Certification No. 41105

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Gessler: DG4 and DG6 LED Exit Signs

Green-Buildings' team of LEED Accredited Professionals performed a benchmark analysis of the 2000/DG4 and 3000/DG6 LED Exit Signs and determined that the DG4 and DG6 Signs will:

A. **Conserve Energy and Electricity**
B. **Reduce GhG Emissions and Pollution**
C. **Improve Building Durability**

Green-Buildings also believes that the use of the Gessler DG4 and DG6 LED Exit Signs are an effective choice when seeking to achieve certification under green building rating systems, such as LEED.

EXECUTIVE SUMMARY

The 2000/DG4 and 3000/DG6 LED exit signs ("DG4 & DG6"), manufactured by Gessler, are decorative emergency exit light-emitting-diode (LED) signs.

Green-Buildings.com ("Green-Buildings") worked with Gessler to complete a review and evaluation of DG4 & DG6. Green-Buildings believes that the DG4 & DG6 meet several important accepted green building principles and, as such, the product is applicable to high-performance building.

Green-Buildings' team of LEED Accredited Professionals performed a benchmark analysis of the DG4 & DG6 and determined that use of the DG4 & DG6 will:

A. **Conserve Energy and Electricity**
B. **Reduce GhG Emissions and Pollution**
C. **Improve Building Durability**

Additionally, Green-Buildings believes that the characteristics of the DG4 & DG6 signs make them an ideal option when seeking to obtain certification through various green building rating systems, such as the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Rating System. While no single product may guarantee a building certification in a green building rating system, Green-Buildings believes that the use of the DG4 & DG6 may contribute towards a LEED Certification[1] in the following categories:

a. **Energy & Atmosphere (EA):** 1-19 Points

DETAILS

An exit sign is defined as “a sign that is permanently fixed in place and used to identify a means of egress”. Typically, an exit sign must have an illuminated, legally-required legend which differs based on country. Exit signs that are required by Life Safety Codes to remain illuminated via an emergency power source upon failure of the normal power supply are (in most countries) designated as green (color). Red exit signs are allowed in many states and municipalities in the US, but green is becoming more favorable due to the fact that it’s less likely to blend in during a fire event.

Currently there are six primary categories of exit signs on the market: incandescent, compact fluorescent, radio luminescent (tritium), Light-Emitting Diode (LED), electroluminescent, and photo luminescent. While each of these types has their own distinct advantages and disadvantages, for the purposes of this report we will focus almost exclusively on LED signs and compare to the others where applicable to quantify savings or benefits.

Gessler has developed the edge-lit DG4 & DG6 LED exit signs as a replacement for the various less efficient, traditional incandescent exit signs found in conventional buildings. The characteristics of the DG4 & DG6 provide several benefits over the conventional emergency sign models. Considering that exit signs must operate day and night, 365 days a year, they can be a significant contributor to energy usage in a building. As such, any associated reduction in energy usage from exit signs quickly adds up.

Though the technology for LED exit signs has been around since approximately 1985, the idea gained momentum in the 1990’s. In 2005, LED products accounted for about 80% of exit signs sold, according to the American Council for an Energy-Efficient Economy, and that percentage has risen with passage of the Energy Policy Act of 2005.

The edge-lit Gessler DG4 and DG6 exit signs shown above include a clear panel that allows for an even ambient glow of light to crest the edges of the sign. The sign's metal or plastic mounting/housing (depending on model) compliments the architecture of the space.

As described below, the DG4 & DG6 provide a long-lasting, energy efficient light which is consistent with green buildings and sustainable design methodology.

A. Conserve Energy and Electricity:

According to the U.S. Department of Energy, buildings are responsible for approximately 39% of the energy consumed in the United States. Of the electricity used, building operations result in approximately 74% of total U.S. consumption. Lighting in buildings represents approximately

one third (28%) of this demand in commercial buildings and approximately twelve percent (12%) in residential buildings.

A key green building principle is the conservation of energy and electricity through the use of energy efficient technologies and controls. The simplest way to reduce electricity demand is to use less of it by eliminating unnecessary use of energy through lighting. Taking steps to replace inefficient lamps and/or lighting components has also been shown to greatly improve the effectiveness and efficiency of green building energy strategies, while simultaneously reducing the demand, and carbon output from, coal-fired power facilities, a common energy source.

Buildings that incorporate high-performance building components, such as the DG4 & DG6, will use less electricity than conventional buildings and result in a cleaner environment. This is because the underlying technological design of the DG4 & DG6 produces light in a far more efficient way than incandescent bulbs or even compact fluorescent lamps. The result is that the same amount of light is delivered from the LED with the use of far less energy.

Specifically, incandescent bulbs for exit signs may require up to four (4) times as much energy to produce the same amount of light, when compared to LEDs. Therefore, LED exit signs provide a valuable energy-savings option in a building retrofit scenario. While it is not the case with the subject product, an existing incandescent exit sign can be retrofitted to utilize LED lamps as well.

A conventional incandescent exit sign contains two (2) 20-watt incandescent bulbs. The idea behind the two-bulb scenario for incandescent bulbs was that if one burns out, the building maintenance staff will notice the dimmer sign and replace the burnt-out bulb. And though in many instances only one bulb is operating, for the purposes of our calculations we'll assume both bulbs are operating as designed. Each 20-watt bulb consumes approximately 175.2 kWh of electricity per year, so one sign costs an average of $28/yr to operate, assuming an average utility rate of $0.08/kWh. Add to that the fact that incandescent bulbs have a much shorter life than LEDs and that someone has to change them (labor costs), total yearly operating cost for an incandescent exit light is something around $76. The DG4 & DG6 LED exit signs operate at 6-watts each, so only would cost $4.20 a year to operate. Labor and maintenance costs would also be saved due to the exceptionally long life of LEDs. In the EPAct of 2005, the US Congress passed a new minimum federal efficiency standard stating that exit signs must have an input power demand of 5 watts or less per face. The DG4 and DG6 provide an average of 4-watts of savings over this baseline. And while some signs have inputs as low as 2-watts, studies have shown that performance and longevity of signs could be compromised if the input power demand is driven below five watts per sign. So at 6-watts per sign, Gessler's products have less probability of running into these issues.

In a retrofit situation, an example life cycle cost estimate savings for one exit sign is included below, using Gessler's 6-watts of input.

Life Cycle Cost Estimate for 1 Exit Sign(s)

This calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual savings may vary.

Number of exit signs	1	
Electricity rate ($/kWh)	$0.103	
	Option A	**Option B**
Type of exit sign	Incandescent	LED
Initial cost per unit (estimated retail price)	$0	$39
Sign wattage	40	6
Number of lamps per sign	2	
Cost per replacement lamp	$1.50	

Annual and Life Cycle Costs and Savings for 1 Exit Sign(s)

	Option A	**Option B**	**Cost Difference**
	Annual Operating Costs for 1 Unit(s) *		
Energy cost	$36	$5	$31
Maintenance cost	$67	$0	$67
Total	**$103**	**$5**	**$98**
	Life Cycle Costs *		
Operating cost (energy and maintenance)	$1,035	$54	$981
Purchase price for 1 unit(s)	$0	$39	-$39
Total	**$1,035**	**$93**	**$942**
		Simple payback of initial additional cost for Option B (years)	**0.4**

** Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. Life cycle costs are based on 10 years of operation, which is the minimum lifetime of most available product types.*

Through the above calculation results, use of the LED exit sign at 6 watts also includes life cycle air pollution reduction equivalent to the CO_2 emission remediation of 0.47 acres of forest (more on carbon savings in the next section).

The additional energy required by the incandescent bulb is then lost in the form of heat to the surrounding environment. In indoor environments, the additional heat causes building temperatures to rise putting incremental pressure on AC systems and greater demand for increased cooling loads. Over the long term, this incremental heat will add significantly to the amount of energy required to keep the building cool and further increase energy usage.

By incorporating the DG4 & DG6 into a holistic, energy-saving green building strategy, building owners and operators may not only save money and realize a positive return over the life of the product, but also save energy and reduce the environmental impacts of greenhouse gas emissions and other harmful pollutants.

B. Reduce GhG Emissions and Pollution:

i. Reduce GhG Emissions

The vast majority of electricity consumed in the U.S. is initially generated through the burning of fossil fuels, such as coal, at conventional power plants. A byproduct of the operation of coal-fired power plants is the production of a significant amount of greenhouse gases (GhG) and other harmful pollutants.

According to the U.S. Green Building Council and the U.S. Environmental Protection Agency, for each megawatt of coal generated electricity produced, an average of 2,249 pounds of carbon dioxide, 13 pounds of sulfur dioxide and 6 pounds of nitrogen oxides are released into the atmosphere. Indeed, more than 65% of the sulfur dioxide pollution in the U.S., or approximately 13 million tons per year, is the result of coal fired power generation.

Considering that the average national emissions factor for electricity in the United States is 1.37 pounds of carbon dioxide (CO_2) per kWh, and using the conservative assumption that the life of the DG4 & DG6 is 45,000 hours (before capacity is decreased), compared to a conventional exit Light as described above, Green-Buildings calculated the benefits of utilizing the DG4 & DG6 in total CO_2 eliminated below.

This calculation assumes a modestly sized building (30,000 sf) has 8 exit signs (also please refer to additional performance characteristics mentioned in the section on ROI calculations herein). As alluded to above, LEDs do not burn out like an incandescent bulb, rather, their brightness slowly fades. So, while the lifespan of an LED might be listed at 45,000 hours, that is the point when the bulb will most likely be shining at around 70% capacity (the industry assumes people notice a decrease in brightness at that point). So we'll assume that total life is double the full-capacity life for the calculations below:

	Full Capacity LED Lifetime (5 years)	Total LED Lifetime (10 years)
Life Cycle Energy Saved:	11,913 kWh	23,827 kWh
Pounds of CO_2 Saved:	18,347	36,694
Tons of CO_2 Saved:	9.2	18.3
Life Cycle Operating Savings:	$3,492	$6,985

To put things into a quantifiable perspective, the 9 year greenhouse gas savings are equivalent to the following:

- Annual GhG emissions from 3.2 passenger vehicles driven 11,000 miles/year that have a fuel efficiency of 20 mpg.
- CO2 emissions from the electricity use of 2 single family homes for one year.
- Carbon sequestered annually by 3.5 acres of pine or fir forest.

ii. Reduce Pollution

The U.S. Environmental Protection Agency (EPA) estimates that indoor pollution levels may be two to five times (potentially up to one hundred times) higher than outdoor pollution levels. As indoor pollution levels and exposure to harmful toxins are also a concern, products that help reduce exposure to potential harmful air pollutants and the presence of biological contaminants are an important consideration in green building. While compact fluorescent lamps (CFL) are significantly more efficient than traditional incandescent bulbs, they also contain mercury. Because CFLs contain mercury, they must be carefully handled and properly disposed of to prevent potentially significant environmental hazards that may occur throughout a product's life. Exposure to mercury poses risks not only to indoor occupants, but also to others in any surrounding environment downstream. The DG4 & DG6 contain no mercury and present an alternative to the potential dangers associated with CFLs.

The use of energy efficient lighting, such as the DG4 & DG6, reduce electricity demand and, therefore, reduce the amount GhG emissions released into the atmosphere from coal-fired power generation. The DG4 & DG6 also reduce incremental mercury pollution as an alternative to compact fluorescent lamps.

C. Improve Building Durability

A key green building principle is to deliver durable, high-performance design and construction to create a built environment that will last. Indeed, according to a survey by PPG Industries, architects report that durability is the most important attribute for a green building product. The use of durable, high-performance building materials and construction may result in a building that may require less frequent renovation, repair and replacement.

By reducing the environmental impacts of materials chosen for construction, i.e. by using materials that provide longer life and performance, builders can reduce waste and system failures, enjoy more predictable maintenance schedules and benefit from a lower cost of ownership.

According to the EPA, depending on their environment and use, LEDs are is capable of lasting between 35,000 and 50,000 hours. For the purposes of our calculations herein, we assume estimate the life of the DG4 & DG6 to be 40,000 hours.

The extremely long operating life of the DG4 & DG6 provides real estate owners and operators with the benefit of reduced labor and materials costs while decreasing the frequency and amount of waste from replacement bulbs that would otherwise be sent to landfills. See ROI calculations below.

Return on Investment (ROI) Considerations:

For better or worse, the relatively short-term incentive to profit by keeping less efficient, less expensive, systems in place may be considered by some to be more important than any potential negative implications that could occur to the environment in the future. Therefore, calculating the potential financial benefits of green building investments is critical to their adoption by the commercial real estate industry.

Green-Buildings computed the return on investment (ROI) as well as the total lifetime savings from replacing fifty (50) traditional exit signs with the DG4 & DG6. Using conservative assumptions, Green-Buildings calculated the following:

Cost Add for LEDs (over incandescent):	**$2,000**
Total lifetime savings:	$5,479
Annual total savings:	$1,200/year
Simple payback:	1 year, 8 months
Return on Investment:	40%

Green-Buildings compared the DG4 & DG6 with a standard 40-watt incandescent exit sign. The model details are as follows:

Model #	Watts/ Fixture	Fixture type	Life (hours)	Unit cost/ bulb	Color	CRI
DG4 & DG6	6	Exit Sign	>30,000	$55	9,016	80
Incandescent	40	Exit Sign	3,000	$3	2,700	100

The following formula illustrates the total lifetime cost savings that may be realized when using the DG4 & DG6 in place of a less efficient, less expensive bulb with a shorter life. The calculation considers factors including labor, inventory and frequency of replacement for one exit sign:

Total lifetime Cost Savings = A/B x (C+D) x E-F
Total lifetime energy savings = A/G x (J x I)

A = Replacement Bulb Life (hours)	**>40,000**
B = Original Bulb Life (hours)	**2,920**
C = Labor cost ($) to Change Original Bulb	**$10**
D = Cost ($) of Original Bulb	**$3**
E = Number of Replacement Bulbs	**28**
F = Cost ($) to Install Replacement Bulbs	**$140**
G = Hours of Operation/Year	**8,760**
H = W Saved	**34**
I = kWh Saved/Year (H x G)	**300**
J = Cost per kWh	**$0.08**
L = Labor Cost/Hour to Replace	**$20**

Total lifetime cost savings	**$4,846**
Total lifetime energy savings	$110
Total Savings from Investment	**$4,956**

LEED Scoring and Certification:

Use of LED lighting products, such as the DG4 & DG6, may contribute materially to the Leadership in Energy and Environmental Design® ("LEED®") green building certification process. Accordingly, use of the DG4 & DG6 may provide measurable performance in the following LEED credit categories:

LEED 2009 - **Energy & Atmosphere: EA (1 to 19 Points)**
Energy efficiency reduces the negative environmental consequences associated with the production and use of energy. As buildings are commonly powered by fossil fuels, energy

savings are critical to green building. The EA credit category represents the primary area where the inherent efficiencies and long life of the DG4 & DG6 product can deliver significant positive impact. (1-19 Points)

LEED v4 - **Energy & Atmosphere: EA (1 to 19 Points)**
Energy efficiency reduces the negative environmental consequences associated with the production and use of energy. As buildings are commonly powered by fossil fuels, energy savings are critical to green building. The EA credit category represents the primary area where the inherent efficiencies and long life of the DG4 & DG6 product can deliver significant positive impact. (1-19 Points)

CONCLUSION

Green Buildings believes that the DG4 & DG6 LED exit signs by Gessler meet three significant criteria used in green building initiatives: **Conserve energy and electricity, reduce GhG emissions and pollution** and **increase building durability**. Furthermore, use of the DG4 & DG6 is an effective choice when seeking to achieve certification under a green building rating system, such as LEED, by potentially earning points in the area of Energy and Atmosphere. Finally, the use of the DG4 & DG6 should result in a positive return on investment (ROI) for owners and operators who are considering the benefits of LEDs in a new building.

[1] Green-Buildings.com has evaluated and reviewed this product using its own methodology. While Green-Buildings.com believes that certain products have characteristics that may allow users of the products to earn points in a LEED certification, only the Green Building Certification Institute (GBCI) may award points and grant certification. Accordingly, Green-Buildings.com does not make any assurances, guarantees, representations, or warranties, express or implied, and specifically disclaims all warranties or representations, that products will earn LEED points, or any project that utilizes such products, will receive LEED® certification.