Professional Awning Manufacturers Association

PAMA Energy Study II Webinar

Professional Awning Manufacturers Association

IFAI division

The Professional Awning Manufacturers Association (PAMA) is the trade association committed to supporting the awning industry in the United States.

Membership is open to companies who manufacture or supply material to the awning industry, and are who are current members of the Industrial Fabrics Association International (IFAI).

PAMA provides a forum to exchange information, solve common problems, and develop mutually beneficial relationships for its members.

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PAMA Energy Study II

1. Background
2. Energy Simulation and Model
3. Overview of Results
4. Highlights of one city: Dallas/Fort Worth

Presented today by: **John Gant, Glen Raven – Sunbrella**
jgant@glenraven.com

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In 2007, PAMA initiated its first study:

"Awnings in Residential Buildings: The Impact on Energy Use and Peak Demand"

with John Carmody, Director of Center for Sustainable Building Research, University of Minnesota. He is nationally recognized as a leading expert in building energy science, and window technology. Dr. Carmody engaged Dr. Joe Huang to carry out the programming and calculations.

Some conclusions were:

"Awnings have advantages that contribute to more sustainable buildings. Awnings result in cooling energy savings by reducing direct solar gain through windows."

"Peak electricity demand is also reduced, potentially resulting in reduced mechanical equipment costs, and overall savings to utility companies from a decreased need to build new generating capacity."

The 2007 research report is available from PAMA or the University of Minnesota CSBR website.

Awnings in Residential Buildings
The Impact on Energy Use and Peak Demand

Version 2.0

John Carmody and Kerry Haglund
Center for Sustainable Building Research, University of Minnesota
Yu Joe Huang
Lawrence Berkeley National Laboratory

August 2007

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In 2012, PAMA contracted with Dr. Joe Huang to update the study. The update increased the number of variations - of cities, shade designs, and fabrics. The new study uses updated information about weather and energy costs, and it includes programming improvements to the simulation model.

Dr. Joe Huang is a research computer scientist with a long career in building energy simulation. He is president of the consulting group White Box Technologies. He has held positions at Lawrence Berkeley National Laboratory and other prestigious organizations in his career. Dr. Huang utilized DOE-2 Simulation Software developed at Berkeley National Lab to model building energy performance.

The complete research report will be available to members on the PAMA website.

PAMA Energy Study II

Purpose

Develop information about the Energy Conservation benefit of Fabric Window Shading for:

1. PAMA to use to educate members
2. Members to use in their marketing and sales efforts
3. Members to use in their product design and application
4. PAMA to use in industry publicity to the market
5. PAMA to use in the promotion of shading to the government and utilities

Technical Performance of Fabric Shading

BENEFITS when installed over Windows:

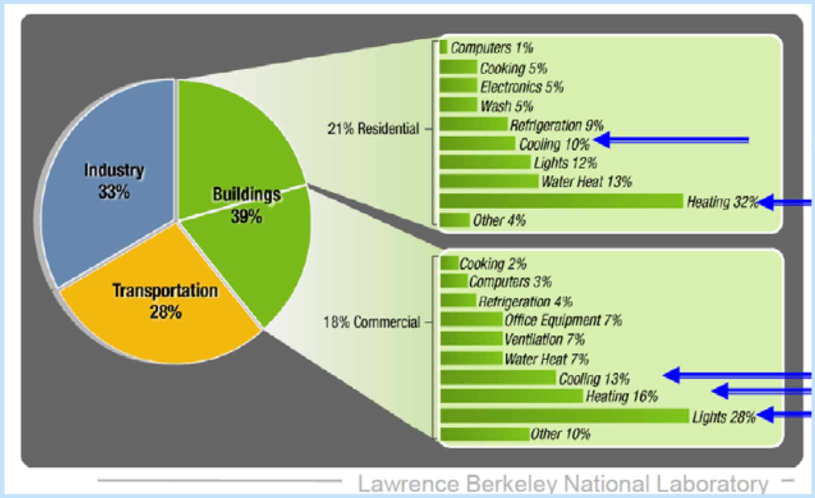
- Solar Shading – Reduce Cooling Costs
- Solar Shading – Thermal Comfort
- Glare Reduction – Visual Comfort
- Daylight Management
- UV Protection - for Health, for Furnishings

Residential & Low Rise Commercial Buildings

Retrofits of Existing Buildings and New Construction

Department of Energy – Call to Action

Buildings consume 40% of Energy, or 71% of Electricity in the USA.
2% of the nation’s energy is used to COOL HOMES.
Windows and “Window Attachments” impact cooling, heating, and lighting.



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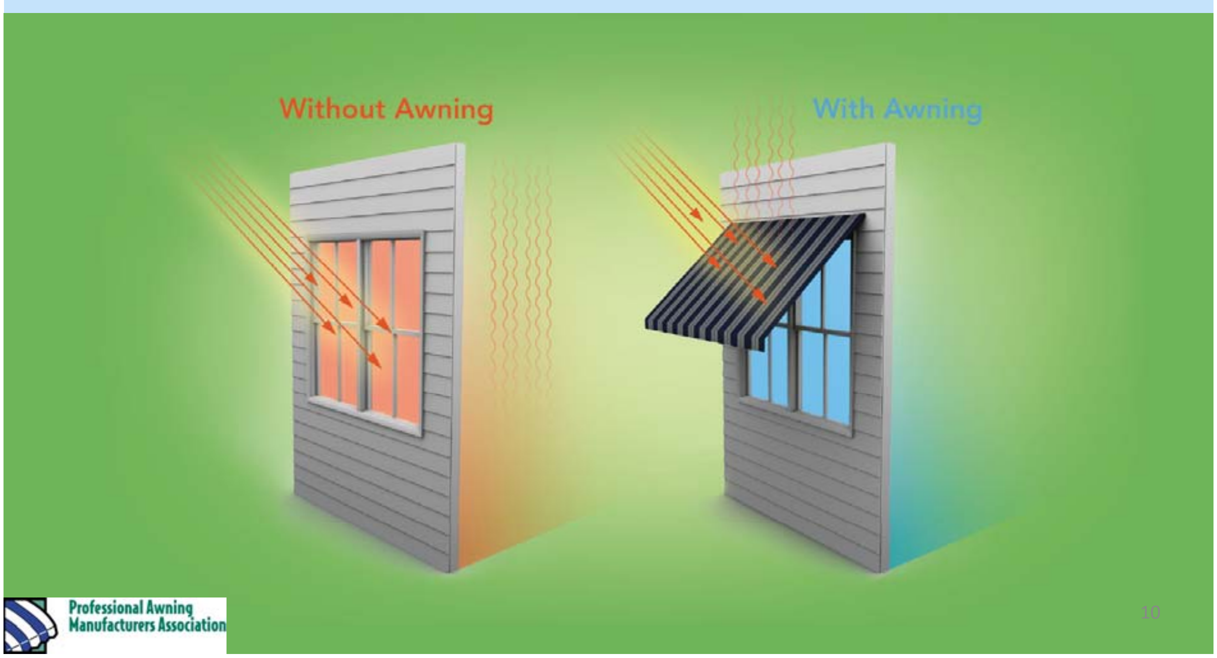
Awnings block the energy of the sun before it is allowed to pass through the window and get trapped in the home.



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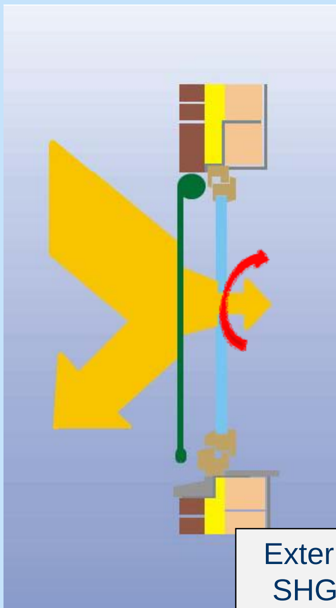
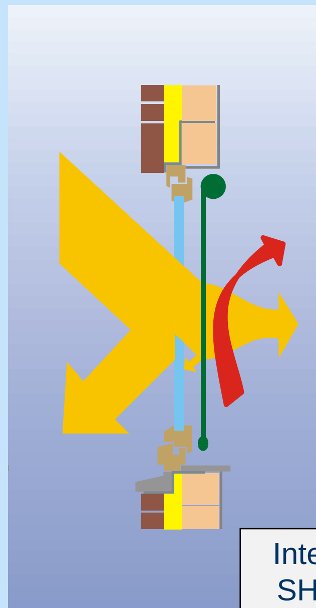
Solar Shading: Exterior versus Interior





Exterior Shade
SHGC = 15%
(**85%** reduction)

Interior Shade
SHGC = 50%
(50% reduction)

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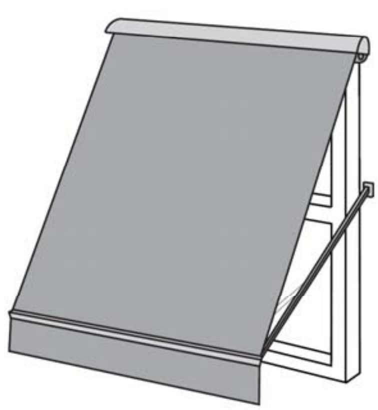
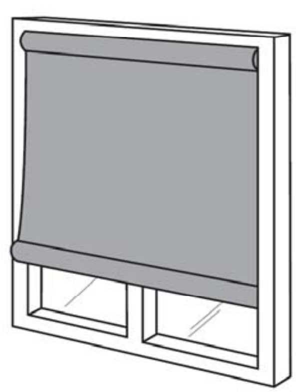
Exterior Fabric Shading for Homes





Stationary Awning
90˚

Drop Arm Awning
165˚

Exterior Roller Screen
Fully Closed

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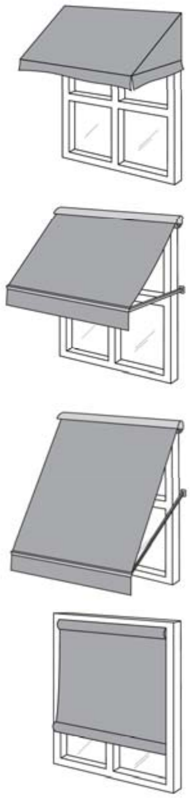

Simulation - Models of Fabric Shading

1. Stationary Awning (90˚)
   Fabric choices: BLACK acrylic
   LINEN acrylic

2. Drop Arm Awning (165˚)
   Fabric choices: BLACK acrylic
   LINEN acrylic

3. Exterior Roller Screen
   Fabric choices: Black/Brown 25% OF
   Black/Brown 10% OF
   Black/Brown 10% OF full basketweave
   Black 5% OF full basketweave
   White 5% OF full basketweave

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Simulation - Models of Fabric Shading

Awning Fabrics

	Solar Transmittance	Openness Factor	Visible Light Transmittance	Shade Coefficient 1/8CL
Linen	**13 %**	**< 0.1%**	**4 %**	**0.24**
Black	**< 0.1%**	**< 0.1%**	**< 0.1%**	**0.11**

Roller Screen Fabrics

	Solar Transmittance	Openness Factor	Visible Light Transmittance	Shade Coefficient 1/8CL
Black/Brown 25% OF	**26 %**	**25 %**	**35 %**	**0.35**
Black/Brown 10% OF	**12 %**	**10 %**	**18 %**	**0.22**
Black/Brown 10% OF Full basketweave	**8 %**	**10 %**	**13 %**	**0.18**
Black 5% OF Full basketweave	**6 %**	**5 %**	**9 %**	**0.17**
White 5% OF Full basketweave	**12 %**	**5 %**	**13 %**	**0.14**

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Simulation – Model Home

Changes from 2007 study

- Older house - less insulation and 10% smaller
- Revised shading impact from neighboring buildings
- Revised utilization schedules
- Electric Rates – up in most areas by as much as 10%

The idea is that Awnings and Shades are smart "retrofits" which help older homes become more energy efficient.

Simulation – Model Home

- 1800 square foot house, circa 1980 and older
- 2 Variations of Shade Utilization – Summer or Year-round
- 3 Variations of window glass
- 4 Variations on primary orientation of the house (N,E,S,W)
- 2 Weather patterns for each City

48 combinations x 9 shade variations = 432 scenarios per city

Simulation – Model Home

Utilization / Operation of the Shading

- AWNINGS - Summer = used for the season, 24 hours a day, each day
  Two positions (90˚ or 165˚) – fully extended for entire cooling period
- ROLLER SHADES – Summer = used hour-to-hour as needed
  Fully Closed position (activated over the window) anytime that cooling is needed through the year
- AWNINGS and ROLLER SHADES : 12 month = permanently installed

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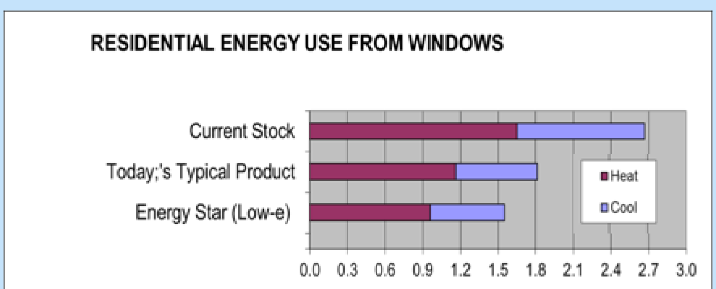
Simulation – Model Home

Window Type	**USA Installed Base**
• Single-pane Clear Glass	46 % of homes = 51 million
• Double-pane Clear Glass	46 %
• Double-pane Hi-Solar Gain Low-E Glass	8 %

15% window/floor ratio:
> 270 ft2 of windows
> 22 windows total …
> 11 awnings?



Graph (portion) from LBL

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Simulation – Model Home

Two Weather Patterns for Each City

- **Typical Year**
  "TMY3" created from a 15 year period consolidation of actual data from 1991 to 2005

- **Hottest Year**
  Selected from past 10 years (2001-2011)

On average, the Hottest Year caused Cooling costs to be 50% higher than in a Typical Year. The savings due to Shading was 27% to 40% higher.

Hottest Years	
Year	# of Cities
2001	3
2002	0
2003	4
2004	1
2005	4
2006	1
2007	8
2008	1
2009	2
2010	15
2011	11

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Simulation - Locations

50 Cities

1. Anchorage, AK
2. Birmingham, AL
3. Mobile, AL
4. Little Rock, AR
5. Phoenix, AZ
6. Tucson, AZ
7. Burbank, CA
8. Fresno, CA
9. Palm Springs, CA
10. Sacramento, CA
11. San Diego, CA
12. San Francisco, CA
13. Denver, CO
14. Washington, DC
15. Jacksonville, FL
16. Miami, FL
17. Tampa, FL
18. Atlanta, GA
19. Honolulu, HI
20. Boise, ID
21. Chicago, IL
22. Indianapolis, IN
23. New Orleans, LA
24. Boston, MA
25. Portland, ME
26. Detroit, MI
27. Minneapolis, MN
28. Kansas City, MO
29. St Louis, MO
30. Charlotte, NC
31. Omaha, NE
32. Albuquerque, NM
33. Las Vegas, NV
34. Buffalo, NY
35. New York, NY
36. Cincinnati, OH
37. Oklahoma City, OK
38. Medford, OR
39. Portland, OR
40. Philadelphia, PA
41. Pittsburgh, PA
42. Charleston, SC
43. Memphis, TN
44. El Paso, TX
45. Fort Worth, TX
46. Houston, TX
47. San Antonio, TX
48. Salt Lake, UT
49. Norfolk, VA
50. Seattle, WA

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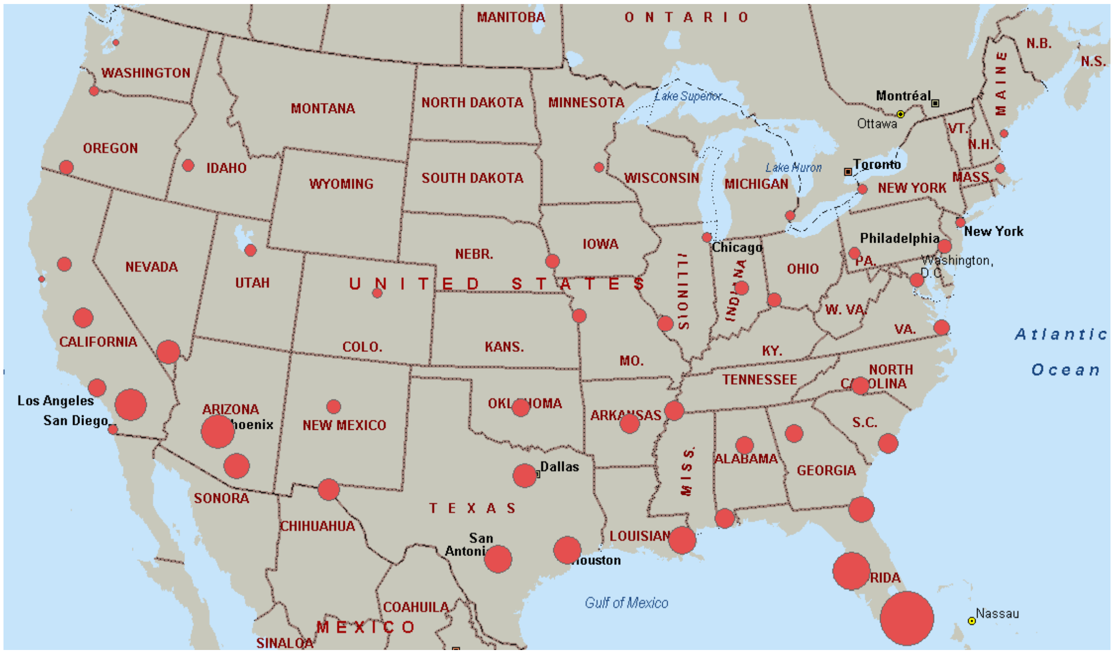
PAMA Energy Study II – Cities

Window Awnings – Hot Year - Cooling Energy Savings

Window Awnings – Hot Year – Cooling Energy Savings



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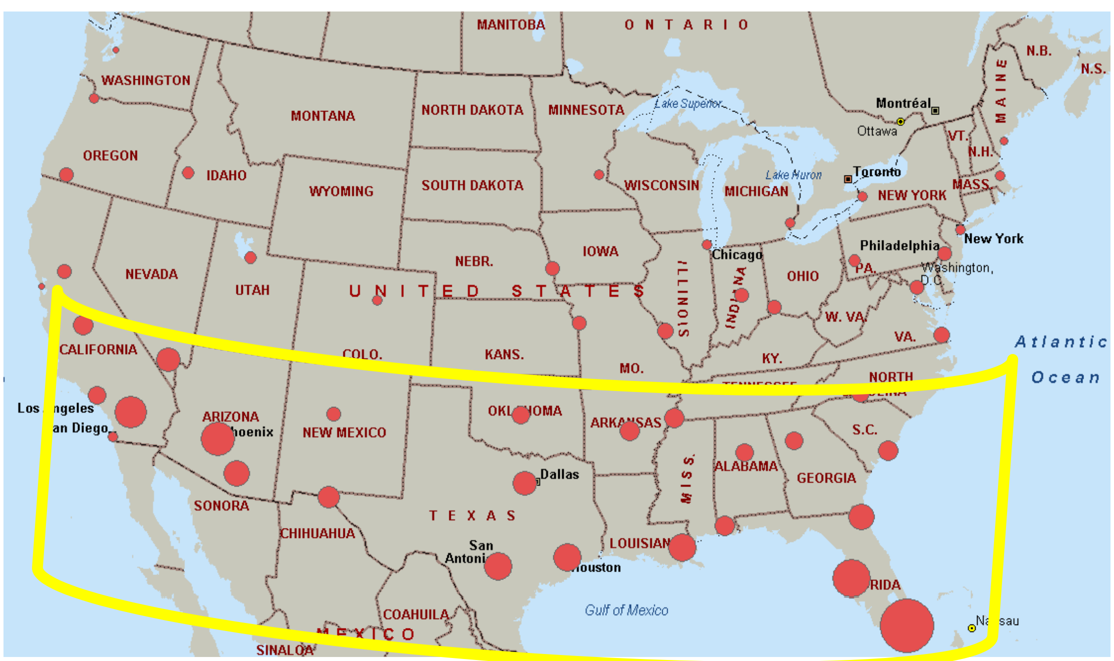
Window Awnings – Hot Year – Cooling Energy Savings



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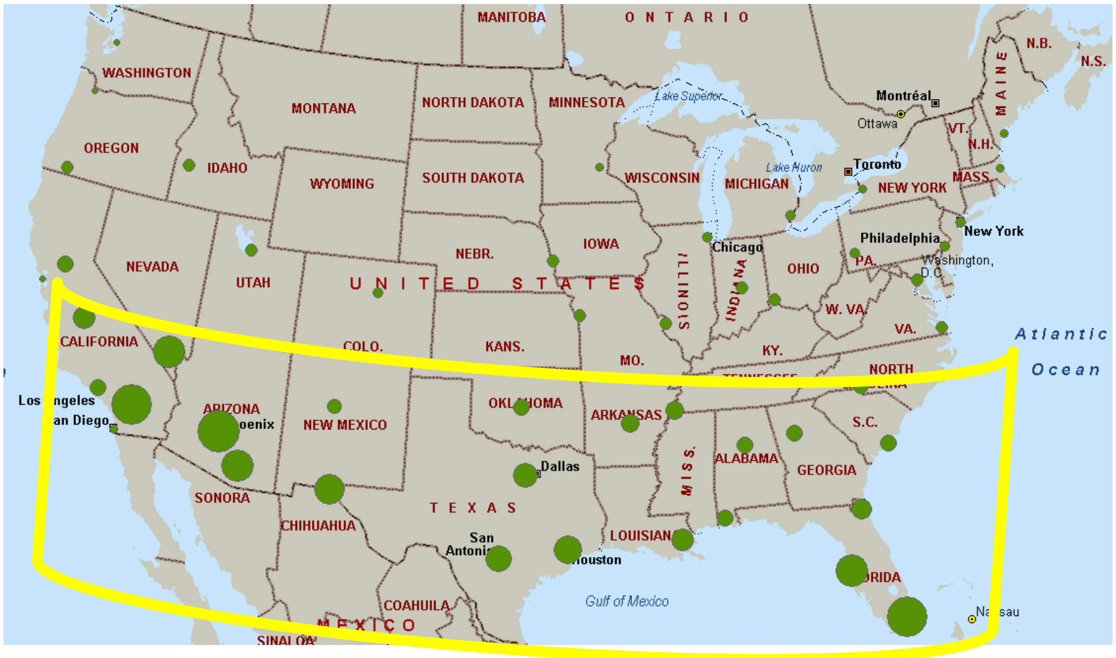
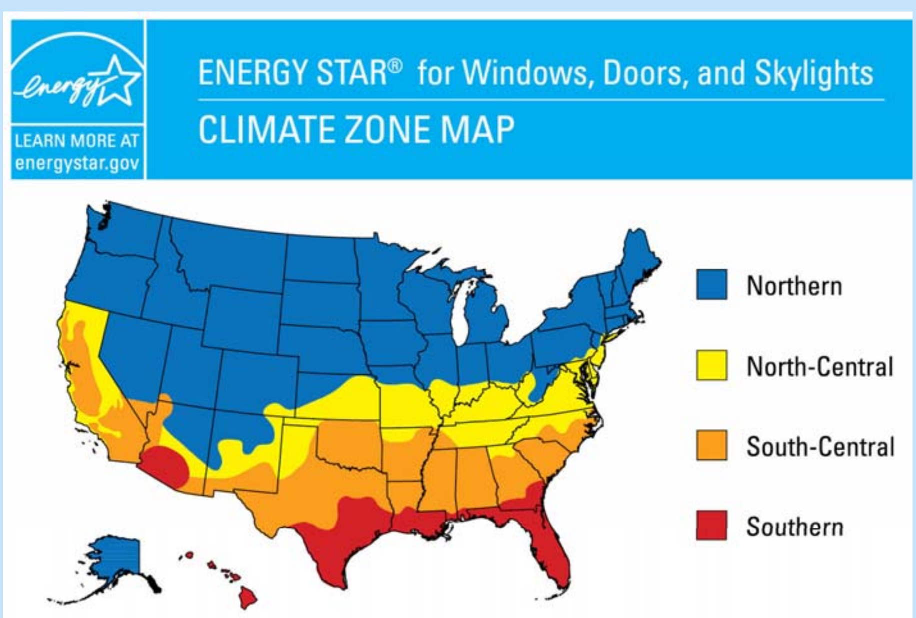
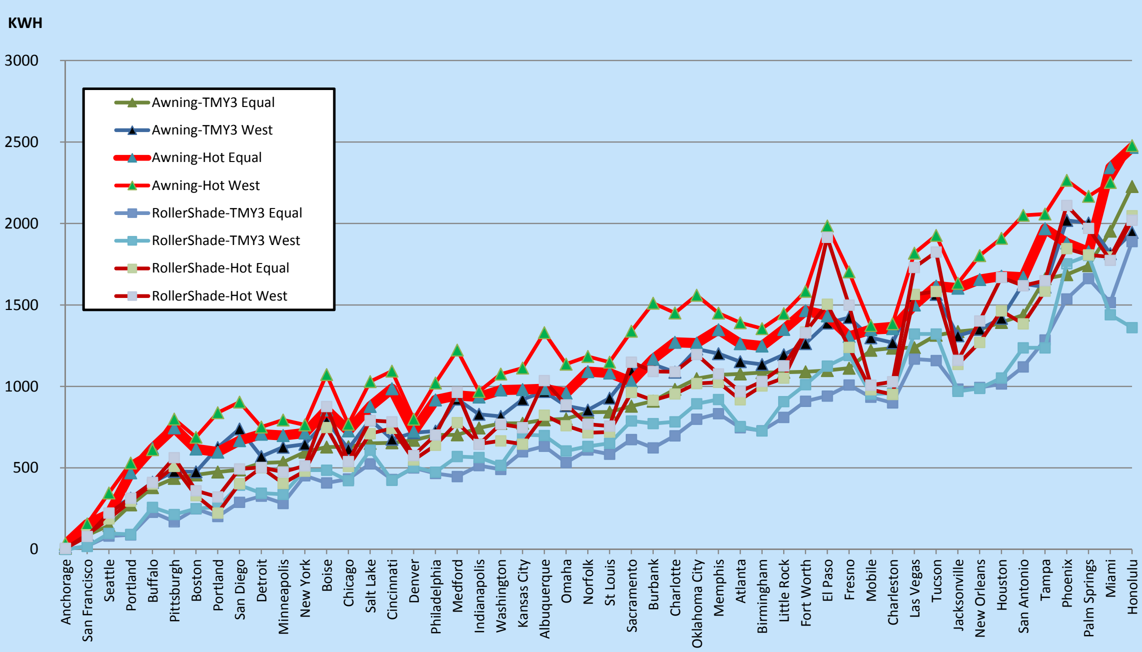
Roller Screens – Hot Year – Cooling Energy Savings





Window Awnings – Hot Year - Cooling Energy Savings

Cooling Energy Savings - Annual KWHs



Fort Worth, Texas

Typical Year (TMY3) HDD65 2779 / CDD65 2743, Hot Year (2010) HDD65 1539 / CDD65 3963

Tables 353-356 show the impact of awnings on a typical house in Fort Worth with different window orientations over a typical year. Tables 357-360 repeat this analysis for a hot year in Fort Worth. The impact varies depending on the type of window glazing and whether the awnings are in place all twelve months or only during the cooling season. For a house with windows equally distributed in the four orientations, Table 353 shows the annual heating and cooling energy use as well as the peak electricity demand for each combination of glazing and shading condition. The table also shows the impact on the total cost for heating and cooling. In all cases, the net and percent savings are in reference to a house with no shading.

Table 353 shows that awnings reduce cooling energy use by 16-25 percent as compared to the unshaded house. The higher savings are for awnings at 165 degrees over windows with clear glazings, while the lower savings are for awnings at 90 degrees over windows with Low-E glazings. Because awnings block useful solar gain in winter, heating energy use increases when the awnings remain in place 12 months a year. Using the awnings only during the cooling season produces the largest net energy savings. The net energy savings are from 8 to 12 percent in Fort Worth when awnings are used only during the cooling season from April through October, while the penalties or savings are from 0 to 1 percent when they are deployed throughout the year.

Table 353 also shows that awnings reduce peak electricity demand by 10-15 percent in Fort Worth, with larger reductions for the clear glazings and smaller reductions for the Low-E glazing. Tables 354, 355, and 356 show results for houses in Fort Worth where the windows predominantly face to the east, south, and west, respectively. Both the cooling energy savings and the peak demand reductions are largest on west-facing awnings. Tables 357-360 show the impact of awnings on a particularly hot year (2010) in Fort Worth. The main effect is to increase the cooling savings by 50 percent due to the hotter or longer summer.

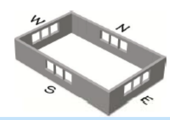


Table 360. Impact of awnings on a house in Fort Worth, Texas with west-facing windows on a hot year

Window Type	Awning	Operation	Heating				Cooling			Heat+Cool			Peak Cooling		
			Energy (MBtu)	Savings (MBtu)	Savings ($)	Cool (kWh)	Savings (kWh)	Savings ($)	Savings (%)	Cost ($)	Savings ($)	Savings (%)	Peak (kW)	Savings (kW)	Savings (%)
Single Clear	None		23.3			8164				1058			5.65		
	Black Awning	summer	23.9	-0.6	-8	6451	1713	160	21	906	152	14	4.14	1.51	27
	90°	12 month	26.5	-3.3	-42	6321	1843	172	23	928	131	12	4.14	1.51	27
	Linen Awning	summer	23.8	-0.5	-7	6685	1479	138	18	927	131	12	4.37	1.29	23
	90°	12 month	26.1	-2.8	-36	6569	1595	149	20	945	113	11	4.37	1.29	23
	Black Awning	summer	24.1	-0.8	-11	6015	2149	201	26	868	190	18	4.05	1.60	28
	165°	12 month	27.8	-4.5	-57	5836	2328	217	29	898	160	15	4.05	1.60	28
	Linen Awning	summer	23.9	-0.7	-9	6349	1815	170	22	897	161	15	4.31	1.34	24
	165°	12 month	26.9	-3.7	-47	6200	1964	183	24	922	137	13	4.31	1.34	24
Double Clear	None		18.9			7403				932			4.96		
	Black Awning	summer	19.4	-0.5	-6	5998	1405	131	19	807	125	13	3.76	1.20	24
	90°	12 month	21.6	-2.7	-34	5897	1506	141	20	825	106	11	3.76	1.20	24
	Linen Awning	summer	19.3	-0.4	-5	6189	1214	113	16	824	108	12	3.94	1.02	21
	90°	12 month	21.2	-2.3	-30	6099	1304	122	18	840	92	10	3.94	1.02	21
	Black Awning	summer	19.6	-0.7	-8	5645	1758	164	24	776	156	17	3.69	1.28	26
	165°	12 month	22.6	-3.6	-46	5505	1898	177	26	801	131	14	3.69	1.28	26
	Linen Awning	summer	19.4	-0.5	-7	5919	1484	139	20	800	132	14	3.90	1.07	22
	165°	12 month	21.9	-3.0	-38	5802	1601	150	22	820	112	12	3.90	1.07	22
Double HiSol LowE	None		17.1			7253				894			4.81		
	Black Awning	summer	17.5	-0.5	-6	5881	1372	128	19	772	122	14	3.64	1.17	24
	90°	12 month	19.6	-2.6	-33	5784	1469	137	20	790	104	12	3.64	1.17	24
	Linen Awning	summer	17.4	-0.4	-5	6067	1186	111	16	788	106	12	3.81	0.99	21
	90°	12 month	19.3	-2.2	-28	5981	1272	119	18	804	91	10	3.81	0.99	21
	Black Awning	summer	17.7	-0.6	-8	5537	1716	160	24	742	152	17	3.55	1.25	26
	165°	12 month	20.6	-3.5	-45	5404	1849	173	25	766	128	14	3.55	1.25	26
	Linen Awning	summer	17.6	-0.5	-6	5804	1449	135	20	765	129	14	3.76	1.05	22
	165°	12 month	19.9	-2.9	-36	5693	1560	146	22	785	109	12	3.76	1.05	22

Window Awnings – Hot Year – Some Findings

1. Awnings provide between 16% and 52% savings in Cooling Costs.
2. Awnings provide between $93 and $217 of annual savings of cooling costs, for single and double pane window scenarios, equal window distribution.
3. Low-E windows can reduce the impact of Shading by 1/4 to 1/2 .
4. Black awning fabric saves 15% - 19% more energy than Linen awning fabric, in the Dallas-Fort Worth model.
5. Western oriented house has similar baseline Cooling costs as equally exposed house, but 18% more Cooling savings with Awnings.
6. In most climates, there is significant value of receiving solar heat in the winter – so that removal or retraction of awnings is vital.
7. Seattle, Portland, Anchorage, and San Francisco have such little air conditioning costs that shading has no impact.

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PAMA Energy Study II - Documents

Written Reports

- Summary Report
- 50 City reports – 5 pages each

Data Files

- Summary_Tables_and_Spreadsheets 5.4 MB

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PAMA Energy Study II – Promotion and Education

June 6	Webinar for Sponsors
June 15	First news release and social media postings
June 28	Webinar for Membership
July 2	Full report posted on PAMA website for members
July 3	Second news release and social media postings
August	Third news release
August	Article in IFAI REVIEW
November	Presentation at PAMA meeting during IFAI Expo

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We thank the Sponsors !

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