

STUDENT ORGANIZATION SUSTAINABILITY INITIATIVE PROPOSAL FORM

Part I- General Information:

Name of Student Organization	Math Emporium Energy Improvement Initiative
Contact/Responsible Person	Daniel Webb
Contact Office Held/Title	Energy Analyst
Contact Email Address	dwebb20@vt.edu
Contact Telephone Number	540-293-3107

Part II- Project Cost Information

Estimated Cost of this Proposal See III.C. below

Estimated Savings - See III.D. below

Net Cost of this Proposal =

Part III- Supporting Information

A. Please describe your sustainability initiative and attach supporting documentation.

Lighting and Controls update to the Math Emporium, see below

My sustainability initiative is to replace the current lights in the Math Emporium with high-efficient LEDs. In addition, new lighting controls will allow the space to be better utilized and save energy on wasted lighting. As I will discuss below, the energy, maintenance, and cost savings of this project make it a great sustainability opportunity for the University. In addition to the sustainability impacts, doing this project will expand functionality of the space and eliminate current problems that are noticed by everyone. This includes the low light level, the hum coming from the lights, and the inability to reduce lighting in zones that are unoccupied.

The Math Emporium is one of the largest spaces that is part of campus and used for education. Located off-campus on University City Blvd., the old department store turned academic space has over 60,000 square feet containing over 500 workstations in the main floor and another 200 workstations in a new testing center. According to the course timetable, over 3500 students are taking courses through the Math Emporium this semester, Fall 2018. Any work done on this space will impact a significant portion of the undergraduate student population.

The current metal halide lights in the Math Emporium are original with the space and do not put off enough light. It is obvious when walking into the main floor that it is quite dim. The building manager told me that the biggest issue she notices, along with students, is that the lighting level in the main floor is low. For a space such as the Math Empo, you would like to see between 30-50 Foot-candles (FC) of illuminance at desk level. Right now, there is an average measured lighting intensity between 12-18 FC, well below what it should be. My proposed upgrade to the lights would increase the light intensity to an average of 42 FC, a much more comfortable level of lighting for students doing work.

Another problem with the current design of the Math Empo is that all the lights in the main floor all come on together at one level. These lights stay on all the time, 24 hours a day. The facility is only open 16 hours a day but the lights do not get shut off during off-hours. When they turn the lights off and back on, some of the lights burn out, causing maintenance to have to come often. To fix this problem, they just always leave the lights on. This is an enormous waste of energy that can easily be remedied by replacing the lights with LEDs. At times, there are parts of the Math Empo that are vacant. However, the lighting remains on full bright when it doesn't need to be. Therefore, I am also proposing to divide the Math Empo lights into 11

zones that will have independent dimming and control. Occupancy sensors could detect when no one is in a zone and then dim the lights accordingly. This is a further method to save energy in the space at times when it is not very full.

It is important that students doing coursework in the Math Empo have a comfortable place to work. The existing ballasts in the metal halide fixtures produce a very noticeable hum throughout the entire space. Replacing the fixtures will eliminate this hum, an additional benefit that will provide more comfort to students trying to learn.

The 2x2 metal halide lights being used in the main floor use 295 watts. Every 2x2 metal halide fixture will be replaced by a 2x4 LED fixture. This LED fixture in comparison uses around 54 watts. This simple difference in wattage makes this project an enormous green initiative for Virginia Tech. There are 311 of these fixtures. Annually, this difference in wattage in conjunction with new controls projects around 736,000 kWh in savings, or \$71,363.98. There are other fixtures that will need replacing as well that have an additional projected 35,711 kWh, or \$3,464.00, in yearly savings. Annually, replacing the lights would save \$10,216.35 in labor savings and \$5,468.06 in material savings. This is roughly what Virginia Tech spends replacing lights in the Math Emporium, which have very low lifetimes.

The best part of this project is the simple payback period, 2.15 years. This means that this project would pay for itself in just over 2 years. While this is a relatively large project, the environmental impact through energy saved, not to mention this short payback period, makes it a very rewarding sustainability initiative. This project would impact thousands of undergraduate students yearly, in addition to improving a facility that needs it.

Please see attached additional information at the end for more specific details on this proposal.

B. How does this initiative help to achieve the goals of the Virginia Tech Climate Action Commitment Resolution and Sustainability Plan?

The Virginia Tech Climate Action Commitment and Sustainability Plan (VTCAC&SP) states that "Virginia Tech will be a leader in Campus Sustainability" and that sustainability is an important part of the university as "it pursues enhanced economic stability" and "environmental stewardship". This initiative demonstrates on a large scale that Virginia Tech is a leader in campus sustainability. It demonstrates that Virginia Tech does so for its students and its surrounding community. This project will demonstrate to others that Virginia Tech is willing to make an investment if it means campus can operate in a more sustainable way.

In addition, the VTCAC&SP says that Virginia Tech has a target of reducing campus GHG emissions to 295,000 tons by 2025. This project, annually, saves 611 equivalent tons of CO₂. This was determined from a direct conversion of kWh to equivalent tons of CO₂ saved using an established conversion factor. The plan also says that Virginia Tech will work toward their emission reduction targets through improved energy efficiency, which is exactly what this project does.

The VTCAC&SP says that "Virginia Tech will improve electricity and heating efficiency of campus facilities and their operations by improving the... lighting efficiency...and metering and control of its existing buildings". This project improves the lighting efficiency of the Math Emporium, both through energy savings and through more light output. The control system is also being proposed in this project, by having zones to the Math Emporium to operate independently of each other. These new controls will save energy by dimming lights when they are not needed.

Another point of the VTCAC&SP says that Virginia Tech will engage students through involvement to develop and implement innovative strategies for efficient and sustainable use of energy in facilities. This project demonstrates a proposed student initiative that will make a facility have a more responsible use of energy. My involvement with a sustainability project like the one I am proposing directly meets the goals of the VTCAC&SP.

The campus sustainability mission says that the pursuit of sustainability is achieved through Virginia Tech's physical environment and operations; student life and experience; and academic learning, discovery, and engagement. This project meets the above-mentioned points by enhancing a facilities operation, helping student life and experience in a classroom setting, and improve academic learning in the space. These things are achieved through energy savings, the increase of lighting in the space, and the elimination of the buzz from the lights in the space.

C. What is the cost of your proposal? Please describe in adequate detail the basis for your cost estimate.

My proposal cost is estimated to be **\$194,268.55**. This includes three main pieces: materials, labor, and third-party services for coordinating the renovation:

The material quote was created by State Electric Supply Co., a reliable company that works with Virginia Tech on a variety of projects. They conducted multiple site visits of the Math Emporium and created reliable fixture counts for the proposal. They broke down the cost by each item needed. This broken down cost can be found in the attached additional information at the end of this proposal. This total material cost is estimated at **\$115,560.55**.

The labor quote was estimated by State Electric Supply Co., based on their expertise with prior labor costs for Virginia Tech projects. They estimated labor to be around **\$65,590.00**.

The remaining cost was to account for a third-party to come in and manage the project, as Virginia Tech would likely not do it internally. The third-party Virginia Tech uses, Gilbane, would find the contractors and manage the project through completion. To account for their services, I added on 20% of the labor cost. This cost ended up being **\$13,118.00**.

Please see attached additional information at the end for more specific details on project cost.

D. Will your proposal produce cost savings for the University? If so, how much? Please describe in adequate detail the basis for your savings estimate.

This project produces significant cost savings for the University. The current lights in the facility remain on 24/7. Knowing this, I calculated the amount of electricity used by the lights based on the wattage of each fixture for an entire year, which ended up being around **850,061.64 kWh, or \$82,455.98**, annually.

In comparison, I did the same thing for the proposed LED lights, which use a lot less power. Also, in my calculations for savings of the new lights, I assumed that they would not be on 24/7, as they would be able to turn these lights off during non-operational hours. As mentioned previously, the current lights are not turned off during closed hours because of an issue where bulbs burn out and maintenance must come often. I assumed for the new lights in my calculations that they would be on for 16 hours a day for 8 months of the year and 10 hours a day for the remaining 4 months of the year. This is slightly an overestimate, as during breaks the facility may be open for less time than I assumed. In addition, by adding occupancy sensors I added an additional 20% reduction in operating hours to my calculations of the new lights. After assuming the above, I calculated the amount of electricity the new lights would use. This was **78,639.13 kWh, or \$7,628.00**, annually.

Comparing the current light operating cost to the proposed lighting operating cost yields savings of **771,422.51 kWh, or \$74,827.98**, annually. In addition, the current bulbs have low lifetimes and need replacement often. The new fixtures would not need to be replaced for over 10 years. Annually, this would save a further **\$5,468.06** in new material cost and **\$10,216.35** in labor costs.

As a result, the overall annual savings come out to be **\$90,512.39**. In comparison to the project's total cost, **\$194,268.55**, the simple payback period for this project is **2.15 years, or 25.76 months**.

During FY2017, the Math Emporium purchased **1,324,800 kWh** at a cost of **\$113,366.75**. The largest consumption of electricity is the lights, estimated to be 64%, followed by the over 500 computers in the space, estimated to be 28%. This project will save the facility significant energy and cost for the rest of its lifetime.

Please see attached additional information at the end for more specific details on these savings.

E. Is this funding request for a One-Time need or an Ongoing need (please check one)?

One-time

Ongoing

F. Is funding available for this request from another source? If yes, describe the funding (source, amount, etc.)

No

STUDENT ORGANIZATION SUSTAINABILITY INITIATIVE PROPOSAL FORM
(Continued)

Part IV- Requestors/Reviewers



Daniel Webb, Electrical Engineering, Energy Analyst

Prepared By (Name of Contact for Student Organization)

Date: 11/15/2018

Ruben Avagyan, Campus Energy Manager, Energy Management

Reviewed By (Name of Appropriate University Official)

Date: 11/15/2018

Denny Cochrane, Sustainability Program Manager, Office of Sustainability

Reviewed By (Name of Office of Energy and Sustainability Representative)

Date: 11/15/2018

Part V- Supporting Documentation

The following supporting documentation was acquired as part of this proposal and gives additional information regarding points made above:

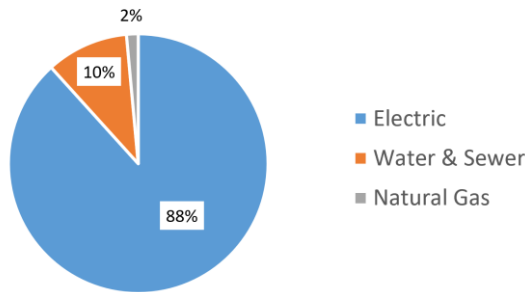
- A. [Current Energy Used by the Math Emporium](#)
- B. [Current Floor Plan of the Facility – Emergency Map](#)
- C. [Lighting Floor Plan of the Facility](#)
- D. [Existing Facility Conditions – Photos taken 10.31.18](#)
- E. [Proposed Lighting Zones for Controls](#)
- F. [Material Cost Breakdown from State Electric Supply Co.](#)
- G. [Maintenance and Labor Savings from State Electric Supply Co.](#)
- H. [Energy ROI from State Electric Supply Co.](#)
- I. [Energy Costs – Existing vs. Proposed](#)
- J. [Summary of Savings, Project Cost, and Simple Payback Period](#)
- K. [Cutsheets for Proposed Fixtures and Wall Box Controls](#)

A. Current Energy Used by the Math Emporium

The Math Emporium uses electric, water, and natural gas utilities. The largest utility and the one I am most concerned about in this proposal is the electric use. Below I show the overall utility usage for FY2017 from utility bills and an estimate for how much electricity the lights, computers, and HVAC systems use:

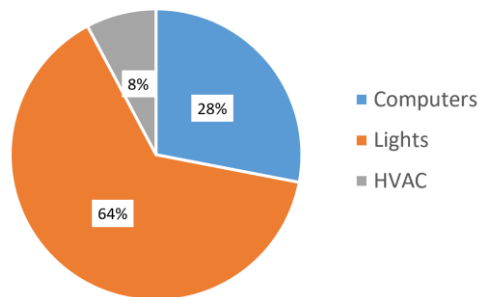
BASELINE ENERGY/WATER CONSUMPTION			
Utility	Amount Used	Units	Cost
Electric	1,324,800	kWh	\$ 113,366.75
Water & Sewer	1190	TGAL	\$ 13,169.38
Natural Gas	2294.89	CCF	\$ 1,869.96
Total			\$ 128,406.09

Utility Cost Breakout



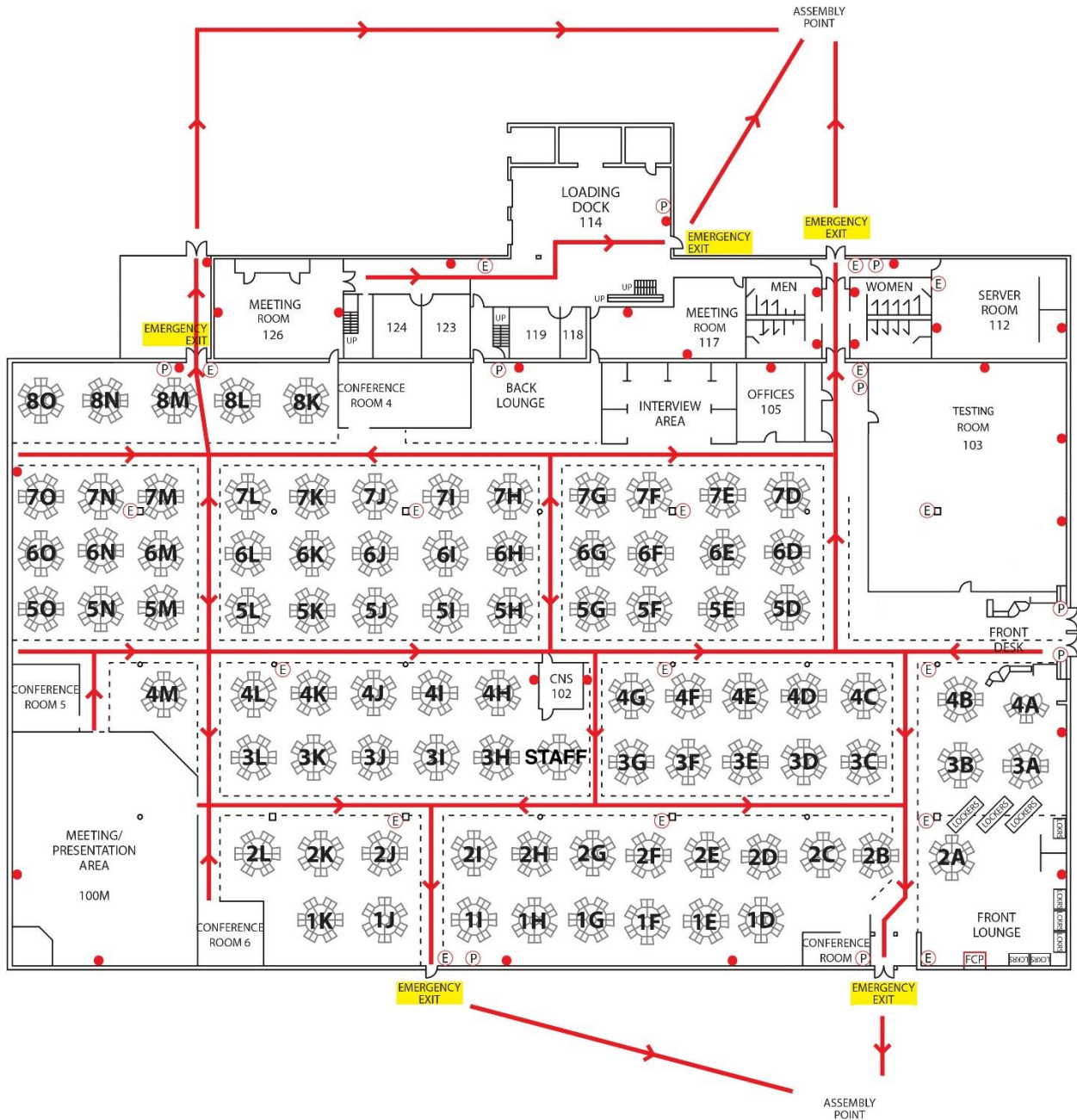
BREAKOUT OF ELECTRIC COST BY THE END USERS		
User	Amount Used (kWh)	Cost
Computers	371,424	\$ 31,783.76
Lights	850,062	\$ 72,742.09
HVAC	103,314	\$ 8,840.89
Total	1,324,800	\$ 113,366.75

Electric Cost Breakout



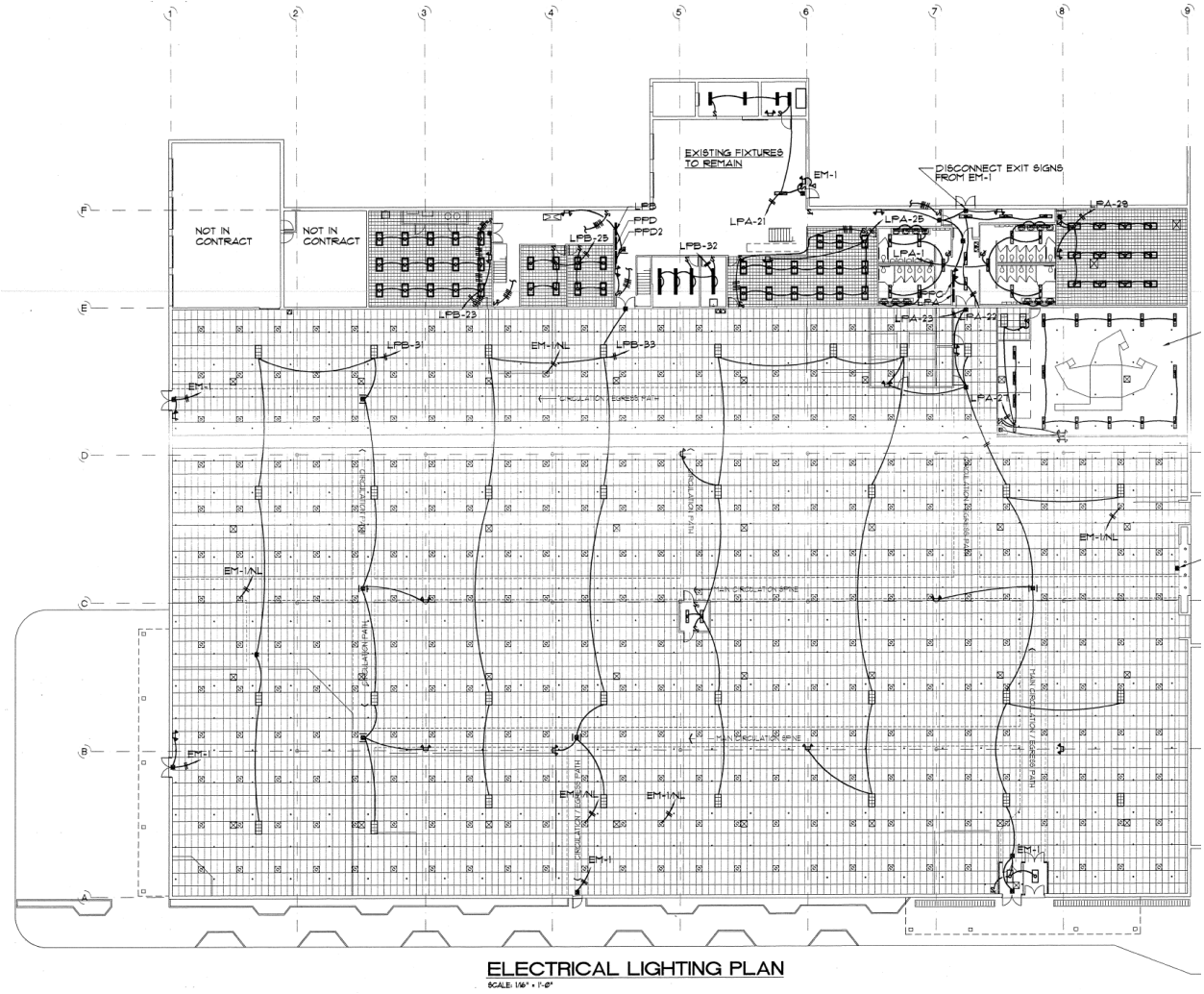
B. Current Floor Plan of the Facility – Emergency Map

The current floor plan of the facility is shown below. The facility recently had a renovation, adding the testing room and various offices.



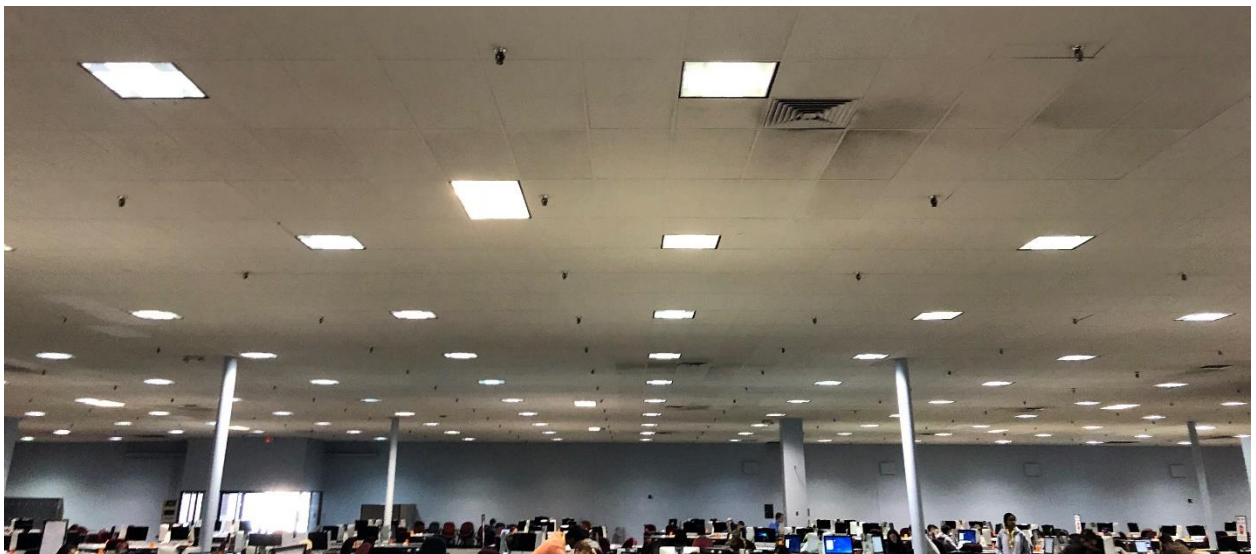
C. Lighting Floor Plan of the Facility

The floor plan below shows the locations of the 2x2 metal halide lights that I am proposing to replace with 2x4 LED fixtures.



D. Existing Facility Conditions – Photos taken 10.31.18

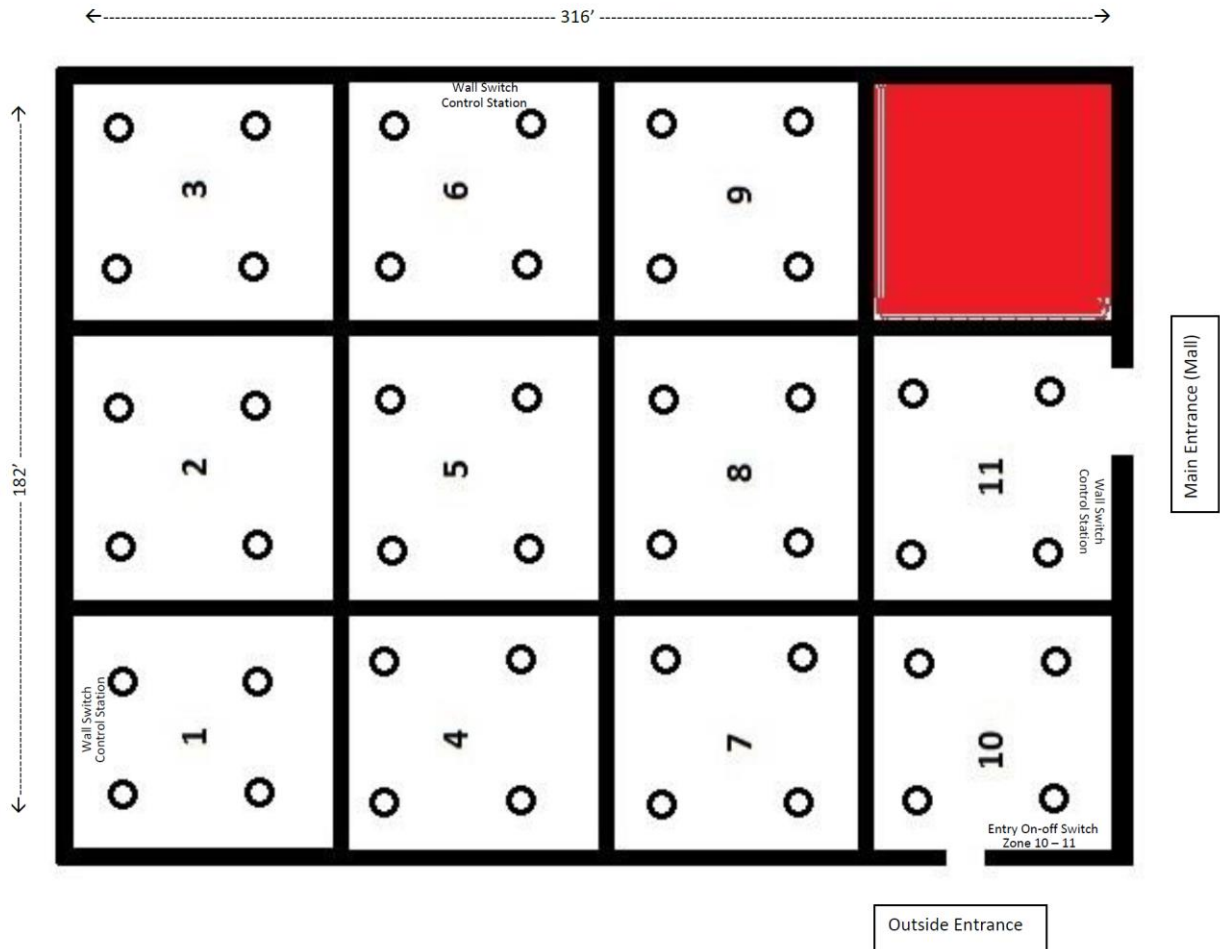
To evaluate the condition of the facility, I visited with the Building Manager and took some photos of the existing lighting layout.



From the lower picture, it is easy to tell how the lighting in the space is very uneven. Where it is very bright directly below a fixture, it is dim in between fixtures. On the back wall, you can see how it is dim in between fixtures.

E. Proposed Lighting Zones for Controls

Part of the project would be to establish lighting zones throughout the main hall. These zones would have independent dimming, where 5 occupancy sensors per zone would control dimming. If no one is in a particular zone for a certain period of time, the lights would dim automatically to save energy. The proposed zones are shown below. The area shaded in red is the new testing area, which would not have zone control.



F. Material Cost Breakdown from State Electric Supply Co.

Tele: (540) 382-6415
 Fax: (540)-381-1520

State Electric Supply Co.
 390 Arbor Drive
 Christiansburg, VA 24073

11/2/2018

CUSTOMER: VPI Renovations Design & Construction

Sterrett Facilities Complex
 Blacksburg, VA 24061

ATTN: Ruben Avaygan
SUBJECT: LED Lighting Audit Upgrade
JOB NAME: Math Emporium
QUOTE DATE: 11/2/18
CONTRACT#: VTG-364-2017
FIN#: 55-038-4235

PART NO.	QUANTITY	DESCRIPTION	UNIT PRICE	UNIT EXTENDED
<u>Main Room</u>				
LIT2GTL 4 72L SWL EZ1 LP840	311	2x4 GTL Series LED Layin Fixture 7200 Lumen 4000k Mvolt0-10V LED Driver	\$ 285.13	\$ 88,674.87
LIT2GTL 4 72L SWL EZ1 EL14L LP840	30	2x4 GTL Series LED Layin Fixture 7200 Lumen 4000k Mvolt0-10V LED Driver w/Bat. Backup	\$ 517.95	\$ 15,538.46
LITLBLE4 4000LM 80CRI 40K MIN10 ZT MVOLT EL14L	2	4' Surface Mt. Wrap with Emergency Back Up Battery	\$ 378.97	\$ 757.95
LITEXR LED EL M6	14	LED EXIT SIGNS	\$ 27.56	\$ 385.90
LUTPJ2-3BRL-GWH-L01	15	Pico 3 Button On-Off, Raise-Lower, w/Preset	\$ 13.31	\$ 199.60
LUTPJ2-2B-GWH-L01	3	Pico 2 Button On-Off	\$ 15.84	\$ 47.52
LUTPICO-WBX-ADAPT	18	Wall Box Adapter	\$ 5.33	\$ 96.00
LUTCW-3-WH	4	3/g Wall Plate White	\$ 9.83	\$ 39.31
LUTCW-2-WH	2	2/g Wall Plate White	\$ 6.47	\$ 12.93
LUTCW-1-WH	1	1/g Wall Plate White	\$ 3.24	\$ 3.24
LUTRMJS-8T-DV-B	30	8A Lutron 0-10v Dimming Relay, Vive Compatible 120/277 No Neut	\$ 104.51	\$ 3,135.20
WCECW09394-PUGY	5000	1000' 16/2 Sol. 0-10V Lighting Cable Plen. Rated	\$ 0.22	\$ 1,080.00
<u>Tutoring Lab Rm 117</u>				
LITLBLE4 LP840	15	4' led Surface Mt. Wrap Fixture Mvolt, 0-10V LED Driver	\$ 140.38	\$ 2,105.77
WCECW09394-PUGY	1000	1000' 16/2 Sol. 0-10V Lighting Cable Plen. Rated	\$ 0.22	\$ 216.00
LUTPJ2-3BRL-GWH-L01	2	Pico 3 Button On-Off, Raise-Lower, w/Preset	\$ 13.31	\$ 26.61
LUTPICO-WBX-ADAPT	2	Wall Box Adapter	\$ 5.33	\$ 10.67
LUTCW-2-WH	1	2/g Wall Plate White	\$ 6.47	\$ 6.47
LUTRMJS-8T-DV-B	2	8A Lutron 0-10v Dimming Relay, Vive Compatible 120/277 No Neut	\$ 104.51	\$ 209.01
LUTLRF2-OCR2B-P-WH	1	Overhead 360 deg. Wireless Occ Sensor	\$ 53.84	\$ 53.84
<u>Main Room Occ Sensor Option</u>				
LUTLRF2-OCR2B-P-WH	55	Overhead 360 deg. Wireless Occ Sensor (5 per Zone)	\$ 53.84	\$ 2,961.20
Total----->			\$ 112,599.35	
Total w/Occ Sensors----->			\$ 115,560.55	

NOTE: Pricing Quotation is for budgeting purposes. Change in Fixture Qty. may effect price levels.

Additional misc. material required by electrician to be field specified. Exact items will not be known until locations and installation methods are determined.

PRICES FIRM 30 Days per Manufacturers Terms.

TERMS: PER CONTRACT

FGT TERMS: Freight Allowed unless requested Rapid Air Delivery, or Special Handling

QUOTED BY: Chris Caldwell
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G. Maintenance and Labor Savings from State Electric Supply Co.

The maintenance and labor savings calculate an approximate annual cost for maintaining the current lights in the Math Emporium. The bulbs have low lifetimes and need to be replaced every 10,000 hours. Since the lights remain on 24/7, this is a little over one year. The new LEDs would have a much longer lifetime and wouldn't need replacement for over a decade.

Material & Labor Maint Savings

Item	Qty	Life	Unit Cost	Repl. Per 100000hr	Total Cost	# yrs @ 8760	Cost per yr
PHLMH250/U	311	10000	13.07	10	\$ 40,647.70	11.42	\$ 3,560.74
ADV71A5770001D	311	61320	42.93	1.63	\$ 21,773.04	11.42	\$ 1,907.32
					\$ 62,420.74	11.42	\$ 5,468.06
Maint. Labor Savings 2x2 Fixtures	Qty	Fixt/hr	Hour Rate/Crew	Re-lamp Cost	Per 100000	# yrs @ 8760	Cost per yr
	311	2	\$ 75.00	\$ 11,662.50	\$ 116,625.00	11.42	\$ 10,216.35

Lighting Burn hour schedule

Session	Weeks	days	Period of days	hours operation	Burn time
Current (All Sessions)	52	7	365	24	8760
Proposed Lighting Schedule after Upgrade	52	7	365	17	6205

H. Energy ROI from State Electric Supply Co.

An energy return on investment (ROI) was provided by State Electric Supply Co. as part of their proposal. This ROI is shown below.



Lighting Upgrade Worksheet

VT Math Emporium

Prepared for: Virginia Tech Student RFP Prepared by: Sara Purpura - Energy Solutions Group
 City: Blacksburg State: VA Phone #: 540-382-6415
 kWh rate: \$ 0.097

Area/Space:	Main Floor	Main Floor	Entry Main FL	Tutor Rm117	EXIT					
Description of existing fixture:	2x2 HID MH	3 Tube T8 EL	4L T8 Surf EL	4L T8 Surf Wrap	Inc. EXIT Sign					
Existing fixture wattage:	295	85	112	112	60					
Existing quantity:	311	30	2	15	14					
Description of new fixture:	2x4 LED	2x4 LED EL	LED Surf NL-EL	LED Surf Wrap	EXIT					
New fixture wattage:	53.32	53.32	32.4	32.4	2					
New quantity:	311	30	2	15	14					
Annual operating hours:	8,760	8,760	8,760	8,760	8,760					
No. fixtures with sensor/control:	311			15						
KW controlled by sensor/control:	16.58	-	-	0.49	-					
Sensor/Control reduction in on-hours:	30%	0%	0%	30%	0%					
Sensor/Control cost energy savings:	\$ 4,227.15	\$ -	\$ -	\$ 123.89	\$ -					
KW saved:	91.75	0.95	0.16	1.68	0.81	0.00	0.00	0.00	0.00	0.00
kWh saved:	702002.19	8325.50	1394.59	11736.65	7113.12	0.00	0.00	0.00	0.00	0.00
Annual savings:	\$ 68,094.21	\$ 807.57	\$ 135.28	\$ 1,138.45	\$ 689.97	\$ -	\$ -	\$ -	\$ -	\$ -

Total Annual KW saved	Total Annual kWh saved	Total Annual Energy Cost Savings	Annual Labor Cost Savings	Annual Material Cost Savings
95.35	730,572	\$ 70,865.49	\$ 10,216.00	\$ 5,470.00

Total Material Cost	Total Labor Cost	Utility Incentives	Other Incentives
\$ 115,561.00	\$ 65,590.00	\$ -	\$ -

Payback (years): **2.09** Payback (months): **25.12**

Equivalent tons CO₂ removed: 579
 Equivalent to CO₂ emissions from the electricity used by 73 homes for one year.
 Equivalent greenhouse gas emissions from 96 passenger cars per year.

www.stateelectric.com

I. Energy Costs – Existing vs. Proposed

I calculated how much the electricity the existing fixtures used in comparison to the ones I am proposing. This was explained previously in section III.D. These energy costs are shown below:

Area/Space:	Existing Lighting					Proposed Lighting				
	Main Floor	Main Floor	Entry Main Floor	Tutor Rm 117	EXIT	Main Floor	Main Floor	Entry Main Floor	Tutor Rm 117	EXIT
Fixture Description:	2x2 HID MH	3 Tube T8 EL	4L T8 Surf EL	4L T8 Surf Wrap	Inc. EXIT Sign	2x4 LED	2x4 LED EL	LED Surf NL-EL	LED Surf Wrap	EXIT
Fixture wattage, kW	0.295	0.085	0.112	0.112	0.06	0.05332	0.05332	0.0324	0.0324	0.002
Fixture Quantity	311	30	2	15	14	311	30	2	15	14
Operating Hours, Hr	8760	8760	8760	8760	8760	5124	5124	5124	5124	5124
Occ Control % reduction	0%	0%	0%	0%	0%	20%	20%	0%	20%	0%
Controlled Hours, Hr	8760	8760	8760	8760	8760	4099.2	5124	5124	4099.2	5124
Load, kW	91.745	2.55	0.224	1.68	0.84	16.58252	1.5996	0.0648	0.486	0.028
Energy, kWh	803,686	22,338	1,962	14,717	7,358	67,975	8,196	332	1,992	143
Energy Cost, \$	77,957.56	2,166.79	190.34	1,427.53	713.76	6,593.58	795.05	32.21	193.24	13.92

From the above, I created a table summarizing energy used by both options and the savings by replacing each type of fixture:

Existing Lighting			Proposed Lighting			Savings	
Fixture Description	Energy, kWh	Energy Cost, \$	Fixture Description	Energy, kWh	Energy Cost, \$	Energy, kWh	Energy Cost, \$
2x2 HID MH	803,686.20	\$ 77,957.56	2x4 LED	67,975.07	\$ 6,593.58	735,711.13	\$ 71,363.98
3 Tube T8 EL	22,338.00	\$ 2,166.79	2x4 LED EL	8,196.35	\$ 795.05	14,141.65	\$ 1,371.74
4L T8 Surf EL	1,962.24	\$ 190.34	LED Surf NL-EL	332.04	\$ 32.21	1,630.20	\$ 158.13
4L T8 Surf Wrap	14,716.80	\$ 1,427.53	LED Surf Wrap	1,992.21	\$ 193.24	12,724.59	\$ 1,234.29
Inc. EXIT Sign	7,358.40	\$ 713.76	EXIT	143.47	\$ 13.92	7,214.93	\$ 699.85
Total	850,061.64	\$ 82,455.98	Total	78,639.13	\$ 7,628.00		
Total Annual Energy Cost Savings:						771,422.51 kWh	\$ 74,827.98

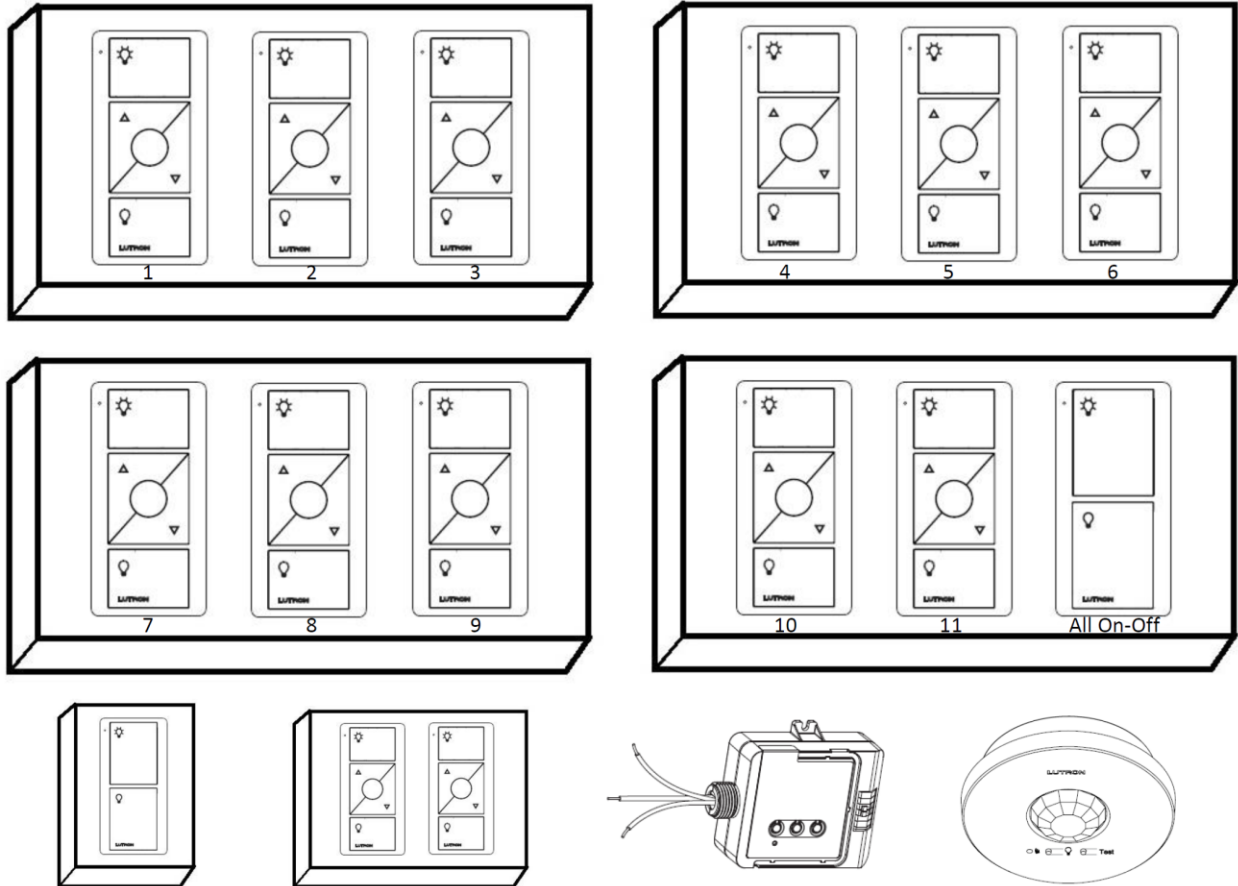
J. Summary of Savings, Project Cost, and Simple Payback Period

Using the information above, I created a table comparing the annual savings and the proposed cost. The proposed cost was divided by the annual savings to find the simple payback period, 2.15 years. In addition to this, I found the corresponding environmental savings annually.

Annual Savings	Cost (\$)	Proposed Project Cost	Cost (\$)	Environmental Savings	
Energy Cost Savings	\$ 74,827.98	Total Material Cost*	\$ 115,560.55	Equivalent tons CO2 removed:	611
Labor Cost Savings	\$ 10,216.35	Total Labor Cost**	\$ 65,590.00	Equivalent to CO2 emissions from the electricity used by	77 homes for one year
Material Cost Savings	\$ 5,468.06	Overhead for Gilbane TPM***	\$ 13,118.00	Equivalent greenhouse gas emissions from	102 passenger cars per year
Total Annual Savings:	\$ 90,512.39	Total Project Cost:	\$ 194,268.55		
		*Material cost quoted by State Electric			
		**Labor cost from State Electric estimate			
		***Add 20% of labor cost to overall project cost to account for Gilbane's project management services			
Simple Payback Period					
Total Project Cost	\$ 194,268.55				
Total Annual Savings	\$ 90,512.39				
Payback (years)	2.15				
Payback (months)	25.76				

K. Cutsheets for Proposed Fixtures and Wall Box Controls

Below shows the configurations of the wall boxes used for controlling the lights. There is a master switch and individual switches for each zone. Switches for three zones are organized on the same panel.



Attached at the end are fixture cutsheets for proposed lighting.

FEATURES & SPECIFICATIONS

INTENDED USE — The 2GTL LED recessed troffer offers a wide range of lumen packages, color temperatures, and lens options to meet the lighting needs for a wide range of applications such as schools, offices, and hospitals. The light engine delivers long life and excellent color to ensure a sound quality, low-maintenance lighting installation. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — Housing formed from 22 gauge cold-rolled steel. Smooth hemmed sides and smooth inward formed end flanges for safe handling. Includes integral T-bar clips. Lighter-weight fixture allows for safe, easy installation.

OPTICS — Highly transmissive pattern #12 lens diffuses the light source without compromising output. Pattern # 19 and satin white lens options also available.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide extended service life. 80% LED lumen maintenance at 72,000 hours (L80/72,000).

elDoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional nLight® embedded controls make each luminaire addressable - allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices and the GTL luminaires using standard Cat-5 cabling. Unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. Lumen Management: Unique lumen management system (option N80) provides onboard intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

The step-level dimming option (SLD) allows the system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

Ballast disconnect is provided where required to comply with U.S. and Canadian codes.

INSTALLATION — LED boards include plug-in connectors for easy of upgradeability. Suitable for direct insulation contact. Suitable for damp location.

LISTINGS — CSA certified to meet U.S. and Canadian standards. IC rated. DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

Catalog Number
Notes
Type



GTL Series

2GTL

2' x 4'

LED Recessed Troffer

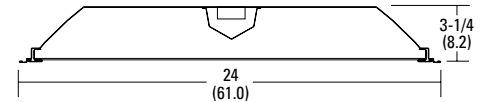


Specifications

Length: 48 (122.0)

Width: 24 (61.0)

Depth: 3-1/4 (8.2)



All dimensions are inches (centimeters) unless otherwise indicated.

A+ Capable Luminaire

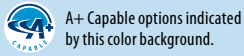
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a **shaded background***
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a **shaded background***

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

2GTL LED Troffer



ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2GTL 4 48L GZ10 LP835

2GTL Series	Trim type	Length	Lumens ¹	Door	Lens	Voltage
2GTL 2' wide recessed LED luminaire	(blank) Grid F Overlapping flange	4 4'	30L 3000 lumens 40L 4000 lumens 48L 4800 lumens 60L 6000 lumens 72L 7200 lumens 88L 8800 lumens 100L 10000 lumens 140L 14000 lumens ²	(blank) Flush steel, white FN Flush aluminum, natural FM Flush aluminum, matte black FW Flush aluminum, white RN Regressed aluminum, natural RM Regressed aluminum, matte black RW Regressed aluminum, white	(blank) #12 pattern acrylic, 0.110" thick A12125 #12 pattern acrylic, frosted, .125" thick A19 #19 pattern acrylic, 0.156" thick SWL Satin white	(blank) MVOLT (120-277V) 120 120V 277 277V 347 347V ³

Driver	Color temperature	Controls ⁶	Options
EZ1 eldoLED dims to 1%	LP830 3000 K	(blank) No controls	EL7L 700 lumen emergency battery (non-CEC compliant) ^{5,7,8}
GZ10 Dims to 10% (0-10V dimming)	LP835 3500 K	N80 nLight with 80% (L80) lumen management	EL14L 1400 lumen emergency battery (non-CEC compliant) ^{5,7,8}
GZ1 Dims to 1% (0-10V dimming)	LP840 4000 K	N80EMG nLight with 80% (L80) lumen management for use with generator supply emergency power	E10WLCP EM Self-Diagnostic battery pack, 10W Constant Power, CEC compliant ^{5,7,8}
SLD Step-level dimming ^{4,5}	LP850 5000 K	N100 nLight without lumen management	BGTD Bodine Generator Transfer Device ^{9,10,11}
EXA1 eldoLED dims to 1%, XPoint wireless enabled		N100EMG nLight without lumen management for use with generator supply emergency power	CP Chicago plenum
			PWS1836 6' pre-wire, 3/8" diameter, 18-gauge, 1-circuit
			PWS1846 6' pre-wire, 3/8" diameter, 18-gauge, 2-circuit
			ABC Door frame gasketing ¹²
			GLR Fast-blowing fuse ¹³
			GMF Slow-blowing fuse ¹³
			LATC Earthquake clip
			NPLT Narrow pallet
			PAF Paint after fab

Accessories: Order as separate catalog number.

DGA24 Drywall grid adapter for 2x4 recessed fixture.
2X4SMK Surface Mount Troffer Kit.

Notes

- 1 Approximate lumen output. Lumen output will vary depending upon lens option chosen.
- 2 Not available with GZ10.
- 3 Not available with SLD, EL7L, EL14L, E10WLCP or BGTD.
- 4 Not available with 100L and 140L.
- 5 When using pre-wire option, use PWS1846.
- 6 Not available with SLD, GZ1, GZ10 or EXA1.
- 7 Not available with SLD or GZ1 or GZ10 or EXA1 when combined with any of the following lumen packages: 72L, 88L, 100L or 140L.
- 8 Not available with EZ1 when combined with 100L or 140L lumen packages.

9 Not Available with SLD

10 Not Available with EXA1 or Controls options when ordered in combination with 100L or 140L lumen packages.

11 Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.

12 Only available with aluminum door.

13 Must specify voltage, 120 or 277.

14 For CEC (T20) compliant option, substitute EL14L option with E10WLCP "EM self-diagnostic battery pack 10W constant power, CEC compliant".

Stock/Non-configurable models are offered for shorter lead times:

ORDERING INFORMATION

Catalog Number	UPC	Description	Lumens	Color Temperature	Voltage	Wattage	Pallet qty.	Standard carton qty.
2GTL4 4400LM LP835	889804706598	2x4 LED lay-in troffer	4391	3500K	120-277	34.10	28	1
2GTL4 4400LM LP840	889804706956	2x4 LED lay-in troffer	4567	4000K	120-277	34.10	28	1
2GTL4 4400LM 347 LP835	889804710243	2x4 LED lay-in troffer, 347v	4391	3500K	347	38.11	28	1
2GTL2 4400LM 347 LP840	889804710359	2x4 LED lay-in troffer, 347v	4567	4000K	347	38.11	28	1
2GTL2 4400LM EL14L LP835 ¹⁴	889804710045	2x4 LED lay-in troffer, emergency battery	4391	3500K	120-277	34.10	28	1
2GTL2 4400LM EL14L LP840 ¹⁴	889804710205	2x4 LED lay-in troffer, emergency battery	4567	4000K	120-277	34.10	28	1
2GTL4 5000LM LP835	889804710366	2x4 LED lay-in troffer	4867	3500K	120-277	38.79	28	1
2GTL4 5000LM LP840	889804710458	2x4 LED lay-in troffer	5062	4000K	120-277	38.79	28	1
2GTL4 5000LM 347 LP835	889804710489	2x4 LED lay-in troffer, 347v	4867	3500K	347	42.78	28	1
2GTL2 5000LM 347 LP840	889804710595	2x4 LED lay-in troffer, 347v	5062	4000K	347	42.78	28	1
2GTL2 5000LM EL14L LP835 ¹⁴	889804710625	2x4 LED lay-in troffer, emergency battery	4867	3500K	120-277	38.79	28	1
2GTL2 5000LM EL14L LP840 ¹⁴	889804710700	2x4 LED lay-in troffer, emergency battery	5062	4000K	120-277	38.79	28	1

Performance Data			
Lumen Package	Lumens	Input Watts	LPW
30L LP830	2923.34	23.3	125
30L LP835	2983	23.3	128
30L LP840	3102.32	23.3	133
30L LP850	3161.98	23.3	136
40L LP830	3843.56	29.83	129
40L LP835	3922	29.83	131
40L LP840	4078.88	29.83	137
40L LP850	4157.32	29.83	139
48L LP830	4681.46	35.79	131
48L LP835	4777	35.79	133
48L LP840	4968.08	35.79	139
48L LP850	5063.62	35.79	141
60L LP830	6093.64	48.82	125
60L LP835	6218	48.82	127
60L LP840	6466.72	48.82	132
60L LP850	6591.08	48.82	135
72L LP830	7203.98	53.32	135
72L LP835	7351	53.32	138
72L LP840	7645.04	53.32	143
72L LP850	7792.06	53.32	146
88L LP830	8563.24	65	132
88L LP835	8738	65	134
88L LP840	9087.52	65	140
88L LP850	9262.28	65	143
100L LP830	10449.74	82.75	126
100L LP835	10663	82.75	129
100L LP840	11089.52	82.75	134
100L LP850	11302.78	82.75	137
140L LP830	13306.44	110.25	121
140L LP835	13578	110.25	123
140L LP840	14121.12	110.25	128
140L LP850	14392.68	110.25	131

Note: Performance based on standard #12 pattern acrylic lens.

How to Estimate Delivered Lumens in Emergency Mode

Use the formula below to estimate the delivered lumens in emergency mode

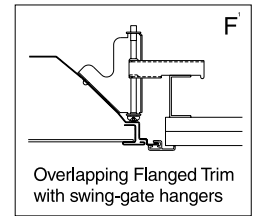
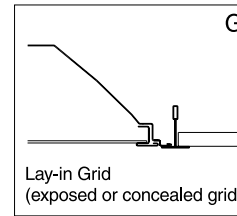
$$\text{Delivered Lumens} = 1.25 \times P \times \text{LPW}$$

P = Output power of emergency driver. P = 10W for E10WLCP option.

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

MOUNTING DATA

Continuous row mounting of flanged units requires CRE and CRM trim options (see Options).

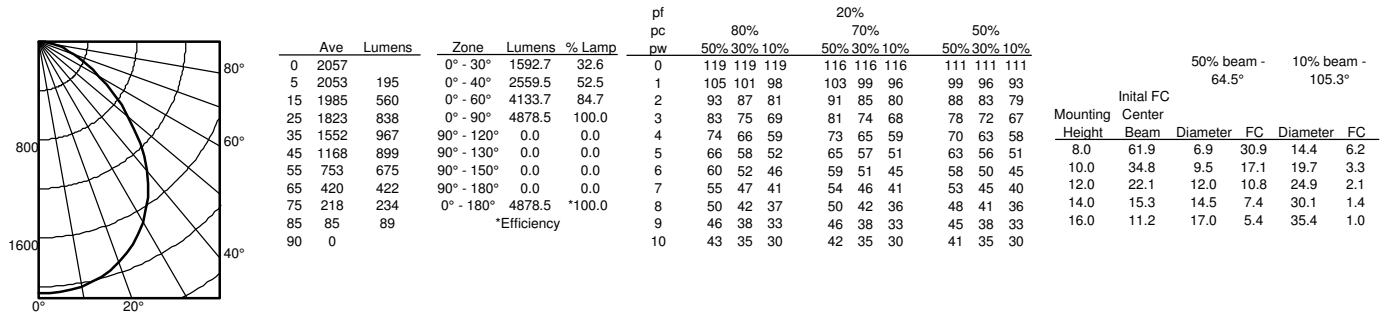


NOTE:

- 1 Recommended rough-in dimensions for F-trim fixtures 24"x48" (Tolerance is +1/4"-0"). Swing-gate range 1-3/16" to 3-15/16". Swing-gate span 23-3/8" to 26-11/16". Fixture swing-gate points require additional 1-1/16" over nominal fixture height.

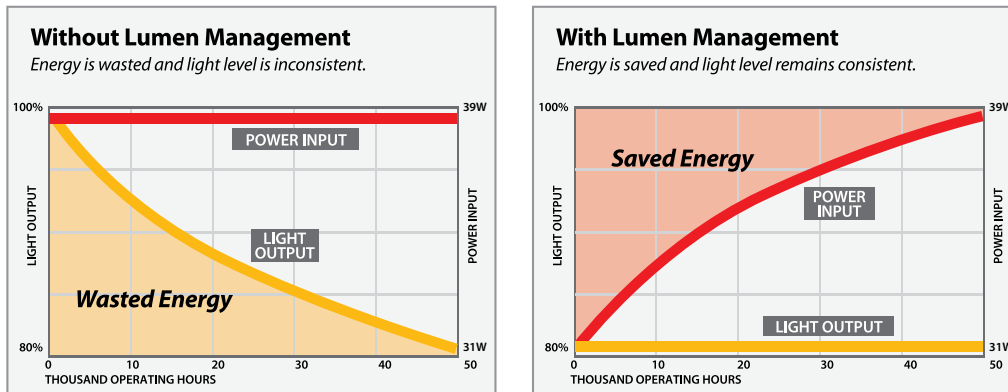
PHOTOMETRICS

2GTL 4 48L LP835, 4878 delivered lumens, test no. ISF 36875P10, tested in accordance to IESNA LM-79.



Constant Lumen Management

Enabled by the embedded nLight control, the GTL actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.



FEATURES & SPECIFICATIONS

INTENDED USE — LBL LED wraparound provides a digital lighting platform to deliver general ambient lighting for surface-mount applications. The LED system delivers long life and excellent color to ensure a quality, low-maintenance lighting installation. Ideal for closets, storage rooms, hallways, stairwells and offices.

CONSTRUCTION — Metal parts are die formed from code-gauge steel. Prismatic diffuser is 100% acrylic with sonically welded luminous ends. Continuous side flanges on fixture body provide light trap and continuous diffuser support to prevent accidental opening and simplify maintenance.

Finish: Five-stage iron phosphate pretreatment assures superior paint adhesion and rust resistance.

Painted parts finished with high-gloss, high-reflectivity baked white polyester enamel (low VOC).

OPTICS — Curved prismatic diffuser with linear side prisms and highly transmissive overlay minimizes lamp image and provides high-angle brightness control. Luminous end plates soften appearance for improved aesthetics.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 90% LED lumen maintenance at 50,000 hours (L90/50,000). The LEDs have a CRI of 82.

eldoLED driver options deliver choice of dimming range and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

CONTROLS — Pair the LBL with the fixture mount Sensor Switch LSXR sensor for additional energy savings when the space is unoccupied. The LSXRHL sensor dims the fixture down to a low-level setting when there is no occupancy. This option is ideal for stairwells, back rooms, and closets due to the low occupancy level in those spaces.

Optional nLight® embedded controls continuously monitor system performance, allow for constant lumen management / compensation function, facilitate simple “plug-and-play” network and controls upgrading via Cat-5 cable. Ballast disconnect provided where required to comply with US and Canadian codes.

LISTINGS — CSA certified to meet U.S. and Canadian standards. Damp listed.

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at

www.acuitybrands.com/CustomerResources/Terms_and_conditions

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

Catalog Number
Notes
Type

Low-Profile Curved-Basket LED Wraparound

LBL4



4' LENGTH, NARROW HOUSING
LED



eldoLED®



Stock version through Contractor Select Offering
LBL4 LP835
LBL4 LP840

CSA+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a **shaded background***
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a **shaded background***

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

LBL4 LED Wraparound



A+ Capable options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: LBL4 4000LM 80CRI 35K MIN1 NLIGHT MVOLT LSXRHL PIR

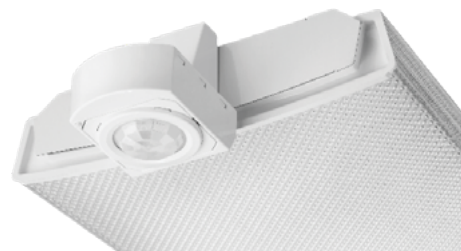
LBL4		Lumens ¹		CRI		Color temperature		Minimum Dimming Level		Control		Voltage	
LBL4	4' LED wrap	3000LM	3000 lumens	80CRI	80 CRI	30K	3000 K	MIN1	Dims to 1% ²	ZT	0-10V Dimming	MVOLT	120-277V
		4000LM	4000 lumens			35K	3500 K	NODIM	On/off, non-dimming ³	NLIGHT	nLight enabled		
		4800LM	4800 lumens			40K	4000 K	SLD	Step-level dimming ³				
		6000LM	6000 lumens			50K	5000 K						
		7200LM	7200 lumens										

Emergency Options		Lumen Management		Occupancy Control		Occupancy Sensor Technology		Options	
EL7L	700 nominal lumen battery pack (non-CEC compliant) ⁵	(blank)	None	LSXRHL	Sensor Switch [®] fixture mount sensor with High/Low occupancy operation ^{7,8}	PIR	Passive Infrared	USPOM	US Point of Manufacture
EL14L	1400 nominal lumen battery pack (non-CEC compliant) ⁵	CL80	Constant lumen output, 80%	LSXR10	Sensor Switch [®] fixture mount sensor with on/off occupancy operation ⁷				
E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, CEC compliant ⁵								
EMG	for use with nLight on generator supply EM power ⁶								

Notes

- 1 Approximate lumen output.
- 2 Requires ZT or NLIGHT
- 3 Not available with Control or Sensor Options.
- 4 Not available with SLD option.
- 5 Not available with 7200LM option.
- 6 nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture. Requires NLIGHT.
- 7 Requires MIN1 and PIR options.
- 8 Dims to approximately 10% light output when unoccupied.

Performance Data			
Lumen Package	Lumens	Input Watts	LPW
3000LM 80CRI 30K	3167	25.6	124
3000LM 80CRI 35K	3237	25.6	127
3000LM 80CRI 40K	3288	25.6	129
3000LM 80CRI 50K	3409	25.6	133
4000LM 80CRI 30K	4097	32.4	126
4000LM 80CRI 35K	4188	32.4	129
4000LM 80CRI 40K	4253	32.4	131
4000LM 80CRI 50K	4410	32.4	136
4800LM 80CRI 30K	4695	40.5	116
4800LM 80CRI 35K	4799	40.5	119
4800LM 80CRI 40K	4874	40.5	120
4800LM 80CRI 50K	5053	40.5	125
6000LM 80CRI 30K	5968	49.7	120
6000LM 80CRI 35K	6101	49.7	123
6000LM 80CRI 40K	6196	49.7	125
6000LM 80CRI 50K	6424	49.7	129
7200LM 80CRI 30K	7066	62.0	114
7200LM 80CRI 35K	7224	62.0	117
7200LM 80CRI 40K	7336	62.0	118
7200LM 80CRI 50K	7606	62.0	123



Sensor Switch LSXRHL Sensor

Lens type: 10 - Low Mount 360° coverage
Dimming: HL - High/Low Occupancy operation
Min Dim Level: 3V - approximately 10% light output when unoccupied
Time Delay: 5M - 5 minutes

How to Calculate Delivered Lumens in Emergency Mode

Use the formula below to determine the delivered lumens in emergency mode

$$\text{Delivered Lumens} = 1.25 \times P \times \text{LPW}$$

P = Output power of emergency driver. P = 10W for E10WLCP option.

LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

MOUNTING DATA

Suspension Kit Ceiling Types: F1 for use with most T-bar and screw slot grid ceiling applications. Designed for on-grid and off-grid installations.

F2 for use with recessed or surface-mount horizontal J-box applications.

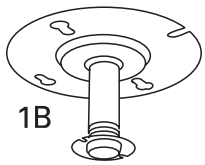
For unit or row installation; surface or suspend mounting.

Individual installation — One double-stem or two single-stem hangers required.

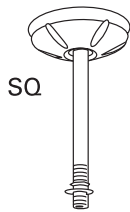
For aircraft cable, one STACG_, STACGF_, or STACGE_ required for each suspension point.

Note: 2' configurations with emergency option cannot be stem mounted.

See ACCESSORIES below for hanging devices.



1B



SQ

DIMENSIONS

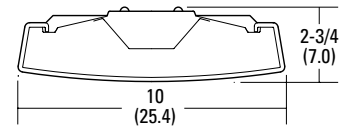
All dimensions are inches (centimeters) unless otherwise noted.

Specifications

Length: 48 (122.0)

Width: 10 (25.4)

Depth: 2-3/4 (7.0)



All dimensions are inches (centimeters) unless otherwise indicated.

FEATURES & SPECIFICATIONS

INTENDED USE

LED lighted exit signs for marking the means of egress in accordance with Life Safety Code NFPA 101.

CONSTRUCTION

Injection-molded, flame-retardant, high-impact, thermoplastic housing with snap-fit design components for easy installation. Universal J-box pattern and universal mounting capabilities: top, back or end mounting (canopy included). Universal chevrons are easily removed for directional indication. Fully assembled single face with extra faceplate for easy field-conversion to double face.

Letters 6" high with 3/4" stroke, with 100 ft viewing distance rating, based on UL924 standards.

OPTICS

The typical life of the LED lamp is 10 years.

ELECTRICAL

Dual-voltage input 120V or 277V AC. Emergency exits provided with test switch, status indicator and rechargeable battery.

Battery: (EL models) maintenance-free ni-cad battery provides 90 minutes of emergency power.

LISTINGS

UL Listed. Meets UL 924, NFPA 101, NFPA 70-NEC and OSHA illumination standards. Indoor damp location 50° to 104°F (10°C to 40°C) listed standard.

WARRANTY

Fixtures are covered by Lithonia Lighting 24-month warranty against mechanical defects in manufacture.

Complete warranty terms located at :

www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.

Note: Specifications subject to change without notice.

Actual performance may differ as a result of end-user environment and application.

Catalog Number
Notes
Type

Contractor Select

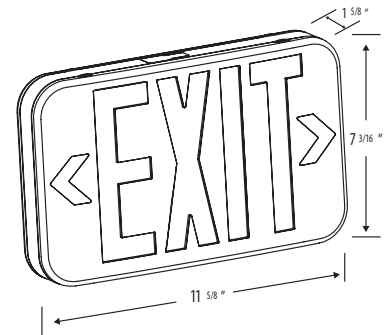
LED Exits



EXR LED

Height with canopy: 7-7/8"

All dimensions are inches (centimeters).



ORDERING INFORMATION

Catalog Number	UPC	Description	Supply Voltage	Input Wattage	Pallet Qty.	Standard Carton Qty.
EXR LED M6	784231874684	Red exit	120/277	2	360	6
EXG LED M6	784231874806	Green exit	120/277	2	360	6
EXR LED EL M6	784231874738	Red exit with backup battery	120/277	2	360	6
EXG LED EL M6	784231874851	Green exit with backup battery	120/277	2	360	6

Accessories¹: Order as separate catalog number.

ELA WG1	Wireguard (back mount only)
ELA WGEXT	Wireguard (top mount only)
ELA WGEXE	Wireguard (end mount only)

Notes

1 See spec sheet [ELA-WG](#).