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## Lighting the Way at the Manor House Hotel

Andre and Melissa Barmore met while attending a prestigious East Coast business school. After graduation, Andre worked for several years in hospitality management with a number of well-known luxury hotel brands. Melissa worked in business development with a real estate investment trust (REIT) where she focused on new property acquisitions. However, Andre and Melissa had long ago set their sights on owning and managing their own business. The most natural fit for the Barmores was the hotel industry where they could leverage their combined work experience.

In early 2012, all of the pieces began to come together. Melissa had come across a mid-rise 1930s hotel building in the heart of Chicago's Gold Coast. The 100-room hotel had numerous classic art deco design elements. However, significant refurbishments would be needed in order to realize the Barmores' goal of re-positioning the hotel as a boutique offering that would cater to a high-end clientele. Fortunately, by making use of their extensive contacts in the Chicago real-estate industry, they had been able to obtain financing for the hotel purchase and remodeling project from a large publicly-traded REIT.<sup>1</sup> The Barmores hoped to complete the remodeling and to re-open the newly named Manor House Hotel in time for the holidays.

By early November the Barmores had finished re-fitting the hotel's common areas with customized lighting. One of the few remaining decisions concerned the choice of guestroom light bulbs. Although the choice might have seemed minor, the Barmores believed in taking a rigorous approach to all managerial decisions and wanted to set a strong example for their new business.

### Lighting Technology

Until the 1800s, people relied on fire fed by combustible materials such as wax, whale oil, or kerosene to create visible light.<sup>2</sup> Then in 1752, the world began to change rapidly after Benjamin Franklin's famous kite flying experiment ushered in the electrical age. By 1802, Humphry Davy had

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<sup>1</sup> A REIT was a special type of company under US tax law that owned and operated income-producing commercial real estate. The REIT structure was designed to provide an investment structure for real estate similar to the one mutual funds provided for stocks and bonds. Specifically, a REIT was allowed to deduct all dividends paid to its owners so long the REIT distributed 90% of its taxable income to investors.

<sup>2</sup> Visible light was electromagnetic radiation (EMR) capable of being detected by the human eye. EMR was a form of energy emitted by charged particles. EMR exhibited wave-like behavior as it moved through space and was classified according to wavelength. The electromagnetic spectrum, in order of decreasing wavelength, consisted of radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. A typical human eye could detect wavelengths from 390 to 700 nanometers.

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created the first incandescent light. However, it was not until 1879 that Thomas Edison perfected an incandescent light bulb that could be commercialized. The incandescent light bulb is still with us today, but several newer technologies have emerged that may soon displace the incandescent bulb.

### *Incandescent Light Bulbs*

Incandescent bulbs produced light by running electric current through a filament wire that was resistant to the flow of electricity. The resistance caused the filament to heat up until it glowed, releasing visible light. This process, known as incandescence, produced around 15 lumens of light per watt of electricity.<sup>3</sup> A typical incandescent bulb cost around fifty cents and had a rated life of 1,000 hours—meaning that after 1,000 hours of use, 50% of bulbs failed when the filament burned out (see **Exhibit 2**). Incandescent bulbs were not particularly energy efficient: only 10% of the energy input of an incandescent bulb was converted into visible light with the rest being converted into heat. However, incandescent bulbs produced light that most people found pleasing because it closely mimicked sunlight and rendered colors accurately. As a result, incandescent bulbs still comprised roughly 75% of the market for light bulbs in 2012, even after 130 years of market dominance.<sup>4</sup>

### *Compact Fluorescent Bulbs*

Compact fluorescent bulbs (CFLs) were introduced in the late 1970s in response to rising energy costs and comprised roughly 20% of the light bulb market by 2012.<sup>5,6</sup> CFLs created light by running electric current through curled glass tubes that contained mercury vapor. The current excited the vapor, causing it to emit ultraviolet radiation. This ultraviolet radiation was then converted to visible light by a phosphorous coating on the inside of the tubes in a process known as fluorescence. Because CFLs had no heated filament they tended to last far longer, with rated lives ranging from 8,000 to 12,000 hours (see **Exhibit 2**).<sup>7</sup> CFLs were also energy efficient, emitting 60 lumens of light per watt of electricity. Furthermore, CFLs were fairly inexpensive: a CFL that produced the same amount of light as a 60-watt incandescent bulb cost about \$5 in 2012. Despite these positive attributes, CFLs had a negative reputation in the market. Specifically, many people thought that CFLs flickered or buzzed, produced light that rendered colors poorly, and took time to warm up to full brightness. Finally, CFLs contained small amounts of mercury, which created some disposal concerns.

### *Light Emitting Diode Bulbs*

Light Emitting Diodes (LEDs) created light through a process known as electroluminescence whereby electrons were forced to flow through small holes, which caused the release of photons.<sup>8</sup> LEDs were first discovered in 1907 when an experimenter at Marconi Labs found that certain crystals emitted light when an electric current was run through them. It was not until the 2000's, however, that LEDs found their way into general lighting applications. Although the materials used in LEDs were rapidly improving, the technology already allowed for bulbs that were very energy efficient, closely mimicked the light quality of incandescent bulbs, and turned on instantly. LEDs did not burn

<sup>3</sup> The lumen is the unit of luminous flux, a measure of the total amount of visible light emitted by a source.

<sup>4</sup> [http://www.energystar.gov/ia/products/downloads/CFL\\_Market\\_Profile\\_2010.pdf](http://www.energystar.gov/ia/products/downloads/CFL_Market_Profile_2010.pdf) p. 8.

<sup>5</sup> [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/cfl\\_lessons\\_learned\\_web.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/cfl_lessons_learned_web.pdf)

<sup>6</sup> [http://www.energystar.gov/ia/products/downloads/CFL\\_Market\\_Profile\\_2010.pdf](http://www.energystar.gov/ia/products/downloads/CFL_Market_Profile_2010.pdf) p. 8.

<sup>7</sup> Like incandescent bulbs, the rated life of a CFL bulb represented the hours of operation until 50% of bulbs would fail.

<sup>8</sup> A photon was the quantum of (i.e., minimum amount of) EMR. According quantum mechanics, the leading theory of EMR, this meant that EMR displayed properties of both waves and particles—i.e., EMR exhibited “wave-particle duality.”

out but slowly dimmed over time. Thus, LEDs were assumed to be at the end of their rated life when they generated 70% of their initial lumen output, which for most LED bulbs was around 24,000 hours (see **Exhibit 2**). While their performance was quite impressive, an LED that produced the same amount of light as a 60-watt incandescent bulb was still quite expensive, selling for between \$10 and \$25 in 2012. However, prices for LEDs were projected to fall by 25% per year until 2015, and then by 12.5% per year until 2020.<sup>9</sup> Furthermore, LED energy efficiency was projected to rise from 65 lumens per watt currently to over 150 by 2020.<sup>10</sup> Accordingly, LED technology, which comprised less than 5% of the lighting market in 2012, was expected to rise to over 70% of the market by 2020.<sup>11</sup>

## Making a Choice

Based on the data provided in **Exhibits 1** and **2**, the Barmores had decided to begin their analysis by considering the following alternatives: i) exclusive use of 60 watt incandescent bulbs, ii) exclusive use of 60 watt equivalent CFL bulbs, and iii) exclusive use of 60 watt equivalent LED bulbs.

In coming to a decision, the Barmores knew that the best choice would be the alternative which offered the lowest cost in present value terms without compromising the hotel's quality standards. For reasons of practicality, the Barmores had decided that any purchase costing less than \$20,000 would be immediately expensed, rather than being depreciated over the estimated life of the investment.<sup>12</sup> However, they knew that reaching a decision would require consideration of more than the initial purchase price of the bulbs. Specifically, the Barmores knew they also needed to forecast the annual stream of expected future costs for each of the alternatives. In this regard, the Barmores anticipated that the price of electricity, the price of new incandescent bulbs, and the replacement labor cost for incandescent bulbs would each grow in line with overall inflation, which was expected to average 2% per annum going forward.<sup>13</sup> For simplicity, the Barmores had also decided to assume that all bulbs would have to be replaced as soon as they reached their rated lifetime. Furthermore, the Barmores had recently heard about the near-term possibility of a permanent one-time 20% rate hike by their local utility. As a result, they were interested in whether their choice might be affected by such a near-term jump in utility rates.

Finally, after consulting with the publicly-traded REIT that was providing the financing for the project, the Barmores had determined that the appropriate discount rate for the guestroom lighting purchase and other capital investments in the Manor House Hotel was 10%. Specifically, analysts at the REIT had determined that its base of broadly diversified investors was currently requiring a 10% return for investments with similar risks and a similar time horizon to investments in hotel development.

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<sup>9</sup> McKinsey "Lighting the Way," p. 19, Exhibit 7.

<sup>10</sup> [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl\\_manuf\\_roadmap\\_july2011.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_manuf_roadmap_july2011.pdf) p.24, Table 5.

<sup>11</sup> McKinsey, *Lighting the Way Perspectives on Global Lighting Market 2012*, p. 50, Exhibit 12.

<sup>12</sup> Since all of these costs would be treated as tax-deductible expenses, this meant that the Barmores could safely ignore tax considerations in their analysis, simply picking the alternative with lowest present value cost in pre-tax dollars.

<sup>13</sup> Electricity costs were estimated to be the dollar cost per kilowatt hour (kWh) divided by 1,000 times the bulb's electrical wattage consumed.

**Exhibit 1** Expected Lighting Usage

<u>Lighting Per Room:</u>	<b>Fixtures Per Room</b>	<b>Number of Rooms</b>	<b>Daily Hrs. Per Bulb</b>	<b>Annual Hrs. Per Bulb</b>	<b>Total Hours</b>
Suites	12	10	2.74	1,000	120,000
Deluxe	7	40	2.74	1,000	280,000
Single	5	<u>50</u>	2.74	1,000	<u>250,000</u>
<b>Total</b>		<b>100</b>			<b>650,000</b>
Total Number of Bulbs	650				
Annual Days of Operation	365				

Source: Casewriter, data is fictionalized.

**Exhibit 2** Light Bulb Specification Data

	<b>Philips 60 Watt Equivalent Incandescent</b>	<b>Philips 60 Watt Equivalent Twister CFL</b>	<b>Philips 60 Watt Equivalent LED 19A</b>	<b>Cree 60 Watt Equivalent LED</b>
<i>Light Bulb Specifications:</i>				
Cost Per Bulb	\$0.41	\$4.47	\$12.97	\$12.97
Wattage	60.0 W	13.0 W	12.5 W	9.5 W
Lumen Output	860 lumens	840 lumens	800 lumens	800 lumens
Rated Lifetime <sup>a</sup>	1,000 hours	12,000 hours	24,000 hours	24,000 hours
Dimable	Yes	No	Yes	Yes

Source: Home Depot website, accessed November 2012.

<sup>a</sup> For LED bulbs, the rated lifetime is the point in time when the bulb is producing 70% of its initial light output.  
For CFL and incandescent bulbs, the rated lifetime is the point in time when 50% of bulbs will burn out.

**Exhibit 3** Operating Cost Data

Cost Per kWh (US ¢)	11.23	Expected Annual Inflation	2.00%
Bulb Replacement Labor Cost	2.81		

Source: Casewriter, data is fictionalized.