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

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The Benefits of Awnings

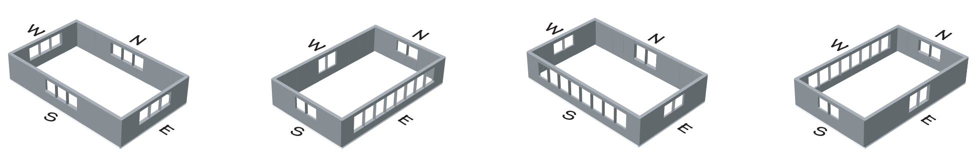
Awnings have advantages that contribute to more sustainable buildings. First, awnings result in cooling energy savings by reducing direct solar gain through windows. This directly reduces the impact of global warming from greenhouse gas emissions. A second benefit is that peak electricity demand is also reduced by awnings potentially resulting in reduced mechanical equipment costs. Reduced peak demand may also result in energy cost savings in the future if residential customers are charged higher rates during peak periods. Another outcome of peak demand reduction is the overall savings to utility companies and the public from a decreased need to build new generating capacity.

Table 1 shows the cooling and electric peak demand percent savings from using awnings in seven U.S. cities with differing climates. For each city, results are shown for a typical house with windows equally distributed on all four orientations, as well as a house with predominantly east-, south-, and west-facing orientations. The north orientation is not shown since the impacts of external shading devices are small.

In each case, there are significant percent savings in cooling costs as a result of using awnings. Similarly, there are significant percent savings in the peak electricity demand in all cities. While percent savings provides a general indication of the positive benefits of awnings, the magnitude of the actual savings must be examined in more detail.

Tables 2, 3 and 4 show the impact of awnings for three cities: a predominantly cold climate (Boston), a mixed heating and cooling climate (St. Louis), and a predominantly hot climate (Phoenix). There are three window types and three shading conditions. The window types are clear double glazing, high-solar-gain low-E glazing, and low-solar-gain low-E glazing. The three shading conditions include: no shading, awnings deployed 12 months a year, and awnings deployed in the summer only.

TABLE 1: SUMMARY OF AWNING IMPACTS IN SEVEN U.S. CITIES



CITY	EQUAL ORIENTATION		EAST ORIENTATION		SOUTH ORIENTATION		WEST ORIENTATION	
	Cooling Energy % Saved	Cooling Peak % Saved	Cooling Energy % Saved	Cooling Peak % Saved	Cooling Energy % Saved	Cooling Peak % Saved	Cooling Energy % Saved	Cooling Peak % Saved
Minneapolis	25-26%	9-10%	29-31%	22-23%	28-34%	5-22%	26-27%	25-32%
Boston	23-24%	17-22%	30-32%	28-37%	24-33%	22-36%	28-30%	33-40%
Seattle	60-70%	35-39%	51-69%	23%	71-80%	44-53%	69-72%	43-49%
Albuquerque	28-31%	11-17%	34-39%	12-27%	28-33%	9-19%	34-39%	35-43%
Phoenix	14-21%	9-13%	15-22%	4-6%	15-22%	3-11%	18-26%	20-31%
St.Louis	14-17%	11-16%	18-21%	13-23%	8-18%	17-30%	18-23%	20-33%
Sacramento	37-39%	15-21%	36-39%	9-13%	40-45%	10-26%	43-48%	30-39%

NOTE: The annual energy performance figures shown here were generated using RESFEN for a typical (new construction) 2000 sq ft house with 300 sq ft of window area. In the first case, the windows are equally distributed on all four sides of the house. Where windows are predominately on one side, the distribution is 240 sq ft on that side and 20 sq ft on the others. U-factor and SHGC are for the total window including frame. RESFEN is a computer program for calculating the annual cooling and heating energy use and costs due to window selection. It is available from Lawrence Berkeley National Laboratory (windows.lbl.gov/software/resfen)

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Cold Climate Impacts

Table 2 shows the impact of awnings on a typical house in Boston, Massachusetts, a predominantly cold climate. The impact varies depending on the type of window glazing and whether the awnings are in place 12 months per year or only in the summer.

For a house with windows equally distributed on the four orientations, Table 2 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 of heating and cooling. In each case, the table shows the percent savings compared to the unshaded condition.

As shown in Table 2, the awnings reduce the cooling energy 23–24 percent compared to a completely unshaded case. However, because awnings block passive solar gain in winter, heating energy increases by 6–9 percent if the awnings remain in place 12 months a year. By removing or retracting the awnings in winter while keeping them in place in the summer, the lowest total energy use is achieved.

The total cost of heating and cooling is about equal in Boston when awnings are only used in the summer, but the total cost is increased if they remain in place 12 months a year.

Table 2 also shows that awnings reduce peak electricity demand by 17–22 percent in Boston. This may contribute to the ability to downsize the mechanical cooling system.

Mixed Climate Impacts

Table 3 shows the impact of awnings on a typical house in St. Louis, Missouri, a mixed climate without either heating or cooling being predominant. The same window orientation, window types, and shading conditions used for Boston in Figure 2 are applied here for St. Louis.

The awnings reduce the cooling energy 14–17 percent compared to a completely unshaded case. However, because awnings block passive solar gain in winter, heating energy increases by 6–9 percent if the awnings remain in place 12 months a year. By removing or retracting the awnings in winter while keeping them in place in the summer, the total cost of heating and cooling is reduced 1–3 percent in St. Louis, but the total cost is increased if they remain in place 12 months a year.

Table 3 also shows that awnings reduce peak electricity demand by 11–16 percent in St. Louis. This may contribute to the ability to downsize the mechanical cooling system.

Hot Climate Impacts

Table 4 shows the impact of awnings on a typical house in Phoenix, Arizona with different orientation conditions. The same window orientation, window types, and shading conditions used for Boston and St. Louis are applied in Phoenix.

In Phoenix, the awnings reduce the cooling energy 14–21 percent compared to a completely unshaded case. However, because awnings block passive solar gain in winter, heating energy increases by 28–39 percent if the awnings remain in place 12 months a year. Of course, the relative importance of the heating versus the cooling season impacts varies by climate. In predominantly warm climates like Phoenix, the impact of awnings on reducing passive solar gain will be less of a concern.

The total cost of heating and cooling is reduced 13–18 percent in Phoenix when awnings are only used in the summer. Table 4 also shows that awnings reduce peak electricity demand by 9–13 percent in Phoenix, potentially contributing to the ability to downsize the mechanical cooling system.

In comparing Tables 2, 3 and 4, it is clear that the impacts of awnings are different depending on the building location and whether the awnings are deployed year-round or only in the summer. A very important consideration in assessing the benefits of awnings is window orientation. A house in any climate with the windows predominantly facing to the east, south, and west will have greater cooling energy use and cooling peak demand than the equal orientation case. This is particularly true with peak demand in the west orientation. Generally, this means energy and cost savings from using awnings is greater with predominantly east, south, and west orientations than when windows are equally distributed. Specific energy and cost savings for a greater number of cities and multiple orientation conditions can be found in the full report.

REFERENCES

Carmody, J., S. Selkowitz, D. Arasteh, and L. Heschong, “Residential Windows: A Guide to New Technologies and Energy Performance,” W.W. Norton & Company, 2007.

Efficient Windows Collaborative Web Site: www.efficientwindows.org

TABLE 2: IMPACT OF AWNINGS ON A HOUSE—BOSTON, MASSACHUSETTS

		COOLING				HEATING		HEAT+COOL		COOLING PEAK	
WINDOW	AWNING	Energy (kWh)	Energy % Saved	Cost ($)	Cost $ Saved	Energy (MBTU)	Energy % Saved	Cost ($)	Cost % Saved	(kW)	% Saved
A	none	855	–	$100	–	68.1	–	$1,254	–	2.7	–
A	12 month	651	24%	$76	$24	74.4	-9%	$1,319	-5%	2.1	22%
A	summer	651	24%	$76	$24	70.3	-3%	$1,253	0%	2.1	22%
B	none	822	–	$96	–	63.3	–	$1,170	–	2.5	–
B	12 month	631	23%	$74	$22	69.0	-9%	$1,228	-5%	2.0	22%
B	summer	631	23%	$74	$22	65.1	-3%	$1,166	0%	2.0	22%
C	none	449	–	$53	–	70.4	–	$1,220	–	1.9	–
C	12 month	343	24%	$40	$12	74.3	-6%	$1,264	-4%	1.6	17%
C	summer	343	24%	$40	$12	72.1	-2%	$1,228	-1%	1.6	17%

TABLE 3: IMPACT OF AWNINGS ON A HOUSE—ST. LOUIS, MISSOURI

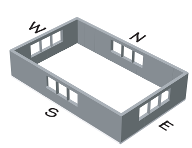
		COOLING				HEATING		HEAT+COOL		COOLING PEAK	
WINDOW	AWNING	Energy (kWh)	Energy % Saved	Cost ($)	Cost $ Saved	Energy (MBTU)	Energy % Saved	Cost ($)	Cost % Saved	(kW)	% Saved
A	none	2366	–	$277	–	54.8	–	$927	–	3.9	–
A	12 month	1970	17%	$231	$46	60.0	-9%	$950	-2%	3.3	16%
A	summer	1970	17%	$231	$46	55.9	-2%	$899	3%	3.3	16%
B	none	2283	–	$267	–	50.8	–	$867	–	3.7	–
B	12 month	1918	16%	$224	$43	55.4	-9%	$888	-2%	3.1	15%
B	summer	1918	16%	$224	$43	51.6	-2%	$840	3%	3.1	15%
C	none	1571	–	$184	–	56.3	–	$863	–	3.0	–
C	12 month	1358	14%	$159	$25	59.8	-6%	$885	-3%	2.7	11%
C	summer	1358	14%	$159	$25	57.5	-2%	$856	1%	2.7	11%

TABLE 4: IMPACT OF AWNINGS—PHOENIX, ARIZONA

		COOLING				HEATING		HEAT+COOL		COOLING PEAK	
WINDOW	AWNING	Energy (kWh)	Energy % Saved	Cost ($)	Cost $ Saved	Energy (MBTU)	Energy % Saved	Cost ($)	Cost % Saved	(kW)	% Saved
A	none	7438	–	$870	–	5.4	–	$992	–	5.6	–
A	12 month	5905	21%	$691	$179	7.6	-39%	$829	16%	4.9	13%
A	summer	6011	19%	$703	$167	5.5	-1%	$816	18%	4.9	13%
B	none	7171	–	$839	–	4.8	–	$950	–	5.3	–
B	12 month	5739	20%	$671	$167	6.6	-39%	$796	16%	4.7	12%
B	summer	5838	19%	$683	$156	4.8	0%	$785	17%	4.7	12%
C	none	5708	–	$668	–	6.3	–	$789	–	4.6	–
C	12 month	4837	15%	$566	$102	8.1	-28%	$704	11%	4.2	9%
C	summer	4884	14%	$571	$96	6.5	-2%	$689	13%	4.2	9%

	GLAZING	FRAME	U-FACTOR	SHGC
A	Double, Clear	Wood/vinyl	0.49	0.56
B	Double, High-solar-gain Low-E	Wood/vinyl	0.37	0.53
C	Double, Low-solar-gain Low-E	Wood/vinyl	0.34	0.30

The annual energy performance figures shown here were generated using RESFEN for a typical (new construction) 2000 sq ft house with 300 sq ft of window area. U-factor and SHGC are for the total window including frame. All cases in this report assume that there are no other shading devices such as overhangs or blinds and that the house is not shaded by trees or other buildings.



The costs shown here are annual costs for space heating and space cooling only and thus will be less than total utility bills. Costs for lights, appliances, hot water, cooking, and other uses are not included in these figures. The mechanical system uses a gas furnace for heating and air conditioning for cooling. Electricity costs used in the analysis are $0.18 per kWh in Boston, $0.10 per kWh in St. Louis, $0.12 per kWh per MBTU in Phoenix. Natural gas costs used in the analysis are $16.20 per MBTU in Boston, $12.46 per MBTU in St. Louis, and $12.84 per MBTU in Phoenix. These figures are based on 25 year projected average costs for electricity during the cooling season and for natural gas during the heating season. All data is provided by the Energy Information Administration (www.eia.doe.gov). RESFEN is a computer program for calculating the annual cooling and heating energy use and costs due to window selection. It is available from Lawrence Berkeley National Laboratory (windows.lbl.gov/software/resfen).

