The case for LED lighting

Osseo's LED street lighting system: A case study

Project: Central Avenue reconstruction project

Client: The City of Osseo, Minnesota

Civil Engineer: Bolton and Menk, Inc.

Landscape Architect: Hoisington Koegler Group, Inc.

Lighting engineer: Mark Ziemer, Barr Engineering Co.

The situation

In 2008, as part of a seven-block reconstruction project on Central Avenue, the city of Osseo began considering street lighting system design approaches.

- **The problem:** The existing system had reached the end of its economic life.
- **The decision:** LED lighting
- **The question:** Was LED the right decision?

Central Avenue … the project location

- Improve aging streets and streetscape through central business district (7 blocks)
- Support growth and redevelopment
- Facilitate redevelopment potential with new, supporting infrastructure

The existing system: inefficient…outdated

- Installed in the early 1980s
- Triple post-top globes
- 70-watt high-pressure sodium lamps
- Low-performance photometrics
- “Cobraheads” at intersections

The existing system in early 2009

Existing system performance

Field measurements

Foot candle (FC) distances (light given by a candle at 1-foot distance)

	Existing Osseo system	Applicable IES standards*
Minimum	Approx. 1 FC	0.2 FC
Maximum	Approx. 3 FC	---
Average	Approx. 1.5 FC	0.8 FC
Average-to-minimum ratio	Approx. 1.5:1	4:1

* Illuminating Engineering Society standards for “collector streets” category (high pedestrian activity)—IES RP-8 Roadway Lighting

Incumbent system technology

High-pressure sodium lamps

- **Rated lamp life:** 24,000 hours – 5.7 years at 4,200 hours per year … (half of lamps have failed)
- **Economic lamp life:** Approximately 70% of rated
- **Ouput:** 85% original light output at 12,000 hours
- **Light color:** Yellowish
- **Warm-up time:** 3 to 4 minutes

New system options

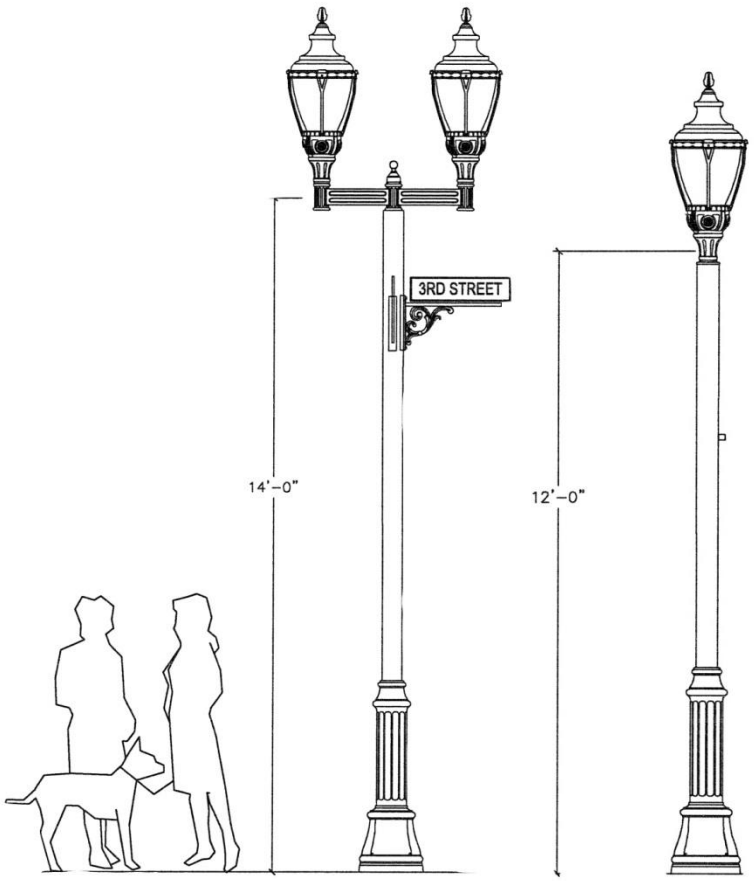
- New traditional-appearance post-top desired
- High-pressure sodium lamp ruled out due to color of light
- Options: Metal halide and LED

Option	Advantages	Disadvantages
Metal halide	• Produces whiter light (moonlight) • Lower cost	• Shorter life than LED • Higher energy costs • More maintenance
Light emitting diode (LED)	• Expected longer life • Significant energy savings • Minimal maintenance	• Very new technology • Higher cost than metal halide

Conventional design alternative

100-watt metal halide lamping

- **Post top:** Acorn-style
- **Mid-block height:** 12 feet
- **Intersection height:** 14 feet
- **Pole spacing**: 65 feet (typical), 45 feet curb-to-curb



Metal halide (MH) considerations

- **Rated lamp life:** 15,000 hours(3.6 years) … 10,000 hour (2.4 year) economic life
- **Light-loss factor:** 70% (at 40% of rated lamp life)
- **Warm-up time:** 3 to 4 minutes
- **Dimming/setback capability:** Not available
- **Color variation:** Yes

Metal halide design meets standards

Design basis: Sternberg A880 ("Town Square") with 100-watt metal halide

Calculated photometrics			
	Initial	**Maintained***	**IES standard**
Average	1.6 FC	1.1 FC	0.8 FC
Maximum	3.4 FC	2.4 FC	----
Minimum	0.4 FC	0.3 FC	0.2 FC
Max/Min	8.5:1	8.5:1	----
Avg/Min	4.0:1	4.0:1	4.0:1

* At the time of replacement

LED lighting option

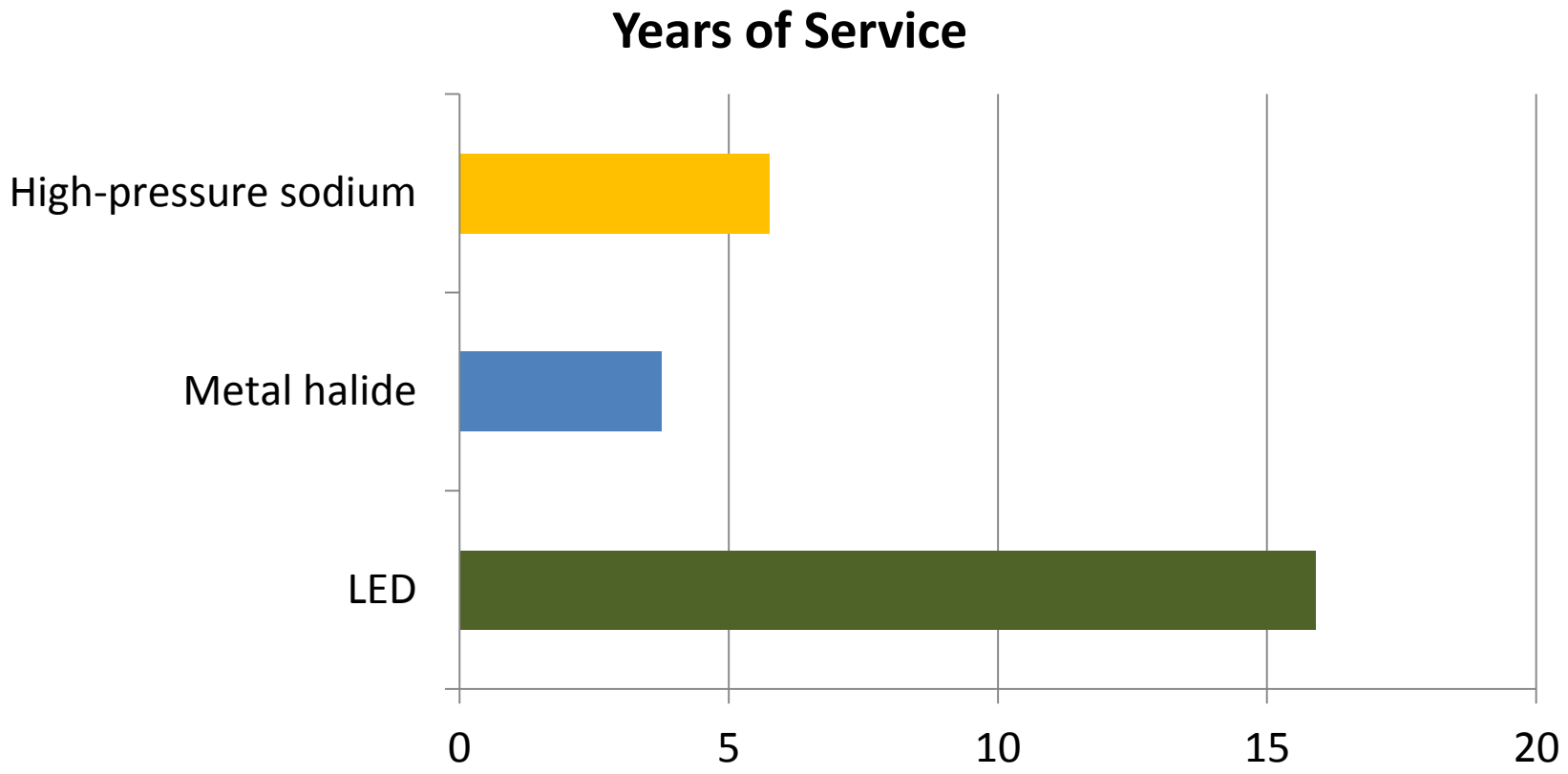
Design basis: Sternberg A880 with Cree LEDs; 63-watt LED array (equivalent to 100-watt MH); same luminaire and pole configuration

Calculated photometrics			
	Initial	**End of life**	**IES standard**
Average	1.1 FC	0.8 FC	0.8 FC
Maximum	2.7 FC	1.9 FC	----
Minimum	0.3 FC	0.2 FC	0.2
Max/Min	9:1	9:1	----
Avg/Min	3.7:1	3.7:1	4:1

LED's many advantages

- **Rated life:** 70,000 hours (16 years)
- **Light output:** 70% at 70,000 hours
- **Instant on:** Yes
- **Good color consistency:** Yes, specifiable color temperature
- **Dimming or setback possible:** Yes, continuous dimming with proportional energy savings

Light source life comparison

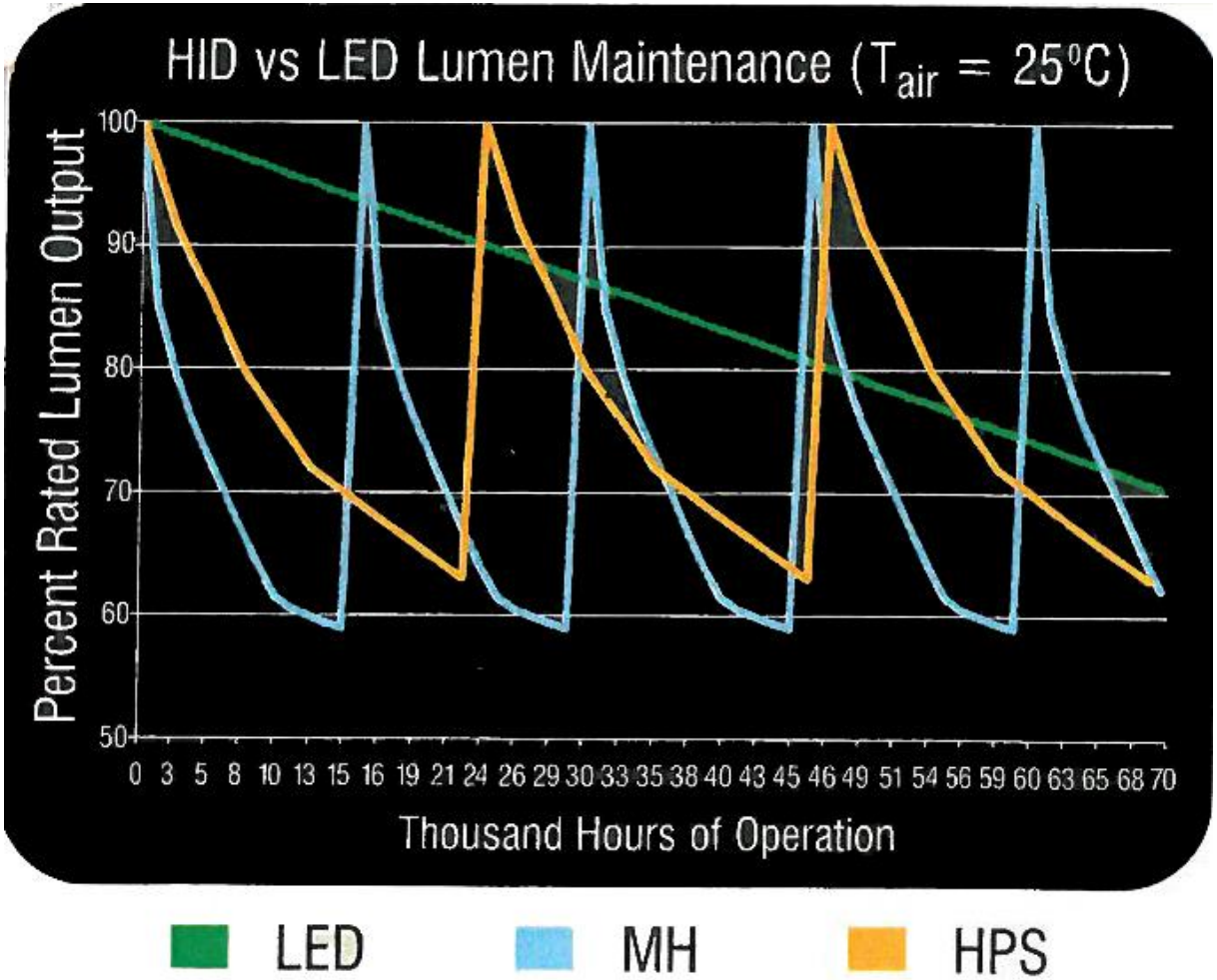


Projected LED economics

Per luminaire comparison	Metal halide	LED	Savings
First cost	Basis	$500	($500)
Watts per luminaire	126	63	63
KWH per year	530	265	265
Energy cost per year	$58	$29	$29
Maintenance cost/year	$67	$20	$47
Total annual savings	$125	$49	$76

Simple payback: 6.6 years ($500 initial cost/$76 per year savings)
* 11 cents per KWH

Reduced maintenance costs



- 70,000 years of lamp life; designed to last 16+ years—compared to much shorter life for metal halide or high-pressure sodium

LED system design chosen—one of the first in Minnesota

- **Construction start:** Early 2009
- **System completed:** October 2009
- **Operating experience:** 4 years, 3 months
- **Operating hours:** Over 18,000 to date

Installed LED system

Actual lighting performance

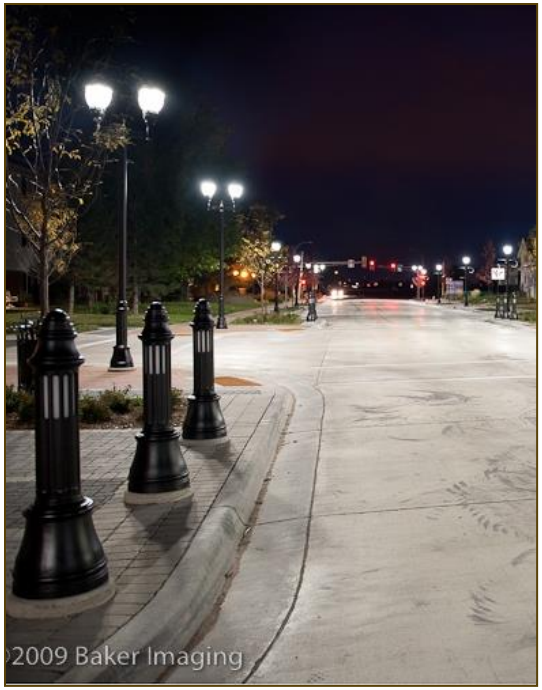
Parameter	Minimum	Maximum
Calculated values	0.3 FC	2.7 FC
Measured values October 2009	0.6 FC	2.6 FC
*Measured values October 2013	0.6 FC	2.8 FC
*Approximately 18,000 hours burn time		

Economic performance

- **Estimated yearly energy savings:** $10,059
- **Actual yearly energy savings:** $9,936*
- **Maintenance:** Virtually none required

* Estimated based on limited data points

Was LED lighting the right decision?



Results:

- **Lumen maintenance:** Excellent
- **Energy savings:** Significant
- **Maintenance required:** Essentially none

Conclusion:

- LED technology has been a good investment for the city of Osseo.

Questions?