

Smart Appliances

Kevin Messner

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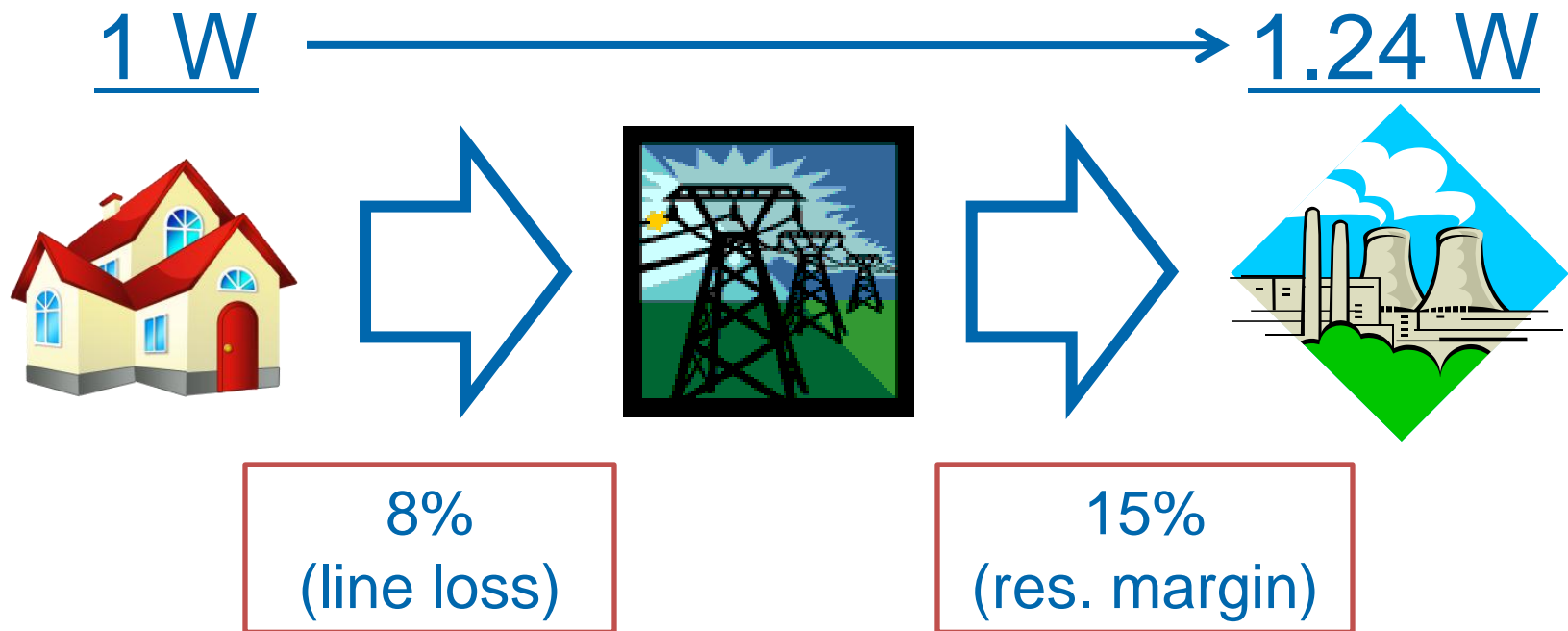


ENERGY STAR

➤ Smart Appliances Will Be a Reality in 2013

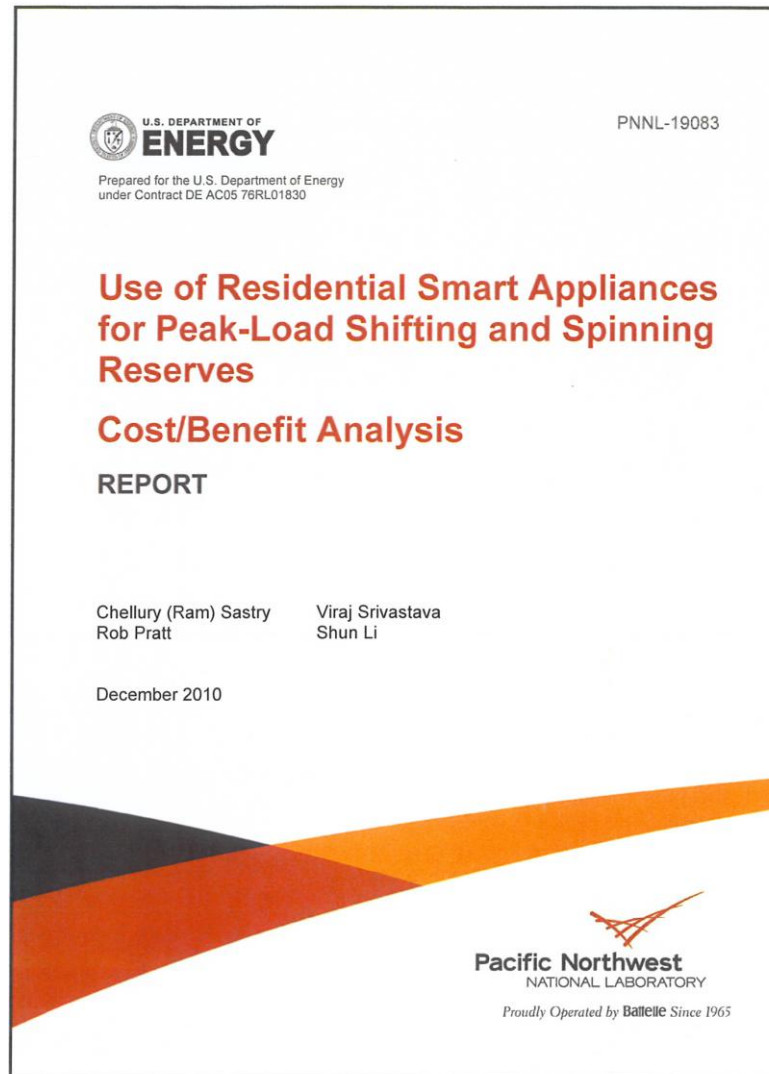
Product	Delay Load	Temporary Load
Refrigerator	Shift Defrost/Ice Making	50%
Clothes Washer	Delay Start	50%
Dryer	Delay Start	80%
Room AC	25%	80%
Dishwasher	Delay Start	50%

Demand Reduction Yields 24% More in Capacity Savings

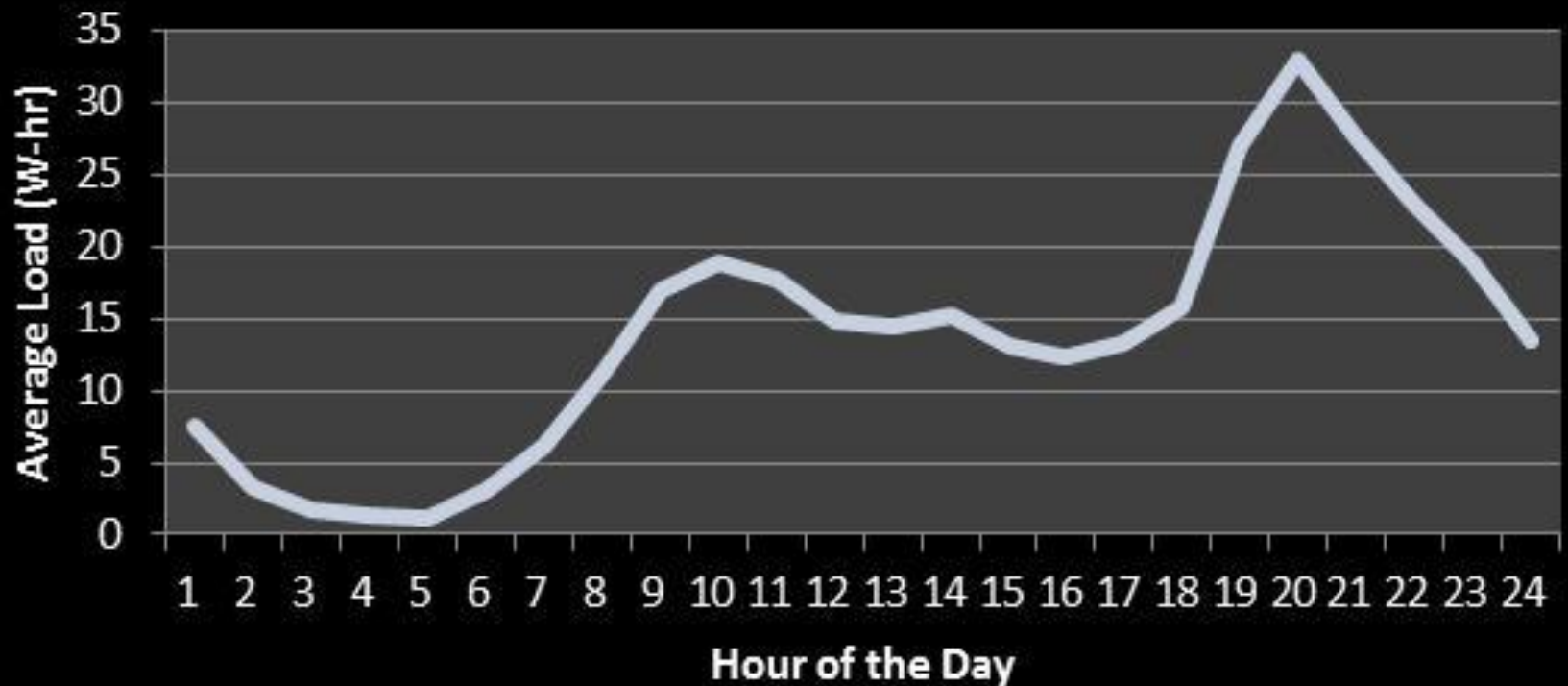


Source: The Brattle Group

PNNL Study



Dishwasher Average Hourly Load



PJM Hourly Wholesale LMP for NE. Columbus OH (2006)

Date	DST Hours	Price (\$MWh)	Month	Day	Hour (Starting)
01/01/2006	1	\$ 35.32	1	1	0
01/01/2006	2	\$ 31.42	1	1	1
01/01/2006	3	\$ 32.84	1	1	2
01/01/2006	4	\$ 27.11	1	1	3
01/01/2006	5	\$ 27.25	1	1	4
01/01/2006	6	\$ 26.73	1	1	5
01/01/2006	7	\$ 27.04	1	1	6
01/01/2006	8	\$ 28.64	1	1	7

PJM Hourly Ancillary Services for Mid-Atlantic (2006)

Date	DST Hours	Regulation (\$MWh)	Synchronized Reserve (\$MWh)	Month	Day
1/1/2006	1	17.51	7.07	1	1
1/1/2006	2	21.88	6.87	1	1
1/1/2006	3	24.38	6.78	1	1
1/1/2006	4	17.89	0	1	1
1/1/2006	5	27.8	0	1	1
1/1/2006	6	26.01	7.83	1	1
1/1/2006	7	19.95	6.68	1	1
1/1/2006	8	22.7	6.76	1	1

Dishwasher Assumptions-Pessimistic

Percentage of DWs with electricity based hot water
40%

Fraction of Customers with Access to Grid Signals
50%

Fraction of Customers Willing to Shift On-Peak Load	Fraction of On-Peak Load that Willing Customers Shift	Net Fraction of On-Peak Load Available to Shift
70%	70%	25%

Fraction of Customers Willing to Provide Spinning Reserves	Fraction of Appliance Load Reduced for Spinning Reserves	Net Fraction of Load Available for Spinning Reserves	Consumer Behavior Feedback Effect
90%	50%	23%	3%



PNNL Study-Results

Shown in Table 1-1 are the highest possible benefit-to-cost ratios (expressed as percentages) of various appliances based on the “optimistic” set of assumptions.

Table 1-1. Benefit-to-Cost Ratios of Smart Appliances Based on “Optimistic” Assumptions

	DW	CW	RAC	Freezer	Refrigerator	Dryer
PJM 2006	528%	563%	733%	539%	536%	680%
ERCOT 2008	817%	871%	1060%	881%	877%	1054%
NYISO 2008	367%	403%	585%	357%	355%	462%
NYISO 2006	353%	389%	712%	346%	344%	442%
CAISO 2008	319%	356%	554%	313%	312%	396%

Shown in Table 1-2 are the low-end benefit-to-cost ratios of various appliances based on “pessimistic” set of assumptions.

Table 1-2. Benefit-to-Cost Ratios of Smart Appliances Based on “Pessimistic” Assumptions

	DW	CW	RAC	Freezer	Refrigerator	Dryer
PJM 2006	136%	134%	131%	150%	150%	207%
ERCOT 2008	203%	200%	295%	230%	228%	337%
NYISO 2008	107%	106%	139%	112%	111%	147%
NYISO 2006	112%	112%	160%	119%	118%	160%
CAISO 2008	99%	100%	135%	102%	101%	134%

Smart Appliances Provide Spinning Reserves

- Spinning reserve requirements are up to 10 minutes.
- Appliance loads can be reduced for 10 minutes or less with little or no impact on the consumer.
- Appliances are environmentally friendly “reserves.”



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