# PAMA Energy Study II Webinar

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.

# 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**

**Professional Awning Manufacturers Association**

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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## Contents

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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

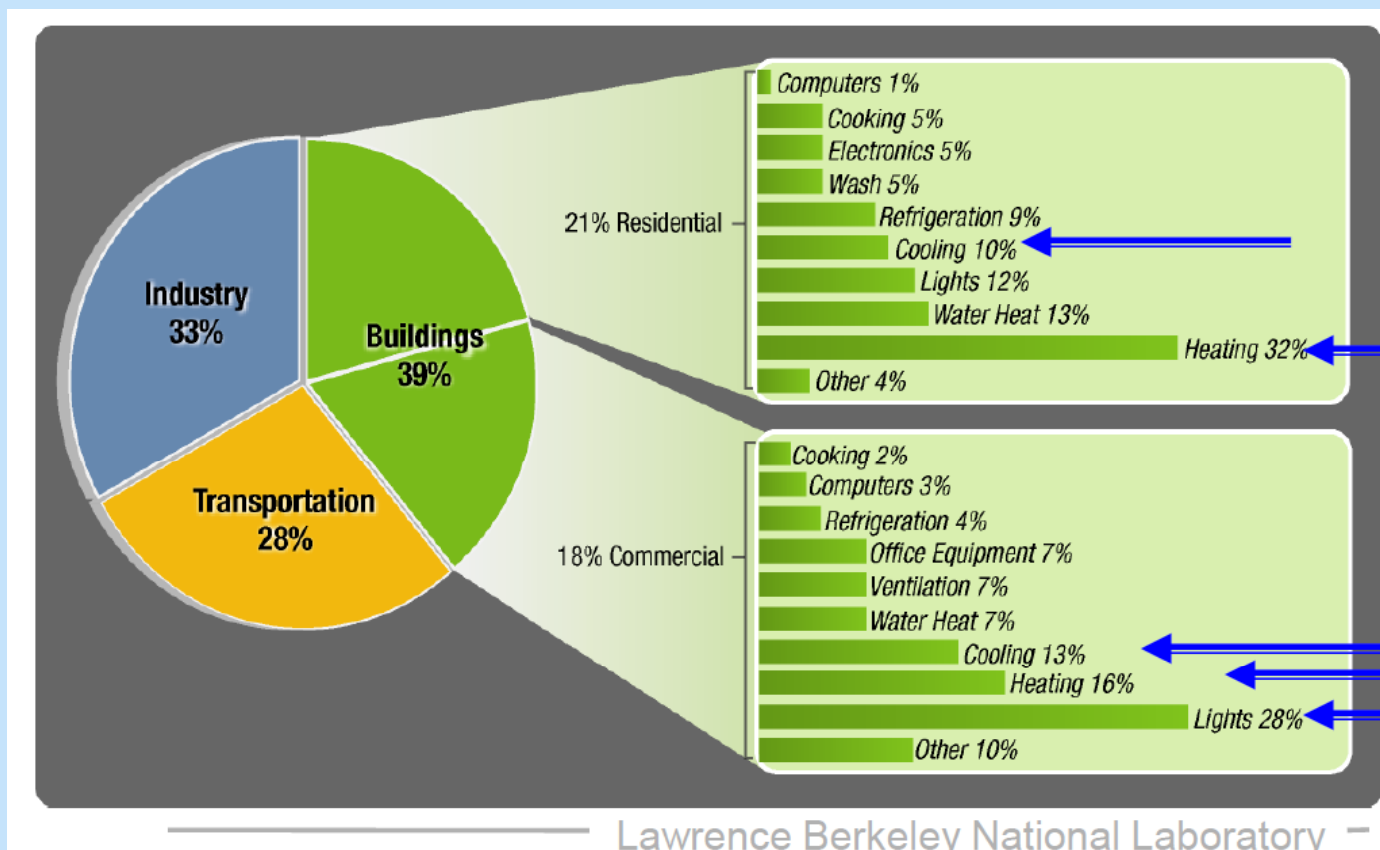**Professional Awning
Manufacturers Association**

# 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.

## 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

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Awnings block the energy of the sun <u>before</u> it is allowed to pass through the window and get trapped in the home.
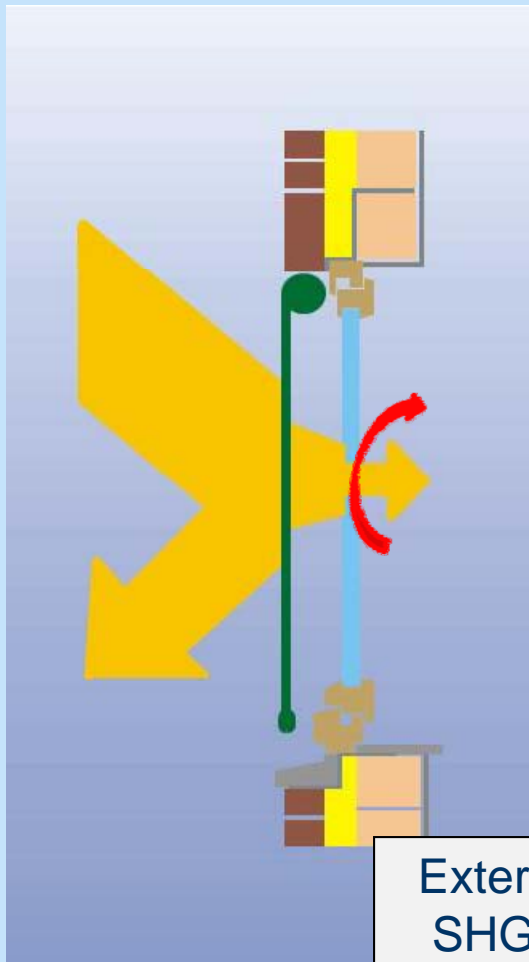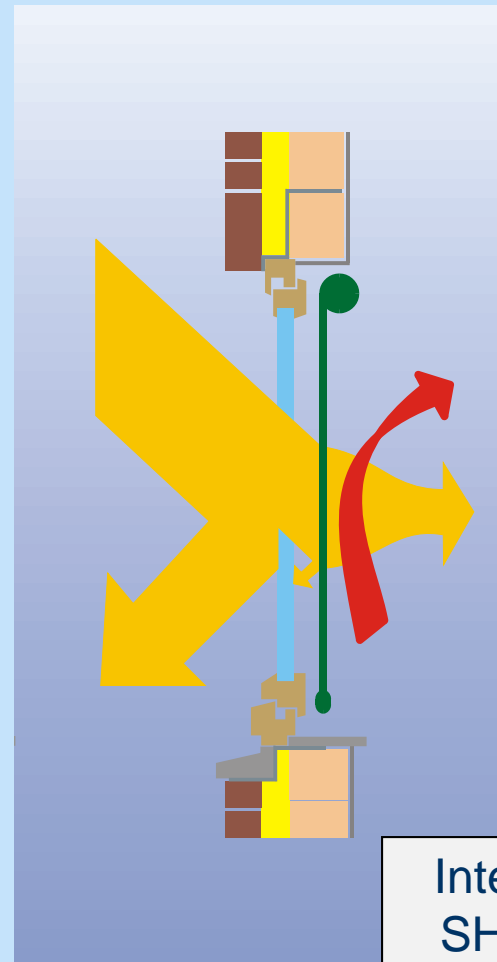
Without Awning
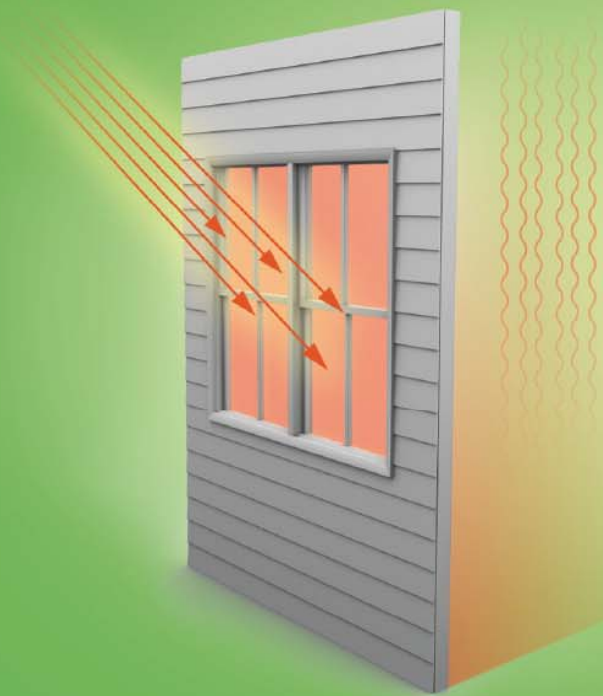
With Awning

# 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
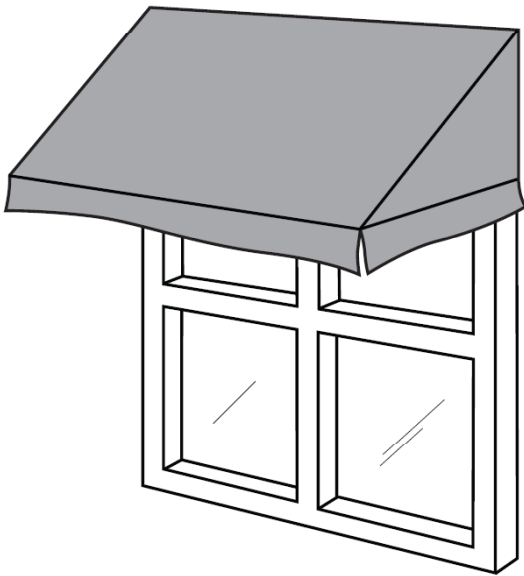


**Stationary Awning**

**90˚**
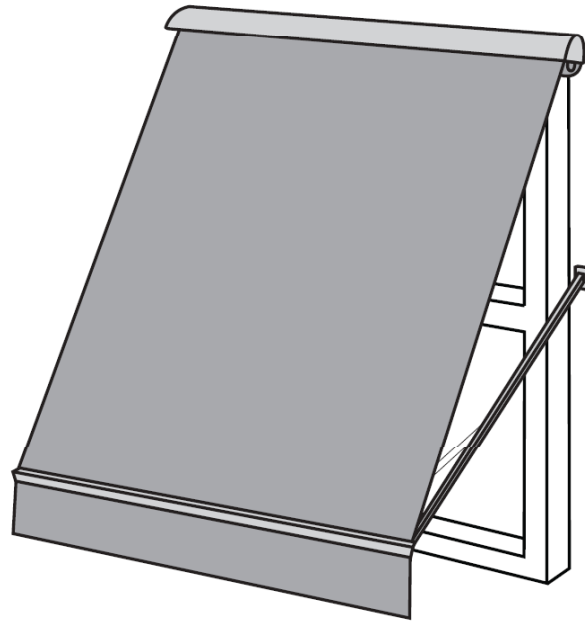
**Drop Arm Awning**

**165˚**
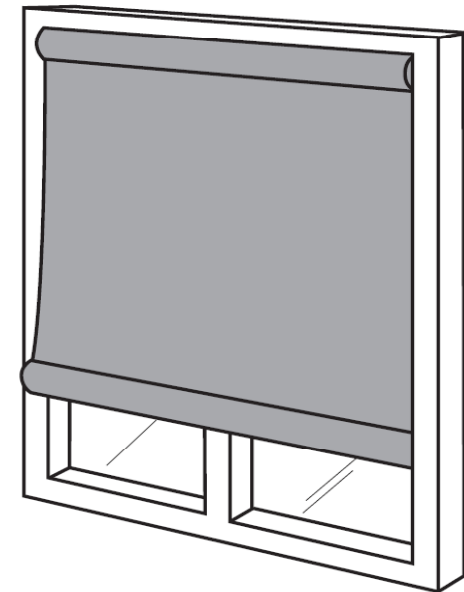
**Exterior Roller Screen**

**Fully Closed**

# Simulation - Models of Fabric Shading
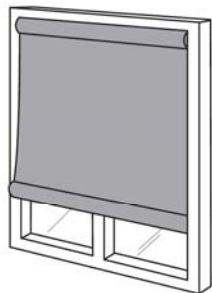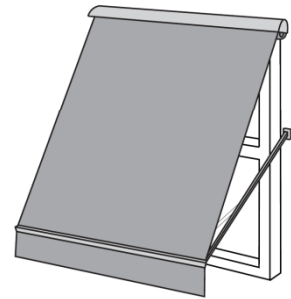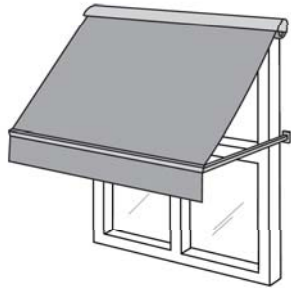
1.  **Stationary Awning**  (90°)

    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

# 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 | 24 % | 25 % | 30 % | 0.33 |
| Black/Brown 10% OF | 11 % | 10 % | 14 % | 0.21 |
| Black/Brown 10% OF Full basketweave | 9 % | 10 % | 11 % | 0.19 |
| Black 5% OF Full basketweave | 5 % | 5 % | 8 % | 0.16 |
| White 5% OF Full basketweave | 15 % | 5 % | 12 % | 0.17 |

# Simulation – Model Home

**Changes from 2007 study**

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

*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 - <u>Summer</u> = used for the season, 24 hours a day, each day
    Two positions (90˚ or 165˚ )

- ROLLER SHADES – <u>Summer</u> = used hour-to-hour as needed !
    Fully  Closed position (activated over the window)

- AWNINGS and ROLLER SHADES :    <u>12 month </u>= permanently installed

# Simulation – Model Home

**Window Type**

- Single-pane Clear Glass                    (46% of US homes:  51 million)
- Double-pane Clear Glass                    (46% of US homes)
- Double-pane Hi-Solar Gain Low-E Glass   ( 8 %, new & modern replacement)

*15% window/floor ratio:*

*> 270 ft2 of windows*

*> 22 windows total …*

*> 11 awnings?*

### RESIDENTIAL ENERGY USE FROM WINDOWS

| Category | |
|---|---|
| Current Stock | |
| Today;'s Typical Product | |
| Energy Star (Low-e) | |
| Dynamic Low-e | |
| Triple Pane Low-e | |
| Mixed Triple, Dynamic | |
| High-R  Superwindow | |
| High-R Dynamic | |

Heat
Cool

0.0  0.3  0.6  0.9  1.2  1.5  1.8  2.1  2.4  2.7  3.0

Annual Primary Energy Consumption, Quads
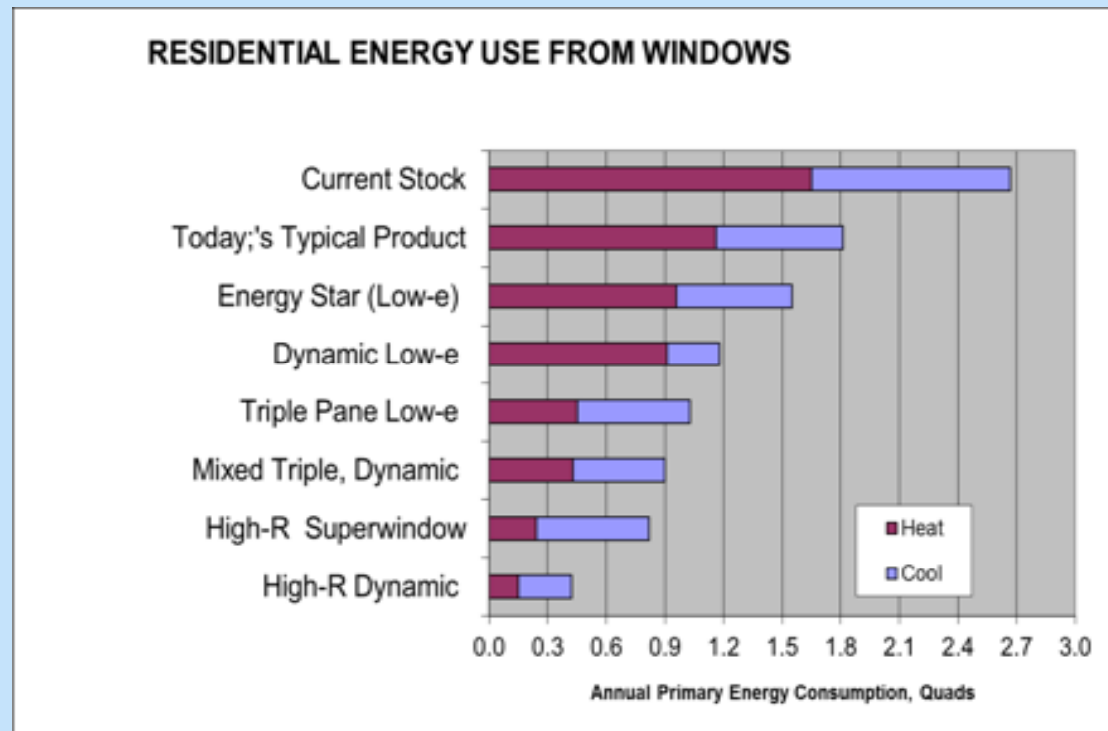
# Simulation – Model Home

**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 than in a Typical Year.*

| 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 |

# Simulation - Locations

## 50 Cities

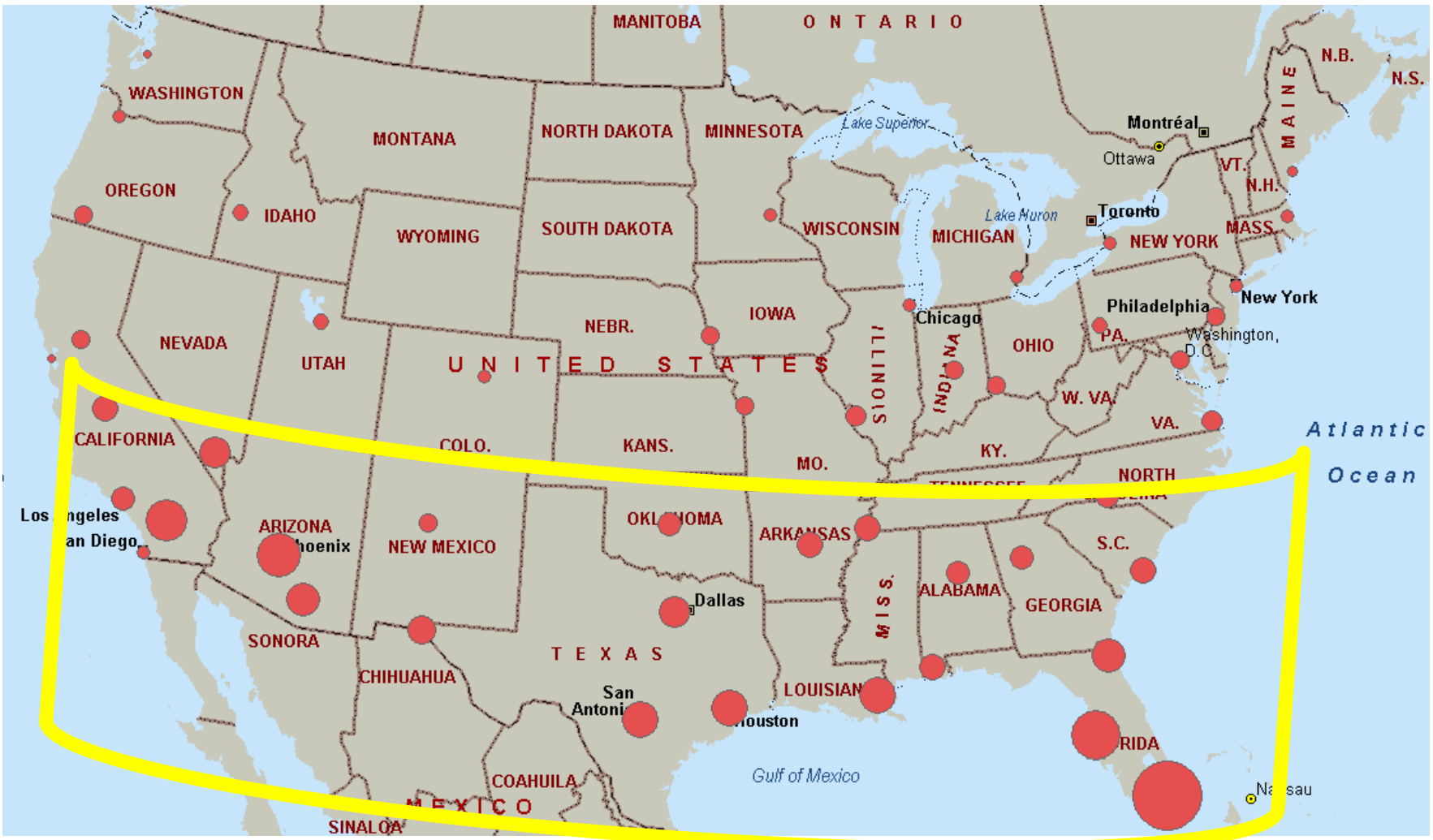| | | |
|---|---|---|
| 1. Anchorage, AK | 18. Atlanta, GA | 35. New York, NY |
| 2. Birmingham, AL | 19. Honolulu, HI | 36. Cincinnati, OH |
| 3. Mobile, AL | 20. Boise, ID | 37. Oklahoma City, OK |
| 4. Little Rock, AR | 21. Chicago, IL | 38. Medford, OR |
| 5. Phoenix, AZ | 22. Indianapolis, IN |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

# PAMA Energy Study II – Cities

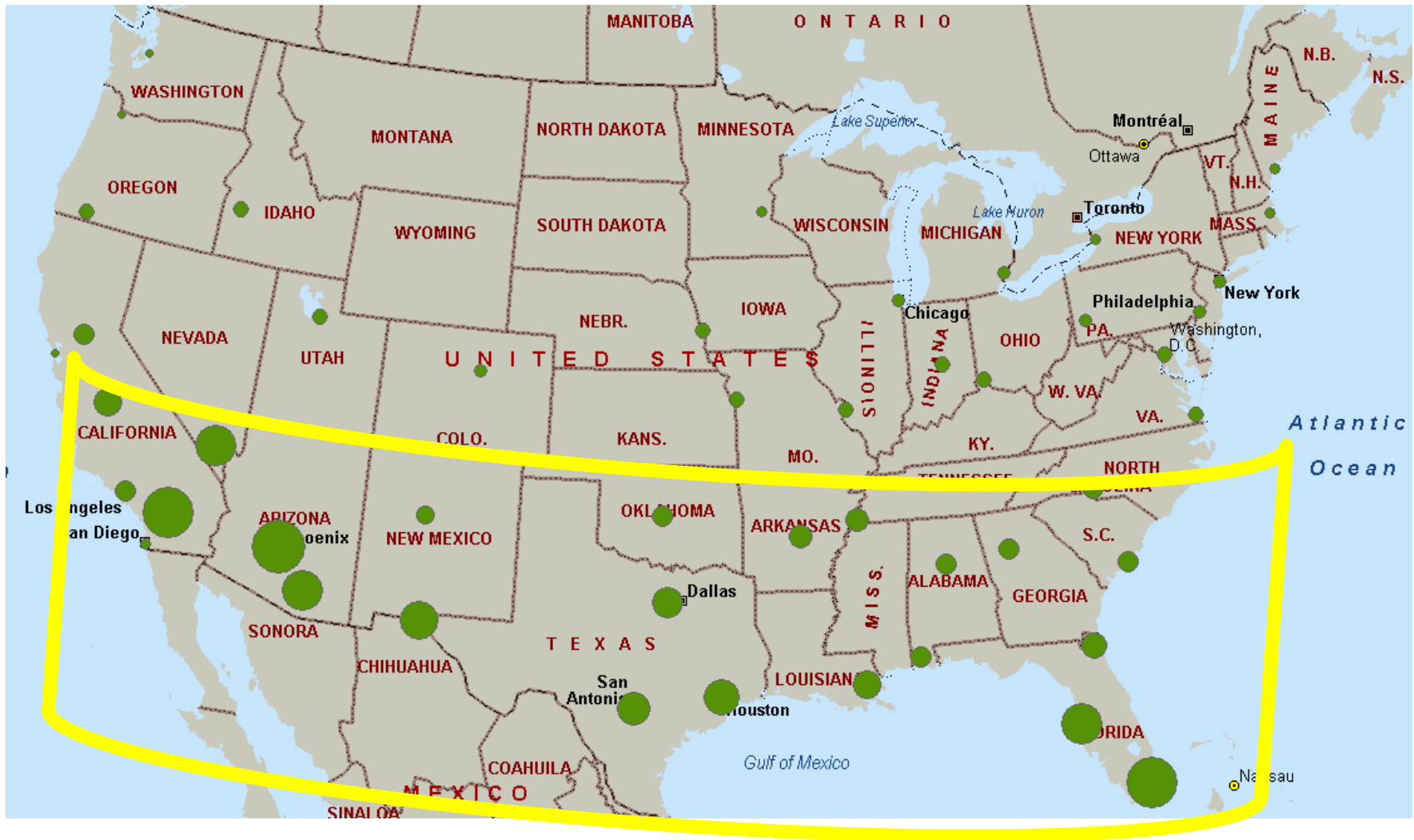# Window Awnings – Hot Year - Cooling Energy Savings

# Window Awnings – Hot Year – Cooling Energy Savings

# Window Awnings – Hot Year – Cooling Energy Savings

# Roller Screens – Hot Year – Cooling Energy Savings

ENERGY STAR® for Windows, Doors, and Skylights

CLIMATE ZONE MAP

Northern

North-Central

South-Central

Southern
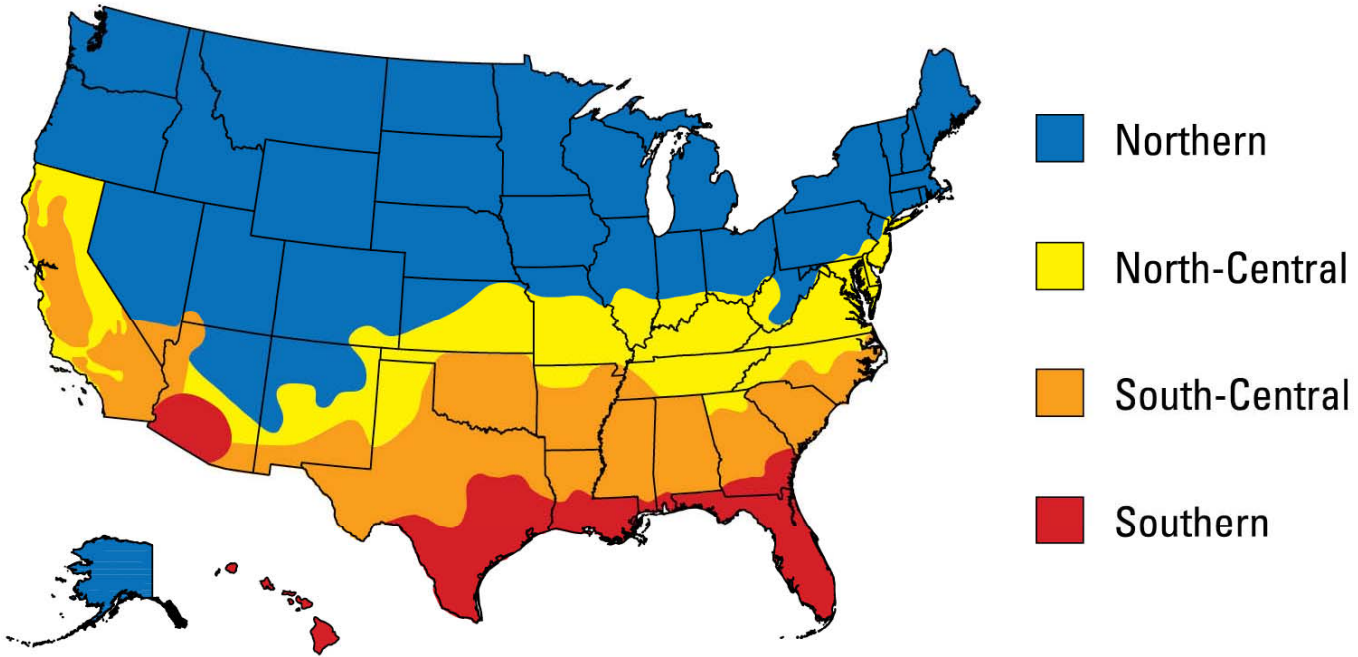
# Window Awnings – Hot Year – Some Findings

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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# 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 on 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 14-25 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 45 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 7 to 11 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 9-15 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 49 percent due to the hotter or longer summer.
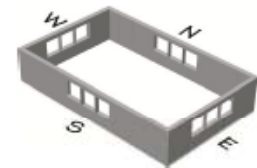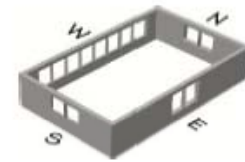
**Table 360. Impact of awnings on a house in Fort Worth, Texas with west-facing windows on a hot year**

| Window Type | Awning | Operation | Heating Energy (MBtu) | Heating Savings (MBtu) | Heating Savings ($) | Cooling Cool (kWh) | Cooling Savings (kWh) | Cooling Savings ($) | Cooling Savings (%) | Heat+Cool Cost ($) | Heat+Cool Savings | Heat+Cool Savings (%) | Peak Cooling Peak (kW) | Peak Cooling Savings (kW) | Peak Cooling Savings (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single Clear | None | | 23.3 | | | 8164 | | | | 1058 | | | 5.65 | | |
| | Black Awning 45° | summer | 23.9 | -0.6 | -8 | 6451 | 1713 | 160 | 21 | 906 | 152 | 14 | 4.14 | 1.51 | 27 |
| | | 12 month | 26.5 | -3.3 | -42 | 6321 | 1843 | 172 | 23 | 928 | 131 | 12 | 4.14 | 1.51 | 27 |
| | Linen Awning 45° | summer | 23.8 | -0.5 | -7 | 6685 | 1479 | 138 | 18 | 927 | 131 | 12 | 4.37 | 1.29 | 23 |
| | | 12 month | 26.1 | -2.8 | -36 | 6569 | 1595 | 149 | 20 | 945 | 113 | 11 | 4.37 | 1.29 | 23 |
| | Black Awning 165° | summer | 24.1 | -0.8 | -11 | 6015 | 2149 | 201 | 26 | 868 | 190 | 18 | 4.05 | 1.60 | 28 |
| | | 12 month | 27.8 | -4.5 | -57 | 5836 | 2328 | 217 | 29 | 898 | 160 | 15 | 4.05 | 1.60 | 28 |
| | Linen Awning 165° | summer | 23.9 | -0.7 | -9 | 6349 | 1815 | 170 | 22 | 897 | 161 | 15 | 4.31 | 1.34 | 24 |
| | | 12 month | 26.9 | -3.7 | -47 | 6200 | 1964 | 183 | 24 | 922 | 137 | 13 | 4.31 | 1.34 | 24 |
| Double Clear | None | | 22.8 | | | 8004 | | | | 1038 | | | 5.53 | | |
| | Black Awning 45° | summer | 23.4 | -0.6 | -8 | 6365 | 1639 | 153 | 20 | 893 | 145 | 14 | 4.09 | 1.45 | 26 |
| | | 12 month | 26.0 | -3.2 | -40 | 6241 | 1763 | 165 | 22 | 913 | 124 | 12 | 4.09 | 1.45 | 26 |
| | Linen Awning 45° | summer | 23.3 | -0.5 | -6 | 6588 | 1416 | 132 | 18 | 912 | 126 | 12 | 4.30 | 1.23 | 22 |
| | | 12 month | 25.6 | -2.7 | -35 | 6478 | 1526 | 143 | 19 | 930 | 108 | 10 | 4.30 | 1.23 | 22 |
| | Black Awning 165° | summer | 23.6 | -0.8 | -10 | 5951 | 2053 | 192 | 26 | 856 | 182 | 17 | 4.00 | 1.53 | 28 |
| | | 12 month | 27.2 | -4.3 | -55 | 5782 | 2222 | 208 | 28 | 885 | 152 | 15 | 4.00 | 1.53 | 28 |
| | Linen Awning 165° | summer | 23.5 | -0.7 | -8 | 6270 | 1734 | 162 | 22 | 884 | 154 | 15 | 4.25 | 1.29 | 23 |
| | | 12 month | 26.4 | -3.5 | -45 | 6129 | 1875 | 175 | 23 | 908 | 130 | 13 | 4.25 | 1.29 | 23 |
| Double HiSol LowE | None | | 20.3 | | | 7123 | | | | 924 | | | 4.87 | | |
| | Black Awning 45° | summer | 20.8 | -0.5 | -6 | 5922 | 1201 | 112 | 17 | 817 | 106 | 11 | 3.78 | 1.09 | 22 |
| | | 12 month | 22.7 | -2.4 | -30 | 5834 | 1289 | 120 | 18 | 833 | 90 | 10 | 3.78 | 1.09 | 22 |
| | Linen Awning 45° | summer | 20.7 | -0.4 | -5 | 6089 | 1034 | 97 | 15 | 832 | 91 | 10 | 3.95 | 0.93 | 19 |
| | | 12 month | 22.4 | -2.1 | -26 | 6011 | 1112 | 104 | 16 | 846 | 78 | 8 | 3.95 | 0.93 | 19 |
| | Black Awning 165° | summer | 20.9 | -0.6 | -8 | 5613 | 1510 | 141 | 21 | 791 | 133 | 14 | 3.72 | 1.15 | 24 |
| | | 12 month | 23.6 | -3.2 | -41 | 5491 | 1632 | 152 | 23 | 812 | 111 | 12 | 3.72 | 1.15 | 24 |
| | Linen Awning 165° | summer | 20.8 | -0.5 | -6 | 5853 | 1270 | 119 | 18 | 811 | 112 | 12 | 3.91 | 0.96 | 20 |
| | | 12 month | 23.0 | -2.6 | -34 | 5752 | 1371 | 128 | 19 | 829 | 94 | 10 | 3.91 | 0.96 | 20 |

**PAMA Energy Study II - Documents**

Written Reports

- Summary Report

- 50 City reports – 5 pages each

- Appendix – Simulation Parameters, Tables, and Notes


 Additional Data Files

- Summary_Tables_and_Spreadsheets          5.4 MB

## PAMA Energy Study II – Promotion and Education

- June 6        Webinar for <u>Sponsors</u>

- June 15       First news release and social media postings, summary report emailed to membership...

- June 28       Webinar for Membership (to be recorded)

- 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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- **Safety Components**

# PAMA Energy Study II

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