

Energy Efficiency & Indoor Air Quality

Americans spend 90% of their day indoors: in classrooms, offices, and at home. Studies show that indoor levels of pollutants are often 5 to 10 times higher than outdoor levels. The number of students and staff that go to U.S. schools is 60 million, which is nearly 20% of the population. When more effective and efficient cleaning and maintenance practices are implemented, the indoor air quality can greatly improve for building occupants.



General Energy-Saving Tips

- Use on-demand hot water heaters.
- When upgrading appliances, purchase ENERGY STAR® appliances.
- Use ENERGY STAR Certified steam cookers to reduce energy costs, while increasing the output rate of meals.

Impacts on Indoor Air Quality



REFERENCES <https://www.epa.gov/iaq-schools> and <https://www.usgbc.org/resources/green-existing-schools-toolkit>



PennTAP
Pennsylvania Technical Assistance Program

The Metropolitan Edison Company/Pennsylvania Electric Company
SUSTAINABLE ENERGY FUND

Energy Efficiency & Indoor Air Quality



Did you know?

- 30% of a school district's total energy may be used inefficiently or unnecessarily.
- School districts can save 30–40% on annual utility costs for new schools and 20–30% for renovated schools by applying high performance design and sustainability concepts.
- A Pennsylvania Department of Education study found that the average cost per square foot of the new schools was nearly twice the cost of the renovations and additions.

Ways to Improve Energy Efficiency & Indoor Air Quality

High-Performance Building Systems

Implement building improvements and technologies in order to use less energy, less water, and fewer natural resources. System upgrades and retrofits also improve indoor air quality and address operational inefficiencies.

Best Practices

Adopt operations and maintenance best practices to ensure project measures are effectively implemented and maintained. Consider systems monitoring, green cleaning, and preventative maintenance procedures.

Sustainable Policies

Establish policies to demonstrate an organization-wide commitment to sustainability. Consider policies to guide recycling programs and the use of eco-friendly products.

Operating and Maintenance (O&M) requirements for Existing Buildings (EB) under Leadership in Energy and Environmental Design (LEED)

High-Performance
Building Systems

+

O&M
Best Practices

+

Sustainable
Policies

=

LEED EB:
O&M



PennTAP
Pennsylvania Technical Assistance Program

The Metropolitan Edison Company/Pennsylvania Electric Company
SUSTAINABLE ENERGY FUND

Weather Stripping

The seals of windows and doors are important in preventing outside air from entering a building. As the seal ages, it becomes brittle and can crack. The outside air can then enter the building, causing the temperature to decrease and the humidity to increase. Resealing the windows and doors will prevent the outside air from entering the building.

Energy Conservation Measure	Door Seal 24' Perimeter			Window Seal 14' Perimeter		
	1/32"	1/16"	1/8"	1/32"	1/16"	1/8"
Size of Gap	1/32"	1/16"	1/8"	1/32"	1/16"	1/8"
Total Energy Cost Savings Per Occurrence (\$/year)	\$2.5	\$5	\$10	\$1.4	\$3	\$6
Cost of the New Seal	\$10	\$10	\$10	\$5	\$5	\$5
Payback Period (years)	4.1	2.0	1.0	3.5	1.7	0.9

Energy-Saving Tips for Heating, Ventilation, and Air Conditioning Systems

- Use a building automation system to set back the temperature when an area is unoccupied.
- Change or clean filters every three months.
- Caulk around foundation and cracks.
- Make sure the ventilation units are clear of obstruction.
- Replace window and door seals every 2-3 years.



Energy Consumption for Small Appliances



There are small appliances being used throughout all schools and municipalities. The table below estimates the annual electrical usage for each small appliance based on the use for a single person.

Equipment	Electrical Usage (kWh/yr)	Annual Cost (\$/yr)
Microwave	22	\$1.70
Coffee Maker	33	\$2.60
Toaster	3	\$0.30
Small Refrigerator	485	\$38.90
Small Point of Use Water Heater	87	\$6.90
Computer Station	125	\$10.00
Cell Phone Charger	2	\$0.10
Printer	20	\$1.60



Foot-Candle Lighting Guide

Foot-candles are the most common unit of measure used to calculate light levels. A foot-candle is defined as the illuminance on a one square foot surface from a uniform source of light. The Illuminating Engineering Society (IES) recommends the following foot-candle levels to ensure adequate illumination and safety for occupants. The foot-candles should be measured where activities will be occurring. For example, in a classroom, the foot-candles should be monitored at each desk.

Space Type	Lighting Level Range (fc)
Classroom	30 - 50
Library	30 - 50
Office	30 - 50
Gym (Sports & Games)	30 - 50
Cafeteria	20 - 30
Kitchen	30 - 75
Restroom	7.5 - 30
Mechanical Room	20 - 50

<https://www.archtoolbox.com/materials-systems/electrical/recommended-lighting-levels-in-buildings.html>

Energy-Saving Tips for Lighting

- Replace bulbs with LED bulbs, providing up to 30% energy savings on lighting costs.
- Turn off the lighting when the room is not in use, especially for mechanical rooms and storage areas.
- Use occupancy sensors in hallways and restrooms.

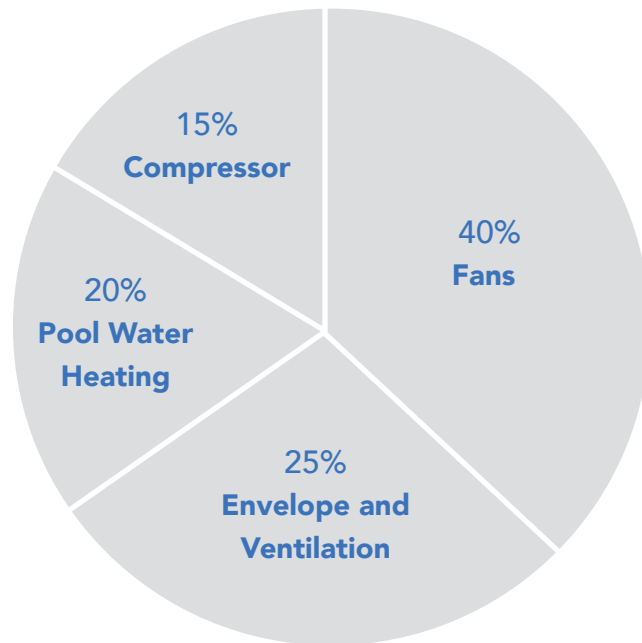


Indoor Pool



Annual Cost

These are projected annual energy costs of an indoor aquatic facility before dehumidification system selection, using gas heat, no energy recovery, occupied 16 hours a day, and ventilating with minimum outdoor air as defined by ASHRAE 62.



Heat Recovery Tips

- Air-to-air heat exchangers are 45% to 75% efficient.
- Use Demand Control Ventilation (DCV) in spectator area.
- Sensible heat wheels may freeze in cold outdoor air conditions.

Indoor Air Quality Tips

- Avoid excess chlorine in pool water, consider UV.
- A poor ventilation system can lead to ineffective removal of chloramines from the occupied space.



Indoor Pool

Pump Tips

- Pool pumps should be sized to complete one turnover in eight hours.
- Clean filters regularly! A dirty filter can double operation costs.
- Consider using VFD for pumps.

Pump Type	Energy Use (kWh/yr)	Energy Savings (kWh/yr)	Savings (\$)	Payback (yr)
Single speed	2,723	—	—	—
Dual speed*	843	1,880	\$244	1
Variable speed*	317	2,406	\$312	2

*Example above uses average electricity cost of 0.12 \$/kWh for a 22,000 gallon pool with 2.5 HP pump in cool climate.
<http://www.inyopools.com/Blog/variable-speed-pool-pump-or-dual-speed-which-is-best-for-me/>

Heating and Dehumidification Tips

- Evaporation accounts for 70% of total energy lost in pools.
- Keep the temperature of the pool and surrounding air within ASHRAE standards and minimize evaporation.
- Control the space relative humidity to 60% (ASHRAE recommendation - 40% to 60%).
- Use outdoor air whenever possible.
- Use a pool cover for off hours.

Pool Type	Air Temp (°F)	Water Temp (°F)
Competition	75 to 85	76 to 82
Diving	80 to 85	84 to 88
Recreational	82 to 85	80 to 85



PennTAP
Pennsylvania Technical Assistance Program

The Metropolitan Edison Company/Pennsylvania Electric Company
SUSTAINABLE ENERGY FUND