Groom Energy Solutions, Inc.

Design, Engineering and Installation of Renewable and Energy Efficiency Technologies

Lighting/Controls and Motor/Drives Solutions:
Application Specific

Presentation by
Bob Kirby
Co-Founder, Executive Vice President
Groom Energy

Groom Energy - What We Do

Solutions
Energy Efficiency Upgrades
- Cogeneration
- Control Systems
- Data Center and UPS
- Demand Charge Reduction
- Demand Response
- HVAC
- LED and HIF Lighting
- Motors and Compressors
- Variable Frequency Drives

Resource Efficiency Upgrades
- Domestic and Process Water
- Waste

Renewable Energy Systems
- Architectural Wind
- Daylight Harvesting
- Solar Photovoltaic
- Solar Thermal

Investment
- Installed System Cost
- Rebates
- Grants
- Tax Incentives
Savings
- kWh, BTU
- Operating
- Maintenance
Return
- Payback
- Lifecycle
- Environmental
Managing Utility Incentives Across the Country

Our Approach and Our Customers

• Turnkey installer of energy efficiency and renewable energy projects
• Analysis, consulting, engineering and multi-region implementation of both renewable and energy-efficiency technologies across the US
• Affiliate of Groom Construction, a full-service commercial construction company
Lighting Choices...?? Which fits your application...

Lumen Loss vs Time...@ 25C

Lumen Maintenance Curves For Various Commercial Light Types

- Metal Halide
- High Power LED
- Fluorescent
- High Pressure Sodium (HPS)
- Internal Inductor Lamps
- External Inductor Lamps

% Rated Lumen Output vs Burning Hours
LED Extremely Long Life in Freezers...100,000 hours of "on" time

At an ambient temperature of -4°F (-20°C):
- $T_j = 45°C$
- $T_{air} = 20°C$
Predicted $L_{70}$ Lifetime > 95,000 hrs

Data courtesy of Cree

Ambient Temp Spaces (77°F) 50,000 Hours

At an ambient temperature of 77°F (25°C):
- $T_j = 90°C$
- $T_{air} = 65°C$
Predicted $L_{70}$ Lifetime > 50,000 hrs

Data courtesy of Cree
Long Life Fluorescent.. Rated 60,000 hours!

73094 – F32T8SXLSPX35ECO
GE Ecolux® Long Life T8 - Office; Long Life
• Super long life
• Meets Federal Minimum Efficiency Standards

E Grade

GENERAL CHARACTERISTICS
Lamp type: Linear Fluorescent - Straight Linear
Bulb: T8
Base: Medium Bi-Pin (G13)
Rated Life: 55,000 hrs
Rated Life (instant start) @ 31,000.0 h @ 3.0 h
45,000.0 h @ 12.0 h
Rated Life (rapid start) @ 55,000.0 h @ 3.0 h
45,000.0 h @ 12.0 h

LED vs Fluorescent in Cold Storage

![Graph showing light output vs. ambient temperature for fluorescent vs. LED lights.](image)

Courtesy of Beta Lighting
LED Performance in Cold Temps

<table>
<thead>
<tr>
<th>Ambient Temperature</th>
<th>Brightness Multiplier @ Cold Startup</th>
<th>Brightness Multiplier @ Stable Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>40°C (104°F)</td>
<td>1.15</td>
<td>0.96</td>
</tr>
<tr>
<td>25°C (77°F)</td>
<td>1.20</td>
<td>1.00</td>
</tr>
<tr>
<td>0°C (32°F)</td>
<td>1.27</td>
<td>1.07</td>
</tr>
<tr>
<td>-20°C (-4°F)</td>
<td>1.33</td>
<td>1.13</td>
</tr>
<tr>
<td>-40°C (-40°F)</td>
<td>1.39</td>
<td>1.19</td>
</tr>
</tbody>
</table>

Control the Light Source for Savings

Intelligent, Efficient, Complete

Smart Light Grid

LightRules™ Energy Management

Intelligent Light Engines
Digital Lumens
Intelligent Light Engine, High Bay 3 Bar

ILE-HB3

High-Quality Light
- Aimable light bars
- Thermal design for long life
- UL Listed
- LM79, LM80 Test Reports available

On-board Computer
- Decision engine
- Built-in networking
- Built-in occupancy sensor
- Open Sensor Bus
- Real-time kWh

Control the Light Source for Savings

ILE-HB-3

71% into aisle (0-30deg)
LM-79 Absolute Photometry

12 ft-cd

400W MH

18% into aisle (0-30deg)

8 ft-cd
Advantage #1
Light Where It’s Needed and How Much

- **Dry Storage**
  - Racked Aisles
  - Active: 100%
  - Inactive: 0%
  - Timeout: 1min

- **Cold Storage**
  - Racked Aisles
  - Active: 75%
  - Inactive: 0%
  - Timeout: 5min

- **Refrigerated Storage**
  - Cross Aisles
  - Active: 100%
  - Inactive: 10%
  - Timeout: 1min

Advantage #2
Light When It’s Needed

- **Shifts**
  - A Shift
  - B Shift
  - C Shift
Advantage #3
Managing the Lighting Service

Are the lights
- all operational?
- properly configured?

How much energy are we saving?
- facility-wide
- by room
- by zone

Can we increase savings by adjusting
- light levels?
- sensor behavior?
- schedules?

HID vs HIF vs LED Energy Consumption

Energy Usage Comparison
15 minute intervals over a typical 24-hour period

- HID: 11.2 kWh/day
- HIF: 6.7 kWh/day
- DL LED: 0.9 kWh/day
LED Freezer Projects So Far - 500 Million Cubic Feet

Percent Occupied (Lights are on)
DESIGN, ENGINEERING AND INSTALLATION OF RENEWABLE AND ENERGY EFFICIENCY TECHNOLOGIES

On Board Metering (Average kWh Usage)

Results - Daily Energy Costs (107 fixtures, $0.078/kWh)
Daily Cost Summary vs Technology 24/7 $.078

<table>
<thead>
<tr>
<th># Fixtures</th>
<th>Fixture Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>157</td>
<td>400 watt HPS</td>
<td>$137/day</td>
</tr>
<tr>
<td>157</td>
<td>350 watt metal halide</td>
<td>$121/day</td>
</tr>
<tr>
<td>157</td>
<td>221 watt 6-lamp T8 w/sensor</td>
<td>$54/day</td>
</tr>
<tr>
<td>107</td>
<td>160 watt LED</td>
<td>$5.34/day</td>
</tr>
</tbody>
</table>

Technology Comparison

**LED Technology**
- Net Cost: $604,035
- Project Return on Investment: 157%
- Utility Incentive: $500,000
- 10 Year Savings after Purchase: $8,888,886

**6L T5 HO Lighting Technology**
- Net Cost: $303,605
- Project Return on Investment: 119%
- Utility Incentive: $43,740
- 10 Year Savings after Purchase: $3,010,328
### Technology Comparison

#### LED Technology
- Net Cost: $432,297
- Project Return on Investment: 90%
- Utility Incentive: $110,066
- 10 Year Savings after Purchase: $3,287,458

#### 6L T5 HO Lighting Technology
- Net Cost: $199,381
- Project Return on Investment: 82%
- Utility Incentive: $46,733
- 10 Year Savings after Purchase: $1,268,097

### Technology comparison

#### LED Technology
- Net Cost: $1,106,758
- Project Return on Investment: 95%
- Utility Incentive: $299,927
- 10 Year Savings after Purchase: $8,288,785

#### 6L T5 HO Lighting Technology
- Net Cost: $422,195
- Project Return on Investment: 102%
- Utility Incentive: $107,824
- 10 Year Savings after Purchase: $3,210,547
Opportunity:

**LED Technology**
Net Cost: $706,750  
Project Return on Investment: 116%  
Utility Incentive: $100,000  
10 Year Savings after Purchase: $5,995,399

Technology Side by Side Aisles

4LT5 Demo: Avg. Foot-Candles  
234 Watts  6.19

400W HPS: Avg. Foot-Candles  
460 Watts  14.33

LED: Avg. Foot-Candles  
160 Watts  15.72

400w HPS Annual Cost ea: $402.96  
6LT Annual Cost ea: $310.10  
4LT Annual Cost ea: $204.98  
LED Annual Cost ea: $21.02
THANK YOU!

DESIGN, ENGINEERING AND INSTALLATION OF RENEWABLE AND ENERGY EFFICIENCY TECHNOLOGIES

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