Updating the LED Life Cycle Assessment

University of Portland

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Background

- 2012/2013 – Completed a 3 part study to determine the energy and environmental effects of LED A-19 products available at the time.

1. Navigant Consulting, "Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products, Part 1: Review of the Life-Cycle Energy Consumption of Incandescent, Compact Fluorescent, and LED Lamps," 2012.

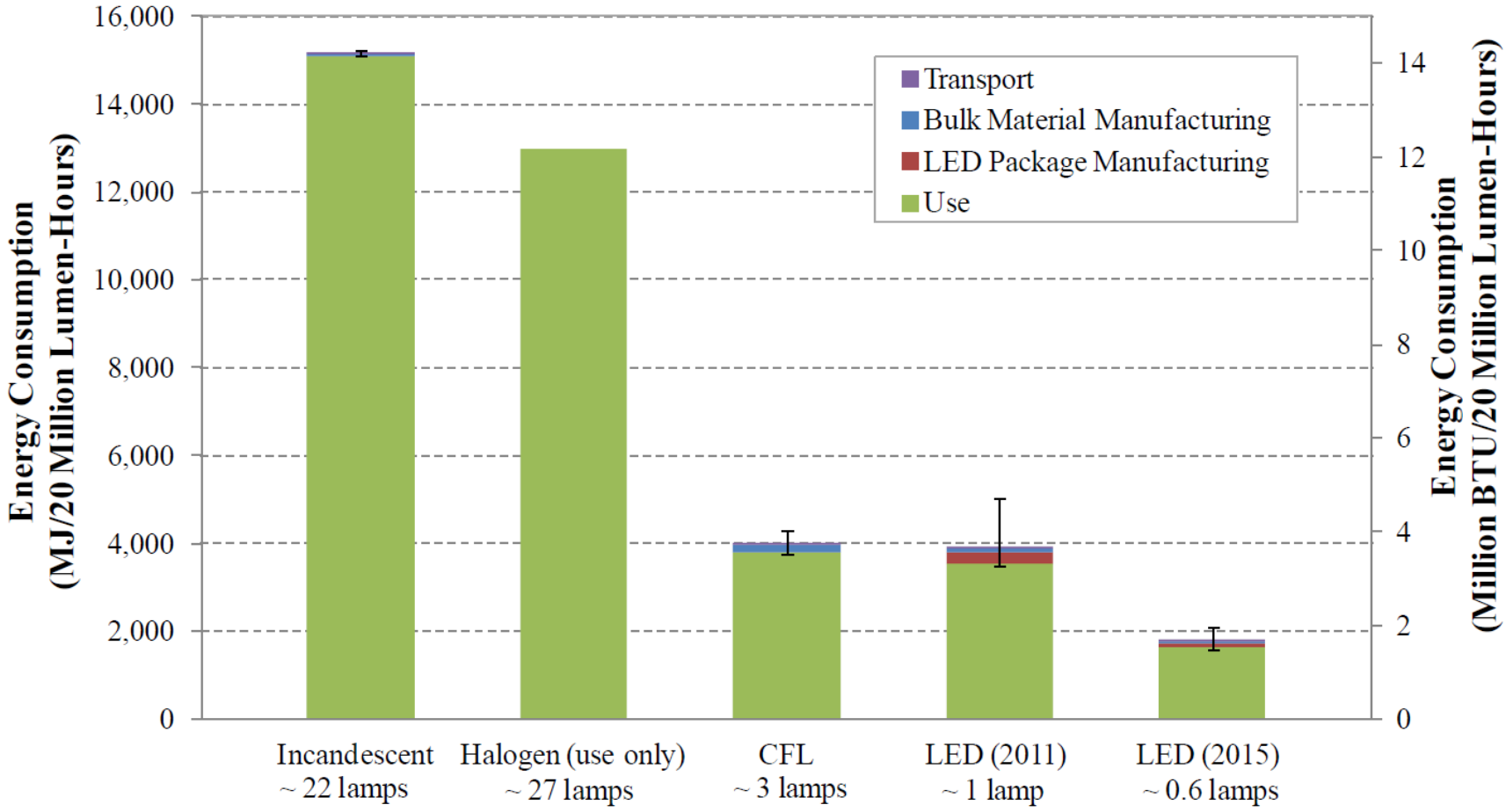
2. M. J. Scholand and H. E. Dillon, "Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products, Part 2: LED Manufacturing and Performance," 2012

3. J. R. Tuenge, B. J. Hollomon, H. E. Dillon, and L. J. Snowden-Swan, "Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products, Part 3: LED Environmental Testing," Richland, WA (United States), Mar. 2013

Part 1: Review of the Life-Cycle Energy Consumption of Incandescent, Compact Fluorescent, and LED Lamps

- Concluded that the life cycle energy consumption of LED lamps and CFLs are similar at approximately 3,900 MJ per 20 million lumen-hours. Incandescent lamps consume significantly more energy (approximately 15,100 MJ per 20 million lumen-hours).
- Concluded that the use phase is the most important contributor to the energy consumption, followed by manufacturing of the lamps and finally transportation (less than 1% of energy consumption).

Part 1: Review of the Life-Cycle Energy Consumption of Incandescent, Compact Fluorescent, and LED Lamps



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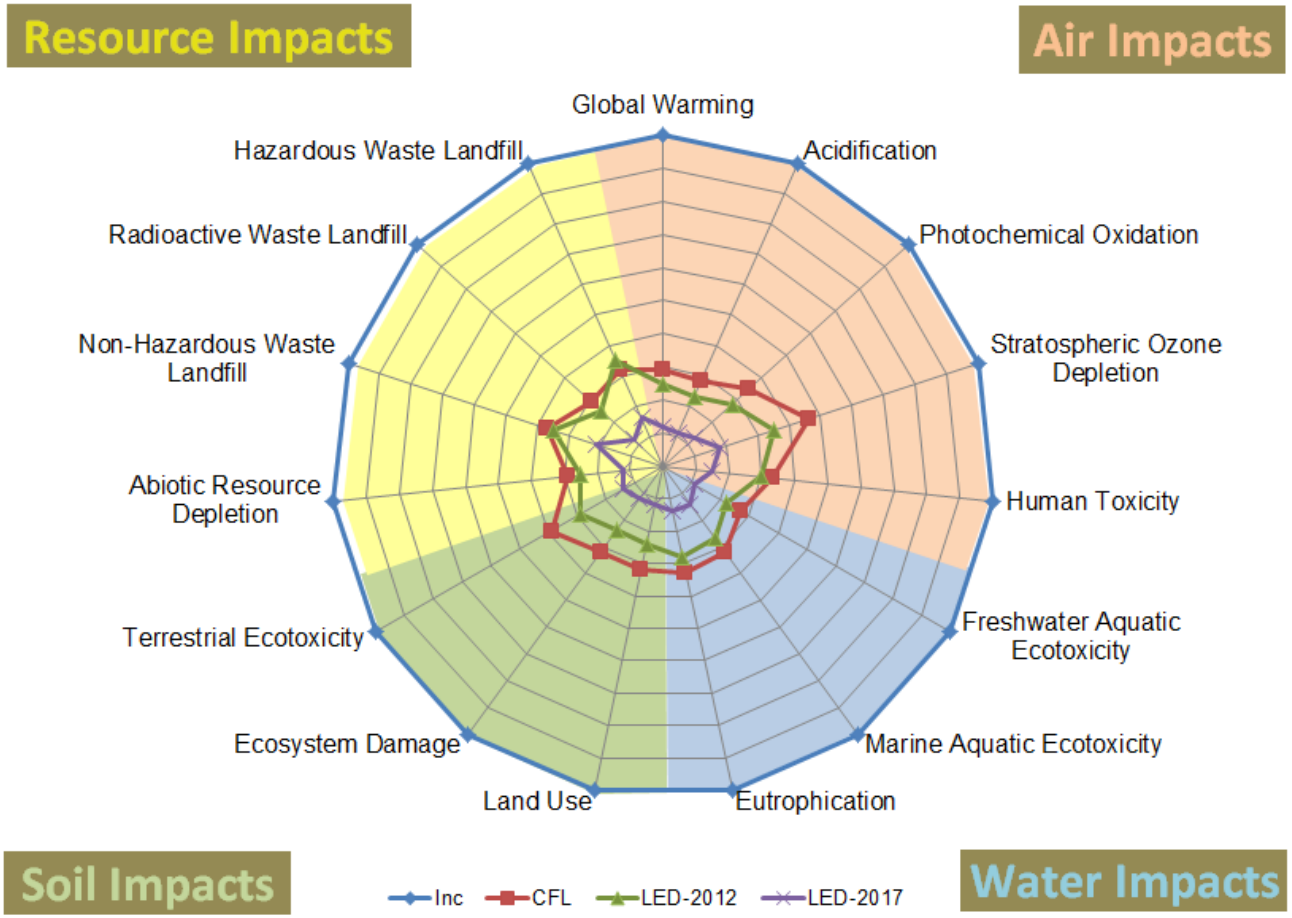
Part 2: LED Manufacturing and Performance Results

- Confirmed that energy-in-use is the dominant environmental impact, with the 12.5-watt LED lamps and 15-watt CFL were performing better than the 60-watt incandescent lamp.
- *Concluded that energy-in-use phase of the life-cycle dominates both energy and environmental impacts.*
- Concluded the CFL is slightly more harmful than the 2012 integrally ballasted LED lamp against all but one criterion – hazardous waste landfill – where the large aluminum heat sink causes the impacts to be slightly greater for the LED lamp than for the CFL.
- Predicted that the 2017 products would significantly outperform the 2012 products and other lighting products like CFL.

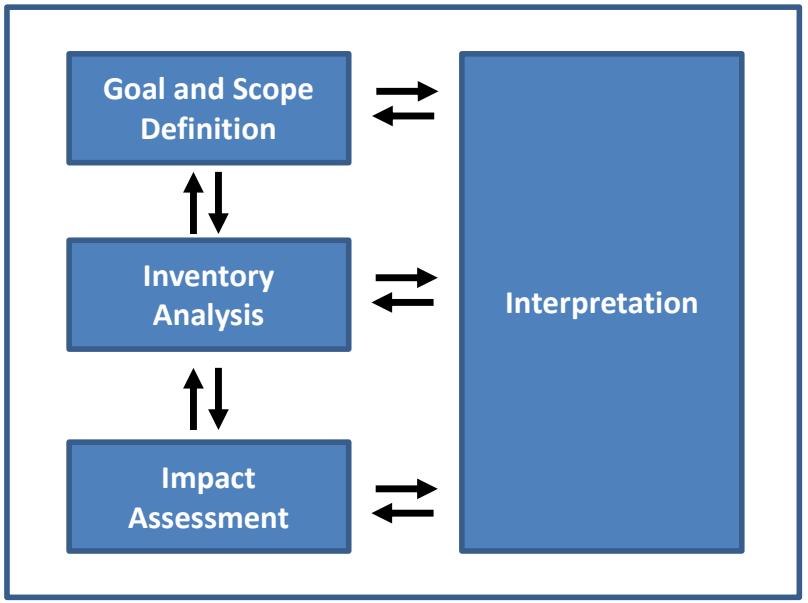
Part 2: LED Manufacturing and Performance



Goal of the New Study

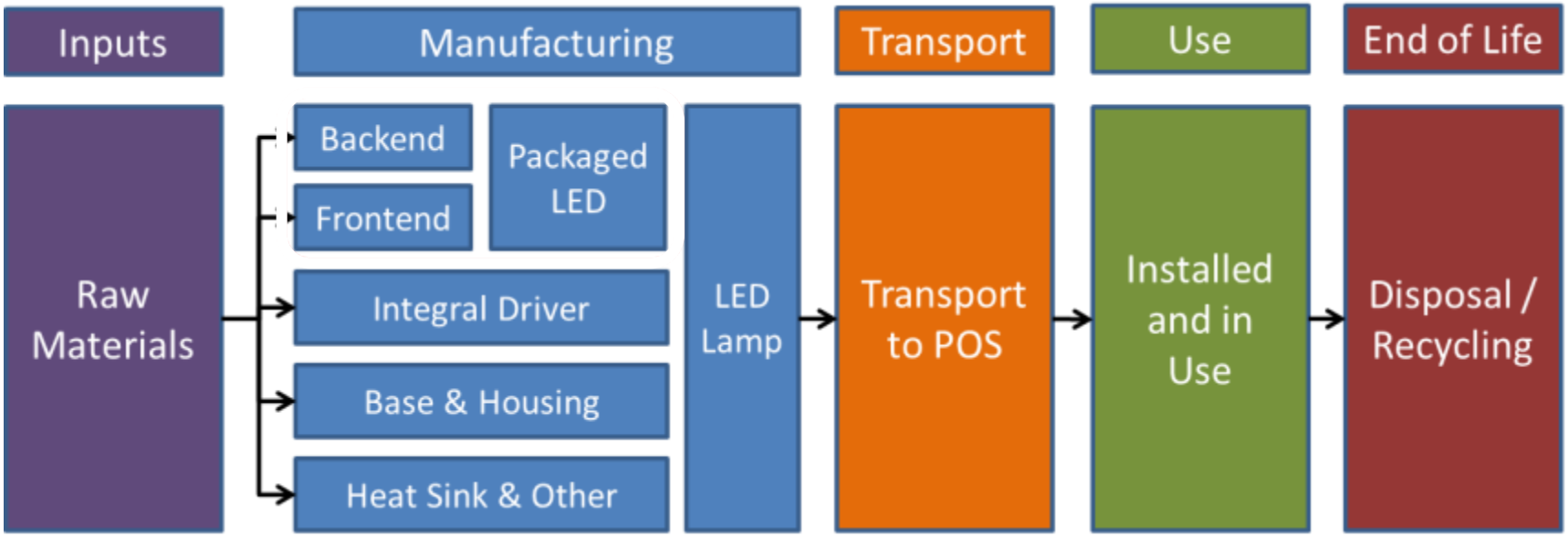
- Review new literature on the life-cycle assessment of LED products.
- Determine if newer A-19 products have achieved the predicted reduction in the environmental impacts as we move toward 2017 products.
- Examine how changes in the A-19 products may impact consumers for end of life planning.

LCA Framework



Source: ISO 14044:2006

Life-Cycle Assessment Scope



2015 LED Products Studied

Input: 8.5 W
Output: 800 lm
Efficacy: 94 lm/W
Lifespan: 10,950 hrs
Mass: 51.069 g

Input: 9.5 W
Output: 800 lm
Efficacy: 84 lm/W
Lifespan: 25,000 hrs
Mass: 82.504 g

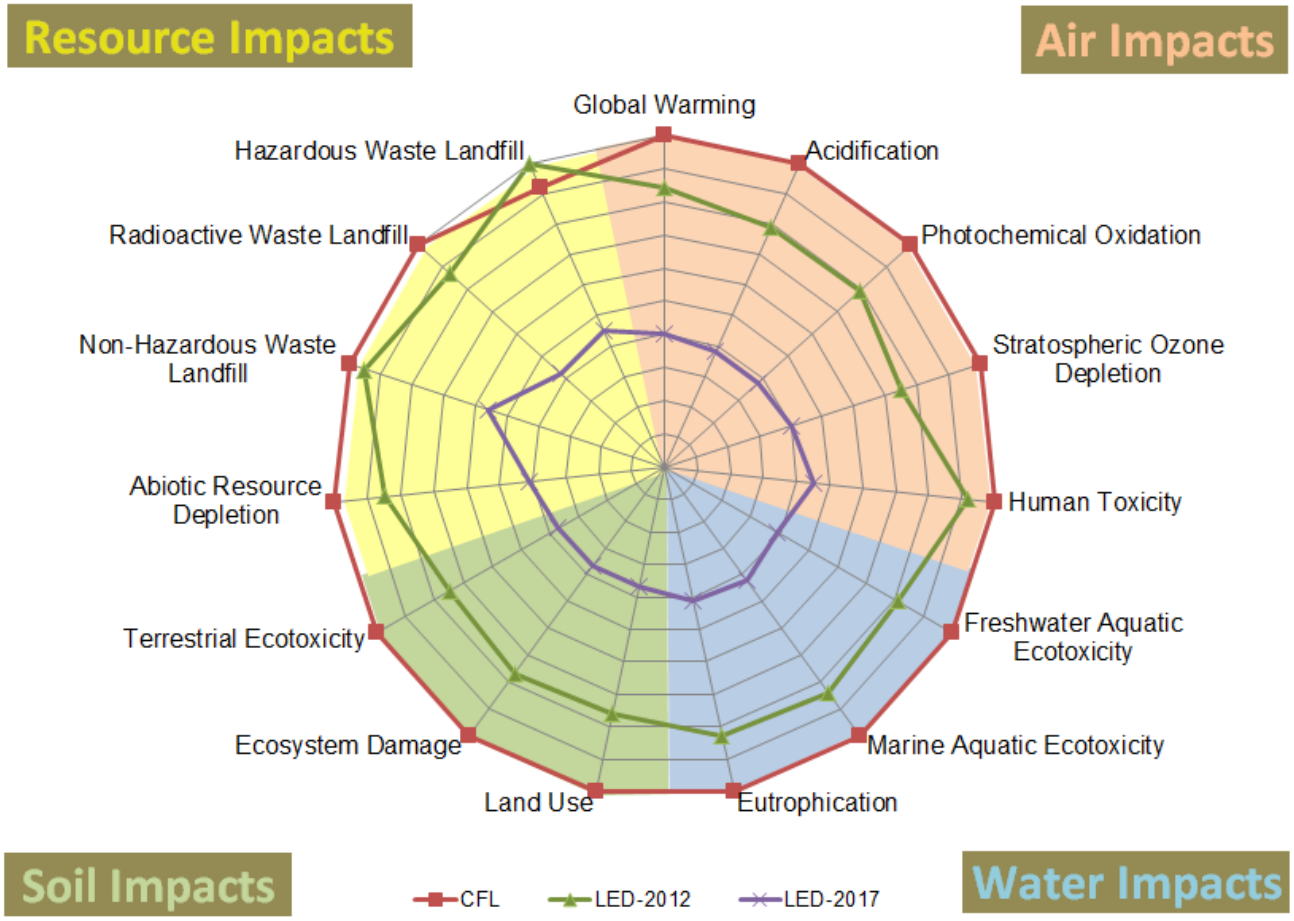
Input: 11 W
Output: 815 lm
Efficacy: 74 lm/W
Lifespan: 25,000 hrs
Mass: 54.445 g

Preliminary Results

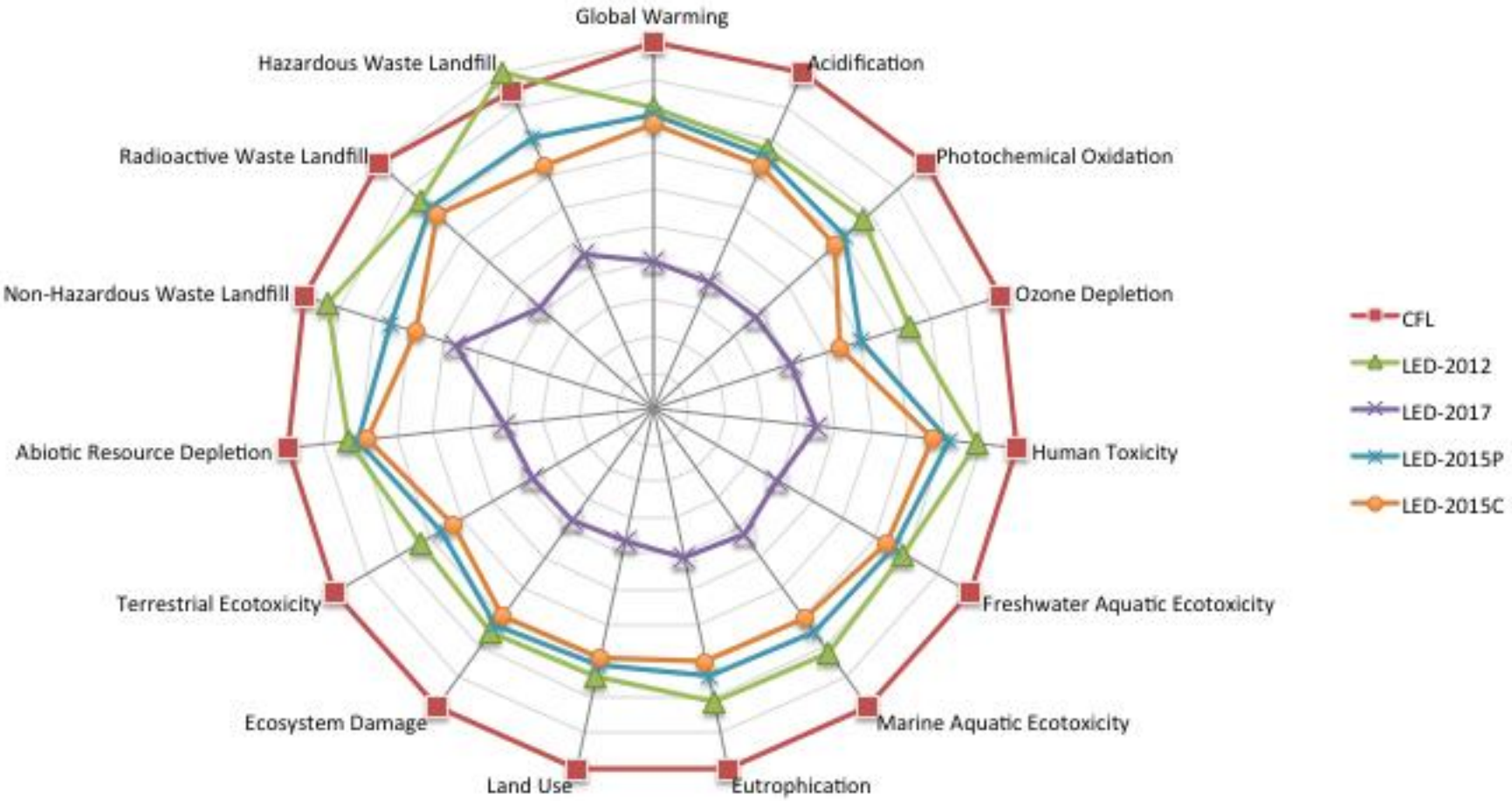
- The three newer products all have a mass significantly lower than the 2012 analysis (50-60% less).
- Some of the newer products have a lifetime rating similar to the 2012 product, but with lower energy requirements and improved efficacy.
- One of the newer products has a rated life of roughly half the 2012 lamp. This impacts the energy use category significantly in the LCA.

Preliminary – Do Not Cite

2012 Results (without Incandescent)



2015 Preliminary Results



Preliminary – Do Not Cite

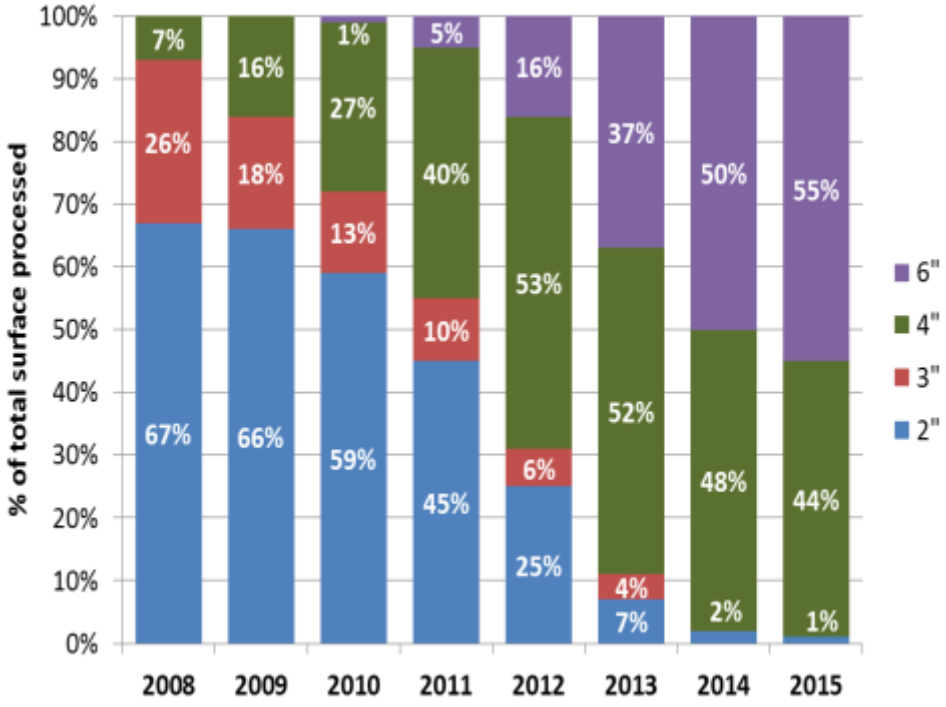
2015 Preliminary Conclusions

- All the newer LED products continue to perform better than CFL and incandescent for environmental impacts.
- The lamp with the lower rated life may have life-cycle environmental impacts less attractive than the 2012 product.
  - Consumers may need to be informed about trade-offs between lamp cost and environmental impacts.
- The 2015 lamps with longer rated life have life-cycle environmental impacts better than the 2012 product, but have not yet reached 2017 predicted levels of performance.
- The 2015 lamps with smaller and lighter heat sinks perform better than the 2012 product in hazardous waste to landfills, making them a clear improvement on CFLs.

Preliminary – Do Not Cite

2015 LCA Challenges

- Have the newer products improve manufacturing methods as we predicted they might? If you are willing to share trends please come chat with me!
- The study uses manufacturer rated lifespans as an assumption. Let me know if you have insights that would change our preliminary findings.



Questions?

- Contact:
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  - University of Portland, Shiley School of Engineering
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