Energy & Store
Development Conference

E+SC 2015

Lighting Retrofit or Renovation: which strategy makes sense?

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Learning Objectives:

1. Understand LED Retrofit Technologies and their benefits
2. Use a total system approach to evaluating lighting system retrofits
3. Understand lighting systems light output and life claims
4. Design lighting solutions with minimal intrusion into store operations

Retrofit or Renovate
What are the questions to ask

Lighting technology today, whether fluorescent or LED, meets or exceeds any technology installed 10 years ago.

- How old is your store?
- How old is your lighting system?
- What are the benefits of improved lighting?
- Should you retrofit or renovate
- Does Title 24 come into play?

Retrofit or Renovate

Grocery store and supermarket “green initiatives” and marketing are well ahead of the rest of other retail markets:

- Green grocery marketing
- Farm to table
- Organic foods
- Reusable bags
- Recycling programs

Retrofit or Renovate: Why Retrofit?

- Uses existing lighting systems – extends life
- Does not generally require disturbing ceilings and/or walls
- May not require a licensed electrician
- May not provide adequate illumination levels or light quality

Retrofit or Renovate: Why Renovate?

- Removal of old lighting which is added to a waste stream
- May be disruptive to store operations
- Requires an electrician and many times a construction permit
- May require a complete lighting redesign

Establish Lighting Goals

- Existing lighting level and/or quality is sufficient?
- Control your lighting?
- Maintenance costs (material and labor) are too high?
- Maintenance is interfering with operation?

Establish Lighting Goals

- SAVING ENERGY?
- Of course you're saving energy! It doesn't have to be a primary goal.
- You can save energy *and* improve the QUALITY of LIGHT.
- You can save energy *and* reduce overhead MAINTENANCE COSTS.

Establish Lighting Goals

- TAKE A HOLISTIC APPROACH TO RE-LIGHTING
- Cherry-picking one or two fixture types generally does not provide the best overall results.
- Evaluate all lighting and note where common sources may create better cost efficiencies.
- Simple solutions that meet lighting needs are generally the best choice
- Do you want to Control the Lighting

Retrofit or Renovate

Are LED lamps and LED fixtures the same?

- According to the most recent data, LED lamps are more energy-efficient than current LED luminaires.

Table 2.1 Average and Most Efficacious Products from LED Lighting Facts[11]

Application	LED Replacement Description	LED Efficacy (lm/W)	
		Average	Best
A-type	A-type replacement lamps	72	107
Decorative	B, BA, C, CA, F, and G replacement lamps	66	90
Directional			
Lamp	PAR, BR, and R lamps	63	111
Luminaire	Retrofit and recessed/surface-mounted downlight luminaires	63	124
Small Directional	MR16 lamps	58	95
Linear Fixtures			
Lamp	Linear tube replacements	108	148
Luminaire	Panels and recessed/surface-mounted troffer luminaires	93	139
Low/High Bay	High and low bay luminaires	97	141
Area/Roadway	Outdoor area/roadway/decorative luminaires	87	137
Parking Lot	Outdoor area/roadway luminaires	87	137
Parking Garage			
Lamp	Linear T8 tube replacements	108	158
Luminaire	Integrated parking garage luminaires	86	150
Building Exterior	Spot and flood lights, architectural, wall pack, bollard, and step/path luminaires	77	132

Source: US DOE EERE Report: Adoption of Light-Emitting Diodes in Common Lighting Applications, July 2015

Retrofit or Renovate

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LED Adoption Rate by Application

According to the U.S. Department of Energy

- Technologies are adopted into applications at different rates and times based on operational cost.
  - Refrigeration cases are at nearly 75% conversion
  - Linear lighting is only 3%
  - Directional lighting is at 5%

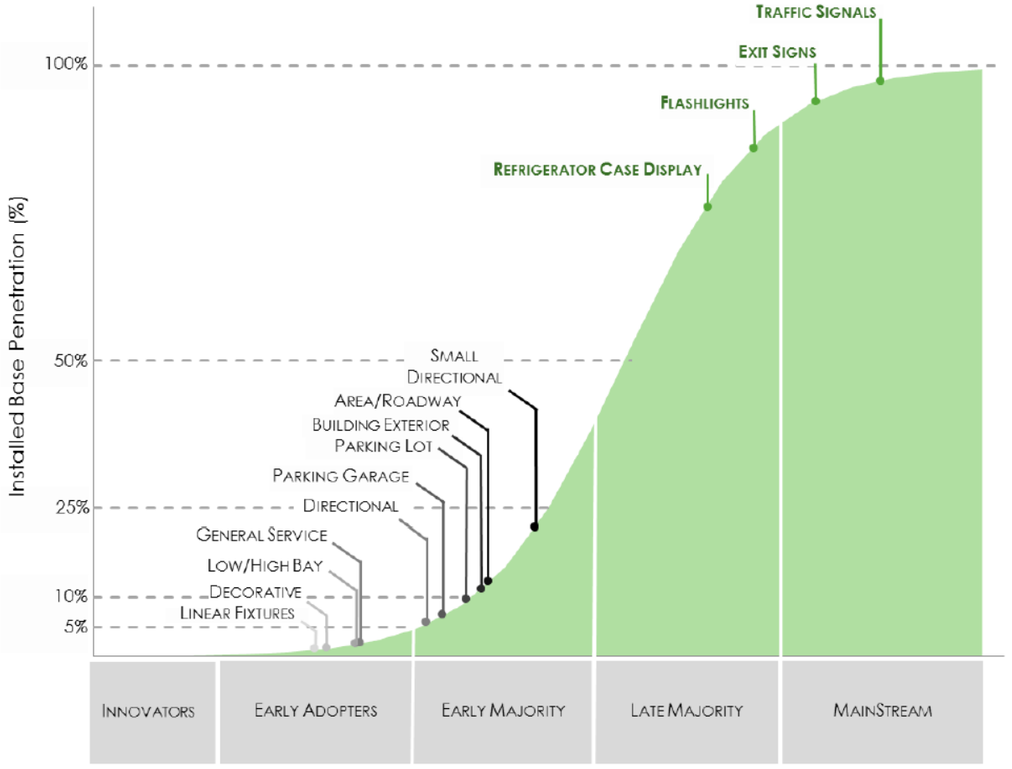


Figure 3.2 2014 Penetration Rates of LED Lighting Applications

Source: US DOE EERE Report: Adoption of Light-Emitting Diodes in Common Lighting Applications, July 2015

LED Adoption Rate by Application

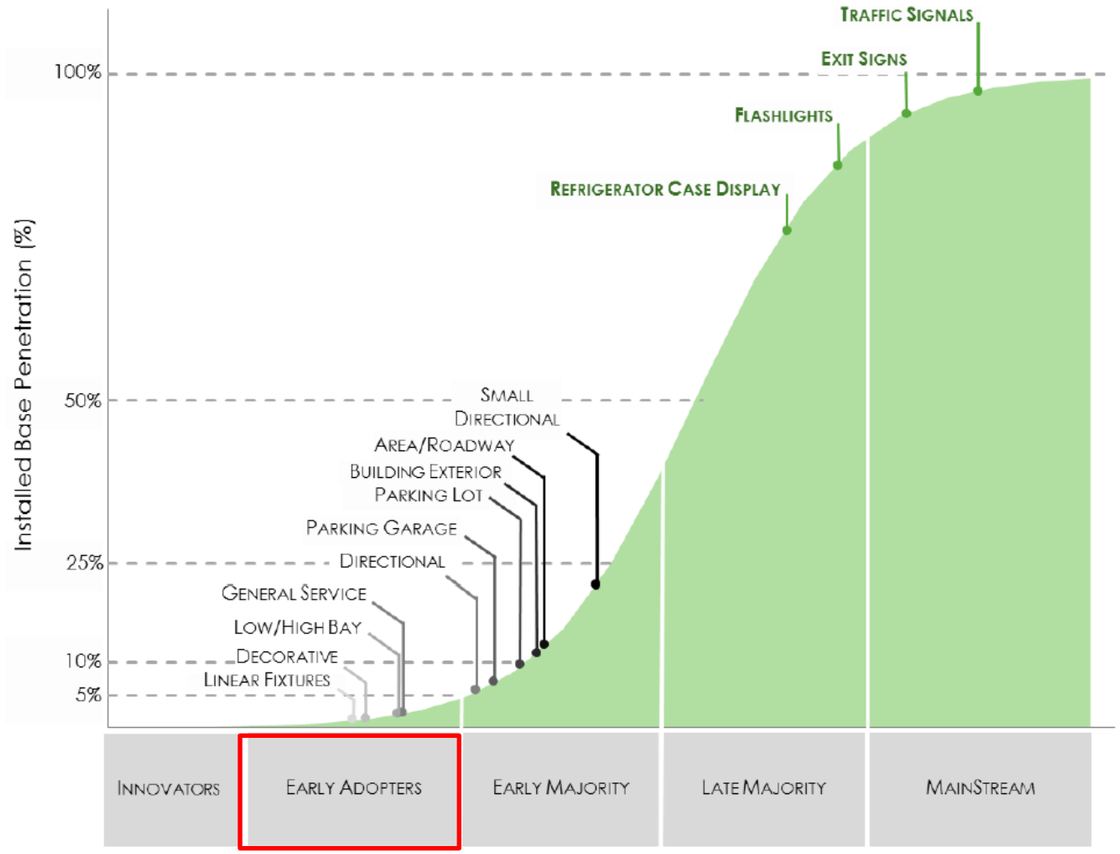


Figure 3.2 2014 Penetration Rates of LED Lighting Applications

This would suggest that MOST lighting applications are still in the EARLY ADOPTION PHASE

Product Selection Considerations

Product Design

- Component replacements or upgrades
  - Ease of replacement
  - Performance specifications

Warranty

- Read the fine print
  - Start date
  - Definition of failure
  - Labor costs

Available Rebates

- Custom or prescriptive

Retrofit or Renovate: Light Sources

What is the current (2015) state of Incandescent and Halogen lighting solutions:

- Most incandescent lamps can no longer be manufactured or purchased in the US unless they meet certain efficiency metrics, or are considered special purpose or decorative.
- Many modified spectrum halogen alternatives still exist for general purpose and directional lighting.
- Lamp life is generally around 500-2000 hours and doubles for every 10% the lamp is dimmed.

Retrofit or Renovate: Light Sources

What is the current (2015) state of Fluorescent lighting solutions:

- T12 lamps are no longer commercially available in the US.
- Magnetic ballasts are no longer commercially available in the US.
- T8 lamps on instant start ballasts have life expectancies of up to 75,000 hours life (50% failure).
- T8 lamps on programmed rapid start ballasts have life expectancies of up to 84,000 hours life (50% failure).

NOTE: At rated EOL, fluorescent T8 lamps retain 94% of initial lumen output.

Retrofit or Renovate: Light Sources

What is the current (2015) state of Fluorescent lighting solutions:

- T5 lamps on program rapid start ballasts have life expectancies of up to 60,000 hours life (50% failure)
- NOTE: At rated EOL, fluorescent T5 lamps retain 95% of initial lumen output.
- Compact fluorescent lamps have life expectancies of up to 20,000 hours (50% failure)

Retrofit or Renovate: Light Sources

What is the current (2015) state of Fluorescent lighting solutions:

- Dimming during periods of non-occupancy, or when enough daylight is present, can save considerable energy.
- All fluorescent lamps can dim when operated on a dimming ballast. Older fluorescent luminaires may not be equipped with dimming ballasts.
- “No new wires” controls, including daylight harvesting.

Retrofit or Renovate: Light Sources

What is the current (2015) state of Metal Halide lighting solutions:

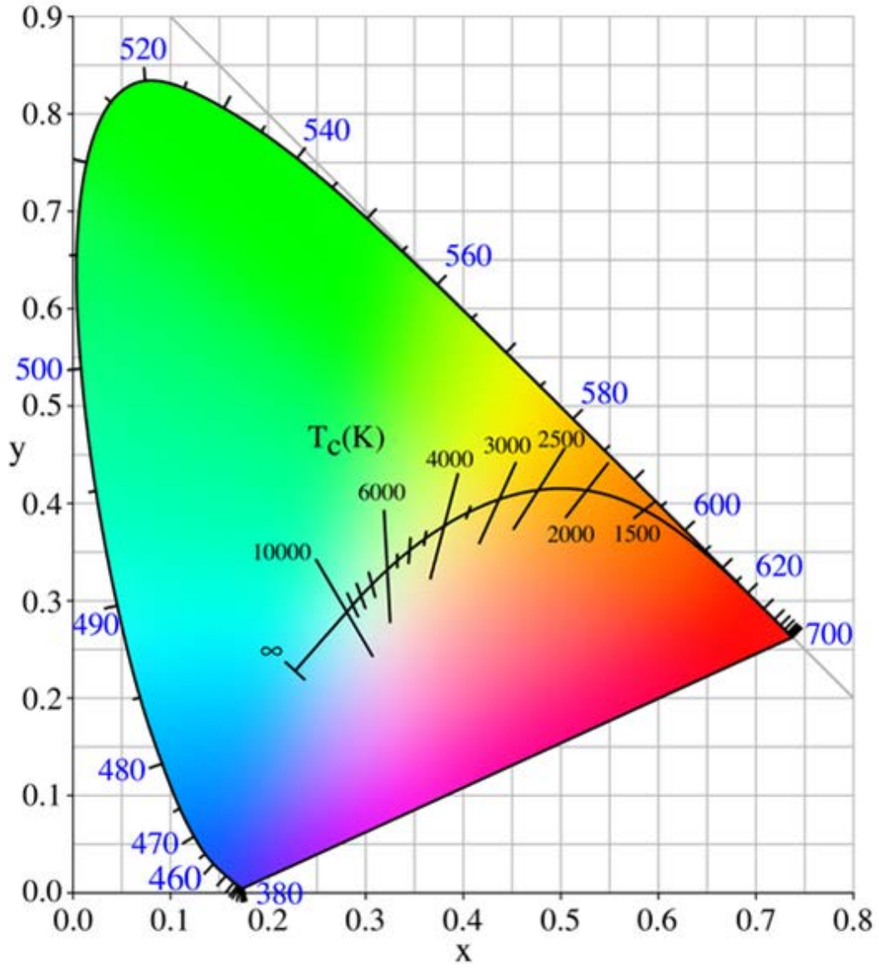
- Ceramic Metal Halide lamps are still available in many form factors and have excellent CRI (80+, 90+) while using low energy compared to incandescent.
- They do not generally dim well, and they have a warm-up period when energized.
- They generally have life ratings around 20,000 hours (mean rated life).

Retrofit or Renovate: Light Sources

- What is Color Temperature?
- What is CRI?

How we express color in white light

- White light is measured by its Correlated Color Temperature (CCT) and is expressed in Kelvin (temperature) with 2200K being a warm white, and 4000K being a cool white.



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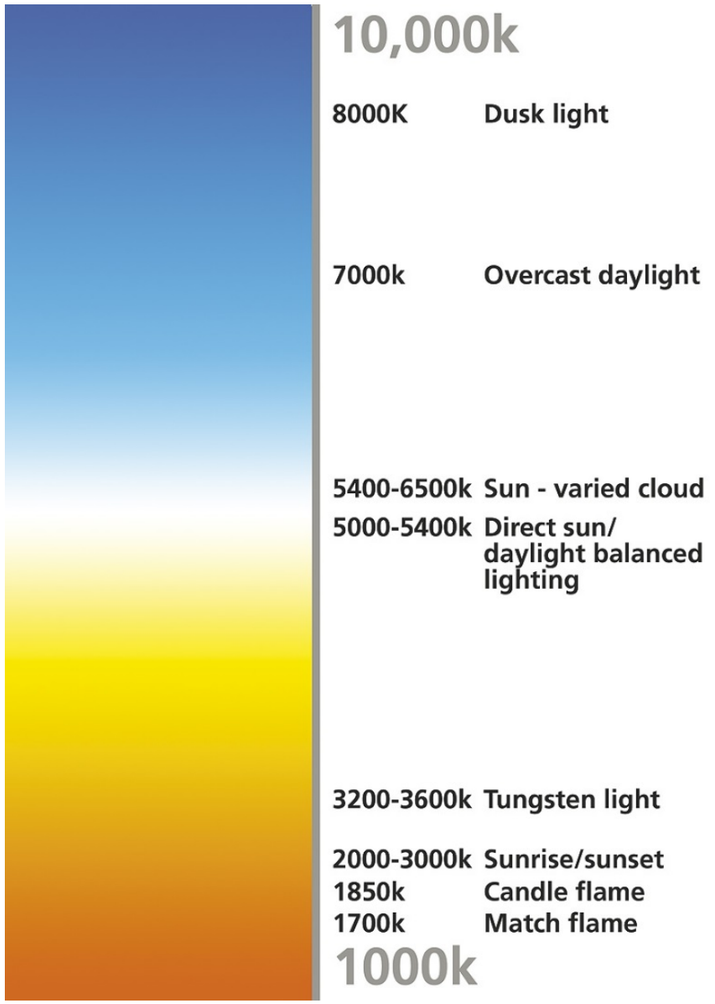
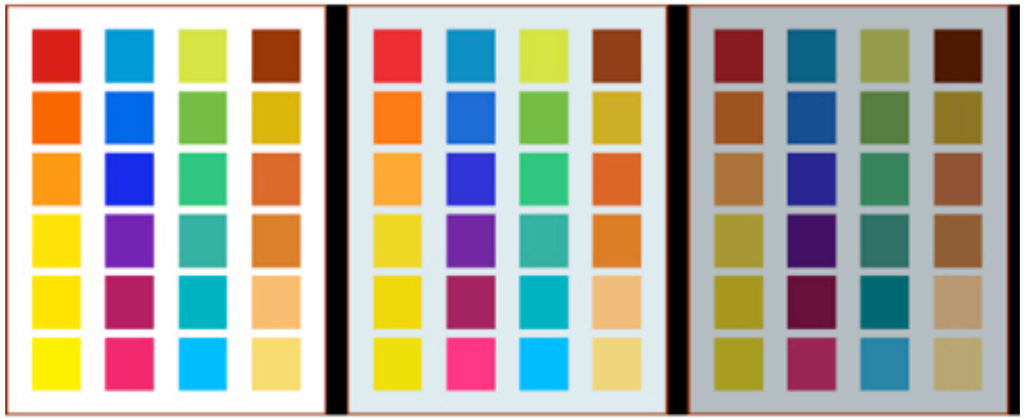


Color Rendering Index (CRI)

- CRI is a measurement of color accuracy as compared to a theoretical black body radiator of equal correlated color temperature. It is meant to be used as a scale for discontinuous spectrum sources only – HID, fluorescent, induction.

	Typical CRI
Metal Halide 400W	65
High Pressure Sodium	22
T12 60W	70
T8 32W	78
T5 54W	85
Induction Lamp 200W	85



Color Accuracy

- In recent years, CRI has been shown to lack enough detail to properly express color accuracy, especially when REDs are being evaluated.
- Many designers are requesting a high R9 value (over 20 or over 50) although this method may not yield the best in-situ results.

- The IES and CIE are currently evaluating other metrics, such as CQS (see www.colorqualityscale.com)

IES TM-30-15 issued in August 2015

CRI

Additional Reference Colors

	Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
XSM 80 Series	81	80	85	89	81	78	80	86	66	16	64	79	58	81	93	75
XSM Artist Series	98	98	99	98	98	98	97	98	98	96	99	98	88	98	98	98
Typical IR coated Halogen Dichroic	98	98	99	99	99	98	98	99	97	92	97	98	97	98	99	97
Typical Compact Metal Halide	82	90	94	69	82	81	81	87	71	27	59	62	55	93	78	88
Typical Compact Fluorescent	87	91	93	86	91	89	90	88	70	17	76	91	81	93	92	81

Independent measurements by University College, London

Color Accuracy

Lamp Life

- LED lamp life is measured on the “theoretical” time it takes for the lamp(s) to lose 30% of their initial lumen (light) output.
- So a lamp rated 50,000 hours (L_{70}) would still have more than ½ of its light output at 50,000 hours.
- All other lamps are rated on a mean life (when 50% of the lamps in a batch would have burned out).
- A fluorescent lamp rated for 75,000 hours might still have up to 94% of initial lumen output at end-of-life.

Because of the difference in the manner that life ratings are expressed, it’s hard to compare source life on a 1-for-1 basis.

Lamp Life

- LED lamps are typically rated 25,000 or 50,000 hours.
- LED luminaires are typically rated 50,000 – 100,000 hours.
- Care must be taken to ensure that the design light level doesn't fall below light levels required.
- Linear Extended Life fluorescent lamps are rated up to 75,000 hours (IS) or 84,000 hours (PRS) depending on the ballast type.
- Energy Saving fluorescent lamps provide nearly 85% light output of full energy lamps.

There are 8760 hours in a year.

12 hours/day operation = 4380 hours/year.

A lamp rated 50,000 hours should last 11.4 years @ 12 hours/day.

Retrofit or Renovate: Lamp Life

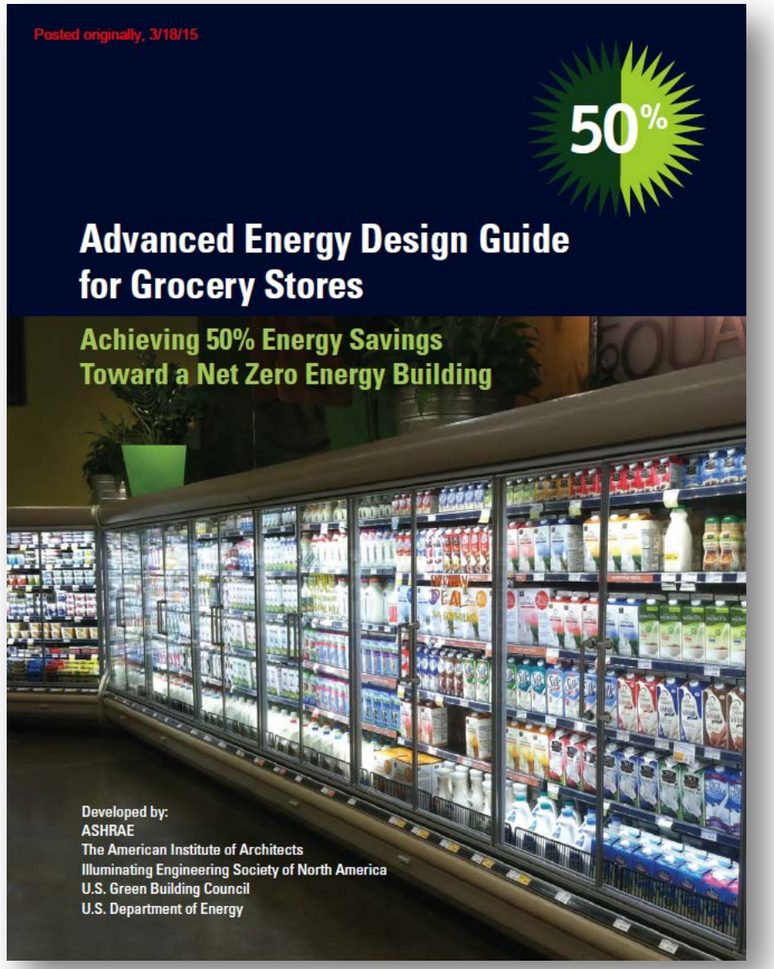
- What is the typical renovation cycle?
- Will there be new store construction in lieu of renovation?
- What is the initial cost to change?
- What is the return on investment?

Technology is rapidly changing. The longest lamp life may not be the most economical decision for your application today.

Tomorrow's lamps will have higher efficacy than today's.

Retrofit or Renovate ASHRAE design guide

- Advance Energy Design Guide for Grocery Stores
  - Free from ASHRAE and IES
  - Talks about all energy end uses, not just lighting
  - IES recommendations include light level recommendations



Retrofit or Renovate: LED PAR Lamps

Retrofit or Renovate: LED Downlight Kits

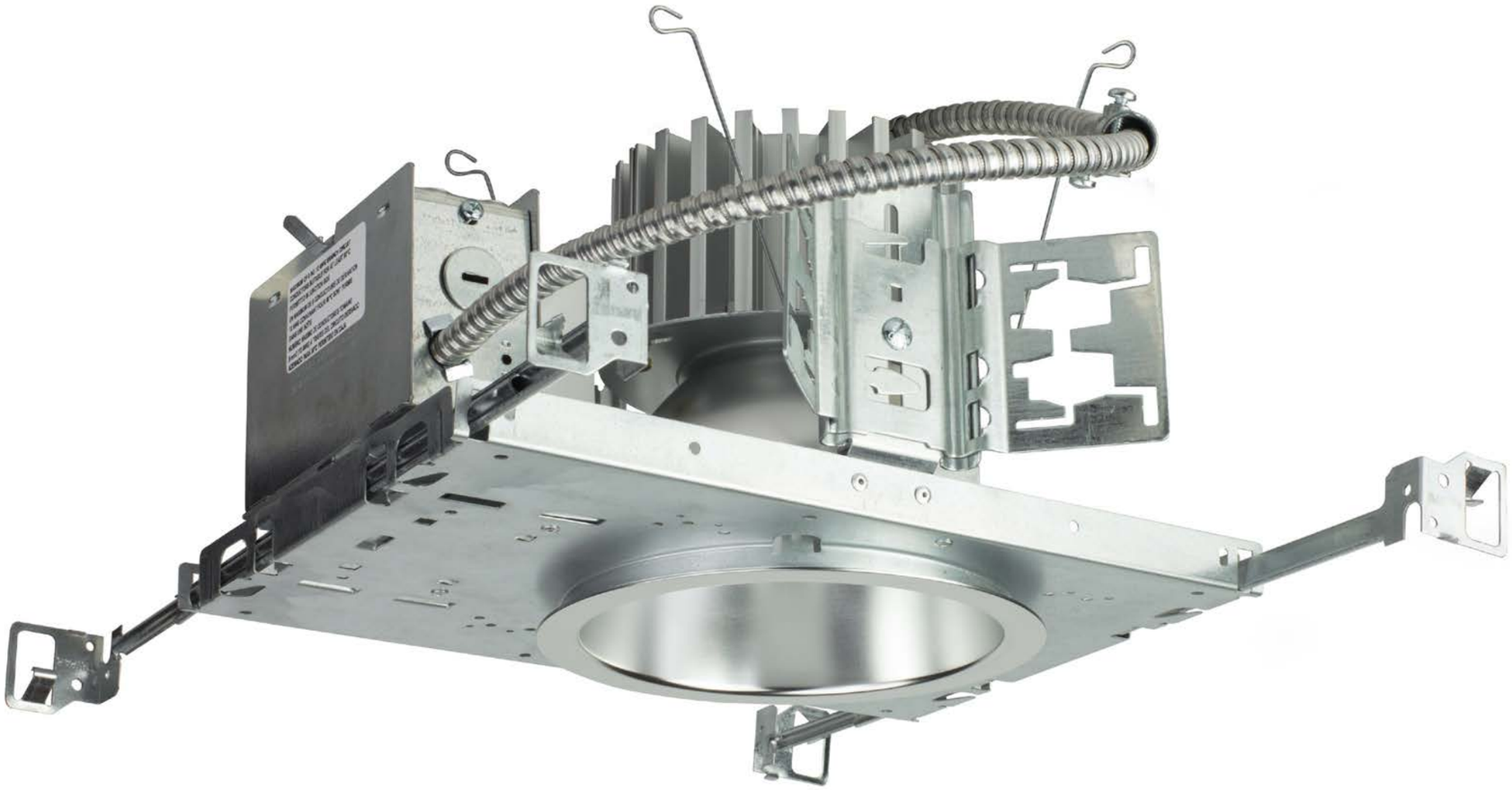
Retrofit or Renovate: LED Linear Lamps

Retrofit or Renovate:
Fluorescent Extended Life/Energy Saving Lamps

Retrofit or Renovate:
LED Continuous Tape Products

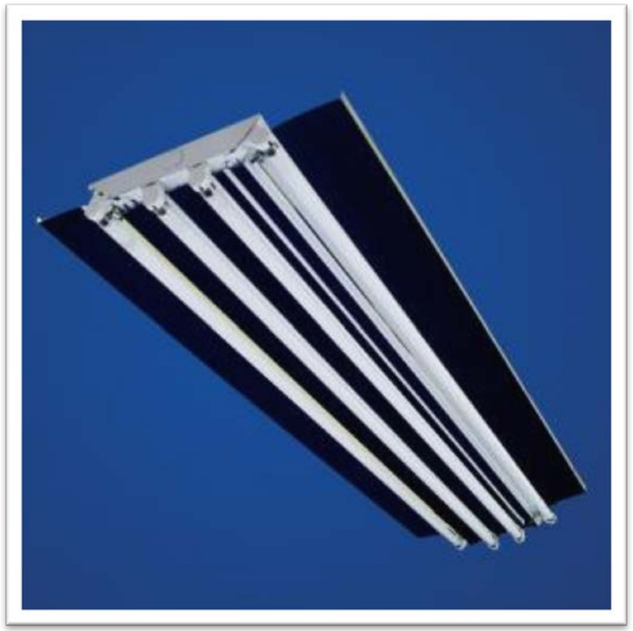
Retrofit or Renovate:
LED Lamp/Driver Systems

Retrofit or Renovate: LED Downlights



Retrofit or Renovate:
LED Troffers/Enclosed Strips/Wraparounds

Retrofit or Renovate:
Fluorescent or LED Industrial Luminaires



Many Thanks.

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