The Garage of the Future Must be Green

By Samuel I. Schwartz, P.E.

Figure 1: 18:44 A driver retrieving his car at a Munich garage inserts a token or credit card to activate the delivery process.

Figure 2: The wait for the car is about 2-3 minutes.

Figure 3: 18:47 Within three minutes, the driver is on his way.

Introduction

Can there be a "green garage" or is that just an oxymoron? My contention is that if you're going to provide parking, you might as well make it as energy efficient as possible, minimize pollution and take up the least space. Add maximizing safety and minimizing crashes and you've got automated parking – a technology that's sweeping Europe and Asia but has barely made a dent in the United States. I'm convinced that with LEED certifications taking a foothold for building design, it is inevitable that automated parking garages will be added to the checklist of components that define a "green" development.

How does Automated Parking Work?

Every driver pulls into what I call a one-car parking garage (actually a box-like structure). The floor of the garage is a moveable pallet. The engine is turned off and the system communicates with the driver (visually and/or audibly) to make sure he/she parked correctly, trunk is closed etc. The driver then exits the one-car garage and everything else is automatic. A brief safety check follows. Next, the car, on the pallet, is transported vertically (up or down) and horizontally (right, left, forward or back) until it is brought to a vacant parking space. I liken the structure to a giant candy machine and your car may be located in G5 next to the M&Ms! When picking up the car, the car retrieval process can be initiated on the spot, or as an option, by phone, internet or SMS request. Upon return the driver will get into his/her car, and, here's the really beautiful part, only drive forward, due to turntables installed at the entry and exit of the garage, which orient the car correctly (no reversing).

Perhaps the single biggest concern that I have encountered from developers is – what happens if the system breaks down? The system essentially uses elevator technology. Many garages in New York City and elsewhere already use elevators to move cars between floors. Redundancy can be built in by having extra trolleys to transport cars and by having manual overrides. Maintenance contracts could require responses within one or two hours. With good preventive maintenance, breakdowns can be minimized. Auxiliary power sources can be available for blackouts. The experience throughout Europe is

that the record speaks for itself. The systems are run well and breakdowns are not significant factors.

Automated Parking Garages Pollute Far Less Than Conventional Garages

EEA Consultants, Inc. an environmental engineering firm, conducted a study for WPS Parking, comparing pollution and energy characteristics of a conventional 350 car garage versus those from an automated garage of the same capacity.[1] The methods, input parameters and calculations used were based on procedures developed for New York City's City Environmental Quality Review Technical Manual. The hourly arrivals and departures to the garage were based on the patterns measured at a similar sized garage in Midtown Manhattan by Sam Schwartz Engineering, PLLC.

The impact on air pollution was determined by scientifically accepted models as referred to by EEA, "Vehicle emission factors (in grams of pollutant per vehicle-mile or per hour of idling) and fuel use (mpg) for an analysis year of 2008 were determined using the USEPA's MOBILE6.2 mobile source emissions model (User's Guide to MOBILE6.1 and MOBILE6.2 Mobile Source Emission Factor Model, EPA420-R-03-010, August 2003). MOBILE6.2 emission factors were based on travel speed, vehicle classification, and engine thermal conditions (Table 4). The speed within the garage was assumed to be 5 mph. Classification represents the proportion of the various types of vehicles."

The results are impressive. As shown in figures 4 through 7, volatile organic compounds were reduced by 68 percent, carbon monoxide by 77 percent, nitrogen oxides by 81 percent and carbon dioxide by 83 percent. The fuel savings also averaged 83 percent. (Figures 4-8)

Safety

Automated parking reduces personal exposure to crime, practically eliminates thefts from vehicles and makes fender benders while parking impossible.

A study conducted by the United States Department of Justice found that one out of 12 rapes occurs in a parking garage.[2] When one looks at sexual assaults by strangers, over 40 percent occur in garages. Automated parking can eliminate nearly all these horrific encounters. A perpetrator in the one-car garage can't hide since heat sensors detect human presence. Furthermore surveillance will need only cover the one-car garage and its environs rather than large floors and dark stairwells.

In Europe, thefts in automated garages are just about non-existent. That's because no one but the owner has keys to the car and the car is placed in a secure place with no public access.

The dings, scrapes and dents commonplace in garages will be eliminated since the car is moving on a pallet and can not make contact with another car, car door, column or wall. Automated parking will be an insurance company's dream.

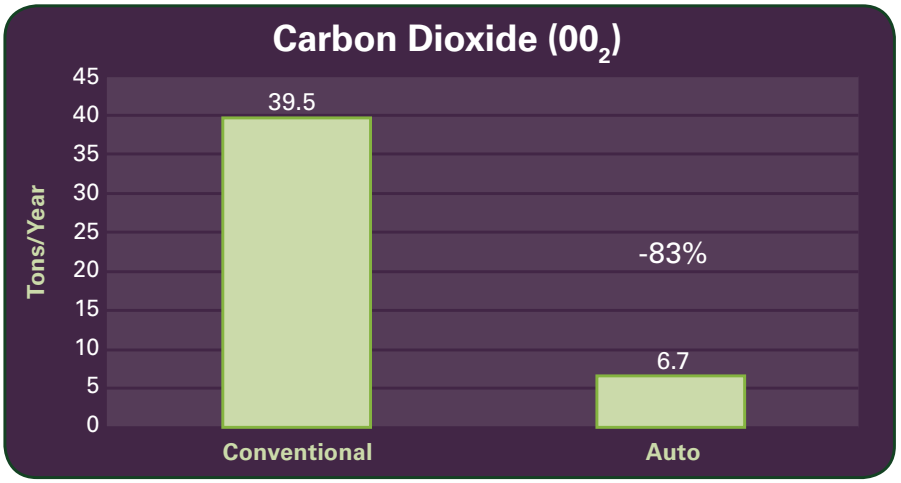

Figure 4

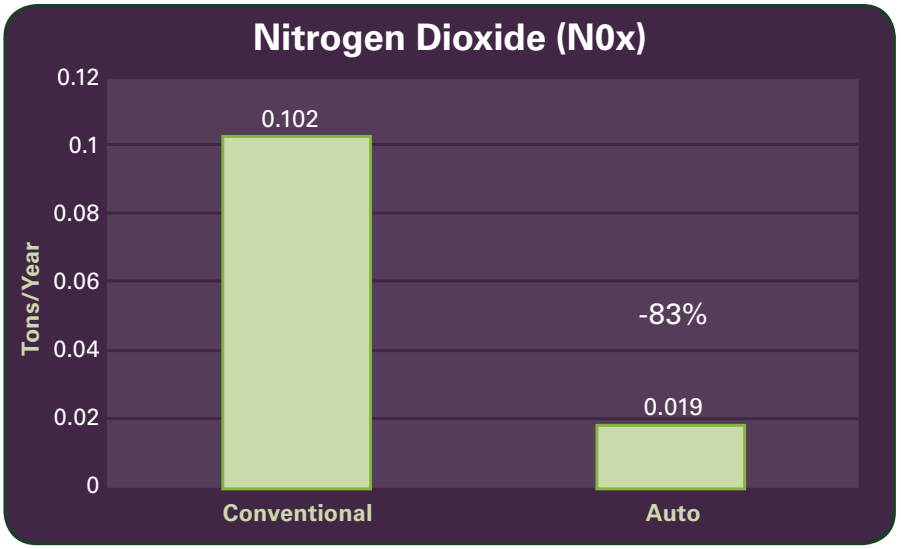

Figure 5

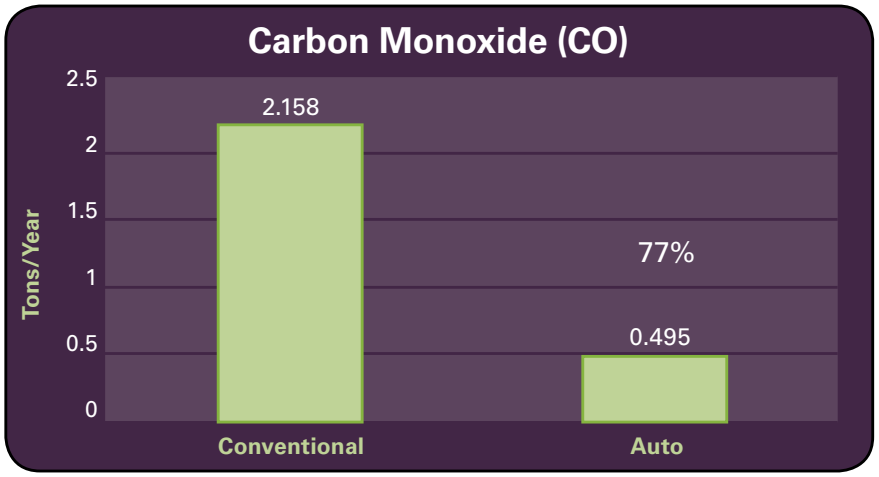

Figure 6

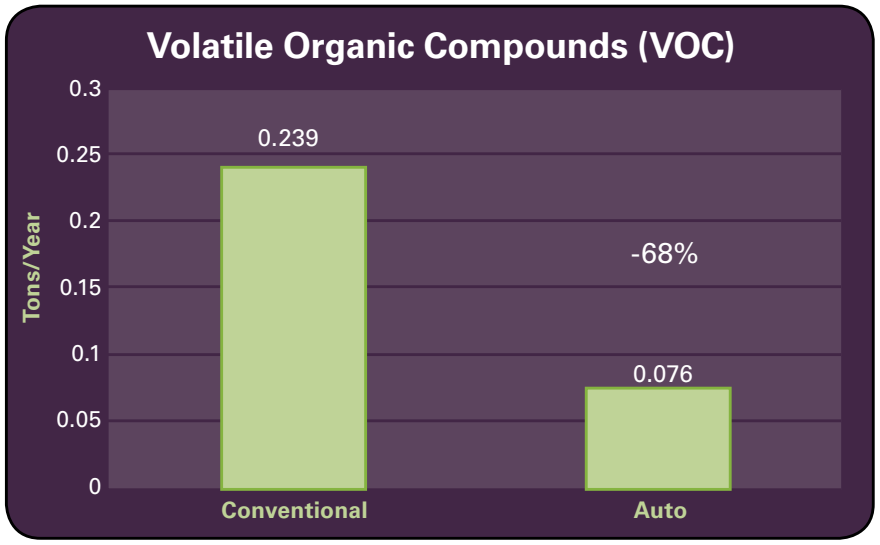

Figure 7

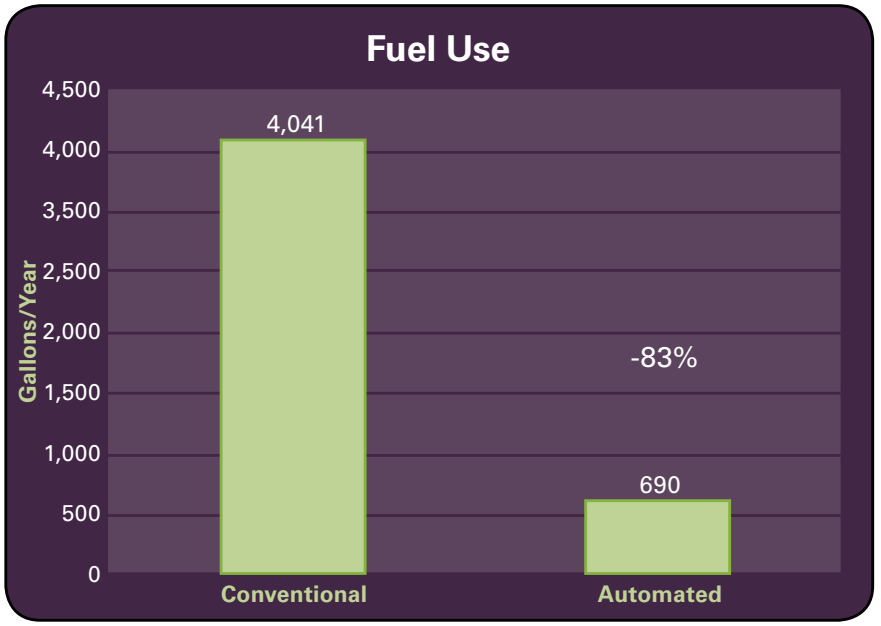

Figure 8: The energy consumed at an automatic garage is one-fifth that of a conventional garage.

Speed

Automated parking garages can process a car every two to three minutes. While one car that just entered is being transported, another pallet returns to the one-car garage, making it ready to accept the next car. In addition, while one car enters, the process to retrieve another car to exit can begin. Internal trolleys can follow program commands to match demand patterns. In essence, automated parking can exceed the performance of most valet systems. Even so, we would not recommend such a system for surge demands such as at an arena or a manufacturing plant with a pronounced departure time. For shopping centers, residential parking, institutions and many other developments, the performance of automated parking will efficiently get the job done.

Space

The greatest competitive advantage automated parking has over conventional garages is space. Simply put, 30-50 percent more cars could fit in the same volume of space. This is often paramount in dense urban environments where space is a premium. Using less space for parking could mean less construction cost for excavation or more space for programming, or a combination of both. No doubt a big part of automated parking's success in Europe has to do with the competitive space advantage it has over conventional garages. There may also be local zoning benefits derived from automated parking. There are no floors per se with automated parking, so jurisdictions that restrict construction by "floor-area ratio" may be able to derive significant bonuses.

Costs

Construction costs are site specific so it is difficult to compare the cost of an automated garage to the cost of a conventional garage. When excavation is required, the advantages of automated parking can result in construction

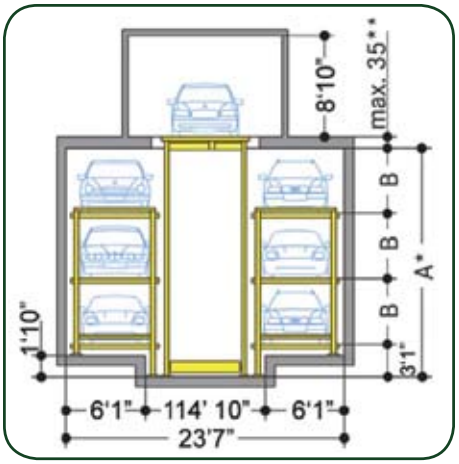

Figure 9: Automated parking garages require 30 – 50 percent less volume to park the same number of cars.

costs being significantly cheaper compared to building a conventional garage. When there aren't any real site restrictions, an automated garage will cost approximately 40 percent more to construct.

However, operating costs for a conventional garage are considerably higher with greater needs for maintenance, security, cleaning, snow and salt removal. In fact, I visited an automated parking garage in Munich, Germany, with only one attendant for six garages. In addition, the useful life of a conventional car deck is about 20 years. The earliest European systems show little or no wear after about 15 years. These steel structures probably have twice the life of conventional garages.

Figure 10 is the comparison of operating costs of a proposed 892 car garage to be located in upper Manhattan. When all factors are considered, the cost of operating an automated garage is less than half (-55%) that of a conventional garage. In this particular case an operator can save over $1.1 million/year with automated parking. In the current real estate climate, this is equivalent to a capital cost savings of over $15 million.

Figure 10: Comparison of expenses and capital costs for Parking Alternatives Case Study: Upper Manhattan, New York City[3]

	Parking Alternatives	
	Conventional Parking	**Automated Parking**
Capacity & Labor Assumptions		
Capacity	892	892
Hours of Operation	24/7	24/7
Expenses		
Payroll & Benefits	$850,000[1]	$145,000
Insurance Expenses	$95,000	$50,000
Utilities Expenses	$165,000	$200,000
Repairs & Maintenance	$145,000	$50,000
Bank Fee Expense	$100,000	$100,000
Marketing Expense	$20,000	$20,000
Support Service Expense	$75,000[2]	$35,000
Other Operating Expense	$150,000[3]	$75,000
Subtotal Operating Expenses	**$1,600,000**	**$675,000**
Real Estate Taxes Expense	$150,000	$150,000
Subtotal Non-Operating Expenses	**$150,000**	**$150,000**
Total Expenses	**$1,750,000**	**$825,000**
Capital Costs		
Security Camera/DVR System	$30,000	$30,000
Capital Account	$240,000[4]	$60,000
Total Capital Cost	**$270,000**	**$90,000**
Grand Total	**$2,020,000**	**$915,000**

1. See Labor Schedule
2. Includes security, legal fees, and adult fees
3. Includes license/permit fees, uniforms, office supplies, claims, etc.
4. Conventional Garage: 30% of garage repaired every 10 years at $50/sf

Conclusion

Automated parking is going to change the way we think about parking garages in urban environments. They will require less space and be far less polluting. Parkers will be safer and there will be less physical damage. The higher capital costs will be by lowered operating costs and lessened space requirements. In total, the benefits of automated parking are so significant that it will become commonplace in cities.

Samuel I. Schwartz, P.E., is the president and CEO of Sam Schwartz Engineering, PLLC, and advisor to WPS Parking Systems. He is a fellow of the Institute of Transportation Engineers. He can be reached at **info@gridlocksam.com**.

Footnotes:

(1) Air Quality Study Autmated Parking System, EEA Consultants Inc., 2007.

(2) Greenfeld, Lawrence A. Sex Offenses and Offenders: An Analysis of Sexual Assault. Washington D.C.: US Department of Justice: Office of Justice Programs, 1997.

(3) Sam Schwartz Engineering, PLLC, 2008.