Characteristics of non-DG customers

We analyze the load research data for the 188 customers for whom there is a full year of hourly observations

- The sample is broadly representative of the larger residential customer class
  - Average monthly energy consumption of 1,020 kWh
  - Average monthly peak demand of 5.9 kW
- Covers the period from October 1, 2013 through September 30, 2014

Residential Sample Load Shape
Characteristics of DG customer data

We analyze the sample of DG customer data for the 266 residential customers with valid data

- Covers the period from October 1, 2013 through February 5, 2017
- Pre-DG load levels are slightly larger than the original load research sample
  - Average monthly energy consumption of 1060 kWh
  - Average monthly peak demand of 6.2 kW

DG Installations Over Time

Source: Westar Energy.
DG customer load shape comparison

DG installation significantly changes customer load shape

- We use regression analysis to compare average load and load shapes before and after DG installation, and also compare to the load research sample
- Pre-DG installation, load shapes for the DG sample are similar to the original load sample, though somewhat higher in the summer
- We find DG reduces net energy consumption by half from 1060 kWh to 530 kWh
- However, average monthly peak demand is virtually unchanged
- In the summertime, DG reduces average residential customer monthly peak load from 6.8 kW to 6.5 kW
- Average net monthly peak export to the grid is 4.0 kW in the summer and 5.4 kW in the winter

Note: Summer defined as June – September

DG Load Shape During Summer

DG Load Shape During Winter
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
Westar system load

Westar System Load Peaks between 5 PM and 6 PM (hour beginning 17)

- Peak output from DG customers occurs at 1 PM (hour beginning 13)
- At system peak, DG output is 48% of peak solar output
- However, the residential class peaks at 6 PM (hour beginning 18) when DG output is only 28% of peak solar output

Westar System Load vs. Solar Generation

Source: Westar Energy
All customers are dependent on the grid

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

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 **49% in the summer**, but only reduced their peak demand by **4.9% 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

- Most individual customers within the DG sample followed the same patterns as observed in the average load shapes of DG customers
Appendix: Comparison to original affidavit

- The solar data we modeled using NREL’s SAM has higher solar output likely driven by our higher average system size estimates
  - Assume 6.5 kW in our modeling which is based on an assumption that DG offsets 80% of a customer’s load
  - Westar’s average residential DG installation is closer to 5.7 kW
- Overall, the qualitative arguments used in the testimony remain unaffected: **Net load shape after DG installation is substantially different than observed for the typical residential customer**