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REFORMING NET METERING

PROVIDING A BRIGHT AND EQUITABLE FUTURE

Tom Tanton

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Reforming Net Metering: Providing a Bright and Equitable Future

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Preface

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

ALEC Opposes Cost Shifting and Subsidies, not Renewable Energy or Distributed Generation

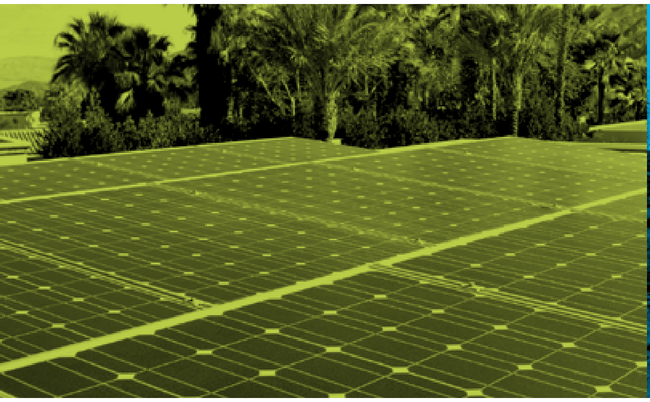
One would be hard-pressed to find an opponent of renewable energy at the American Legislative Exchange Council (ALEC). New energy technologies and constant innovation are critically important in the United States. That is ALEC's position. In fact, ALEC has members that represent renewable energy technologies and others that work with and supply products and services to the renewable energy industry as a whole.

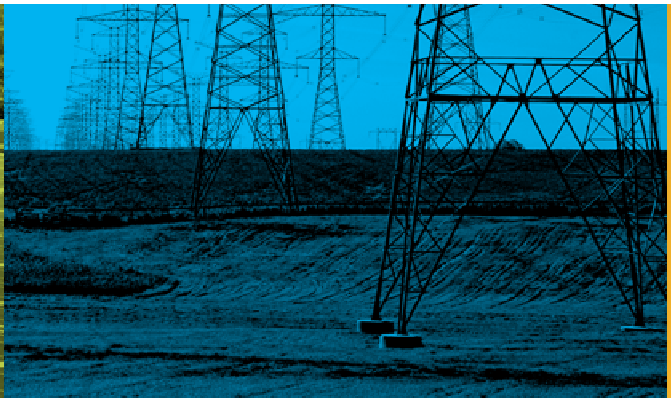
With that said, one can support renewable energy while disagreeing with how these technologies are deployed in the public sphere. More specifically, ALEC is opposed to government policy that distorts the energy market in a way that promotes the use of one type of energy over another. ALEC holds that the free market, rather than government, produces more opportunities, more energy, lower prices, and fewer economic disruptions.

As it pertains specifically to distributed generation (DG) and net metering policies, ALEC opposes instances where DG customers are able to utilize the services associated with the electric grid without paying for its construction and maintenance. Such policies amount to a subsidy that benefits one source of energy and one class of ratepayers at the expense of everyone else who must pay for these services.

ALEC opposes all mandates and subsidies, regardless of who may benefit financially, and holds that government programs designed to encourage and advance energy technologies often do more harm than good by reducing energy choices or supply. Policies should not limit the production of electricity, for example, only to politically preferable technologies.

ALEC fully supports voluntary efforts to expand and advance renewable energy so long as no technology or class of technologies is given an unfair competitive advantage. Additionally, customers who voluntarily elect to use renewables should pay for all associated expenses, including those related to being connected to the electric power grid.





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Executive Summary

Across the country, more and more customers are using rooftop solar panels and other small-scale, on-site power sources known as distributed generation (DG). To encourage the introduction of these systems when they first came to market years ago, many states approved a billing system called net metering. Forty-three states plus the District of Columbia have net metering policies and regulations. While these policies vary in details, customers with such systems are typically credited at the full retail electric rate for any excess electricity that they generate. The retail rate includes the price of the power itself, as well as the cost of paying for the grid, which delivers electricity to and from distributed customers and assures that power supplies operate safely and reliably. Electric companies are required to buy this power at the retail rate, even though it would cost less to produce the electricity themselves or to buy the power on the wholesale market.

New distributed generation technologies rely extensively upon the electric grid to operate efficiently. They need the distribution grid to be changed from a one-way delivery system to a complicated two-way network, a process that demands extensive investment in new technologies. Ironically, however, net metering policies permit distributed generators to avoid paying their share of the costs of these grid investments, leaving the costs to be paid by other electricity users. The growing use of distributed generation and its impact on ratepayers means that net metering policies and regulations need to change to properly allocate costs and to minimize the impact on non-net metered customers. Net metering policies pose a threat by neglecting to fund the critical infrastructure called the electric grid. Net metering upends the historical regulatory compact, conflicts with federal law, and creates perverse economic inefficiencies. Net metering, as currently implemented, is a regressive tax subsidizing the rich by picking the pockets of the poor.

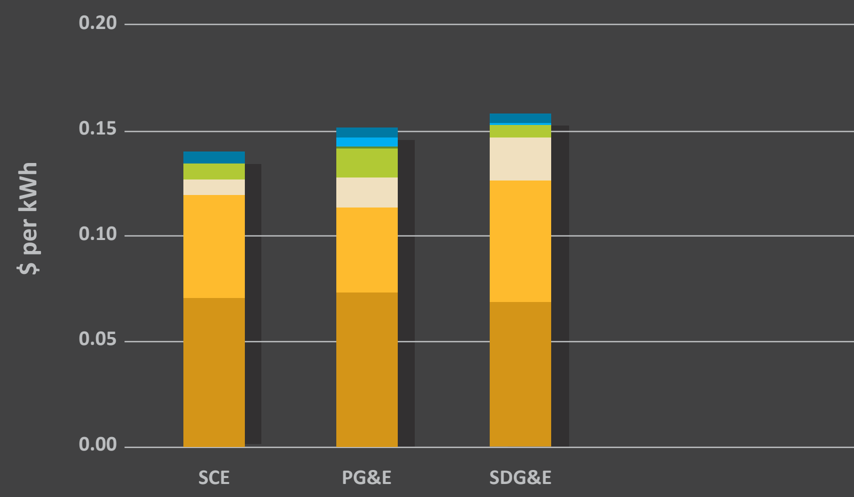
When utilities are required to purchase DG power at retail rates without accounting for infrastructure costs, this amounts to a subsidy from non–net metered customers to net metered customers. Often lost in the message is that there are numerous other subsidies and preferential treatments that, combined (stacked one on top of another), are *egregiously extravagant* and often counterproductive (by virtue of reducing incentive to innovate). Such net metering conflicts with the Public Utility Regulatory Act (PURPA) requirement on utilities to purchase "qualifying facility" output at no more than "avoided cost." Purchasing such generation does not avoid the cost of transmission and distribution. Thus paying retail rates is above market rates. Utilities have a historic agreement with state regulatory agencies to serve all their customers at just and reasonable rates. This obligation has been turned on its head into a mandate to buy power even when not economic or just and reasonable.

The issue lies with what is a fair and equitable price to pay customer-generators for their output. That is not a trivial matter, and the issue grows exponentially with more net metering. In some parts of Hawaii, distributed generation accounts for close to 30 percent of total capacity. In Wisconsin, for instance, the average retail price is 400 percent more than wholesale. A study prepared for Arizona Public Service showed that the amount that net metered customers pay is below the utilities' costs for servicing those customers. Utilities must then charge higher amounts to non–net metered customers to cover those fixed costs. A California study reported that customers who do not install net metering will be paying an extra $1.1 billion in shifted costs annually by 2020.

Customers with DG systems still rely on the power grid. By its nature, electricity—regardless of how it is generated—has unique properties that do not allow it to be easily or economically stored for later use. It must be

FIGURE 1.
California Rate Components

- DWR BOND CHARGE
- ENERGY RECOVERY BOND CHARGE
- NUCLEAR DECOMMISSIONING
- PUBLIC PURPOSE PROGRAMS
- FERC TRANSMISSION
- DISTRIBUTION
- GENERATION



Source: California Public Utilities Commission

generated and delivered at the precise moment it is needed. Because the majority of rooftop solar and DG systems do not have battery storage, net-metered customers remain connected to the local electric grid and use the grid to buy power from their local electric company during times when their systems are not producing enough energy to meet their needs. Net metered customers also use the grid to sell power to their electric company when their systems are producing more electricity than is needed. Since net-metered customers are both buying and selling electricity, they are relying on the grid as much or more than customers without such systems, but not paying for grid support. Net metered customers also impose costs to reconfigure the electric network to handle two-way power flow. Finally, a variety of regulatorily imposed public goods programs, such as low-income assistance, are included in retail rates. These costs are not recovered when net metered customers are reimbursed at the retail rate.

Figure 1 shows the rate component for three utilities in California.[1] While it varies from utility to utility, and from state to state, the energy component shown in blue (generation) typically makes up only 40 to 60 percent of the total cost.

Based on rates in California, a typical customer paying a $400 total bill would pay about $225 dollars for generation; $125 dollars for distribution, including social programs; and about $50 for transmission. Similarly, and based on rates in Potomac Electric Power Company (PEPCO), a typical customer paying $336 in total bill would pay about $259 dollars for generation; $69 dollars for distribution, including social programs; and $8 for transmission.[2]

Current net metering policies are doubly regressive, being generally available to and used by the well off, and placing additional cost burdens on the less fortunate.

Current net metering policies should be reformed, and prices set fairly and reasonably. As rooftop solar and other DG systems become more developed, net metering policies and rate structures should be updated so that everyone who uses the electric grid helps pay to maintain it and to keep it operating reliably at all times. This will ensure that all customers have safe and reliable electricity and that electric rates are fair and affordable for all customers.

Introduction: Distributed Generation and Net Metering Basics

Providing electricity to home owners and businesses entails four components: making the electricity (generation), moving the electricity (transmission), delivering the electricity (distribution) and miscellaneous and overhead for social programs (for example, the costs of programs to support low-income customers or promote other policy goals, such as efficiency). Historically, electricity was generated at large power plants that were built to capture economies of scale, sent through transmission lines, and then distributed to homes and businesses.

To understand the economics of distributed generation (DG) and net metering billing policies, it is useful to understand that several new technologies, like solar photovoltaic (PV), benefit from economy of scope—not scale. Factory mass production is the key to cost reduction. Geographic dispersion is enabled through smaller individual installation. As opposed to large centralized generation, DG systems are small, on-site energy sources located at homes or businesses.

"DG requires investments in the common electric grid to become effective. Customers with solar panels or other DG facilities are able to draw electricity from the utility when their panels do not provide sufficient power for their needs."

Yet, DG requires investments in the common electric grid to become effective. Customers with solar panels or other DG facilities are able to draw electricity from the utility when their panels do not provide sufficient power for their needs (e.g., night time, overcast days, high usage, etc.) and sell excess electricity back to the utility when panels generate more than is immediately needed. This changes operation of the distribution

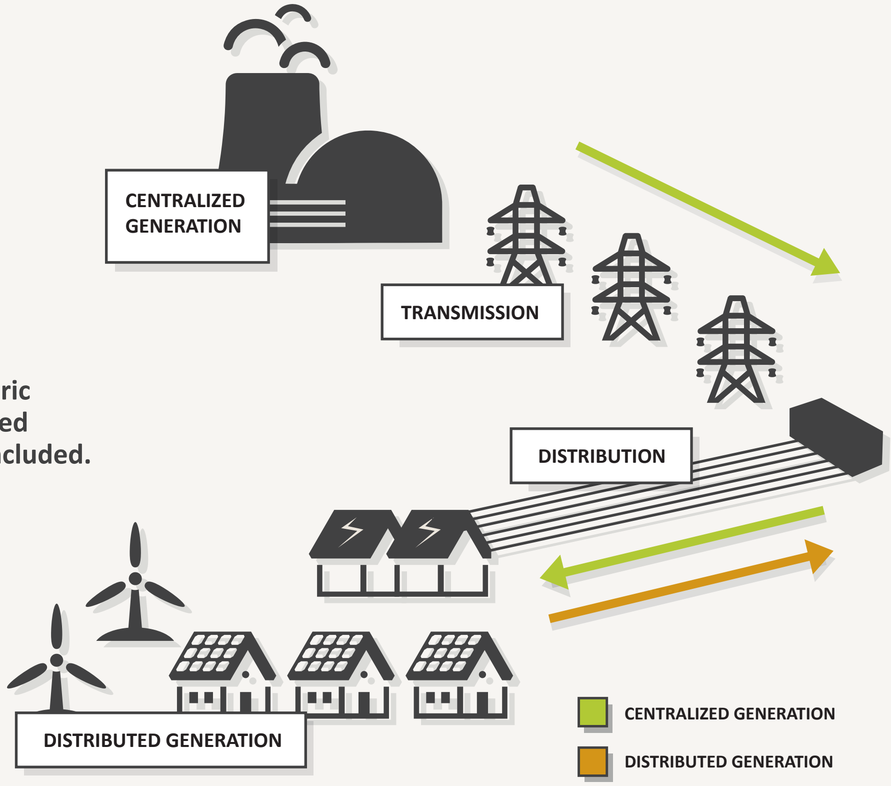


FIGURE 2.
Schematic of electric grid with distributed generation (DG) included.

network, and occasionally the transmission grid, by creating a two-way power flow rather than the historical configuration of distribution grids for one-way flow, from generators to users.

What Is Net Metering?

Net metering policies began in the mid 1980s to encourage distributed generation. Each state with a net metering policy included its preferred technologies, size, aggregate amounts, and other details. The federal Energy Policy Act of 2005 mandated that all public utilities commissions and non-regulated utilities must consider whether to provide net metering of "electric energy." It did not require such options, and it did not require that net metering "turn the meter backward" or use the retail rate to pay for surplus electric energy. Currently, 43 states and the District of Columbia have adopted formal net metering policies.

Under state regulatory requirements, when this excess electricity is sent back to the grid, the electric company must then buy that energy. The billing system measures the "net" used minus electricity sold back to the utility over a monthly period, and issues a bill or a check.

The map shown in Appendix 1, from DSIRE,[3] shows the states with net metering programs and summarizes each state program.

The rate that the utility pays to net metering customers for their electricity is at the heart of the matter. While there are variations, customers are generally reimbursed for their electricity at the full retail rate. Thus, utilities pay much more for electricity from net metered customers than they do for electricity from power plants, even central station solar and wind energy resources.

How much higher are retail rates from wholesale rates? Figure 3 shows the cost of retail versus wholesale electricity in key states for the first half of 2013.[4]

Under net metering, utilities in Arizona pay over three times the cost for electricity than from the competitive market. Regulators then pass these added costs onto non-solar customers in order to maintain reliable service. This cost shift from solar users to their non-solar neighbors is the core of the debate about net metering. Restructuring these billing issues in a reasonable and fair manner, while promoting long-term stability and grid reliability, is essential.

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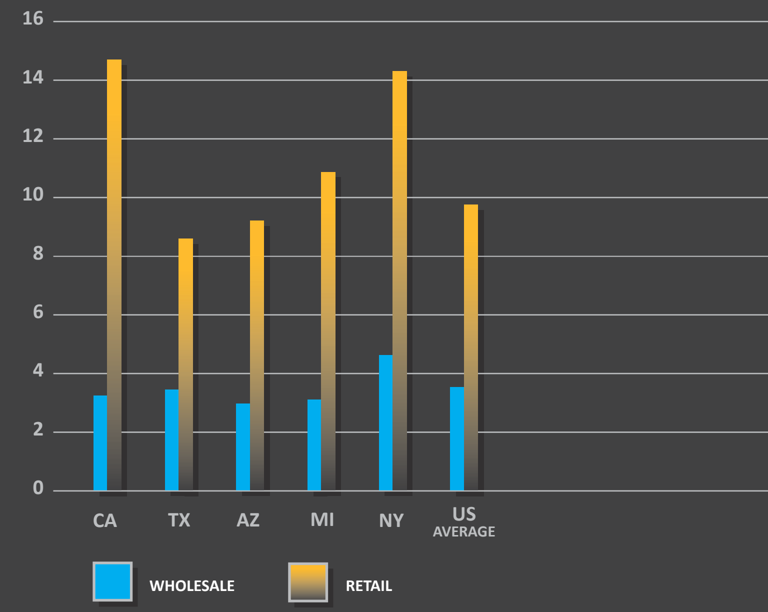
FIGURE 3.
Comparison of retail and wholesale electricity prices (Cents/kwh)



Source: Energy Information Administration

Other states and regions have similar differences. The average U.S. residential price of electricity is currently around 12.5 cents per kWh.[5] According to published data as of November 2013, the market price of energy from wholesale generators is averaging, in most locations, between two and three cents per kWh during off-peak periods and between four and five cents per kWh during on-peak periods. Net metering requires utilities to buy energy at two to six times the market price. These prices are eventually paid by their non-net metered customers.[6]

Fair and Equitable Solutions?

Fair policy would ensure that fair and equitable rates be set that both encourage cost-effective solar and DG while assuring that all customers who benefit from the distribution grid help to pay the costs involved. Retail electricity rates include costs approved by the utility regulatory commission for the wholesale cost of electricity and the costs of planning, building, and maintaining the electrical grid. When solar panel customers are paid under current net metering rates, they are not paying for the wires, poles, meters, or hardware and "smart grid" operation necessary to provide reliable, around-the-clock electricity—even when their operation causes part of that cost.[7] Currently, those costs are unfairly and unreasonably shifted onto their neighbors in a non-transparent manner. As a California study shows, the costs can involve billions of dollars, yet the lack of transparency makes it difficult for policymakers to fully understand the economic and policy implications involved. The issue becomes more important as more solar panels are installed.

Other Considerations

Net metering policies currently fail to pay for costs of the grid, while they shift costs to other customers and lack the transparency necessary for policymakers to make informed decisions. Other considerations also militate for reform of state level net metering policies.

Current net metering policies tend to emphasize the role of solar customers as energy producers, while failing to recognize their place as energy consumers. Homes and businesses with solar panels are still reliant on the grid for more than half of all hours. PV panel output only weakly coincides with peak needs throughout the grid. Wholesale prices vary throughout the day, but retail prices—the basis of net metering rates—seldom do.

In Hawaii, distribution circuits for the local utility have effectively maxed out their ability to accommodate more residential solar power on about 25 percent of Oahu. The utility has expressed worries that circuits will be at capacity for residential solar within six months.

All customers will suffer if more distributed generation is added without making grid and other upgrades. Upgrades have costs. Electrical workers will have their safety compromised by the two-way power flow associated with net metering. By 2014, almost 10 percent of the utility's customers will be equipped with solar panels, placing additional strain on an already taxed system.

Hawaii is experiencing the challenges of integrating[8] intermittent renewables onto the electrical grid, and these challenges are spreading across the country as solar net metering adoption accelerates. "The Grid was not built for renewables," Trieu Mai, a senior analyst at the National Renewable Energy Laboratory, told the L.A. Times.[9] Some fear we are nearing a point at which grid operators have to pay renewable energy providers *not* to produce power, a situation already happening elsewhere, including Ontario, Canada, and Great Britain.[10] [11]

Net metering advocates also claim that net metering limits or avoids the need for new power plants and new distribution and transmission facilities. This is not usually the case. Solar production only weakly correlates with peak utility demand, leaving utilities to maintain adequate capacity—both generation and transmission/distribution—for availability during other periods. In

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fact, as experiences in Hawaii and Germany demonstrate, the widespread introduction of intermittent generation can impose substantial new costs to maintain power quality and reliability.[12] "We want to support renewable energy," said Hawaii state Rep. Marcus Oshiro. "But not at the expense of all the taxpayers who are heavily subsidizing this one component. We cannot sustain this rate of expenditure for this one sector," Oshiro said. "It is about time they get off the training wheels and run on their own." In Hawaii, the number of solar systems has doubled since 2007. Solar tax credits are up from $34 million in 2010 to $173 million in 2012.[13]

As reported by *BusinessWeek,* Germany is currently considering a new customer charge to help pay for these new costs that have been caused by the rapid expansion of renewable power there.[14]

In addition to physical considerations, there are legal and regulatory complications. Writing in *Harvard Business Law Review Online,*[15] David B. Raskin wrote:

> *Net metering raises a number of legal issues that are just beginning to be explored. The definition of "net metering service" in the Energy Policy Act of 2005 indicates that Congress did not endorse the subsidy described above. Section 111(d)(11) of the*

Public Utility Regulatory Policies Act (PURPA) was added in 2005 to a list of retail ratemaking practices that state utility commissions are required to evaluate for use in their jurisdictions. This provision defines "net metering service" as follows:

> *Net Metering – Each electric utility shall make available upon request net metering service to any electric consumer that the electric utility serves. For purposes of this paragraph, the term "net metering service" means 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 energy provided by the electric utility to the electric consumer during the applicable billing period.*

The [Federal Energy Regulatory Commission (FERC)], however, permits net meter customers to avoid this price cap. The FERC holds that unless a retail customer with on-site generation is a net supplier of energy to the grid over the state retail billing period (almost always one month), no sale takes place under PURPA or the Federal Power Act, even if there are substantial deliveries of energy to the grid during the month. In the absence of a "sale" to the utility, FERC deems that no mandatory purchase of energy is taking place under PURPA and the avoided cost price cap does not apply.

The FERC's theory, that the existence of a "sale" can be determined by netting metered inflows and outflows over the course of a month, was recently rejected in two appellate cases involving FERC's use of this same theory to determine whether a retail sale has occurred when generators acquire energy for station service purposes, the mirror image of the net metering situation. In these two cases, the D.C. Court of Appeals held that netting could not be used to determine whether a sale has taken place and that there is a sale whenever energy is delivered from the generator to the utility and vice versa. The FERC's disclaimers of jurisdiction in MidAmerican and SunEdison may therefore be subject to a renewed challenge, which, if successful, would require net metering rules to be changed at the state level. [16 17 18 19 20 21 22]

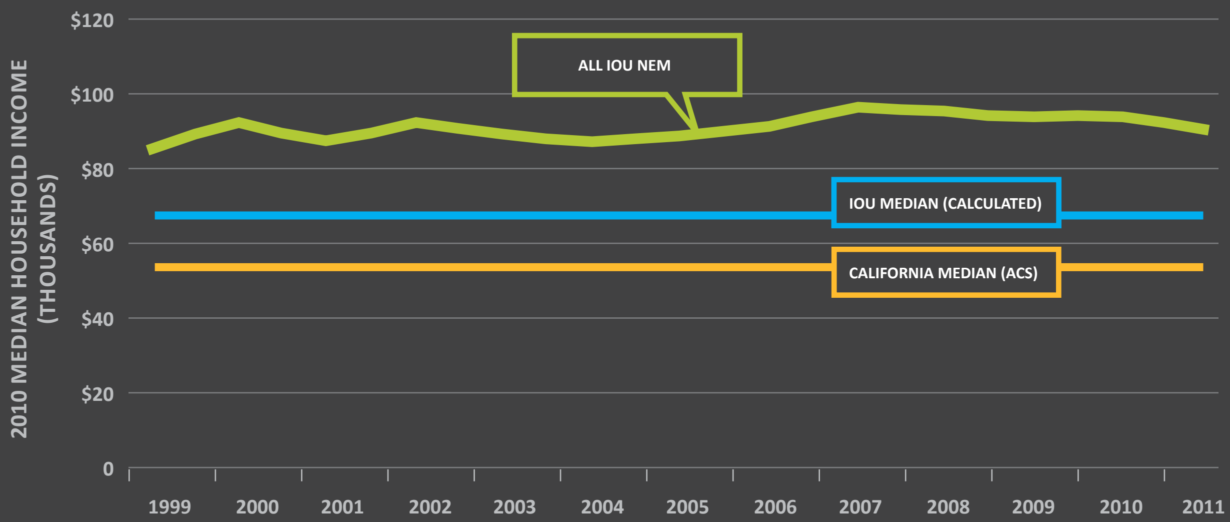
It would be better if changes in net metering policies were to take place in each state legislature and public utility or service commission, and account for each state's uniqueness and existing electric grid characteristics, than in one-size-fits-all FERC regulations or court orders.

Finally, there are equity concerns with current net metering policies. Net metering is "doubly regressive"—first by effectively excluding some customers from net metering because of its high initial cost, including lease and credit requirements; second by hitting those least able to afford the associated cost increases.

A report recently issued by the California Public Utilities Commission forecasts that net metering will cost the state $1.1 billion per year in 2020.[23] It also finds that the average net metering customer in California has an income almost twice the state's average,[24] con-

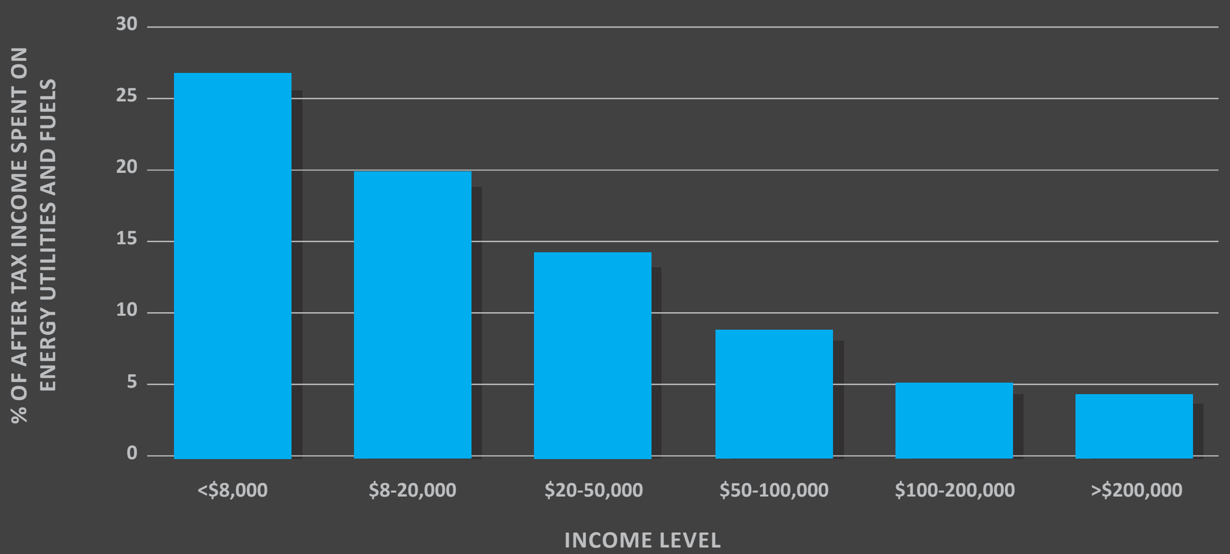
"Net metering is 'doubly regressive'—first by effectively excluding some customers from net metering because of its high initial cost, including lease and credit requirements; second by hitting those least able to afford the associated cost increases."

FIGURE 4.
NEM 2010 Household Income by Installation Year Compared to IOU and California Median Income



Source: California Public Utilities Commission Energy Division

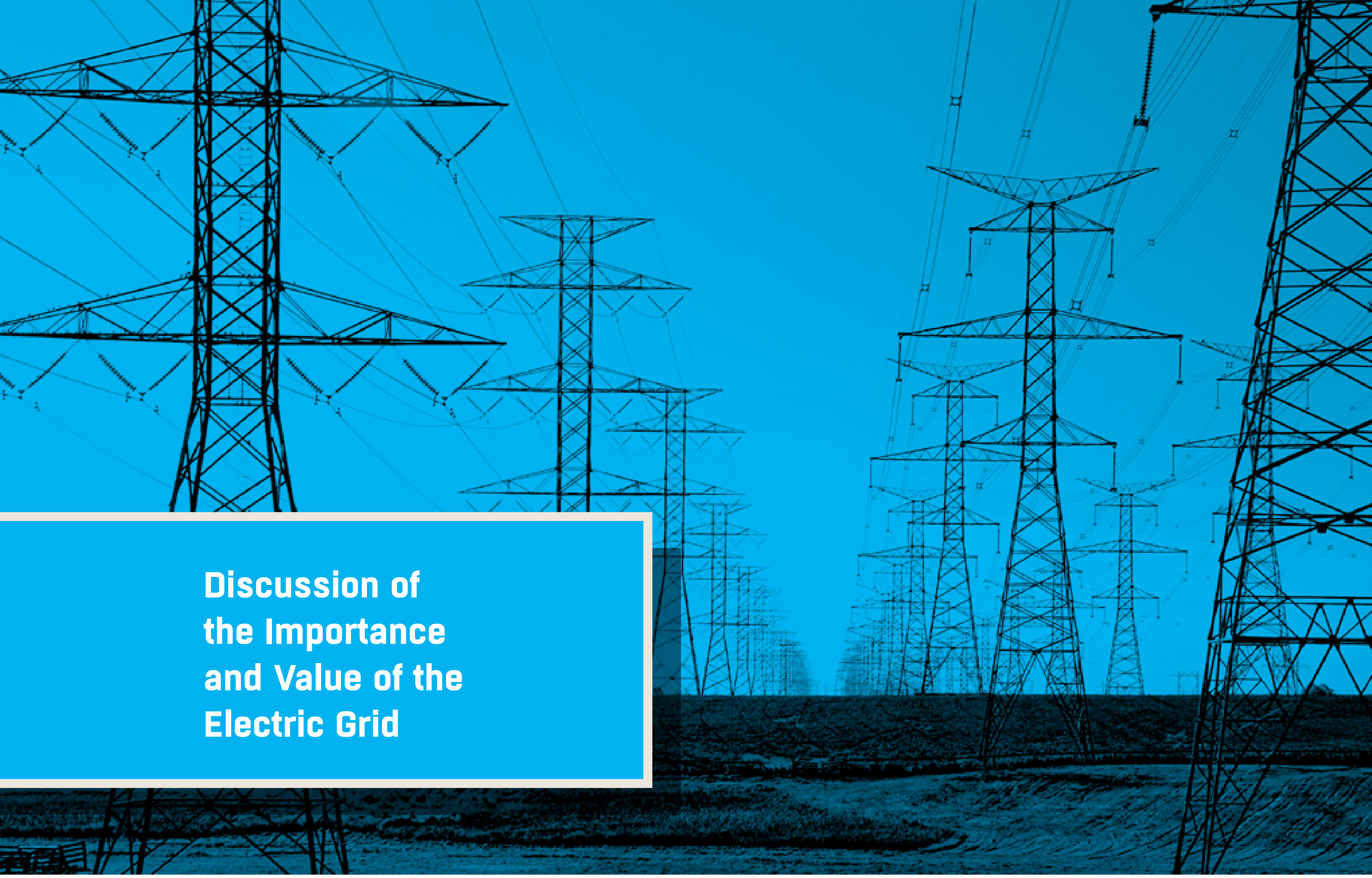
FIGURE 5.
Who Pays More When Energy Costs Increase?



Source: Bureau of Labor Statistics

firming claims that net metering entails a wealth transfer from low- to high-income consumers.

Second, lower-income customers spend a larger percentage of after-tax income on energy utilities than higher-income customers. According to Bureau of Labor Statistics data, a household earning only $8,000 spends 40 percent of its income on energy utilities and fuels, while a household earning $250,000 spends just four percent of its income.



Discussion of the Importance and Value of the Electric Grid

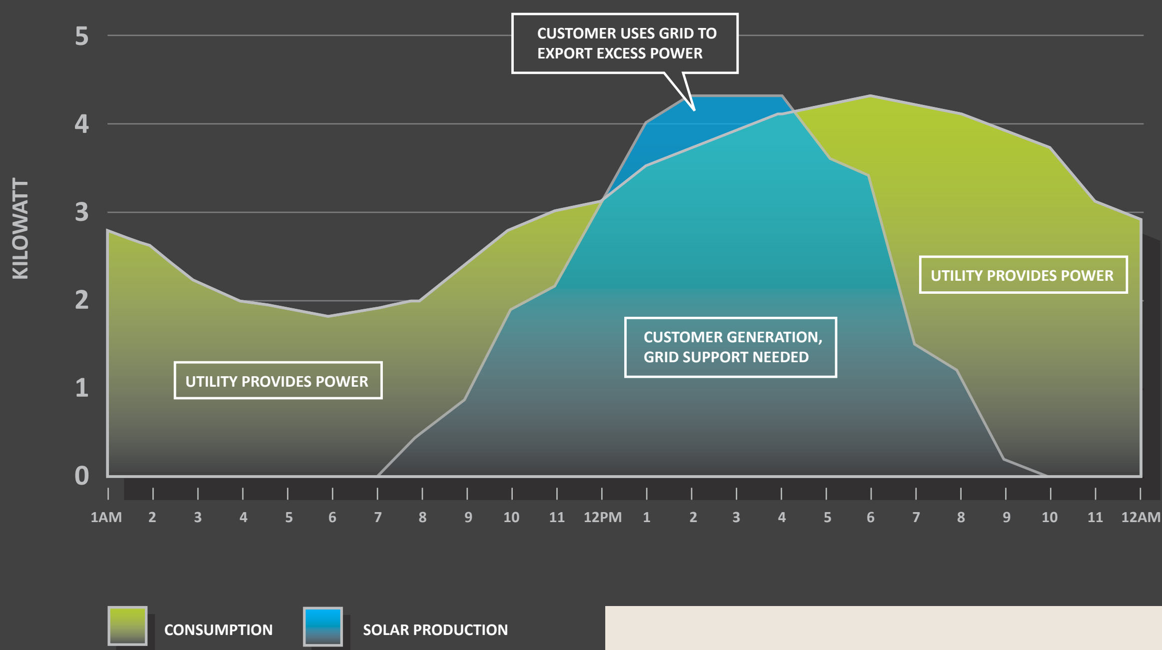
Distributed Generation customers derive valuable benefits from staying connected to the utility's grid.[25] While advocates claim such customers are "free from the grid," that is not true—not even for those DG customers who produce the same amount of energy that they consume in any given day or other time interval, because output and consumption do not match on an instantaneous basis. DG customers, who constantly make use of the utility's distribution support system, should pay fair prices for the grid services they use. The utility's cost of providing grid services consists of at least four components:

- balance supply and demand in sub-second intervals to maintain stable frequency (i.e., regulation service);
- resell energy during hours of net generation and deliver energy during hours of net consumption;
- provide the energy needed to serve the customer's total load during times when on-site generation is inoperable because of equipment maintenance, unexpected physical failure, or prolonged overcast conditions (i.e., backup service);
- provide voltage and frequency control services and maintain high alternating current quality.

"While advocates claim such customers are 'free from the grid,' that is not true—not even for those DG customers who produce the same amount of energy that they consume in any given day or other time interval, because output and consumption do not match on an instantaneous basis."

A typical residential or small commercial customer with solar panels will have an hourly pattern of energy pro-

FIGURE 6.
Typical Energy Production and Consumption for a Small Customer with Solar PV



Source: Edison Electric Institute

duction and consumption such as that shown in Figure 6, from an analysis performed by Lisa Wood and Robert Borlick.[26]

The green area represents the energy consumed by the customer. The blue curve shows the energy produced by the solar panels. The area below the blue curve and above the green line is the excess energy "sold" to the utility. The customer's consumption and generation are almost never equal; the customer will be taking net energy from the grid during many hours of the day. For example, the customer depicted in Figure 6 takes power from the grid in all hours except from noon to about 4:30 P.M.

Even if the customer's total energy production over a billing cycle nets out its consumption over that time, the customer is still using the above grid services during that period.

How much value does a customer with solar PV receive from staying connected to the grid? Figure 7 provides a typical breakdown of components to a consumer's electric bill in the Potomac Electric Power Company service territory of Washington, D.C., and parts of Maryland.

FIGURE 7.
Typical breakdown of components to a consumer's electric bill

ACCOUNT DETAILS		
Services for Jul 8, 2010 to Aug 6, 2010:		
Summer rates in effect		
Distribution services:		
Customer Charge		6.65
Energy Charge	First 400 KWH x 0.0051000	2.04
	Next 1873 KWH x 0.0191030	35.78
Energy Assistance Trust Fund	at 0.0007500 per KWH	1.70
Sustainable Energy Trust Fund	at 0.0013000 per KWH	2.95
Public Space Occupancy Surcharge	at 0.0018300 per KWH	4.16
Delivery Tax	at 0.0070000 per KWH	15.91
Residential Aid Discount Surcharge	at 0.0000500 per KWH	0.11
Total Charges - Distribution		**69.30**
Generation Services:		
Minimum Charge	Includes First 30 KWH	3.34
Energy Charge	Next 2243 KWH x 0.1114700	250.02
Procurement Cost Adjustment	at 0.0024330 per KWH	5.53
Total Charges - Generation		**258.89**
Transmission Services:		
Minimum Charge	Includes First 30 KWH	0.12
	Next 2243 KWH x 0.0034400	7.71
Total Charges - Transmission		**7.83**
CURRENT CHARGES THIS PERIOD		**$336.12**

Source: Clean Currents

> “It is unfair for DG customers to avoid paying for these grid services, thereby shifting the cost burden to non-DG customers.”

Based on PEPCO rates, a typical customer paying a $336 total bill would pay about $259 dollars for generation; $69 dollars for distribution, including social programs; and $8 for transmission.[27]

The costs that the DG customer does not pay for distribution and transmission, which can be significant, will be shifted to other retail customers. In this example, each DG customer shifts up to $950 per year in costs to other retail customers. Put another way, the non–net metered pay a subsidy to the net metered. This cost shift can be substantial and is simply not equitable.

The grid provides a lower-cost option to a solar PV customer compared to what it would cost that customer to use some combination of energy storage and/or thermal generation (e.g., a large battery pack), which can cost that customer substantially more than the $70 charge shown in the example.[28] This is why most DG customers remain voluntarily connected to the grid today and utilize grid services.

The balancing and backup services that the grid provides to DG customers are needed and have substantial value. It does not make economic sense for a DG customer to self-provide these services. It is unfair for DG customers to avoid paying for these grid services, thereby shifting the cost burden to non-DG customers. DG customers should pay the cost of the grid services that the host utility provides and that are voluntarily used by the customer

The Need for Modernizing and Maintaining the Grid

The National Academy of Engineering has called the North American power grid the "… supreme engineering achievement of the 20th century." Experts have been identifying the electric grid's needs for upgrade and refurbishment into the 21st century. A report by the American Society of Civil Engineers (ASCE)[29] described the nation's electrical grid as a patchwork system that ultimately will break down unless $673 billion is invested in it by 2020. That investment is hampered by similarly dated regulatory treatment, including increasing numbers of free riders.[30] If investment isn't increased by at least $11 billion a year, the report said, electrical service interruptions between now and 2020 will cost $197 billion, including lost productivity and damages and health impacts caused by outages.

"If we keep investing as we are today, we're headed for some serious financial and economic difficulties," said Jim Hoecker,[31] former chairman of the FERC. "The investment gap that we're facing is a little scary. In fact, it's a little more scary … We've got a congested system that keeps electricity costs artificially high, and that translates into higher rates for consumers."

The electric grid is dependent upon and depended on by other critical infrastructures, including banking and transportation and fuels delivery. The grid is responsible now as much for delivering quality as it is for delivering quantity, both of which are increasing.
The seminal work done under the joint EPRI/Department of Defense on Complex Interactive Networks[32] concluded:

> *The increasing complexity and interconnectedness of energy, telecommunications, transportation, and financial infrastructures pose new challenges for secure, reliable management and operation. No single entity has complete control of these multi-scale, distributed, highly interactive networks, or the ability to evaluate, monitor, and manage in real time. In addition, the conventional mathematical methodologies that underpin to-*

day's modeling, simulation, and control paradigm are unable to handle their complexity and interconnectedness. Complex interactive networks are omnipresent and critical to economic and social well-being. Many of our nation's critical infrastructures are complex networked systems, including:

- *Electric power grid*
- *Oil and gas pipelines*
- *Telecommunication and satellite systems*
- *Computer networks such as the Internet*
- *Transportation networks*
- *Banking and finance*
- *State and local services: Water supply and emergency services.*

In an increasingly electrified world, even the slightest disturbances in power quality and reliability cause loss of information, processes, productivity, and untold dollar amounts. Interruptions and disturbances measuring less than one cycle (less than 1/60th of a second) can crash computer servers, manufacturing activities, intensive care and life support machines, automated equipment, and other microprocessor-based devices. Still, grid provision of these critical quality issues is generally more cost effective than providing them through a multitude of individual, isolated pieces of equipment.

Review of Existing Studies on the Cost and Cost Shifting Elements of Net Metering

A number of states have attempted to look at the question of rate impacts of net metering, specifically whether a subsidy or "cost shift" is occurring from non-participants to those participating in net metering. In using or comparing the results from the various studies, a few caveats need to be kept in mind:

- Most studies treat net metering subsidies in isolation and do not consider multiple and overlapping subsidies. For example, the federal Production Tax Credit provides a $22/MWh subsidy to certain renewable technologies, yet the analyses of net metering do not always account for that. Other forms of subsidy pancaking are ignored.

- Most of the analyses ignore distributional impacts, or social justice considerations. As indicated above, net metering is doubly regressive, and few of the analyses even address this aspect.

- Treatment of Net Energy Metering (NEM) is within the context of complex rate structures and often lacks the transparency necessary for policymakers to make informed decisions. Further, some of the state analyses treat some assumptions as asymmetrically distributed; for example, benefits are assigned to solar under an assumption that PV panels "may" last longer than 30 years, but no debits are levied for panels lasting less than 30 years. Worse, some analyses discriminate in assigning "benefits" to only select groups of alternatives. One example of this is when the benefits of hypothetical emission savings are assigned to net-metered rooftop solar panels, but not to central station solar panels.

- All of the analyses look at whether benefits exceed costs (and, in some cases, they do not) but do not look at efficiency or cost effectiveness. In other words, can the benefits be achieved at lower cost? In essence, this is a fundamental change in the regulatory compact, from a cost of service to a value of service, not available to non–net metered customers or energy providers, and ignores less expensive alternatives.

A 2010 E3[33] study, commissioned by the California Public Utilities Commission (CPUC), specifically looks at the quantifiable, incremental costs and benefits of net metering. The benefits are calculated as utility-avoided costs of energy and capacity procurement.

The CPUC calls the E3 report methodology "the most rigorous and quantitative methodology ever conducted on the NEM mechanism." The costs and benefits are evaluated for both participants in net metering as well as other, non-participating ratepayers and utilities.

E3 also estimated incremental operational costs to the utility of net metering, which would theoretically include incremental interconnection, integration and billing costs; however, only data for billing costs were available. Integration costs were not quantified.

Another oft-cited study by LBNL in 2010[34] did not examine the value of net metering of solar to non-participating ratepayers; instead, the authors reviewed the impact of retail rate design on hypothetical net metering bill savings. Overall, they concluded that if a feed-in tariff[35] were employed to compensate net metering customers rather than rate-based compensation, the prices would need to be well above the current avoided cost to continue to drive solar market growth.

In January 2012, R. Thomas Beach and Patrick G. McGuire of Crossborder Energy[36] reevaluated their own and LBNL's earlier analyses. In 2012, they looked only at the PG&E utility territory, which includes more than two thirds of the net costs of net metering for non-participants, as well as for all ratepayers across the state of California. They updated the analyses because since the 2010 studies, the California Public Utilities Commission significantly restructured PG&E residential rates, which lowered net metering rates and reduced the rate impacts of those customers to non-participants. Beach and McGuire also incorporated new avoided cost modeling that assumes greater benefits of net metering, largely because of a separate state mandate, the Renewable Portfolio Standard. E3 had calculated that residential NEM customers impose a net cost of $0.19 per kWh of power they export to the grid, a significant level given that the average IOU residential rate is in the range of $0.17 to $0.19 per kWh.

> "One key point on which several studies agree is that, in the final analysis, any 'cost shift' resulting from NEM is a function of rate design."

The LBNL study suggests that NEM is only slightly more expensive than if the power exported to the grid were priced at an avoided cost rate as noted above, less than $0.02 to $0.05 per kWh of power exported.

One key point on which several studies agree is that, in the final analysis, any "cost shift" resulting from net energy metering is a function of rate design.

Beach and McGuire used an hourly approach—the same as used in the E3 and LBNL studies—though they used a modeling approach rather than analyzing individual billing records. They first simulated a net metering customer's net metering output priced at full retail rate, and then ran the same load profile with excess production priced at avoided costs (updated as described above). In cases where the avoided cost calculation was more than when using the retail price calculation, they found no net cost to non-participants. However, based on CPUC decisions that "avoided cost" is defined by the cost of renewables and not by the lower cost of other options, they effectively assumed a tautology: If only certain technologies are considered, then only those technologies can be found cost effective.

A 2012 study by Crossborder Energy[37] updated their earlier analysis, for The Vote Solar Initiative. Using the same methodology, Crossborder extended their analysis to include other utility service territories in addition to PG&E, and considered whether concerns about cost-shifts from solar to non-solar customers are valid.

According to this latter study, extrapolating the results out to the full implementation of the California Solar Initiative yields a net benefit to non-participants of $1.7 million per year; extrapolating out to the five percent net metering cap (recently reinterpreted by the California Public Utilities Commission) yields a net benefit of $3 million. The authors point out the diminutive nature of the numbers in comparison to the utilities' annual electric revenues of about $25 billion, and—as with their earlier study—emphasize that any cost impacts of net metering on non-participants is a function of the underlying electric rate design. This study did not consider cost effectiveness or whether the benefits could be obtained at less cost. It also suffered—as do most of such studies—from effectively allowing for double counting of subsidies across multiple public policies.

Other studies have attempted to quantify the value (but not costs) of distributed solar photovoltaics in geographically diverse areas, each of which is summarized briefly below.

A 2006 analysis by Clean Power Research, LLC,[38] estimated the value of distributed solar photovoltaics to Austin Energy, the utility, and the City of Austin ratepayers, to support the municipal utility's plan to install 100 MW of solar by 2020. The study was updated in 2012.[39] The authors estimated component values of energy production, generation capacity, transmission and distribution (T&D) deferrals, reduced transformer and line losses, environmental benefits, and natural gas price hedge. The authors found a solar net present value of $1,983–$2,938/kW or, on a levelized basis, $0.109–$0.118/kWh—higher than electricity rates at the time. The highest value occurred with one-axis tracking systems oriented 30 degrees west of south to coincide with utility peak demand. More than two thirds of the value came from the energy generated by the solar panels and about one quarter of the value from avoided environmental impacts. They assumed the avoided emissions would actually occur and would have consistent price. Neither assumption is valid in many grids and situations. Further, Clean Power Research, in 2006, did not consider whether other options would achieve the energy or environmental benefits at lower cost and increase the benefit-to-cost ratio, nor did they consider impacts on different income levels.

In 2008, Arizona Public Service (APS) commissioned a study, led by R.W. Beck,[40] to assess the values to the utility of various penetration scenarios (0.5 percent, 6.4 percent, and 14 percent by 2025) of distributed solar photovoltaics, solar hot water systems, and commercial day lighting systems. The authors sought to establish a boundary of expected solar values to use as a benchmark for further studies and analyses. The study did not look at costs to the utility or to ratepayers of solar, distributed generation, or the net metering mechanism.

The additive avoided transmission and distribution (T&D), operation and maintenance (O&M), capacity, and energy cost values ranged from $0.0791 to $0.1411/kWh in 2008 dollars (for reference, current customers under the Standard rate plan pay $0.09417/kWh November–April and $0.0968–$0.17257/kWh—depending on usage—from May to October). Most of the value comes from avoided energy purchases, followed by O&M, capacity, and T&D savings.

Interestingly, the study also found that peak solar production (mid-day) is not coincident with APS customer peak (late in the day), thereby limiting capacity savings.

A 2011 study by Richard Perez, Ken Zweibel, and Thomas E. Hoff[41] estimated the combined value of solar energy in New York City. They described the value that solar energy delivers to ratepayers for energy and capacity, and to taxpayers for environmental, fuel price mitigation,[42] outage risk protection, and long-term economic growth. The authors assessed the costs as the being the stream of revenues/incentives needed for a solar developer to break even—$0.20–$0.30/kWh—plus up to $0.05/kWh in infrastructure and operational costs imposed on the utility to reliably meet demand.[43] Value to the ratepayers and taxpayers ranged from $0.15–$0.41/kWh, with the majority so-called "social benefits." However, the study does not specifically call out net metering or break out the components of the costs to ratepayers and taxpayers, so it is impossible to understand how net metering credits, billing costs, etc., are being considered in the analysis.

> "As with most studies that attempt to value "jobs created," the report failed to account for jobs lost because of higher overall energy costs, or the jobs created in the base case of traditional utility operation."

In 2012, Richard Perez[44] Thomas E. Hoff and Benjamin L. Norris of Clean Power Research undertook a similar study of values that a fleet of distributed solar systems provide to utilities, ratepayers, and taxpayers in Pennsylvania and New Jersey. The Clean Power Research report estimated levelized values for a fleet of distributed solar arrays in seven different locations across New Jersey and Pennsylvania: The sum of all values ranges from $0.26/ kWh to $0.32/kWh in the various locations studied. The authors note that Market Price Reduction and Economic Development Value provide the most benefit; the former (average $55/MWh) attributable to coincidence between locational marginal price and solar output, and the latter (average $44/MWh) reflecting the tax revenue enhancement of local jobs created—even under the conservative assumption that 80 percent of the related manufacturing jobs would remain out of state. As with most studies that attempt to value "jobs created," the report failed to account for jobs lost because of higher overall energy costs, or the jobs created in the base case of traditional utility operation.

In addition to generalized studies, a number of proposals have been put forth based upon specific rate structures and utility characteristics.

Duke Energy Corp. is asking North Carolina utility regulators to allow it to pay businesses and homeowners less money for the solar power they generate. The utility wants to overhaul a pricing rule that allows owners of rooftop solar systems to sell the surplus electricity they generate to Duke at $0.11/kWh, the retail bundled rate. Rob Caldwell, Duke's vice president of renewable generation development, said that the company wants to pay only the generating cost, which is between five and seven cents regionally. James McLawhorn, director of the electric division of the Public Staff, agreed that the rapid spread of small solar producers is making their fee schedule a concern, because other power customers are subsidizing the higher payments that utilities make for power purchases (The Public Staff is an independent state agency that advocates for consumers in utility rate cases).[45]

In Colorado, Xcel Energy, Colorado's dominant electricity provider operating as PSCo, will have its 2014 Renewable Energy Standard (RES) Compliance Plan reviewed by the state Public Utilities Commission in February. In its filings, the utility proposed to change net energy metering (NEM) to recover infrastructure costs from the Renewable Energy Standard Adjustment (RESA) fund. Xcel wants to deduct those incremental costs from the

RESA fund. In Xcel's formulation, taking the net metering incentive from the RESA fund would make it as "transparent" as other performance-based incentives. Xcel's study applied an "avoided costs" method. It concluded that the revenue lost to net metering is the retail rate of $0.104/kWh. The system's avoided cost (or benefit) is $0.046/kWh. Xcel wants the $0.058 per kilowatt-hour difference shifted from the RESA fund to Xcel's ECA account to compensate for revenues lost to solar owners. The Colorado Public Service Commission has "severed" the Net Energy Metering proceeding from the proceeding on the renewable energy standard which could further distort the market through inconsistent treatment in rates and surcharges.

In Arizona, according to Arizona Public Service (APS), the state's largest utility, each solar customer avoids about $1,000 annually in costs for operating the grid, which residents with net metering use to buy and sell power. As more solar systems are installed, the utility's costs are spread across fewer users. This will cause power rates to spiral up, primarily harming poor and middle-class residents who spend a larger share of their income on energy. Net metering is already costing the average power user a $16.80 premium per year. In 2013, Arizona Public Service asked the state utility commission to address the cost shift by modifying net metering for future solar adopters. The utility proposed compensating solar customers for their power at the wholesale rather than retail rate, or alternatively, adding a flat charge to their bills to account for the fixed costs they are not sharing. After extensive debate, the commission adopted a plan that would add roughly $5 monthly ($0.70 per kW of installed capacity) to solar customers' bills. While this surcharge would do little to mitigate the entirety of the cost shift, the commission voted to implement this proposal pending the utility's next rate review in 2015. The approval can be viewed from two perspectives: First, the principle was approved that solar net metering should pay their share of infrastructure costs. Second, the actual charge needs to be calculated more rigorously. That more rigorous analysis should include all of the factors noted at the beginning of this section, and include less-expensive alternatives, not just a simple comparison of hypothetical benefits and costs.

Analyzing benefits of net energy metering includes a substantial amount of subjectivity. One such area of difference is the estimation of capacity displacements by distributed solar, which solar advocates value five times higher than the utility industry, at $51/MWh. According to Energy Information Administration (EIA) estimates,[46] an advanced combustion turbine (peaking plant) operating at a 30 percent capacity factor has a levelized capital cost of $30.4/MWh. Thus, according to the solar lobby, every kW of non-dispatchable solar capacity can safely displace about 1.7 kW of dispatchable gas peaker plants—a rather bizarre notion.

Another such area is assigning a dollar value to avoided air pollutant emissions. First, the amount of emissions avoided, if any, varies tremendously from one location to another, and by both the existing generation fleet and amount of net metering. Second, the value of any avoided emissions varies depending on where the avoided emission would have been emitted, the actual air quality, assumed dollar value of mortality, and even the cost of money. Valuing the externality of air emissions, actual or hypothetically avoided, is perhaps the most speculative endeavor in this field.

All the other points are also highly debatable, but a primary point remains: Why push toward small scale distributed generation that is twice as expensive and substantially less flexible than utility scale? Solar PV is a highly inefficient CO_2 abatement mechanism as it is. Insisting on doing it at double the already high cost just makes no sense.

Analysis of Net Metering From a Competitive Market Perspective

The regulatory compact is undergoing structural change. The utilities no longer have a regulated monopoly for the three main elements of electricity service. Only "open access" to transmission (owned by the utility in contract with customers) and obligation to serve at distribution remain. Even those are undergoing institutional change. Subsidies and tax credits abound favoring one technology over another, irrespective of actual performance. Similarly, subsidies and tax preferences favor some organizational types over others.

What the battle over net metering has come to represent, however, is a fight between a relatively wealthy minority taking advantage of lucrative economic handouts at the expense of their lower-income neighbors who simply cannot afford, or are not eligible to adopt, solar usage.

Arizona Public Service said in a statement earlier this month, "We see a future of rapidly increasing adoption of solar power, where individual customers can 'go solar' by putting solar panels on their homes and businesses. Our responsibility is to make sure the electricity grid is in place to support that goal. As more people install solar on their homes, it becomes more important that everyone who uses the grid helps cover the cost of keeping it operating at all times. Under current rules, rooftop solar customers benefit from a reliable grid, but pay little to nothing for their use of it."

In an interesting twist in Arizona, both sides of the argument claim that they are just trying to promote free-market principles as they relate to solar energy, although net metering advocates miss the fact they are relying upon major subsidies from others and miss the fact they are using utility property without paying for it. Who does the T&D infrastructure belong to? It belongs to the utility, acting—under the regulatory agreement—on behalf of consumers.

Solar advocates in the state claim that APS is essentially a monopoly trying to strong-arm competition and eliminate consumer choice. The group Tell Utilities Solar Won't Be Killed (TUSK) is appealing to free-market advocates by comparing the choice of solar energy for consumers to that of a charter school for concerned parents. They fail to acknowledge that solar customers still use the public system.

This is not truly a free-market argument. Solar owners get a 30 percent rebate in the form of an investment tax credit from the federal government on most installations on top of any state and local funding, along with the generous mandated net metering payout. This faulty argument also ignores the property right, held by the utility for the benefit of all customers, for the existing grid and delivery system. Arguments that ignore that property right and claim free right of use call for a non-market confiscation. Those costs are then passed on to their neighbors in the form of higher taxes and larger utility bills. The incentives provided for solar adopters further distort and invalidate any "free market" arguments.

> "Ideally, no source of electricity would be given preferential treatment. There would be no subsidies, no government stimulus, and no rebates."

Another change taking place is an attempt to shift from a cost of service basis to a value of service basis. Under the historical regulatory compact, utilities were granted exclusive access to a geographic area, in exchange for the obligation to serve those within the area and based on rates determined as the reasonable cost to serve. Today, solar supporters argue that elements of the rates should be priced based on their value to the customer, which often is different than the cost to the provider. But a mixed market, partially based on regulatorily determined costs and partially based on value, is likely to result in mixed market signals—even though it would be preferable to a faux market established by fiat.

All Americans use power. Not all, however, can afford to buy their way into the financial incentives that come from purchasing or even leasing and installing solar units for their homes or businesses. Restructuring net metering compensation to consider the cost of grid maintenance and development incurred by utilities when supporting solar users aims to remove some of the distortion caused by inefficient subsidy initiatives.

Ideally, no source of electricity would be given preferential treatment. There would be no subsidies, no government stimulus, and no rebates. All sources would compete on an even footing in a free market, subject to performance-based environmental standards. Further, this is a distributional factor, not a technology-choice factor. It is as much "against" the utility compact, as it is "for" specific technologies. Ironically, many of the environmental benefits of alternative energy forms are used to justify "social justice" programs, but the results of net metering work in direct opposition to such programs, even granting the assumptions of environmental arguments.

In Arizona and elsewhere, utilities are not calling for the elimination of net metering. They are calling for fair and just compensation of solar power created by customers. They are calling for a system in which all ratepayers are justly charged for their use of the electrical grid and energy services, and fairly paid for their surplus power.

By revising net metering policies, states can ensure that middle- to low-income families (those hurt most by high utility rates) are not subsidizing their wealthier neighbors who see solar power and all of its related government payouts and mandates mainly as a lucrative investment. Government programs that confer benefits on some at the expense of others are not free-market solutions, and only hinder the effective progress of solar power and other options in becoming competitive in the marketplace.

Ideas for Net Metering Reform

ALEC, through nonpartisan research and analysis and the input of state legislators, has approved a model resolution calling for updating net metering policies in the states in order to address cost shifting. The Resolution is shown in Appendix 2.

Others have called for reform as well, including the American Consumer Institute.[47] The American Consumer Institute Center for Citizen Research is a 501(c)(3) nonprofit educational and research institute that focuses on economic policy issues that affect society as a whole, using economic tools and principles to find public policies that work best for consumers.

> *We have heard about all of "good deeds" enacted in the "public's interest." However, not only do some of these "good deeds" turn out to do more harm than good for consumers, but they often have a disproportionate and negative impact on low-income consumers. Let's look at a few examples … Net Metering is a policy found in a number of states that is designed to encourage alternative energy production. The policy lets consumers put solar panels on their roofs, benefit directly from cleaner solar energy, and then sell back any excess energy to the public utility. On the surface, the concept is not a bad idea. However, an increasing number of states have allowed consumers with solar panels to be paid more selling the energy back to the public utility than the public utility can resell it to anyone else, including other consumers.*

At the Fall 2013 Forum of the National Conference of State Legislators (NCSL), the organization's Energy Supply Task Force and Natural Resources and Infrastructure Standing Committee discussed and voted on changes to their National Energy Policy Directive, adding language on the value of the electric power grid. The changes were approved by the Task Force and the Standing Committee, and included language that asserts "… *the value of the electric power grid as an asset that must be maintained, improved and supported by all of those who use the grid and operate it*." A final vote to make the amendments official will occur later. In the meantime, the NCSL staff is authorized to advocate for the principles in the amendments.

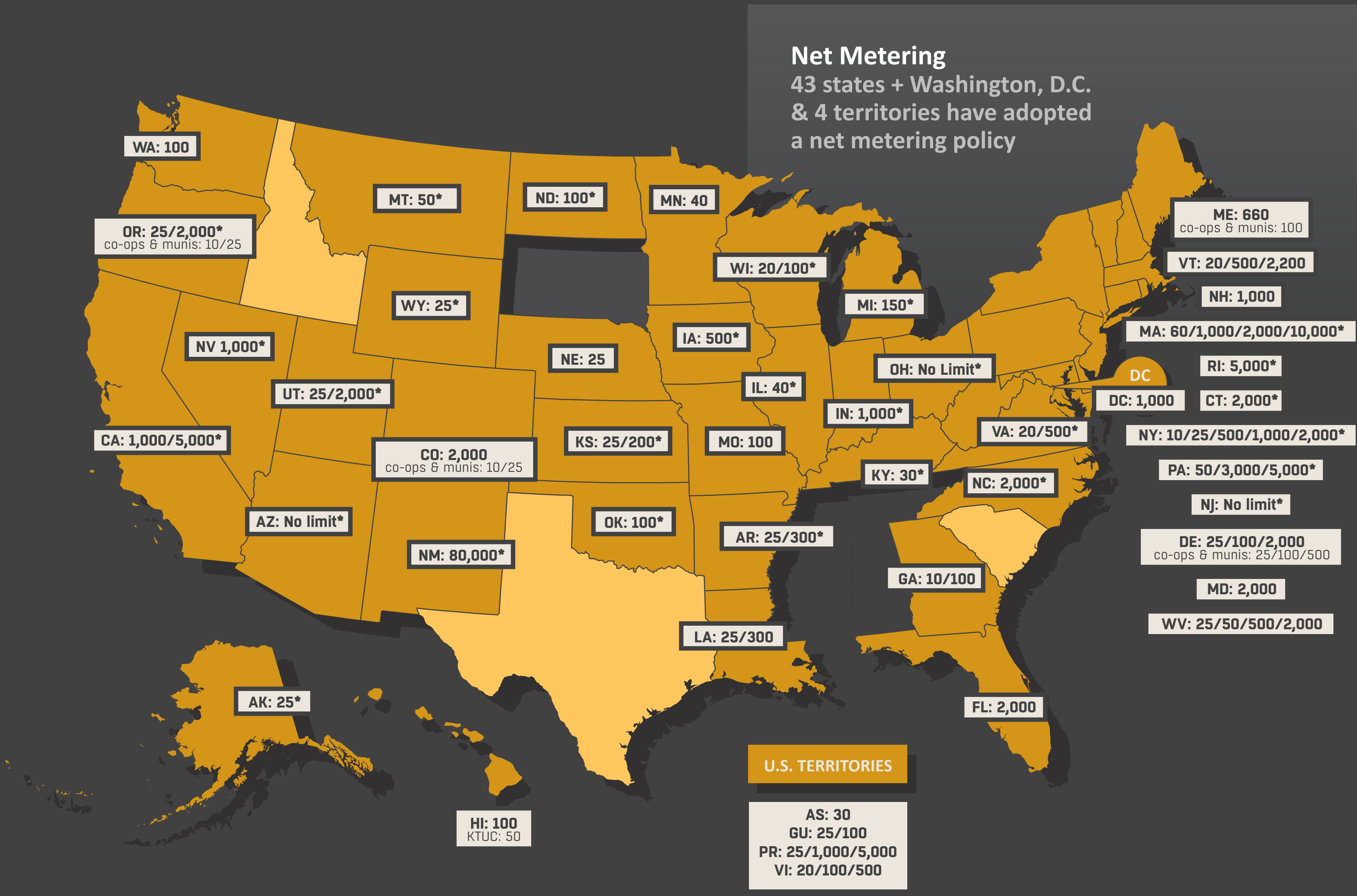
Three basic approaches to net metering are under examination across the nation, each of which seeks to ensure that a DG customer using grid services pays its fair share of the costs of those services while still receiving fair compensation for the energy that it produces:

- Redesign retail tariffs such that they are more cost-reflective (including adoption of one or more demand charges) until a value-based, all-inclusive market can be established;
- Charge the DG customer for its gross consumption under its current retail tariff and separately compensate the customer for its gross (i.e., total on-site) generation; and
- Impose transmission and distribution (T&D) connection and charges on DG customers.

The following are policies and mechanisms that states may consider adopting:

- Legislation could be enacted that limits new net metering connections until rates are re-configured;
- Analyze pancaked subsidies and eliminate multiple use of the same benefit in benefit-cost analysis;
- In the interim, states could impose a demand charge on DG customers, intended to recover the costs associated with transmission, distribution and miscellaneous costs.

APPENDIX 1—States' Programs of Net Metering



Numbers indicate individual system capacity limit in kilowatts. Some limits vary by customer type, technology and/or application. Other limits might also apply. This map generally does not address statutory changes until administrative rules have been adopted to implement such changes.

Second number in some cases refers to aggregate limit.

STATE POLICY

VOLUNTARY UTILITY PROGRAM(S) ONLY

* STATE POLICY APPLIES TO CERTAIN UTILITY TYPES ONLY (E.G., INVESTOR-OWNED UTILITIES)

Source: Database of State Incentives for Renewables & Efficiency

APPENDIX 2—Updating Net Metering Policies Resolution

WHEREAS, the U.S. electric grid delivers a product essential to all Americans; and

WHEREAS, electricity runs our economy—it powers our homes, businesses, industries, and the smart technologies and innovations that enhance our quality of life; and

WHEREAS, the electric power industry is leading the transformation to make the grid more flexible and more resilient to meet the growing demands of our digital society; and

WHEREAS, the electric power industry directly employs more than 500,000 American workers and is the nation's most capital-intensive industry, investing more than $90 billion per year, on average, in capital expenditures, including investments in transmission and distribution infrastructure; and

WHEREAS, ALEC's Electricity Transmission Principles assert that the electricity transmission system must be "coordinated in a manner that satisfies current needs and future growth, and that provides energy consumers with the necessary levels of system security, overall reliability, and access to the most economic and diverse sources of electricity"; and

WHEREAS, there is growing interest among customers to self-serve with on-site rooftop solar panels; and

WHEREAS, there is growing interest among renewable energy service providers in installing rooftop solar panels and other small-scale, on-site distributed generation (DG) systems; and

WHEREAS, it is recognized that when these rooftop solar and other DG systems first came to market years ago, many states approved a billing plan called net metering that provided a subsidy to distributed generators to encourage their introduction; and

WHEREAS, some states now have net metering policies that credit rooftop solar or other DG customers for any excess electricity that they generate and sell using the grid, and require utilities to buy this power at the full retail rate; and

WHEREAS, the full retail rate of electricity often includes the fixed costs of the poles, wires, meters, advanced technologies, and other infrastructure that make the electric grid safe, reliable, and able to accommodate solar panels and other DG systems; and

WHEREAS, when net-metered customers are credited for the full retail cost of electricity, they effectively avoid paying the grid costs, and these costs for maintaining the grid then are shifted to those customers without rooftop solar or other DG systems through higher utility bills; and

WHEREAS, the use of rooftop solar and other DG systems now has become more widespread, and many states are reviewing their net metering polices; and

WHEREAS, there have been several recent public policy developments, such as a National Association of Regulatory Utility Commissioners resolution, a Southern States Energy Board resolution, development of Critical Consumer Issues Forum policy principles, and even state regulatory proceedings, that recognize the need for proper allocation of costs to support customers' use of the electric power grid; and

THEREFORE BE IT RESOLVED that the American Legislative Exchange Council encourages state policymakers to recognize the value the electric grid delivers to all and to:

1. Update net metering policies to require that everyone who uses the grid helps pay to maintain it and to keep it operating reliably at all times;
2. Create a fixed grid charge or other rate mechanisms that recover grid costs from DG systems to ensure that costs are transparent to the customer; and
3. Ensure electric rates are fair and affordable for all customers and that all customers have safe and reliable electricity.

Adopted by the Energy, Environment, and Agriculture Task Force on December 6, 2013.

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About the Author

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Mr. Tanton is President of T^2 & Associates, a firm providing consulting services to the energy and technology industries. T^2 & Associates are active primarily in the area of renewable energy and interconnected infrastructures, analyzing and providing advice on their impacts on energy prices, environmental quality and regional economic development. Mr. Tanton is a strong proponent of free market environmentalism and consumer choice, and frequently publishes and speaks against alarmist and reactionary policies and government failures. Most recently, Mr. Tanton presented invited testimony to the House Energy and Commerce Committee, regarding energy technology focused Federal policies, and provided Hill briefings on the critical nature of Rare Earths markets.

Mr. Tanton has 40 years direct and responsible experience in energy technology and legislative interface, having been central to many of the critical legislative changes that enable technology choice and economic development at the state and federal level.

As the General Manager at Electric Power Research Institute, from 2000 to 2003, Mr. Tanton was responsible for the overall management and direction of collaborative research and development programs in electric generation technologies, integrating technology, market infrastructure, and public policy. From 2003 through 2007, Mr. Tanton was Senior Fellow and Vice President of the Houston based Institute for Energy Research. Until 2000, Mr. Tanton was Principal Policy Advisor at the California Energy Commission, including serving on the Governor's Task force on Critical Infrastructure for the 21st Century.

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