

# Do Load Shapes of PV Customers Differ From Other Customers?

PRESENTED AT

CRRI 31<sup>st</sup> Annual Western Conference

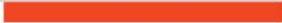
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THE **Brattle** GROUP

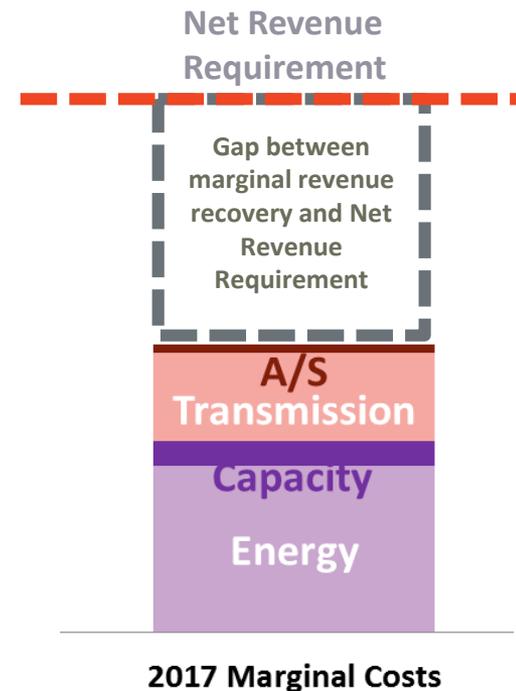
# Motivation

Long history of recovering utilities' fixed costs in the same way as marginal costs: volumetrically

As a result, customers have a strong incentive to reduce their kWh consumption

One group of customers, those who install rooftop solar, are particularly effective at reducing their allocation of fixed costs

This results in cross-subsidies between customers without PV to customers with PV, which continue to rise with increased penetration of rooftop solar



POSTED MARCH 26, 2018 BY LUCAS DAVIS / 146 COMMENTS

# Why Am I Paying \$65/year for Your Solar Panels?

*700,000 California homes now have solar panels; what does this mean for everyone else's rates?*

"This is the future," one of my neighbors recently told me, proudly showing off his rooftop solar panels, "Forget the old, inefficient utility." The panels do look great, and, for a moment, I got caught up in my neighbor's "green glow" of eco-righteousness. Should I be doing "my part" for climate?

But wait a second. I already am! As Severin Borenstein has been [pointing out](#) for years, a big part of the reason why rooftop solar is so popular in California is our electricity rates. And because of the way rates work, every time another neighbor installs solar, my rates go up. I'm tired of it. Why should they get all the "green glow"? Why should I be paying more for *their* rooftop solar, particularly given that grid-scale renewables are so much [cheaper](#)?

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*Important Question:*

**Is there is sufficient cost justification  
to create a separate rate class  
for residential customers  
with distributed generation?**

**One of the factors that will influence this decision  
is whether their load shapes are different**

# Setting

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**Today, I present results of an analysis using data from Westar Energy in Kansas**

**We conducted an econometric analysis using hourly data on net load for hundreds of Westar customers**

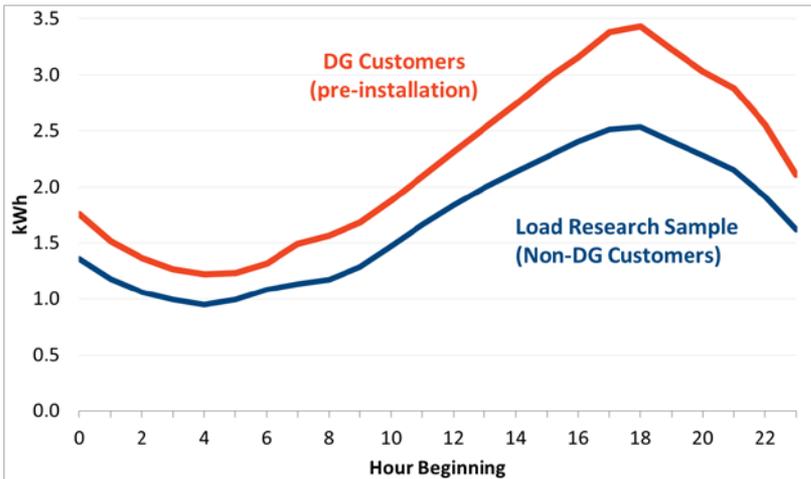
- Data on a representative sample of customers who never install PV
- Data on all customers who do install PV, both before and after installation
- Our “fixed effects” methodology controls for many omitted variables that may otherwise bias results

We've seen qualitatively similar results in other settings, including Idaho Power

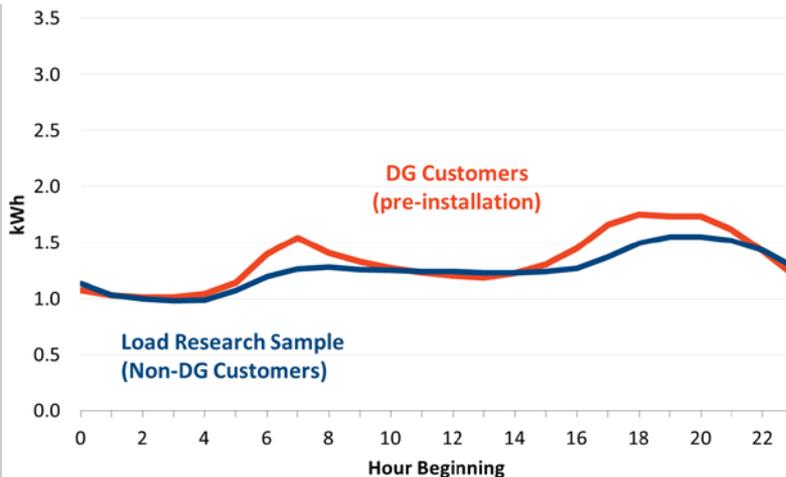
# Load Shapes and Bills Before DG Installation

## Average Load Shapes Before DG Installation

Summer



Winter



## Observations

- Prior to the installation of DG, the average DG customer is larger than the average Westar customer
- However, the hourly shape of the DG customer's load is similar to that of the average non-DG customer, with an evening peak in the summer and a (lower) dual peak in the winter
- Prior to the installation of DG, the average DG customer's monthly bill is **\$151/month** under the current rates

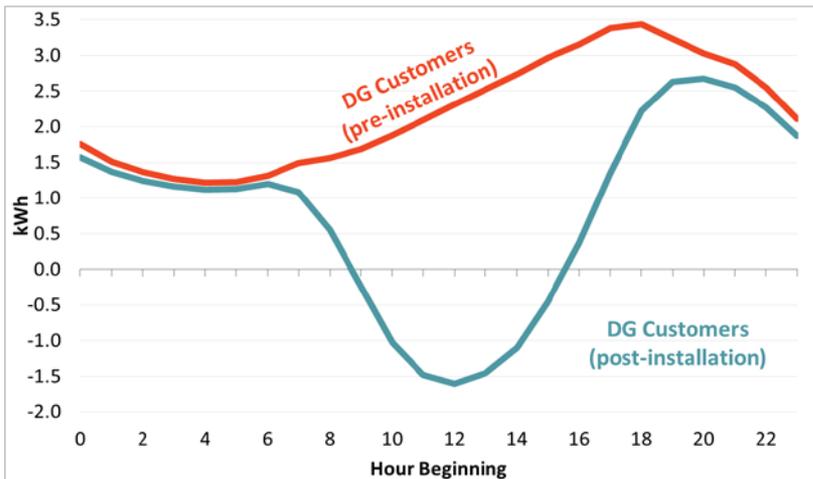
Source:

<https://www.fortnightly.com/fortnightly/2018/02/do-load-shapes-pv-customers-differ>

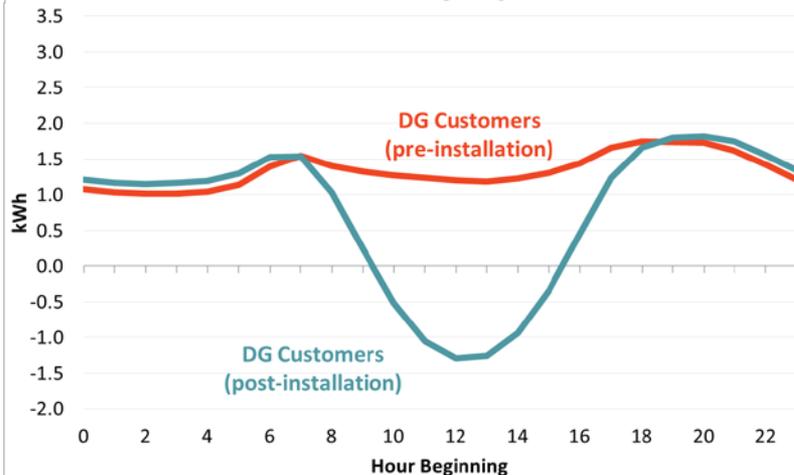
# Load Shapes and Bills After DG Installation

## Average Load Shapes After DG Installation

Summer



Winter



## Observations

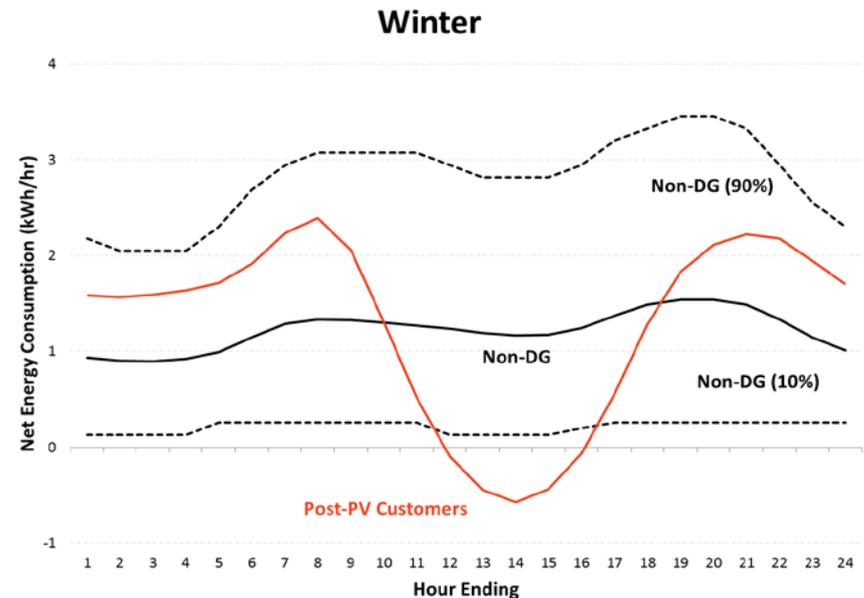
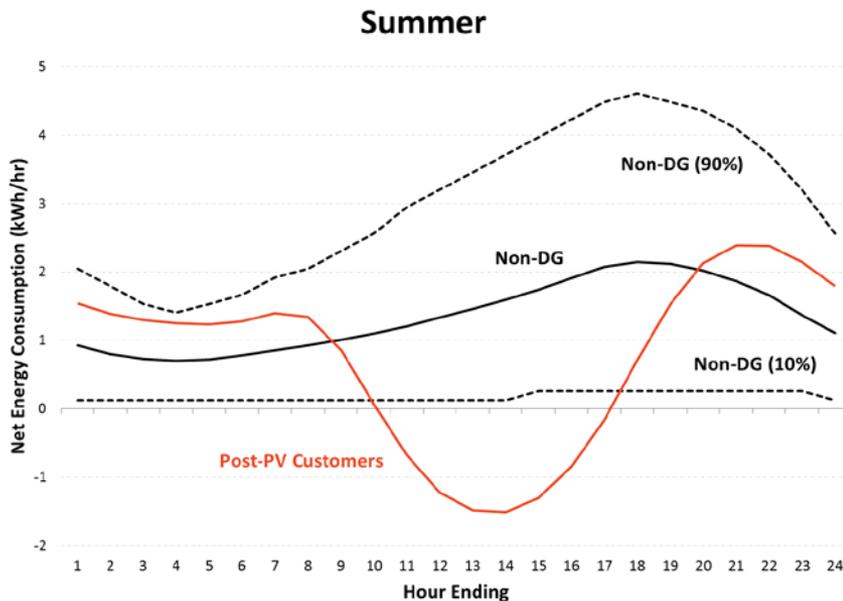
- The installation of DG reduces the average DG customer's net annual energy consumption from 1,060 kWh/yr to 530 kWh/yr (50% reduction)
- However, the DG customer's average peak monthly demand is virtually unchanged; in the summer, it decreases from 6.8 kW to 6.5 kW (4% reduction)
- Under the current rates, the average DG customer's monthly bill would decrease from **\$151/month to \$78/month (48%)** after installing DG

Source:

<https://www.fortnightly.com/fortnightly/2018/02/do-load-shapes-pv-customers-differ>

# Load Diversity

There is significant variation in load shapes of residential customers, but DG customers consistently fall outside the range of load observed for several hours each day in all seasons



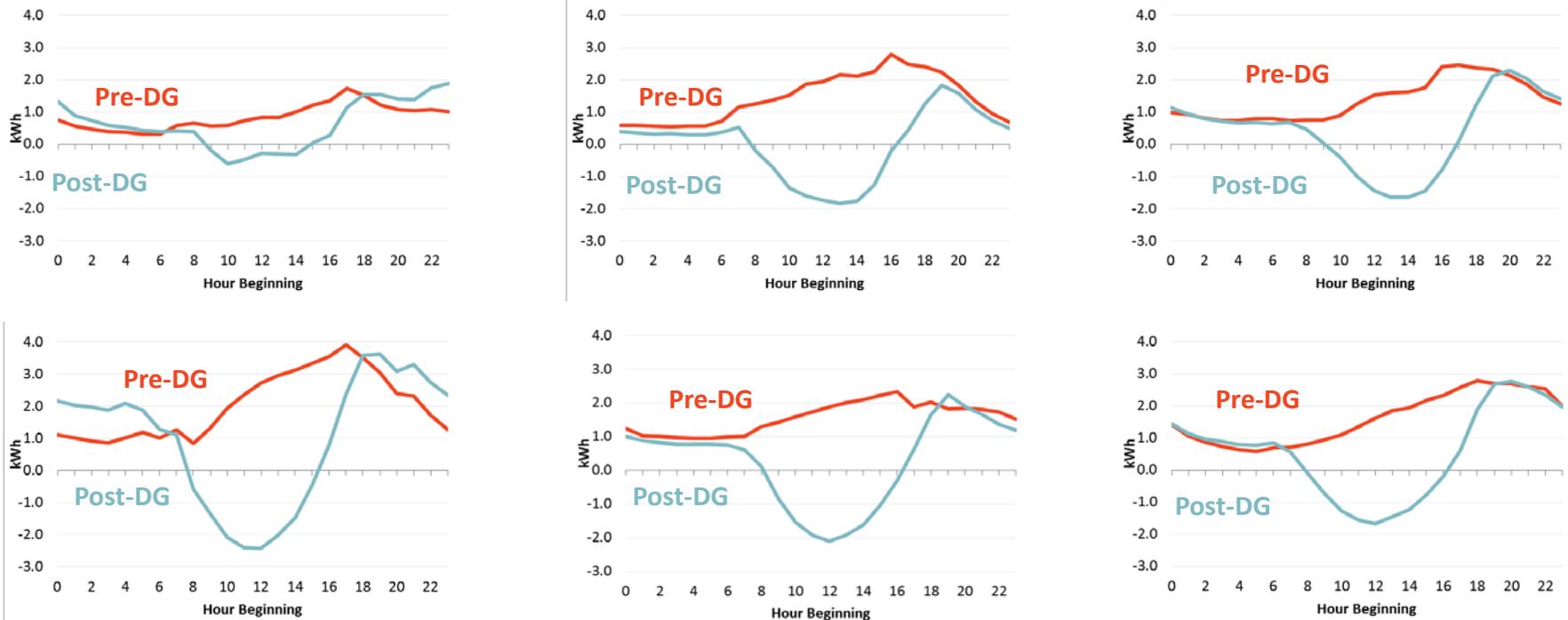
Source: <https://www.fortnightly.com/fortnightly/2018/02/do-load-shapes-pv-customers-differ>

Note: illustrative data from a similar analysis using data from Idaho Power, averages will not correspond to those from the Westar Analysis.

# Individual Customers Show Similar Patterns

Individual customers with Pre-DG and Post-DG data had similar patterns as observed on average across DG customers

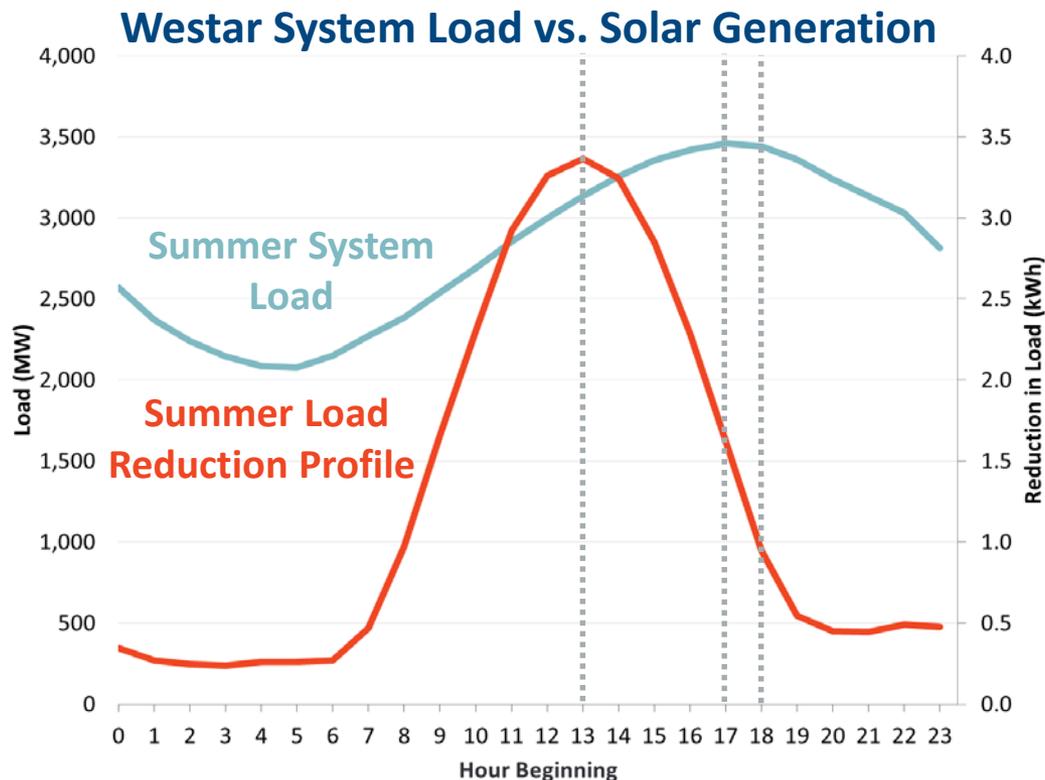
## Examples of Individual Customers Load Shapes During the Summer



# Alignment With System Peak

## Westar system load peaks between 5 PM and 6 PM

- Peak output from DG customers occurs at 1 PM
- At system peak, DG output is **48%** of peak solar output
- However, the residential class peaks at 6 PM when DG output is only **28%** of peak solar output



Source:  
<https://www.fortnightly.com/fortnightly/2018/02/do-load-shapes-pv-customers-differ>

# All Customers are Dependent on the Grid

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## The installation of DG does not make customers independent from the grid

- After installation of DG, customers are still **reliant on the grid for 99.2% of 15-minute intervals** (i.e., power is flowing either to the customer or from the customer back to the grid)
- This number may be understated due to some customers with missing data for several days or even months
  - After removing customers-months with no load data for the full month, we found that customers are **relying on the grid 99.8% of the time**

**This finding is consistent with previous results that show DG customers are still heavily reliant on the distribution infrastructure**

# Key Takeaways

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## **The installation of DG by a residential customer results in a substantially different load profile**

- After DG installation, customers reduced their monthly energy consumption by **50% in the summer**, but only reduced their peak demand by **4% during the same months**, resulting in a **significantly lower load factor**
- Although the DG sample had somewhat higher overall energy consumption than the original load research sample before installing DG, their load shapes and usage patterns were relatively similar
- After installation, the net load shapes of DG customers are dramatically different than non-DG customers, including periods of significant net export of electricity to the power grid

**These findings provide evidence that DG customers are sufficiently different from other residential customers to justify the creation of a separate rate class**