KyPSC Staff Second Set Data Requests
Duke Energy Kentucky
Case No. 2007-00477
Date Received: January 3, 2008
Response Due Date: January 14, 2008

KyPSC-DR-02-012

REQUEST:

Referring to Discovery Response, Item 1, page 7 of 66, the schedule shows capital spending for 2007-2012. Specfically, under the heading of "environmental", please provide a description of what projects are anticipated in these expenditures. Provide total cost estimates for these projects, if expenditures extend beyond 2012.

RESPONSE:

Environmental expenditures by jurisdiction are as follows:

($ in millions)	2008	2009	2010	2011	2012	Total
Duke Energy Carolinas	422	197	25			644
Duke Energy Kentucky	3	3	3	11	1	21
Duke Energy Indiana	125	25	97	89	99	435
Total	550	225	125	100	100	1100

Duke Energy Carolinas
The environmental expenditures are associated with the North Carolina Clean Air Plan (NCCAP). Expenditures for the NCCAP program began in 2001 and will be completed in 2010 at a projected total cost of approximately $2 Billion. Among the on-going projects to be completed in the 2008-2010 timeframe are:

- Allen Steam Station Units 1-5 Scrubbers (SO2)
- Belews Creek Steam Station Units 1-2 Scrubbers
- Cliffside Unit 5 Scrubber
- Allen Steam Station Unit 5 SNCR (NOx)
- Marshall Steam Station Unit 3 SCR

Duke Energy Kentucky

- East Bend Ash Pond
- East Bend Landfill
- East Bend Catalyst Bed
- Miami Fort 6 FGC System

Duke Energy Indiana

- Cayuga Units 1&2 FGD Systems (SO2)
- Cayuga Unit 1&2 SCR Systems (Nox)
- Cayuga Landfill
- Gallagher Landfill
- Gallagher Bag Houses
- Gibson Scrubber upgrades (SO2)
- Wabash River FGD Systems (SO2)

WITNESS RESPONSIBLE: Brian P. Davey

KyPSC Staff Second Set Data Requests
Duke Energy Kentucky
Case No. 2007-00477
Date Received: January 3, 2008
Response Due Date: January 14, 2008

KyPSC-DR-02-013

REQUEST:

Referring to Discovery Response, Item 1, page 8 of 66, the schedule shows capital spending re "System Growth" for 2007-2012. Please provide additional descriptive information regarding the Edwardsport IGCC, CC/CT Additions – Carolinas, and Cliffside projects.

RESPONSE:

Edwardsport IGCC

Duke Energy Indiana has selected its existing power plant site in Edwardsport, Ind., as the site for the new 630 MW IGCC plant. Upon completion of the IGCC project, the existing plant with coal and oil units built between 1944 and 1951 – will be retired.

Integrated gasification combined cycle technology uses a coal gasification system to convert coal into a synthesis gas (syngas). The syngas is processed to remove sulfur, mercury and ash before being sent to a traditional combined cycle power plant, using two combustion turbines and a steam turbine to efficiently produce electricity

CC/CT Additions Carolinas

On December 14, 2007 Duke Energy Carolinas filed with the North Carolina Utilities Commission (NCUC) to build two 620-MW natural gas-fired units at two existing plants – Buck Steam Station in Rowan County, N.C and Dan River Steam Station in Rockingham County, N.C. When completed, two older, less efficient coal units at each facility will be retired. Hearings related to the filings are expected in the spring of 2008. The units at Buck could begin operating in 2010, with units at Dan River following in 2011.

Additionally, the plan included 564-MW of combustion turbine peaking capacity to begin operation in 2011 to support reserve margins.

The Cliffside modernization project includes:

- One 800-megawatt, highly efficient coal-fired unit projected to come on line as early as 2011
- The retirement of Cliffside units 1-4 with a capacity of 160 megawatts and the removal of the site's heated water discharge in the Broad River
- Extensive emissions controls to ensure the plant will be among the cleanest coal plants in the nation
- Cost savings by leveraging existing Cliffside facilities, such as water intakes and transmission equipment, and sharing new unit sulfur dioxide scrubber equipment with the unit 5 scrubber scheduled to come on line by 2010
- CPCN received March 2007. Still awaiting air permit.
- Construction expected to begin in Spring 2008, pending receipt of the air permit.

WITNESS RESPONSIBLE: Dianne L. Jenner

KyPSC Staff Second Set Data Requests
Duke Energy Kentucky
Case No. 2007-00477
Date Received: January 3, 2008
Response Due Date: January 14, 2008

KyPSC-DR-02-014

REQUEST:

Referring to Discovery Response, Item 1, page 17 of 66, please provide a breakdown of the 900 MW to be derived from energy efficiency projects.

RESPONSE:

At the time of the analyst presentation Duke Energy estimated the incremental MW savings from new energy efficiency programs to be about 900 MW for North and South Carolina, and Indiana. Duke Energy has submitted applications to the appropriate regulatory commissions for new energy efficiency programs, as well as a new regulatory model, in North and South Carolina and Indiana. Testimony has also been filed in South Carolina and Indiana. In South Carolina, a hearing is scheduled for February 2008. Hearings are expected in Indiana and North Carolina sometime in 2008.

Duke Energy Carolinas – 675MW
Duke Energy Indiana – 225MW

WITNESS RESPONSIBLE: Brian P. Davey

KyPSC Staff Second Set Data Requests
Duke Energy Kentucky
Case No. 2007-00477
Date Received: January 3, 2008
Response Due Date: January 14, 2008

KyPSC-DR-02-015

REQUEST:

Based on discovery responses and interview notes, Duke has issued RFPs for renewable resources in Indiana and North Carolina. Please provide a summary of these RFPs, including the product/service sought, key contract terms and conditions, etc. Please provide a description of the RFP responses, including number of bidders, capacity/energy offered by technology, range of bid prices, status of any contract negotiations, etc.

Does Duke have any plans to issue a renewables RFP in Kentucky? If so, provide a brief description of the expected parameters, timing, etc.

RESPONSE:

Duke Energy Indiana, Inc. Renewable RFPs

The RFP was issued by Duke Energy Indiana, Inc. in November 2005 for 100 MW of renewable energy. The RFP process yielded six proposals representing six – 100 MW wind projects located in four different states. The contract negotiations were completed with Indiana Utility Regulatory Commission approval in December of 2006. The successful project is located in Benton County, Indiana and is estimated to be in commercial operation by June of 2008. Prices and contract terms are confidential.

Duke Energy Indiana, Inc. has issued a second renewable RFP for up to 200 MW of renewable energy. The RFP was issued in November of 2007 and has the same general requirements for renewable sources of utility scale energy. Bids pursuant to that RFP have not been finalized and that RFP process is ongoing. Prospective bidders have been assured of confidentiality with respect to their bids

Duke Energy Carolinas, LLC Renewable RFP

Duke Energy Carolinas, LLC issued an RFP on April 20, 2007 seeking proposals for a supply portfolio of energy and capacity generated from new (placed in service on or after January 1, 2007) renewable or existing NC Green Power sources. The Company received Notice of Intent to Bid responses from 74 companies. Bid proposal packages were received from 26 different companies; with a grand total of 94 different proposal permutations. A breakdown of the technologies and related information follows:

Technology	Summer Net Capacity Range (MW)
Bio-Source	2.5 – 233.0
Poultry	4.0 – 55.0
Solar	2.2 – 156.0
Swine	2.0
Wind	100.0 – 720.0

Duke Energy Kentucky, Inc. has not issued a renewable energy RFP at this time.

WITNESS RESPONSIBLE: James M. Lefeld

KyPSC Staff Second Set Data Requests
Duke Energy Kentucky
Case No. 2007-00477
Date Received: January 3, 2008
Response Due Date: January 14, 2008

KyPSC-DR-02-016

REQUEST:

Referring to Discovery Response, Item 1, page 8 of 66, the presentation indicates the construction of two new nuclear units in South Carolina. Please provide a general description of this project, including its current status. Who are the members of the "AP Owner's Group"? What is the purpose of the group?

What are Duke's current plans regarding the potential addition of any other nuclear units at its other existing sites?

RESPONSE:

On December 13, 2007 Duke Energy filed its combined construction and operating license (COL) application with the U.S. Nuclear Regulatory Commission (NRC) for the proposed Lee Nuclear Station to be located in South Carolina. The station will consist of two 1117-MW units utilizing the Westinghouse AP1000 technology. The NRC's "acceptance review" of the application is expected to take 60 days and once completed, the NRC will undertake a thorough review of the application, which could take up to 42 months. The projected commercial operation date of the first unit is 2018.

The AP Owner's Group is a Limited Liability Company registered in the state of Delaware made up of companies that are planning to build the Westinghouse AP1000 power plants. Its primary purpose is to capture the economic opportunities associated with standardized plants, while at the same time creating the incentive to maintain that standardization. Areas of standardization could include: creation of operation and maintenance procedures, building training simulator models, creating preventative maintenance and equipment reliability plans. Initial members of APOG, LLC include Duke Energy, Progress Energy, SCE&G, and Southern Company.

There are currently no plans to add additional nuclear units at existing sites.

WITNESS RESPONSIBLE: Diane L. Jenner

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Program	Incremental MWH (year-to-date through 11/2007)	Incremental MW (year-to-date through 11/2007)	Cumulative MWH (year-to-date through 11/2007)	Cumulative MW (year-to-date through 11/2007)
Residential Programs / Measures				
Residential Conservation and Energy Education	186.9	0.1	1,642.2	0.5
Refrigerator Replacement	64.0	0.0	334.1	0.1
Home Energy House Call	333.0	0.1	8,889.3	2.1
Residential Comprehensive Energy Education(NEED)	150.0	0.0	208.2	0.1
Home Energy Assistance Plus (continuing)	-	-	-	-
Power Manager	-	0.4	-	8.0
CFL's (Compact Flouresent Lights)	2,640.0	0.8	7,224.6	2.2
Torchieres	194.0	0.0	421.4	0.1
Energy Efficiency Web Site Measures	215.3	0.1	249.1	0.1
Personalized Energy Report	840.0	0.3	1,683.0	0.5
Non-Residential Programs/Measures				
Lighting Measures	5,430.0	1.4	11,712.9	2.9
HVAC Measures	68.4	0.1	167.9	0.1
Motors - Additional Measures	10.8	0.0	12.8	0.0
Setback/Programmable Thermostat	401.1	-	401.1	-
Engineered Nozzles - COMPRESS AIR	-	-	-	-
Zone Shutoff Valves -COMPRESSED AIR	-	-	-	-
Dew Point Controlled Desiccant Dryers - Compressed air	-	-	-	-
Moisture Traps - Condensate Drain Valve	-	-	-	-
Chilled Water Reset	-	-	-	-
Central Lighting Control	-	-	-	-
Switching Controls for Multilevel Lighting	-	-	-	-
Daylight Sensor controls	-	-	-	-
Trim Impellers/Reduce Throttling Pumps	-	-	-	-
Unoccupied Cycle - CONTROLS	-	-	-	-
Commercial Clothes Washers - Washer Only	-	-	-	-
Commercial Clothes Washer - Electric Dyer & Washer	-	-	-	-
Supply Air Reset - Controls	-	-	-	-
Ventilation Scheduling - Controls	-	-	-	-
Optimal Start/Stop - Controls	-	-	-	-
Economizer Cycle - Controls	-	-	-	-
Vending Equipment Controller	-	-	-	-
Barrel Wraps (inj Mold & Extruders)	-	-	-	-
High Efficiency Units - Refrigeration Display Cases	-	-	-	-
Efficient condenser Refrigeration	-	-	-	-
Head Pressure Control	-	-	-	-
Night covers for displays	-	-	-	-
Window Film	-	-	-	-
Air Flow Restricition Curtains	-	-	-	-
Pellet Dryer Tanks & Ducts	-	-	-	-
HI-EFF Multiplex Compressor	-	-	-	-
Hourly Pricing Interruptible and Interruptible	-	-	-	2.0
RTP	-	-	-	1.0
Power Share Call Option	-	1.8	-	1.8

- The following table summarizes the cost-effectiveness test results. The avoided costs in the test include estimates of capacity, energy, losses, and reserve margin.

Program/Measure	TRC	UCT	RIM	Participant Test
Residential Programs / Measures				
Residential Conservation and Energy Education	0.93	0.93	0.46	NA
Refrigerator Replacement	1.03	1.03	0.46	NA
Home Energy House Call	3.38	3.38	2.26	NA
Residential Comprehensive Energy Education(NEED)	1.57	1.57	0.64	NA
Home Energy Assistance Plus (continuing)	included in weatherization			
Power Manager	3.98	3.32	3.32	NA
CFL's (Compact Flourescent Lights)	7.92	9.75	0.66	18.13
Torchieres	7.92	9.75	0.66	18.13
Energy Efficiency Web Site Measures	2.49	1.95	0.57	NA
Personalized Energy Report	10.76	5.78	0.71	NA
Non-Residential Programs/Measures				
Lighting Measures	1.32	4.73	0.84	3.6
HVAC Measures	1.32	2.17	0.79	1.67
Motors - Additional Measures	1.23	1.39	0.61	2.03
Setback/Programmable Thermostat	9.26	52.81	1.12	13.47
Engineered Nozzles - COMPRESS AIR	85.64	256.91	1.26	152.89
Zone Shutoff Valves -COMPRESSED AIR	1.03	3.10	0.86	2.2
Dew Point Controlled Desiccant Dryers - Compressed air	4.92	14.77	1.21	10.05
Moisture Traps - Condensate Drain Valve	3.54	19.04	1.19	5.39
Chilled Water Reset	2.09	6.69	1.06	4.06
Central Lighting Control	0.63	3.46	0.90	1.09
Switching Controls for Multilevel Lighting	0.41	1.76	0.72	0.9
Daylight Sensor controls	0.67	2.89	0.86	1.28
Trim Impellers/Reduce Throttling Pumps	0.52	1.56	0.70	1.43
Unoccupied Cycle - CONTROLS	119.9	359.69	1.26	213.85
Commercial Clothes Washers - Washer Only	0.44	3.26	0.87	0.71
Commercial Clothes Washer - Electric Dyer & Washer	0.64	4.77	0.95	0.96
Supply Air Reset - Controls	3.7	11.10	1.14	7.09
Ventilation Scheduling - Controls	0.5	1.82	0.75	1.19
Optimal Start/Stop - Controls	4 7	14.11	1.16	8.87
Economizer Cycle - Controls	1.55	4.65	1.00	3.26
Vending Equipment Controller	0.97	4.09	0.83	1.7
Barrel Wraps (inj Mold & Extruders)	6.08	18.25	0.99	10.37
High Efficiency Units - Refrigeration Display Cases	0.69	2.06	0.78	1.73
Efficient condenser Refrigeration	2.76	8.29	1.14	5.86
Head Pressure Control	5.46	16.37	1.18	10.21
Night covers for displays	0.84	1.98	0.77	2.48
Window Film	0.75	3.01	0.85	1.44
Air Flow Restricition Curtains	2.68	10.73	1.10	4.38
Pellet Dryer Tanks & Ducts	1.44	4.57	0.99	2.94
HI-EFF Multiplex Compressor	0.59	1.76	0.74	1.55
Hourly Pricing Interruptible and Interruptible	NA	NA	NA	NA
RTP	NA	NA	NA	NA
Power Share Call Option	261 94	2.16	1 86	NA

- The attached file (DR-02-017 Binder_of_assumptions) provides more detail on the development of the estimates of demand reduction.
- Generally, Duke Energy and its third party evaluation consultants follow nationally accepted Evaluation, Measurement, & Verification guidelines, as exemplified by the California Measurement & Verification Protocols, compiled by TecMarket Works and Dr. Nick Hall.

WITNESS RESPONSIBLE: Richard G. Stevie

BE - 5L
Table 1
High Bay Fluorescents & Pulse-Start HIDs

Assumptions	
Average kWh Cost	$ 0.042
Minimum Operating Hours	1,800
Demonstration Operating Hours*	4,160

* hours based on 16hrs/day, 5 days/week, 52 weeks/year

Minimum Operating Hours	1,800																Payback - years 3			
Energy Efficient Installation Hi Bay Fluorescents	Energy Efficient System Wattage	Energy Efficient Initial Lumens	Energy Efficient Mean** Lumens	Standard Installation	Standard System Wattage	Standard Initial Lumens	Standard Mean** Lumens	Differential Mean** Lumens	delta P Mean** Lumens	Watts Savings	kW Savings	Minimum Operating Hours	Energy Savings kWh/yr	Savings $/yr	Differential Material Cost $	Prelim Payback yrs	Differential Cost Required for Target Payback $	Incentive Required $	Incentive % of Diff. Cost %	Payback if 50% Incentive yrs
4L T5 HO	243	20,000	19,800	400 W HID	455	41,000	22,500	(3,700)	-16%	212	0.212	1,800	382	$16.03	$74	4.6	$48.08	$26	35%	2.3
6L F32 T8	224	20,886	16,258	400 W HID	455	41,000	22,500	(6,242)	-28%	231	0.231	1,800	416	$17.48	$6	0.4	$52.39	$0	0%	0.2
8L 42W CFL	372	21,200	19,080	400 W HID	455	41,000	22,500	(3,420)	-15%	83	0.083	1,800	149	$6.27	$395	63.0	$18.82	$376	95%	31.5
320 Watt Metal Halide - Pulse Start	342	32,000	22,500	400 W HID	455	41,000	22,500	0	0%	113	0.113	1,800	203	$8.54	$66	7.7	$25.63	$40	61%	3.8
350 Watt Metal Halide - Pulse Start	375	36,000	25,200	400 W HID	455	41,000	22,500	2,700	12%	80	0.08	1,800	144	$6.05	$66	10.9	$18.14	$48	72%	5.4
400 Watt Metal Halide - Pulse Start	455	41,000	28,700	400 W HID	455	41,000	22,500	6,200	28%	0	0	1,800	0	$0.00	$66	0.0	$0.00	$66	100%	#DIV/0!

**Mean Lumens is the light output at 40% of rated lamp life.

Demonstration Operating Hours	4,160																Payback - years 3			
Energy Efficient Installation Hi Bay Fluorescents	Energy Efficient System Wattage	Energy Efficient Initial Lumens	Energy Efficient Mean** Lumens	Standard Installation	Standard System Wattage	Standard Initial Lumens	Standard Mean** Lumens	Differential Mean** Lumens	delta P Mean** Lumens	Watts Savings	kW Savings	Demonstration Operating Hours	Energy Savings kWh/yr	Savings $/yr	Differential Material Cost $	Prelim Payback yrs	Differential Cost Required for Target Payback $	Incentive Required $	Incentive % of Diff. Cost %	Payback if 50% Incentive yrs
4L T5 HO	243	20,000	19,800	400 W HID	455	41,000	22,500	(3,700)	-16%	212	0.212	4,160	882	$37.04	$74	2.0	$111.12	$0	0%	1.0
6L F32 T8	224	20,886	16,258	400 W HID	455	41,000	22,500	(6,242)	-28%	231	0.231	4,160	961	$40.36	$6	0.2	$121.08	$0	0%	0.1
8L 42W CFL	372	21,200	19,080	400 W HID	455	41,000	22,500	(3,420)	-15%	83	0.083	4,160	345	$14.50	$395	27.2	$43.51	$351	89%	13.6
320 Watt Metal Halide - Pulse Start	342	32,000	22,500	400 W HID	455	41,000	22,500	0	0%	113	0.113	4,160	470	$19.74	$66	3.3	$59.23	$6	10%	1.7
350 Watt Metal Halide - Pulse Start	375	36,000	25,200	400 W HID	455	41,000	22,500	2,700	12%	80	0.08	4,160	333	$13.98	$66	4.7	$41.93	$24	36%	2.4
400 Watt Metal Halide - Pulse Start	455	41,000	28,700	400 W HID	455	41,000	22,500	6,200	28%	0	0	4,160	0	$0.00	$66	0.0	$0.00	$66	100%	#DIV/0!

**Mean Lumens is the light output at 40% of rated lamp life.

Fixture Installation	Material Cost
400 W Metal Halide - Probe Start	$150.00
320 Watt Metal Halide - Pulse Start	$215.71
350 Watt Metal Halide - Pulse Start	$215.71
400 Watt Metal Halide - Pulse Start	$215.71
4L T5 HO	$223.88
6L F32 T8	$158.27
8L 42W CFL	$545.00

Product Description	Lumens Initial per Lamp	Lumens Mean* per Lamp	Avg Rated Life
400 W Metal Halide - Probe Start	41,000	22500	20,000
4L T5 HO	20,000	19,800	20,000
6L F32 T8	20,886	16,258	20,000
8L 42W CFL	21,200	19,080	10,000
320 Watt Metal Halide - Pulse Start	32,000	22,500	25,000
350 Watt Metal Halide - Pulse Start	36,000	25,200	25,000
400 Watt Metal Halide - Pulse Start	41,000	28,700	25,000

**Mean Lumens is the light output at 40% of rated lamp life.

Avg % Load	65%		Table BE - 5 High Efficiency Pumps Impact Calculations				
(Global Assumption) Do Not Change							
Do Not Change These (2) Columns		Enter From Actual Project Data	Auto Calcs	Enter From Actual Project Data	Auto Calcs	Auto Calcs	Do Not Change For Info Only
Pump Motor HP	Base Eff %	Actual Eff %	Eff Gain %	Annual Oper Hrs Hrs/yr	kW Reduction kW	kWh Reduction kWh/yr	Min Qual Eff %
1.5	63%		-63%		-0.46	0	73%
2	63%		-63%		-0.61	0	73%
3	63%		-63%		-0.92	0	73%
5	63%		-63%		-1.53	0	73%
7.5	65%		-65%		-2.36	0	73%
10	70%		-70%		-3.39	0	75%
15	75%		-75%		-5.46	0	77%
20	75%		-75%		-7.27	0	77%

These values established from initial pump study.

SAVINGS for MODEL

Example Table for a (1) pump Application

Pump Motor HP	Base Eff %	Actual Eff %	Eff Gain %	Annual Oper Hrs Hrs/yr	kW Reduction kW	kWh Reduction kWh/yr
1.5	73%	80%	0.07	3120	0.05	158.85
2	73%	80%	0.07	3120	0.07	211.80
3	73%	80%	0.07	3120	0.10	317.71
5	73%	80%	0.07	3120	0.17	529.51
7.5	73%	80%	0.07	3120	0.25	794.27
10	**75%**	**80%**	**0.05**	3120	**0.24**	**756.44**
15	77%	82%	0.05	3120	0.36	1134.67
20	77%	82%	0.05	3120	0.48	1512.89

Example:

A high efficiency pump application shows the following information:

1	Motor HP	10	HP
2	Pump Efficiency at Design Selection	80%	%
3	Annual Operating Hrs	6000	Hrs/yr

Enter 80% & 6000 Hrs in the table in the row corresponding to 10 HP.

Table automatically calculates the kW reduction & the annual kWh savings

Pump Efficiency Summary

Pump No	#1 Pump HP	#2 Pump HP	#1 Pump Eff	#2 Pump Eff	#1 Pump $	#2 Pump $	Diff Eff	Diff $
1	1.5	2	63.55	69.21	678	996.66	5.66	318.66
2	5	5	58.39	61.25	1077	1152.39	2.86	75.39
3	2	2	64.48	71.96	1506	1972.86	7.48	466.86
4	5	5	53.89	75.19	1047	1350.63	21.3	303.63
5	5	7.5	61.15	74.05	1047	1800.84	12.9	753.84
6	7.5	7.5	64.04	71.52	1728	2384.64	7.48	656.64
7	10	10	67.68	70.64	2181	2311.86	2.96	130.86
8	3	3	69.63	76.82	1647	2108.16	7.19	461.16
9	7.5	7.5	68.03	74.08	1914	2411.64	6.05	497.64
10	10	10	73.03	77.63	2370	2701.8	4.6	331.8
11	5	3	65.68	79.43	1794	2134.86	13.75	340.86
12	10	10	67.01	79.26	2499	2648.94	12.25	149.94
13	20	20	74.39	76.84	3216	4245.12	2.45	1029.12
14	5	5	54.94	79.48	1794	2403.96	24.54	609.96
15	15	15	64.28	80.37	2787	3372.27	16.09	585.27
16	20	15	70.69	79.93	2931	3429.27	9.24	498.27
17	20	20	74.81	78.81	2931	3780.99	4	849.99

	Pump No	#1 Pump HP	#2 Pump HP	#1 Pump Eff	#2 Pump Eff	#1 Pump $	#2 Pump $	Diff Eff	Diff $	Low Eff Pump Avg Eff	High Eff Pump Avg Eff		PossibleTarget Eff Req'd for Incentive	
			Up to 5 HP							61.51	73.33		???	
1	1	1.5	2	63.55	69.21	678	996.66	5.66	318.66					
2	2	5	5	58.39	61.25	1077	1152.39	2.86	75.39					
3	3	2	2	64.48	71.96	1506	1972.86	7.48	466.86					
4	4	5	5	53.89	75.19	1047	1350.63	21.3	303.63					
5	8	3	3	69.63	76.82	1647	2108.16	7.19	461.16				73%	
6	11	5	3	65.68	79.43	1794	2134.86	13.75	340.86				1 thru 7.5 HP	
7	14	5	5	54.94	79.48	1794	2403.96	24.54	609.96	Eff Diff	11.83		Assume Base Eff =	63%
			Up to 7.5 HP											
8	5	5	7.5	61.15	74.05	1047	1800.84	12.9	753.84	64.41	73.22			
9	6	7.5	7.5	64.04	71.52	1728	2384.64	7.48	656.64					
11	9	7.5	7.5	68.03	74.08	1914	2411.64	6.05	497.64	Eff Diff	8.81		Assume Base Eff =	65%
			10 HP											
10	7	10	10	67.68	70.64	2181	2311.86	2.96	130.86	69.24	75.84		75%	
12	10	10	10	73.03	77.63	2370	2701.8	4.6	331.8				10 HP	
13	12	10	10	67.01	79.26	2499	2648.94	12.25	149.94	Eff Diff	6.60		Assume Base Eff =	70%
			15 HP											
14	15	15	15	64.28	80.37	2787	3372.27	16.09	585.27	67.49	80.15			
15	16	20	15	70.69	79.93	2931	3429.27	9.24	498.27	Eff Diff	12.67			
													77%	
			20 HP										15 & 20 HP	
16	13	20	20	74.39	76.84	3216	4245.12	2.45	1029.12	74.60	77.83		Assume Base Eff =	75%
17	17	20	20	74.81	78.81	2931	3780.99	4	849.99	Eff Diff	3.23			

BE -4L
Table 1
Light Tubes

Assumptions	
Average kWh Cost	$ 0.042
Minimum Operating Hours	2,000

Minimum Operating Hours	2,000																			Payback - years 3			
Energy Efficient Installation	Quantity	Energy Efficient System Wattage	Energy Efficient Average Lumens	Energy Efficient Total Lumens	Standard Installation	Standard Quantity	Standard System Wattage	Standard Initial Lumens	Standard Mean** Lumens	Standard System Mean Lumens	Differential Mean** Lumens	delta P Mean** Lumens	Avg Rated Life	Watts Savings	kW Savings	Minimum Operating Hours	Energy Savings kWh/yr	Savings $/yr	Material Cost $	Prelim Payback yrs	Cost Required for Target Payback $	Incentive Required $	Incentive % of Cost %	Payback if 50% Incentive yrs
21" Tubular Skyight / Light Tube	1	0	13,900	13,900	400 W HID	0.6	454	41,000	22,500	13,500	400	2%	20,000	272	0.3	2,000	545	$22.85	$423	18.5	$68.84	$354	84%	9.2
21" Tubular Skylight / Light Tube	10	0	13,900	139,000	400 W HID	6.0	454	41,000	22,500	135,000	4,000	18%	20,000	2,724	2.7	2,000	5,448	$228.62	$4,229	18.5	$685.45	$3,543	84%	9.2

**Mean Lumens is the light output at 40% of rated lamp life.

Product Description	Material Cost
21" Tubular Skylight / Light Tube	$422.90

BE-34 – Premium Efficiency Motors

For this technology, we evaluated a range of motors from 1 HP to 300 HP. A total of 250 motors were evaluated. The analysis includes the following categories:

1. TEFC - 1200 RPM
2. TEFC - 1800 RPM
3. TEFC - 3600 RPM
4. ODP - 1200 RPM
5. ODP - 1800 RPM
6. ODP - 3600 RPM

The analysis is based on the assumption that in the base case (without incentives) the owner will install a motor that meets the requirements of the Energy Policy Act of 1992. The act became effective for motor on October 24, 1997. The act mandates that certain motors sold in the U.S. must be of energy efficient design. This act specifies the minimum, nominal full load efficiency for single speed, 230/460V, 60 cycle motors, 1200,1800 or 3600 rpm from 1 HP to 200 HP. (For 250 and 300 HP, the base case efficiency was assumed to be the efficiency listed for energy efficient motors in NEMA Table 12-11.)

The analysis assumes that to receive incentives under the program, the owner must install a motor that meets or exceeds the specifications of a "Premium Efficiency" motor as defined by NEMA Table 12-12. These efficiencies are typically 1% to 3% higher than EPAct compliant motors. (Efficiency differences decrease as horsepowers increase.)

The efficiency and cost information used in the analysis is based on U.S. DOE Motor Master +4.0. Since Baldor motors were found in nearly all sizes in the database, and because Baldor's motor list prices were more recent than most other manufacturers, Baldor pricing was generally used. Discussions with representatives of Baldor suggest that a discount of 35% from list price for small quantities would be appropriate.

Methodology and Assumptions

Several key assumptions used in the analysis include:

1. Average motor load was assumed to be 65%. Increasing percent motor load improves the economics. Previous end use analysis performed by Balance Engineering in commercial and industrial facilities indicated that 65% is a reasonable load estimate. The attached spreadsheet models allow this variable to be changed.

2. Annual operating hours were assumed to be 1500 hours/year. This is the minimum requirement in the existing program. As operating hours increase, project economics are improved. The attached spreadsheet models allow the annual operating hours to be changed to test the results for other run hour scenarios.

3. The average electrical cost is assumed to be $0.042/kWh. The attached spreadsheet models allow this variable to be changed.

Results Summary

Highlights of the analysis are listed below:

1. At 1500 operating hours/year, even with incentives equal to 50% of the differential cost to upgrade to premium efficiency motors, the simple paybacks are much longer than 3 years.

2. As the operating hours increase to 8760 hours/year, the paybacks drop to the 1 to 6 year range, if incentives of 50% of differential cost are offered.

3. There are significant differences in the differential costs across the six (6) motor categories. Differential costs are highest for 1200 RPM TEFC.

Attachments

The information developed for this analysis is shown in the attached Tables:

BE34 - Table 1	TEFC	1200 RPM	Premium Efficiency Motors
BE34 - Table 2	TEFC	1800 RPM	Premium Efficiency Motors
BE34 - Table 3	TEFC	3600 RPM	Premium Efficiency Motors
BE34 - Table 4	ODP	1200 RPM	Premium Efficiency Motors
BE34 - Table 5	ODP	1800 RPM	Premium Efficiency Motors
BE34 - Table 6	ODP	3600 RPM	Premium Efficiency Motors

BE 34 Table 6 ODP
Premium Efficiency Motors
ODP 3600 RPM

Hrs/yr Operation	1500
Average % Load, (BHP)	65%
Average Elec Cost $/kWh	$ 0.042
List Price Discount <=200 HP	35% (Baldor)
List Price Discount >200 HP	25% (Lincoln)

Notes: (For the Cinergy CI Program)

1. Assume that all new applications will be EPAct efficiency unless incentivize to encourage NEMA Premium Efficiency.
2. Delta Eff is the difference between NEMA Prem & EPAct.
3. Delta Cost is the difference between NEMA Prem & EPAct.
4. EPAct Eff Rating not avail for 250 & 300 HP Motors- Use Energy Efficient form NEMA Table 12-11

	Motor Cost & Efficiency Data								Energy Consumption & Operating Costs							
	EPAct High Eff			NEMA Premium Eff					EPAct High Eff			NEMA Premium Eff				
Motor HP	Eff %	List Price *** $	Cost $	Eff %	List Price $	Cost $	Delta Eff	Delta Cost	kW	kWh	Opr Cost $/yr	kW	kWh	Opr Cost $/yr	Opr Diff $/yr	Payback yrs
1	NA	$ 262	$ 170	77.0%	$ 297	$ 193	#VALUE!	$ 23	#VALUE!	#VALUE!	#VALUE!	0.63	945	$ 40	#VALUE!	#VALUE!
1.5	82.5%	$ 315	$ 205	84.0%	$ 365	$ 237	1.5%	$ 33	0.86	1,322	$ 56	0.87	1,299	$ 55	$ 1	32.8
2	84.0%	$ 349	$ 227	85.5%	$ 428	$ 278	1.5%	$ 51	1.15	1,732	$ 73	1.13	1,701	$ 71	$ 1	40.2
3	84.0%	$ 371	$ 241	85.5%	$ 435	$ 283	1.5%	$ 42	1.73	2,598	$ 109	1.70	2,552	$ 107	$ 2	21.7
5	85.5%	$ 383	$ 249	86.5%	$ 475	$ 309	1.0%	$ 60	2.84	4,254	$ 179	2.80	4,204	$ 177	$ 2	29.0
7.5	87.5%	$ 527	$ 343	88.5%	$ 755	$ 491	1.0%	$ 148	4.16	6,234	$ 262	4.11	6,164	$ 259	$ 3	50.1
10	88.5%	$ 662	$ 430	89.5%	$ 862	$ 560	1.0%	$ 130	5.48	8,219	$ 345	5.42	8,127	$ 341	$ 4	33.7
15	89.5%	$ 968	$ 629	90.2%	$ 1,226	$ 797	0.7%	$ 168	8.13	12,190	$ 512	8.06	12,096	$ 508	$ 4	42.2
20	90.2%	$ 1,239	$ 805	91.0%	$ 1,440	$ 936	0.8%	$ 131	10.75	16,127	$ 677	10.66	15,986	$ 671	$ 6	21.9
25	91.0%	$ 1,499	$ 974	91.7%	$ 1,730	$ 1,125	0.7%	$ 150	13.32	19,982	$ 839	13.22	19,830	$ 833	$ 6	23.4
30	91.0%	$ 1,587	$ 1,032	91.7%	$ 2,041	$ 1,327	0.7%	$ 295	15.99	23,979	$ 1,007	15.86	23,796	$ 999	$ 8	36.4
40	91.7%	$ 2,235	$ 1,453	92.4%	$ 2,631	$ 1,710	0.7%	$ 257	21.15	31,727	$ 1,333	20.99	31,484	$ 1,322	$ 10	25.1
50	92.4%	$ 2,316	$ 1,505	93.0%	$ 2,866	$ 1,863	0.6%	$ 358	26.24	39,359	$ 1,653	26.07	39,105	$ 1,642	$ 11	33.5
60	93.0%	$ 3,236	$ 2,103	93.6%	$ 3,626	$ 2,357	0.6%	$ 254	31.28	46,926	$ 1,971	31.08	46,625	$ 1,958	$ 13	20.1
75	93.0%	$ 3,861	$ 2,510	93.6%	$ 4,758	$ 3,093	0.6%	$ 583	39.10	58,657	$ 2,464	38.85	58,281	$ 2,448	$ 16	36.9
100	93.0%	$ 4,366	$ 2,838	93.6%	$ 5,086	$ 3,306	0.6%	$ 468	52.14	78,210	$ 3,285	51.81	77,708	$ 3,264	$ 21	22.2
125	93.6%	$ 4,982	$ 3,238	94.1%	$ 6,256	$ 4,066	0.5%	$ 828	64.76	97,135	$ 4,080	64.41	96,619	$ 4,058	$ 22	38.2
150	93.6%	$ 6,725	$ 4,371	94.1%	$ 7,717	$ 5,016	0.5%	$ 645	77.71	116,563	$ 4,896	77.30	115,943	$ 4,870	$ 26	24.8
200	94.5%	$ 7,419	$ 4,822	95.0%	$ 8,745	$ 5,684	0.5%	$ 862	102.62	153,937	$ 6,465	102.08	153,126	$ 6,431	$ 34	25.3
250	94.5%	$ 10,205	$ 7,654	95.0%	$ 11,973	$ 8,980	0.5%	$ 1,326	128.28	192,421	$ 8,082	127.61	191,408	$ 8,039	$ 43	31.2
300	95.0%	$ 11,905	$ 8,929	95.4%	$ 13,968	$ 10,476	0.4%	$ 1,547	153.13	229,689	$ 9,647	152.48	228,726	$ 9,607	$ 40	38.3

*** 250 & 300 HP prices are based on Lincoln.

***** EPAct did not specify an efficiency for 1 HP, 3600 RPM ODP

Paybacks with Various Incentives

Motor HP	Payback with 25% of Diff Cost Incentive	Payback with 50% of Diff Cost Incentive	Incentive Req'd for 3 yr PB
1	#VALUE!	#VALUE!	#VALUE!
1.5	24.6	16.4	$ 30
2	30.2	20.1	$ 48
3	16.3	10.9	$ 36
5	21.7	14.5	$ 54
7.5	37.6	25.0	$ 139
10	25.3	16.9	$ 118
15	31.7	21.1	$ 156
20	16.5	11.0	$ 113
25	17.6	11.7	$ 131
30	28.8	19.2	$ 272
40	18.9	12.6	$ 227
50	25.1	16.8	$ 326
60	15.0	10.0	$ 216
75	27.7	18.5	$ 536
100	16.7	11.1	$ 405
125	28.7	19.1	$ 763
150	18.6	12.4	$ 567
200	19.0	12.7	$ 760
250	23.4	15.6	$ 1,198
300	28.7	19.1	$ 1,426

BE 34 Table 5 ODP
Premium Efficiency Motors
ODP 1800 RPM

Hrs/yr Operation	1500	
Average % Load, (BHP)	65%	
Average Elec Cost $/kWh	$ 0.042	
List Price Discount <=200 HP	35%	(Baldor)
List Price Discount >200 HP	25%	(Lincoln)

Notes: (For the Cinergy CI Program)

1. Assume that all new applications will be EPAct efficiency unless incentivize to encourage NEMA Premium Efficiency.
2. Delta Eff is the difference between NEMA Prem & EPAct.
3. Delta Cost is the difference between NEMA Prem & EPAct.
4. EPAct Eff Rating not avail for 250 & 300 HP Motors- Use Energy Efficient form NEMA Table 12-11

Motor Cost & Efficiency Data

Motor HP	EPAct High Eff Eff %	EPAct High Eff List Price *** $	EPAct High Eff Cost $	NEMA Premium Eff Eff %	NEMA Premium Eff List Price $	NEMA Premium Eff Cost $	Delta Eff	Delta Cost
1	82.5%	$ 268	$ 174	85.5%	$ 370	$ 241	3.0%	$ 66
1.5	84.0%	$ 285	$ 185	86.5%	$ 388	$ 252	2.5%	$ 67
2	84.0%	$ 307	$ 200	86.5%	$ 415	$ 270	2.5%	$ 70
3	86.5%	$ 335	$ 218	89.5%	$ 448	$ 291	3.0%	$ 73
5	87.5%	$ 370	$ 241	89.5%	$ 491	$ 319	2.0%	$ 79
7.5	88.5%	$ 526	$ 342	91.0%	$ 722	$ 469	2.5%	$ 127
10	89.5%	$ 644	$ 419	91.7%	$ 875	$ 569	2.2%	$ 150
15	91.0%	$ 881	$ 573	93.0%	$ 1,240	$ 806	2.0%	$ 233
20	91.0%	$ 1,250	$ 813	93.0%	$ 1,558	$ 1,013	2.0%	$ 200
25	91.7%	$ 1,515	$ 985	93.6%	$ 1,899	$ 1,234	1.9%	$ 250
30	92.4%	$ 1,771	$ 1,151	94.1%	$ 2,077	$ 1,350	1.7%	$ 199
40	93.0%	$ 2,259	$ 1,468	94.1%	$ 2,710	$ 1,762	1.1%	$ 293
50	93.0%	$ 2,652	$ 1,724	94.5%	$ 2,991	$ 1,944	1.5%	$ 220
60	93.6%	$ 3,272	$ 2,127	95.0%	$ 3,765	$ 2,447	1.4%	$ 320
75	94.1%	$ 4,016	$ 2,610	95.0%	$ 4,622	$ 3,004	0.9%	$ 394
100	94.1%	$ 4,384	$ 2,850	95.4%	$ 5,271	$ 3,426	1.3%	$ 577
125	94.5%	$ 5,040	$ 3,276	95.4%	$ 6,466	$ 4,203	0.9%	$ 927
150	95.0%	$ 6,524	$ 4,241	95.8%	$ 7,182	$ 4,668	0.8%	$ 428
200	95.0%	$ 7,612	$ 4,948	95.8%	$ 8,976	$ 5,834	0.8%	$ 887
250	95.4%	$ 10,179	$ 7,634	95.8%	$ 11,943	$ 8,957	0.4%	$ 1,323
300	95.4%	$ 10,536	$ 7,902	95.8%	$ 12,362	$ 9,272	0.4%	$ 1,370

*** 250 & 300 HP prices are based on Lincoln.

Energy Consumption & Operating Costs

Motor HP	EPAct High Eff kW	EPAct High Eff kWh	EPAct High Eff Opr Cost $/yr	NEMA Premium Eff kW	NEMA Premium Eff kWh	NEMA Premium Eff Opr Cost $/yr	Opr Diff $/yr	Payback yrs
1	0.59	882	$ 37	0.57	851	$ 36	$ 1	51.0
1.5	0.87	1,299	$ 55	0.84	1,261	$ 53	$ 2	42.5
2	1.15	1,732	$ 73	1.12	1,682	$ 71	$ 2	33.4
3	1.68	2,523	$ 106	1.63	2,438	$ 102	$ 4	20.7
5	2.77	4,156	$ 175	2.71	4,063	$ 171	$ 4	20.2
7.5	4.11	6,164	$ 259	4.00	5,995	$ 252	$ 7	17.9
10	5.42	8,127	$ 341	5.29	7,932	$ 333	$ 8	18.3
15	7.99	11,989	$ 504	7.82	11,731	$ 493	$ 11	21.5
20	10.66	15,986	$ 671	10.43	15,642	$ 657	$ 14	13.9
25	13.22	19,830	$ 833	12.95	19,427	$ 816	$ 17	14.8
30	15.74	23,615	$ 992	15.46	23,189	$ 974	$ 18	11.1
40	20.86	31,284	$ 1,314	20.61	30,918	$ 1,299	$ 15	19.1
50	26.07	39,105	$ 1,642	25.66	38,484	$ 1,616	$ 26	8.5
60	31.08	46,625	$ 1,958	30.63	45,938	$ 1,929	$ 29	11.1
75	38.65	57,972	$ 2,435	38.28	57,422	$ 2,412	$ 23	17.1
100	51.53	77,295	$ 3,246	50.83	76,242	$ 3,202	$ 44	13.0
125	64.14	96,210	$ 4,041	63.54	95,303	$ 4,003	$ 38	24.3
150	76.56	114,845	$ 4,823	75.92	113,886	$ 4,783	$ 40	10.6
200	102.08	153,126	$ 6,431	101.23	151,848	$ 6,378	$ 54	16.5
250	127.07	190,605	$ 8,005	126.54	189,809	$ 7,972	$ 33	39.6
300	152.48	228,726	$ 9,607	151.85	227,771	$ 9,566	$ 40	34.1

Paybacks with Various Incentives

Motor HP	Payback with 25% of Diff Cost Incentive	Payback with 50% of Diff Cost Incentive	Incentive Req'd for 3 yr PB
1	38.3	25.5	$ 62
1.5	31.8	21.2	$ 62
2	25.0	16.7	$ 64
3	15.5	10.3	$ 63
5	15.1	10.1	$ 67
7.5	13.4	9.0	$ 106
10	13.8	9.2	$ 126
15	16.2	10.8	$ 201
20	10.4	6.9	$ 157
25	11.1	7.4	$ 199
30	8.3	5.6	$ 145
40	14.3	9.5	$ 247
50	6.3	4.2	$ 142
60	8.3	5.6	$ 234
75	12.8	8.5	$ 325
100	9.8	6.5	$ 444
125	18.2	12.2	$ 813
150	8.0	5.3	$ 307
200	12.4	8.3	$ 725
250	29.7	19.8	$ 1,223
300	25.6	17.1	$ 1,249

BE 34 Table 4 ODP
Premium Efficiency Motors
ODP 1200 RPM

Notes: (For the Cinergy CI Program)

1. Assume that all new applications will be EPAct efficiency unless incentivize to encourage NEMA Premium Efficiency.
2. Delta Eff is the difference between NEMA Prem & EPAct.
3. Delta Cost is the difference between NEMA Prem & EPAct.
4. EPAct Eff Rating not avail for 250 & 300 HP Motors- Use Energy Efficient form NEMA Table 12-11

Hrs/yr Operation	1500	
Average % Load, (BHP)	65%	
Average Elec Cost $/kWh	$ 0.042	
List Price Discount <=200 HP	35%	(Baldor)
List Price Discount >200 HP	35%	(Baldor)

Motor Cost & Efficiency Data

Motor HP	EPAct High Eff Eff %	EPAct High Eff List Price *** $	EPAct High Eff Cost $	NEMA Premium Eff Eff %	NEMA Premium Eff List Price $	NEMA Premium Eff Cost $	Delta Eff	Delta Cost
1	80.0%	$ 377	$ 245	82.5%	$ 435	$ 283	2.5%	$ 38
1.5	84.0%	$ 442	$ 287	86.5%	$ 509	$ 331	2.5%	$ 44
2	85.5%	$ 434	$ 282	87.5%	$ 520	$ 338	2.0%	$ 56
3	86.5%	$ 509	$ 331	88.5%	$ 662	$ 430	2.0%	$ 99
5	87.5%	$ 667	$ 395	89.5%	$ 868	$ 564	2.0%	$ 170
7.5	88.5%	$ 825	$ 536	90.2%	$ 1,042	$ 677	1.7%	$ 141
10	90.2%	$ 1,067	$ 694	91.7%	$ 1,356	$ 881	1.5%	$ 188
15	90.2%	$ 1,397	$ 908	91.7%	$ 1,830	$ 1,190	1.5%	$ 281
20	91.0%	$ 1,714	$ 1,114	92.4%	$ 2,228	$ 1,448	1.4%	$ 334
25	91.7%	$ 2,408	$ 1,565	93.0%	$ 2,691	$ 1,749	1.3%	$ 184
30	92.4%	$ 2,538	$ 1,650	93.6%	$ 2,807	$ 1,825	1.2%	$ 175
40	93.0%	$ 3,725	$ 2,421	94.1%	$ 4,000	$ 2,600	1.1%	$ 179
50	93.0%	$ 4,484	$ 2,915	94.1%	$ 4,842	$ 3,147	1.1%	$ 233
60	93.6%	$ 5,230	$ 3,400	94.5%	$ 6,025	$ 3,916	0.9%	$ 517
75	93.6%	$ 6,176	$ 4,014	94.5%	$ 6,709	$ 4,361	0.9%	$ 346
100	94.1%	$ 6,677	$ 4,340	95.0%	$ 6,735	$ 4,378	0.9%	$ 38
125	94.1%	$ 7,144	$ 4,644	95.0%	$ 7,975	$ 5,184	0.9%	$ 540
150	94.5%	$ 7,722	$ 5,019	95.4%	$ 9,392	$ 6,105	0.9%	$ 1,086
200	94.5%	$ 9,831	$ 6,390	95.4%	$ 12,347	$ 8,026	0.9%	$ 1,635
250	95.4%		$ -	95.4%		$ -	0.0%	$ -
300	95.4%		$ -	95.4%		$ -	0.0%	$ -

*** List prices not shown for 250 & 300 HP since there is no efficiency difference

Energy Consumption & Operating Costs

Motor HP	EPAct High Eff kW	EPAct High Eff kWh	EPAct High Eff Opr Cost $/yr	NEMA Premium Eff kW	NEMA Premium Eff kWh	NEMA Premium Eff Opr Cost $/yr	NEMA Premium Eff Opr Diff $/yr	Payback yrs
1	0.61	909	$ 38	0.59	882	$ 37	$ 1	32.6
1.5	0.87	1,299	$ 55	0.84	1,261	$ 53	$ 2	27.6
2	1.13	1,701	$ 71	1.11	1,663	$ 70	$ 2	34.2
3	1.68	2,523	$ 106	1.64	2,466	$ 104	$ 2	41.5
5	2.77	4,156	$ 175	2.71	4,063	$ 171	$ 4	43.5
7.5	4.11	6,164	$ 259	4.03	6,048	$ 254	$ 5	28.9
10	5.38	8,064	$ 339	5.29	7,932	$ 333	$ 6	33.9
15	8.06	12,096	$ 508	7.93	11,898	$ 500	$ 8	33.9
20	10.66	15,986	$ 671	10.50	15,744	$ 661	$ 10	32.8
25	13.22	19,830	$ 833	13.03	19,552	$ 821	$ 12	15.8
30	15.74	23,615	$ 992	15.54	23,313	$ 979	$ 13	13.8
40	20.86	31,284	$ 1,314	20.61	30,918	$ 1,299	$ 15	11.6
50	26.07	39,105	$ 1,642	25.77	38,648	$ 1,623	$ 19	12.1
60	31.08	46,625	$ 1,958	30.79	46,181	$ 1,940	$ 19	27.7
75	38.85	58,281	$ 2,448	38.48	57,726	$ 2,425	$ 23	14.9
100	51.53	77,295	$ 3,246	51.04	76,563	$ 3,216	$ 31	1.2
125	64.41	96,619	$ 4,058	63.80	95,704	$ 4,020	$ 38	14.1
150	76.97	115,452	$ 4,849	76.24	114,363	$ 4,803	$ 46	23.7
200	102.62	153,937	$ 6,465	101.66	152,484	$ 6,404	$ 61	26.8
250	127.07	190,605	$ 8,005	127.07	190,605	$ 8,005	$ -	#DIV/0!
300	152.48	228,726	$ 9,607	152.48	228,726	$ 9,607	$ -	#DIV/0!

Paybacks with Various Incentives

Motor HP	Payback with 25% of Diff Cost Incentive	Payback with 50% of Diff Cost Incentive	Incentive Req'd for 3 yr PB
1	24.4	16.3	$ 34
1.5	20.7	13.8	$ 39
2	25.7	17.1	$ 51
3	31.2	20.8	$ 92
5	32.6	21.7	$ 158
7.5	21.7	14.5	$ 126
10	25.4	17.0	$ 171
15	25.4	16.9	$ 257
20	24.6	16.4	$ 304
25	11.9	7.9	$ 149
30	10.3	6.9	$ 137
40	8.7	5.8	$ 133
50	9.1	6.1	$ 175
60	20.8	13.9	$ 461
75	11.1	7.4	$ 277
100	0.9	0.6	$ (55)
125	10.5	7.0	$ 425
150	17.8	11.9	$ 948
200	20.1	13.4	$ 1,452
250	#DIV/0!	#DIV/0!	$ -
300	#DIV/0!	#DIV/0!	$ -

BE 34 Table 3 TEFC
Premium Efficiency Motors
TEFC 3600 RPM

Hrs/yr Operation	1500
Average % Load, (BHP)	65%
Average Elec Cost $/kWh	$ 0.042
List Price Discount <=200 HP	35% (Baldor)
List Price Discount >200 HP	35% (Baldor)

Notes: (For the Cinergy CI Program)

1. Assume that all new applications will be EPAct efficiency unless incentivize to encourage NEMA Premium Efficiency.
2. Delta Eff is the difference between NEMA Prem & EPAct.
3. Delta Cost is the difference between NEMA Prem & EPAct.
4. EPAct Eff Rating not avail for 250 & 300 HP Motors- Use Energy Efficient form NEMA Table 12-11

	Motor Cost & Efficiency Data								Energy Consumption & Operating Costs							
	EPAct High Eff			NEMA Premium Eff					EPAct High Eff			NEMA Premium Eff				
Motor HP	Eff %	List Price *** $	Cost $	Eff %	List Price $	Cost $	Delta Eff	Delta Cost	kW	kWh	Opr Cost $/yr	kW	kWh	Opr Cost $/yr	Opr Diff $/yr	Payback yrs
1	75.5%	$ 292	$ 190	77.0%	$ 382	$ 248	1.5%	$ 59	0.64	963	$ 40	0.63	945	$ 40	$ 1	74.2
1.5	82.5%	$ 448	$ 291	84.0%	$ 499	$ 324	1.5%	$ 33	0.88	1,322	$ 56	0.87	1,299	$ 55	$ 1	33.4
2	84.0%	$ 505	$ 328	85.5%	$ 519	$ 337	1.5%	$ 9	1.15	1,732	$ 73	1.13	1,701	$ 71	$ 1	7.1
3	85.5%	$ 604	$ 393	86.5%	$ 656	$ 426	1.0%	$ 34	1.70	2,552	$ 107	1.68	2,523	$ 106	$ 1	27.3
5	87.5%	$ 747	$ 486	88.5%	$ 807	$ 525	1.0%	$ 39	2.77	4,156	$ 175	2.74	4,109	$ 173	$ 2	19.8
7.5	88.5%	$ 851	$ 553	89.5%	$ 935	$ 608	1.0%	$ 55	4.11	6,164	$ 259	4.06	6,095	$ 256	$ 3	18.9
10	89.5%	$ 1,022	$ 664	90.2%	$ 1,097	$ 713	0.7%	$ 49	5.42	8,127	$ 341	5.38	8,064	$ 339	$ 3	18.4
15	90.2%	$ 1,335	$ 868	91.0%	$ 1,511	$ 982	0.8%	$ 114	8.06	12,096	$ 508	7.99	11,989	$ 504	$ 4	25.6
20	90.2%	$ 1,466	$ 953	91.0%	$ 1,659	$ 1,078	0.8%	$ 125	10.75	16,127	$ 677	10.66	15,986	$ 671	$ 6	21.1
25	91.0%	$ 1,865	$ 1,212	91.7%	$ 2,164	$ 1,407	0.7%	$ 194	13.32	19,982	$ 839	13.22	19,830	$ 833	$ 6	30.3
30	91.0%	$ 2,024	$ 1,316	91.7%	$ 2,339	$ 1,520	0.7%	$ 205	15.99	23,979	$ 1,007	15.86	23,796	$ 999	$ 8	26.6
40	91.7%	$ 2,894	$ 1,881	92.4%	$ 3,333	$ 2,166	0.7%	$ 285	21.15	31,727	$ 1,333	20.99	31,487	$ 1,322	$ 10	28.3
50	92.4%	$ 2,941	$ 1,912	93.0%	$ 3,859	$ 2,508	0.6%	$ 597	26.24	39,359	$ 1,653	26.07	39,105	$ 1,642	$ 11	55.9
60	93.0%	$ 4,489	$ 2,918	93.6%	$ 5,421	$ 3,524	0.6%	$ 606	31.28	46,926	$ 1,971	31.08	46,625	$ 1,958	$ 13	48.0
75	93.0%	$ 5,452	$ 3,544	93.6%	$ 6,308	$ 4,100	0.6%	$ 556	39.10	58,657	$ 2,464	38.85	58,281	$ 2,448	$ 16	35.2
100	93.6%	$ 6,823	$ 4,435	94.1%	$ 8,624	$ 5,606	0.5%	$ 1,171	51.81	77,708	$ 3,264	51.53	77,295	$ 3,246	$ 17	67.5
125	94.5%	$ 9,286	$ 6,036	95.0%	$ 10,134	$ 6,587	0.5%	$ 551	64.14	96,210	$ 4,041	63.80	95,704	$ 4,020	$ 21	25.9
150	94.5%	$ 11,027	$ 7,168	95.0%	$ 11,880	$ 7,722	0.5%	$ 554	76.97	115,452	$ 4,849	76.56	114,845	$ 4,823	$ 26	21.7
200	95.0%	$ 11,968	$ 7,779	95.4%	$ 14,069	$ 9,145	0.4%	$ 1,366	102.08	153,126	$ 6,431	101.66	152,484	$ 6,404	$ 27	50.6
250	95.4%	$ 17,327	$ 11,263	95.8%	$ 19,722	$ 12,819	0.4%	$ 1,557	127.07	190,605	$ 8,005	126.54	189,809	$ 7,972	$ 33	46.6
300	95.4%	$ 29,112	$ 18,923	95.8%	$ 31,706	$ 20,609	0.4%	$ 1,686	152.48	228,726	$ 9,607	151.85	227,771	$ 9,566	$ 40	42.0

*** 250 & 300 HP prices are based on Baldor.

	Paybacks with Various Incentives		
Motor HP	Payback with 25% of Diff Cost Incentive	Payback with 50% of Diff Cost Incentive	Incentive Req'd for 3 yr PB
1	55.7	37.1	$ 56
1.5	25.1	16.7	$ 30
2	5.3	3.6	$ 5
3	20.5	13.6	$ 30
5	14.8	9.9	$ 33
7.5	14.2	9.4	$ 46
10	13.8	9.2	$ 41
15	19.2	12.8	$ 101
20	15.8	10.5	$ 108
25	22.8	15.2	$ 175
30	20.0	13.3	$ 182
40	21.2	14.1	$ 255
50	42.0	28.0	$ 565
60	36.0	24.0	$ 568
75	26.4	17.6	$ 509
100	50.6	33.8	$ 1,119
125	19.4	13.0	$ 487
150	16.3	10.9	$ 478
200	38.0	25.3	$ 1,285
250	34.9	23.3	$ 1,456
300	31.5	21.0	$ 1,566

BE 34 Table 2 TEFC
Premium Efficiency Motors
TEFC 1800 RPM

Hrs/yr Operation	1500
Average % Load, (BHP)	65%
Average Elec Cost $/kWh	$ 0.042
List Price Discount <=200 HP	35% (Baldor)
List Price Discount >200 HP	35% (Baldor)

Notes: (For the Cinergy CI Program)

1. Assume that all new applications will be EPAct efficiency unless incentivize to encourage NEMA Premium Efficiency.
2. Delta Eff is the difference between NEMA Prem & EPAct.
3. Delta Cost is the difference between NEMA Prem & EPAct.
4. EPAct Eff Rating not avail for 250 & 300 HP Motors- Use Energy Efficient form NEMA Table 12-11

Motor Cost & Efficiency Data | **Energy Consumption & Operating Costs**

Motor HP	EPAct High Eff Eff %	EPAct High Eff List Price *** $	EPAct High Eff Cost $	NEMA Premium Eff Eff %	NEMA Premium Eff List Price $	NEMA Premium Eff Cost $	Delta Eff	Delta Cost	EPAct High Eff kW	EPAct High Eff kWh	EPAct High Eff Opr Cost $/yr	NEMA Premium Eff kW	NEMA Premium Eff kWh	NEMA Premium Eff Opr Cost $/yr	NEMA Premium Eff Opr Diff $/yr	Payback yrs
1	82.5%	$ 417	$ 271	85.5%	$ 547	$ 356	3.0%	$ 85	0.59	882	$ 37	0.57	851	$ 36	$ 1	65.0
1.5	84.0%	$ 425	$ 276	86.5%	$ 566	$ 368	2.5%	$ 92	0.87	1,299	$ 55	0.84	1,261	$ 53	$ 2	58.1
2	84.0%	$ 461	$ 300	86.5%	$ 594	$ 386	2.5%	$ 86	1.15	1,732	$ 73	1.12	1,682	$ 71	$ 2	41.1
3	87.5%	$ 607	$ 395	89.5%	$ 674	$ 438	2.0%	$ 44	1.66	2,494	$ 105	1.63	2,438	$ 102	$ 2	18.6
5	87.5%	$ 617	$ 401	89.5%	$ 675	$ 439	2.0%	$ 38	2.77	4,156	$ 175	2.71	4,063	$ 171	$ 4	9.7
7.5	89.5%	$ 823	$ 535	91.7%	$ 900	$ 585	2.2%	$ 50	4.06	6,095	$ 256	3.97	5,949	$ 250	$ 6	8.1
10	89.5%	$ 886	$ 576	91.7%	$ 1,011	$ 657	2.2%	$ 81	5.42	8,127	$ 341	5.29	7,932	$ 333	$ 8	9.9
15	91.0%	$ 1,190	$ 774	92.4%	$ 1,390	$ 904	1.4%	$ 130	7.99	11,989	$ 504	7.87	11,808	$ 496	$ 8	17.0
20	91.0%	$ 1,438	$ 935	93.0%	$ 1,685	$ 1,095	2.0%	$ 161	10.66	15,986	$ 671	10.43	15,642	$ 657	$ 14	11.1
25	92.4%	$ 1,779	$ 1,156	93.6%	$ 2,205	$ 1,433	1.2%	$ 277	13.12	19,679	$ 827	12.95	19,427	$ 816	$ 11	26.1
30	92.4%	$ 2,101	$ 1,366	93.6%	$ 2,617	$ 1,701	1.2%	$ 335	15.74	23,615	$ 992	15.54	23,313	$ 979	$ 13	26.4
40	93.0%	$ 2,788	$ 1,812	94.1%	$ 3,422	$ 2,224	1.1%	$ 412	20.86	31,284	$ 1,314	20.61	30,918	$ 1,299	$ 15	26.8
50	93.0%	$ 2,886	$ 1,876	94.5%	$ 3,740	$ 2,431	1.5%	$ 555	26.07	39,105	$ 1,642	25.66	38,484	$ 1,616	$ 26	21.3
60	93.6%	$ 4,422	$ 2,874	95.0%	$ 5,383	$ 3,499	1.4%	$ 625	31.08	46,625	$ 1,958	30.63	45,938	$ 1,929	$ 29	21.6
75	94.1%	$ 4,927	$ 3,203	95.4%	$ 6,295	$ 4,092	1.3%	$ 889	38.65	57,972	$ 2,435	38.12	57,182	$ 2,402	$ 33	26.8
100	94.5%	8770	$ 4,401	95.4%	$ 8,619	$ 5,602	0.9%	$ 1,202	51.31	76,968	$ 3,233	50.83	76,242	$ 3,202	$ 30	39.4
125	94.5%	$ 9,134	$ 5,937	95.4%	$ 10,188	$ 6,622	0.9%	$ 685	64.14	96,210	$ 4,041	63.54	95,303	$ 4,003	$ 38	18.0
150	95.0%	$ 10,700	$ 6,955	95.8%	$ 11,936	$ 7,758	0.8%	$ 803	76.56	114,845	$ 4,823	75.92	113,886	$ 4,783	$ 40	19.9
200	95.0%	$ 13,152	$ 8,549	96.2%	$ 14,359	$ 9,333	1.2%	$ 785	102.08	153,126	$ 6,431	100.81	151,216	$ 6,351	$ 80	9.8
250	95.0%	$ 15,759	$ 10,243	96.2%	$ 18,113	$ 11,773	1.2%	$ 1,530	127.61	191,408	$ 8,039	126.01	189,020	$ 7,939	$ 100	15.3
300	95.4%	$ 23,458	$ 15,248	96.2%	$ 24,966	$ 16,228	0.8%	$ 980	152.48	228,726	$ 9,607	151.22	226,824	$ 9,527	$ 80	12.3

*** 250 & 300 HP prices are based on Baldor.

Paybacks with Various Incentives

Motor HP	Payback with 25% of Diff Cost Incentive	Payback with 50% of Diff Cost Incentive	Incentive Req'd for 3 yr PB
1	48.8	32.5	$ 81
1.5	43.6	29.1	$ 87
2	30.8	20.6	$ 80
3	14.0	9.3	$ 37
5	7.2	4.8	$ 26
7.5	6.1	4.1	$ 32
10	7.4	5.0	$ 57
15	12.8	8.5	$ 107
20	8.3	5.6	$ 117
25	19.6	13.1	$ 245
30	19.8	13.2	$ 297
40	20.1	13.4	$ 366
50	16.0	10.6	$ 477
60	16.2	10.8	$ 538
75	20.1	13.4	$ 790
100	29.6	19.7	$ 1,110
125	13.5	9.0	$ 571
150	15.0	10.0	$ 683
200	7.3	4.9	$ 544
250	11.4	7.6	$ 1,229
300	9.2	6.1	$ 741

BE 34 Table 1 TEFC
Premium Efficiency Motors
TEFC 1200 RPM

Hrs/yr Operation	1500
Average % Load, (BHP)	65%
Average Elec Cost $/kWh	$ 0.042
List Price Discount <=200 HP	35% (Baldor)
List Price Discount >200 HP	35% (Baldor)

Notes: (For the Cinergy CI Program)

1. Assume that all new applications will be EPAct efficiency unless Incentivize to encourage NEMA Premium Efficiency.
2. Delta Eff is the difference between NEMA Prem & EPAct.
3. Delta Cost is the difference between NEMA Prem & EPAct.
4. EPAct Eff Rating not avail for 250 & 300 HP Motors- Use Energy Efficient form NEMA Table 12-11

	Motor Cost & Efficiency Data								Energy Consumption & Operating Costs							
	EPAct High Eff			NEMA Premium Eff					EPAct High Eff			NEMA Premium Eff				
Motor HP	Eff %	List Price *** $	Cost $	Eff %	List Price $	Cost $	Delta Eff	Delta Cost	kW	kWh	Opr Cost $/yr	kW	kWh	Opr Cost $/yr	Opr Diff $/yr	Payback yrs
1	80.0%	$ 550	$ 358	82.5%	$ 612	$ 398	2.5%	$ 40	0.61	909	$ 38	0.59	882	$ 37	$ 1	34.8
1.5	85.5%	$ 603	$ 392	87.5%	$ 729	$ 474	2.0%	$ 82	0.85	1,276	$ 54	0.83	1,247	$ 52	$ 1	66.9
2	86.5%	$ 645	$ 419	88.5%	$ 740	$ 481	2.0%	$ 62	1.12	1,682	$ 71	1.10	1,644	$ 69	$ 2	38.7
3	87.5%	$ 846	$ 550	89.5%	$ 923	$ 600	2.0%	$ 50	1.66	2,494	$ 105	1.63	2,438	$ 102	$ 2	21.4
5	87.5%	$ 937	$ 609	89.5%	$ 1,072	$ 697	2.0%	$ 88	2.77	4,156	$ 175	2.71	4,063	$ 171	$ 4	22.5
7.5	89.5%	$ 1,143	$ 743	91.0%	$ 1,528	$ 993	1.5%	$ 250	4.06	6,095	$ 256	4.00	5,995	$ 252	$ 4	59.3
10	89.5%	$ 1,273	$ 827	91.0%	$ 1,745	$ 1,134	1.5%	$ 307	5.42	8,127	$ 341	5.33	7,993	$ 336	$ 6	54.5
15	90.2%	$ 2,031	$ 1,320	91.7%	$ 2,328	$ 1,513	1.5%	$ 193	8.06	12,096	$ 508	7.93	11,898	$ 500	$ 8	23.2
20	90.2%	$ 2,454	$ 1,595	91.7%	$ 3,100	$ 2,015	1.5%	$ 420	10.75	16,127	$ 677	10.58	15,864	$ 666	$ 11	37.9
25	91.7%	$ 2,961	$ 1,925	93.0%	$ 3,508	$ 2,280	1.3%	$ 356	13.22	19,830	$ 833	13.03	19,552	$ 821	$ 12	30.5
30	91.7%	$ 3,592	$ 2,335	93.0%	$ 4,053	$ 2,634	1.3%	$ 300	15.86	23,796	$ 999	15.64	23,463	$ 985	$ 14	21.4
40	93.0%	$ 3,980	$ 2,587	94.1%	$ 5,051	$ 3,283	1.1%	$ 696	20.86	31,284	$ 1,314	20.61	30,918	$ 1,299	$ 15	45.3
50	93.0%	$ 5,051	$ 3,283	94.1%	$ 6,104	$ 3,968	1.1%	$ 684	26.07	39,105	$ 1,642	25.77	38,648	$ 1,623	$ 19	35.6
60	93.6%	$ 6,249	$ 4,062	94.5%	$ 7,261	$ 4,720	0.9%	$ 658	31.08	46,625	$ 1,958	30.79	46,181	$ 1,940	$ 19	35.3
75	93.6%	$ 7,049	$ 4,582	94.5%	$ 8,456	$ 5,496	0.9%	$ 915	38.85	58,281	$ 2,448	38.48	57,726	$ 2,425	$ 23	39.2
100	94.1%	$ 8,811	$ 5,727	95.0%	$ 11,128	$ 7,233	0.9%	$ 1,506	51.53	77,295	$ 3,246	51.04	76,563	$ 3,216	$ 31	49.0
125	94.1%	$ 11,309	$ 7,351	95.0%	$ 12,572	$ 8,172	0.9%	$ 821	64.41	96,619	$ 4,058	63.80	95,704	$ 4,020	$ 38	21.4
150	95.0%	$ 13,359	$ 8,683	95.8%	$ 14,175	$ 9,214	0.8%	$ 530	76.56	114,845	$ 4,823	75.92	113,886	$ 4,783	$ 40	13.2
200	95.0%	$ 15,908	$ 10,340	95.8%	$ 18,567	$ 12,069	0.8%	$ 1,728	102.08	153,126	$ 6,431	101.23	151,848	$ 6,378	$ 54	32.2
250	95.0%	$ 19,924	$ 12,951	95.8%	$ 26,119	$ 16,977	0.8%	$ 4,027	127.61	191,408	$ 8,039	126.54	189,809	$ 7,972	$ 67	60.0
300	95.0%	$ 25,432	$ 16,531	95.8%	$ 33,332	$ 21,666	0.8%	$ 5,135	153.13	229,689	$ 9,647	151.85	227,771	$ 9,566	$ 81	63.7

*** 250 & 300 HP prices are based on Baldor.

Paybacks with Various Incentives

Motor HP	Payback with 25% of Diff Cost Incentive	Payback with 50% of Diff Cost Incentive	Incentive Req'd for 3 yr PB
1	26.1	17.4	$ 37
1.5	50.1	33.4	$ 78
2	29.0	19.3	$ 57
3	16.0	10.7	$ 43
5	16.9	11.2	$ 76
7.5	44.5	29.7	$ 238
10	40.9	27.3	$ 290
15	17.4	11.6	$ 168
20	28.4	18.9	$ 387
25	22.9	15.3	$ 321
30	16.1	10.7	$ 258
40	34.0	22.7	$ 650
50	26.7	17.8	$ 627
60	26.5	17.6	$ 602
75	29.4	19.6	$ 845
100	36.7	24.5	$ 1,414
125	16.0	10.7	$ 706
150	9.9	6.6	$ 410
200	24.1	16.1	$ 1,567
250	45.0	30.0	$ 3,825
300	47.8	31.9	$ 4,893

kW & kWh Reductions for Prem Eff Motors

(Based on Operating Hrs & % load Assumptions in Individual Worksheets)

	1200 TEFC		1800 TEFC		3600 TEFC		1200 ODP		1800 ODP		3600 ODP				
Motor HP	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Average 6 Categories Delta kW	Average 6 Categories Delta kWh/yr	
1	0.02	57.31	0.02	64.34	0.01	39.04	0.02	57.31	0.02	64.34	#VALUE!	#VALUE!	0.02	56	New Program
1.5	0.02	60.67	0.03	78.08	0.02	49.12	0.03	78.08	0.03	78.08	0.02	49.12	0.02	66	New Program
2	0.03	79.05	0.03	104.11	0.02	63.19	0.03	80.89	0.03	104.11	0.02	63.19	0.03	82	New Program
3	0.04	115.91	0.04	115.91	0.02	61.37	0.04	118.58	0.06	175.88	0.03	94.79	0.04	114	New Program
5	0.06	193.19	0.06	193.19	0.03	97.68	0.06	193.19	0.06	193.19	0.03	102.28	0.05	162	New Program
7.5	0.07	208.98	0.10	304.16	0.05	143.25	0.08	241.64	0.11	352.23	0.05	146.53	0.07	233	New Program
10	0.09	278.63	0.13	405.54	0.04	131.18	0.09	274.36	0.13	405.54	0.06	191.00	0.09	281	New Program
15	0.13	411.54	0.12	377.84	0.07	221.18	0.13	411.54	0.17	536.29	0.06	196.77	0.12	359	New Program
20	0.18	548.72	0.23	715.06	0.09	294.90	0.16	503.79	0.23	715.06	0.09	294.90	0.16	512	
25	0.18	576.55	0.17	524.78	0.10	317.27	0.18	576.55	0.27	837.25	0.10	317.27	0.17	525	
30	0.22	691.86	0.20	629.74	0.12	380.73	0.20	629.74	0.28	887.39	0.12	380.73	0.19	600	
40	0.24	760.65	0.24	760.65	0.16	499.95	0.24	760.65	0.24	760.65	0.16	507.03	0.22	675	
50	0.30	950.82	0.41	1291.08	0.17	528.17	0.30	950.82	0.41	1291.08	0.17	528.17	0.30	923	
60	0.30	923.62	0.46	1429.18	0.20	625.68	0.30	923.62	0.46	1429.18	0.20	625.68	0.32	993	
75	0.37	1154.52	0.53	1643.14	0.25	782.10	0.37	1154.52	0.37	1142.35	0.25	782.10	0.36	1,110	
100	0.49	1523.13	0.48	1510.32	0.28	858.84	0.49	1523.13	0.70	2190.85	0.33	1042.80	0.46	1,442	
125	0.61	1903.91	0.61	1887.90	0.34	1053.25	0.61	1903.91	0.61	1887.90	0.34	1073.55	0.52	1,618	
150	0.64	1994.80	0.64	1994.80	0.41	1263.90	0.73	2265.48	0.64	1994.80	0.41	1288.26	0.58	1,800	
200	0.85	2659.73	1.27	3973.01	0.43	1335.44	0.97	3020.64	0.85	2659.73	0.54	1685.20	0.82	2,556	
250	1.07	3324.66	1.59	4966.26	0.53	1655.36	0.00	0.00	0.53	1655.36	0.68	2106.50	0.73	2,285	
300	1.28	3989.60	1.27	3956.35	0.64	1986.43	0.00	0.00	0.64	1986.43	0.64	2003.16	0.74		Do Not Use

	1200 TEFC		1800 TEFC		3600 TEFC		1200 ODP		1800 ODP		3600 ODP			
Motor HP	Delta Cost		Delta Cost		Delta Cost		Delta Cost		Delta Cost		Delta Cost		Average 6 Categories Delta Costs	
1	$ 40.30	$ -	$ 84.50	$ -	$ 58.50	$ -	$ 37.70	$ -	$ 66.30	$ -		$ -	$ 57.46	New Program
1.5	$ 81.90	$ -	$ 91.65	$ -	$ 33.15	$ -	$ 43.55	$ -	$ 66.95	$ -	$ 32.50	$ -	$ 58.28	New Program
2	$ 61.75	$ -	$ 86.45	$ -	$ 9.10	$ -	$ 55.90	$ -	$ 70.20	$ -	$ 51.35	$ -	$ 55.79	New Program
3	$ 50.05	$ -	$ 43.55	$ -	$ 33.80	$ -	$ 99.45	$ -	$ 73.45	$ -	$ 41.60	$ -	$ 56.98	New Program
5	$ 87.75	$ -	$ 37.70	$ -	$ 39.00	$ -	$ 169.65	$ -	$ 78.65	$ -	$ 59.80	$ -	$ 78.76	New Program
7.5	$ 250.25	$ -	$ 50.05	$ -	$ 54.60	$ -	$ 141.05	$ -	$ 127.40	$ -	$ 148.20	$ -	$ 128.59	New Program
10	$ 306.80	$ -	$ 81.25	$ -	$ 48.75	$ -	$ 187.85	$ -	$ 150.15	$ -	$ 130.00	$ -	$ 150.80	New Program
15	$ 193.05	$ -	$ 130.00	$ -	$ 114.40	$ -	$ 281.45	$ -	$ 233.35	$ -	$ 167.70	$ -	$ 186.66	New Program

Assume Hours at 3120 = 12 hours per day for 5 days a week - RM

Technology

Commercial Clothes Washers

Energy Savings – kWh & Summer Peak Savings

Savings in water use, washer electricity and dryer energy use are all associated with this technology. We have not estimated water savings and have savings separated for the washer only and washer with electric dryer.

Based on Energy Star defaults (attached), average electric savings would be 464 kWh ($39/year). WI Focus on Energy ACES default savings for washer/dryer combination is 384 kWh, 0.0 kW, and 22 therms (from reduced drying requirements). If an electric dryer is used, the total savings for washer/dryer would be 1,029 kWh/year. Assuming 55% average reduction in electric use on available Energy Star machines (list attached) approximately 340 kWh/year of energy savings would result.

Aggregating Sources

Washer Only	400 kWh/year
Washer w/Electric Dryer	950 kWh/year

Measure Life

10-12 years

Initial One-Time Cost

Manufacturers, our program development experience, and Energy Star indicate an increased cost of $300 per washer. Website and supplier pricing indicate median cost for non-Energy Star top loaders is somewhere in the $349 to $399 range, with a median cost for top loading Energy Star machines in the $719 to $799 range, and front loading Energy Star machines in the $899 to $999 range. This data would indicate a greater incremental cost but much of it is for residential machines.

Incremental cost estimate: $325/unit

Any Recurring Costs

None

Suggested Incentive

WI Focus on Energy - ACES New Construction provides $20 per unit which on the low end of the spectrum. Alliant Energy - Iowa $100 top loading Energy Star, $150 front loading Energy Star incentives tend toward the higher end. Energy Star website offers a 'find a rebate program'.

Suggested Incentive: $50/unit

Requirements

For Application – energy factor (EF) and modified energy factor (MEF) requirements are listed below. Please note that some top load machines also now qualify in addition to the front load machines.

Size – The ENERGY STAR website, the FEMP website, and the CEE website offer guidelines for purchasing a properly sized washing machine. Energy Star ratings are available for machines between 1.6 and 3.8 cubic feet. We would recommend this size range requirement on an incentive.

Existing Energy Standards

There is currently an ENERGY STAR standard for this product and a timeline for increases in the standard. Details on the calculation of Energy Factor (EF) and Modified Energy Factor (MEF) are supplied in the attachments.

Criteria/Product Class	Current	January 1, 2004	January 1, 2007
Energy Star-top and front loading	MEF[1] ≥1.26	MEF ≥1.42	
Federal-top loading	EF[2] ≥1.18	MEF ≥1.04	MEF ≥1.26
Federal-front loading	NA		

[1] MEF = modified energy factor

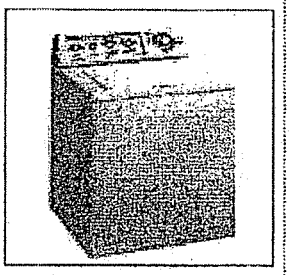
[2] EF = energy factor, use of this term discontinued after January 1, 2004

Source of Info

Energy Star website; Private consultation with manufacturers, CEE; FEMP; manufacturer's web sites

Clothes Washers

Compared to a 10-year old model, an ENERGY STAR qualified washer can save up to $120 per year on your utility bills.



FIND A STORE
SPECIAL OFFERS

Earning the ENERGY STAR means a product meets strict energy efficiency guidelines set by the US Environmental Protection Agency and the Department of Energy.

+ Through superior design and system features, ENERGY STAR qualified clothes washers clean clothes using 50% less energy than standard washers.
+ Full-sized ENERGY STAR qualified washers use 18-25 gallons of water per load, compared to the 40 gallons used by a standard machine.
+ ENERGY STAR qualified washers extract more water from clothes during the spin cycle. This reduces the drying time and saves energy and wear and tear on your clothes.
+ Two clothes washer designs carry the ENERGY STAR: top loading and front loading.

Remember, saving energy prevents pollution. By choosing ENERGY STAR, you are helping prevent global warming and promote cleaner air without sacrificing the product quality and performance you expect.

You may also be interested to know that you can save extra energy while washing clothes, whether with a standard or an ENERGY STAR model:

+ Wash full loads: Clothes washers are most efficient when operated with full loads.
+ Wash clothes in cold water
+ Air dry clothes whenever possible

For Consumers
+ Residential Clothes Washers Product Search
+ Residential Clothes Washers Product List
+ Residential Clothes Washers Product List (Excel)
+ Commercial Clothes Washers Product List
+ Purchasing Tips
+ Manufacturer List
+ Savings Calculator (Excel)

For Business
+ Key Product Criteria
+ Purchasing & Procurement
+ Information Resources

For Partners
+ Partner Commitments
+ QPI Form
+ Products in Development
+ Partner Resources

Top Loading & Front Loading Clothes Washers

Top-loading models look like conventional machines from the outside, but these ENERGY STAR qualified washers use different types of washing action to get clothes clean with less water and energy. Many have sensors to monitor incoming water temperature closely. They also rinse clothes with repeated high-pressure spraying instead of soaking them in a full tub of water.

Front-loading models are similar to machines used in laundromats. They use a horizontal or tumble-axis basket to lift and drop clothing into the water instead of rubbing clothes around a central agitator. Both top-loading and front-loading ENERGY STAR qualified clothes washers save water and energy. They also use faster spin speeds to extract more water from clothes, reducing dryer time and energy use.

For both models, check to see if you need to use special detergent. Low-water washers use special low-suds detergent for best results. Ask your sales representative for recommendations on detergent use.

Clothes Washers Key Product Criteria

Equipment	Specification
Clothes Washers	Minimum Modified Energy Factor (MEF) of 1.26.

The Clothes Washers ENERGY STAR specifications changed on January 1, 2001. The new ENERGY STAR specifications require that qualified products have a Modified Energy Factor (MEF) of 1.26 or greater. MEF is a new equation for Energy Factor that takes into account the amount of dryer energy used to remove the remaining moisture content in washed items.

Criteria/Product Class	Current	January 1, 2004	January 1, 2007
ENERGY STAR-top and front loading	MEF[1] ≥1.26	MEF ≥1.42	
Federal-top loading	EF[2] ≥ 1.18	MEF ≥1.04	MEF ≥1.26
Federal-front loading	NA		

[1]MEF = modified energy factor

[2]EF = energy factor, use of this term discontinued after January 1,2004

ENERGY STAR Clothes Washer Eligibility

Only front and top loader clothes washers with capacities of greater than 1.6 ft^3 are eligible to earn the ENERGY STAR.

Energy Performance Metrics

Energy factor (EF) is the present energy performance metric for clothes washers. It is the quotient of the capacity of the clothes container, C, divided by the sum of the machine electrical energy for the mechanical action of a cycle, M, and the water heating energy required for a cycle, E. The equation is shown here:

$$EF = \frac{C}{M + E}$$

The water heating energy may be from a gas or electric water heater. The units are cubic feet per kWh per cycle, ft^3/kWh/cycle. The higher the value, the more efficient the clothes washer is.

Modified Energy Factor, MEF, is the energy performance metric for ENERGY STAR qualified clothes washers and the future metric for all clothes washers beginning January 1, 2004.

This metric has the same units as the energy factor (EF): ft^3/kWh/cycle. MEF is the quotient of the capacity of the clothes container, C, divided by the total clothes washer energy consumption per cycle, with such energy consumption expressed as the sum of the machine electrical energy consumption, M, the hot water energy consumption, E, and the energy required for removal of the remaining moisture in the wash load, D. The higher the value, the more efficient the clothes washer is. The equation is shown below:

$$MEF = \frac{C}{M + E + D}$$

Water Factor, WF, is the present water performance metric that allows the comparison of clothes washer water consumption independent of clothes washer capacity. Manufacturers must submit their water consumption factors with their ENERGY STAR qualified clothes washers. However, neither the federal standard nor the ENERGY STAR criteria require a maximum WF. WF is the quotient of the total weighted per-cycle water consumption, Q, divided by the capacity of the clothes washer, C. The lower the value, the more water efficient the clothes washer is. The equation is shown below:

$$WF = \frac{Q}{C}$$

The federal EnergyGuide label on clothes washers shows annual energy consumption and cost. These figures use the energy factor, average cycles per year, and the average cost of energy to make the energy and cost estimates. The EF, MEF, or WF may not appear on the EnergyGuide label.

Purchasing Tips

- **Choose a size that meets your household needs.** ENERGY STAR labeled clothes washers are available in many sizes, ranging in capacity from 1.6 to 3.8 cubic feet. ENERGY STAR qualified models are also available in stackable and under-the-counter designs, which fit in smaller spaces.
- **Look for several water level options.** Choose a washing machine that has several options for adjusting the water level to fit the load.
- **Choose a model with a "mini-basket."** A mini-basket is a small tub that fits over the agitator, allowing you to wash very small loads.
- **Look for pre-soaking and suds-saver options.** Both pre-soaking options and suds-saver features conserve energy.
- **Choose a washing machine with faster spin speeds.** Higher spin speeds can result in better water extraction, reducing drying times.
- **Check the yellow EnergyGuide label.** This label helps you determine how much energy it takes to operate the model, compare the energy use of similar models, and estimate annual operating costs. View a sample label.
- **Ask for ENERGY STAR.** When buying a clothes washer from a contractor rather than a retail outlet, request an ENERGY STAR qualified model to ensure that it is energy efficient.

Last Uploaded December 1, 2003

Brand	Manufacturer	Model	Volume	kWh/year	Modified Energy Factor	Energy Factor	Active	Federal Standard	Percent Better	Water Factor	Active Date	Annual Water Use
Amana	Amana	ALW895SA*	3.28	544	1.29	2.36	TRUE	1.18	100%		9/27/2001	
Amana	Maytag	NAV8800AW	3.16	460	1.29	2.69	TRUE	1.18	128%	0	7/17/2003	0
Asko	ASKO	W600	1.9	182	1.62	4.09	TRUE	1.18	247%	9	9/7/1999	6703
Asko	ASKO	W6021	1.96	209	1.658	3.88	TRUE	1.18	212%	7.482	1/29/2002	5749
Asko	ASKO	W620	1.9	177	1.63	4.21	TRUE	1.18	257%	9	9/7/1999	6703
Asko	ASKO	W6221	1.96	209	1.58	3.68	TRUE	1.18	212%	7.483	1/29/2002	5749
Asko	ASKO	W640	1.9	181	1.59	4.11	TRUE	1.18	249%	9.1	9/7/1999	6778
Asko	ASKO	W6441	1.96	189	1.736	4.07	TRUE	1.18	245%	7.482	1/29/2003	5749
Asko	ASKO	W650	1.9	178	1.62	4.23	TRUE	1.18	259%	9	9/7/1999	6703
Asko	ASKO	W6641	1.96	189	1.736	4.07	TRUE	1.18	245%	7.482	1/29/2002	5749
Asko	ASKO	W6661	1.96	189	1.837	4.07	FALSE	1.18	245%	7.482	1/29/2002	5749
Asko	ASKO	W6761	1.96	189	1.837	4.07	TRUE	1.18	245%	7.482	1/29/2003	5749
Asko	ASKO	WCAM1812	2.48	217	2.5	4.44	TRUE	1.18	277%	7.48	7/22/2003	7213
Avanti	Samsung	W1082F	1.77	227	1.48	3.06	TRUE	1.18	159%	10.63	3/15/2000	7378
Avanti	Samsung	W6082F	1.77	227	1.48	3.06	FALSE	1.18	159%	10.63	3/15/2000	7378
Avanti	Samsung	W8082F	1.77	227	1.48	3.06	FALSE	1.18	159%	10.63	3/15/2000	7378
Bosch	BSH Home Appliances	WFK2401(A)UC	1.62	188	1.399	3.38	TRUE	1.18	186%	8.1	8/14/1998	5144
Bosch	BSH Home Appliances	WFL2060UC	1.85	194	1.8	3.74	TRUE	1.18	217%	8.47	3/27/2002	4892
Bosch	BSH Home Appliances	WFMC3200UC	3.03	186	2.1	6.39	TRUE	1.18	441%	5.3	11/3/2003	6295
Bosch	BSH Home Appliances	WFMC8400UC	3.03	178	2.2	6.67	TRUE	1.18	465%	4.5	11/3/2003	5345
Bosch	BSH Home Appliances	WFR2460UC	1.85	184	2.08	3.94	TRUE	1.18	234%	5.73	3/27/2002	4155
Danby Designer	Gorenje	DWM5500W	1.7	267	1.27	2.50	TRUE	1.18	112%	7.58	7/29/2002	5051
Danby Designer	Gorenje	DWM5500W-1	1.7	154	1.8	4.33	TRUE	1.18	267%	6.53	11/5/2003	4418
Equator	Equator	EZ 1612 V	1.52	135	2.04	5.58	TRUE	1.18	372%	4.85	12/16/2002	3650
Equator	Equator	EZ 2512 CEE	1.6	125	1.83	5.02	TRUE	1.18	325%	6	12/16/2002	3763
Equator	Equator	EZ 3612 CEE	1.62	143	1.92	5.26	TRUE	1.18	346%	5	12/16/2002	3763
Equator	Philco	EZ 3600 CEE	1.9	200	1.73	3.72	TRUE	1.18	216%	10.04	2/4/1999	7478
Eurotech	Eurotech	EWC177	2.48	217	2.5	4.44	TRUE	1.18	277%	7.48	7/22/2003	7213
Eurotech	Eurotech	EWF150	1.6	241	1.45	2.60	TRUE	1.18	121%	11.84	8/16/2002	7301
Eurotech	Eurotech	EWF172	2.5	306	1.515	3.20	TRUE	1.18	171%	8.04	8/16/2002	7879
Fisher & Paykel	Fisher & Paykel Appliances Inc.	GWL10	3	298	2.2	3.95	TRUE	1.18	234%	6.9	12/10/1999	10466
Fisher & Paykel	Fisher & Paykel Appliances Inc.	GWL11	3	217	1.91	5.43	TRUE	1.18	360%	8.45	10/24/2002	9937
Frigidaire	Electrolux	39012	2.65	259	1.57	4.01	FALSE	1.18	240%	9.1	7/13/1998	9453
Frigidaire	Electrolux	39022	2.65	259	1.57	4.01	FALSE	1.18	240%	9.1	7/13/1998	9453
Frigidaire	Electrolux	CRTF1240A	2.65	351	1.44	2.58	TRUE	1.18	151%	9.44	8/30/2001	9806
Frigidaire	Electrolux	CRTR8300A*	2.65	352	1.44	2.55	TRUE	1.18	150%	9.44	7/1/2002	9808
[illegible]idaire	Electrolux	FTF1040A	2.65	259	1.68	4.01	FALSE	1.18	240%	9.43	7/26/2001	9796
[illegible]aire	Electrolux	FTF830A	2.65	259	1.68	4.01	TRUE	1.18	240%	9.43	7/26/2001	9796
[illegible]ire	Electrolux	FTR830A	2.65	259	1.68	4.01	TRUE	1.18	240%	9.43	7/26/2001	9796
[illegible]re	Electrolux	FWT645RH	2.65	259	1.68	4.01	TRUE	1.18	240%	9.43	3/15/2000	9796
[illegible]aire	Electrolux	GLTF1040A	2.65	259	1.68	4.01	TRUE	1.18	240%	9.43	12/3/2001	9796
Frigidaire	Electrolux	GLTF1240A	2.65	351	1.44	2.96	TRUE	1.18	151%	9.44	7/26/2001	9806
Frigidaire	Electrolux	GLTF1670A	2.65	351	1.44	2.96	TRUE	1.18	151%	9.44	7/26/2001	9806
Frigidaire	Electrolux	GLTR1670A	2.65	351	1.44	2.96	TRUE	1.18	151%	9.44	7/26/2001	9806
Frigidaire	Electrolux	GLWS1939A*	2.99	651	1.38	1.80	TRUE	1.18	53%		5/6/2003	
Frigidaire	Electrolux	GLWS1939C	2.99	652	1.38	1.80	TRUE	1.18	52%	11.7	10/6/2003	13713
Frigidaire	Electrolux	GSTF1670A	2.65	351	1.44	2.96	TRUE	1.18	151%	9.44	9/27/2001	9806
Frigidaire	Electrolux	GSTR1670A	2.65	351	1.44	2.96	TRUE	1.18	151%	9.44	9/27/2001	9806
Galaxy	Whirlpool	1410*30	2.48	298	1.26	3.24	TRUE	1.18	174%			
General Electric	Electrolux	WPXH214A**	2.65	351	1.47	2.96	TRUE	1.18	151%	9.47	12/18/2000	9837
General Electric	Electrolux	WSXH208A**	2.65	259	1.59	4.01	TRUE	1.18	240%	9.45	9/26/2000	9817
General Electric	GE Appliances	WHSB8000D**	3.15	679	1.27	1.82	TRUE	1.18	54%		10/15/2001	
General Electric	GE Appliances	WHSB9000B**	3.15	696	1.3	1.80	TRUE	1.18	53%	12.1	10/3/2001	14941
General Electric	GE Appliances	WHSE5240D	3.15	302	1.52	4.09	TRUE	1.18	247%	12.09	8/29/2003	14929
General Electric	GE Appliances	WNRD2050D	3.45	320	1.49	4.22	TRUE	1.18	258%	11.85	7/8/2003	16026
General Electric	GE Appliances	WPRB8050D	3.45	346	1.46	3.91	TRUE	1.18	231%	11.52	6/18/2003	15580
General Electric	GE Appliances	WPRB9110D	3.45	257	1.54	5.26	TRUE	1.18	346%	11.58	6/18/2003	15061
General Electric	GE Appliances	WPRB9220C**	3.47	557	1.33	2.44	TRUE	1.18	107%	11.94	1/29/2003	16241
General Electric	GE Appliances	WPRB9220D**	3.45	368	1.5	3.68	TRUE	1.18	211%	10.84	10/30/2003	14660
General Electric	GE Appliances	WPRB9250C**	3.47	557	1.33	2.44	TRUE	1.18	107%	11.94	1/29/2003	16241
General Electric	GE Appliances	WPRB9250D**	3.45	368	1.5	3.68	TRUE	1.18	211%	10.84	10/30/2003	14660
General Electric	LG Electronics	WPGT9350C***	3.531	422	1.449	3.28	TRUE	1.18	178%	6.298	3/28/2003	8717
Gibson	Electrolux	GTF1040A	2.65	351	1.44	2.96	FALSE	1.18	151%	9.44	7/26/2001	9806
Gibson	Electrolux	GTF1040C	2.65	351	1.505	2.96	TRUE	1.18	151%	9.44	8/29/2003	9806
Gibson	Electrolux	GTR1040A	2.65	351	1.44	2.96	FALSE	1.18	151%	9.44	7/26/2001	9806
Gibson	Electrolux	GTR1040C	2.65	351	1.505	2.96	TRUE	1.18	151%	9.44	8/29/2003	9806
Imperial	Electrolux	LFW201E	2.65	259	1.68	4.01	TRUE	1.18	240%	9.43	1/29/2001	9796
Kenmore	Electrolux	4204	2.65	196	1.86	5.30	FALSE	1.18	349%	7.15	9/27/2001	7427
Kenmore	Electrolux	4205	2.65	196	1.86	5.30	FALSE	1.18	349%	7.15	9/27/2001	7427
Kenmore	Electrolux	4214*	2.65	196	1.86	5.30	FALSE	1.18	349%	7.15	9/27/2001	7427
Kenmore	Electrolux	4304	2.65	196	1.9	5.30	TRUE	1.18	349%	5.86	10/23/2002	6087
Kenmore	Electrolux	4305	2.65	196	1.9	5.30	TRUE	1.18	349%	5.86	10/23/2002	6087
Kenmore	Electrolux	4314	2.65	196	1.9	5.30	TRUE	1.18	349%	5.86	10/23/2002	6087
Kenmore	Electrolux	4407	2.65	213	2.07	4.88	TRUE	1.18	313%	5.87	8/11/2003	6098
Kenmore	Electrolux	4410	2.65	259	1.68	4.01	TRUE	1.18	240%	9.43	8/11/2003	9796
Kenmore	Whirlpool	2105*	3.01	337	1.5	3.50	TRUE	1.18	197%	8.11	7/12/2000	9569
Kenmore	Whirlpool	2108*	3.01	337	1.5	3.50	TRUE	1.18	197%	8.11	7/12/2000	9569
Kenmore	Whirlpool	2205*	3.01	337	1.5	3.50	TRUE	1.18	197%	8.11	5/3/2001	9569
Kenmore	Whirlpool	2208*	3.01	337	1.5	3.50	TRUE	1.18	197%	8.11	5/3/2001	9569
[illegible]ore	Whirlpool	2408*20	3.01	337	1.5	3.50	TRUE	1.18	197%	8.11	2/27/2003	9569
[illegible]ore	Whirlpool	4282*20	3.18	268	1.81	4.65	TRUE	1.18	294%	4.36	9/28/2001	5435
[illegible]ore	Whirlpool	4283*	3.18	282	1.6	4.42	TRUE	1.18	275%	4.36	9/28/2001	5435
[illegible]ore	Whirlpool	4292*20+	3.18	278	1.96	4.48	TRUE	1.18	280%	4.43	6/14/2001	5522
[illegible]more	Whirlpool	4293*	3.18	286	1.7	4.36	TRUE	1.18	269%	4.43	6/14/2001	5522

Brand	Manufacturer	Model	Volume	kWh/year	Modified Energy Factor	Energy Factor	Active	Federal Standard	Percent Better	Water Factor	Active Date	Annual Water Use
Kenmore	Whirlpool	4390*20+	3.18	298	1.7	4.36	TRUE	1.18	269%	4.43	1/23/2003	5522
Kenmore	Whirlpool	4482*30+	3.18	268	1.81	4.65	TRUE	1.18	294%	4.27	8/29/2003	5323
Kenmore	Whirlpool	4483*20+	3.18	268	1.81	4.65	TRUE	1.18	294%	4.36	1/23/2003	5435
Kenmore	Whirlpool	4483*30+	3.18	268	1.81	4.65	TRUE	1.18	294%	4.27	8/29/2003	5323
Kenmore	Whirlpool	4492*30+	3.18	278	1.96	4.48	TRUE	1.18	280%	4.1	8/29/2003	5111
Kenmore	Whirlpool	4493*20+	3.18	278	1.96	4.48	TRUE	1.18	280%	4.43	1/23/2003	5522
Kenmore	Whirlpool	4493*30+	3.18	278	1.96	4.48	TRUE	1.18	280%	4.1	8/29/2003	5111
Kirkland	Whirlpool	SAWS900J	3.16	596	1.297	2.68	TRUE	1.18	76%	10.847	8/26/2002	13436
Kirkland	Whirlpool	SAWS900M*	3.16	596	1.3	2.68	TRUE	1.18	76%	10.85	7/22/2003	13440
LG Electronics	LG Electronics	WD-324*RHD	1.96	115	2.1	6.68	TRUE	1.18	466%	5.04	7/26/2001	3872
LG Electronics	LG Electronics	WD-327*RHD	2.05	155	2.02	5.18	TRUE	1.18	339%	5.21	9/19/2002	4187
LG Electronics	LG Electronics	WM0532H*	3.22	221	1.832	5.71	TRUE	1.18	384%	3.999	4/2/2003	5048
LG Electronics	LG Electronics	WM1811C*	3.22	215	1.758	5.86	TRUE	1.18	397%	4.262	12/17/2002	5380
LG Electronics	LG Electronics	WM1832C*	3.22	215	1.758	5.86	TRUE	1.18	397%	4.262	12/17/2002	5380
LG Electronics	LG Electronics	WM2011H*	3.22	221	1.832	5.72	TRUE	1.18	384%	3.999	12/17/2002	5048
LG Electronics	LG Electronics	WM2032H*	3.22	221	1.832	5.72	TRUE	1.18	384%	3.999	12/17/2002	5048
LG Electronics	LG Electronics	WM2411H*	3.22	225	1.87	5.61	TRUE	1.18	375%	3.992	12/17/2002	5039
LG Electronics	LG Electronics	WM2432H*	3.22	225	1.87	5.61	TRUE	1.18	375%	3.992	12/17/2002	5039
LG Electronics	LG Electronics	WM3611H*	3.22	225	1.87	5.61	TRUE	1.18	375%	3.992	5/20/2003	5039
LG Electronics	LG Electronics	WM3632H*	3.22	225	1.87	5.61	TRUE	1.18	375%	3.992	5/20/2003	5039
Maber	Maber	P21	1.65	178	1.51	3.68	TRUE	1.18	211%	10.6	10/29/2002	6858
Maber	Maber	P25	2.47	164	1.84	5.90	TRUE	1.18	400%	9.9	10/29/2002	9506
Maber	Maber	WD 1000	1.65	178	1.48	3.83	TRUE	1.18	208%	10.4	10/29/2002	6727
Maytag	Maytag	MAH4000	2.9	282	1.72	4.03	TRUE	1.18	242%	8	2/26/1999	9094
Maytag	Maytag	MAH5500	2.9	282	1.64	4.03	TRUE	1.18	242%	8	9/27/1999	9094
Maytag	Maytag	MAH5500B	2.9	288	1.47	3.85	TRUE	1.18	235%	8.47	10/27/2000	9629
Maytag	Maytag	MAH55FLB	2.9	288	1.47	3.95	TRUE	1.18	235%	8.47	3/24/2003	9629
Maytag	Maytag	MAH6500	2.9	329	1.55	3.46	TRUE	1.18	193%	8.23	6/19/2002	9358
Maytag	Maytag	MAH7500*	2.9	362	1.66	3.14	TRUE	1.18	166%	8.1	10/6/2000	9208
Maytag	Maytag	MAV7501	3.11	524	1.29	2.33	TRUE	1.18	97%	8.95	1/27/2003	10911
Maytag	Maytag	MAV7557	3.11	524	1.29	2.33	TRUE	1.18	97%	8.85	4/15/2003	10911
Maytag	Maytag	MAV7580	3.1	524	1.29	2.32	TRUE	1.18	97%	9.84	11/5/2001	10956
Maytag	Maytag	MAV8501	3.13	524	1.29	2.34	TRUE	1.18	98%	9.33	12/6/2002	11448
Maytag	Maytag	MAV8557	3.13	524	1.29	2.34	TRUE	1.18	98%	9.33	4/15/2003	11448
Maytag	Maytag	MAV9600	3.2	418	1.3	3.00	TRUE	1.18	154%	10.38	10/12/2000	13021
Maytag	Maytag	MAVT734	3.11	524	1.29	2.33	TRUE	1.18	97%	8.95	1/27/2003	10911
Maytag	Maytag	MLE2000 (stack unit	2.9	314	1.69	3.62	TRUE	1.18	207%	8	2/26/1999	9094
Maytag	Maytag	MLG2000 (stack unit	2.9	314	1.69	3.62	TRUE	1.18	207%	8	2/26/1999	9094
[illegible]g	Maytag	SAV4710AW	3.2	460	1.29	2.73	TRUE	1.18	131%		7/28/2003	
[illegible]g	Maytag	SAV5150AW	3.16	460	1.29	2.69	TRUE	1.18	128%	0	7/17/2003	0
[illegible]	Maytag	SAV5701AW	3.16	460	1.36	2.69	TRUE	1.18	128%		10/24/2002	
[illegible]	Maytag	SAV5910AW	3.16	460	1.29	2.69	TRUE	1.18	128%	0	7/17/2003	0
[illegible]e	Miele, Inc	W1903	1.69	249	1.41	2.66	TRUE	1.18	125%	9.12	6/1/1997	8042
Miele	Miele, Inc.	W1918	1.69	257	1.64	2.48	TRUE	1.18	110%	8.34	6/1/1997	5525
Miele	Miele, Inc.	W1926	2.01	279	1.64	2.82	TRUE	1.18	139%	7.57	10/22/1998	5985
Miele	Miele, Inc.	W1930	1.69	257	1.64	2.48	TRUE	1.18	110%	8.34	6/1/1997	5525
Miele	Miele, Inc.	W1966	2.01	258	1.638	3.05	TRUE	1.18	159%	5.07	1/11/2002	3995
Miele	Miele, Inc.	W1986	2.01	258	1.63	3.05	TRUE	1.18	159%	5.07	1/11/2002	3995
Questino	Appliances International	WD9900	2	277	1.59	2.83	TRUE	1.18	140%	7.44	1/24/2000	5833
Samsung	Samsung	P1092	1.77	227	1.66	3.06	TRUE	1.18	159%	8.83	5/3/2002	6127
Simplicity	Gorenje	SWM5500W	1.7	267	1.27	2.50	TRUE	1.18	112%	7.58	7/29/2002	5051
Simplicity	Gorenje	SWM5500W-1	1.7	154	1.8	4.33	TRUE	1.18	267%	6.63	11/5/2003	4418
Splendide	Merloni	WD2000S	1.8	187	1.55	3.35	TRUE	1.18	184%	5.94	5/8/2003	3728
Splendide	Merloni	WD2100	1.92	196	1.74	3.84	TRUE	1.18	225%	5.2	5/8/2003	3914
Splendide	Merloni	WDC5200	1.92	187	1.55	4.02	TRUE	1.18	241%	5.94	5/8/2003	4471
Splendide	Merloni	WDC6200CEE	1.92	215	1.62	3.50	TRUE	1.18	197%	5.24	5/8/2003	3944
Splendide	Philco	WDC1025MCEE	1.9	200	1.73	3.72	TRUE	1.18	216%	10.04	1/8/1999	7478
Staber	Staber	HXW2304	2	265	1.48	2.96	TRUE	1.18	151%	7.113	2/22/2000	5577
Summit	Gorenje	SPW-1100	1.7	267	1.27	2.50	TRUE	1.18	112%	7.58	6/10/2002	5051
Summit	Gorenje	SPW1102	1.7	154	1.8	4.33	TRUE	1.18	267%	6.63	11/5/2003	4418
Thor	Thor	WD9900	2	277	1.59	2.83	TRUE	1.18	140%	7.44	1/29/2001	5833
Thor	Thor	XQG6S-11	2.01	203	1.85	3.89	TRUE	1.18	230%	5.7	5/22/2002	4491
Whirlpool	Whirlpool	GHW9100L*	3.18	282	1.69	4.42	TRUE	1.18	275%	4.28	8/31/2001	5335
Whirlpool	Whirlpool	GHW9200L*	3.18	294	1.68	4.24	TRUE	1.18	256%	4.36	8/31/2001	5435
Whirlpool	Whirlpool	GHW9250M*	3.18	282	1.68	4.42	TRUE	1.18	275%	4.36	7/21/2003	5435
Whirlpool	Whirlpool	GSW9545JQ	3.02	468	1.28	2.54	TRUE	1.18	115%	8.38	5/3/2000	9921
Whirlpool	Whirlpool	GSW9550L*	3.16	619	1.3	2.00	TRUE	1.18	70%	8.21	7/17/2002	10170
Whirlpool	Whirlpool	GSW9650L*	3.16	596	1.3	2.08	TRUE	1.18	76%	10.85	7/18/2002	13440
Whirlpool	Whirlpool	GVW9950K	2.99	337	1.53	3.48	TRUE	1.18	195%	8.02	4/11/2001	9400
White-Westinghouse	Electrolux	WTR1240A	2.65	351	1.44	2.96	TRUE	1.18	151%	9.44	8/30/2001	9806

ENERGY STAR Qualified Commercial Clothes Washers

Models that appear (in parenthesis and in red) have been discontinued, but may be still available in stores. Discontinued models may appear on this list up to a year after their last production date.

Definitions of terms used in column headers

Last Modified : 12/09/2003

Brand	Model	Volume	kWh/year	Modified Energy Factor
Continental	H5020CCA1351G (Commercial)	2.83	290	1.49
Continental	H5020CCA1351P (Commercial)	2.83	288	1.52
Continental	H5020CCA1371G (Commercial)	2.83	290	1.49
Continental	H5020CCA1371P (Commercial)	2.83	288	1.52
Continental	H5020LCA1061G (Commercial)	2.83	449	1.29
Continental	H5020LCA1061P (Commercial)	2.83	438	1.29
Continental	H5020LCA1081G (Commercial)	2.83	449	1.29
Continental	H5020LCA1081P (Commercial)	2.83	438	1.29
General Electric	WCCH404VOWW (Commercial)	2.65	157	1.57
(Huebsch)	(FTZ80 (Commercial))	(2.84)	(293)	(1.85)
Huebsch	FTZ90A*N	2.84	224	1.89
Huebsch	FTZ91A*N	2.84	224	1.89
Huebsch	HTET17*N	2.84	181	2.03
(Huebsch)	(HTEX17 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HTEX17*N	2.84	181	2.03
(Huebsch)	(HTEY17 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HTEY17*N	2.84	181	2.03
(Huebsch)	(HTEZ17 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HTGT19*N	2.84	181	2.03
(Huebsch)	(HTGX19 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HTGX19*N	2.84	181	2.03
(Huebsch)	(HTGY19 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HTGY19*N	2.84	181	2.03
(Huebsch)	(HTGZ19 (Commercial))	(2.84)	(186)	(1.9)
(Huebsch)	(HWF261 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HWFT61*N	2.84	181	2.03
Huebsch	HWFT63*N	2.84	181	2.03
(Huebsch)	(HWFX61 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HWFX61*N	2.84	181	2.03
(Huebsch)	(HWFY61 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HWFY61*N	2.84	181	2.03

(Huebsch)	(HWFZ61 (Commercial))	(2.84)	(186)	(1.9)
(Huebsch)	(HWR261 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HWR961*N	2.84	181	2.03
Huebsch	HWR963*N	2.84	181	2.03
Huebsch	HWRT61*N	2.84	181	2.03
(Huebsch)	(HWRX61 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HWRX61*N	2.84	181	2.03
(Huebsch)	(HWRY61 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HWRY61*N	2.84	181	2.03
(Huebsch)	(HWRZ61 (Commercial))	(2.84)	(186)	(1.9)
Huebsch	HWTT20**	2.69	279	1.5
Huebsch	HWTT21**	2.69	279	1.5
Huebsch	HWTX20**	2.69	279	1.5
Huebsch	HWTX21**	2.69	279	1.5
Huebsch	HWTY20**	2.69	279	1.5
Huebsch	HWTY21**	2.69	279	1.5
(Huebsch)	(LTZ80 (Commercial))	(2.84)	(293)	(1.85)
(Huebsch)	(LTZ85 (Canada Only) (Commercial))	(2.84)	(242)	(1.68)
(Huebsch)	(LTZ87 (stack-elec dryer) (Commercial))	(2.84)	(293)	(1.85)
(Huebsch)	(LTZ89 (stack-gas dryer) (Commercial))	(2.84)	(293)	(1.85)
Huebsch	LTZ90A*N	2.84	224	1.89
Huebsch	LTZ97A*N	2.84	224	1.89
Huebsch	LTZ99A*N	2.84	224	1.89
Maytag	MAH20PD*** (Commercial)	2.86	177	1.99
Maytag	MAH20PN*** (Commercial)	2.86	160	2.04
Maytag	MAH20PR*** (Commercial)	2.86	177	1.99
Maytag	MAH20PS*** (Commercial)	2.86	177	1.99
Maytag	MAH21PD*** (Commercial)	2.86	143	2.13
Maytag	MAH21PN*** (Commercial)	2.86	143	2.13
Maytag	MAH21PR*** (Commercial)	2.86	143	2.13
Maytag	MAH21PS*** (Commercial)	2.86	143	2.13
Maytag	MAT12PDS (Commercial)	2.4	304	1.35
Maytag	MAT12PRS (Commercial)	2.4	304	1.35
Maytag	MFR18PD*** (Commercial)	2.61	346	1.28
Maytag	MFR25PD*** (Commercial)	3.14	351	2.19
Maytag	MLE19PD*** (Commercial)	2.86	171	2
Maytag	MLE19PR*** (Commercial)	2.86	171	2
Maytag	MLG19PD*** (Commercial)	2.86	171	2
Maytag	MLG19PR*** (Commercial)	2.86	171	2
(Speed Queen)	(FTS80 (Commercial))	(2.84)	(293)	(1.85)
Speed Queen	FTS90A*N	2.84	224	1.89
Speed Queen	FTS91A*N	2.84	224	1.89

(Speed Queen)	(LTS80 (Commercial))	(2.84)	(293)	(1.85)
(Speed Queen)	(LTS80A (Commercial))	(2.84)	(293)	(1.85)
(Speed Queen)	(LTS84 (Commercial))	(2.84)	(235)	(1.76)
(Speed Queen)	(LTS85 (Commercial))	(2.84)	(242)	(1.68)
(Speed Queen)	(LTS87 (stack-elec dryer) (Commercial))	(2.84)	(293)	(1.85)
(Speed Queen)	(LTS89 (stack-gas dryer) (Commercial))	(2.84)	(293)	(1.85)
Speed Queen	LTS90A*N	2.84	224	1.89
Speed Queen	LTS95A*N	2.84	258	1.77
Speed Queen	LTS97A*N	2.84	224	1.89
Speed Queen	LTS99A*N	2.84	224	1.89
Speed Queen	LWS04 (Commercial)	3.26	483	1.28
Speed Queen	LWS05**	3.26	288	1.55
Speed Queen	LWS49**	3.26	288	1.55
(Speed Queen)	(STEA17 (stack-electric dryer) (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STEA17*N	2.84	181	2.03
(Speed Queen)	(STEB17 (stack-electric dryer) (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STEB17*N	2.84	181	2.03
(Speed Queen)	(STEC17 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STEC17*N	2.84	181	2.03
(Speed Queen)	(STED17 (stack-electric dryer) (Commercial))	(2.84)	(186)	(1.9)
(Speed Queen)	(STEF17 (stack-electric dryer) (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STEF17*N	2.84	181	2.03
Speed Queen	STEH17*N	2.84	181	2.03
Speed Queen	STEJ17*N	2.84	181	2.03
Speed Queen	STET17*N	2.84	181	2.03
(Speed Queen)	(STEX17 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STEX17*N	2.84	181	2.03
(Speed Queen)	(STEY17 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STEY17*N	2.84	181	2.03
(Speed Queen)	(STEZ17 (Commercial))	(2.84)	(186)	(1.9)
(Speed Queen)	(STGA19 (stack-gas dryer) (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STGA19*N	2.84	181	2.03
(Speed Queen)	(STGB19 (stack-gas dryer) (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STGB19*N	2.84	181	2.03
(Speed Queen)	(STGC19 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STGC19*N	2.84	181	2.03
(Speed Queen)	(STGD19 (stack-gas dryer) (Commercial))	(2.84)	(186)	(1.9)
(Speed Queen)	(STGF19 (stack-gas dryer) (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STGF19*N	2.84	181	2.03
Speed Queen	STGH19*N	2.84	181	2.03
Speed Queen	STGJ19*N	2.84	181	2.03
Speed Queen	STGT19*N	2.84	181	2.03
(Speed Queen)	(STGX19 (Commercial))	(2.84)	(186)	(1.9)

Speed Queen	STGX19*N	2.84	181	2.03
(Speed Queen)	(STGY19 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	STGY19*N	2.84	181	2.03
(Speed Queen)	(STGZ19 (Commercial))	(2.84)	(186)	(1.9)
(Speed Queen)	(SWF261 (Commercial))	(2.84)	(186)	(1.9)
(Speed Queen)	(SWFA61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFA61*N	2.84	181	2.03
(Speed Queen)	(SWFB61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFB61*N	2.84	181	2.03
Speed Queen	SWFB62*N	2.84	181	2.03
Speed Queen	SWFB63*N	2.84	181	2.03
Speed Queen	SWFBE1*N	2.84	156	2.2
(Speed Queen)	(SWFC61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFC61*N	2.84	181	2.03
(Speed Queen)	(SWFD61 (Commercial))	(2.84)	(186)	(1.9)
(Speed Queen)	(SWFF61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFF61*N	2.84	181	2.03
(Speed Queen)	(SWFH61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFH61*N	2.84	181	2.03
(Speed Queen)	(SWFJ61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFJ61*N	2.84	181	2.03
Speed Queen	SWFT61*N	2.84	181	2.03
Speed Queen	SWFT63*N	2.84	181	2.03
(Speed Queen)	(SWFX61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFX61*N	2.84	181	2.03
(Speed Queen)	(SWFY61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWFY61*N	2.84	181	2.03
(Speed Queen)	(SWFZ61 (Commercial))	(2.84)	(186)	(1.9)
(Speed Queen)	(SWR261 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWR961*N	2.84	181	2.03
Speed Queen	SWRA61*N	2.84	181	2.03
Speed Queen	SWRB61*N	2.84	181	2.03
Speed Queen	SWRBE1*N	2.84	156	2.2
(Speed Queen)	(SWRC61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWRC61*N	2.84	181	2.03
Speed Queen	SWRF61*N	2.84	181	2.03
Speed Queen	SWRH61*N	2.84	181	2.03
Speed Queen	SWRJ61*N	2.84	181	2.03
Speed Queen	SWRT61*N	2.84	181	2.03
(Speed Queen)	(SWRX61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWRX61*N	2.84	181	2.03
(Speed Queen)	(SWRY61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWRY61*N	2.84	181	2.03

(Speed Queen)	(SWRZ61 (Commercial))	(2.84)	(186)	(1.9)
Speed Queen	SWTT20**	2.69	279	1.5
Speed Queen	SWTT21**	2.69	279	1.5
Speed Queen	SWTX20**	2.69	279	1.5
Speed Queen	SWTX21**	2.69	279	1.5
Speed Queen	SWTY20**	2.69	279	1.5
Speed Queen	SWTY21**	2.69	279	1.5
Staber	HXW2404 (Commercial)	2	265	1.48
Staber	HXW2504 (Commercial)	2	265	1.48
Staber	HXW2901 (Commercial)	2	239	1.43
Staber	HXW2921 (Commercial)	2	239	1.43
(Unimac)	(FTU80 (Commercial))	(2.84)	(293)	(1.85)
Unimac	FTU91A*N	2.84	224	1.89
(Unimac)	(LTU80 (Commercial))	(2.84)	(293)	(1.85)
(Unimac)	(LTU87 (stack-elec dryer) (Commercial))	(2.84)	(293)	(1.85)
(Unimac)	(LTU89 (stack-gas dryer) (Commercial))	(2.84)	(293)	(1.85)
Unimac	LTU97A*N	2.84	224	1.89
Unimac	LTU99A*N	2.84	224	1.89
Wascomat	E620	2.69	219	1.3
Wascomat	WE16 (Commercial)	2.65	157	1.57
Whirlpool	CAW2762K (Commercial)	3.03	337	1.32

Definitions for Clothes Washer product listing column headers

Brand and Model

This is how a particular washer is identified. Retailers can identify products they stock using the brand and model number. Some products may also be identified with a name or SKU which is different from the brand or model number, but you should always be able to find the brand and model number on a product.

Volume

This is the tub capacity of the clothes washer in cubic feet.

KWH/Year

This number is the estimated annual energy use of this machine under typical conditions. It is based on an average usage of 392 loads of laundry per year, or just under 8 loads per week. Your actual energy consumption will vary depending on the amount of laundry you do, the size of the loads, and the temperature settings you use. This figure is calculated according to Department of Energy test procedures and incorporates the estimated energy consumed by the washer, and the energy needed to heat water with an electric water heater. If you use a gas water heater, you will use significantly fewer kilowatt hours, but will consume some gas to heat the same water.

Modified Energy Factor

Modified Energy Factor (MEF) is a new equation that replaced Energy Factor as a way to compare the relative efficiency of different units clothes washers. MEF takes into account the amount of dryer energy used to remove the remaining moisture content in washed items. For more information about this calculation, please see the August 27, 1997 Federal Register entry regarding 10 CFR Part 430.

Energy Factor

This **Energy Factor** is a number computed for each washer which enables you to compare the relative efficiency of different units. The higher the Energy Factor is, the more efficient the clothes washer is. For clothes washers, Energy Factor is calculated using the following formula:

$$\text{Energy Factor} = \frac{392 \times \text{Volume } (ft^3)}{\text{Annual Energy Usage (kWh)}}$$

Water Factor

The **Water Factor** is a the number of gallons per cycle per cubic foot that the clothes washer uses. The lower the water factor, the more efficient the washer is. So, if a clothes washer uses 30 gallons per cycle and has a tub volume of 3.0 cubic feet, then the water factor is 10.0.

ENERGY STAR Qualified Clothes Washer Calculator		
Directions: This calculator approximates the annual savings of an ENERGY STAR qualified clothes washer compared to a non-qualifying clothes washer. To use this calculator, enter any values you know of from your washer in the input area. You can change the number of models, the capacity, the energy factor, the cost, the estimated product life, and your electric rate. If you know the kWh/year and want to determine the energy factor, energy factor is calculated by multiplying 392 by the volume in cubic feet and dividing the result by the kilowatt hours per year. 392 is the estimated cycles per year. Although the ENERGY STAR criteria requires the Modified Energy Factor (MEF) instead of the Energy Factor (EF), this calculator uses EF since it is easier to estimate energy savings from EF and non-qualified models do not list their MEF. So, enter the EF values. If you do not know any values, then leave the defaults since they are the national averages. Your annual operating costs, savings, and estimated payback period will appear below. If you have any questions, please contact Bill McNary of D&R International		

INPUT AREA		
(Please insert the relevant figures in the input boxes)	ENERGY STAR Qualified Unit	Non-ENERGY STAR Qualified Unit
Number of Clothes Washers	1	1
Clothes Washer Capacity	2.65	2.65
Energy Factor (EF) (not MEF)	2.5	1.18
Initial Cost per Unit	$750	$450
Assumed product life in years	12	12
Your Electric Rate	8.5	cents per kWh
Discount Rate	4%	
Annual Operating Costs		
Energy Consumption, kWh	416	880
Energy Cost	$35.19	$74.56
Lifetime Operating Cost	$330.30	$699.80
Total Purchase Price	$750	$450
Additional Investment	$300	
Annual Energy Savings	$39	
Approximate Lifetime Savings	$369.49	
Net Savings	$69.49	
Years to recoup initial investment	7.6	
kWh Saved	5,578	
Equivalent Cars Removed from Road	0.879644819	

880
-416
464 Kwh

PLEASE CHECK ONE ANSWER FOR EACH:

Building type:

- ☐ Single-family home
- ☐ Manufactured home
- ☐ Multi-family dwelling

Approximate year home constructed?

_____

Water heater type:

- ☐ Natural Gas
- ☐ Electric
- ☐ Other

Washer type:

- ☐ ENERGY STAR-rated top-loading ($100)
- ☐ ENERGY STAR-rated horizontal-axis ($150)

I would prefer:

- ☐ Check for rebate amount.
- ☐ Donate rebate and help local families in need. (tax deductible)

Customer agreement: I certify this high-efficiency ENERGY STAR-rated washing machine was purchased on or after September 1, 2003. All statements made in this application are correct. I understand that Alliant Energy reserves the right to inspect and verify any equipment before issuing incentives.

_____

Customer signature Date

Mail completed claim form and copy of sales receipt to:
Alliant Energy
Home Efficiency Solutions
P.O. Box 351
Cedar Rapids, IA 52406-0351

art of efficiency

For more information on this and other *Home Efficiency Solutions*, give us a call at
1-800-723-7635

This program is effective September 1, 2003-December 31, 2004, and is subject to periodic review and modification by Alliant Energy. Please check with an Alliant Energy representative regarding program expiration date. Alliant Energy does not guarantee that the installation of high-efficiency equipment will result in reduced usage or demand, or in cost savings. Alliant Energy makes no warranties, expressed or implied, with respect to any equipment purchased and/or installed, including, but not limited to, any warranty of merchantability or fitness for a particular purpose. In no event shall Alliant Energy be liable for any incidental or consequential damage.

Products and services from Alliant Energy detailed here are offered to customers of Interstate Power and Light Company, a wholly-owned subsidiary of Alliant Energy Corp.

www.alliantenergy.com

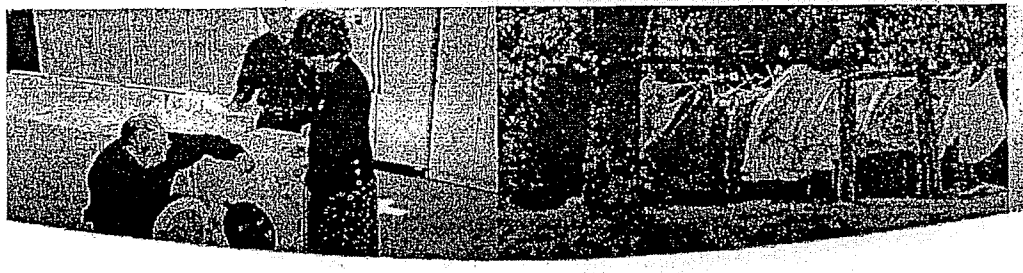
ALLIANT ENERGY.

2003-2004

High Efficiency Washers - Iowa

art of efficiency

ALLIANT ENERGY.



2003-2004

High Efficiency Washers-Iowa

Fact: up to 90 percent of the cost of washing clothes comes from heating the water. That's why a high-efficiency washing machine is such a good investment: it uses up to 60 percent less water than a traditional washer.

Top-loading models look like conventional machines from the outside, but these ENERGY STAR qualified washers use different types of washing action to get clothes clean with less water and energy. Many have sensors to monitor incoming water temperature closely. They also rinse clothes with repeated high-pressure spraying instead of soaking them in a full tub of water.

Front-loading models are similar to machines used in laundromats. They use a horizontal or tumble-axis basket to lift and drop clothing into the water instead of rubbing clothes around a central agitator.

A high-efficiency washer can help you save in other ways:

- Through superior design and system features, ENERGY STAR qualified clothes washers clean clothes using 50 percent less energy than standard washers.
- Full-sized ENERGY STAR qualified washers use 18-25 gallons of water per load, compared to the 40 gallons used by a standard machine.
- ENERGY STAR qualified washers extract more water from clothes during the spin cycle. This reduces the drying time and saves energy and wear and tear on your clothes.

Not only will you save on energy costs, but Interstate Power and Light Company, a wholly-owned subsidiary of Alliant Energy™ hereinafter referred to as "Alliant Energy," offers you up to $150 incentive on the purchase price!

How do I qualify?

- This program is open to residential electric and/or or natural gas customers in Iowa.
- Any brand washer with an ENERGY STAR® label qualifies.
- A sales receipt and completed claim form are required.
- Failure to complete the claim form will result in a delay processing your claim.
- Washer must be installed in Alliant Energy service territory in Iowa to be eligible for incentive.
- Up to two washers per installed address.
- Washer(s) must be purchased and installed between September 1, 2003 and December 31, 2004.
- Claim form must be returned within 30 days of installation.
- Other restrictions may apply.

Qualifying washers:

- ENERGY STAR top-loading – $100 incentive
- ENERGY STAR horizontal-axis – $150 incentive

Compared to a 10-year old model, an ENERGY STAR qualified washer can save up to $120 per year on your utility bills.

How do I apply?

Simply complete both sides of the form and include a copy of the sales receipt showing the date your machine was purchased. Mail it to the address shown and you will receive a check for the incentive amount directly from Alliant Energy.

Please allow six to eight weeks for receipt of your check after we have received your properly completed claim form and itemized sales receipt.

If you have questions, give us a call today at **1-800-723-7635.** We're looking forward to working with you!

Help neighbors in need

Help local families in need stay warm by donating your rebate to Alliant Energy's low-income heat fund. Every dollar of your tax deductible donation will be used to provide energy assistance to families in your area. Plus, Alliant Energy will match your contribution by 25 percent.

ALLIANT ENERGY.

Claim Form

Customer information:

Name _____

Address _____

City _____ State _____

ZIP _____

Phone # _____

Best time to call: _____ am/pm

Alliant Energy-IP&L account number:

_____

Equipment information:

Installation date _____

Brand _____

Model # _____

Serial # _____

Installed address (if different than above):

Address _____

City _____ State _____

ZIP _____

How did you learn about the program?

☐ Dealer ☐ Newspaper ☐ Other_____
☐ Direct Mail ☐ Radio
☐ Internet ☐ Television

Newsroom: Recent News Releases

Alliant Energy, Energy Star® Offer $150 Rebate Toward Qualifying Clothes Washers

Save money and energy when you purchase energy-efficient clothes washer

CEDAR RAPIDS, Iowa - April 14, 2003 - Alliant Energy announces its partnership with Energy Star to provide a $150 rebate to Alliant Energy customers in Iowa and Minnesota who purchase a qualifying Energy Star clothes washer.

"Not only can customers save money when purchasing an Energy Star clothes washer, but they can also save up to $100 per year on utility costs as well," said Kim King, product manager, Alliant Energy. "This is the perfect time to replace that old washer that's using up too much money and energy."

Energy Star-qualified washers use up to 2/3 less energy and save about 25 gallons of water per load, which adds up to approximately 7,000 gallons per year. They also save more energy, water and money than any other major home appliance.

In order to receive the rebates, customers must purchase the clothes washer between April 15, 2003 and July 15, 2003. The washer must be a qualifying manufacturer model: Electrolux/Frigidaire, Equator, Fisher & Paykel, GE, Maytag, Miele, Sears Kenmore or Whirlpool. Look for Energy Star-qualified models at participating appliance retailers.

Alliant Energy also offers a variety of rebates, financing and other money-saving programs to its customers, which can be found at www.alliantenergy.com/residential.

For more information, call Alliant Energy's Efficiency Solutions Hotline at 1-800-723-7635.

Questions?

Call our 24-hour newsline at **608-458-7257**, use our Contact Us form or e-mail news@alliantenergy.com.

Cash-Back Rewards↓

Appliances | Lighting >>

Appliance Cash-Back Rewards are listed by appliance type and manufacturer, and new ones are added periodically. If you have any questions, please contact the Focus on Energy Information Center at 800.762.7077 or e-mail us at **ESinfo@focusonenergy.com**.

Clothes Washer Rewards
Start the Savings Cycle with ENERGY STAR. Save now on the purchase price with a $50 mail-in Cash-Back Reward and save on your utility bill every day.

Whirlpool
Dates: August 1 - December 31, 2003
Reward Amount: $50

Models:
Duet ®
GHW9100L
GHW9200L
GHW9250M

Calypso®
GVW9959K

Resource Saver ®
GSW9559L
GSW9650L
GSW9545JQ

Whirlpool Reward Form (104KB)

Fisher & Paykel
Dates: August 1 - December 31, 2003
Reward Amount: $50

Models:
EcoSmart
GWL10
GWL11

Fisher & Paykel Reward Form (45KB)

Sears
Dates: November 10 - December 31, 2003
Reward Amount: $50

Models: Select ENERGY STAR qualified Clothes Washers and Refrigerators

The following Maytag clothes washer models are not eligible for this offer: MAH4000, MAH5500, MAH6500, MAH7500, MLE2000, MLG2000.

Maytag refrigerator model MZD2766GEW is not eligible for this offer.

>**Change a**
Change
Wisconsi
World
Starting S
up to $2 ir
STAR qual
>**Give the**
Cleaner E
This holida
for gifts wi
STAR. The
generation
you.

Dehumidifier Rewards
Be cool with ENERGY STAR when you purchase and take delivery of the ENERGY STAR qualified dehumidifiers listed below.

Therma-Stor
Dates: June 1 - December 31, 2003
Reward Amount: $50

Models:
Santa Fe
Santa Fe RX

Therma-Stor Reward Form (43KB)

Mail Reward forms to:
Focus ENERGY STAR Appliances
c/o EFI Fulfillment Center
40 Washington St., Suite 300
Westborough, MA 01581-1012

Other Terms and Conditions:
- Focus on Energy reserves the right to withdraw this offer without notice.
- Valid for residential customers of Focus on Energy and participating electric utilities only.
- Customers of some municipal or cooperative utilities may not be eligible.
- Cash-Back Reward not to exceed purchase price.
- Photocopies or facsimiles of the reward form are not acceptable.

Appliances | Lighting >>

Technology

Vending Equipment Controls

The most prevalent and available control is Bayview Technology's (owned by US Technologies, Inc) VendingMiser. There are companies that produce controls that are more integrated into the equipment, which may reduce or eliminate tampering or disconnection of measure, but would face potential installation and bottler resistance/ obstacles.

Energy Savings – kWh

Typical vending equipment consumes 7-14 kWh/day depending on size.
VendingMiser claims savings range is from 30%-50%
Potential annual energy saving calculate between 766.5 and 2,555 kWh per unit/year.
Tufts Climate initiative estimated 1752 kWh/year savings (see attached) based on a very limited study.

We have had experience with the installation of thousands of these units on programs over the last couple of years. We feel the units are effective in some applications but misapplications and persistency lead us to savings on the low end of expectations. We recommend assuming a savings level of 800 kWh/year.

Summer Peak Savings

N/A – same as above

Measure Life

Questions about persistence have been raised because the units are easily accessed and removed or unplugged. Position of sensor is also important for optimum performance. Although the quality of the product will allow for a longer life, we have assumed 5 years, as with other plug load technologies, analyzed, due to the persistency issue.

Initial One-Time Cost

Prices vary primarily due to institutional rates that are available to Utility and Government conservation programs. Identified costs vary from $140 to $180 per unit.

Any Recurring Costs

Re-enforcement and training (see Tufts University document)

Suggested Incentive

Rebates from throughout the US range from $30 - $120 per unit (see attached list). Rebates vary/varied from "limited time" to "limited number" offers. Incentives are appealing due to 'ease of implementation' and management. Incentives in the upper half of the range specified can lead to paybacks from months to under two years. We recommend a $30 incentive be considered.

Requirements

May need to move equipment away from the wall to access the outlet. Should follow placement of sensor directions closely. (see Tufts University document attached)

Existing Energy Standards

None, for the controls. There are pending Energy Star standards for the vending equipment. (see attached; comments on pending standards by Bayview Technologies also included)

Source of Info

Bayview Technologies; EPA Energy Star; multiple utility/government program sites; Tufts University

ENERGY STAR® Program Requirements for Refrigerated Beverage Vending Machines

Partner Commitments
DRAFT 2

Commitment

The following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacturing of ENERGY STAR qualified refrigerated beverage vending machines. The ENERGY STAR Partner must adhere to the following program requirements:

- comply with current ENERGY STAR Eligibility Criteria, defining the performance criteria that must be met for use of the ENERGY STAR certification mark on refrigerated beverage vending machines and specifying the testing criteria for refrigerated beverage vending machines. EPA may, at its discretion, conduct tests on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at EPA's request;

- comply with current ENERGY STAR Identity Guidelines, describing how the ENERGY STAR logos and name may be used. Partner is responsible for adhering to these guidelines and for ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance;

- qualify at least one refrigerated beverage vending machine model within one year of activating the refrigerated beverage vending machine portion of the agreement. When Partner qualifies the product, it must meet the specification (e.g., Tier 1 or 2) in effect at that time;

- provide clear and consistent labeling of ENERGY STAR qualified refrigerated beverage vending machines. The ENERGY STAR label must be clearly displayed on the front of the machine or on or next to the nameplate of the machine, in product literature (i.e., user manuals, spec sheets, etc.), and on the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed;

> **Note:** During the Draft 1 comment period, EPA received feedback from industry stakeholders that placing the label on the front of the machine could interfere with the intended marketing presentation of the beverage product and company. EPA continues to believe that visibility of the ENERGY STAR mark on qualifying models is important as it is the primary way to build awareness of ENERGY STAR, which serves to benefit all partners. However, EPA is also willing to work with stakeholders to determine the most appropriate location to place the label while ensuring product identification on site. EPA recognizes that most machine purchases are made without the host site actually seeing the machine, and in that case, the ENERGY STAR mark itself may not sway the purchaser's decision. However, it is important that once the machine is placed on site, the end user that requested an ENERGY STAR qualified machine is assured the energy savings by seeing the label on the actual machine when it is delivered. Therefore, at this time EPA is proposing that if the ENERGY STAR label cannot be placed on the front of the machine, that it be placed on or next to the machine nameplate. EPA may revisit the idea of requiring placement of the ENERGY STAR label on the front of the machine during the Tier II performance level review. Stakeholders are encouraged to provide feedback on this proposed placement of the ENERGY STAR label on qualifying machines.

- provide to EPA, on an annual basis, an updated list of ENERGY STAR qualifying refrigerated

STAR Web Linking Policy (this document can be found in the Partner Resources section on the ENERGY STAR Web site at www.energystar.gov), EPA may provide links where appropriate to the Partner Web site;

- provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR Web pages, etc. The plan may be as simple as providing a list of planned activities or planned milestones that Partner would like EPA to be aware of. For example, activities may include: (1) increase the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrate the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) provide information to users (via the Web site and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) build awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event;

- provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.

2) **Qualifying Products:** In order to qualify for the ENERGY STAR, a refrigerated beverage vending machine must meet the definition in Section 1A. All qualifying models must also meet the performance requirements provided in Section 3, below, at the time of manufacturing. The following products may qualify under this specification: closed-front, glass front, and live display machine models. **This Version 1.0 specification applies only to new machine models. Requirements for refurbished machines will be determined within one year of the effective date provided in Section 5, below.**

> **Note:** There continues to be concern from many stakeholders that excluding the existing machine inventory from the ENERGY STAR specification could create a sudden demand for new machines that would be challenging to supply, threatening the current balance in the marketplace. According to stakeholders, many of today's existing machine models could be retrofitted with new components to meet the performance requirements of this specification. EPA recognizes the uniqueness of this distribution channel and realizes that including refurbished machines would ensure a greater market penetration of energy-efficient machines and a further reduction of energy usage, which is ultimately the goal of ENERGY STAR. However, there is still work to be done to determine how a retrofit component could be implemented and managed.
>
> EPA is currently working with vending machine manufacturers, beverage companies, bottling companies, and Underwriters Laboratory (UL) to determine the most efficient way to address the installed base of refrigerated beverage vending machines. While it is EPA's intention to move forward with a new machine specification, it is our hope that a Version 1.1 amendment will be developed within the next year that addresses refurbished machines. As such, a placeholder has been inserted in Section 2 above, for a refurbished machine requirement.

3) **Energy-Efficiency Specifications for Qualifying Products:** Only those products listed in Section 2 that meet both criteria A and B provided below may qualify as ENERGY STAR.

A. Energy Consumption: Qualifying models shall consume equal to or less energy in a 24-hr period than the values obtained from the equations[3], shown below. Effective dates for Tier I and Tier II are provided in Section 5 of this specification.

Tier I

$Y = 0.55\ [8.66 + (0.009 \times C)]$

Tier II

$Y = 0.45\ [8.66 + (0.009 \times C)]$

Where:
Y = 24 hr energy consumption (kWh/day) after the machine has stabilized
C = vendible capacity

Example: Under Tier I, a 650-can capacity machine may consume no more than 7.9805, or 7.98 kWh/day (rounded). Under Tier II, a 650-can may consume no more than 6.5295 or 6.53 kWh/day (rounded).

Note: Approximately one year before Tier II becomes effective, EPA will reassess the performance level presented in this specification to ensure its feasibility in the marketplace.

[3] The energy consumption equation is based on CAN/CSA C804-96 *Energy Performance of Vending Machines* (for Machine Type A).

A. In performing these tests, partner agrees to measure a model's daily energy consumption according to ASHRAE Standard 32.1-1997R, *Methods of Testing for Rating Vending Machines for Bottled, Canned, and Other Sealed Beverages,* using the test conditions provided in Section 6 of the standard:

1. Machines designated as "Suitable for Outdoor Use" by UL must be tested at 90±2 °F (32.2±1 °C); 65±5% relative humidity; and 36±1 °F (2.2±0.5 °C) beverage temperature throughout the test.
2. Machines designated as "For Indoor Use Only" by UL may be tested at 75±2 °F (23.9±1 °C); 45±5% relative humidity; and 36±1 °F (2.2±0.5 °C) beverage temperature throughout the test.

B. Test results must be reported to EPA using the Refrigerated Beverage Vending Machine Qualifying Product Information (QPI) form.

Note: It is EPA's understanding that the revision of ASHRAE Standard 32.1-1997 is near completion. As such, the latest version (1997R) is referenced in the Test Criteria section above and the energy consumption test criteria adopted for purposes of qualifying machines under this specification. EPA also recognizes that most, if not all, glass front machines are designed for indoor use only and therefore, should be tested under operating conditions other than 90±2 °F (32.2±1 °C) and 65±5% relative humidity. Therefore, models that are UL listed as "For Indoor Use Only" may be tested according to the alternative criteria set forth in the ASHRAE Standard 32.1-1997R [75±2 °F (23.9±1 °C) and 45±5% relative humidity] to qualify as ENERGY STAR. Please note that indoor models must meet the same minimum performance requirements as outdoor machines, provided in Section 3 of this specification.

Once ASHRAE Standard 32.1-1997R is finalized, EPA will review its requirements and update the reference in this specification, as appropriate.

5) Effective Date: The date that manufacturers may begin to qualify products as ENERGY STAR will be defined as the *effective date* of the agreement.

A. Tier I – The first phase, Tier I, shall go into effect on **January 1, 2004** and conclude on **December 31, 2006**. Upon signing the agreement, the Partner may begin to use the ENERGY STAR on qualifying product models and related marketing materials. Refer to the ENERGY STAR Identity Guidelines at www.energystar.gov/partners.

B. Tier II – The second phase of this specification, Tier II, shall commence on **January 1, 2007**. All products, including models originally qualified under Tier I, with a **date of manufacture** on or after **January 1, 2007**, must meet Tier II requirements in order to bear the ENERGY STAR on the product or in product literature.

Note: EPA had hoped to announce the ENERGY STAR vending machine Version 1.0 specification at the NAMA Expo in October 2003. However, based on the volume of comments received on the Draft 1 version, additional time was needed to review, research, and address a number of outstanding issues prior to finalizing the document. Based on additional discussions with industry stakeholders, EPA now hopes that this Draft 2 version addresses industry stakeholders concerns and represents a fair, yet challenging, specification. EPA's intent is to finalize this Version 1.0 document by the end of this year (2003) and announce the Refrigerated Beverage Vending Machine specification January 1, 2004.

Furthermore, in response to manufacturer concerns that the two-year lead-time between Tier I and Tier II in Draft 1 was too short, EPA has extended this time period to three years. Two years from the January 1, 2004 effective date, EPA will revisit the Tier II requirements and determine whether or not the proposed performance requirements are feasible prior to Tier II taking effect.

To meet a January 1, 2004 date, stakeholders are asked to submit any final comments or suggestions to EPA for consideration by November 21, 2003.

Response to EPA proposed draft.

1. The definition excludes "on site labor intervention" yet the low power mode requires settings "adjustable on site". This is a conflict and allows for changes in the field. If the machines are alterable in the field to achieve a standard as opposed to improving over the standard, there will be great difficulty in determining compliance. The ultimate consumer or facility can be told the machine is programmed to meet specs but in fact they will be in no position to know that for sure.
2. Based on our tests in the field (and recognizing that the chamber ASHRAE test is more rigorous) the formula does not appear to put a very high bar on Energy Star status.
    a. A typical 400 can machine in the field, based on 127 total samples, uses an average of 8.208 kWh/day. The test would require 6.743 or approximately an 18% reduction from field tests.
    b. A typical 600 can machine in the field, based on 127 total samples, uses an average of 8.688 kWh/day. The test would require 7.733 or approximately an 11% reduction from field tests.
    c. A typical 800 can machine in the field, based on 127 total samples, uses an average of 10.464 kWh/day. The test would require 8.723 or approximately a 17% reduction from field tests.

    Delamping machines will produce this savings and possibly T-8 lights. The unknown factor is lack of data from ASHRAE conditions to see what the spread is between the test standard and the ASHRAE consumption measurement.

    We suggest that the test be ASHRAE chamber but the temperature be room temperature, i.e. 72-75. That way a more realistic and easier determination can be made by those involved.

3. The formula should be written as $Y=0.55(8.66 + (0.009 \times C))$. Otherwise you get the wrong answer.
4. Low power mode is still troublesome in what it is, how is it achieved and what constitutes field programmable controls. Is unplugging a field control?
5. Our data shows that the 400-800 can consumption is not lineal. Therefore the equation will be to favorable to the 600 can even if the ASHRAE test results in a higher kWh/day. You may need a more complicated formula to deal with that.

We would suggest much more test data to see if the formula achieves its intended result.

Marc Geman
President
Bayview Technology Group LLC

Comments on EPA Draft Eligibility Requirements for Refrigerated Beverage Vending Machines:

1C - Low Power Mode - The definition is not precise enough to be implementable. It claims that a low power state is one which operates "without jeopardizing its ability to keep vend product cool and return to full

operational mode when required by the host site." Since no parameters for this operation, or return from this state, are supplied, one could easily meet this specification by simply unplugging the machine.

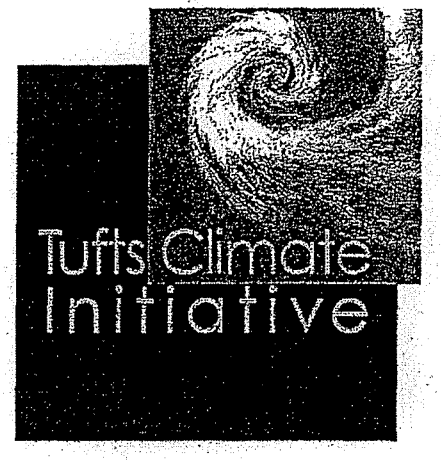
3B - Low Power Mode - allowing product temperature to rise and then not specify how and in what time frame it must return to acceptable temperature seems of little value. Again, the machine can simply be unplugged. Allowing Aspartame products to cycle will cause them to degrade. In addition, a 50 degree product is deemed by the suppliers as unacceptable temperature wise, so how would one prevent a customer from purchasing such a product (i.e. a roving security guard after the facility has closed). Finally, making the feature site adjustable ensures that the feature will almost never be used due to the dynamics of the vending business. The personnel that place the machines do not open them or program them. In order to set site specific controls, a machine technician would need to be specially dispatched to program and enable these features. This is not likely to happen given the cost of such a service call to the machine supplier, who in fact does not pay the electricity bill for the machine's operation. Finally, when the machine is swapped out for repair, another special technician trip would be needed to set site adjustable controls. Finally, the customer who actually pays the utility bill will have no way to verify the settings of such controls.

I highly suggest that the whole concept of site adjustable controls be removed. In addition, the description of a "Low Power Mode" without detailing how it operates, how one would test it, and how one would ensure that it is in fact operating correctly, seems to be of dubious value. In fact, efficiency standards should be set for the machine, and how a manufacturer meets them is left to their engineering skills.

David Schanin

Chief Technical Officer

Bayview Technology Group LLC



Vending Misers: Facts and Issues

Vending Misers are nifty little devices that can be installed on beverage vending machines. Vending machines run very inefficiently. At Tufts, each vending machine costs the University about $380 in electricity costs each year. With a Vending Miser, the electricity consumption can be cut in half. Vending misers cost about $165 and have a pay-back of about 1-2 years. They are manufactured by Bayview Technology (www.bayviewtech.com)

Tufts has installed about 90 vending misers. Although we recommend vending misers whole-heartedly, there are several issues that should be taken into account before launching into a vending miser project. This handout is meant to help other institutions use vending misers successfully and avoid some of the mistakes we have made.

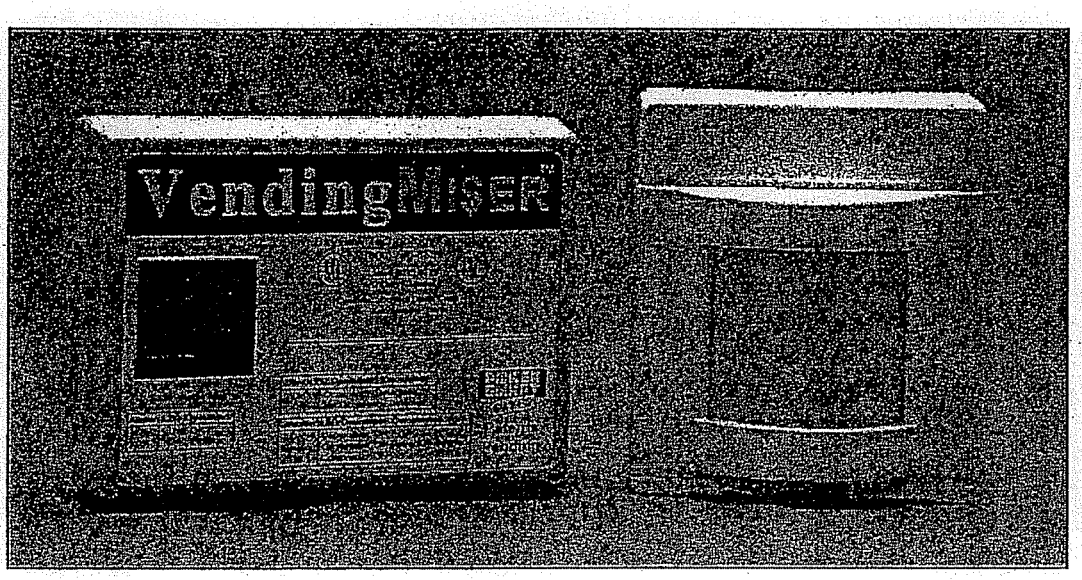
If you have any additional questions, feel free to contact: Anja Kollmuss: phone: 617-627-5517 anja.kollmuss@tufts.edu

How much Does a Vending Misers Save?

Electricity Usage Of One Vending machine w and w/o a Vending Miser	Without Vending Miser	With Vending Miser
Electricity Use Per Year (this number was estimated, after a energy consumption of a vending machine was measured for one week in an occupied dormitory)	**3468 kWh**	**1716 kWh**
CO2 emissions per year @ 1.3 lbs/kWh	2.26 tons	1.12 tons
Cost of vending miser	--	$165
Cost over 52 weeks Cost of electricity @ $0.11/kWh	**$381**	**$189**
Cost of installation		
Payback Not including installation costs	--	less than 1 year

A typical beverage vending machine uses almost 3500kWh per year (That is an average of almost 0.4 kWh per hour. This translates into 4500 lbs of CO2 emissions per vending machine per year.) To put this in perspective, a modern residential refrigerator (22 ft3) uses 450-800kWh per year.

How Does a Vending Miser Work?



A vending miser consist of a motion sensor and the miser itself (see picture). The vending machine is plugged into the vending miser, which is attached to a wall and plugged in to an outlet. The motion sensor is plugged in to the vending miser.

If no one is near the vending machine for 15 minutes and the compressor is not running, the vending miser will shut off the machine. If someone walks by the machine, the motion sensor will sense the movement and send power back to the machine (lights turn on). The internal thermostat of the vending machine will then decide, if the compressor needs to come on or not. In other words, the Vending Miser does not influence the internal thermostat or the compressor.

The vending miser also measures ambient room temperature. If the room is very warm, the vending miser will more often send power to the machine than if the machine is in a cold room. The machine will come on every 1-3 hours, EVEN IF NOONE WALKS BY THE MACHINE. Like this, the beverages stay cool, even if no one walks by the vending machine for many hours.

The vending miser has three LED lights.

- If the green light is on, the miser is working properly.
- If the red light is on, occupancy is detected.
- If the amber light is on, the compressor is ON.

If all three lights are blinking, something is wrong with the vending machine. Very likely, it means that the compressor of this machine never turns off. Such a machine should immediately be repaired. Identifying these machines quickly means you save even more energy!

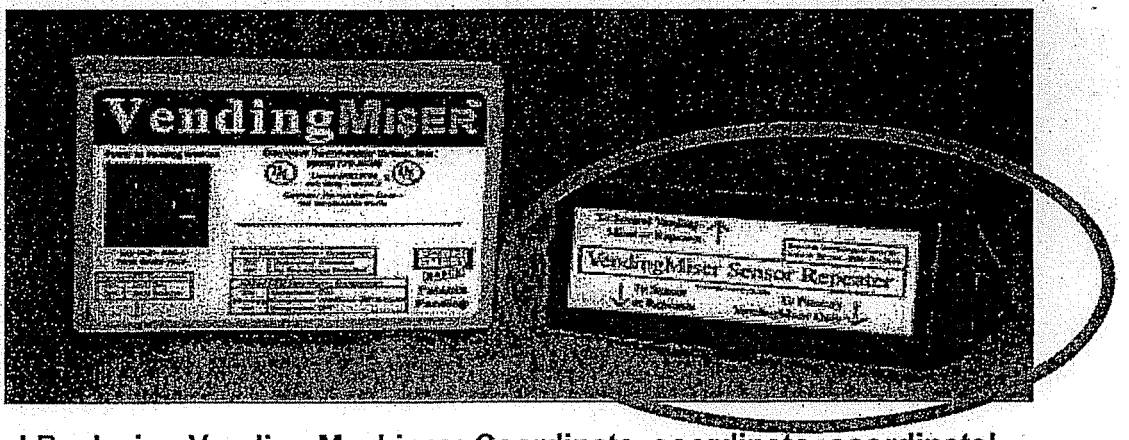
What Are the Issues and Potential Problems?

Permanent installation is not hard but needs to be done correctly. Here are some issues to watch out for:

1. Electrical Circuits: Make sure your circuits are not overloaded!
Sometimes several vending machines are plugged into the same circuit. (By code, only two can be on the same circuit.) At Tufts Vending Misers helped us to identify potentially over-loaded circuits since these circuits tripped, once vending misers were installed, because all the machines would come on simultaneously, when someone walked past them.

At Tufts the problem was successfully addressed in three ways:

- Machines were switched to different outlets.
- Several new electrical circuits were installed.
- Vending Miser Repeaters were installed in several locations (see picture). Repeaters stagger the start time of machines by a few seconds.



2. Moving and Replacing Vending Machines: Coordinate, coordinate, coordinate!
Make sure you coordinate with whom ever is in charge of adding, replacing and moving vending machines. Motion sensors and the vending misers have to be mounted permanently into the wall or ceiling. Having to move the misers to a new location is cumbersome and should be avoided.

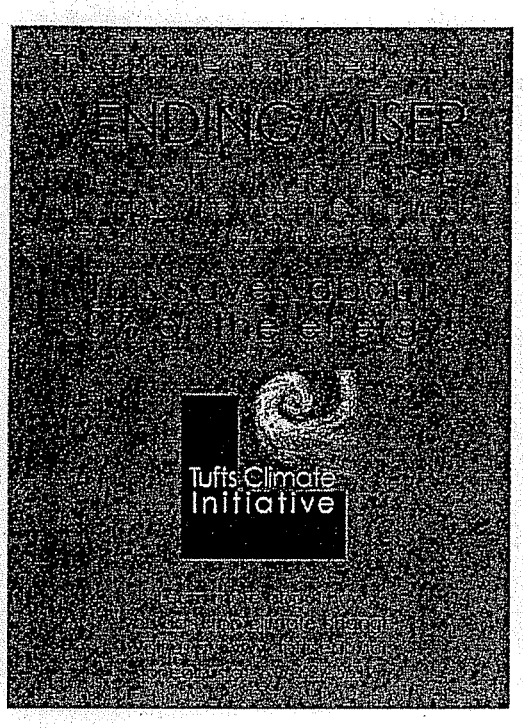
3. Misconception about Misers: Educate everybody!
At Tufts, several Misers were found unplugged after they had been correctly installed. Also, Coke employees expressed strong dislike for the misers, mostly because Coke staff has not been educated about how they work. Several myths prevailed, e.g. misers make beverages warm or misers hurt the compressors. However the technology has been approved by Coke.

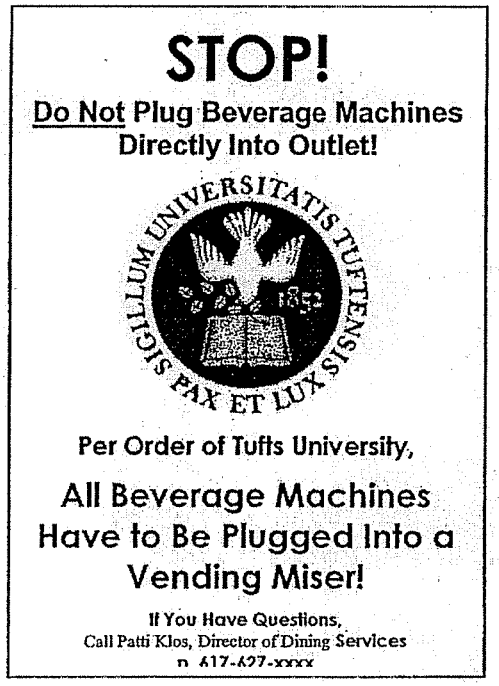
It is extremely important to coordinate the installation with all parties involved. Even though we put up signs on all the machines with our contact info, it was only by accident that we heard from Coke that employees had complained. Don't expect people to come to you. Seek out everybody who is involved with the vending machines and get them together for a meeting to explain who the misers work. Develop a plan about how problems, moves, repairs should be reported.

After we had an educational meeting with Coke representatives, all the issues could be resolved.

Be aware that turn over rates of employees may be high and that each new delivery person has to be informed.

Tufts has put up signs on (see left) and behind (see right) all vending machines:





4. Malfunctioning Vending Machines
As mentioned above, when all LED lights on the miser are blinking, the vending machine is not working properly. Most likely this means that the compressor never shuts down (there are several possible reasons for this). These machines use even more electricity than a properly functioning machine and they should therefore be repaired immediately. The miser is likely to be blamed for vending machine failure – however, in fact, the miser has simply identified a pre-existing problem.

Keys to saving energy with vending misers

- Appoint a coordinator
- Inform all involved parties (students, staff, facilities, vendors, etc.)
- Provide training on how the misers work early on
- Establish a system for when vending machines have to be moved
- Don't let misers take the blame for problems

Other opportunities to save
Assess if each vending machine is paying its way – increase awareness of true costs of vending machines.

Bayview Technology Group

Rebates

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MISER PRODUCT REBATES

Utilities across the U.S. offer rebates on the purchase of energy efficient products. Rebates for Miser Products, from $30 up to $120 per unit, are available from a growing number of utilities. Take a look at the list of rebate programs below, to see if you can benefit. Please use the links and contact information provided to learn more about the programs and how to earn your rebate.

- City of Palo Alto, CA
  $65 rebate
  Click here to apply.
  Call 650-329-2241 with questions.

- Connecticut Light & Power and Western Mass. Electric Co. (subsidiaries of Northeast Utilities)
  $75 rebate
  Available through the end of 2003
  Call 1-877-602-SAVE for more information or to apply for your rebate.

- Dakota Electric
  $75 rebate
  Expires December 31, 2003
  Call 1-800-874-3409

- ECOS Consulting (Rebate valid for customers of San Diego Gas & Electric)
  $80 rebate
  First 500 units before August 2003
  Call 1-503-525-2700

- Efficiency Maine
  $50 rebate
  Expires December 31, 2003
  Call 1-866-376-2463
  Rebate is available to small businesses, non-profit organizations, public and private schools, and municipalities for facilities in Maine.

- Efficiency Vermont
  $45 rebate
  Expires December 31, 2003
  Call 1-888-921-5990 and press "0" to apply for this rebate or download the application online.

- Great River Energy (29 member co-ops in Minnesota)
  $75 rebate
  Expires December 31, 2003
  Find out if your utility is a member company. Contact Great River Energy at 1-763-241-3682 to apply.

- Hawaiian Electric Company
  $50 rebate through their Energy$olutions Customized Incentives program.
  Contact HECO for pre-approval at 94-POWER. HECO will work with you to process your application and determine your incentive.

- Nevada Power Company

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$100 rebate
Rebate runs out after the first 700 vending machine controllers are purchased in 2003.
Act fast by calling Bayview at 1-800-331-3103 and apply for your rebate.

- **New York State Energy Research & Development Authority**
  Expires March 31, 2004
  Click here to apply.

- **Puget Sound Energy**
  $80 rebate
  Expires December 31, 2003
  Download an application or call Puget Sound Energy with questions at 1-800-562-1482 in the state of Washington or 1-425-454-6363 from out-of-state.

- **Seattle City Light**
  $80 rebate
  Currently no expiration
  Call Seattle City Light at 206-684-3254 to apply. Please make sure to have an approved application BEFORE purchasing VendingMisers.

- **Sierra Pacific Power Company**
  $100 rebate
  Rebate runs out after the first 300 vending machine controllers are purchased in 2003.
  Act fast by calling Bayview at 1-800-331-3103 and apply for your rebate.

- **Silicon Valley Power**
  $120 rebate
  Customers participating in the Silicon Valley Power Energy Audit Program are eligible for this rebate. Customers not participating in an energy audit can still receive an **$80 rebate**. Learn more about the Energy Audit Program by calling Silicon Valley Power at 1-408-615-5694.

- **California's Express Efficiency Program**
  The Express Efficiency Program teams up Pacific Gas & Electric Company, Southern California Edison, and San Diego Gas & Electric Company to help customers reduce energy use and save money. CA's Express Efficiency Program offers a **$30 rebate** for vending machine controllers (VendingMiser qualifies) and a $20 rebate for plug-load sensors (PlugMiser and MonitorMiser Plus qualify). The program has recently broadened their customer eligibility to allow schools, tax-exempt entities, and non-profit organizations to benefit from available rebates. To learn more your utility's participation in the Express Efficiency Program or to apply, please use the following links:

  Pacific Gas & Electric
  Click here to apply.

  San Diego Gas & Electric
  Click here to apply online.

  Southern California Edison
  Click here to apply.

Technology

High Performance Windows and Window Films

Please note the information provided is generally on a square footage basis.

Energy Savings – kWh & Summer Peak Savings

The benefit of, and motivation for, providing incentives on window technologies varies considerable depending on region and perspective regarding heating and cooling. Since Cinergy is an electric only provider in Indiana, we strictly looked at the benefits to cooling load. With this perspective the key window or window film characteristic becomes the solar heat gain coefficient (SHGC). The lower the factor, the lower the heat gain, the greater the air conditioning savings. The coefficient is a number from 0 to 1 that basically corresponds to the percentage of heat that is allowed into the conditioned space.

The analysis would be significantly more complicated if we attempted to consider electric space heat and the importance of the window/glass U-factor and infiltration rates.

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Window Film	12 kWh/square foot/year

Window savings are discounted slightly from window film. We have assumed that window films are added more often to high heat gain windows and new or replacement window installations are done uniformly around a building. The improvement in the SHGC is assumed to be similar for new windows and window film.

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Windows	20 years
Window Film	10 years

Initial One-Time Cost

Windows – $25 to $100 per square foot depending on complexity, features and difficulty of installation. Analysis assumes $60 per square foot.

Window films – costs are in the $3 to $9 per square foot range. Analysis assumed $6 per square foot.

Any Recurring Costs

None

Suggested Incentive

Windows – No incentive is recommended because we feel that incentives that can be reasonably afforded will not impact the purchase decision. The potential air conditioning savings is a very low percentage of the cost of a window, thus for replacement windows, we are assuming air conditioning savings are not a critical component of the decision making process. For new windows the incremental cost of a window that reduces heat gain may be a factor but still likely outweighed by other issues such as location (low SHGC most helpful on south and west exposures), aesthetics, U-factor and other window features.

Window films: $.25/ft^2

We feel incentives can impact decision making process on reflective window film applications. The lower cost, compared to new windows, results in shorter paybacks, indicating decisions for energy efficiency reasons, not others like aesthetics and condition of existing units.

Requirements

A maximum SHGC of .40 after window film application. Application must improve overall SHGC by at least .10.

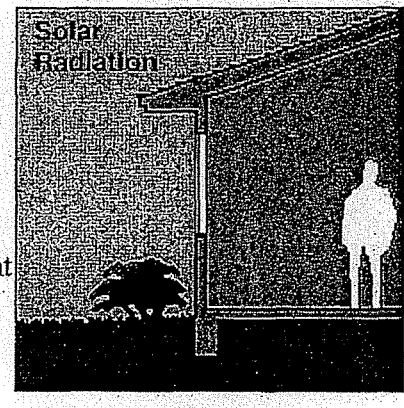
Existing Energy Standards

No meaningful standard. The variability of window location, orientation to the sun, U-factors, SHGC, Visible Transmittance and other variables make establishing a standard very difficult.

Source of Info

Efficient windows collaborative, various manufacturer websites and utility websites

Solar Heat Gain Coefficient (SHGC)



The SHGC is the fraction of incident solar radiation admitted through a window, both admitted through a window, both directly transmitted, and absorbed and subsequently released inward. SHGC is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat it transmits.

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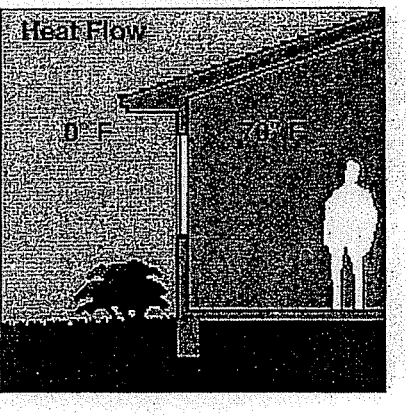
Southern Climate Recommendation: A low SHGC is the most important window property in warm climates. Select windows with a SHGC less than 0.40.

U-Factor | Solar Heat Gain Coefficient | Visible Transmittance | Air Leakage

U-Factor



The rate of heat loss is indicated in terms of the U-factor (U-value) of a window assembly. The insulating value is indicated by the R-value which is the inverse of the U-value. The lower the U-value, the greater a window's resistance to heat flow and the better its insulating value.

Northern Climate Recommendation: Select windows with a U-factor of 0.35 or less. If air conditioning loads are minimal, windows with U-factors as high as 0.40 are also energy-efficient if the Solar Heat Gain Coefficient is 0.50 or higher. Some double-glazed low-e products have U-factors below 0.30. Some three-layer products have U-factors as low as 0.15.

Central Climate Recommendation: Select windows with a U-factor of 0.40 or less. The larger your heating bill, the more important a low U-factor becomes.

Southern Climate Recommendation: A low U-factor is useful during cold days when heating is needed. A low U-factor is helpful during hot days when it is important to keep the heat out, but it is less important than SHGC in warm climates. Select windows with a U-factor lower than 0.75 and preferably lower than 0.60.

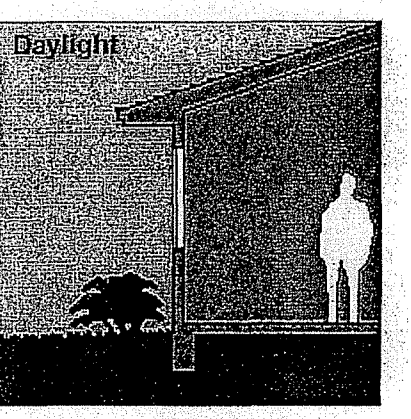
U-Factor | Solar Heat Gain Coefficient | Visible Transmittance | Air Leakage

Efficient Windows Collaborative

Search

RESOURCES

Visible Transmittance (VT)



The visible transmittance (VT) is an optical property that indicates the amount of visible light transmitted. The NFRC's VT is a whole window rating and includes the impact of the frame which does not transmit any visible light. While VT theoretically varies between 0 and 1, most values are between 0.3 and 0.8. The higher the VT, the more light is transmitted. A high VT is desirable to maximize daylight.

Recommendation: Select windows with a higher VT to maximize daylight and view.

U-Factor | Solar Heat Gain Coefficient | Visible Transmittance | Air Leakage

Small Business - IA

Your Account
Payment Options
Customer Service
Rebates & Incentives
Heating & Cooling
Lighting Incentives
Low-Interest Financing
Replacement Windows
Variable Speed Drives
Custom Rebates
Energy Expertise
Safety
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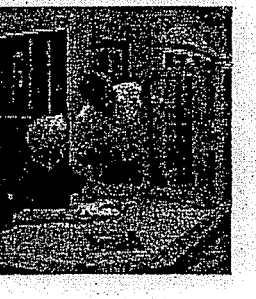
Utility Service: Small Business

Rebates & Incentives – Replacement Windows



With Alliant Energy-Interstate Power and Light's Efficiency Solutions **Replacement Windows** program, you can invest in high-performance windows that can significantly reduce your energy costs without sacrificing style, convenience or comfort.

Download a printable claim form
[PDF format – two pages, 97kb]

Download the customer brochure
[PDF format – two pages, 1.4mb]

How much is the incentive?

Alliant Energy-IPL will pay you $25 per qualifying window!

What types of windows qualify?

- ENERGY STAR-rated windows must be certified by the National Fenestration Ratings Council with a minimum rating of 0.55 or less solar heat gain coefficient and a U-value of 0.40 or less. To simplify product selection, look for an ENERGY STAR® or NFRC label.
- You must replace a minimum of three windows per claim (one opening = one window).
- Minimum window size acceptable is eight square feet.
- Storm window or sash replacement only is not eligible.
- New windows must be purchased and installed between September 1, 2003, and December 31, 2004.
- Applications must be received by January 31, 2005, and submitted within 30 days of window installation.
- Alliant Energy-IPL reserves the right to verify all window installations before funds are issued.
- Other restrictions may apply.

Who is eligible?

- You must be a small business customer of Alliant Energy-IPL in Iowa or Minnesota.
- New windows must be installed in a conditioned space heated or cooled with energy supplied by Alliant Energy-IPL.

How do I find a qualified dealer?

Use our Dealer Locator to find a qualified Efficiency Solutions window retailer near you. They'll help you choose the best windows for your business and make sure they qualify for this program.

Are other incentive options available?

Yes - if you prefer, you can choose our Low-Interest Financing program instead.

How do I apply?

- Download the Replacement Windows claim form [PDF format].

- Print, complete and sign the claim form.
- Attach a copy of your dated, itemized sales receipt from your dealer.
- Mail it to address on the form.

You'll receive a check for the incentive amount directly from Alliant Energy within six to eight weeks. To avoid delays, please make sure your claim form is filled out completely.

Products and services from Alliant Energy detailed here are offered to customers of Interstate Power and Light Company, a wholly-owned subsidiary of Alliant Energy Corp.

This program is effective September 1, 2003, to December 31, 2004, and is subject to periodic review and modification by Alliant Energy. Please check with an Alliant Energy representative regarding program expiration date.

Alliant Energy does not guarantee that installation of high-efficiency equipment will result in reduced usage or demand, or in cost savings. Alliant Energy makes no warranties, expressed or implied, with respect to any equipment purchased and/or installed, including, but not limited to, any warranty of merchantability or fitness for purpose. In no event shall Alliant Energy be liable for any incidental or consequential damage.

Questions?

Call our Small Business Resource Center at **1-866-ALLIANT**, use our Small Business Feedback Form or e-mail smallbusiness@alliantenergy.com.

Small Business - IA

Your Account
Payment Options
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Rebates & Incentives
- Heating & Cooling
- Lighting Incentives
- Low-Interest Financing
- Replacement Windows
- Variable Speed Drives
- Custom Rebates

Energy Expertise
Safety
Resources

Utility Services: Small Business

Rebates & Incentives – Low-Interest Financing

With **Low-Interest Financing** from Alliant Energy-Interstate Power & Light and Wells Fargo Bank, you can invest in energy efficiency without worrying about loan fees, points, security liens or even a down payment.

You can tailor your financial package to meet your needs, and you'll benefit from lower energy costs for years to come.

Download a printable request form
[PDF format – two pages, 93kb]

Download the customer brochure
[PDF format – two pages, 1.3mb]

How do I qualify?

- Financing is available to small business customers of Alliant Energy-IPL in Iowa and Minnesota.
- Eligible property includes owner-occupied single-family homes and small businesses.
- All equipment financed through this program must use electricity or natural gas provided by Alliant Energy-IPL, and must meet minimum energy efficiency standards.

Please note: Alliant Energy-IPL is not involved in the loan approval process. Wells Fargo Bank is an Equal Housing Lender.

What kind of equipment can I finance?

- High-efficiency heating and cooling equipment
- High-efficiency lighting
- Replacement windows
- Variable speed drives

How much can I borrow?

The minimum required amount for each qualified applicant is $1,500. The maximum amount available is $25,000.

What is the interest rate?

The interest rate is a fixed Annual Percentage Rate based on the term of the loan. Terms range between zero to 60 months, with the corresponding APR between zero and 6.9 percent. If you sign a loan for 12 months, you could borrow funds interest-free!

However, if a longer term better suits your financial needs, you could sign for a term of 60 months at 6.9 percent. For example, a loan for $5,000 for a term of 60 months would have monthly payments of $98.77.

The term and interest rate are determined upon origination of the loan. The term and rate are not adjustable following closing.

Are there other fees?

There are no fees to obtain the loan. If you qualify for the loan according to the bank's requirements, you won't have to pay any loan processing

fees, points, down payments or security liens.

Can I apply for other Alliant Energy-IPL incentives?

No - if you participate in the Low-Interest Financing program, you are not eligible for other incentives on the equipment financed.

How do I apply for a loan?

- Download the Low-Interest Financing Claim Form [PDF format].
- Ask your dealer for the specifications on your new equipment, including brand name, model number, size, and energy use.
- Call Alliant Energy's *Home Efficiency Solutions* hotline at **1-800-723-7635**. We'll verify that the equipment meets our energy efficiency standards.
- Complete the claim form and send it to the address shown. We'll fax the information to Wells Fargo Bank, and then a bank representative will contact you regarding the loan application process.
- Wells Fargo Bank will notify you within 48 hours if your loan is approved. After the paperwork is processed, you can have the equipment installed.
- When the equipment is installed, send in your completed verification and release form (provided by your dealer). We'll fax it to Wells Fargo Bank for release of the funds.

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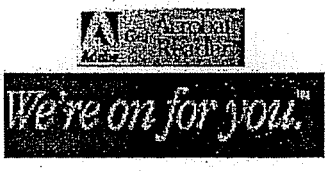

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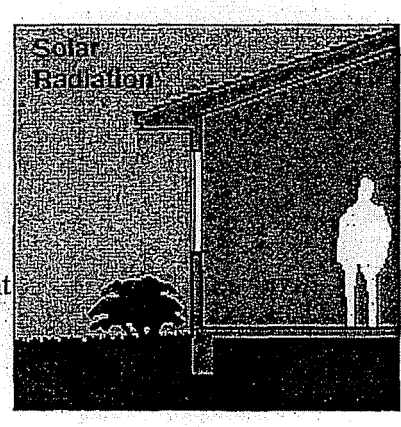

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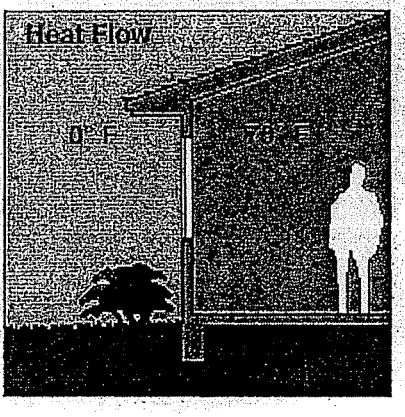
U-Factor



The rate of heat loss is indicated in terms of the U-factor (U-value) of a window assembly. The insulating value is indicated by the R-value which is the inverse of the U-value. The ower the U-value, the greater a window's resistance to heat flow and the better its nsulating value.

Northern Climate Recommendation: Select windows with a U-factor of 0.35 or less. If ir conditioning loads are minimal, windows with U-factors as high as 0.40 are also nergy-efficient if the Solar Heat Gain Coefficient is 0.50 or higher. Some double-glazed ow-e products have U-factors below 0.30. Some three-layer products have U-factors as ow as 0.15.

Central Climate Recommendation: Select windows with a U-factor of 0.40 or less. The arger your heating bill, the more important a low U-factor becomes.

Southern Climate Recommendation: A low U-factor is useful during cold days when heating is needed. A low U-factor helpful during hot days when it is important to keep the heat out, but it is less important than SHGC in warm s. Select windows with a U-factor lower than 0.75 and preferably lower than 0.60.

U-Factor | Solar Heat Gain Coefficient | Visible Transmittance | Air Leakage

Efficient Windows Collaborative

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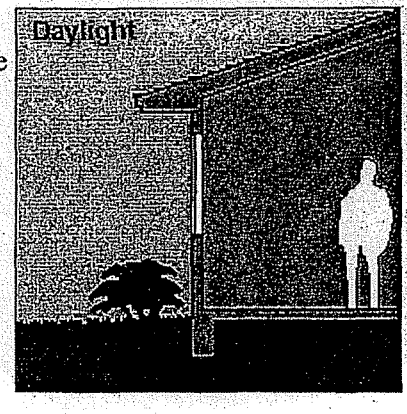
RESOURCES

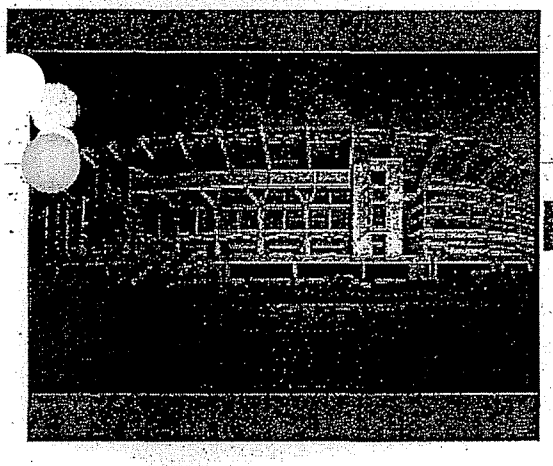
Visible Transmittance (VT)



The visible transmittance (VT) is an optical property that indicates the amount of visible light transmitted. The NFRC's VT is a whole window rating and includes the impact of the frame which does not transmit any visible light. While VT theoretically varies between 0 and 1, most values are between 0.3 and 0.8. The higher the VT, the more light is transmitted. A high VT is desirable to maximize daylight.

Recommendation: Select windows with a higher VT to maximize daylight and view.

U-Factor | Solar Heat Gain Coefficient | Visible Transmittance | Air Leakage



Cleveland Browns Stadium

Products:	1" *Azuria*™/*Sungate*® 500 (3) I.G. Units
Location:	Cleveland, Ohio
Architect:	Hellmuth, Obata & Kassabaum
Glass Fabricator:	Perilstein Distributing Corp.

Click here for more details on this project.
Click here for a listing of additional projects using Sungate®.

SUNGATE® Low-E Coatings

Products Home

PPG ***Sungate***® Low-E glasses enhance energy efficiency and maintain the original clear or tinted glass substrate color.

All ***Sungate***® Low-E insulating glass units improve thermal performance and reduce solar heat gain. Because the coatings are neutral, ***Sungate***® glasses are the ideal solution for energy-efficient commercial structures where the original appearance of the glass is desired.

PPG manufactures two ***Sungate***® coated Low-E glasses for commercial construction.

Sungate® **100 Low-E Glass**
Sungate® 100 glass combines a clear glass appearance with excellent thermal properties.

The U-Value of a ***Sungate***® 100 insulating glass unit is improved 35% compared with a standard clear glass unit. Visible light transmittance of the ***Sungate***® 100 glass unit is 92% as high as a clear uncoated glass unit.

Sungate® **500 Low-E Glass**
Sungate® 500 glass provides the clarity and color neutrality of clear uncoated glass with some of the best performance characteristics available.

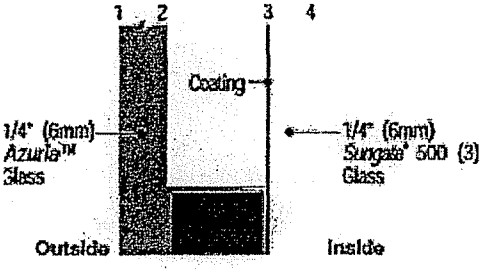
Using ***Sungate***® 500 glass in an insulating unit improves U-Value 27% over a standard clear glass unit. Additionally, the ***Sungate***® 500 glass unit transmits almost 94% as much visible light as a standard clear unit.

Click here to view Architectural Glass Specifications for this and other PPG glass products that can be used to build Section 8800 Glass Specifications for your projects.

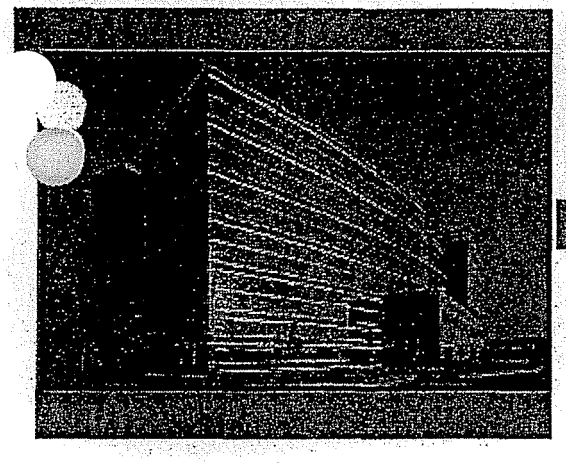
Sungate® **Performance -**
One Inch Insulating Glass Unit Comparison Using 1/4" (6mm) Glass

Product	Visible Light Transmittance %	Winter Nighttime U-value	Shading Coefficient	Light to Solar Gain Ratio (LSG)
***SUNGATE*® 100 Glass**				
Sungate 100 (2) Clear	73	0.31	0.59	1.43
Sungate 100 (3) Clear	73	0.31	0.66	1.30
Sungate 100 (3) *Solexia*	63	0.31	0.47	1.58
Sungate 100 (3) *Atlantica*	55	0.31	0.38	1.72
Sungate 100 (3) *Azuria*	55	0.31	0.37	1.72
Sungate 100 (3) Bronze	44	0.31	0.45	1.13
Sungate 100 (3) Gray	36	0.31	0.40	1.06
Sungate 100 (3) *Optigray 23*	19	0.31	0.24	0.95
Sungate 100 (3) *Graylite*	11	0.31	0.26	0.50
***SOLARCOOL* + *SUNGATE*® 100 Glass**				
Solarcool (2) *Azuria* + 1/2" Air + *Sungate* 100 (3) I.G. Unit	21	0.31	0.20	1.24
Solarcool (2) Bronze + 1/2" Air + *Sungate* 100 (3) I.G. Unit	17	0.31	0.27	0.74
Solarcool (2) Gray + 1/2" Air + *Sungate* 100 (3) I.G. Unit	14	0.31	0.24	0.67
***SUNGATE*® 500 Glass**				
Sungate 500 (2) Clear	74	0.35	0.70	1.23
Sungate 500 (3) Clear	74	0.35	0.75	1.14
Sungate 500 (3) *Solexia*	64	0.35	0.51	1.45
Sungate 500 (3) *Atlantica*	56	0.35	0.40	1.65
Sungate 500 (3) *Azuria*	56	0.35	0.39	1.70
Sungate 500 (3) *Bronze*	44	0.35	0.52	0.98
Sungate 500 (3) Gray	37	0.35	0.45	0.95

Sungate 500 (3) *Optigray 23*	19	0.35	0.27	0.83
Sungate 500 (3) *Graylite*	11	0.35	0.32	0.41
'LARCOOL + SUNGATE® 500 Glass				
ol (2) *Azuria* + 1/2" Air + *Sungate* 500 (3) I.G. Unit	22	0.35	0.22	1.16
Sol ol (2) Bronze + 1/2" Air + *Sungate* 500 (3) I.G. Unit	18	0.35	0.33	0.64
S ol (2) Gray + 1/2" Air + *Sungate* 500 (3) I.G. Unit	14	0.35	0.29	0.56



Azuria (formerly Azurlite®)
Atlantica (formerly Solargreen®)
Solexia (formerly Solex®)



Office Building

Products: 1" *Solarcool® Azuria™* (2) I.G. Units

Location: Brooklyn, Ohio

Architect: KA Inc., Architecture

Glass Fabricator: Hoffer's Glassmont

Click here for more details on this project.
Click here for a listing of additional projects using Solarcool®.

SOLARCOOL® Reflective Tinted Glasses

Products Home

Since their introduction in 1972, PPG ***Solarcool®*** reflective coated glasses have enhanced the appearance of buildings while providing comfortable interiors.

Solarcool® glasses provide maximum flexibility due to the durability of the metallic oxide coating, which is deposited onto the float glass during production.

Thus, ***Solarcool®*** glass can be glazed with the reflective coating positioned on either the first (#1) or second (#2) surface. The glass has improved performance, higher exterior visible reflectivity and a slight bronze hue when installed with the coating on the first surface. When installed with the coating on the second surface, ***Solarcool®*** glass has lower exterior visible reflectivity while maintaining the substrate glass color.

Solarcool® coated glass can be used monolithically or combined with clear glass in an insulating glass unit for greater thermal performance. When joined with PPG's ***Solarban® 60*** solar control, Low-E glasses, even more significant performance results. Click here to see insulated glass unit comparison data.

New! **Solarcool® Caribia™ Glass**
Caribia™ glass, when combined with ***Solarcool®*** coating on the #2 surface, creates a unique warm green aesthetic that blends nicely with the surrounding environment. Along with the other ocean-inspired reflective products, ***Solarcool® Azuria™*** and ***Solarcool® Solexia™*** glasses, ***Solarcool®,Caribia™*** provides both excellent light transmittance and a low solar heat gain coefficient for exceptional solar control performance.

The warm green hue of ***Solarcool® Caribia™*** glass becomes muted when the reflective coating is used on the #1 surface. The result is a more reflective, metallic appearance.

Solarcool® Solexia™ Glass
With the soft reflectivity of ***Solarcool®*** coated glass and light green color of ***Solarcool®*** tinted glass, ***Solarcool® Solexia™*** glass can create standout aesthetics for any commercial project.

When glazed with the reflective coating facing inboard (#2), ***Solarcool®*** (2) ***Solexia™*** glass has a natural-green reflectivity that enhances the beauty of its surroundings, while harmonizing with other natural building materials.

When glazed with reflective coating on the outboard (#1) surface, ***Solarcool®*** (1) ***Solexia™*** glass has higher visible light reflectivity that adapts to changing light conditions and the surrounding andscape.

Solarcool® Azuria™ Glass
Solarcool® coated ***Azuria™*** glass takes the best properties of two superb PPG glass products and combines them into one. With the coating on the #2 surface, the softly reflective aquamarine color of the glass is visually stunning. Because ***Solarcool® Azuria™*** glass transmits more visible light than most competitive products, building interiors will be brighter and will require less artificial lighting.

When the ***Solarcool***® coated surface is in the #1 position, outdoor reflectivity is increased and the solar heat gain is decreased, resulting in reduced air-conditioning loads. Outdoor reflected color is more neutral.

Solarcool® Bronze Glass
Solarcool® bronze glass provides a silver-bronze aesthetic and reduced solar heat gain when glazed with the reflective coating on the outboard (#1) surface and a dark-bronze aesthetic when glazed with the reflective coating on the inboard (#2) surface. With the reflective coating on the #2 surface, ***Solarcool***® bronze glass has subtle reflectivity.

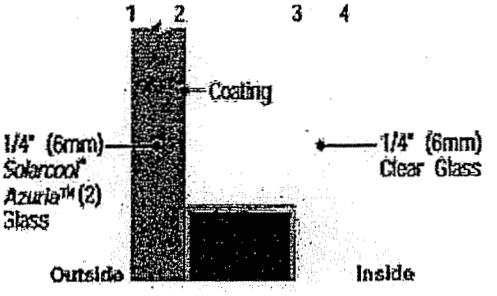
Solarcool® Gray Glass
Solarcool® gray glass provides a silvery aesthetic when glazed with the reflective coating on the outboard (#1) surface and a dark gray aesthetic when glazed with the reflective coating on the inboard (#2) surface. ***Solarcool***® (2) gray glass is the solution when a true gray color is desired in a low-reflectivity glass.

Solarcool® Graylite® Glass
Solarcool® Graylite® glass provides a rich silver aesthetic when glazed with the reflective coating on the outboard (#1) surface and a dramatic, almost-black aesthetic when glazed with the reflective coating on the inboard (#2) surface. The very low visible light transmittance of ***Solarcool® Graylite***® glass (5% for one inch insulating unit) makes it ideal for privacy glazing applications or high sunlight climates where glare control is required

Click here to view Architectural Glass Specifications for this and other PPG glass products that can be used to build Section 08800 Glass Specifications for your projects.

Solarcool® Performance - Monolithic 1/4" (6mm) Glass and One Inch Insulating Glass Unit Comparisons Using 1/4" (6mm) Glass

Product	Visible Light Transmittance %	Winter Nighttime U-value	Shading Coefficient	Light to Solar Gain Ratio (LSG)
***SOLARCOOL* Glass; 1/4" (6mm) Monolithic**				
Solarcool (1) *Azuria* 1/4"/6mm, Monolithic	26	1.09	0.34	0.90
Solarcool (1) *Caribia* 1/4"/6mm, Monolithic	26	1.09	0.35	0.87
Solarcool (1) Bronze 1/4"/6mm, Monolithic	21	1.09	0.46	0.54
Solarcool (1) Gray 1/4"/6mm, Monolithic	17	1.09	0.42	0.47
Solarcool (1) Solexia 1/4"/6mm, Monolithic	9	1.09	0.42	0.83
Solarcool (1) *Graylite* 1/4"/6mm, Monolithic	5	1.09	0.36	0.16
Solarcool (2) *Azuria* 1/4"/6mm, Monolithic	26	1.09	0.41	0.72
Solarcool (2) *Caribia* 1/4"/6mm, Monolithic	26	1.09	0.42	0.72
Solarcool (2) Bronze 1/4"/6mm, Monolithic	21	1.09	0.52	0.47
Solarcool (2) Gray 1/4"/6mm, Monolithic	17	1.09	0.49	0.40
Solarcool (2) Solexia 1/4"/6mm, Monolithic	9	1.09	0.48	0.71
Solarcool (2) *Graylite* 1/4"/6mm, Monolithic	5	1.09	0.44	0.13
***SOLARCOOL* Glass; One Inch Insulating Units**				
Solarcool (1) *Azuria* + 1/2" Air + Clear, I.G. Unit	24	0.48	0.24	1.15
Solarcool (1) *Caribia* + 1/2" Air + Clear, I.G. Unit	23	0.48	0.24	1.10
Solarcool (1) *Bronze* + 1/2" Air + Clear, I.G. Unit	19	0.48	0.35	0.63
Solarcool (1) Gray + 1/2" Air + Clear, I.G. Unit	15	0.48	0.31	0.56
Solarcool (1) Solexia + 1/2" Air + Clear, I.G. Unit	7	0.48	0.31	1.00
Solarcool (1) *Graylite* + 1/2" Air + Clear, I.G. Unit	5	0.48	0.25	0.23
Solarcool (2) *Azuria* + 1/2" Air + Clear, I.G. Unit	24	0.48	0.27	1.00
Solarcool (2) *Caribia* + 1/2" Air + Clear, I.G. Unit	24	0.48	0.28	1.00
Solarcool (2) Bronze + 1/2" Air + Clear, I.G. Unit	19	0.48	0.38	0.58
Solarcool (2) Gray + 1/2" Air + Clear, I.G. Unit	16	0.48	0.35	0.53
Solarcool (2) Solexia + 1/2" Air + Clear, I.G. Unit	7	0.48	0.35	0.90
Solarcool (2) *Graylite* + 1/2" Air + Clear, I.G. Unit	5	0.48	0.29	0.20



Azuria (formerly Azurlite®)
Atlantica (formerly Solargreen®)
Solexia (formerly Solex®)

SOLARBAN 80
SOLAR CONTROL LOW-E GLASS

PPG's Newest Architectural Glass

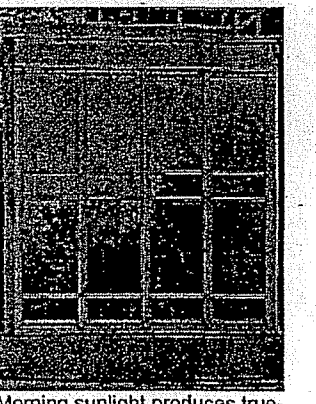
Looks Are Still Everything

Glass Technology
SINCE 1883

Solarban® 80 glass is PPG's newest architectural glass and is designed to address the need of a single product for superior solar control, excellent visible light transmittance and aesthetic appeal.

Like no other glass, ***Solarban® 80*** glass creates a dynamic exterior aesthetic. A sample viewed indoors provides a glimpse of the same steel jade appearance exhibited by ***Solarban® 80*** glass when shaded from the sun. When the glass is bathed in direct sunlight, the glass transforms into a satin reflective finish, with true color reflected images... of the sky that looks blue and trees and landscaping that looks green.

The performance of ***Solarban® 80*** glass is phenomenal, with a solar heat gain coefficient of 0.23 and an excellent U-value that results in the glass helping to control radiant reflected energy from the outdoors. A one-inch insulating unit provides a high visible light transmittance of 47% relative to the superior solar heat gain coefficient of 0.23. This provides building occupants with both solar control and abundant daylighting. The 47% visible light transmittance softens the reflective characteristic of ***Solarban® 80*** glass, letting it appear as non-reflective in the shade while providing some privacy when fully bathed in the sun.

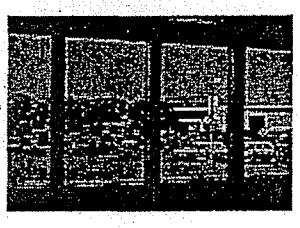


Morning sunlight produces true-to-life reflective images of the sky and trees.

Solarban® 80 glass has a Light to Solar Gain (LSG) Ratio* of an unbeatable 2.04, placing it at the top of its class.

^ one-inch insulating unit of ***Solarban® 80*** (2) clear glass provides:

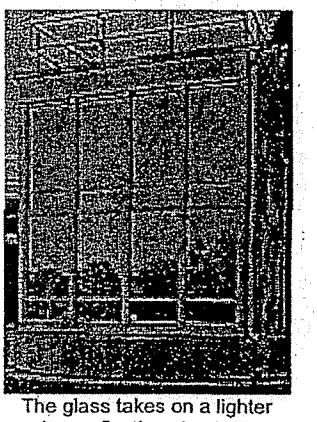
- Optimum balance among visible light transmittance, glare control and superior solar control
- A satin finish that reflects undistorted images, clear and crisp, but not overpowering
- Solar control properties that meet the most stringent mechanical requirements
- True color transmittance for building occupants



Indoors, the 47% visible light transmittance of Solarban 80 glass gives building occupants a clear view of the outdoors.

Indoors, ***Solarban® 80*** glass allows occupants to experience the feeling of being outdoors without enduring the excessive discomfort of the sun's powerful energy.

Designed with architects for architects, ***Solarban® 80*** glass is the first in a series of next-generation solar control, low-emissivity products from PPG. Now, architectural designs can have unparalleled and distinctive aesthetic appearance, solar control that will provide owners with value for years to come, a look that supports the uniqueness of an architectural design, and a glass product occupants will appreciate.



The glass takes on a lighter hue reflecting clouds in morning shade.

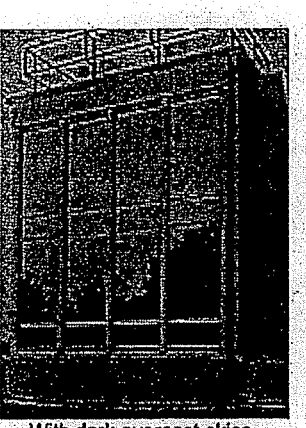
Thermal Stress Factors

The thermal stress factors for ***Solarban® 80*** are as follows:

- North Elevation: 200
- All Other Elevations: 430

Availability

Solarban® 80 glass is available from your regional PPG Certified Fabricator. Part of an elite group of suppliers, PPG Certified Fabricators are ready and able to discuss the needs of your architectural design. PPG Certified Fabricators stand ready to deliver this glass product on time to meet the most demanding project schedule. To help them meet this commitment, PPG maintains an inventory of ***Solarban® 80*** glass strategically located around North America, ensuring availability for your project when it is required.



With dark overcast skies, Solarban 80 glass becomes gray.

To obtain a list of PPG Certified Fabricators' facilities, visit www.ppgcfp.com or call **800-377-5267**

Additional Resources

Click here to view Architectural Glass Specifications for this and other PPG glass products that can be used to build Section 8800 Glass Specifications for your projects.

Click here to order a sample of ***Solarban® 80.***

To learn more about this or other exciting PPG architectural glass products or to obtain a sample, please call the PPG Solutions Hotline at: **800-377-5267** or visit our commercial glass website at www.ppgglazing.com.

To obtain a sample specification of this product or any PPG glass product visit our website at www.ppgspecs.com

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Monolithic Float Glass Data

Glass	Thickness	U-Factor		Shading Coefficient	Solar Heat Gain Coefficient	Transmittance (%)			Reflectance (%)	
		Winter	Summer			UV	Visible	Solar	Visible	Solar
Clear	P-16	1.12	1.03	1.03	.89	78	91	88	8	8
	SGL	1.12	1.03	1.03	.88	77	91	87	8	8
	LAMI	1.11	1.03	1.02	.88	74	91	86	8	8
	1/8	1.11	1.03	1.01	.87	73	90	85	8	8
	5/32	1.10	1.02	1.00	.86	70	90	84	8	8
	3/16	1.10	1.02	0.99	.85	67	89	82	8	8
	1/4	1.09	1.02	0.96	.83	66	88	79	8	7
Clear Heavy	5/16	1.07	1.02	.93	.80	61	87	75	7	7
	3/8	1.06	1.02	.91	.78	58	86	72	7	7
	1/2	1.04	1.01	.87	.75	54	84	68	7	6
	5/8	1.02	0.99	.86	.74	54	84	67	7	6
	3/4	1.00	0.99	.77	.66	38	82	57	6	5
Solarshield Bronze	SGL	1.12	1.07	.89	.76	45	74	70	7	6
	1/8	1.11	1.08	.83	.71	38	68	63	6	6
	5/32	1.10	1.09	.79	.68	32	63	57	6	6
	3/16	1.10	1.09	.75	.64	27	59	53	6	5
	1/4	1.09	1.09	.71	.61	23	54	48	6	5
Solarshield Gray	1/8	1.11	1.09	.81	.70	37	62	61	6	6
	5/32	1.10	1.09	.76	.65	32	56	54	6	6
	3/16	1.10	1.10	.71	.61	28	50	48	5	5
	1/4	1.09	1.10	.67	.58	24	45	43	5	5
Solarshield Green	SGL	1.12	1.08	.87	.75	49	86	67	7	6
	1/8	1.11	1.09	.81	.70	43	83	61	7	6
	3/16	1.10	1.09	.73	.63	34	79	51	7	6
	1/4	1.09	1.10	.70	.60	30	77	47	7	5
Forest Green (HA26 Green)	SGL	1.12	1.10	.79	.68	36	81	58	7	6
	1/8	1.11	1.11	.72	.62	29	77	49	7	5
	3/16	1.10	1.12	.71	.55	20	71	39	7	5
	1/4	1.09	1.12	.60	.51	16	67	34	6	5

For purposes of these performance values, the following Imperial to Metric measurements apply:
1/2 inch = 12 mm; 1/4 inch = 6 mm; 3/16 inch = 5 mm; 5/32 inch = 4 mm; 1/8 inch = 3 mm; SGL = 2.5 mm

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Insulating Glass Data

Please Note: Comfort E2 is a pyrolytic product of AFG Industries, Inc.

Glass	Glass Thickness	Air Space Thickness	U-Factor				Transmittance (%)			Shading Coefficient		Solar Heat Gain Coefficient
			Winter		Summer							
			Air	Argon	Air	Argon	UV	Visible	Solar	Air	Argon	
Dual Glazed Clear/Clear	SS	1/4	.57	.52	.61	.57	63	83	77	.92	.93	.80
	SS	1/2	.50	.46	.54	52	63	83	77	.93	.93	.80
	1/8"	1/4	.57	.52	.61	.57	58	82	74	.90	.90	.78
	1/8"	1/2	.49	.46	.55	.52	58	82	74	.90	.91	.78
	3/16"	1/4	.56	.51	.61	.57	51	80	69	.87	.87	.75
	3/16"	1/2	.49	.46	.55	.52	51	80	69	.87	.87	.75
	1/4"	1/4	.56	.51	.62	.58	50	78	64	.83	.84	.72
	1/4"	1/2	.48	.45	.55	.53	50	78	64	.84	.84	.72
Dual Glazed Comfort-E2 with Clear (3)	SS	1/4	.46	.38	.51	.43	47	76	62	.84	.85	.73
	SS	1/2	.35	.31	.38	.33	47	76	62	.86	.86	.74
	1/8"	1/4	.46	.38	.51	.43	44	76	60	.83	.83	.71
	1/8"	1/2	.35	.30	.38	.33	44	76	60	.84	.84	.72
	3/16"	1/4	.45	.38	.51	.43	40	74	56	.80	.81	.69
	3/16"	1/2	.35	.30	.38	.33	40	74	56	.81	.82	.70
	1/4"	1/4	.45	.38	.50	.43	39	73	53	.77	.78	.67
	1/4"	1/2	.35	.30	.38	.33	39	73	53	.79	.79	.68
Dual Glazed Comfort-E2 with Bronze (3)	SS	1/4	.46	.38	.51	.44	30	62	49	.70	.71	.61
	SS	1/2	.35	.30	.39	.33	30	62	49	.71	.71	.61
	1/8"	1/4	.46	.38	.51	.44	25	57	44	.65	.65	.56
	1/8"	1/2	.35	.30	.39	.34	25	57	44	.65	.65	.56
	3/16"	1/4	.45	.38	.51	.44	18	49	36	.56	.56	.48
	3/16"	1/2	.35	.30	.39	.34	18	49	36	.56	.56	.48
	1/4"	1/4	.45	.38	.51	.44	15	45	32	.52	.52	.45
	1/4"	1/2	.35	.30	.39	.34	15	45	32	.51	.51	.44
Dual Glazed Comfort-E2 with Gray (3)	1/8"	1/4	.46	.38	.51	.44	24	52	42	.63	.63	.54
	1/8"	1/2	.35	.30	.39	.34	24	52	42	.62	.62	.54
	3/16"	1/4	.45	.38	.51	.44	19	42	33	.53	.52	.45
	3/16"	1/2	.35	.30	.39	.34	19	42	33	.52	.52	.45
	1/4"	1/4	.45	.38	.51	.44	16	37	29	.48	.48	.42
	1/4"	1/2	.35	.30	.39	.34	16	37	29	.47	.47	.41
Dual Glazed Comfort E2 with AFG Solarshield Green (3)	SS	1/4	.46	.38	.51	.44	33	72	48	.69	.69	.59
	SS	1/2	.35	.31	.39	.33	33	72	48	.69	.69	.59
	1/8"	1/4	.46	.38	.51	.44	28	69	43	.63	.63	.54
	1/8"	1/2	.35	.30	.39	.34	28	69	43	.63	.63	.54
	3/16"	1/4	.45	.38	.51	.44	22	66	36	.55	.55	.48
	3/16"	1/2	.35	.30	.39	.34	22	66	36	.55	.54	.47
	1/4"	1/4	.45	.38	.51	.44	19	63	33	.52	.51	.45
	1/4"	1/2	.35	.30	.39	.34	19	63	33	.51	.50	.44

Notes:
(1) Performance values are based on representative production samples.
Actual values may differ due to variations in the manufacturing process.
(2) Performance Data calculated using LBL Window 4.1.
(3) Comfort E2 installedon surface #3.

For purposes of these performance values, the following Imperial to Metric measurements apply:
1/2 inch = 12 mm; 1/4 inch = 6 mm; 3/16 inch = 5 mm; 1/8 inch = 3 mm; SS/SGL = 2.5 mm;

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Monolithic Comfort E2 Performance Data*

Glass Thickness	Transmittance (%)			Reflectance (%)				U-Factor (BTU/h/ft²/°F) (Winter)	Shading Coefficient	Solar Heat Gain Coefficient
	Visible	Solar	Ultraviolet	Visible		Solar				
				rf	rb	rf	rb			
SGL	83	70	57	9	10	10	12	.77	.85	.73
1/8"	83	69	55	9	10	10	12	.77	.84	.72
5/32"	83	67	52	9	10	10	12	.76	.83	.71
3/16"	83	66	52	9	10	9	12	.76	.82	.71
1/4"	82	65	50	9	10	9	12	.75	.81	.70

*Performance Data Calculated Using LBL Window 4.1. All calculations with coating on second surface.

Glazing Performance Comparison Data* Center of Glass Values

Glass	Transmittance (%)		U-Factor (BTU/h/ft²/°F)		R-Value (1 ÷ U-Factor)		Solar Heat Gain Coefficient		Shading Coefficient		UV% Transmission	Interior Surface Glass Temperature (F) (5)	
	Visible	Solar	Air	Argon	Air	Argon	Air	Argon	Air	Argon		Air	Argon
Monolithic Clear	90	85	1.11	NA	0.90	NA	.87	NA	1.00	NA	73	17	NA
Dual Glazed Clear and Clear	82	74	.49	.46	2.04	2.17	.78	.78	.90	.91	58	45	47
Triple Glazed Clr-Clr-Clr	75	64	.32	.29	3.13	3.45	.70	.70	.82	.82	48	54	55
Dual Glazed Clear with Comfort E2 (1)	76	60	.35	.30	2.86	3.33	.72	.73	.84	.84	44	52	54
Triple Glazed Clear Clear with Comfort E2 (2)	69	52	.24	.21	4.17	4.76 (4)	.65	.66	.76	.76 (4)	37	57	59
Triple Glazed Comfort E2 (3) with Clear and Comfort E2 (2)	64	45	.20	.17	5.00	5.88 (4)	.56	.56	.65	.66 (4)	28	59	61

*Performance Data Calculated Using LBL Window 4.1.(1/8" glass - 1/2" space)
(1) Comfort E2 installed on number three (3) surface.
(2) Comfort E2 installed on number five (5) surface.
(3) Comfort E2 installed on number two (2) surface.
(4) All airspaces Argon filled.
(5) Nighttime outside temperature of 0°F, inside temperature of 70°F with 15 mph. wind speed.

Comfort E2 Typical Insulating Glass Performance**

Glass	Glass Thickness	Transmittance (%)		Air Space Thickness	U-Factor (Winter)		Shading Coefficient		Relative Heat Gain	UV% Transmission
		Visible	Solar		Air	Argon	Air	Argon		
Dual Glazed Clear/Clear	SS	83	77	1/4"	.57	.52	.92	.93	193	63
	SS	83	77	1/2"	.50	.46	.93	.93	193	63
	1/8"	82	74	1/4"	.57	.52	.90	.90	189	58
	1/8"	82	74	1/2"	.49	.46	.90	.91	189	58
	3/16"	80	69	1/4"	.56	.51	.87	.87	182	51
	3/16"	80	69	1/2"	.49	.46	.87	.87	182	51
	1/4"	78	64	1/4"	.56	.51	.83	.84	176	50
	1/4"	78	64	1/2"	.48	.45	.84	.84	175	50
Dual Glazed Comfort E2 with Clear (1)	SS	76	62	1/4"	.46	.38	.84	.85	176	47
	SS	76	62	1/2"	.35	.31	.86	.86	177	47
	1/8"	76	60	1/4"	.46	.38	.83	.83	172	44
	1/8"	76	60	1/2"	.35	.30	.84	.84	173	44
	3/16"	74	56	1/4"	.45	.38	.80	.81	167	40
	3/16"	74	56	1/2"	.35	.30	.81	.82	168	40
	1/4"	73	53	1/4"	.45	.38	.77	.78	162	39
	1/4"	73	53	1/2"	.35	.30	.79	.79	163	39
	SS	62	49	1/4"	.46	.38	.70	.71	148	30

Dual Glazed Comfort E2 with AFG Bronze (1)	SS	62	49	1/2"	.35	.31	.71	.71	147	30
	1/8"	57	44	1/4"	.46	.38	.65	.65	136	25
	1/8"	57	44	1/2"	.35	.30	.65	.65	134	25
	3/16"	49	36	1/4"	.45	.38	.56	.56	120	18
	3/16"	49	36	1/2"	.35	.30	.56	.56	117	18
	1/4"	45	32	1/4"	.45	.38	.52	.52	111	15
	1/4"	45	32	1/2"	.35	.30	.51	.51	108	15
Dual Glazed Comfort E2 with AFG Gray (1)	1/8"	52	42	1/4"	.46	.38	.63	.63	132	24
	1/8"	52	42	1/2"	.35	.30	.62	.62	130	24
	3/16"	42	33	1/4"	.45	.38	.53	.52	112	19
	3/16"	42	33	1/2"	.35	.30	.52	.52	110	19
	1/4"	37	29	1/4"	.45	.38	.48	.48	104	16
	1/4"	37	29	1/2"	.35	.30	.47	.47	100	16
Dual Glazed Comfort E2 with AFG Green (1)	1/8"	69	43	1/4"	.46	.38	.63	.63	133	28
	1/8"	69	43	1/2"	.35	.30	.63	.63	131	28
	3/16"	66	36	1/4"	.45	.38	.55	.55	118	22
	3/16"	66	36	1/2"	.35	.30	.55	.54	115	22
	1/4"	63	33	1/4"	.45	.38	.52	.51	111	19
	1/4"	63	33	1/2"	.35	.30	.51	.50	107	19

**Performance Data Calculated Using LBL Window 4.1.
(1) Comfort E2 installed on number three (3) surface.

For purposes of these performance values, the following Imperial to Metric measurements apply:
1/2 inch = 12 mm;1/4 inch = 6 mm; 3/16 inch = 5 mm; 5/32 inch = 4 mm; 1/8 inch = 3 mm; SGL = 2.5 mm

Typical Window (1) U-Value Using Comfort E2 Glass*
Type of Frame Material

Spacer Type		Vinyl	Wood	Thermally Broken Aluminum	Aluminum
Aluminum	Air	.37	.40	.56	.80
	Argon	.35	.38	.53	.77
Stainless Steel	Air	.36	.39	.55	.79
	Argon	.33	.36	.52	.75
Butyl-Metal	Air	.34	.39	.54	.78
	Argon	.32	.36	.51	.75
Insulating	Air	.34	.37	.53	.76
	Argon	.31	.34	.49	.73

*Performance Data Calculated Using LBL Window 4.1.
(1) Typical 24" x 48" casement window with insulated unit makeup 1/8" clear - 1/2" airspace - 1/8" Comfort E2 on third surface.

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Product	Transmittance visible	solar	UV	Reflectance vis-out	vis-in	solar	ASHRAE U-Value winter	summer	Shading Coefficient	Relative Heat Gain	SHGC	European U-Value
1" (24mm) Clear VE 1-2M #2	70%	32%	10%	11%	12%	31%	0.29	0.28	0.43	90	0.37	1.6
1" (24mm) Green VE 2-2M #2	60%	24%	5%	9%	11%	10%	0.29	0.30	0.35	74	0.30	1.6
1" (24mm) Gray VE 3-2M #2	35%	17%	4%	6%	10%	13%	0.29	0.30	0.27	58	0.23	1.6
1" (24mm) Bronze VE 4-2M #2	42%	19%	5%	7%	10%	16%	0.29	0.30	0.30	64	0.26	1.6
1" (24mm) Blue VE 5-2M #2	44%	20%	6%	7%	10%	12%	0.29	0.30	0.31	66	0.27	1.6
1" (24mm) Blue-Green VE 6-2M #2	60%	25%	6%	10%	11%	12%	0.29	0.30	0.36	75	0.31	1.6
1" (24mm) Azurlite VE 7-2M #2	54%	20%	7%	8%	11%	7%	0.29	0.30	0.31	66	0.27	1.6
1" (24mm) EverGreen VE 8-2M #2	53%	20%	3%	8%	10%	7%	0.29	0.30	0.30	65	0.26	1.6

Notes:

1. This performance data applies to insulating glass with two plies (clear inboard) of 1/4" (6 mm) glass and a 1/2" (13 mm) air space. All coatings are applied to the second surface.
2. If Solarscreen reflective coatings are applied to tinted glass, the glass must be heat treated.
3. Solarscreen 2000 coated products require minimum orders.

Solarscreen Code Chart

Coating Type	Outboard Glass Substrate
VS = Stainless Steel	1 = Clear
VT = Titanium Blue	2 = Green
VA = Antique Silver	3 = Gray
VE = Low-E	4 = Bronze
VY = Crystal Chrome	5 = Blue
VH = VH Series	6 = Blue-Green
VRE = Radiant Low-E	7 = Azurlite™
	8 = EverGreen™

The solar and optical data presented in this guide is based on the National Fenestration Rating Council measurement standards. They were calculated using Lawrence Berkeley Laboratories (LBL) new WINDOW 4.1 software. In some cases performance data changed in comparison to

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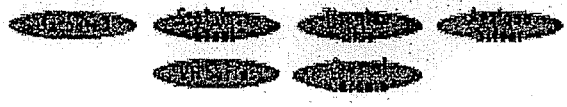
Product	Transmittance visible	solar	UV	Reflectance vis-out	vis-in	solar	ASHRAE U-Value winter	summer	Shading Coefficient	Relative Heat Gain	SHGC	European U-Value
1/2" (12.76mm) Clear VS 1-08 #2	8%	5%	< 1%	42%	38%	34%	1.02	1.05	0.25	65	0.21	5.4
1/2" (12.76mm) Clear VS 1-14 #2	13%	9%	< 1%	32%	38%	27%	1.02	1.05	0.30	75	0.26	5.4
1/2" (12.76mm) Clear VS 1-20 #2	19%	12%	< 1%	24%	33%	21%	1.02	1.06	0.35	85	0.30	5.4
1/2" (12.76mm) Clear VS 1-30 #2	28%	19%	< 1%	15%	27%	14%	1.02	1.06	0.42	100	0.37	5.4
1/2" (12.76mm) Clear VS 1-40 #2	38%	26%	< 1%	10%	22%	9%	1.02	1.05	0.50	115	0.43	5.4
1/2" (12.76mm) Green VS 2-08 #2	7%	3%	< 1%	31%	38%	16%	1.02	1.07	0.29	73	0.25	5.4
1/2" (12.76mm) Green VS 2-14 #2	11%	5%	< 1%	24%	37%	14%	1.02	1.07	0.32	78	0.27	5.4
1/2" (12.76mm) Green VS 2-20 #2	16%	8%	< 1%	18%	33%	11%	1.02	1.07	0.34	84	0.30	5.4
1/2" (12.76mm) Green VS 2-30 #2	25%	12%	< 1%	12%	26%	8%	1.02	1.07	0.39	94	0.34	5.4
1/2" (12.76mm) Green VS 2-40 #2	32%	16%	< 1%	8%	22%	6%	1.02	1.07	0.43	100	0.37	5.4
1/2" (12.76mm) Gray VS 3-08 #2	4%	3%	< 1%	14%	38%	15%	1.02	1.07	0.29	73	0.25	5.4
1/2" (12.76mm) Gray VS 3-14 #2	7%	5%	< 1%	12%	38%	13%	1.02	1.07	0.32	78	0.27	5.4
1/2" (12.76mm) Gray VS 3-20 #2	10%	7%	< 1%	10%	33%	11%	1.02	1.07	0.34	83	0.29	5.4
1/2" (12.76mm) Gray VS 3-30 #2	14%	10%	< 1%	7%	27%	6%	1.02	1.08	0.38	91	0.33	5.4
1/2" (12.76mm) Gray VS 3-40 #2	19%	14%	< 1%	6%	22%	6%	1.02	1.07	0.41	98	0.36	5.4
1/2" (12.76mm) Bronze VS 4-08 #2	5%	3%	< 1%	17%	38%	16%	1.02	1.07	0.29	73	0.25	5.4
1/2" (12.76mm) Bronze VS 4-14 #2	8%	5%	< 1%	14%	39%	13%	1.02	1.07	0.32	78	0.27	5.4
1/2" (12.76mm) Bronze VS 4-20 #2	11%	8%	< 1%	11%	33%	11%	1.02	1.07	0.34	84	0.30	5.4
1/2" (12.76mm) Bronze VS 4-30 #2	17%	12%	< 1%	8%	27%	6%	1.02	1.08	0.39	93	0.34	5.4
1/2" (12.76mm) Bronze VS 4-40 #2	23%	16%	< 1%	6%	22%	6%	1.02	1.07	0.43	101	0.37	5.4
1/2" (12.76mm) Blue VS 5-08 #2	5%	3%	< 1%	18%	38%	14%	1.02	1.08	0.29	74	0.25	5.4
1/2" (12.76mm) Blue VS 5-14 #2	8%	5%	< 1%	15%	38%	12%	1.02	1.08	0.32	79	0.27	5.4
1/2" (12.76mm) Blue VS 5-20 #2	12%	7%	< 1%	12%	33%	10%	1.02	1.08	0.34	83	0.29	5.4
1/2" (12.76mm) Blue VS 5-30 #2	17%	11%	< 1%	8%	27%	8%	1.02	1.07	0.38	91	0.33	5.4
1/2" (12.76mm) Blue VS 5-40 #2	24%	15%	< 1%	7%	22%	6%	1.02	1.07	0.42	99	0.36	5.4
1/2" (12.76mm) Blue-Green VS 6-08 #2	7%	4%	< 1%	31%	38%	18%	1.02	1.07	0.29	72	0.25	5.4
1/2" (12.76mm) Blue-Green VS 6-14 #2	11%	6%	< 1%	24%	39%	15%	1.02	1.07	0.31	78	0.27	5.4
1/2" (12.76mm) Blue-Green VS 6-20 #2	16%	8%	< 1%	18%	33%	12%	1.02	1.07	0.35	84	0.30	5.4
1/2" (12.76mm) Blue-Green VS 6-30 #2	25%	13%	< 1%	11%	26%	8%	1.02	1.07	0.40	95	0.34	5.4
1/2" (12.76mm) Blue-Green VS 6-40 #2	32%	17%	< 1%	8%	22%	7%	1.02	1.07	0.44	103	0.38	5.4
1/2" (12.76mm) Azurlite VS 7-08 #2	6%	3%	< 1%	27%	36%	13%	1.02	1.08	0.29	74	0.25	5.4
1/2" (12.76mm) Azurlite VS 7-14 #2	10%	4%	< 1%	21%	36%	11%	1.02	1.08	0.31	78	0.27	5.4
1/2" (12.76mm) Azurlite VS 7-20 #2	15%	6%	< 1%	16%	31%	9%	1.02	1.08	0.34	82	0.29	5.4
1/2" (12.76mm) Azurlite VS 7-30 #2	21%	9%	< 1%	11%	27%	7%	1.02	1.08	0.37	88	0.31	5.4
1/2" (12.76mm) Azurlite VS 7-40 #2	29%	12%	< 1%	8%	22%	6%	1.02	1.08	0.40	94	0.34	5.4
1/2" (12.76mm) EverGreen VS 8-08 #2	6%	2%	< 1%	25%	38%	12%	1.02	1.08	0.30	74	0.26	5.4
1/2" (12.76mm) EverGreen VS 8-14 #2	10%	4%	< 1%	20%	38%	10%	1.02	1.08	0.32	78	0.27	5.4
1/2" (12.76mm) EverGreen VS 8-20 #2	14%	6%	< 1%	15%	33%	9%	1.02	1.08	0.34	83	0.29	5.4
1/2" (12.76mm) EverGreen VS 8-30 #2	21%	10%	< 1%	10%	26%	6%	1.02	1.08	0.37	89	0.32	5.4
1/2" (12.76mm) EverGreen VS 8-40 #2	28%	12%	< 1%	8%	22%	6%	1.02	1.08	0.40	95	0.35	5.4

Notes:

1. This performance data applies to laminated glass constructed with two plies (clear inboard) of 1/4" (6 mm) glass and one ply of clear .030" (.76 mm) pvb interlayer.
2. If Solarscreen reflective coatings are applied to clear glass, contact Viracon's Technical Services Department to determine the possibility of using annealed glass.
3. If Solarscreen reflective coatings are applied to tinted glass, the glass must be heat treated. In this case, a .060" (1.5 mm) pvb interlayer may be required.



Solarscreen Code Chart

Coating Type	Outboard Glass Substrate
VS = Stainless Steel	1 = Clear
VT = Titanium Blue	2 = Green
VA = Antique Silver	3 = Gray
VE = Low-E	4 = Bronze
VY = Crystal Chrome	5 = Blue
VH = VH Series	6 = Blue-Green
VRE = Radiant Low-E	7 = Azurlite™
	8 = EverGreen™

The solar and optical data presented in this guide is based on the National Fenestration Rating Council measurement standards. They were calculated using Lawrence Berkeley Laboratories (LBL) new WINDOW 4.1 software. In some cases performance data changed in comparison to previous versions of LBL's WINDOW program.

Los datos solares y ópticos que se ofrecen en esta guía están basados en los estándares de medida del National Fenestration Rating Council. Los datos se calcularon utilizando el software WINDOW 4.1 de los Laboratorios Lawrence Berkeley (LBL). En algunos casos los datos de desempeño cambiaron en comparación con las versiones anteriores del programa WINDOW de LBL.

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SOLARSCREEN STAINLESS STEEL REFLECTIVE MONOLITHIC GLASS

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Product	Transmittance visible	solar	UV	Reflectance vis-out	vis-in	solar	ASHRAE U-Value winter	summer	Shading Coefficient	Relative Heat Gain	SHGC	European U-Value
1/4" (6mm) Clear VS 1-08 #2	8%	6%	4%	42%	38%	33%	0.84	0.83	0.22	56	0.19	4.3
1/4" (6mm) Clear VS 1-14 #2	14%	11%	8%	32%	38%	27%	0.88	0.88	0.29	69	0.25	4.5
1/4" (6mm) Clear VS 1-20 #2	20%	15%	11%	24%	32%	21%	0.93	0.95	0.35	84	0.30	4.9
1/4" (6mm) Clear VS 1-30 #2	29%	23%	17%	14%	27%	14%	0.99	1.01	0.45	105	0.39	5.1
1/4" (6mm) Clear VS 1-40 #2	40%	32%	22%	9%	22%	9%	1.03	1.05	0.55	126	0.48	5.4
1/4" (6mm) Green VS 2-08 #2	7%	4%	2%	31%	38%	16%	0.84	0.86	0.24	61	0.21	4.3
1/4" (6mm) Green VS 2-14 #2	11%	6%	4%	24%	38%	14%	0.88	0.91	0.28	69	0.24	4.5
1/4" (6mm) Green VS 2-20 #2	17%	9%	5%	18%	32%	11%	0.93	0.97	0.33	80	0.28	4.9
1/4" (6mm) Green VS 2-30 #2	26%	15%	9%	11%	26%	8%	0.99	1.03	0.40	95	0.35	5.1
1/4" (6mm) Green VS 2-40 #2	33%	19%	9%	8%	22%	6%	1.03	1.07	0.45	106	0.39	5.4
1/4" (6mm) Gray VS 3-08 #2	4%	4%	2%	14%	38%	15%	0.84	0.86	0.25	62	0.21	4.3
1/4" (6mm) Gray VS 3-14 #2	7%	6%	4%	12%	38%	13%	0.88	0.91	0.29	70	0.25	4.5
1/4" (6mm) Gray VS 3-20 #2	10%	9%	5%	10%	32%	11%	0.93	0.97	0.33	80	0.29	4.9
1/4" (6mm) Gray VS 3-30 #2	15%	12%	6%	7%	27%	6%	0.99	1.03	0.39	92	0.33	5.1
1/4" (6mm) Gray VS 3-40 #2	20%	17%	9%	6%	21%	6%	1.03	1.07	0.44	104	0.38	5.4
1/4" (6mm) Bronze VS 4-08 #2	5%	4%	1%	17%	38%	16%	0.84	0.86	0.25	62	0.21	4.3
1/4" (6mm) Bronze VS 4-14 #2	8%	6%	3%	14%	38%	13%	0.88	0.91	0.29	70	0.25	4.5
1/4" (6mm) Bronze VS 4-20 #2	12%	9%	4%	11%	31%	11%	0.93	0.97	0.33	81	0.29	4.9
1/4" (6mm) Bronze VS 4-30 #2	18%	14%	6%	7%	27%	6%	0.99	1.03	0.41	95	0.35	5.1
1/4" (6mm) Bronze VS 4-40 #2	24%	20%	8%	6%	21%	6%	1.03	1.07	0.47	108	0.40	5.4
1/4" (6mm) Blue VS 5-08 #2	5%	4%	2%	18%	38%	14%	0.84	0.86	0.25	62	0.21	4.3
1/4" (6mm) Blue VS 5-14 #2	8%	6%	4%	15%	38%	12%	0.88	0.91	0.29	70	0.25	4.5
1/4" (6mm) Blue VS 5-20 #2	12%	9%	5%	12%	32%	10%	0.93	0.97	0.33	80	0.28	4.9
1/4" (6mm) Blue VS 5-30 #2	18%	13%	8%	8%	27%	8%	0.99	1.03	0.39	92	0.34	5.1
1/4" (6mm) Blue VS 5-40 #2	25%	18%	11%	6%	21%	6%	1.03	1.07	0.45	105	0.39	5.4
1/4" (6mm) Blue-Green VS 6-08 #2	7%	4%	2%	31%	38%	18%	0.84	0.86	0.24	61	0.21	4.3
1/4" (6mm) Blue-Green VS 6-14 #2	11%	7%	4%	24%	38%	15%	0.88	0.91	0.29	70	0.25	4.5
1/4" (6mm) Blue-Green VS 6-20 #2	17%	10%	5%	18%	32%	12%	0.93	0.97	0.33	81	0.29	4.9
1/4" (6mm) Blue-Green VS 6-30 #2	26%	16%	9%	11%	26%	8%	0.99	1.02	0.41	96	0.35	5.1
1/4" (6mm) Blue-Green VS 6-40 #2	34%	21%	11%	8%	22%	6%	1.03	1.07	0.47	108	0.40	5.4
1/4" (6mm) Azurlite VS 7-08 #2	6%	3%	3%	27%	37%	13%	0.84	0.87	0.24	61	0.21	4.3
1/4" (6mm) Azurlite VS 7-14 #2	10%	5%	5%	21%	38%	11%	0.88	0.91	0.28	68	0.24	4.5
1/4" (6mm) Azurlite VS 7-20 #2	15%	7%	7%	16%	32%	9%	0.93	0.98	0.32	77	0.27	4.9
1/4" (6mm) Azurlite VS 7-30 #2	22%	10%	11%	11%	27%	7%	0.99	1.03	0.36	87	0.31	5.1
1/4" (6mm) Azurlite VS 7-40 #2	30%	14%	15%	7%	21%	6%	1.03	1.08	0.41	98	0.35	5.4
1/4" (6mm) EverGreen VS 8-08 #2	6%	3%	1%	25%	38%	12%	0.84	0.87	0.25	62	0.21	4.3
1/4" (6mm) EverGreen VS 8-14 #2	10%	5%	2%	20%	38%	10%	0.88	0.91	0.28	69	0.24	4.5
1/4" (6mm) EverGreen VS 8-20 #2	15%	7%	2%	15%	32%	9%	0.93	0.98	0.32	77	0.27	4.9
1/4" (6mm) EverGreen VS 8-30 #2	22%	10%	3%	9%	26%	6%	0.99	1.03	0.37	89	0.32	5.1
1/4" (6mm) EverGreen VS 8-40 #2	30%	14%	5%	7%	21%	5%	1.03	1.08	0.42	99	0.36	5.4

Notes:

1. This performance data applies to 1/4" (6 mm) glass. All Solarscreen reflective coatings are applied to the second surface.
2. If Solarscreen reflective coatings are applied to tinted glass, the glass must be heat treated.
3. If Solarscreen reflective coatings are applied to clear glass, contact Viracon's Technical Services Department to determine the possibility of using annealed glass.

Solarscreen Code Chart

Coating Type	Outboard Glass Substrate
VS = Stainless Steel	1 = Clear
VT = Titanium Blue	2 = Green
VA = Antique Silver	3 = Gray
VE = Low-E	4 = Bronze
VY = Crystal Chrome	5 = Blue
VH = VH Series	6 = Blue-Green
VRE = Radiant Low-E	7 = Azurlite™
	8 = EverGreen™

The solar and optical data presented in this guide is based on the National Fenestration Rating Council measurement standards. They were calculated using Lawrence Berkeley Laboratories (LBL) new WINDOW 4.1 software. In some cases performance data changed in comparison to previous versions of LBL's WINDOW program.

Los datos solares y ópticos que se ofrecen en esta guía están basados en los estándares de medida del National Fenestration Rating Council. Los datos se calcularon utilizando el software WINDOW 4.1 de los Laboratorios Lawrence Berkeley (LBL). En algunos casos los datos de desempeño cambiaron en comparación con las versiones anteriores del programa WINDOW de LBL.

glass@viracon.com

Search

Rebate Details

Rebate Program:	Commercial Advantage Program - Reflective Window Film
Rebate Amount:	$0.50/square foot
Deadline:	See Program Administrator for Details
Entity Information:	City of Palo Alto Utilities
Type:	Business
Description:	This program offers incentives for installing energy-efficient reflective window film.
Related Products:	Windows
Phone:	(650) 329-2241
Rebate URL:	www.cpau.com/programs/ci-advantage/cindex.html
Category:	Windows

Print Page | Close Window

3M Scotchtint™ Sun Control Window Film

Night Vision Series

Product Benefits

- A warm bronze natural hue invites warmth and beauty to any room
- Low interior and exterior reflectivity, especially at night!
- Great heat rejection for dual pane windows
- New 3M technology means stability you can live with!
- Reduce air conditioning costs and stay cooler by reducing excessive solar heat especially in hot sunny climates.
- Extend the life and vibrancy in the fabric of furniture and carpets.
- Increases personal safety from flying or broken glass.

Performance Data

With NV-25	¼" single clear	¼" single tinted	Double Pane Clear	Double Pane Tinted
Solar Heat Reduction	59%	48%	38%	32%
Heat Loss Reduction	1%	1%	6%	6%
Glare Reduction	72%	72%	71%	71%
UV Blocked	99%	99%	99%	99%
Total Solar Energy Rejected	66%	67%	57%	67%

Technical Data

Glass Type	Applied Product	Shading Coefficient	Visible Light		Visible Light Transmitted	Emissivity	"U" Value
			Exterior Reflection	Interior Reflection			
¼" single clear	None	0.94	8%	8%	0.88	0.84	1.06
	NV-25	0.39	29%	13%	0.24	0.72	1.05
¼" single tinted	None	0.69	5%	5%	0.50	0.84	1.06
	NV-25	0.38	12%	13%	0.14	0.72	1.05
Double Pane Clear	None	0.81	14%	14%	0.78	0.84	0.50
	NV-25	0.50	32%	13%	0.22	0.72	0.47
Double Pane Tinted	None	0.55	8%	8%	0.45	0.84	0.50
	NV-25	0.37	15%	13%	0.13	0.72	0.47

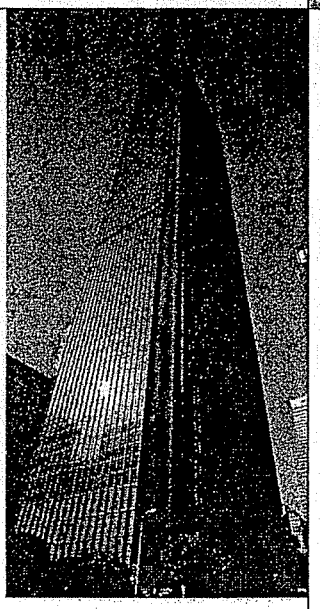
3M™ Window Film Solutions

Consumer Safety and Light Management

3M Canada Company
www.3M.com/windowfilm
1-800-3M-HELPS

3M™ Night Vision™ Window Film Saves Energy, Improves Views at L.A. Skyscraper

CASE HISTORY



PROBLEM

At 62 stories, the AON Center, towering over the sweeping vistas of Los Angeles, is one of the world's tallest buildings. Built in 1974, the AON Center features windows from top to bottom. To control heat and glare, the building's management had window film applied to the glass in the late 1980s. But while the film did improve energy efficiency, most window films at that time had one serious flaw—eventually they acquired an unwelcome purplish tint. Almost two decades later, the AON Center was due for a facelift.

SOLUTION

Motivated to increase the building's energy efficiency and take advantage of new energy rebate offers, Operations Manager David Thompson called in two competing window film dealers to participate in an informal performance test. Harry Stallmach, owner of ADEC, Inc., an authorized 3M window film dealer, and his competitor each applied film to a test area. Building engineers then measured temperatures over a two-month period.

"The 3M window film outperformed the competing film in both energy efficiency and price," says Thompson. "In addition, the Department of Water and Power, which offered the rebates, wanted high light transmission. The 3M Night Vision window film offered that, plus the energy efficiency properties we wanted."

3M Scotchtint Night Vision window film is an innovative new line of window film that uses proprietary technology developed by 3M. "Often, films with the greatest sun control and glare reduction capabilities are so reflective that they are difficult to see through, especially at night," says Stallmach. "Night Vision blocks solar heat by up to 59 percent and UV rays by up to 99 percent, and it reduces glare by 72 percent, making it one of the top performers in the industry. And, when you're on the inside looking out, the film's low reflectivity gives you clear views—an important factor when you're in L.A."

The same technology that tones down reflectivity also makes the Night Vision film color-stable, ensuring the color won't change.

RESULTS

Preliminary results indicate that the AON Center will realize annual energy savings of more than $200,000. Combining those savings with the energy rebates, Thompson expects the project's cost will be recovered in less than two years.

"We're now able to cool the building using outside air for more months out of the year," he says. "And, on the really hot summer days, we're able to run with one less chiller, which is a significant savings."

Other pleasing results include fewer tenant comfort complaints, positive feedback about clearer views—even at night, and a noticeable improvement in the building's exterior appearance.

THE 3M DIFFERENCE

While the performance of the 3M film and his relationship with Stallmach were the main selling points, Thompson says he was also impressed with the support that came from 3M's corporate offices: "3M really stepped up to the plate. Night Vision was a new product, and they wanted to be sure we had all of the information we needed. They even brought in the person at 3M who invented the technology to show us how the film works. It was much more than we expected."

PROJECT SUMMARY

3M Dealer: Harry Stallmach, ADEC, Inc., Torrance, California

Installation Date: May 2002

Area Covered: 4,788 total window panes, which included 168,000 square feet of glass on the south, east, and west sides of the building. The north side will be completed in 2003.

Installation Time: 4 months

Type of Film: 3M Night Vision 25

Remedies Considered Prior to Window Film: None

Project Notes: ADEC, Inc., had anticipated that the existing film would be difficult to remove. But, because the existing film was manufactured by 3M, ADEC could "sweat" off the old film, a process that involves heating up the adhesive to release it from the glass. It turned out to be a fairly simple process.

Consumer Safety and Light Management
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St. Paul, MN 55144
Ph. 800-480-1704
Fx. 651-736-0611
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3M Innovation

70-0709-0137-9

3M Window Film Performance Specifications -**SINGLE TINTED GLASS**

	SHADING COEFFICIENT	VISIBLE LIGHT REFLECTED	TRANSMITTED	EMISSIVITY	U VALUE	HEAT GAIN REDUCTION	HEAT LOSS	GLARE	UV BLOCKED	TOTAL SOLAR ENERGY REJECTED
1/4 INCH TINTED GLASS	$ 0.69	5%	50%	$ 0.84	$ 1.06	NA	NA	NA	81%	40%
CS 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CS 20	0.50	4%	10%	0.84	1.06	34%	0%	80%	99%	57%
CS 35	0.59	5%	22%	0.84	1.06	22%	0%	56%	99%	49%
CS 50	0.63	5%	30%	0.84	1.06	17%	0%	41%	99%	45%
LE 20SIAR	0.27	22%	10%	0.45	0.82	61%	23%	80%	99%	77%
LE 35AMARL	0.30	18%	19%	0.34	0.74	57%	30%	62%	99%	74%
P-18ARL	0.30	20%	10%	0.65	0.95	57%	10%	80%	99%	74%
RE15SIXL	0.16	62%	8%	0.84	1.06	77%	0%	84%	99%	86%
NV 15	0.33	19%	9%	0.70	1.04	52%	2%	82%	99%	71%
NV 25	0.38	13%	14%	0.72	1.05	48%	1%	72%	99%	67%
NV 35	0.44	11%	21%	0.74	1.06	40%	0%	58%	99%	62%
NV 45	0.52	7%	27%	0.74	1.06	29%	0%	45%	99%	55%
RE 50NIARL	0.42	10%	27%	0.60	0.95	39%	11%	45%	99%	63%
RE 65NIARL	0.52	7%	34%	0.74	1.01	28%	5%	31%	99%	56%
RE 20NEARL	0.37	8%	9%	0.84	1.06	46%	0%	82%	99%	68%
RE 35NEARL	0.45	9%	22%	0.84	1.06	35%	0%	56%	99%	61%
RE 50NEARL	0.84	6%	25%	0.84	1.06	30%	0%	50%	99%	58%
RE 70NEARL	0.61	6%	41%	0.87	1.08	12%	0%	18%	99%	47%
RE 35AMARL	0.33	22%	18%	0.68	0.95	52%	10%	64%	99%	71%
RE 35BRARL	0.49	6%	21%	0.84	1.06	29%	0%	58%	99%	57%
RE 35SIARL	0.38	16%	18%	0.68	0.97	45%	0%	64%	98%	67%
S20SIAR 400	0.30	20%	10%	0.65	0.95	57%	10%	80%	99%	74%
S35NEAR 400	0.45	9%	22%	0.84	0.50	35%	0%	56%	99%	61%
S50NEAR 400	0.48	6%	25%	0.84	1.06	30%	0%	50%	99%	58%
SCLARL 150	0.68	7%	49%	0.87	1.09	1%	0%	2%	99%	NA
SCLARL 400	0.68	6%	48%	0.87	1.09	1%	0%	4%	99%	NA
ULTRA 600	0.68	6%	47%	0.89	1.10	1%	0%	6%	99%	NA

Avg: 02%

3M Innovation

3M Window Film Performance Specifications -**DOUBLE CLEAR GLASS**

	SHADING COEFFICIENT	VISIBLE LIGHT REFLECTED	TRANSMITTED	EMISSIVITY	U VALUE	HEAT GAIN REDUCTION	HEAT LOSS	GLARE	UV BLOCKED	TOTAL SOLAR ENERGY REJECTED
DOUBLE CLEAR REFERENCE	$ 0.81	14%	78%	0.84	0.51	NA	NA	NA	NA	30%
CS 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CS 20	0.65	13%	14%	0.84	0.50	19%	0%	82%	99%	45%
CS 35	0.71	13%	34%	0.84	0.50	11%	0%	57%	99%	38%
CS 50	0.73	14%	46%	0.84	0.50	9%	0%	42%	99%	37%
LE 20SIAR	0.36	51%	16%	0.45	0.43	56%	14%	79%	98%	69%
LE 35AMARL	0.35	54%	29%	0.34	0.40	57%	20%	63%	99%	70%
P-18ARL	0.34	55%	17%	0.65	0.47	58%	6%	78%	99%	70%
RE 15SIXL	0.15	63%	15%	0.84	0.50	81%	0%	81%	99%	87%
NV 15	0.43	20%	14%	0.70	0.47	48%	6%	82%	99%	63%
NV25	0.50	13%	22%	0.72	0.47	38%	6%	71%	99%	57%
NV 35	0.58	13%	31%	0.74	0.47	28%	6%	60%	99%	50%
NV45	0.67	9%	49%	0.78	0.48	17%	6%	48%	99%	42%
RE 50NIARL	0.54	27%	55%	0.74	0.49	23%	2%	30%	99%	46%
RE 65NIARL	0.62	20%	55%	0.74	0.49	23%	2%	30%	99%	46%
RE 20NEARL	0.56	21%	14%	0.84	0.50	31%	0%	82%	99%	51%
RE 35NEARL	0.58	24%	33%	0.84	0.50	28%	0%	58%	99%	50%
RE 50NEARL	0.65	20%	45%	0.84	0.50	20%	0%	42%	99%	43%
RE 70NEARL	0.73	15%	59%	0.87	0.50	10%	0%	24%	98%	37%
RE 35AMARL	0.37	53%	28%	0.68	0.47	54%	6%	64%	99%	68%
RE 35BRARL	0.65	15%	31%	0.84	0.50	20%	0%	60%	99%	43%
RE 35SIARL	0.45	45%	30%	0.68	0.47	44%	6%	62%	98%	61%
S20SIAR 400	0.34	55%	17%	0.65	0.47	58%	6%	78%	99%	70%
S35NEAR 400	0.58	24%	33%	0.84	0.50	28%	0%	58%	99%	50%
S50NEAR 400	0.65	20%	45%	0.84	0.50	20%	0%	42%	99%	43%
SCLARL 150	0.78	17%	77%	0.87	0.50	4%	0%	1%	99%	NA
SCLARL 400	0.79	18%	75%	0.87	0.50	2%	0%	0%	99%	NA
ULTRA 600	0.79	18%	73%	0.89	0.50	2%	0%	6%	99%	NA

Avg: 53%

3M Window Film Performance Specifications - DOUBLE TINTED GLASS

	SHADING COEFFICIENT	VISIBLE LIGHT REFLECTED	TRANSMITTED	EMISSIVITY	U VALUE	HEAT GAIN REDUCTION	HEAT LOSS	GLARE	UV BLOCKED	TOTAL SOLAR ENERGY REJECTED
DOUBLE TINTED GLASS	0.55	8%	45%	$ 0.84	$ 0.50	NA	NA	NA	NA	52%
CS 5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CS 20	O.51	6%	8%	0.84	NA	16%	0%	82%	99%	56%
CS 35	0.54	7%	19%	0.84	NA	11%	0%	57%	99%	53%
CS50	0.56	7%	26%	NA	NA	8%	0%	42%	99%	51%
LE 20SIAR	0.29	21%	9%	0.45	0.43	47%	14%	80%	99%	75%
LE 35AMARL	0.28	22%	17%	0.34	0.40	49%	20%	62%	99%	76%
P-18ARL	0.28	20%	9%	0.65	0.47	49%	6%	80%	99%	76%
RE 15SIXL	0.10	62%	7%	0.84	0.50	82%	0%	84%	99%	91%
NV 15	0.33	20%	9%	0.70	0.47	40%	6%	80%	99%	71%
NV 25	0.37	13%	13%	O.72	0.47	32%	6%	71%	99%	67%
NV 35	0.42	13%	19%	0.74	0.47	24%	6%	59%	99%	63%
NV45	0.48	9%	24%	0.78	0.48	13%	6%	47%	99%	58%
RE 50NIARL	0.40	9%	24%	0.60	0.47	29%	6%	44%	99%	65%
RE 65NIARL	0.45	7%	30%	0.74	0.49	20%	2%	30%	99%	61%
RE 20NEARL	0.41	11%	9%	0.84	0.50	25%	0%	80%	99%	64%
RE 35NEARL	0.43	10%	19%	0.84	0.50	22%	0%	58%	99%	63%
RE 50NEARL	0.48	9%	28%	0.84	0.50	13%	0%	38%	99%	58%
RE 70NEARL	0.52	8%	36%	0.87	0.50	5%	0%	20%	99%	55%
RE 35AMARL	0.30	22%	17%	0.68	0.47	45%	6%	62%	99%	74%
RE 35BRARL	0.45	7%	18%	0.84	0.50	18%	0%	60%	99%	61%
RE 35SIARL	0.34	18%	18%	0.68	0.47	38%	6%	60%	98%	70%
S20SIAR 400	0.28	20%	9%	0.65	0.47	49%	6%	80%	99%	76%
S35NEAR 400	0.43	10%	19%	0.84	0.50	22%	0%	58%	99%	63%
S50NEAR 400	0.48	9%	28%	0.84	0.50	13%	0%	38%	99%	58%
SCLARL 150	0.53	8%	47%	0.87	0.50	4%	0%	2%	99%	NA
SCLARL 400	0.55	8%	42%	0.87	0.50	0%	0%	7%	99%	NA
ULTRA 600	0.55	8%	41%	0.89	0.50	0%	0%	8%	99%	NA

Avg: 65%

3M Innovation

3M Window Film Performance Specifications -SINGLE CLEAR GLASS

	SHADING COEFFICIENT	VISIBLE LIGHT REFLECTED	TRANSMITTED	EMISSIVITY	U VALUE	HEAT GAIN REDUCTION	HEAT LOSS	GLARE	UV BLOCKED	TOTAL SOLAR ENERGY REJECTED
1/4 INCH CLEAR REFERENCE	0.94	8%	88%	1.O6	NA	NA	NA	NA	NA	18%
CS 5	0.48	5%	7%	0.84	NA	49%	NA	91%	99%	58%
CS 20	0.55	5%	16%	0.84	NA	41%	NA	83%	99%	52%
CS 35	0.70	6%	38%	0.84	NA	25%	NA	56%	98%	39%
CS 50	0.77	7%	51%	0.84	NA	18%	NA	42%	98%	33%
LE 20SIAR	0.25	53%	17%	0.45	0.82	73%	23%	81%	98%	78%
LE 35AMARL	0.29	56%	31%	0.34	0.74	69%	30%	65%	99%	75%
P-18ARL	0.26	58%	19%	0.65	0.95	72%	10%	78%	99%	77%
RE15SIXL	0.20	63%	16%	0.84	1.06	79%	0%	83%	99%	83%
NV 15	0.29	19%	15%	0.70	1.04	69%	2%	83%	99%	75%
NV 25	0.39	13%	24%	0.72	1.05	59%	1%	72%	99%	66%
NV 35	0.49	12%	35%	0.74	1.06	49%	0%	60%	99%	45%
NV 45	0.63	8%	45%	0.78	1.06	34%	0%	49%	99%	45%
RE 50NIARL	0.49	23%	48%	0.60	0.95	48%	11%	45%	99%	57%
RE 65NIARL	0.63	15%	61%	0.74	1.01	33%	5%	31%	99%	45%
RE 20NEARL	0.39	17%	16%	0.84	1.06	59%	0%	82%	99%	66%
RE 35NEAR	0.51	20%	37%	0.84	1.06	45%	0%	58%	99%	56%
RE 50NEARL	0.66	15%	51%	0.68	1.06	30%	0%	42%	98%	43%
RE 70NEARL	0.76	9%	66%	0.87	1.08	19%	0%	25%	98%	34%
RE 35AMARL	0.30	55%	30%	0.68	0.95	68%	10%	66%	99%	74%
RE 35BRARL	0.59	9%	35%	0.84	1.06	37%	0%	60%	99%	49%
RE 35SIARL	0.40	42%	33%	0.68	0/97	57%	8%	63%	98%	65%
S20SIAR 400	0.26	58%	19%	0.65	0.95	72%	10%	78%	99%	77%
S35NEAR 400	0.51	20%	37%	0.84	1.06	45%	0%	58%	99%	56%
S50NEAR 400	0.66	15%	51%	0.84	1.06	30%	0%	42%	98%	43%
SCLARL 150	0.92	11%	87%	0.87	1.09	2%	0%	1%	98%	NA
SCLARL 400	0.91	11%	86%	0.87	1.09	3%	0%	2%	98%	NA
SCLARL 600	0.90	10%	84%	0.89	1.10	6%	0%	2%	99%	NA

Avg: 1.01 = U-factor

$$\frac{\delta}{A} = \frac{T_i - T_o}{R} = \frac{\delta}{A} = U(T_i - T_o)$$

Avg: 57%

3M Innovation

Chart: Fig 5, page

Solar radiation on earth: 425 Btu/h·ft²·micron (0.5 microns)

= 212.5 Btu/hr ft²

example

$$q_i = E_t \underbrace{\left(T_s + N_i \alpha_s\right)}_{SHGC}$$

single pane of glass

q_i = inside solar gain

E_t = incident solar irradiance outside

T_s = Solar transmittance

α_s = Solar absorptance

N_i = inwardly flowing fraction of absorbed irradiance

SHGC = fraction of energy that enters through the glazing as heat gain

q_i = total rate of heat flow inward solely from radiation from unshaded single glazing

$N_i = U/h_o$

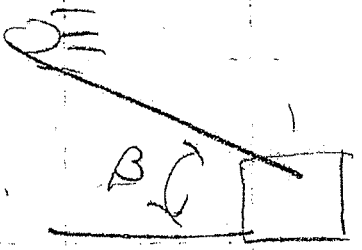
SHGC = 0.4, 0.6

find q_i difference

$$E_t = \frac{A}{\exp\left(\frac{B}{\sin\beta}\right)} \qquad A = 351 \text{ (August)} \qquad B = 0.201 \qquad \beta = 65°$$

$$E_t = \frac{351}{e^{\left(\frac{0.201}{\sin 65°}\right)}} = 281$$

$\left(e^{0.22}\right)$



8

Equation (6) relates Apparent Solar Time (AST) to Local Standard Time (LST) as follows:

$$AST = LST + ET + 4(LSM - LON) \quad (6)$$

where

ET = equation of time, minutes of time
LSM = local standard time meridian, ° of arc
LON = local longitude, ° of arc
4 = minutes of time required for 1.0 degree rotation of earth

Because the earth's equatorial plane is tilted at an angle of 23.45° to the orbital plane, the solar declination δ (the angle between the earth-sun line and the equatorial plane) varies throughout the year, as shown in Figure 4 and Table 7. This variation causes the changing seasons, with their unequal periods of daylight and darkness.

The spectral distribution of solar radiation beyond the earth's atmosphere (Figure 5) resembles the radiant energy emitted by a blackbody at about 10,800°F. The invisible ultraviolet region with wavelengths between 0.29 and 0.40 μm contains about 7% of the total energy, while the visible region between 0.4 and 0.7 μm contains 39%, and the near infrared region between 0.7 and 3.5 μm contains the remaining 52%. The peak intensity, about 700 Btu/h·ft²·μm, is reached at about 0.45 μm in the green portion of the visible spectrum.

In passing through the earth's atmosphere, the sun's radiation is reflected, scattered, and absorbed by dust, gas molecules, ozone, water vapor, and water droplets (clouds). The extent of the depletion at any given time is determined by atmospheric conditions, position and length of the atmospheric path traversed by the solar rays. This length is expressed in terms of the air mass m, the ratio of the mass of atmosphere in the actual earth-sun path to the mass which would exist if the sun were directly overhead at sea level (m = 1.0). For most purposes, the air mass at any time equals the cosecant of the solar altitude, multiplied by the ratio of the actual barometric pressure to standard pressure. Beyond the atmosphere, m = 0.

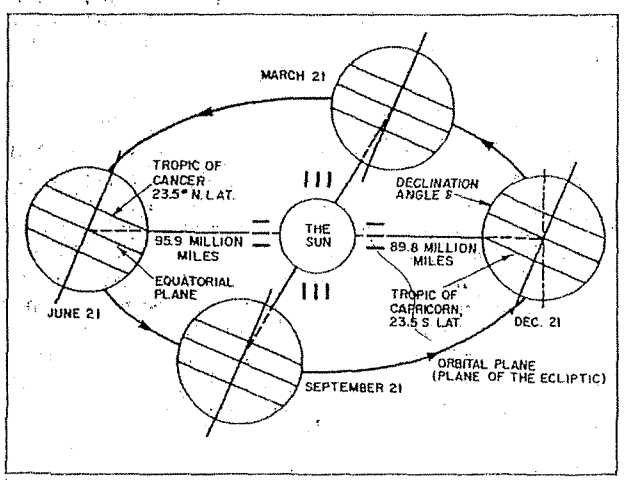


Fig. 4 Motion of Earth around Sun

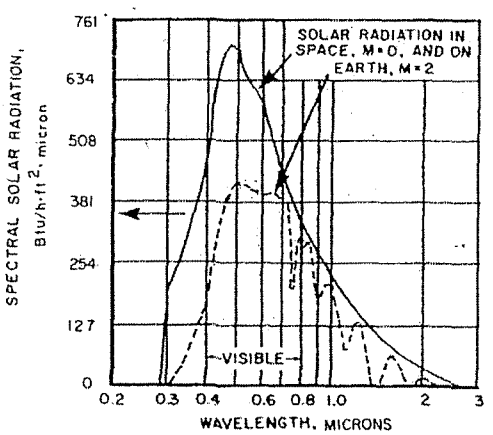


Fig. 5 Extraterrestrial and Terrestrial Solar Radiation

Most ultraviolet solar radiation is absorbed by the ozone in the upper atmosphere, while part of the radiation in the short wave portion of the spectrum is scattered by air molecules, imparting the blue color to the sky. Water vapor in the lower atmosphere causes the characteristic absorption bands observed in the solar spectrum at sea level (Figure 5). For a solar altitude of 41.8° (air mass = 1.5), the spectrum of the sun's direct radiation on a clear day at sea level shows less than 3% of the total energy in the ultraviolet, 38% in the visible region, and the remaining 59% in the infrared (ASTM 1987). The maximum intensity occurs at 0.5 μm, and virtually no solar energy exists at wavelengths beyond 2.2 μm.

The spectral distributions shown in Part A, Figure 5 for m = 0 and m = 2.0 are adapted from Moon (1940), whose solar radiation data took no account of monthly variations in intensity caused by changes in the earth-sun distance and by the atmosphere's varying average moisture content. Moon used a solar constant of about 420 Btu/h·ft², while the presently recommended value is 433.3 Btu/h·ft². The solar heat gain factors (SHGF) in Tables 12 through 18 are based on terrestrial measurements (Threlkeld and Jordan 1958) and are not affected directly by the change in the accepted value of the solar constant. However, these calculations may be affected by the accuracy of the calculated solar irradiance incident on the glazing. Iqbal (1983), Galanis and Chatiguy (1986), and Gueymard (1993) discuss the accuracy and universality of the radiation model used to produce these data and propose possible improvements.

For many years the glazing industry has used Moon's spectrum (air mass = 2) to obtain spectrally average optical characteristics of glazings. The National Fenestration Rating Council recommends a spectrum at a standard air mass of 1.5 as described in ASTM *Standard* E 891 (1987a). This difference in reference spectrum may result in slight deviations of the solar heat gain coefficient of spectrally selective glazings, whereas the visible transmittance of all types of glazings should remain unchanged.

Some short-wave radiation scattered by air molecules and dust reaches the earth in the form of diffuse radiation E_d. Since this diffuse radiation comes from all parts of the sky, its intensity is difficult to predict and varies as moisture and dust content of the atmosphere change throughout any given day. On a completely overcast day, the diffuse component accounts for all solar radiation reaching the ground.

Some energy absorbed by carbon dioxide and water vapor in the sky reaches the earth in the form of long-wave atmospheric radiation. Because the apparent emittance of the atmosphere depends primarily on its water vapor content (Parmelee and Aubele 1952, Bliss 1961) and is always less than 1.00, usually long-wave radiant energy flows from terrestrial surfaces.

The total short-wave irradiance E_t reaching a terrestrial surface is the sum of the direct solar radiation E_D, the diffuse sky radiation E_d, and the solar radiation reflected from surrounding surfaces E_r. The irradiance of the direct component is the product of the direct normal irradiation E_{DN} and the cosine of the angle of incidence θ between the incoming solar rays and a line normal (perpendicular) to the surface:

$$E_t = E_{DN} \cos \theta_V + E_d + E_r \quad (7)$$

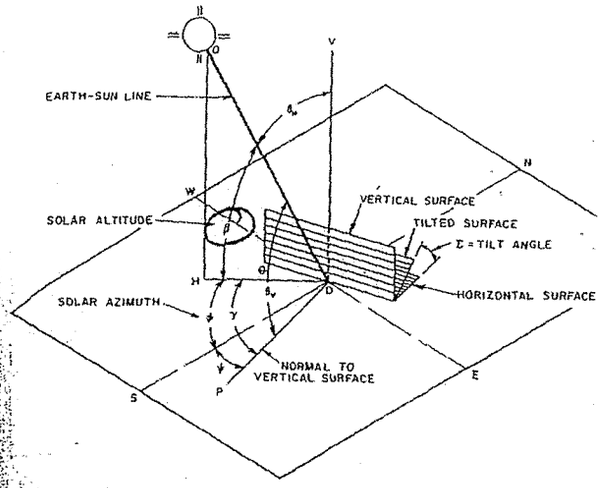


Fig. 6 Solar Angles for Vertical and Horizontal Surfaces

A method of computing all the factors on the right side of Equation (7) follows. Perez *et al.* (1986) give a more detailed model for E_t, which separates the diffuse sky radiation into three components.

Solar Angle Determination

The sun's position in the sky is conveniently expressed in terms of the solar altitude β above the horizontal and the solar azimuth ϕ measured from the south (Figure 6). These angles, in turn, depend on the local latitude L; the solar declination δ, which is a function of the date (Table 7); and the apparent solar time, expressed as the hour angle H, where $H = 0.25$ (number of minutes from local solar noon), in degrees.

Equations (8a) and (8b) relate β and ϕ to the three angles just mentioned:

$$\sin \beta = \cos L \cos \delta \cos H + \sin L \sin \delta \tag{8a}$$

$$\cos \phi = (\sin \beta \sin L - \sin \delta)/(\cos \beta \cos L) \tag{8b}$$

Figure 6 shows the solar position angles and incident angles for horizontal and vertical surfaces. Line OQ leads to the sun, the north-south line is NOS, and the east-west line is EOW. Line OV is perpendicular to the horizontal plane in which the solar azimuth, angle HOS, and the surface azimuth, angle POS (ψ) are located. Angle HOP is the surface solar azimuth defined as:

$$\gamma = \phi - \psi \tag{9}$$

The solar azimuth ϕ is positive for afternoon hours and negative for morning hours. Likewise, surfaces that face west have a positive surface azimuth ψ; those facing east, have a negative surface azimuth (Table 8). If γ is greater than 90° or less than 270°, the surface is in the shade. Table 8 gives values in degrees for the surface azimuth ψ, applicable to the orientations of interest.

The angle of incidence θ for any surface is defined as the angle between the incoming solar rays and a line normal to that surface. For the horizontal surface shown in Figure 6, the incident angle θ_H is QOV; for the vertical surface, the incident angle θ_V is QOP.

Table 8 Surface Orientations and Azimuths, Measured from South

Orientation	N	NE	E	SE	S	SW	W	NW
Surface azimuth, ψ	180°	−135°	−90°	−45°	0	45°	90°	135°

For any surface, the incident angle θ is related to β, γ and the tilt angle of the surface Σ by:

$$\cos \theta = \cos \beta \cos \gamma \sin \Sigma + \sin \beta \cos \Sigma \tag{10}$$

where Σ = tilt angle of surface from horizontal.

When the surface is horizontal, $\Sigma = 0°$, and

$$\cos \theta_H = \sin \beta \tag{11a}$$

For a vertical surface, $\Sigma = 90°$, and

$$\cos \theta_V = \cos \beta \cos \gamma \tag{11b}$$

Example 5. Find the solar azimuth and altitude at 0830 central time on October 21 at 32° north latitude and 95° west longitude.

Solution: Local time is 0830 + 4 (90 − 95) = 0810. The equation of time (Table 7) is +15 min, so apparent solar time (AST) = 0810 + 15 = 0825, or 215 min. before noon, and $H = 0.25 \times 215 = 53.8°$. Table 7 gives the solar declination on October 21 as −10.5°.

Thus, by Equation (8a):

$$\sin \beta = \cos (32) \cos (-10.5) \cos (53.8) + \sin (32) \sin (-10.5) = 0.396$$

$$\beta = 23.3°$$

Using Equation (8b):

$$\cos \phi = \frac{\sin (23.3) \sin (32) - \sin (-10.5)}{\cos (23.3) \cos (32)} = 0.503$$

$$\phi = 59.8°$$

Example 6. For the conditions of Example 5, find the incident angle at a window facing southeast.

Solution: Since the solar azimuth ϕ is to the east (AST < 1200) and the surface azimuth ψ is to the east (Table 8), they are both negative— $\phi = -59.8$, $\psi = -45.0$.

$$\gamma = -59.8 - (-45.0) = -14.8°$$

A negative surface-solar azimuth γ indicates that the sun is east of the normal to the surface. Thus, using Equation (11b)

$$\cos \theta_V = \cos 23.3 \cos (-14.8) = 0.888$$

$$\theta_V = 27.4°$$

Direct Normal Irradiance

At the earth's surface on a clear day, direct normal irradiation, or solar intensity E_{DN} is represented by

$$E_{DN} = A/[\exp (B/\sin \beta)] \tag{12}$$

where

A = apparent solar irradiation at air mass $m = 0$ (Table 7)
B = atmospheric extinction coefficient (Table 7)

(Values of E_{DN} based on these data are given in Tables 13 through 19 for the daylight hours of the 21st day of each month, for latitudes 16 to 64° North in 8° increments.)

Values of A and B vary during the year because of seasonal changes in the dust and water vapor content of the atmosphere and because of the changing earth-sun distance. Equation (12) does not give the maximum value of E_{DN} that can occur in each month, but yields values that are representative of conditions on cloudless days for a relatively dry and clear atmosphere. For very clear atmospheres, E_{DN} can be 15% higher than indicated by Equation (12), using values of A and B in Table 7.

Absorbed Solar Radiation

The absorbed radiation, including ultraviolet, visible, and infrared, is turned to heat inside the absorbing material. In a window, the glazing loses the heat through conduction, convection, and radiation. Some heat goes outside the building, and the remainder adds to the directly transmitted solar heat gain. The size of this inwardly flowing fraction depends on the nature of the air boundary layers adjacent to both sides of the glazing, including any gas trapped between the panes of a multiple-glazed window.

If E_t is the incident solar irradiance (outside), τ_s is the solar transmittance, α_s is the solar absorptance, and N_i is the inwardly flowing fraction of the absorbed irradiance for a single pane of glass, the solar gain q_i (inside) is

$$q_i = E_t(\tau_s + N_i \alpha_s) \tag{21}$$

The quantity in parentheses is the solar heat gain coefficient (SHGC). It is the fraction of incident irradiance that enters through the glazing as heat gain. It includes both the directly transmitted portion τ_s and the absorbed and reemitted portion $N_i\alpha_s$. The SHGC is needed to determine the solar radiant heat gain from a window. The SHGC should be included, along with window U-factor and other properties, in any description of a window's energy performance.

The total rate of heat flow inward (Vild 1964) by radiation and convection from an unshaded single glazing is

$$q_{RCi} = E_t(\tau_S + N_i \alpha_S) + U(t_o - t_i) \tag{22}$$

where

N_i = inward-flowing fraction of absorbed radiation
E_t = incident irradiance

For unshaded single glazing, $N_i = U/h_o$, and Equation (22) becomes:

$$q_{RCi} = U\left[\frac{\alpha E_t}{h_o} + t_o - t_i\right] + E_o\tau_s \tag{23}$$

Shading Coefficient

Tables in this chapter list data that may be used to calculate heat gain through a standard reference glazing system. The shading coefficient is a widely used indicator of solar gain that was devised as a convenient way to convert these numbers to equivalent values for different glazing systems. It is defined as the ratio of the solar gain q_i of the window to that of a standard reference window of single-pane, double-strength clear glass, irradiated in the same way and under the same environmental conditions. It is, therefore, equal to the ratio of solar heat gain coefficients of the two windows

$$SC = \frac{SHGC_{Test}}{SHGC_{Ref}} = \frac{\tau_{Test} + N_{i,\,Test}\,\alpha_{Test}}{\tau_{Ref} + N_{i,\,Ref}\,\alpha_{Ref}} \tag{24}$$

If the reference window's SHGC is constant, then the SC would differ from the SHGC only by a constant multiplier. However, in general, the SHGC is a function of the direction of incidence of the radiation as well as its spectral distribution. This is true both of the reference window and the test window.

As fenestration systems become more complex, however, the shading coefficient is being replaced by the solar heat gain coefficient (McCluney 1991). For energy analyses, including hourly building performance simulation calculations, the angle-dependent values of the solar heat gain coefficient give better results than the shading coefficient (McCluney 1987).

Data on solar heat gain coefficients are available from some manufacturers of fenestration products. Computer programs are available for calculating solar heat gain factors (incident solar irradiances and solar heat gains per unit area of glazing area) automatically (LBL 1992).

Solar Gain for Complex Multipane Windows

For multiple-pane windows with gas fills other than air and with spectrally selective coatings on one or more of the glazing surfaces, the foregoing equations are inadequate for determining the solar heat gain coefficient, and they do not explicitly include angle-dependent and spectrally selective effects. LBL (1992) has developed a calculation procedure and computer program (WINDOW 4.0) that performs the needed calculations for determining this coefficient for complex windows where the glazings do not exhibit significant scattering effects and where the glazing coatings have known angle-dependent optical properties.

The National Fenestration Rating Council (NFRC) is working to standardize this procedure for use in a national fenestration certification and labeling program. Until such a standard is available, the fenestration manufacturer should be consulted for data on the angle-dependent SHGC of its products.

Frame and Other Nonglazing Elements

Solar radiant heat also enters a building through opaque elements such as the frame and any mullion bars and dividers that are part of the fenestration system. A solar heat gain coefficient can be defined for these opaque elements and used to determine the overall solar gain q_i of the fenestration system as follows

$$q_i = E_t\left(A_g F_g + A_f F_f + \sum_{i=1}^{N} A_i F_i\right) \tag{25}$$

where

A_g = area of glazing with solar heat gain coefficient F_g
A_f = area of frame with solar heat gain coefficient F_f
A_i = area of the i^{th} additional opaque element having F_i as its solar heat gain coefficient

The overall, area-weighted solar heat gain coefficient $< F >$ can be defined by

$$< F > = \frac{\sum_{i=1}^{M} A_i F_i + A_g F_g + A_f F_f}{\sum_{i=1}^{M} A_i + A_g + A_f} \tag{26}$$

where M is the total number of different opaque and transparent elements over the total area of the fenestration aperture.

Passive Solar Gain

Energy analysis of a fenestration product should include the value of passive solar gain through the product in winter. As described in Chapter 30 of the 1991 ASHRAE *Handbook—Applications*, the magnitude of this energy gain depends on such variables as latitude and orientation. In some cases, properly designed and operated fenestration allows more energy into the building over a heating season than it loses, thus making it energy contributing rather than energy consuming. Excessive solar gain must be controlled during the cooling season, however.

Solar Gain Rejection

For some buildings in certain climates, preventing solar gain is more important from an energy perspective than improved thermal insulation using multiple panes of glazing. For example, internal load-dominated buildings in cool, clear climates can have

Technology

Air Flow Restriction Curtain

Energy Savings – kWh & Summer Peak Savings

This measure assumes that air flow in and out of large refrigerated spaces is reduced by plastic curtains, air curtains or rapid shutting doors.

There is a significant range of savings associated with this measure given the variables of size opening, temperature, traffic in and out of the refrigerated space, barometric pressure differences and existing condition of opening prior to improvement, among others. This was listed in the original spreadsheet as a prescriptive measure technology, but feel that the only way to insure accuracy is on a custom basis.

We have created a custom calculation spreadsheet and completed multiple scenarios, one of which is attached for your review. We have used this as our estimate of average savings. (14,640 kWh, see attached).

It was time effective, but this calculation is still relatively limited since it does not address latent versus sensible cooling, doesn't clearly define a base case, ignores increased power usage for motors and has other limiting factors.

Summer Peak Savings

Assumed to be zero. Some savings may exist, although quantifying will be difficult.

Measure Life

The various technology options (physical curtain, air curtain, rapid movement doors) all should last 10 to 15 years. A consideration would be persistency. If users of the space view it as a hassle they may bypass the measure. A physical curtain (fabric or plastic strips) may be most likely to get bypassed, other options should be persistent. Assume 12 year average life.

Initial One-Time Cost

Cost, as with savings, will vary significantly. On the low end for smaller overhead doors a physical curtain might be as low as $500 to $1,000 with rapid movement and air curtains on large doors ranging up over $5,000. For this analysis we have assumed an average cost of $2,400.

Any Recurring Costs

Plastic/Fabric strip replacement. Routine maintenance.

Suggested Incentive

We are advising a custom calculation. Perhaps a set amount per kWh of savings with a cap on percentage of project cost. We have assumed $.03/kWh of annual savings up to a 25% of project cost cap.

14,640 kWh x .03 = $440

Requirements

Verification of condition before any change is made would be critical. If the base case is unknown it would be very difficult to give any reasonable estimate of savings.

Existing Energy Standards

None

Source of Info

ASHRAE Fundamentals and manufacturer catalogs and websites.

NOTE: We feel this technology is too complicated and variable, for a relatively few number of likely participants, to result in a cost effective program delivery.

Abc Company

Air Curtain - Cooler Space

This measure estimates the energy and related cost savings realized by installing an air curtain above cooler doors.

Assumptions:

3	Average measure wind speed of temperature differential based on field measurements
88	Conversion factor from mph to f/min
8	Door Height, feet
8	Door Width, feet
64	Area of door opening (square feet)
1.085	Conversion factor
70	Ta - Average Ambient temperature (°F)
38	Tc - Average Cooler temperature (°F)
0.0793	Do - Outside Air Density
0.0749	Di - Inside Air Density
0.9396	Dr - Air Density Ratio
0.50	Cv - Effectiveness of opening (0.5 perpendicular wind, 0.25 diagonal wind)
1.00	Amount of time doors are open, per day (hours)
1	Days per week doors are open
1	Average heating season length, weeks
1	Amount of time doors are open (hrs/yr)
1.0 KW/ton	Average us of refrigeration equipment
3.412	Conversion factor (Btu/kWh)
60%	Estimated improvement in infiltration (%) for change as compared to existing situation
$0.065	Average cost of electricity (per kWh)
$3,500	Cost of Rapid Movement Door
$2,400	Cost of Air Curtain
$500	Cost of Vinyl Strip Door

ESTIMATED CONSUMPTION:

F1 = .48 + [0.0023 X (Ti - To)]	=	0.5536
F2 = 40 X Door Height X Door Width	=	2560
F3 = 64.4 X Door Height X (1-Dr)	=	31.1064
F4 = (1 + Dr^(1/3))³	=	7.7560
F5 = [F3 / F4]²	=	16.0852

Air Flow due to Temperature:

FLT = F1 x F2 x F5 = 22796 cfm

Air Flow due to Wind:

FLW = 88 ft/min x Cv x Door Height x Door Width x Avg. Wind Speed = 8,448 cfm

Total Air Flow:

Default to lower savings = 8,448 cfm

Total Heat Loss:

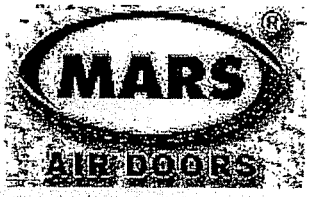
HL = 1.085 x TAF x (Ta - Tc) = 293,315 Btu/hr

Cooling Load

$$CL = \frac{293{,}315 \text{ Btu/hr} \times 1.0 \text{ Kw/ton}}{12000.0 \text{ Btu/watt-hour}} = 24.44 \text{ kW}$$

Estimated Savings

ES = CL x 1000 hours x .60 = 14665.73 kWh



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MARS Commercial Models Comparison Chart

Commercial Air Curtains
Industrial Air Curtains
Food Service
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Company Background
What's NEW!

AIR CURTAINS

MARS® Air Doors stabilize environments, and save energy by minimizing the heated/air conditioned air loss through open doorways. They also effectively repel flying insects, dust and pollutants.

MARS Air Doors brand Air Curtains - Home Page

MARS Air Systems Home Page

Goto: Industrial Models Comparison Chart

Model	Door Wdt. Inches	Door Hgt. Feet	Air Velocity FPM @Nozzle	Air Volume CFM @Nozzle	Full Load 1 Phase 208/230v (Note:1)	Amps 3 Phase 480v (Note:2)	Motor Horse Power	Sound Pressure Level (Note:3)	Net Wt. Lbs (unheated)	Ele H ava (Not
WHISPURR AIR MODELS				---	---	---	1550RPM	---	---	
WA 36	36	up to 7	1800	900	0.8	NA	1@1/6	49	16	
WA 42	42	up to 7	1800	1050	0.9	NA	1@1/6	50	19	
WA 48	48	up to 7	1800	1200	1.0	NA	1@1/6	52	22	
WA 60	60	up to 7	1800	1500	1.1	NA	1@1/4	52	25	
WA 72	72	up to 7	1800	1800	1.2	NA	1@1/4	53	28	

Model	Door Wdt. Inches	Door Hgt. Feet	Air Velocity FPM @Nozzle	Air Volume CFM @Nozzle	Full Load 1 Phase 208/230v (Note:1)	Amps 3 Phase 480v (Note:2)	Motor Horse Power	Sound Pressure Level (Note:3)	Net Wt. Lbs (unheated)	Ele H ava (Not
C MODELS				---	---	---	1750 RPM	---	---	
36C	36	UP TO 8	2275	1700	2.5	0.6	1@1/2	56	50	

38C	38	UP TO 8	2150	1700	2.5	0.6	1@1/2	56	52	
42C	42	UP TO 8	1950	1700	2.5	0.6	1@1/2	56	55	
48C	48	UP TO 8	1700	1700	2.5	0.6	1@1/2	56	60	
60C	60	UP TO 8	2040	2550	2.5	0.6	1@1/2	56	65	
60C-2	60	UP TO 8	2720	3400	5.1	1.2	2@1/2	63	95	
72C	72	UP TO 8	2275	3400	5.1	1.2	2@1/2	63	105	
96C	96	UP TO 8	1700	3400	5.1	1.2	2@1/2	63	130	

Model	Door Wdt. Inches	Door Hgt. Feet	Air Velocity FPM @Nozzle	Air Volume CFM @Nozzle	Full Load 1 Phase 208/230v (Note:1)	Amps 3 Phase 480v (Note:2)	Motor Horse Power	Sound Pressure Level (Note:3)	Net Wt. Lbs (unheated)	Ele H ava (Not
CH MODELS				---	---	---	1750 RPM	---	---	
36CH	36	8-10	3400	2550	2.5	0.6	1@1/2	63	50	
38CH	38	8-10	3225	2550	2.5	0.6	1@1/2	63	52	
42CH	42	8-10	2925	2550	2.5	0.6	1@1/2	63	55	
48CH	48	8-10	2550	2550	2.5	0.6	1@1/2	63	60	
60CH-2	60	8-10	4080	5100	5.1	1.2	2@1/2	65	95	
72CH	72	8-10	3400	5100	5.1	1.2	2@1/2	65	105	
96CH	96	8-10	2550	5100	5.1	1.2	2@1/2	65	130	

Model	Door Wdt. Inches	Door Hgt. Feet	Air Velocity FPM @Nozzle	Air Volume CFM @Nozzle	Full Load 1 Phase 208/230v (Note:1)	Amps 3 Phase 480v (Note:2)	Motor Horse Power	Sound Pressure Level (Note:3)	Net Wt. Lbs (unheated)	Ele H ava (Not
CHS MODELS				---	---	---	1750 RPM	---	---	

42CHS	42	10-12	4600	4000	8.0	2.0	1@1	69	80	
48CHS	48	10-12	4000	4000	8.0	2.0	1@1	69	85	
60CHS	60	10-12	3200	4000	8.0	2.0	1@1	69	90	
96CHS	96	10-12	4000	8000	16.0	4.0	2@1	72	160	
COMBI MODELS				---	---	---	1750RPM	---	---	
36COMBI	36	UP TO 10	3400/2275	2550/1700	2.5	NA	1@1/2	56/63	50	
38COMBI	83	UP TO 10	3225/2150	2550/1700	2.5	NA	1@1/2	56/63	52	
42COMBI	42	UP TO 10	2925/1950	2550/1700	2.5	NA	1@1/2	56/63	55	
48COMBI	48	UP TO 10	2550/1700	2550/1700	2.5	NA	1@1/2	56/63	60	
60COMBI	60	UP TO 10	2040/1360	2550/1700	2.5	NA	1@1/2	56/63	65	
60-2COMBI	60	UP TO 10	4080/2720	5100/3400	5.1	NA	2@1/2	59/65	95	
72COMBI	72	UP TO 10	3400/2275	5100/3400	5.1	NA	2@1/2	59/65	105	
96COMBI	96	UP TO 10	2550/1700	5100/3400	5.1	NA	2@1/2	59/65	130	
Model	Door Wdt. Inches	Door Hgt. Feet	Air Velocity FPM @Nozzle	Air Volume CFM @Nozzle	Full Load 1 Phase 208/230v (Note:1)	Amps 3 Phase 480v (Note:2)	Motor Horse Power	Sound Pressure Level (Note:3)	Net Wt. Lbs (unheated)	Ele H ava (Not
SUPER COMBI (S/C) MODELS				---	---	---	1750 RPM	---	---	
42(S/C)	42	10-12	4600/3200	4000/2800	8.0	NA	1@1	65/69	80	
48(S/C)	48	10-12	4000/2800	4000/2800	8.0	NA	1@1	65/69	85	
60(S/C)	60	10-12	3200/2240	4000/2800	8.0	NA	1@1	65/69	90	
96(S/C)	96	10-	4000/2800	8000/5600	16.0	NA	2@1	68/72	160	

		12								
NATIONAL SANITATION FOUNDATION MODELS						---	1750RPM	---	---	
36 NCH	36	UP TO 7	3400	2550	2.5	0.6	1@1/2	63	50	I
38 NCH	38	UP TO 7	3225	2550	2.5	0.6	1@1/2	63	52	I
42 NCH	42	UP TO 7	2925	2550	2.5	0.6	1@1/2	63	55	I
48 NCH	48	UP TO 7	2550	2550	2.5	0.6	1@1/2	63	60	I
72 NCH	72	UP TO 7	3400	5100	5.1	1.2	2@1/2	65	105	I
NHV 42	42	UP TO 7	4600	4000	8.0	2.0	1@1	69	80	I
NHV 48	48	UP TO 7	4000	4000	8.0	2.0	1@1	69	85	I
SERVICE WINDOW MODEL W-25				---	---	---	3450 RPM	---	---	
W25	30	UP TO 5	1400	1900	0.5	NA	1@1/2	59	20	
HEPAC				---	---	---	1750 RPM	---	---	
HF-40	40	UP TO 8	2175	1800	2.5	0.6	1@1/2	56	125	I

NOTES:

1) Single phase full load current for 208/230v shown; for 115v single phase, multiply by 2. For ampacity multiply current by 1.25.

2) Three phase full load current for 480v shown; for 208/230v three phase, multiply by 2. For ampacity multiply current by 1.25.

3) The dBA is measured in free air 10 feet from the nozzle.

4) Heat not available with 115v, single phase air curtains.

5) Commercial Models available in Electric Heat

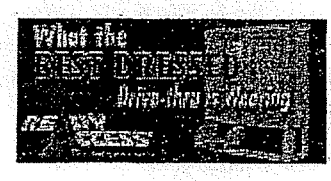
Only

General Notes: Specify voltage and phase when ordering. Electric motors are available in any other voltages, phases and frequencies.

MARS Air Doors
14716 South Broadway
Gardena, California 90248

Phone: 310-532-1555 | FAX: 310-324-3030
EMail: marsinfo@marsair.com

08343/15845 - Air Curtain Doors



Ready Access GEO-SPECS For over twenty-five years, Ready Access has been an innovator and leader in the manufacturing and distribution of pass-thru window systems. These systems can be used in many different applications; from resorts and hotels to golf courses and schools, the possiblilities are endless!

see also: 08300 - Specialty Doors

- Actron, Inc.
- Berner International Corporation - Air curtain doors for environmental separation and insect control, drive-up windows to dock doors.
- Daw Technologies, Inc.
- Dynaforce
- King Company
- Marley Engineered Products
- Mars Air Products
- Miniveil Air Systems
- Powered Aire, Inc.
- **Ready Access** GEO-SPECS For over twenty-five years, Ready Access has been an innovator and leader in the manufacturing and distribution of pass-thru window systems. These systems can be used in many different applications; from resorts and hotels to golf courses and schools, the possiblilities are endless!

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SPEC CAD GEO-SPECS

Last Modified: December 14, 2003

Back to 4specs Home Page

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Submit Query

AIR CURTAINS

MARS® Air Doors stabilize environments, and save energy by minimizing the heated/air conditioned air loss through open doorways. They also effectively repel flying insects, dust and pollutants.

800-421-1266

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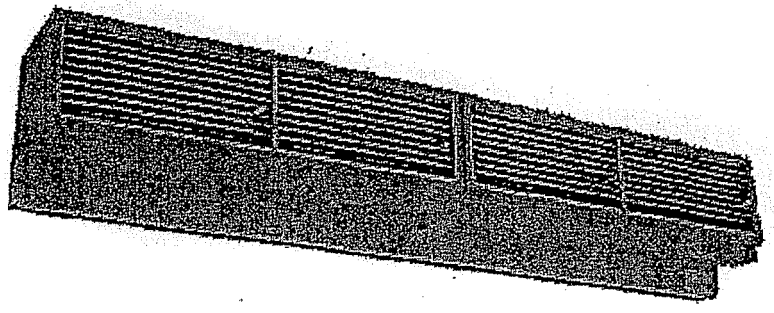
Standard, HV and EP Series

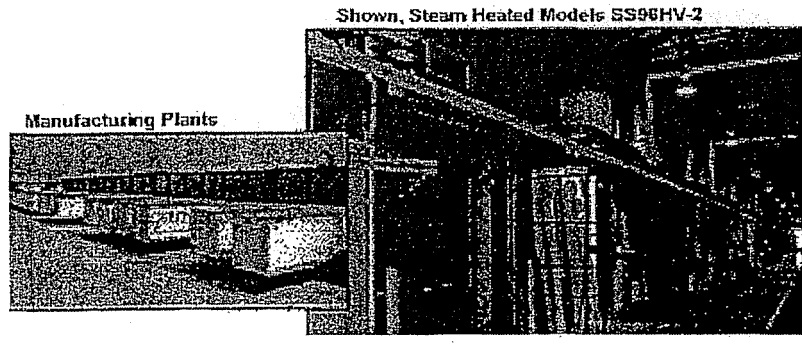


Model 96HV-2

the widest possible number of industrial uses, Mars Standard, High Velocity (HV) and Extra Power (EP) Series air u efficiently keep dirt, dust and insects out of your food facilities and other areas requiring a clean environment. hese compact, unobtrusive units are popular for meat packing and food processing plants, supermarkets and ommissaries, breweries, restaurants, schools, hospitals and cold storage plants. They are highly effective over large cold torage doors where they reduce humidity and ice buildup and seal in cold air. This results in substantial energy savings y preventing excessive operation of your refrigeration system.
he unit's self-contained one-piece metal housing is corrosion-proof and fire-retardant, easy to install and designed for astening to the wall on both ends without any intermediate support.

Key Features:

Models available in widths from 28" up to 12' and for door heights up to 16'
Creates protective air barrier against dust, pollens and insects
Maintains desired interior temperature for more comfortable working conditions
Limits entry of warm, moist air into cold storage rooms when doors are open
Minimizes refrigeration system overload
nates need for expensive flapper or plastic strip curtains
Prevents possibility of accidents by providing unobstructed view of passageway



Shown, Steam Heated Models SS96HV-2

Manufacturing Plants

'eated models available with Electric, Gas, Steam and Hot Water

MARS Air Doors
14716 South Broadway
Gardena, California 90248

Phone: 310-532-1555 | FAX: 310-324-3030
EMail: marsinfo@marsair.com

Created by LTGA INCORPORATED

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Actronaire & Powered Aire™ Doors

Introduction | FDA / USDA advice | How air doors work
Air Door features | Aire Door models | Make up air fans
Summary | Free consultation | Wind factors | Negative air pressure

Air curtains vs. wind factors

Wind affects the efficiency of an air curtain. An air curtain must generate sufficient velocity and be correctly adjusted to prevent wind from penetrating its seal.

Accurately analyzing the air flow in the vicinity of an air curtain to determine the optimum discharge angle involves some fairly complicated mathematics and physics. But it is possible to take a simplified view of the situation and get a feel for what is going on.

Air curtains designed to exclude insects from doors up to 10 feet high can have maximum velocities at the nozzle in excess of 4000 feet per minute, or over 45 mph. If the nozzle were angled at 90° to the vertical, that is, blowing horizontally instead of straight down, then a 45 mph horizontal wind could be countered.

But only a negligible amount of the air stream's power would protect levels much below the top of the door, so this would obviously not be an optimum angle. If the nozzle were placed at a 45° angle, half of the 90° angle between the horizontal and vertical plane, about half of the force of the air stream would now oppose external wind at the nozzle. So it would be able to stop about 23 mph winds at the top of the door, and less than that as the air stream gets weaker farther away from the nozzle.

This deterioration in the air velocity over distance must be factored into the equation when deciding at what angle to point the nozzle. The more it is angled towards the horizontal, the farther it must travel before reaching the floor. This means a greater deterioration in airspeed, and also leaves a larger gap between the air stream and the doorway through which external wind could flow.

When these additional factors are taken into account, it turns out that an angle of 20° offers the most efficient distribution

of the power of the air curtain. This roughly amounts to splitting the 45° angle that we earlier reasoned could stop a 23 mph wind. Although the actual calculations are quite complex, we can intuitively see that as in the 45° example, we are once again redirecting about half of the horizontal velocity toward the floor. So it should not be surprising that, in actual use, air curtains are capable of stopping about half of 23 mph, or approximately 10-12 mph winds. And this protection extends over the entire surface of the doorway.

It's probably not a coincidence that average wind speed is in the range between 10 and 12 mph. Wind speeds lower than this cannot penetrate the seal of an air curtain. If the wind is stronger than this, its velocity after penetration will be reduced by about 10 to 12 mph.

Back

Introduction | FDA / USDA advice | How air doors work
Air Door features | Aire Door models | Make up air fans
Summary | Free consultation | Wind factors | Negative air pressure

P. O. Box 572244, Tarzana CA 91357-2244 USA
Phones: (800) 866-8887 (toll free in USA only)
or (818) 654-9744 (USA or International)
Fax: (818) 654-9788 email

Concept, content, navigation by : Assist Business Solutions
Visual concept, layout and images created by:
Kim at designplace.com

POWERED AIRE INC.

www.poweredaire.com

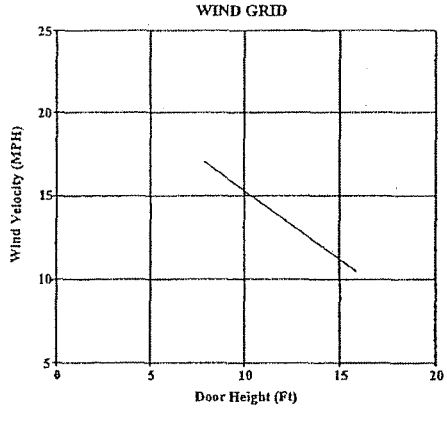
MODEL: ETD - Dual Speed Unheated
Climate Control Eight Ten Door
Door Height: Up to Ten Feet

PRODUCT DATA DUAL SPEED UNITS
(H) HIGH SPEED (L) LOW SPEED

Model	ETD 1-36	ETD 1-42	ETD 1-48	ETD 1-60	ETD 2-60	ETD 2-72	ETD 2-84	ETD 2-96	ETD 3-108	ETD 3-120	ETD 3-132	ETD 4-144
Nozzle width inches	36	42	48	60	60	72	84	96	108	120	132	144
Max. FPM at Nozzle	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837	H 4218 L 2837
Max. CFM at Nozzle	H 2899 L 1950	H 3384 L 2276	H 3867 L 2601	H 4374 L 2792	H 5050 L 3252	H 5803 L 3903	H 6766 L 4551	H 7732 L 5201	H 8702 L 5853	H 9668 L 6503	H 10853 L 7155	H 11606 L 7806
Avg. FPM at Nozzle	H 3695 L 2487	H 3169 L 2133	H 2771 L 1865	H 2218 L 1493	H 3315 L 2231	H 3696 L 2488	H 3169 L 2133	H 2773 L 1866	H 3702 L 2486	H 3174 L 2134	H 2792 L 1885	H 3696 L 2488
CFM at Nozzle	H 2541 L 1710	H 2532 L 1696	H 2559 L 1721	H 2528 L 1703	H 3812 L 2565	H 5082 L 3420	H 5063 L 3382	H 5081 L 3417	H 7623 L 5130	H 7614 L 5127	H 7589 L 5104	H 10164 L 6840
Outlet Velocity Uniformity	95%	93%	92%	91%	94%	95%	93%	92%	95%	94%	94%	95%
Number of Motors	1	1	1	1	2	2	2	2	3	3	3	4
Horse Power	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Weight (Lbs)	90	97	104	117	147	169	187	203	245	274	290	338

Sound Level: High Speed 63 dba Low Speed 56 dba
Sound level measured 10 feet from unit in a free field based on a 1 motor unit.

Voltage Available: 120/1/60 208/240/1/60
Amp. Draw Per Motor: (H) 8.0 (L) 6.7 (H) 3.6 (L) 2.4
** Nozzle width equals door width.
** For three phase motors consult factory.
** For unit over twelve feet long consult factory.



451 Second St. Greenville, PA 16125 PHONE: 724-646-0240 FAX: 724-646-0242
June, 2003

POWERED AIRE, INC.

HOME

ABOUT US

AIR CURTAIN OVERVIEW

INDUSTRIAL AIR DOORS
STANDARD INDUSTRIAL (TSD)
EXTRA HIGH DOOR (EHD)
CORROSIVE AREA (HDC)
HAZARDOUS AREA (HDX)

]ERCIAL ...RTAINS

INDUSTRIAL ...IR CURTAINS

MAKE UP AIR SYSTEMS

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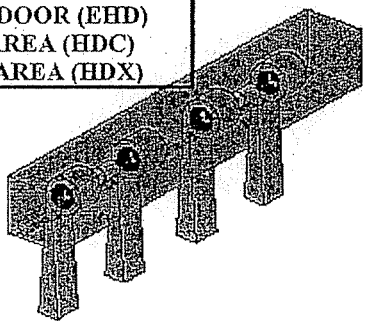
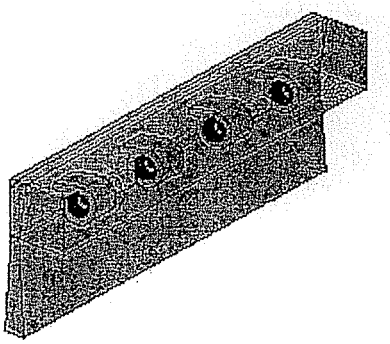
WHY USE POWERED AIRE AIR CURTAINS?

The use of plenums in our air curtains makes the air flowing out of the discharge more uniform across the length of the nozzle. Most of our competitors aim the discharge of each blower directly down and the air flows right out of the nozzle. These blowers cannot be placed directly beside each other since the return air enters from the sides. There are also motors in between the blowers spreading them out further. When the blowers force air directly out of the discharge of the air curtain, there will be dead spots wherever there are spaces between the blowers.

Competition



Powered Aire



In Powered Aire's units, the air coming out of the blowers is pointed toward the back of the air curtain. Here it fills a specially designed plenum. When the plenum is pressurized, the air is then forced out evenly across the entire length of the plenum discharge.

Another benefit of this design is a reduction in the noise level. The noise generated by the turbulent air being discharged from the blowers that can be heard in our competitors' models is absorbed by the plenum. The air discharged from the plenum is more evenly dispersed across a larger cross-section, drastically lowering the sound levels.

Another advantage to using Powered Aire air doors is that every air curtain we sell is constructed of stainless steel. We still remain competitive with other manufacturers who make their units out of plastics, painted steel, or aluminum by avoiding costs associated with expensive molds, disposing of chemicals, maintaining a paint booth, extra labor, etc. Other than being corrosion resistant, stainless steel also gives our air doors an aesthetically pleasing look. The reflective properties of the metal allow our air curtains to blend in with the architecture by mirroring the color of their surroundings.

One area where we feel we particularly stand out is the after sale support. We don't forget about the customer after the purchase is made. Our qualified staff is available to provide technical assistance during and after installation of our products.

POWERED AIRE INC.

www.poweredaire.com

MODEL: TSD Unheated
Door Height: Up to Seventeen Feet

PAAC-101

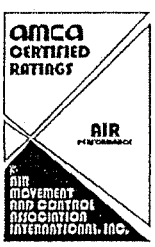
Model	Door Width Feet	Nozzle Width Inches	Max FPM At Nozzle	Avg. Outlet Velocity FPM	CFM At Nozzle	Outlet Velocity Uniformity	Power Rating KW	Number Of Motors	Horse Power	Weight Lbs.
TSD 1-48	4	48	6200	3530	4554	92%	2.0	1	3	342
TSD 1-60	5	60	5800	3006	4855	92%	2.1	1	3	380
TSD 1-72	6	72	5900	2891	5579	86.3%	2.5	1	3	400
TSD 2-96	8	96	6200	3530	9108	92%	4.0	2	3	681
TSD 2-108	9	108	6200	3239	9409	92%	4.1	2	3	719
TSD 2-120	10	120	5800	3006	9710	92%	4.2	2	3	757
TSD 2-132	11	132	5900	2943	10434	86.3%	4.6	2	3	777
TSD 2-144	12	144	5900	2891	11158	86.3%	5.0	2	3	797
TSD 3-144	12	144	6200	3530	13662	92%	6.0	3	3	1020
TSD 3-156	13	156	6200	3328	13963	92%	6.1	3	3	1058
TSD 3-168	14	168	6200	3257	14687	86.3%	6.5	3	3	1078
TSD 3-180	15	180	6200	3100	14988	86.3%	6.6	3	3	1116
TSD 3-192	16	192	6200	3051	15712	86.3%	7.0	3	3	1136
TSD 4-192	16	192	6200	3530	18216	92%	8.0	4	3	1359
TSD 3-204	17	204	5900	2925	16013	86.3%	7.1	3	3	1174
TSD 4-204	17	204	6200	3376	18517	92%	8.1	4	3	1397
TSD 3-216	18	216	5900	2891	16737	86.3%	7.5	3	3	1194
TSD 4-216	18	216	6200	3317	19241	86.3%	8.5	4	3	1417
TSD 4-228	19	228	6200	3191	19542	86.3%	8.6	4	3	1455
TSD 4-240	20	240	6200	3147	20266	86.3%	9.0	4	3	1475
TSD 5-240	20	240	6200	3530	22770	92%	10.0	5	3	1698
TSD 4-252	21	252	6200	3040	20567	86.3%	9.1	4	3	1513

*See Reverse Side For Larger Sizes

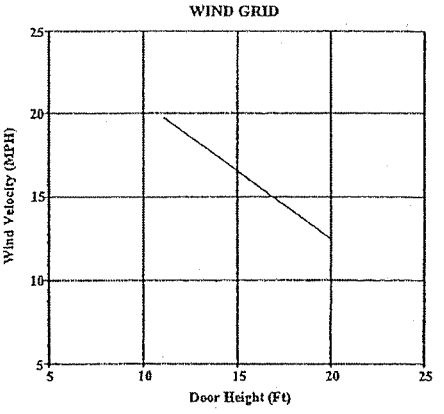
The AMCA Certified Ratings Seal applies to air performance ratings only.
Sound level measured 10 feet from a one motor unit in a free field: 69 dBA

Velocity Projection Model: TSD 1-48
Distance From Nozzle: 4' 12' 18'
Core Velocity (fpm) : 2800 1800 1482

Voltage Available: 208 / 240 / 480 / 575 /3/60 HZ 380/3/50 HZ
Amp. Draw Per Motor: 13.1 /12.2/ 6.1 / 5.0 9.0



Powered Aire, Inc. certifies that the air curtains shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.



The AMCA Certified Ratings Seal applies to airflow rate, average outlet velocity, outlet velocity uniformity, velocity projection and power rating at free delivery only. Rated data shown is only for base (unheated) units, as shown.

451 Second St. Greenville, PA 16125 PHONE: 724-646-0240 FAX: 724-646-0242

June, 2003

POWERED AIRE INC.

www.poweredaire.com

MODEL: TSD Unheated
Door Height: Up to Seventeen Feet

PAAC-102

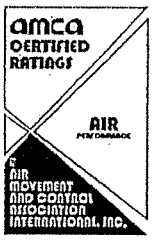
Model	Door Width Feet	Nozzle Width Inches	Max FPM At Nozzle	Avg. Outlet Velocity FPM	CFM At Nozzle	Outlet Velocity Uniformity	Power Rating KW	Number Of Motors	Horse Power	Weight Lbs.
TSD 5-252	21	252	6200	3405	23071	92%	10.1	5	3	1736
TSD 4-264	22	264	6200	3007	21291	86.3%	9.5	4	3	1533
TSD 5-264	22	264	6200	3356	23795	86.3%	10.5	5	3	1756
TSD 4-276	23	276	5900	2916	21592	86.3%	9.6	4	3	1571
TSD 5-276	23	276	6200	3250	24096	86.3%	10.6	5	3	1794
TSD 4-288	24	288	5900	2891	22316	86.3%	10.0	4	3	1591
TSD 5-288	24	288	6200	3211	24820	86.3%	11.0	5	3	1814
TSD 6-288	24	288	6200	3530	27324	92%	12.0	6	3	2037
TSD 5-300	25	300	6200	3119	25121	86.3%	11.1	5	3	1852
TSD 6-300	25	300	6200	3425	27625	92%	12.1	6	3	2075
TSD 5-312	26	312	6200	3088	25845	86.3%	11.5	5	3	1872
TSD 6-312	26	312	6200	3383	28349	86.3%	12.5	6	3	2095
TSD 5-324	27	324	6200	3007	26146	86.3%	11.6	5	3	1910
TSD 6-324	27	324	6200	3291	28650	86.3%	12.6	6	3	2133
TSD 5-336	28	336	6200	2982	26870	86.3%	12.0	5	3	1930
TSD 6-336	28	336	6200	3257	29374	86.3%	13.0	6	3	2153
TSD 7-336	28	336	6200	3530	31878	92%	14.0	7	3	2376
TSD 5-348	29	348	5900	2911	27171	86.3%	12.1	5	3	1968
TSD 6-348	29	348	6200	3175	29675	86.3%	13.1	6	3	2191
TSD 7-348	29	348	6200	3440	32179	92%	14.1	7	3	2414
TSD 5-360	30	360	5900	2891	27895	86.3%	12.5	5	3	1988
TSD 6-360	30	360	6200	3147	30399	86.3%	13.5	6	3	2211
TSD 7-360	30	360	6200	3403	32903	86.3%	14.5	7	3	2434

The AMCA Certified Ratings Seal applies to air performance ratings only.
Sound level measured 10 feet from a one motor unit in a free field: 69 dBA

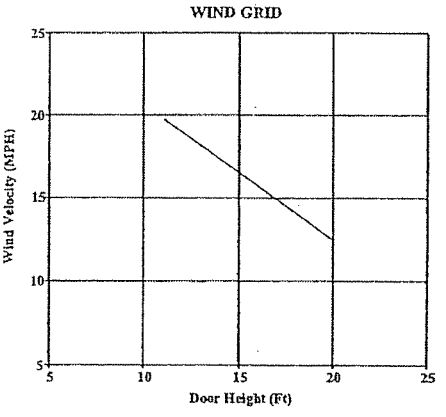
Velocity Projection Model: TSD 1-48

Distance From Nozzle:	4'	12'	18'
Core Velocity (fpm) :	2800	1800	1482

Voltage Available: 208 / 240 / 480 / 575 /3/60 HZ 380/3/50 HZ
Amp. Draw Per Motor: 13.1 /12.2/ 6.1 / 5.0 9.0



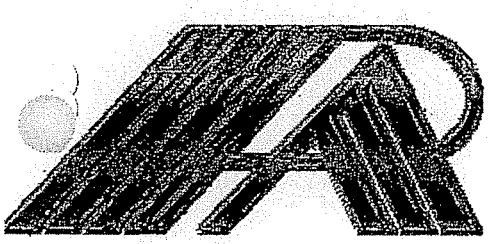
Powered Aire, Inc. certifies that the air curtains shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.



The AMCA Certified Ratings Seal applies to airflow rate, average outlet velocity, outlet velocity uniformity, velocity projection and power rating at free delivery only. Rated data shown is only for base (unheated) units, as shown.

451 Second St. Greenville, PA 16125 PHONE: 724-646-0240 FAX: 724-646-0242

June, 2003



POWERED AIRE, INC.

AIR CURTAIN SELECTION GUIDE

HOME
ABOUT US
URTAIN ERVIEW
COMMERCIAL AIR CURTAINS
INDUSTRIAL AIR CURTAINS
MAKE UP AIR SYSTEMS
REP FINDER

Door Height	Wind Stopping Capability (mph)						
	MP	CED	BCE	BCT	ETD LDC LDX	TSD HDC HDX	EHD
4	15.0						
5	13.9						
6	13.1						
7	12.2						
8	11.5	12.8	14.7	16.4	16.4		
9	10.9	11.9	14.0	15.5	15.5		
10	10.2	11.0	13.2	14.8	14.8	20.4	
11	9.3	10.1	12.1	13.9	13.9	19.8	
12	8.6	9.2	11.2	13.1	13.1	19.0	21.3
13		8.3	10.4	12.4	12.4	18.0	20.6
14		7.4	9.7	11.9	11.9	17.2	20.0
15				11.5	11.5	16.6	19.1
16						15.8	18.0
17						15.0	17.5
18						14.1	16.9
19						13.5	16.1
20						12.9	15.2
21							14.7
22							13.2

mini-power (MP)
Compact low profile design ideal for drive through windows and entrances where space is limited.

Customer Entrance Door (CED)
Used in retail applications to separate inside and outside environments for comfort and energy savings. Low velocity air steam used to minimize air blowing on customers.

Bug Control (BCE & BCT)
Designed to stop insects, dust, and other debris from entering through door. Comes in light duty model (BCE) and heavy duty (BCT).

Climate Control (ETD)
For use in stopping cold or warm air from entering climate controlled environment.

Industrial (TSD)

Used over dock doors or large openings in an industrial environment.

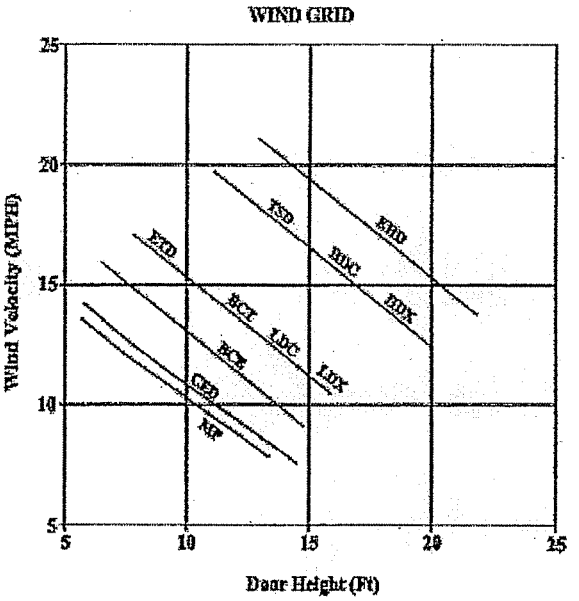
REQUEST CATALOG

Extra High Door (EHD)
For use in industrial settings where maximum air capacity is desired.

Corrosion Duty (LDC & HDC)
For use in corrosive atmospheres. Comes in light duty model (LDC) and heavy duty model (HDC).

CONTACT US

Hazardous Environment (LDX & HDX)
Non-spark construction for use in explosive atmospheres. Comes in light duty model (LDX) and heavy duty model (HDX).



Up

Miniveil Air Systems

Air Curtain History

General Information

Air Curtain Benefits

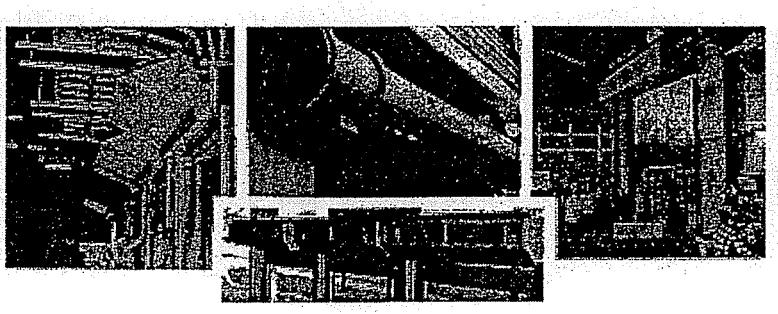
Air Curtain Usage

Systems/Models

FAQ

Selecting a System

Uses of Air Curtains



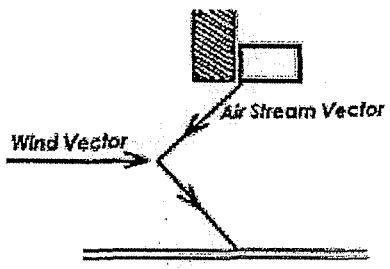
Air Curtains can be used in many types of applications. Here are a few:

Industrial Climate Control

The primary purpose of the Climate Control Air Curtain is to prevent the influx of outside air through an opening in to heated or cooled area. Opening where an Air Curtain would typically be used are exterior shipping and receiving doors to plants and warehouses and interior doors between plant areas of different temperatures. (these applications are discussed in further detail below). In addition there are special applications such as the control of oven temperature, humidity and dust or the control of the fresh air . Other applications not discussed here are preventing the drifting of over spray from spray paint booths; blowing water off of hot steel after it has been dipped; and blowing scrap paper from a paper cutter into a collecting intake.

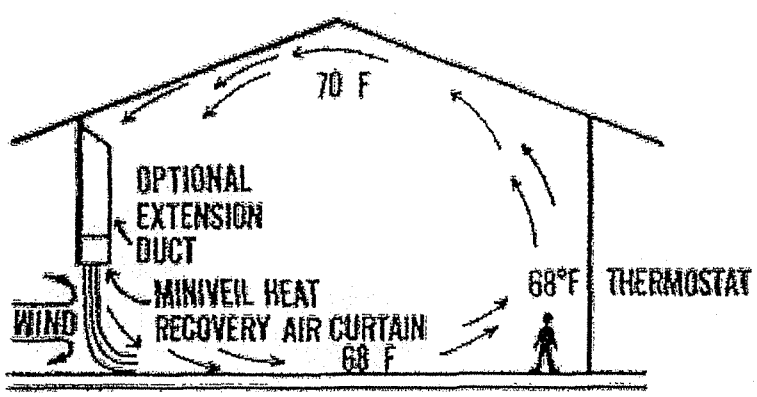
In order to control climate an Air Curtain emits an air stream with enough velocity at the nozzle and the width of the nozzle. For different door sizes and different wind conditions , different air velocities at the nozzle are required.

To prevent the entry of outside winds the discharge nozzle is angled outward so that the air leaving it meets the wind trying to enter. The wind will meet or strike the Air Curtain stream in the doorway. This working principle is shown in the figure below:



When the vector representing the air stream and the vector representing the wind equalize they form a resultant which should meet the floor in the door plane for maximum efficiency.

In many buildings with high ceilings the air tends to stratify into a warmer layer at the ceiling and a considerably cooler one at the floor. For such buildings it is recommended that the air curtain be mounted across the top of the doorway opening and that it be provided with a top intake connected to a duct extending up to the ceiling. (as illustrated):



The warm air will then be drawn down into the Air Curtain and blown to the floor putting otherwise wasted heat to use. This warmer air also helps to reduce the wind chill of the moving air.

Air Conditioned Areas +UP

Air conditioned areas are normally well balanced and seldom have negative pressure. In fact a slight over-pressure is more common where air conditioning systems are bringing fresh air into an area.
Air Curtains for interior door need only be sized for the draft due to the temperature differences between the two sides. On interior openings between the air conditioned areas and non

air conditioned areas, the Air Curtain should be mounted on the non air conditioned side, angled away from the air conditioned areas, and the air should be dampered back until there is a minimum amount of air splitting at the floor and going in toward the air conditioned side.
Doors between an air conditioned area and the outside are exposed to winds which must be considered in the selection of the Air Curtain. For application on such doors the Air Curtain should be installed on the inside for the best possible efficiency, and the nozzle angle should be adjusted so that a minimum of air conditioning is discharged from the inside. This inside mounting allows the Air Curtain to be used in the winter to prevent cold outside air from entering.

Industrial Oven Openings ↑UP

Using Air Curtains on opening to ovens has resulted in fuel savings of up to 40% of the total oven fuel consumption. Air Curtains are normally installed horizontally over the oven opening and angled slightly inward toward the oven to contain the hot air that is trying to come out at the top. Many Air Curtains are successfully operating on ovens with temperatures up to 475° F. The Air Curtain drive motor should be located to the side of the oven opening to protect them from damage from hot air that would escape in the even of a shutdown of the Air Curtain. Oven applications should be designed case by case to meet each set of unique conditions.

Dust and Humidity Control ↑UP

Air Curtains should be installed on the clean or humidity controlled side of the opening, blowing toward the dirty or uncontrolled side. This will prevent the influx of the dust particles or atmospheric vapour. Air Curtain units for dust and humidity control are approximately 70% efficient. The 30% inefficiency is caused by particles are air becoming entrained in the Air Curtain stream and working their way through.

Mines ↑UP

Air Curtains are in use in a hard rock mine at the 1100 foot depth to control the flow of fresh air that is introduced into the mine. Installed at several points along the main airway the Air Curtain deflects some of the fresh air flow out into the shafts. For more detailed information on this very successful application please contact the factory.

Commercial Entrances ↑UP

Commercial Entrance Air Curtains are becoming widely used in building entrances to reduce energy consumption and provide comfort. In winter they retain warm inside air and

prevent the influx of cold air. They can also supply additional heat in the door area using optional electrical, steam or hot water heaters. In the summer Air Curtains keep hot humid air out and prevent the escape of air conditioning. The working principle of Commercial Entrance Air Curtains is to provide the most effective air screen possible without blowing so hard that it is objectionable to people passing through.
Air Curtains are ideal for application on high traffic doorways in commercial establishments such as stores, restaurants and banks. They are also ideal for public buildings such as hospitals, terminals and schools. In many cases where a vestibule was installed, or planned, to reduce the inflow, an Air Curtain is a better approach. This is particularly true for high traffic entrances where both doors are frequently open at the same time, defeating the purpose of the vestibule. A continuously operating Air Curtain allows the vestibule to be dispensed with resulting in large savings -- both in initial and operating costs -- and increasing the usable floor space.
Commercial Entrance Air Curtains are normally mounted horizontally above the door which keeps the unit out of the way and practically eliminates any chance of damage and/or accidents. During the heating season, the air stream should be directed slightly toward the outside and should never be obstructed by door operators or the door header.
It is recommended that the Air Curtain fan motor be run continuously, since the power needed to operate it is minimal. It is preferable to control the heater in heated units with a built-in, or wall mounted, thermostat, in order to maintain a constant, comfortable temperature in the entrance area. In addition to providing comfort through the elimination of cold drafts and the addition of heat to door areas. Commercial Entrance Air Curtains have many other benefits. For example, they can decrease door maintenance costs since doors need to be opened and closed left often. In restaurants they stop uncomfortable cold drafts at customer's feet. Many schools purchase Air Curtains to save energy and find that, as an additional benefit, they keep floors dry and safe and hallways warm during the winter months. In buildings with high ceilings the Air Curtain re-circulates the warm stratified air that rises to the ceiling.
Commercial Entrance Air Curtains are quiet and compact and pay for themselves in a very short time. Most units may be used all year round and are adjustable for seasonal conditions using either a damper or a duel speed motor.

Insect Control ↑UP

Insect Control Air Curtains, sometimes called "Fly Fans," are used in food processing plants, dairies, bakeries, bottling plants, restaurants, supermarkets, hospitals, school cafeterias and other areas where the control of flying insects is required. The powerful stream of air that is produced by an Insect Control Air Curtain is an excellent deterrent to insects which will usually avoid the air stream simply because of it's

emits an air stream which reaches the floor at an angle and splits into two separate air streams. By properly adjusting the volume of the air and the angle of the nozzle, one air stream is made to balance against the other which is trying to leave the cooled room, while the other counteracts the warm air trying to enter. The correct Air Curtain sizing and adjustments must be made for each specific application so that a narrow, high velocity, low volume stream of air is projected over the entire opening creating a sufficiently stiff curtain of air. Built-in adjustments in the Air Curtain must include fully adjustable mounting brackets, variable volume controls and individually adjustable louvers in the nozzle. The narrow nozzle limits the amount of air in the doorway area and hence the turbulence, thus increasing the efficiency of the unit.

In addition to providing a substantial energy savings and increased safety, Cold Storage Air Curtains can increase the time between defrosting almost four fold, depending on the particular freezer or cooler. Also, their ability to maintain the cold room temperature right up to the doorway improves product quality and increases the useful floor space.

Summary ↑UP

Over the long life of an Air Curtain system, tremendous benefits can be realized which pay for the system many times over. Some of these include:

- Increased employee comfort.
- Energy savings through control of air transfer.
- Faster and safer traffic flow and increased production due to clear and open doorways.
- Door maintenance cost savings due to decreased breakdowns.
- Increased usable space near door areas.
- Elimination of ice and fog in cold storage areas.
- Increased safety in door areas due to better visibility.

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CANADA L1A 4A6
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Email: info@miniveil.com

unnaturally high velocity.
The most effective Air Curtain design for insect control has a nozzle that can angle the air stream away from the area to be protected. An angle of about 20° from the vertical is usually optimal. The unit should meet or exceed Department of Agriculture and Federal Drug Administration standards, which call for an air stream 2-5 inches wide at the nozzle capable of producing a minimum velocity of 1600 fpm of air 3 feet above the floor and across the entire door opening. It is very important that the entire doorway be covered so that there are no gaps for the insects to enter.
The Insect Control Air Curtains can be mounted on the inside or outside of the doorway. When mounted on the inside the unit can help control the building's climate in the winter by stopping the influx of cold outside air. (For more info on this effect see the Industrial Climate Control or Commercial Entrance Sections). When the building contains odours which are attractive to flying insects it is recommended that the Air Curtain be mounted on the outside.
When a negative pressure exists inside the building one of two approaches must be taken to make the Air Curtain fully effective in keeping the flying insects out. One alternative is to slightly alter the mounting of the unit, moving it out form the wall to relieve pressure on the Air Curtain and to allow the outside air to enter the building. The outside air will be drawn to the intake of the curtain through the gap between the wall and the unit. This gap must be covered by a screen and the gaps along the door jamb, caused by moving the unit back from the wall, should be closed by side panels.
The Air Curtain is equally effective mounted horizontally or vertically. However, measures should be taken to prevent damage to the Air Curtain caused by traffic when mounted vertically.

Cold Storage UP

When opened a door separating a cold storage area from a warm room permits a substantial loss of refrigerated air. Warm air flows into the cold room through the lower part. This results in energy losses, safety hazards in the form of condensation and icing on the floor and fog in the doorway; and possibly food spoilage. Strip doors used on coolers and freezers to reduce these effects impair visibility and are unpleasant to pass through due to condensation and frosting and accumulate dirt and possible bacterial growth.

Studies have proven that Air Curtains, when properly sized and adjusted, are up to 85% efficient in controlling the flow of air through cooler and freezer doorways. If the cold storage door is open over one hour per day the Air Curtain is a cost effective way to save refrigeration costs.

Installed on the warm side of the doorway the Air Curtain

Technology

Window and Through-the Wall AC Units (w/ louvers & w/o louvers). Please note units with louvers are window units with more heat exchanger surface on sides of units. Units without louvers are units installed in a sleeve with outside exposure only to front, not sides of unit.

Energy Savings – kWh & Summer Peak Savings

Savings are based on number of full load cooling hours. The tables below show savings for both 700 and 900 full load hours. Energy savings were calculated using the ENERGY STAR website's on-line calculator. CEE states that savings are greater than what ENERGY STAR predicts. Peak Savings are difference between ENERGY STAR product and Federal Standard product and can be multiplied by utility diversification factor.

700 full load cooling hours				
Equipment (Btu/h)	**ENERGY STAR, w/ louvers kWh Savings**	**ENERGY STAR w/ louvers kW Savings**	**ENERGY STAR, w/o louvers kWh Savings**	**ENERGY STAR w/o louvers kW Savings**
< 6,000	40	0.1156	42	0.1212
6,000 to 7,999				
8,000 to 13,999	66	0.1134	126	0.1352
14,000 to 19,999	108	0.1156		
⩾ 20,000	189	0.1747		
900 full load cooling hours				
Equipment (Btu/h)	**ENERGY STAR, w/ louvers kWh Savings**	**ENERGY STAR w/ louvers kW Savings**	**ENERGY STAR, w/o louvers kWh Savings**	**ENERGY STAR w/o louvers kW Savings**
< 6,000	52	0.1156	55	0.1212
6,000 to 7,999				
8,000 to 13,999	85	0.1134	162	0.1352
14,000 to 19,999	139	0.1156		
⩾ 20,000	243	0.1747		

The following estimates are provided assuming 800 hours and a mix of sizes.

- w/Louvers under 14,000 Btu/hr; 70kWh and .114 KW
- w/Louvers 14,000 Btu/hr and over; 185 kWh and .151 KW
- w/o Louvers under 14,000 Btu/hr; 80 kWh and .121 KW
- w/o Louvers 14,000 Btu/hr and over; 190 kWh and .16 KW
-

Measure Life

10-12 years

Initial One-Time Cost

Increased costs vary by manufacturer, but average around $70 for units 12,500 Btu/h and smaller $100 per unit for larger units.

Any Recurring Costs

None

Suggested Incentive

According to Consumer Reports, much of the Northeast is offering a $25 rebate for an ENERGY STAR model, and $50 in California. An incentive of around $25 for smaller units is the highest we would recommend given the size of the savings. A second level of incentive at $40 for larger units could be considered.

Requirements

For Application – EER requirements are listed in the table below.
Size – The ENERGY STAR website, the FEMP website, and the CEE website offer guidelines for properly sizing a window AC unit. Proper sizing can save more energy than upgrading to an ENERGY STAR model.

Existing Energy Standards

There is currently an ENERGY STAR standard for this product. ENERGY STAR standards are divided based on whether the units have side louvers, with standard and casement window units having louvers, and through-the wall units not having louvers. The following table lists the ENERGY STAR standards.

Equipment (Btu/h)	Federal EER, w/ louvers	ENERGY STAR EER, w/ louvers	Federal EER, w/o louvers	ENERGY STAR EER, w/o louvers
< 6,000	≥ 9.7	≥ 10.7	≥ 9.0	≥ 9.9
6,000 to 7,999				
8,000 to 13,999	≥ 9.8	≥ 10.8	≥ 8.5	≥ 9.4
14,000 to 19,999	≥ 9.7	≥ 10.7		
≥ 20,000	≥ 8.5	≥ 9.7		

Source of Info

Energy Star website; Prices from Consumer Reports website; CEE; FEMP; manufacturers web sites

Room Air Conditioners

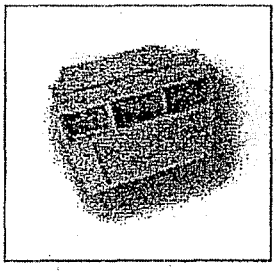
Replacing a 10-year-old room air conditioner with a new ENERGY STAR qualified model could save up to $20 a year on electricity.

Earning the ENERGY STAR means a product meets strict energy efficiency guidelines set by the US Environmental Protection Agency and the Department of Energy.

+ ENERGY STAR qualified room air conditioners use at least 10% less energy than conventional models.

Remember, saving energy prevents pollution. By choosing ENERGY STAR, you are helping prevent global warming and promoting cleaner air without sacrificing the product quality and performance you expect.

You may also be interested to know that many people buy an air conditioner that is too large. ENERGY STAR suggests making sure your unit is properly sized.



FIND A STORE
SPECIAL OFFERS

For Consumers
+ Product Search
+ Purchasing Tips
+ Manufacturer List
+ Product List Excel
+ Savings Calculator (Excel)

For Business
+ Key Product Criteria
+ Purchasing & Procurement
+ Information Resources

For Partners
+ Partner Commitments
+ QPI Form
+ Products in Development
+ Partner Resources

Room Air Conditioners Key Product Criteria

Equipment	Specification
Room Air Conditioners	At least 10% more energy efficient than the minimum federal government standards.

ENERGY STAR Qualified Room Air Conditioner (RAC) Eligibility

Currently, ENERGY STAR only qualifies room air conditioners units with louvered sides and no reverse cycle. These criteria became effective October 1, 2000. Below are the current Room Air Conditioner criteria.

Equipment (Btu/Hr)	Federal Energy Efficiency Ration, EER	ENERGY STAR Energy Efficiency Ratio, EER
<6,000	≥9.7	≥10.7
6,000 to 7,999		
8,000 to 13,999	≥9.8	≥10.8
14,000 to 19,999	≥9.7	≥10.7
≥20,000	≥8.5	≥9.4

Upcoming Changes to the ENERGY STAR Qualified RAC Criteria

On October 1, 2003, the ENERGY STAR RAC criteria will expand to include units without louvers commonly referred to as "built in" or though-the-wall (TTW) units. The casement product class will also be added. Units with reversing cycle are still excluded. The table below shows the qualifying levels:

Equipment (Btu/Hr)	Federal EER, w/louvers	ENERGY STAR EER, w/louvers	Federal EER, wo/louvers	ENERGY STAR EER, wo/louvers
<6,000	≥9.7	≥10.7	≥9.0	≥9.9
6,000 to 7,999				
8,000 to 13,999	≥9.8	≥10.8	≥8.5	≥9.4
14,000 to 19,999	≥9.7	≥10.7		
≥20,000	≥8.5	≥9.4		
	Federal EER		ENERGY STAR EER	
Casement only	≥8.7		≥9.6	
Casement-slider	≥9.5		≥10.5	

Features that help room air conditioners achieve this efficiency include:
+ High-efficiency compressors
+ High-efficiency fan motors
+ Improved heat transfer surfaces

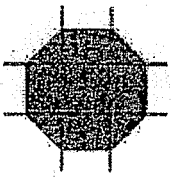
Properly Sized Room Air Conditioners

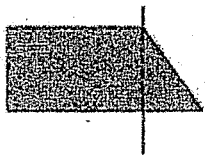
Many people buy an air conditioner that is too large, thinking it will provider better cooling. However, an oversized air conditioner is actually less effective - and wastes energy at the same time. Air conditioners remove both heat and humidity from the air. If the unit is too large, it will cool the room quickly, but only remove some of the humidity. This leaves the room with a damp, clammy feeling. A properly sized unit will remove humidity effectively as it cools.

To figure out which size unit is best for your cooling needs:

1. Determine the square footage of the area to be cooled using the following formulas:
+ For square and rectangular rooms, multiply the length of the area by its width
+ For a triangular area, multiply the length of the area by the width and divide by 2

Most rooms can be further divided into these basic shapes to determine the square footage.





If the shape of your room is other than square or rectangular, ask your sales associate to help you determine the square footage.

2. Using the square footage and the chart below, determine the correct cooling capacity. Cooling capacity is measured in British thermal units (BTUs) per hour.

Area To Be Cooled (square feet)	Capacity Needed (BTUs per hour)
100 to 150	5,000
150 to 250	6,000
250 to 300	7,000
300 to 350	8,000
350 to 400	9,000
400 to 450	10,000
450 to 550	12,000
550 to 700	14,000
700 to 1,000	18,000
1,000 to 1,200	21,000
1,200 to 1,400	23,000
1,400 to 1,500	24,000
1,500 to 2,000	30,000

2,000 to 2,500	34,000

3. Make any adjustments for the following circumstances:

+ If the room is heavily shaded, reduce capacity by 10 percent.
+ If the room is very sunny, increase capacity by 10 percent.
+ If more than two people regularly occupy the room, add 600 BTUs for each additional person.
+ If the unit is used in a kitchen, increase capacity by 4,000 BTUs.
+ Consider where you install the unit. If you are mounting an air conditioner near the corner of a room, look for a unit that can send the airflow in the right direction.

Purchasing Tips

+ Qualified room air conditioners must have louvered sides and no reverse cycle (heating). Check the yellow EnergyGuide label for this information.
+ Note the voltage. The standard household receptacle has a connection for a 115-volt branch unit circuit. Large room units rated at 115 volts may require a dedicated circuit. Room units rated a 230 volts may require a special circuit.
+ Select the unit with the highest Energy Efficiency Ratio (EER) for greater savings. The EER is the cooling capacity in BTUs divided by the watts.
+ Look for a unit whose filter slides out easily for regular cleaning. Clean filters help keep your unit in good working condition.
+ Check the yellow EnergyGuide label. This label helps you determine how much energy it takes to operate the model, compare the energy use of similar models, and estimate annual operating costs. View a sample label. 74k
+ Consider a unit with controls. Controls such as a digital readout for the thermostat setting, and a built-in timer help you adjust your unit to use less energy.

An air conditioner transfers heat-from the inside of a building, where it is not wanted, to the outside. The compressor sends cooled refrigerant through the coils. The refrigerant draws heat from the air as it is forced over the coils. A fan blows outside air over the hot coil, transferring heat from the refrigerant to the outdoor air. Because the heat is removed from the indoor air, the indoor area is cooled.

By using advanced heat transfer technologies, ENERGY STAR qualified room air conditioners transfer more heat from the air into the coils than conventional models transfer, saving the energy required to compress the refrigerant.

RESIDENTIAL HEATING AND COOLING PRODUCTS

Air-source Heat Pumps and Central Air Conditioners*

The Vendor Must:

Provide central air-conditioning units and air-source heat pumps bearing the ENERGY STAR label that are rated below 65,000 Btuh, powered by single-phase current, and that meet the ENERGY STAR specifications for energy efficiency. The vendor shall ensure that any ductwork installed with this product is sealed with permanent leak reduction technologies (duct tape alone is insufficient) and that any thermostats or controls installed with the equipment is designed for use with such equipment (e.g., heat pump thermostats shall be installed with heat pumps). The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Product Type	Current Criteria		
	SEER	EER	HSPF (for heat pumps only)
Split Systems	≥13	≥11	≥8.0
Single Package Equipment (including gas/electric package units)	≥12	≥10.5	≥7.6

Additional considerations for the procurement official:

Request that the vendor ensure:

- the unit is properly sized and installed to ensure maximum comfort and efficiency using industry accepted sizing protocols such as ACCA's Manual J.
- contractors are well trained in the proper installation of air-source heat pumps and central air-conditioners.

Room Air Conditioners

The Vendor Must:

Provide room air conditioners that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency. The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Product Class (Btu/Hr.)	Current Criteria
<8000	10.7
8,000 to 13,999	10.8
14,000 to 19,999	10.7
20,000	9.4

NOTE: The current ENERGY STAR specification for room air conditioners is 10 percent above the NAECA criteria.

Boilers**

The Vendor Must:

Provide residential gas or oil fired boilers of less than 300,000 Btu per hour energy input, that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency. The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Product Type	Current Criteria
Boiler	≥85% AFUE EER
Combination Space Heating and Water Heating Appliance	≥85% CAafue EER

AFUE: Annual Fuel Utilization Efficiency

CAafue: Combined Appliance Annual Fuel Utilization Efficiency

Additional considerations for the procurement official:
Request that the vendor ensure:

- the unit is properly sized and installed to ensure maximum comfort and efficiency using industry accepted sizing protocols such as ACCA's Manual J.
- contractors are well trained in the proper installation of boilers.

Furnaces**

The Vendor Must:
Provide gas or oil fired furnaces that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency. The vendor shall ensure that any ductwork installed with this product is sealed with permanent leak reduction technologies (duct tape alone is insufficient) and that any thermostats or controls installed with the equipment is designed for use with such equipment. The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Product Type	Current Criteria
Furnace	≥90% AFUE EER

AFUE: Annual Fuel Utilization Efficiency

Additional considerations for the procurement official:
Request that the vendor ensure:

- the unit is properly sized and installed to ensure maximum comfort and efficiency using industry accepted sizing protocols such as ACCA's Manual J.
- contractors are well trained in the proper installation of furnaces.

Geothermal Heat Pumps

The Vendor Must:
Provide single or multi-speed geothermal heat pumps that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency. The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Product Type	Current Criteria		
	EER	COP	Water Heating
Closed Loop System	14.1	3.3	YES
With integrated WH	14.1	3.3	N/A
Open Loop System	16.2	3.6	YES
With integrated WH	16.2	3.6	N/A
DX System	15	3.5	YES
With integrated WH	15	3.5	N/A

NOTE: These specifications apply to single-speed models. Multi-speed models may be qualified based on EER = (high speed EER+low speed EER)/2; and COP = (high speed COP+low speed COP)/2.

Additional considerations for the procurement official:
Request that the vendor ensure:

- the heat pump is properly sized for the conditioned space to ensure optimal operational cycles and comfort using industry accepted sizing protocols such as ACCA's Manual J.
- contractors are properly trained on the following issues:
  - equipment installation and hookup,
  - domestic water heater connection for desuperheater or integrated water heating, and
  - code compliance.

Thermostats*

The Vendor Must:

Provide programmable thermostats that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency. The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Table 1: Programmable Thermostat Setpoint Temperatures

Setting	Setpoint Temperature (Heat)	Setpoint Temperature (Cool)
Wake	≤70°F	≥78°F
Day	setback at least 8°F	setup at least 7°F
Evening	≤70°F	≥78°F
Sleep	setback at least 8°F	setup at least 4°F

Table 2: Acceptable Setpoint Times and Temperature Settings

Setting	Time	Setpoint Temperature(Heat)	Setpoint Temperature (Cool)
Wake	6 a.m.	70°F	78°F
Day	8 a.m.	62°F	85°F
Evening	6 p.m.	70°F	78°F
Sleep	10 p.m.	62°F	82°F

Ventilating Fans**

The Vendor Must:

Provide ventilating fans that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency. The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Performance Characteristic	Current Criteria	
Duty and Airflow (cfm)	Maximum Allowable Sound Level (sones)	Minimum Efficacy Level (cfm/W)
Range Hoods (up to 500 cfm)	4.0	2.8
Bathroom and Utility Room Fans (1 to 75 cfm)	2.0	1.4
Bathroom and Utility Room Fans (76 cfm and over)	1.5	2.8
Light Source	Must be an ENERGY STAR qualified light fixture. Night lights must consume no more than 4 watts.	

Room Air Conditioners Purchasing & Procurement Language

What is ENERGY STAR Purchasing & Procurement?

Purchasing & Procurement for all Products

ENERGY STAR makes it easy for organizations to purchase energy-efficient products, reduce their energy costs, and prevent air pollution. Institutions and businesses can save hundreds of thousands of dollars annually by purchasing and using ENERGY STAR labeled and Federal Energy Management Program (FEMP) recommended products.

Sample Procurement Language (Download Residential Heating and Cooling Procurement Language - MS Word | 67K)

The Vendor Must:

Provide room air conditioners that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency. The vendor is encouraged to visit energystar.gov for an updated list of qualifying products.

Product Class (Btu/Hr.)	Current Criteria
< 8000	10.7
8,000 to 13,999	10.8
14,000 to 19,999	10.7
20,000	9.4

NOTE: The current ENERGY STAR specification for room air conditioners is 10 percent above the NAECA criteria.

Room Air Conditioners Information Resources

Information Source: List of ENERGY STAR labeled room air conditioners.

Information Source: California Energy Commission database

How to Access: Downloadable via an on-line bulletin board service by dialing (916) 654-4069.

A "Read Me" file describes all of the information available and gives instructions for downloading and use of the database files, including file decompression procedures. The fields in each database are described in a separate text file. Three-letter codes for Manufacturer names and Brand names, for all product types together, are listed in alphabetical order in two separate text files containing approximately 1,500 names and codes.

To make a special request for a printed list, contact:
Appliance Certification Program
California Energy Commission
(916) 654-5106
(916) 654-4304 (fax)
Email: efftech@energy.ca.gov

Scope: On-line listing shows over 300 models that have an Energy Efficiency Rating (EER) of 9.2 or better (approximately 40 percent models of this type in the database).

+ 115 and 230 volt models
+ Cooling capacities from 5,000 - 27,600 Btuh
+ Includes some models with heat pump and electric resistance heating capability
+ 230 and 208 volt, single-phase systems

Downloadable file contains over 800 models that meet minimum federal and California standards (available in DBF, comma-delimited, or ASCII format).

+ Includes room air conditioners, packaged terminal air conditioners, and packaged terminal heat pumps in one file
+ 115 and 230 volt models
+ Cooling capacities from 4,400 - 34,000 Btuh
+ Includes some models with heat pump and electric resistance heating capability
+ 230 and 208 volt, single-phase systems

Original Data Source: Provided directly to the Commission by manufacturers.

Update Frequency: Monthly

Information Source: American Council for an Energy-Efficient Economy's (ACEEE)

Listings of the Most Efficient Appliances.

How to Access: On-line: http://hes.lbl.gov/HES/new.html

Listings are also printed in ACEEE's *Consumer Guide to Home Energy Savings*, 6th ed, 1998, available in bookstores or directly from ACEEE; orders may be placed by phone, fax, or email.

Contact:
Publications Manager American Council for an Energy-Efficient Economy
(202) 429-0063
(202) 429-0193 (fax)
Email: ace3pubs@ix.netcom.com

Cost:
1-25 copies: $8.95 each
26-99 copies: $6.36 each
100-499 copies: $4.77 each
500-999 copies: $3.98 each

Scope: List includes 81 models from among 18 brands that have Energy Efficiency Ratios (EER) ranging from 10.0 to 11.8 (5 models w/cooling capacities > 18,000 Btuh have EERs = 9.5).

Cooling capacities from 5,000 ?? 18,900 Btuh.

Models are grouped by size (cooling capacity), and listed in order of descending EER.

Original Data Source: Derived from *Directory of Certified Room Air Conditioners*, Association of Home Appliance Manufacturers, Chicago, IL, October 1997

Update Frequency: Annually

Expansion of ENERGY STAR® Room Air-Conditioner Criteria to Include Through-the-Wall Units

Executive Summary

The Department of Energy (DOE) proposes to expand the current ENERGY STAR room air-conditioner (RAC) criteria to include through-the-wall (TTW) RAC without heating. The proposed ENERGY STAR performance level is at 10% above the current federal minimum energy efficiency ratios (EERs) for RACs defined in the federal standard (10CFR430). The proposed effective date is May 1, 2003.

Approximately one-third of the existing products in the market would qualify for an ENERGY STAR label at a 10% more efficient than the federal standard. This allows the current market to participate in and promote the ENERGY STAR program. It also makes affordable ENERGY STAR qualified TTW RACs available to middle and low-income consumers, a large consideration as this market segment is key for TTW RAC.

The 10% level is consistent with the existing ENERGY STAR RAC (louvered and without heating) criteria. Maintaining consistency will help to prevent consumer and manufacturer confusion on RAC ENERGY STAR criteria. The expansion of the ENERGY STAR RAC criteria also helps the Department to achieve these goals:

- Increase the potential national energy savings beyond the October 1, 2000, RAC federal standard
- Respond to partner demand for and ENERGY STAR criteria for TTW RAC
- Provide consumer-friendly guidance for selecting high efficiency TTW RACs
- Expand the ENERGY STAR program to more products, including products that are used in multi-family housing

Introduction

Currently, only RACs without heat and with side louvers are eligible for the ENERGY STAR label. DOE is proposing to expand ENERGY STAR RAC coverage to include RACs without side louvers and without heating. These units may be referred to as "through-the-wall" (TTW) RACs. They ship as complete units and fit into a sleeve or hole cut through a wall. These models were not included in the initial ENERGY STAR criteria for RAC because of their small market share. DOE recognized the need to include these products in the overall ENERGY STAR RAC criteria to provide options for consumers seeking high-efficiency replacement units for their existing TTW RAC applications, and to complete the coverage to represent the full extent of the RAC without heating market.

Market

TTW RAC market share is small relative to louvered RAC and estimated at about 10% of the total RAC market, making the TTW RAC market about 500,000 units shipped per year. In urban areas, the market share of TTW RAC may be closer to 20%. TTW RAC is most commonly applied in multi-family housing. The breakdown of TTW RAC shipments is about 65% residential (mostly apartment buildings, multifamily residences) and 35% commercial (hotels/motels). Two main sizes of TTW RACs are manufactured:

- 27" wide:
  - This is the size configuration Fedders offered when they began mass-producing TTW RAC units in the early '80s. Friedrich entered the market 13 years ago and produced the same size.
- 26" wide:
  - GE joined the TTW RAC market later, offering a competing 26" unit and succeeded in building an alternative market. Many other overseas manufacturers have joined the 26" unit market as well.

Approximately 60% of the TTW RAC market is comprised of imported units and this is increasing rapidly. The majority of the 26" TTW RAC units are imports while the 27" TTW RAC units are typically domestic. The eight 26" Friedrich TTW RAC units are all imported. Frigidaire is currently shifting all of their production overseas and will label LG Electronics and Samsung products. TTW RACs are distributed directly from distributors (50%) and at retailers (50%). New, highly efficient TTW RAC products are predicted to come onto the market in the coming year. TTW RAC shipments have been increasing among most manufacturers and continued growth is predicted. At the right is a table showing the total RAC market including TTW and louvered RACs.

Manufacturer	2001 Share
LG Electronics	28.0%
Fedders	22.0%
Electrolux (Frigidaire)	11.5%
Whirlpool	10.0%
Haier	9.0%
Goodman	6.0%
UT/Trane	3.0%
Sharp	2.5%
Friedrich	2.0%
Matsushita	2.0%
Samsung	1.5%
Other	2.5%
Total RAC Sales	*5.5M*

Source: AHAM

Typical price premiums for ENERGY STAR RACs are 10% leading to paybacks of two to six years. RACs are an inexpensive form of air conditioning and competitively priced. The ENERGY STAR RAC will save $5 to $10 annually over a non-qualifying unit.

Engineering Considerations

Improving the energy performance in a RAC can be done is several ways:

- More efficient compressors
- More efficient condenser and evaporator fans
- Improved heat exchanger performance

Many of these improvements may be cost prohibitive. RACs are a relatively inexpensive form of air conditioning focused on middle and lower income consumers, leading manufacturers to pursue less expensive and reliable features.

Compressors

Rotary compressors are the most common type of RAC compressor and improvements with their performance may lead to increased performance. The most efficient rotary compressors may achieve EER of 10.7 to 11.1. Rotary compressors are typically used in RACs < 16,000 Btu/hr. Scroll compressors are another RAC option that may lead to EER levels of 11.5 to 12.0, but more perform in the range of 10.8 to 11.1. Scroll compressors are typically used in RACs > 16,000 Btu/hr in capacity. Scroll compressors are 1 to 2 inches higher than rotary compressors making them a better fit in larger units. Variable speed compressors are another RAC option, but are cost prohibitive in the small capacity range of a RAC. Reciprocating compressors are available, but typically in the range of > 18,000 Btu/hr. These compressors are heavier and require larger, stronger encasements that may lead to increased product costs.

Condenser and evaporator fan motors

Most condenser and evaporator fan motors in RACs are permanent split capacitor (PSC) motors (nearly 98% of market). Their efficiencies range from 50 to 70%, with larger motors being more efficient. Electronically commutated motors (ECM) are an expensive option for increasing a RAC's efficiency. Most are nearly double the cost of the common PSC motor and thus they are rarely applied.

Improved heat exchanger performance

Grooving the inside of the coil, using enhanced fins on the outside, or increasing the size of the coil may achieve increased heat exchanger performance. Manufacturers pursue each of these while optimizing their overall RAC design. Increasing coil sizes leads to reduced dehumidification, increased chassis size, and increased production cost. Manufactures are careful to optimize all of these parameters in their design process. The 1997 RAC final rule did not increase the EER for TTW RAC units > 8,000 Btu/hr and < 20,000 Btu/hr since it may have resulted in increased chassis size and hurt the replacement market.

Proposed ENERGY STAR performance levels for TTW RACs without heating

The current ENERGY STAR RAC criteria cover the majority of the RAC market. The ENERGY STAR performance levels are set at 10% more efficient than the current federal standards. DOE proposes to include TTW RACs without heat at the same performance levels, or 10% more efficient than the federal standard. The current AHAM directory lists several TTW RACs meeting the proposed 10% requirement. The chart below shows the existing federal minimums and the current and proposed ENERGY STAR levels for the expansion. Increasing the performance levels to potentially higher levels, e.g. 15% or 20% above the federal minimum, would exclude a majority of the available product in the marketplace. DOE wants the expansion of the ENERGY STAR RAC criteria to be effective in the marketplace and the proposed 10% level achieves this goal. Higher performance levels may force manufacturers to increase cabinet size making direct replacement of equipment difficult or increasing product cost reducing overall participation in the ENERGY STAR RAC expansion.

ENERGY STAR and Federal Performance Levels[1]

Capacity (Btu/Hr)	NAECA RAC w/louvers (EER)	ENERGY STAR RAC w/louvers (EER)	NAECA TTW RAC (EER)	*Proposed ENERGY STAR TTW RAC (EER)*	*Qualifying/Available TTW RAC Models (as of 12/02)*
<6,000	≥9.7	≥10.7	≥9.0	*≥9.9*	*0/3*
6,000 to 7,999					
8,000 to 13,999	≥9.8	≥10.8	≥8.5	*≥9.4*	*14/35*
14,000 to 19,999	≥9.7	≥10.7			
≥20,000	≥8.5	≥9.4			

[1]Only units without heating are included in the ENERGY STAR criteria

As shown above, approximately one third (14/38) of the available TTW RAC units qualify for the proposed ENERGY STAR performance levels. The effective date for the expansion is proposed for May 1, 2003.

Current ENERGY STAR RAC Criteria

DOE reviewed the current field of available products and concluded the current ENERGY STAR levels are appropriate and meet DOE goals for energy savings and consumer/manufacturer participation. The current ENERGY STAR RAC performance levels continue to represent the most efficient products in the market. Much less than a majority of models currently available qualify, which allows for product differentiation based on the ENERGY STAR label. DOE will continue to monitor changes in RAC aggregate performance and update performance levels as necessary.

Energy Savings

Below are three tables estimating the national energy savings of the addition of TTW RACs to the existing ENERGY STAR RAC criteria. The AHAM method to calculate annual energy consumption (AEC) was used and is shown below:

- AEC = [Capacity (Btu/hr) X 750 hrs X 0.001] / EER
- For the two product classes, these capacities were used for the AEC
  - 7,000 BTU/hr model for < 8,000 Btu/hr product class
  - 10,000 BTU/hr model for > 8,000 Btu/hr product class

10% ENERGY STAR Market Penetration Savings

Capacity, Btu/hr	ENERGY STAR Shipments (10% penetration)	NAECA AEC, kWh/yr	ENERGY STAR AEC, kWh/yr	Savings/Unit, kWh/yr	National, Aggregate, MWh/yr
<8,000	5,000	583	525	58	290
>8,000	45,000	882	794	88	3,960
				Total Savings:	4,250

10% penetration assumptions:

- Out of 50,000 total ENERGY STAR shipments
  - Shipments 10% for units < 8000 Btu/hr
  - 90% for units > 8000 Btu/hr

20% ENERGY STAR Market Penetration Savings

Capacity, Btu/hr	ENERGY STAR Shipments (20% penetration)	NAECA AEC, kWh/yr	ENERGY STAR AEC, kWh/yr	Savings/Unit, kWh/yr	National, Aggregate, MWh/yr
<8,000	10,000	583	525	58	580
>8,000	90,000	882	794	88	7,920
				Total Savings:	8,500

20% penetration assumptions:

- Out of 100,000 total ENERGY STAR shipments
  - Shipments 10% for units < 8000 Btu/hr
  - 90% for units > 8000 Btu/hr

43% ENERGY STAR Market Penetration Savings

Capacity, Btu/hr	ENERGY STAR SHIPMENTS (43% penetration)	NAECA AEC, kWh/yr	ENERGY STAR AEC, kWh/yr	Savings/Unit, kWh/yr	National, Aggregate, MWh/yr
<8,000	21,575	583	525	58	1,251
>8,000	194,175	882	794	88	17,087
				Total Savings:	18,338

43 % penetration assumptions:

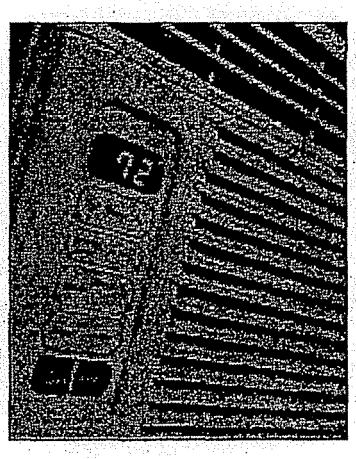
- Out of 215,750 total ENERGY STAR shipments (43.15% of 500,000 total shipments)
  - Shipments 10% for units < 8000 Btu/hr
  - 90% for units > 8000 Btu/hr

For the three market penetration scenarios above, the energy savings increases significantly from 4.2 GWh/yr at 10% to 18.3 GWh/yr at 43%. The final 43% market penetration scenario is the current market penetration of ENERGY STAR louvered RACs.

Summary

The addition of TTW RAC without heating to the ENERGY STAR program will enable retailers and energy efficiency programs to better use the ENERGY STAR label to promote all efficient RACs and increase national energy savings. Please forward comments to richardkarney@ee.doe.gov or fax them to 202-586-4617 by March 21, 2003. The proposed effective date for this proposed expansion is May 1, 2003.

Air conditioners: Cool choices



A competitive market has put window air conditioners among life's lower-priced luxuries. Models sized for small rooms now begin at just over $100, while larger units start at about $200.

Large, high-volume retailers such as Wal-Mart, which accounts for 24 percent of sales, are driving those low prices. Air conditioners are also getting better.

More efficiency for less. Models that use the least electricity have historically cost the most, but that's changing. Most of the tested models, including a few CR Best Buys, do better than the 9.7 energy-efficiency rating (EER) required for units below 8,000 British thermal units per hour (Btu/hr.) and the 9.8 EER for those 8,000 to 13,999 Btu/hr. (a higher EER is better). Many qualify for energy rebates.

More conveniences. Electronic controls with temperature readouts (above) are another high-end feature that's trickling down. All but five tested models have them, and most include a remote control and timers. But essentially similar non-electronic models, which lack defined temperature settings, cooled just as well and cost about $30 less.

Functions you may not need. One is the dehumidifier cycle on some Amana, Haier, LG, Panasonic, and Samsung models; limited testing revealed that this cycle functioned similarly to the low-cool mode. Another is the built-in air cleaner on the large Kenmore 76129. We tested a smaller-capacity version of this model with the same air-cleaning component and found no meaningful air cleaning.

HOW TO CHOOSE

Determine your needs. Once you know the space you're cooling, match the air-conditioner capacity to that space based on the model's Btu/hr. rating (see Match to the space). You'll find the Btu/hr. in the Ratings, on manufacturers' Web sites, and on appliance tags at the store.

Weigh efficiency against cost. You'll find an air conditioner's EER on the tag that lists its Btu/hr. information. Top-scoring models have the 10.7 EER or higher that's needed for Energy Star status. Besides helping the environment, models displaying the star are eligible for rebates of $25 in much of the Northeast and $50 in some California, Nevada, and Texas cities (see www.energystar.gov for details). That can cover much of any added cost for a high-EER model. Don't expect huge savings on your energy bill, however.

For example, a 10,000-Btu/hr. model with an EER of 11 would save you only about $60 over 10 years compared with a 10-EER model, based on average energy costs of 8.3 cents per kilowatt-hour and typical use of 750 hours per year. You'll save even less with a smaller air conditioner. Unless you pay more for energy or cool more often, you may want to consider a lower-priced model with a lower EER.

Decide whether noise matters. Some of the lowest-priced air conditioners we tested were the noisiest. But unless you're cooling a bedroom, the trade-off may be worth it.

The Home Depot sells Maytag models in the eastern region of the country; Lowes sells some Goldstar and Whirlpool models; Sears sells Kenmore and some Carrier models; and Wal-Mart sells some Fedders, GE, Goldstar, and Haier models. Other models are sold at regional chains and dealers. On essentially similar models, expect to pay about $30 more for electronic controls.

See our latest ongoing Ratings and model recommendations, which we update periodically with additional models and/or new price and availability information.

Previous page
Air Conditioners buying advice, features and more

RATINGS

AIR CONDITIONERS

Shop Smart

All air conditioners we tested should keep you cool. Top-scoring models perform efficiently and quietly. But other models cool adequately and sometimes cost les

The Ratings rank models by overall performance within size groups: small (5,00 Btu/hr.); mid-sized (7,000 to 8,200 Btu/hr.); and large (9,800 to 12,500 Btu/hr.). I guidelines to choose the size category that matches the room. Decide if you wa controls, then check the following models for the best blend of performance, pric

Efficient and quiet; the best models for most people: A CR Best Buy, the W Designer ACQ058MM, $160, is a small model best for directing air to the left or otherwise, you can pay $10 less for the small non-electronic LG LW5200E. The LG LW8000PR, $300, and the large Panasonic Deluxe CW-XC103HU, $330, a Buy, and LG LW1000ER, $350, are also fine values.

If you don't mind less efficiency: Choose either the small Goldstar R5050, GE Series AGV05LC, or Samsung AW0501B.

If you don't mind more noise: The mid-sized Maytag Q Series M7Q08F2A, Sa AW0891L, and the GE Value Series ASH08FC are all very good choices.

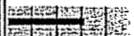
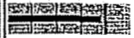
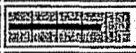
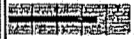
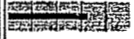
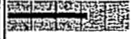
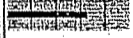
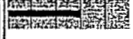
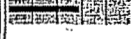
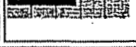
Within groups, listed in performance order: For details on performance an *click on a model in the table below.*

OVERALL RATINGS

● Excellent ◓ Very good ○ Good

BRAND AND MODEL	PRICE	OVERALL SCORE	BTU/HR.	EER	COMFORT	MOISTURE REMOVAL (PINTS/HR.)	NOISE	EASE OF USE
5,000 TO 6,000 BTU/HR. (COOLING: 100-300 SQ. FT.)								
Whirlpool Designer ACQ058MM	$160.00		5000	10.7	●	1.6	◓	●
Panasonic Deluxe CW-XC63HU	$235.00		6000	10.7	●	1.8	◓	◓
Kenmore (Sears) 73055	$200.00		5600	11	●	1.5	○	◓
Friedrich XStar XQ05J10	$400.00		5400	10.7	●	1.5	◓	○

LG LW5200ER	$180.00		5200	10.8	●	1.4	◓	◓
Carrier Solaire ACA051T	$230.00		5400	11.2	●	1.1	○	◓
LG LW5200E	$150.00		5200	10.8	●	1.4	◓	◓
Sharp AF-R50DX	$200.00		5000	10	●	1	◓	◓
GE Deluxe Series AGM05LA	$200.00		5200	10.8	●	1.4	○	◓
Goldstar R5050	$110.00		5050	9.7	●	1.3	◓	◓
Fedders X Series A6X06F2A Maytag M6X06F2A	$170.00		6000	9.7	●	1.4	○	◓
GE Value Series AGV05LC AGR05LB, AGT05LB	$120.00		5200	9.7	●	1.4	○	◓
Samsung AW0501B	$140.00		5200	9.8	●	1.5	○	◓
Fedders X Series A6X05F2B	$120.00		5200	9.7	●	1.4	◒	●
Frigidaire Electrolux FAA053M7A	$190.00		5200	11	●	1.35	○	○
Haier Preference Plus HWR06XCA	$200.00		6000	9.7	●	1.5	○	◓
Amana Touch Cooling AAC061STA	$240.00		6000	9.7	●	1.5	○	◓
7,000 TO 8,200 BTU/HR. (COOLING: 250-550 SQ. FT.)								
LG LW8000PR	$300.00		8200	10.9	●	2.2	◓	◓
Sharp AF-S80DX	$350.00		8000	11	●	2.3	○	○
Carrier G Series GCA081B	$310.00		8000	10	●	2.7	○	○
Maytag Q Series M7Q08F2A	$280.00		8000	10.8	●	2.6	◒	◓
Samsung AW0891L	$250.00		8000	10.8	●	2.1	◒	◓
Friedrich Quietmaster Electronic	$600.00		8200	11	◓	2	◒	○

SS08J10R								
GE Value Series ASH08FC ASW08FB	$220.00		8000	9.8	●	2.1	◒	○
Kenmore (Sears) 75088 Frigidaire FAC085M7A	$270.00		8000	10.8	●	2.8	●	◓
9,800 TO 12,500 BTU/HR. (COOLING: 350-950 SQ. FT.)								
Panasonic Deluxe CW-XC103HU	$330.00		9800	10.8	●	3.3	◓	◓
LG LW1000ER	$350.00		10000	11	●	2.7	◓	○
Kenmore (Sears) 76129	$450.00		12300	10.8	●	3.4	○	◓
Carrier XC Series XCD121D	$475.00		12000	10	◓	4.3	◓	◒
GE Quietaire Series AGQ10AB AGL10AB	$270.00		10000	9.8	●	3	◒	◓
Amana Touch Cooling AAC101STA	$370.00		10800	9.8	●	3	○	◓
Fedders Y Series A6Y12F2A Maytag M6Y12F2A	$270.00		12000	9.8	●	3.2	◒	◓
Frigidaire Electrolux FAL135M1A Kenmore (Sears) 73125	$375.00		12500	10.8	◓	4	◒	◓
Whirlpool Designer Style Series ACQ122XK	$400.00		11600	9.8	●	3.5	◒	◒
Kenmore (Sears) 73106	$350.00		10000	9.8	◓	3	◒	◓

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Technology

Compact Fluorescent Lamps and Hardwired CFL Fixtures

Estimated Energy Savings – kWh

Screw based Compact Fluorescent Lamp annual savings 178 kWh/lamp. Assumes 1- 15W CFL replacing 60W incandescent lamp.

Compact Fluorescent Fixtures (hardwired) annual savings 368 kWh/fixture. Assumes 1 fixture with 2 -13W lamps (27W total) replacing 1 incandescent fixture with 2-60W lamps.

Assumptions include: 3,956 annual hours of operation (average of all commercial and industrial customers).

Summer Peak Savings

Screw based Compact Fluorescent Lamp – .0405 kW/lamp. Assumes 1- 15W CFL replacing 60W incandescent lamp.

Compact Fluorescent Fixtures (hardwired) - .0837 kW/fixture. Assumes 1 fixture with 2 -13W lamps (27W total) replacing 1 incandescent fixture with 2-60W lamps.

Assumes 90% of lighting is on during peak times.

Measure Life

Screw in Compact Fluorescent lamps 2 years (available with average rated life of 6,000 to 10,000 hours. Assumed mean life would be 8,000 hours for CFLs.)

Hardwired Compact Fluorescent fixtures: 12 years. Attached materials indicate 14 to 16 year life.

Initial One-Time Cost

Screw in CFLs range in price from less than $3.00/lamp for shorter lifetime mainstream wattage lamps to over $20.00/lamp for specialty CFLs such as dimmable ballast reflector floods and other decorative styles.

Compact Fluorescent Fixtures are available for as little as $15.00/fixture for simple single lamp indoor or outdoor fixtures with magnetic ballasts, and over $200.00/fixture for commercial grade decorative fixtures with multiple lamps and electronic ballast. Median price range is $35.00-85.00/fixture for most common configurations.

Any Recurring Costs

Lamps will require replacement approximately every 2.5 years in a commercial building due to assumed average rated lamp life of 8,000 hours.

Suggested Incentive

CFL screw in lamps: $1.00 to $2.00 for standard units.

Hardwired new CFL fixtures: $10.00/fixture

Could consider greater incentive for specialty items.

Requirements

For Application –

Compact fluorescent lamps must be replacing incandescent lamps. CFL fixtures should contain pin based lamps and be a hardwired installation. CFLs specified should be approximately ¼ of the wattage of the incandescent they are replacing.

Existing Energy Standards

Energy Star standards are available for both technologies for residential use. Considerations include rated lamp life, flicker free lamps, and descriptive information on packaging. Many commercial fixtures have not been evaluated for Energy Star residential list, but are appropriate replacements for incandescent and should not be excluded.

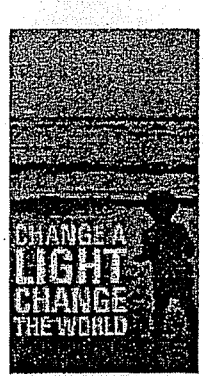
Source of Info

Energy Star, lightsearch.com, manufacturer's web sites

Compact Fluorescent Light Bulbs

If every household in the U.S. replaced one light bulb with an ENERGY STAR qualified compact fluorescent light bulb (CFL), it would prevent enough pollution to equal removing one million cars from the road. CFLs provide high-quality light, smart technology, and design, requiring less while lasting longer than typical incandescent bulbs.

FIND A STORE
SPECIAL OFFERS



Learn about ENERGY STAR's fall campaign.

Earning the ENERGY STAR

+ ENERGY STAR qualified CFLs use 66% less energy than a standard incandescent bulb and last up to 10 times longer. Replacing a 100-watt incandescent with a 32-watt CFL can save you at least $30 in energy costs over the life of the bulb.

+ ENERGY STAR qualified CFLs operate at less than 100F, they are also safer than typical halogen bulbs, which are frequently used in floor lamps or torchieres and burn at 1,000F. Due to their high heat output, halogens can cause burns and fires. CFLs are cool to the touch.

Remember, saving energy prevents pollution.
ENERGY STAR qualified CFLs provide the same amount of light (lumens) as standard incandescent bulbs, but have lower wattage ratings. This means they use less energy and cause less pollution. If you are unfamiliar with the best CFL wattage to use for your lighting needs, always refer to the lumen, or light output on the product packaging as your guide. For example, most 60-watt incandescents provide around 800 lumens, so look for ENERGY STAR qualified CFLs that provide 800 lumens or more.

Use the table below to become familiar with the lumen or light output range for the most popular residential incandescent bulbs.

A-shaped Incandescent Bulb (Watts)	Typical Lumens (Measure of Light Output)
40	> 450
60	> 800
75	> 1,100
100	> 1,600
150	> 2,600

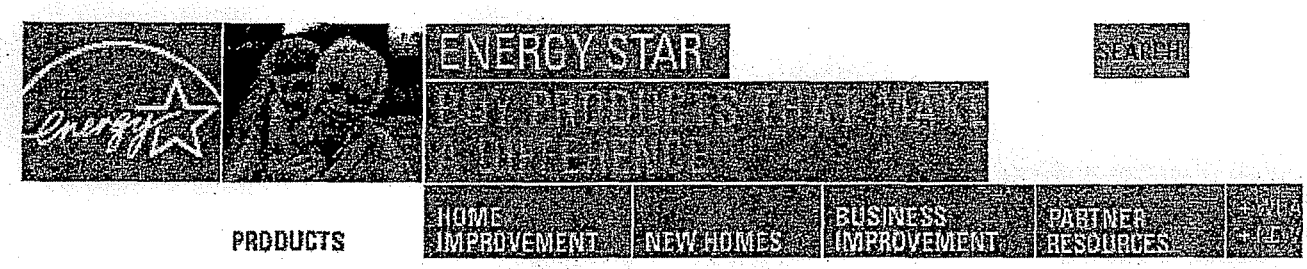
Lighting Buyers Guide

Take the ENERGY STAR Quiz

For Consumers
+ Product List Excel
+ Purchasing Tips
+ Manufacturer List

For Business
+ Key Product Criteria
+ Savings Calculator (Excel)
+ Purchasing & Procurement

For Partners
+ Partner Commitments
+ QPI Form
+ Products in Development
+ Partner Resources



Appliances
Heating & Cooling
Home Electronics
Lighting
+ CFLs
+ Light Fixtures
+ Ceiling Fans
+ Exit Signs
+ Traffic Signals
Office Equipment
Purchasing & Procurement
Interested in Partnering?
+ For Manufacturers & Retailers
+ Specifications in Development

Home > Products > Lighting > CFL's > Key Product Criteria

Compact Fluorescent Light Bulbs Key Product Criteria

Equipment	Specification
Compact Fluorescent Lamps (CFLs)	+ Energy-efficiency specifications based on input wattage, lamp efficacy maintenance and average rated lifetime greater than 6,000 hours. In g use 66% less energy than a standard incandescent bulb and last up tc longer. + Must also comply with power and operating characteristics, and meet reliability guidelines.

ENERGY STAR qualified compact fluorescent light bulbs and lamp systems shall comply as aj the labeling requirements of the US Federal Trade Commission and the EMI requirements of tl Communications Commission.

Table 1
Key Product Criteria for ENERGY STAR Qualified Compact Fluorescent Light Bulbs

Performance Characteristics	ENERGY STAR Specification
Lamp Efficacy (The performance and electrical requirements of compact fluorescent lamps are taken at the end of the 100-hour aging period in accordance with ANSI C78.5.)	lumens per Watt (Based upon initial lumen d:
Scope (a)(b) Bare lamps: <15 Watts >15 Watts	45 60
Scope (c) Covered lamps (except for reflector type) <14 Watts 15-19 Watts 20-24 Watts >25 Watts	40 48 50 55
Scope (d) Reflector type: <19 Watts >20 Watts	*For multi-level or dimmable systems, measu be at the highest setting. 33 40
Burning Position	The lamp efficacy shall be the lesser of the lu Watt measured in the base up and base dow
Lumen Depreciation	Per ANSI C78.5, Clause 4.10, the lumen dep 40 percent of rated life shall not be less than