Example 5 — LED lighting retrofit

Summary

This example looks at energy savings from retrofitting light fixtures to LED equivalents in an industrial setting. CircuitMeter provided the metering and analysis that identified significant opportunities to increase energy efficiency by replacing each light fixture with an equivalent-lumens LED alternative. On average, efficiency improvements of 48% results in $74.19 net savings per fixture, an investment that is paid off in one year.

**Type:** Energy efficiency / Efficiency  
**Sector:** Industry & Buildings

Background

An industrial facility consists of many types of energy loads, including lighting. In order to qualify for government rebates on LED lighting retrofits, these loads were specifically isolated through CircuitMeter technology. By monitoring loads before retrofit, the data logs helped to identify the best LED technology and compare before and after energy consumption. Data shows that the replacement LEDs saved energy on average 48% per fixture.

In addition to the direct energy savings calculated here, the capital replacement budget and associated maintenance costs would also be reduced, as LEDs have longer run times than traditional bulbs. Given a typical 10-hour operating day, a replacement LED may last up to 15 years.\(^1\) Recent U.S. DOE testing of LED fixtures has confirmed such results.\(^2\) Figure 1 shows lighting operating lifetime comparisons for various sources.

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\(^2\) LEDs Magazine, *DOE testing of L Prize LED lamp passes 40,000 hours* (2015).  
Methodology and assumptions

A technical and financial model was developed that used empirical data collected via WebMeters for a lighting load of 10,254 kWh per day before retrofit. Assuming a 36 W equivalent fluorescent lighting fixture, and a measured after-retrofit load of 4,936 kWh, the energy savings is calculated as a 48% improvement, or a 18 W LED equivalent. (Data was logged over different time spans and then converted to a daily average value.) The facility’s management noticed a 9% upward drift in energy consumption, likely due to lights being left on for longer periods, which is carried forward into the financial model to determine net savings and payback.

The financial model calculates the payback period (how long an investment in LED lighting retrofits pay off through energy savings), and a net-present value (NPV) of cash flows over the lifetime of the investment. An internal rate of return (IRR) — an equivalent return calculated by devaluing future cash flows at which the NPV is zero — cannot be calculated for this project as the CircuitMeter investment is less than immediate cost savings in the project’s first year. Key assumptions are summarized in Table 1.

Table 1: Summary of financial assumptions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Assumption</th>
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</thead>
<tbody>
<tr>
<td>Depreciation</td>
<td>5%</td>
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<tr>
<td>Energy consumption drift</td>
<td>9%</td>
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<tr>
<td>Project lifetime</td>
<td>15 years</td>
</tr>
<tr>
<td>Energy price</td>
<td>$110 / MWh*</td>
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</tbody>
</table>

* Price of electricity is given in case study dataset

Energy savings are calculated by taking the energy savings for an LED (compared to an equivalent incandescent fixture) and including an upward drift in energy consumption. The upward drift for this example is calculated based on empirical data at 9%. Use of this number was supported by a Fraunhofer study that found an estimated 6.3% rebound effect, meaning lighting is turned on for longer time periods after replacement with LED technology.4

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Results

Retrofitting lighting fixtures with LED equivalents yield annual energy savings of up to 70 kWh per fixture. The resulting project NPV is $74 per fixture. Payback of investment occurs in one year. Net and cumulative cash flows are summarized in Figure 2.

Figure 2: Net and cumulative cash flow for retrofitting lighting fixtures

CircuitMeter provided the data validation necessary for the project to qualify for a government lighting retrofit program; it also gave facility management insight into the rebound effect caused by facility end-user behavior, as captured by a 9% upward drift in energy consumption. CircuitMeter’s energy reports may be used by management to track and change behaviors as necessary to minimize future drift.