GOTHAM ARCHITECTURAL DOWNLIGHTING
A DIVISION OF ACUITY LIGHTING GROUP, INC.
1400 LESTER RD., CONYERS, GEORGIA 30012
P 800 315 4982 F 770 860 3129
www.gothamlighting.com
An Acuity Brands Company

Economic Analysis for Comparable Illumination
(2400 ft^2 retail area. 24 hour operation)

Luminaire Type	Recessed Accent	Recessed Accent	Recessed Accent
Lamp	75W PAR30	39W PAR30	39W T6
Type	PAR Halogen	PAR Ceramic MH	T6 Ceramic MH
Mean Lamp Lumens[1]	1050	1430	2600
Luminaire Efficiency	86.1%	94.1%	67.7%
Delivered Lumens	904	1346	1760
Required Luminaires	100	67	51
Average Maintained Footcandles	42.5 FC	42.6 FC	42.5 FC
Approximate Initial Installed Cost [2]	$19,800	$25,460	$20,961
Annual Cost of Energy and Maintenance [3]	$10,600	$5,798	$3,817
Total 10 year Life- Cycle Cost [4]	$81,850	$44,767	$29,477
LCCBA (Life-cycle Cost/Benefit Analysis)	$101,650 (Good)	$70,227 (Better)	$50,438 (Best)
Lighting Power Density	3.1 w/ft^2	1.1 w/ft^2	.8 w/ft^2 *

*This lighting power density is 55% better than ASHRAE/IESNA 90.1 and thus eligible for maximum LEED points as determined by USGBC.

1) HID, PAR and T6 input watts equal 44.
2) Includes installation labor, lamp and luminaire costs.
3) Considers fewer fixtures are required for the T6 application, longer lamp life and less consumed energy.
4) Based on a 5% discount rate.

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CASE STUDY – RETAIL

Gotham Architectural Lighting Financial Analysis of T4/T6 Ceramic Metal Halide

Retail Lighting Scenario – Using Life Cycle Cost Benefit Analysis

In this case study, we will look at a situation where the lighting practitioner must light a produce merchandise area at a high-end grocery store. Since the owner built their last store, the new Energy Policy Act has taken effect and the lighting practitioner knows that they need to keep the total energy for the store under 2.1 watts/ft^2 for general lighting, with an allowance for an additional 1.6 watts/ft^2 for accent lighting. Total lighting power density for the store being at 3.7 w/ft^2 or below. In the past, the store management had a preference for high CRI fluorescents for general lighting, with the merchandise accented by recessed downlights with 75PAR30 halogen flood lamps. The store will be open 24 hours a day.

The lighting practitioner wants to select the best available lighting system while keeping at or below ASHRAE/IESNA 90.1. The owner wants at least the same illuminance as they had before, which was 45 footcandles on the merchandise with 15 footcandles ambient. The store will reuse some parabolic troffers for general lighting and they will contribute 0.9 watts/ft^2 to the lighting power density.

Here are the accent lighting systems the designer is considering:

System One – Base

6” recessed accent with 75 watt PAR30 120V halogen lamp[3]
Rated Average Life: 3000 hrs
Initial Lumens: 1050
Mean Lumens: (not published)
Max Beam Candlepower: FL 25° 4200
Luminaire Efficiency: 86.1%
Distributor Price[1]: $120.00
Lamp cost: $ 6.00
Lumen factor[2]: 1.00

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System Two

6" recessed accent with 39 watt Ceramic PAR30 metal halide lamp[3]
Rated Average Life: 9000 hrs
Initial Lumens: 2200
Mean Lumens: 1430
Max Beam Candlepower: FL 30° 7400
Luminaire Efficiency: 94.1%
Distributor Price[1]: $235.00
Lamp cost: $ 45.00
Lumen factor[2]: .67

System Three

6" recessed accent with 39 watt T6 Ceramic metal halide lamp[3]
Rated Average Life: 12000 hrs
Initial Lumens: 3300
Mean Lumens: 2600
Max Beam Candlepower: NA
Luminaire Efficiency: 67.7%
Distributor Price[1]: $345.00
Lamp cost: $ 46.00
Lumen factor[2]: .51

[1] Distributor cost reflects a 10% margin for luminaire and lamp

[2] Lumen factor is a multiplier that allows comparison between different lighting systems with dramatically different efficacies. In order to compare 'apples to apples' we can use a lumen factor to assure an equal measure of illuminance from each system. In this scenario, the accent lighting in the base system would require 100 luminaires, system two would require only 67 luminaires, and system three would only require 51 luminaires to provide similar lighting levels.

[3] All lamp data from Philips Specification and Application Guide 2006.

Now, Let's look at the cost of a single luminaire over the life of the system:

Initial Costs	**System One**	**System Two**	**System Three**
Luminaire Cost	$ 132.00	$ 258.50	$ 379.50
Lamp	6.00	45.00	46.00
Installation Costs	60.00	65.00	65.00
Total:	$ 198.00	$ 368.50	$ 490.50

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Annual Costs – First Year – For One Luminaire

(Not discounted to current dollar values)

Lamps	$ 18.00	$ - [4]	$ - [4]
Labor ($6/lamp spot relamping)	18.00	- [4]	- [4]
Energy Costs (8760 hrs @ .09/KwH)	59.13	30.74	30.74
Air Conditioning	11.83	6.15	6.15
Total Annual Costs:	$ 106.96	$ 36.89	$ 36.89

[4] There are no expected lamp failures for systems two and three for the first year. Average rated lamp life exceeds annual burning hours of 8760 hours.

Twenty-five Year Life Cycle Costs for one Luminaire

Lamps	$ 129.21	$ 331.88	$ 253.88
Labor (spot relamping)	129.21	44.25	33.19
Energy Costs	436.08	226.70	226.70
Air Conditioning	87.22	45.34	45.34
Total 25 yr. costs per fixture (Future cash flows discounted to current dollar value. Interest rate = 5%)	$ 781.72	$ 648.17	$ 559.11

As you can see, just looking at one fixture over its life, system two comes out as having the lowest life cycle cost. But that is only part of the story. What about performance?

Performance:

All of the above financial data does not take into consideration the improvement in performance for the metal halide lamps over the 75-watt halogen PAR lamp. Using reasonable efficiency and lamp lumen data, we can use the efficiency gains from systems two and three to use fewer fixtures to light the space. This is where the higher initial costs are offset by dramatically improved performance and fewer luminaires used to achieve the same result.

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For example: To illuminate the produce section of a 40' x 60' grocery department, the lighting practitioner may:

Use	Or, use	Or, use
System One: 100 adjustable 75-watt halogen PAR accent lights producing 42.5 footcandles, (average maintained),	**System Two**: 67 adjustable 39 watt ceramic MH PAR accent lights producing 42.6 footcandles, (average maintained),	**System Three:** 51 adjustable 39 watt ceramic T6 accent lights producing 42.5 footcandles, (average maintained).

Simple Payback:
If we stop right here and calculate a Simple Payback we see:

System One Initial Installed Cost:	System Two:	System Three:
$198.00 X 100 =	$368.50 X 67 =	$490.50 X 51 =
$19,800.00	$24689.50 – $19,800 =	$25015.50 – $19,800 =
	$4889.50 / ($70.07 x 67)	$5215.50 / ($70.07 x 51)
	= 1.04 year payback.	= 1.46 year payback.

Clearly, system two has a quicker payback than system three so it should be the specified system. Right? Well, not so fast. Let's check the numbers with a little more analysis. Multiplying the single fixture life-cycle costs by the actual number required to light this specific space, and if we consider future cash flows and the time value of money we see the following:

	System One	**System Two**	**System Three**
Number of luminaires required:	**100**	**67**	**51**
Initial cost of luminaires:	$ 13,200.00	$ 17,319.50	$ 19,354.50
Initial cost of lamps:	600.00	3,015.00	2,346.00
Installation costs:	6,000.00	4,355.00	3,315.00
Total first costs:	$ 19,800.00	$ 24,689.50	$ 25,015.50
Total Life-cycle cost[5]	$ 78,172.00	$ 43,427.39	$ 28,514.61
Total:	$ 97,972.00	$ 69,116.89	$ 53,530.11

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[5] The IESNA recommended practice of using 25-year life-cycle costs looks at the initial costs of a lighting system in today's dollars, with expected maintenance costs, lamps, and energy costs discounted to current values.

Conclusion:

Considering all the important criteria, the lighting practitioner would most prudent to specify system three, despite the higher initial cost. This brief analysis is on the conservative side: there is no factor for inflation and interest rates are assumed to be a relatively low 5% annually. We know prices will fluctuate, but with history as our model, we can safely assume that the ceramic metal halide lamps won't always be selling for $45 and $46. Most industry analysts believe they will settle out at around $25.00 over the next couple of years. Energy costs will certainly climb. All of these factors will only support the decisions to select the most energy efficient lighting systems available. Cost of recycling fixtures and lamps at end of life is assumed to be the same for all three types, and thus is not included in this analysis.

Lighting Power Density Criteria from Energy Policy Act (and ASHRAE/IES 90.1)

Limits for general merchandise retail spaces: 2.1 watts/ft^2 general plus 1.6 w/ft^2 accent.

Total area: 2400 $ft.^2$. The total allowable for this space would be 3.7 w/ft^2.

System One: 3.1 w/ft^2 plus 0.9 for the fluorescent = 4.0 (No good)

System Two: 1.1 w/ft^2 plus 0.9 for the fluorescent = 2.0 (Very good)

System Three: 0.8 w/ft^2 plus 0.9 for the fluorescent = 1.7 (Excellent. 55% better than ASHRAE/IESNA 90.1)