

Prove it!

Prove the Lighting savings
Before You Start

Presented by

Energy Optimization Inc.

Energy Conference and Exhibition
Hosted by DTE Energy and The Engineering Society of Detroit
May 4, 2010

Lighting retrofit should be easy

- Suburban police station
 - Operates 24/7
 - Most lighting is on all the time
- Retrofit old T-12 system with T-8 system
- Payback expected within one year

Our proposed retrofit solution

- Existing T-12 system - 40w lamps
 - Over 300 Four lamp 48” LF ceiling fixtures
 - Over 100 Two lamp 48” LF ceiling fixtures
- Proposed T-8 system – 32w (or 28w) lamps
 - Electronic ballast for 2 and 3 lamp application
 - De-lamp fixtures
 - Occupancy sensors as needed

The energy and illumination impact

Today: Focus on four lamp LF ceiling fixtures

- Recommended for most rooms
 - 69% energy savings per fixture with two 32w lamps and de-lamping two lamps
 - 35% mean lumen reduction
- For rooms needing more illumination
 - 59% energy savings per fixture with three 32w lamps and de-lamping one lamp
 - 3% mean lumen reduction

Cost objectives of our solution

- Minimize materials costs
 - De-lamping reduces the number of lamps
 - Use long life lamps to minimize life cycle costs
 - Ballasts must work with two and three lamp solutions
- Maintain only one lamp and one ballast for replacement inventory
- Meet the requirements for utility incentives

Illumination requirements: What are they?

- Saving energy is half of the solution
- Employees, visitors and other users must have the illumination they need
 - Too much is wasteful
 - Too little can be dangerous
- ASHRAE, IESNA / NAEG, OSHA and others provide guidelines but each facility and workspace need their own set of requirements

Two barriers to progress

- Project Manager does not trust savings and payback calculations from contractors and consultants

“The answers I get from the internet are confusing”

“We never see the kinds of savings you guys promise.”

- Limited funds for facility upgrades during lean economic times

Some answers off the internet

- Different benefits than we projected
 - Local Michigan utility – 62%
 - Out-of-State utility project calculator – 63%
- Lighting provider offers a 15% savings solution by converting from 40w lamps to 25w lamps
 - Change all four lamps - no de-lamping
- Simple 8 watt reduction (40w to 32w) is 20%

To prove the savings we measured the energy use of ceiling fixtures

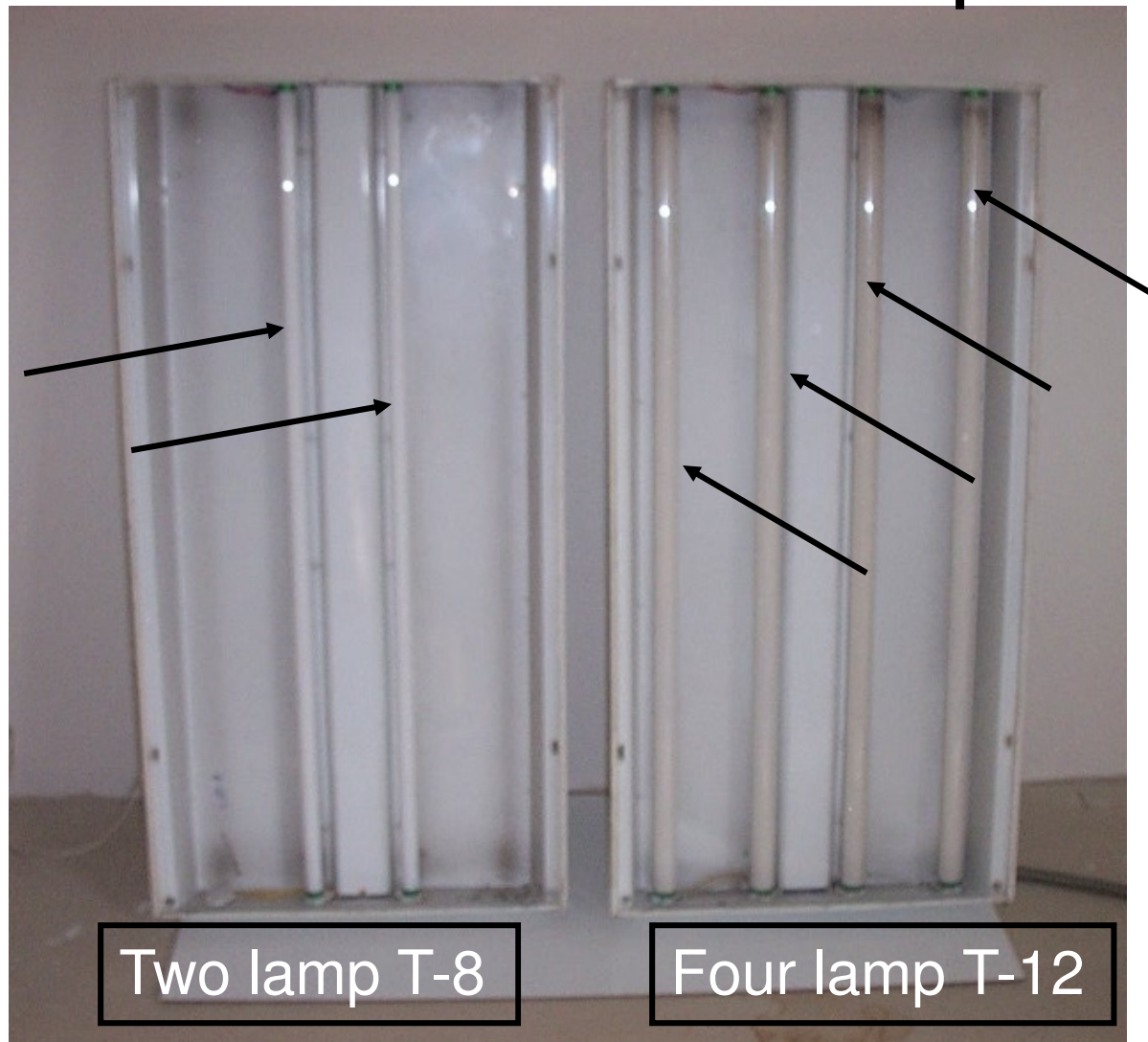
We configured two ceiling fixtures for plug-in and used Kill-a-watt meter for measurement

- One fixture configured with existing T-12 system
 - Four 40w lamps and 2 magnetic ballasts
- Second fixture configured with a T-8 system
 - Two and three 32w lamp configuration
 - One electronic ballast with 1.0 BF
- We also measured illumination

Next: Demonstration Fixtures

- Fixtures with lamps
- Fixtures with ballasts and lamps
- Top side with Plug-in retrofit
- Fixture with reflector kit
(option for rooms needing more light)

Fixtures with lamps



Fixtures with ballasts exposed



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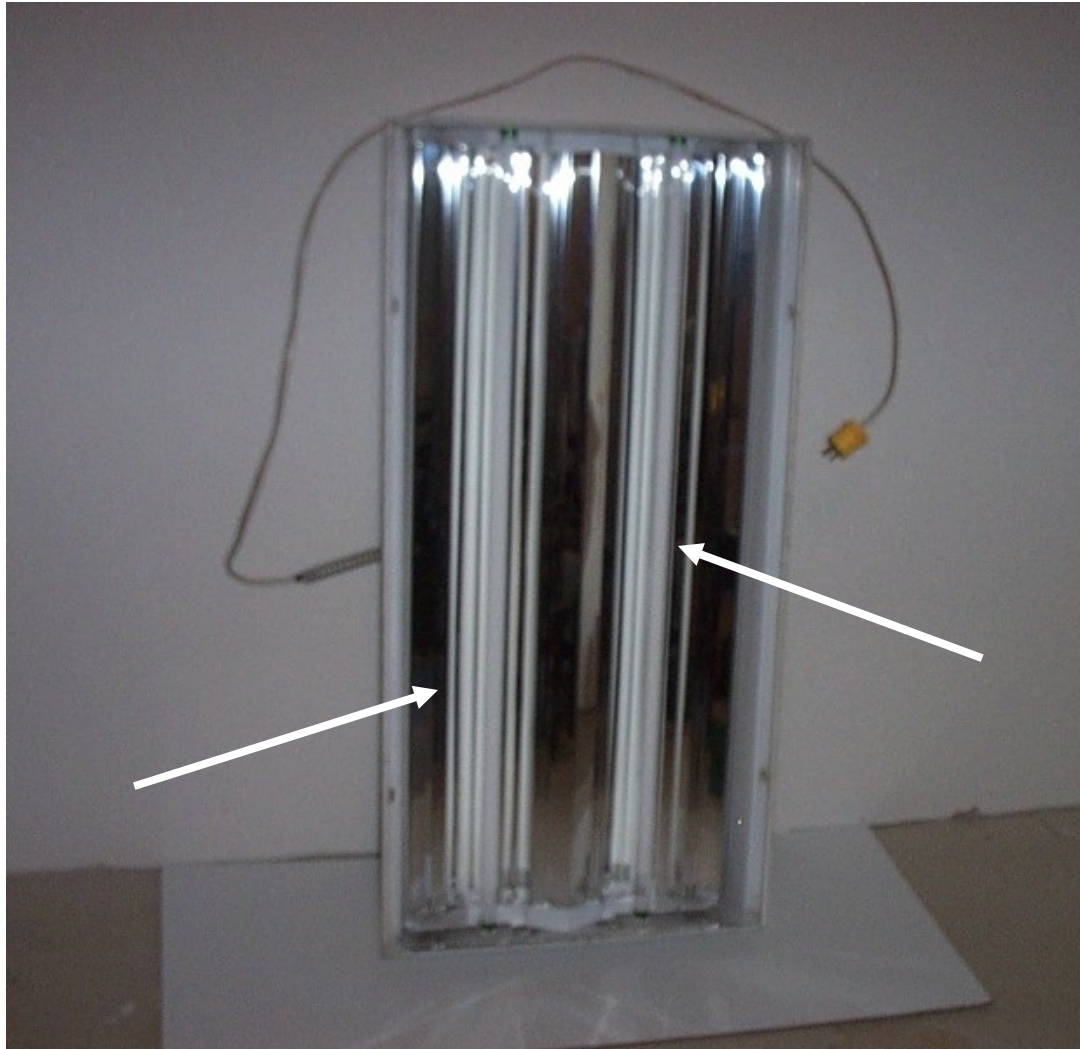
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Retrofit plug-ins



Ground wire is anchored to fixture

Fixture with reflector kit



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TEST RESULTS: T-8 configuration reduced fixture wattage by 69%

T-12 Results

- **Fixture Watts 192**

T-12 System

- 40w lamps (4)
- Nominal watts 160
- Ballasts – Magnetic
 - BF >1.0 estimated
 - PF <.9 estimated

T-8 Results

- **Fixture Watts 59**
- **Reduction 69%**

T-8 System

- 32w lamps (2)
- Nominal watts 64
- Ballast - Electronic
 - Ballast Factor 1.0
 - Power Factor >.98

Testing results provide a more accurate payback picture

Four lamp fixtures example

- Electricity cost payback in 4.5 months
 - Operate 24/7, 365 days per year
- Savings are more important for normal office operations
 - Simple payback in 15.2 months
 - Operate 10 hours per day and 5 days per week
- Retrofitting other lighting fixtures and controls add.....
 - Much less to energy savings
 - Significantly to retrofit costs
 - Many months to the payback period

Other benefits reduce payback period

- Skeptical customers question how much and when other benefits kick in
 - Utility and tax incentives
 - Lower life cycle costs
 - Almost no maintenance the first few years
 - Longer lamp life
 - Fewer ballasts and lamps to replace
 - Inflation's impact on energy prices
- One extra cost – interest on retrofit loan money

Solutions for illumination requirements

- Primary lighting – two lamp LF with 32 w lamps replacing four lamps
- Options for more illumination
 - Add a third lamp
 - Use a reflector kit
- Initial focus is on lumens
- Foot Candles – light at point of use

Lumen comparison

<u>Lamps</u>	<u>Initial Lumens</u>	<u>Mean Lumens</u>	<u>Difference – Mean Lumens</u>
Four lamp 40w – T12	12,600	8,320	Base
Two Lamp 32w – T8	5,700	5,400	-35%
Three Lamp 32w – T8	8,550	8,100	-3%

Foot Candle Comparison

<u>Lamps</u>	<u>BF 1.0</u>	<u>Difference</u>
Four lamp 40w – T12	52	Base
Two Lamp 32w – T8	38	-27%
Three lamp 32w – T8	52	0
Two Lamp 28w – T8	35	-33%

Foot Candle Variations: Ballast Factors (BF) and Reflector Kit

<u>Lamps</u>	<u>BF 1.0</u>	<u>BF 1.18</u>	<u>Reflector</u>
Two Lamp 32w – T8	38	48 (+26%)	No
Two Lamp 32w – T8		105	Yes
Two lamp 28w – T8	35	43 (+23%)	No
Two Lamp 28w – T8		97	Yes

Versus base of 52 Foot Candles

Watts increase (or decrease) with Ballast Factor (BF) changes

<u>Lamps</u>	<u>BF 1.0</u>	<u>BF 1.18</u>	<u>Reflector</u>
Two Lamp 32w – T8	38 (59 watts)	48 (74 watts)	No
Two Lamp 32w – T8		105	Yes
Two lamp 28w – T8	35 (51 watts)	43 (59 watts)	No
Two Lamp 28w – T8		97	Yes

Watts and luminance decrease with BF's of .88 and .77

Lessons learned

- Lighting requirements should drive the solution
- Test your solution to get accurate savings and luminance metrics
- Consider simple variations that help you meet illumination and budget objectives
 - Short term retrofit costs
 - Long term savings and maintenance costs

Testing is not limited to lighting

- Use data logging meters to test energy efficiency claims for motors, compressors and controls
 - Energy Meters can be localized to test specific equipment
- Survey your staff to insure that comfort and performance objectives are met
- Results back up savings when you go for funding