

**The University of Michigan
Plant Operations
Utilities & Plant Engineering
Energy Management Section**

Energy Conservation Measures

Energy Conservation Measures

Outline:

- Definition of ECM
- Common (and not so common) ECM's
- Case Studies (Museum of Art, GG Brown)
- Results
- Questions

Energy Conservation Measures

Definition of ECM

- An ECM is to improve the energy efficiency of building infrastructure, including heating/cooling/ventilation systems, utility systems, roof, and windows. This is achieved by an engineering investigation to identify potential replacements of, or upgrades to, existing systems that enhance energy efficiency in a cost-effective manner.

Energy Conservation Measures

Commonly Used ECM's

- Direct Digital Controls
- Variable Speed Drives
- VAV Boxes
- Insulation
- Lighting Retrofits

Not So Common ECM's

- Window Films
- Green Roofs

Energy Conservation Measures

Case Study: Alumni Memorial Hall



Energy Conservation Measures

Case Study: Alumni Memorial Hall

Lighting Retrofit

- Replacement of 220 ballasts & 440 lamps
- Replacement of 33 incandescent fixtures with compact fluorescent Fixtures
- Completed June, 1999

Energy Conservation Measures

Case Study: Alumni Memorial Hall

DDC Controls for Air Handling Units

- Replacement of existing pneumatic controls
- Allows for scheduling & 24 hour monitoring
- Includes carbon dioxide sensors, and controls for enthalpy, humidity, temperature
- Completed June, 2000

Energy Conservation Measures

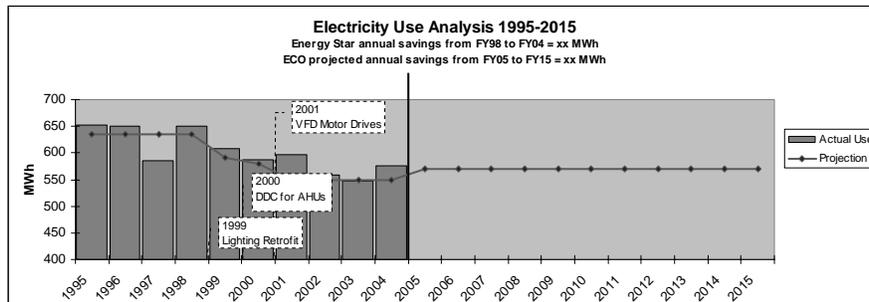
Case Study: Alumni Memorial Hall

Variable Frequency Motor Drives for Cooling Tower fans

- Reduces maintenance requirements
- Avoids hard starts and stops
- Controls fan speed based on demand
- Completed May, 2001

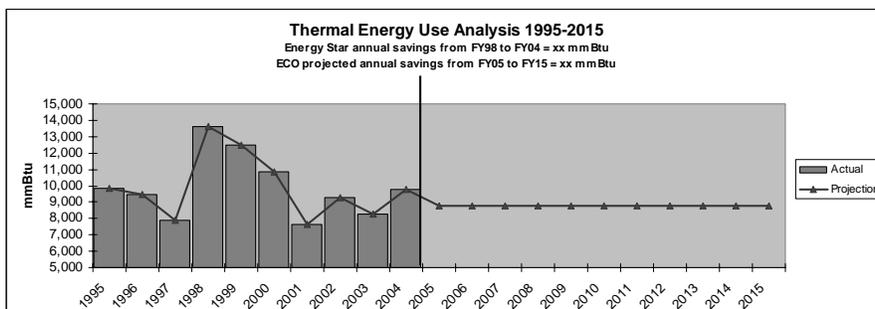
Energy Conservation Measures

Case Study: Alumni Memorial Hall Electricity Use Analysis



Energy Conservation Measures

Case Study: Alumni Memorial Hall Thermal Energy Use Analysis



Energy Conservation Measures

Case Study: Alumni Memorial Hall Quantity & Consumption Data: Electricity

Annual Utility Report Data					E-Star, ECO Baselines*		ECM Projected Amount		ECM Savings	
Year	Qty (kWh)	Cost (\$)	kWh/Sqft	Cost/Sqft	Qty (kWh)	Cost (\$)	Qty (kWh)	Cost (\$)	Qty (kWh)	Saved (\$)
1995	652,800	\$52,224	15.19	\$1.215	635,200	\$50,816	635,200	\$50,816		
1996	650,800	\$52,064	15.14	\$1.211	635,200	\$50,816	635,200	\$50,816		
1997	586,000	\$46,880	13.63	\$1.091	635,200	\$50,816	635,200	\$50,816		
1998	651,200	\$52,096	15.15	\$1.212	635,200	\$50,816	635,200	\$50,816		
1999	609,200	\$49,954	14.17	\$1.162	635,200	\$50,816	591,200	\$47,316	26,000	\$862
2000	587,600	\$48,183	13.67	\$1.121	635,200	\$50,816	579,005	\$46,316	47,600	\$2,633
2001	597,045	\$45,375	13.89	\$1.056	635,200	\$50,816	548,883	\$43,846	38,155	\$5,441
2002	559,155	\$46,410	13.01	\$1.080	635,200	\$50,816	548,883	\$43,846	76,045	\$4,406
2003	547,000	\$44,854	12.73	\$1.044	635,200	\$50,816	548,883	\$43,846	88,200	\$5,962
2004	575,000	\$47,725	13.38	\$1.110	635,200	\$50,816	548,883	\$43,846	60,200	\$3,091
E-Star ECM Electricity Savings							86,317	\$6,970	56,033	\$22,394

Energy Conservation Measures

Case Study: GG Brown



Energy Conservation Measures

Case Study: GG Brown

Lighting Retrofit

- Replacement of approximately 3000 fluorescent fixtures with higher energy efficient fixtures
- Replacement of incandescent and mercury vapor fixtures
- Completed January, 2000

Energy Conservation Measures

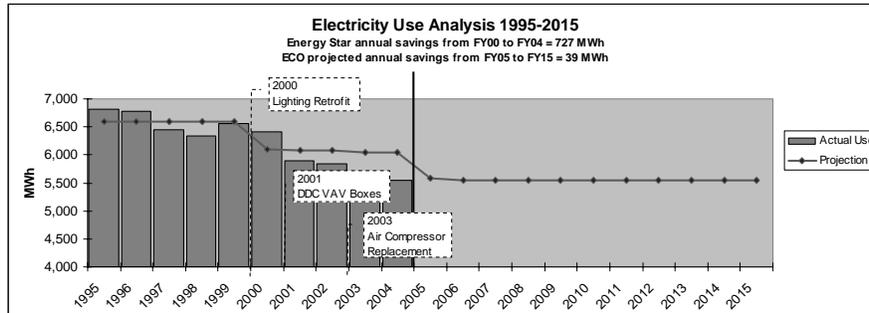
Case Study: GG Brown

DDC Operated VAV Boxes in Lecture Hall

- Installation of DDC controls to VAV boxes
- Allows for central control of HVAC system to reduce ventilation during unoccupied periods
- Completed September, 1999

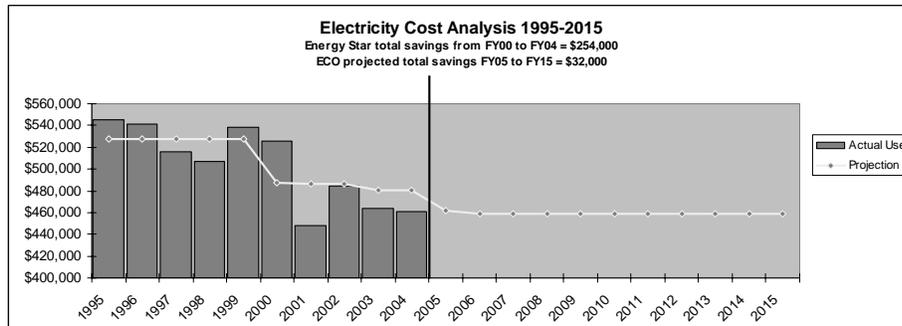
Energy Conservation Measures

Case Study: GG Brown Electricity Use Analysis



Energy Conservation Measures

Case Study: GG Brown Electricity Cost Analysis



Energy Conservation Measures

Case Study: GG Brown

Quantity & Consumption Data: Electricity

Electricity Chart										
Annual Utility Report Data					E-Star, ECO Baselines*		ECM Projected Amount		ECM Savings	
Year	Qty (kWh)	Cost (\$)	kWh/Sqft	Cost/Sqft	Qty (kWh)	Cost (\$)	Qty (kWh)	Cost (\$)	Qty (kWh)	Saved (\$)
1995	6,817,323	\$545,386	31.05	\$2.484	6,593,390	\$527,471	6,593,390	\$527,471		
1996	6,771,642	\$541,731	30.85	\$2.468	6,593,390	\$527,471	6,593,390	\$527,471		
1997	6,452,856	\$516,228	29.39	\$2.352	6,593,390	\$527,471	6,593,390	\$527,471		
1998	6,331,740	\$506,539	28.84	\$2.307	6,593,390	\$527,471	6,593,390	\$527,471		
1999	6,560,086	\$537,927	29.86	\$2.448	6,593,390	\$527,471	6,593,390	\$527,471		
2000	6,412,532	\$525,828	29.19	\$2.393	6,593,390	\$527,471	6,093,390	\$487,471	180,858	\$1,644
2001	5,897,196	\$448,187	26.84	\$2.040	6,593,390	\$527,471	6,077,990	\$486,239	696,194	\$79,284
2002	5,842,112	\$484,895	26.59	\$2.207	6,593,390	\$527,471	6,077,990	\$486,239	751,278	\$42,576
2003	5,632,432	\$463,581	25.63	\$2.110	6,593,390	\$527,471	6,038,453	\$480,404	960,958	\$63,890
2004	5,548,019	\$460,486	25.25	\$2.096	6,593,390	\$527,471	6,038,453	\$480,404	1,045,371	\$66,986
E-Star ECM Electricity Savings							554,937	\$47,067	726,932	\$254,379

Energy Conservation Measures

Energy Savings under Energy Star

- -10.2% Thermal consumption
- -12.7% Electricity consumption
- Annual energy savings of \$5.4 million

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