought to be factored in and what externalities should be considered.

Q. Please continue.

A. Before delving into this issue any further, it is important to note that the U.S. E.P.A., whose jurisdiction over carbon emissions has been affirmed by the U.S. Supreme Court (Massachusetts v. Environmental Protection Agency, 549 US 497 (2007)), has proposed new rules under Section 111(d) of the Environmental Protection Act that would, if promulgated, internalize the costs of carbon into electricity ratemaking. If this were to occur, the issue of whether or not to consider the costs of carbon would no longer be debatable. Thus, in the short term, there is a great deal of uncertainty, which effectively strengthens the hand of those who contend consideration of carbon emissions would be a form of insurance against future regulation. In the longer run, however, if carbon limitations are imposed, then the cost of carbon will be fully internalized in all energy resources. The effect of that, of course, is almost inevitably that carbon-free resources would be of greater value, while those that emit carbon would have less value. Should that happen, therefore, the market itself should produce the right price signals for all
forms of generation, including renewable ones such as solar. At that point, special programs such as RPS and NEM could actually serve to impede the most efficient ways of reducing carbon, by diluting price signals that are formed with carbon control in mind. Regardless, the environmental issue, in terms of solar PV DG, is how cost-effective such installations are for reducing carbon.

I have already testified to some of the key factors in evaluating the cost-effectiveness of solar PV DG for reducing carbon. There is little dispute that small scale solar PV is the least efficient of all renewable energy resources in common use in this country. As noted, there is even a consensus, which includes Amory Lovins, that solar PV DG is the least efficient renewable resource for reducing carbon. That view is fully supported by the facts in the California duck graph, as well as the ISO-New England and EPRI Value of the Grid data, which demonstrate conclusively that solar PV is consistently off peak. As I mentioned earlier, that means it has less value as energy, but is also powerful evidence that it also has less environmental value. This is because, as a general rule, the least efficient and “dirtiest” plants are dispatched at times of peak demand. Thus, when solar PV DG is producing energy, it is not displacing the most carbon emitting plants. Instead, it is displacing more efficient, less polluting generating units. Moreover, as an intermittent resource, its availability is highly uncertain and fossil plants are often called upon to operate on a less efficient, more carbon-emitting "ramping" basis than if they were running as pure baseload. Thus, as a tool for carbon reduction, solar PV DG is very expensive.

Those conclusions have also been borne out by developments in Germany. In Germany, where there has been a very dramatic increase in reliance on intermittent energy, prices
have risen since 2005 and were accompanied by a spike in carbon emissions. (See Eddy, Melissa. German Energy Push Runs Into Problems. *The New York Times*, March 19, 2014. (Ex.-WEPCO/WG-Brown-9). While there are very significant differences between Wisconsin, or MISO, and Germany, (perhaps most notably that Germany has decided to close down its nuclear plants), the experience in that country is very telling. It clearly demonstrates that an increased dependence on renewable energy resources, and particularly intermittent resources, does not, as many solar proponents claim, *ipso facto* mean fewer carbon emissions, and may, in fact, cause the opposite to occur. It also demonstrates that prices will escalate dramatically if the feed in tariffs are as far in excess of market as NEM prices are, as shown by the DTE graph I discussed earlier in my testimony. The Germans, incidentally, have recognized their miscalculations and are dramatically recalibrating their strategy.

Q. What would happen to the cost effectiveness of solar PV DG for reducing carbon if WE’s proposal to use LMP for pricing solar were in place?

A. The cost-effectiveness of solar PV DG to reduce carbon would improve. This would occur not because solar PV would reduce more carbon, but because its value as a carbon offset would be priced more appropriately. In other words, the actual price of solar PV DG would more accurately reflect the value of the resource both economically and environmentally.

Indeed, because of the nature of the dispatch model, LMP is almost elegant, in that it effectively aligns both environmental and economic values. It also obviates any need to debate the on- or off-peak nature of the energy being produced, because LMP automatically captures that.
Q. How does NEM distort price signals for energy efficiency?

A. Arbitrary price NEM does not reflect value, and it also provides absolutely no price signal to customers regarding the value of demand side management and energy efficiency. Compounding the problem is that the flat price paid for solar DG through net metering and many forms of incentives actually deprives customers of the price signal necessary for truly efficient use of energy. In fact, the subsidy inherent in NEM distorts the price signal for efficiency. NEM completely distorts and dilutes the very precise price signals produced by the LMP pricing in the ISO.

Under net metering, not only is the price likely to be higher (although in theory it could also be lower) than it might be if assessed based on what is available in the market, but also non-solar customers are compelled to pay both their distribution costs and part of the distribution costs of solar customers. In fact, a recent study by E3 Consulting for the California Public Utilities Commission projects the annual costs of net metering to be $1.1 billion by 2020. This cost will have to be absorbed by the utilities, non-solar customers, or both, unless there is a change in rate design.

Arguably, the payment of a single price for solar DG regardless of its capacity and energy value may actually contribute to a need for more capacity than would be needed if the price signal were more appropriate. Some may also argue that adverse energy efficiency effects are a result of solar DG users (1) failing to pay for fixed costs and (2) failing to recognize the costs of the solar-produced energy because the energy is subsidized by the high prices the utility pays and passes on to non-solar customers through net metering.

The intermittent nature of solar DG (also true of wind and large scale solar) has still another effect that may serve to dampen environmental expectations. Because the
capacity required to supplement the renewable is ramping rather than baseload, the
signals to investors to build new, more efficient generators is diluted, and is therefore less
attractive from a financial point of view. (This is a particularly interesting issue in the
context of the California duck chart.) If the new investments are not made, then older
and likely “dirtier” plants will have to have their lives extended and/or be operated on a
ramping basis for which they were not designed. The result will be less efficiency and,
therefore, likely increased emissions. As discussed earlier, developments in Germany
have clearly demonstrated this outcome. Thus, to be truly meaningful and intellectually
honest, any analysis of environmental impact must take into account the change in
dispatch and operations

One of the more interesting aspects of net metering is that it subsidizes, and therefore
incentivizes, a highly inefficient use of solar DG. Without getting into a debate over
whether subsidies in general are a good or bad idea, it seems obvious that if a subsidy is
to be deployed to support some technology, that it ought to be designed to enable
resources to be more efficient and more commercially viable so that the subsidy can
eventually be eliminated. In the case of solar DG, one of its critical shortcomings is its
intermittent availability. Indeed, that intermittency not only reduces its economic value,
but as discussed it also reduces the likelihood of attaining the desired environmental
results.

Q. What is the social impact of substantial cross-subsidies for distributed solar PV?
A. There are social effects beyond the environment that have to be taken into account if
externalities are to be factored into ratemaking. Any failure to examine environmental
externalities without recognizing that there are other social externalities to be considered
as well will yield highly skewed results. Perhaps the most important of those is the social impact.

The social impacts of solar DG are caused by three main factors. First, as noted above, solar DG users have their electricity costs cross-subsidized by their neighbors who completely rely on the grid. Second, some data suggests that solar DG users are unusual electricity users. Third, not everyone can afford to be a solar DG user. To address the second point: unlike typical residential customers, in some regions solar DG users use little or no grid power when solar production peaks, but quickly ramp up demand on peak, when PV production often wanes (as is demonstrated by the charts from the New England and California ISOs). Utilities must be able not only to serve full load on days when solar PV is not performing, but also to ramp up resources quickly to address the peak created by solar DG users. In order to ramp up as needed, utilities will purchase energy at the marginal price and then distribute those costs across all users, not just solar DG users. Thus, users without solar DG may be penalized for the use patterns of their solar DG neighbors. A comparison of residential electricity consumers in the western United States may be found in the Pacificorp chart below:
Further, the impact of net metering is not simply the creation of a cross-subsidy from non-solar PV customers to solar PV customers, but, as has been pointed out in a recent study by E3, a prominent economic consulting firm, it is a cross-subsidy from less affluent households to more affluent ones. Indeed, the average median household income of net energy metering customers in California is 68% higher than that of the average household in the state, according to the study. Energy+Environmental Economics, Inc., *California Net Energy Metering Ratepayer Impacts Evaluation*, October 28, 2013, p.11. In a recent proceeding, the staff of the Arizona Commerce Commission noted the same consequence. Net metering is “Robin Hood” in reverse. In order to install rooftop solar panels, often individuals must be homeowners with high credit ratings or sufficient capital. Leasing arrangements are also widespread, but are generally available only to customers who own their own premises, and they require the assignment of most of the rooftop solar benefits to the lessor. Leasing arrangements also customarily transfer most of the subsidy benefits from the solar host to the lessor. Thus, more affluent solar DG customers derive disproportionately higher benefits from DG than their less affluent peers. Many electricity customers, particularly less affluent ones, do not own homes or lost their homes in the most recent recession. The electricity customers who are unable to afford rooftop solar are forced to subsidize those who are already in a more favorable financial position. Thus, it is entirely fair to characterize NEM as a wealth transfer from less affluent ratepayers to more affluent ones.

Q. What is the impact of Solar PV on jobs?

A. The impact of solar PV on jobs is often cited as an externality benefit. Indeed, RENEW witness Rabago does exactly that in his testimony, albeit as a mere naked assumption
with no supporting data. (Direct-RENEW-Rabago-13, 16, 46). Any analysis of the job impact must be comprehensive and not an effort to cherry-pick data. Many aspirations for more jobs manufacturing PV units in the United States have not materialized due to the fact that China has captured more than 50% of the market. Other impacts to be considered are the effect of solar PV on electric rates and the impact of that on the job market, not only in terms of what happens with rates, but also in terms of the rate structure that is implemented as a result of more market penetration by solar DG. If, for example, the increased presence of solar PV DG paid for through NEM artificially drives up prices, there will be an inevitable adverse impact on jobs offsetting the gains Mr. Rabago so cavalierly assumes. In addition, if, as illustrated by the duck chart, California has to embark on significant investments or contracts for redundant generating capacity because of solar PV DG’s poor capacity factor, there is likely to be a secondary negative impact on jobs. My point is not that solar has an inherently adverse impact on jobs, but rather that any job impact is very difficult to predict or even to gauge, and for that reason ought not be determinative of anything in DG decisions such as this one.

Q. Does this conclude your testimony?

A. Yes it does.