



Energy Savings in Enclosed Parking Garages

When people think about saving energy, the temptation is to think first of inhabited space like office buildings and residences. Recently published statistics indicate that other important opportunities exist. One of the most important is in reducing energy consumption in enclosed parking garages. Installing ventilation controllers based on carbon monoxide sensors can substantially reduce consumption of both electricity and natural gas and pay for itself in under a year.

Parking garage energy use is surprisingly high. According to the Department of Energy, parking garages consume about the same amount of electricity per square foot as commercial buildings whose purpose is education, public assembly and public order & safety, and significantly more than warehouses or churches.ⁱ They are greater consumers of natural gas than any category except food service.ⁱⁱ

What can account for these results? A glimpse at another government publication provides an explanation for the electricity usage. The EPA's theoretical analysis of electricity demand for parking garages indicates 1.2 watts per square foot are needed to ventilate the structure to ASHRAE specifications. A further .26 watts per square foot are required for illuminationⁱⁱⁱ. These figures are consistent with the 10.9 KWH per square foot per year that DOE cited for high energy use parking garages.^{iv}

The natural gas consumption is likely based on the need to heat parking garages in colder climates. This is what we have observed in practice. If ventilating fans are running continuously, it is not surprising that heating costs are very high indeed!

One effective solution is to control the operation of the ventilating fans based on the quality of the air inside the parking garage. The reason that the ventilation is required at all is the presence of carbon monoxide^v produced by vehicles moving through the garage. A system which operated the fans only when carbon monoxide levels are elevated could reduce the fans' operating time substantially. This will not only reduce electricity and natural gas consumption but could extend the life of the fans as well.

Theoretical savings for this strategy can be significant indeed. At current non-demand commercial electrical costs, the 1.2 watts to ventilate a square foot of parking garage for a year amounts to about \$.74 per square foot annually, assuming continuous operation^{vi}. If the fan use was reduced by 80%, a 10,000 square foot parking garage could save nearly \$5,900 in electricity costs.^{vii} While not every parking garage is heated, the natural gas cost savings in a heated garage can be even greater than the electrical savings.

Ventilation control equipment is inexpensive by comparison. This equipment typically will start fans when the carbon monoxide concentration reaches a specified level based on OSHA and building code requirements. Some units allow this level to be set by the building owner and installer. Suggested retail price for the sensors and controllers is typically from 2 to 6 months of theoretical energy savings.

Macurco has published data on one retrofit which provides an empirical check on these figures. A 46,000 square foot parking garage in Bloomington MN was retrofitted with CM-21A detector/ controllers. The hours of operation for the fans and energy use were measured for a two month period in the same season before and after the retrofit. The run time for the fans was reduced by 97.5%! During the test, an independent testing company monitored the carbon monoxide levels for 5 days continuously. The time weighted average CO concentration was 20 parts per million, well within established guidelines. Energy consumption during the test period demonstrated a payback of both material and installation of less than a year.

There are a large number of parking garages built before 1976 in which the ventilation fans run continuously. They were designed this way because until that time there was no provision in the Uniform Building Code for ventilation controllers. There is currently a specific authorization. "Automatic carbon

monoxide-sensing devices may be employed to modulate the ventilation system to maintain a maximum average concentration of carbon monoxide of 50 parts per million during any eight hour period, with a maximum concentration not greater than 200 parts per million for a period not exceeding one hour.”^{viii}

Enclosed parking garages consume large quantities of energy. There is a simple retrofit available which can economically save a substantial portion of this energy. This paper has shown that installing ventilation controllers based on Carbon Monoxide sensors should be high on the list of energy saving measures for any project containing an enclosed parking garage.

ⁱ Rebuild America Handbook, page 31 currently found at <http://www.eren.doe.gov/buldings/rebuild/PDFs/handbookback.pdf>
data also found at <ftp://ftp.eia.doe.gov/pub/consumption/commercial/cbcetb92.pdf>

ⁱⁱ Ibid. page 32.

ⁱⁱⁱ Pages 8-9 of Energy Star Benchmarking Tool, Supporting Documents, Technical Description currently found at <http://www.epa.gov/buildings/label/html/supportdocs.html>

^{iv} 1.46 watt per square foot * 8760 hours per year = 12.8 KWH per square foot per year assuming continuous usage

^v Some local codes require that other combustion byproducts like Nitrogen Dioxide be detected and controlled as well.

^{vi} Current rates are about \$.07 per KWH in Denver. 1.2watts * 24 hours per day * 365 days per year * \$.07 per KWH * .001 KW per watt = \$.736 per year

^{vii} \$.736 per sq. ft. per year * 10,000 sq. ft. * 80% reduction = \$5,888

^{viii} 1997 Uniform Building Code, Section 1202.2.7, page 1-136.