



## Considerations When Investing in LED Lighting

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## Economic Viability of LEDs



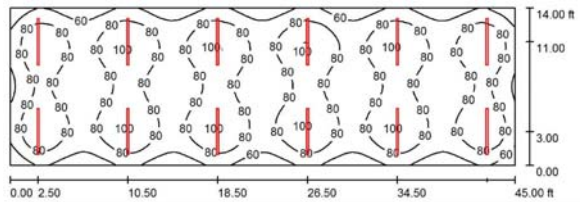
- Fixture & installation costs
- Electrical supply
- Fixture efficacy ( $\mu\text{mol}/\text{J}$ )
- Fixture longevity and maintenance
- Light spectrum (for plants and people)
- Electricity rate
- Hours of lamp operation
- Impact on temperature and heating
- Utility rebates

## Fixture Installation and Costs

- Work with lighting companies (or suppliers) to obtain a customized lighting map and price quotation for a specific average light intensity, in  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ .
- Quotation should be for your specific facility and consider hanging height
- They should provide you with details of the light spectrum, efficiency, expected lifetime, and warranties


## Fixture Installation and Costs

- Review the lighting map and consider the uniformity of the light intensity
- A 10-20% variation in light intensity is generally acceptable




## Electrical supply

- Do you already have enough electricity, or do you need more power? If so, what are the costs?



## Fixture Efficacy (Efficiency)

- The efficacy of a lamp refers to the number of photons of light emitted per amount of energy consumed
- The total output of a lamp is measured in an integrating sphere and requires expertise to operate



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### Fixture Efficacy (Efficiency)

- For example, a lamp that emits 400  $\mu\text{mol}\cdot\text{s}^{-1}$  of photosynthetic photons, and consumes 200 Watts, the efficacy =  $400 \mu\text{mol}\cdot\text{s}^{-1} / 200 \text{ J}\cdot\text{s}^{-1} = 2 \mu\text{mol}\cdot\text{J}^{-1}$
- The higher the value, the more efficient the fixture

### Efficiency of Supplemental Lighting

| Lamp type                      | Electrical input (W) | Manufacturer and model         | Efficiency ( $\mu\text{mol}\cdot\text{J}^{-1}$ ) |
|--------------------------------|----------------------|--------------------------------|--|
| <b>High-pressure sodium</b>    |                      |                                |  |
| 400-W magnetic                 | 443                  | Sunlight Supply Sun Star       | 0.9  |
| 600-W electronic               | 636                  | Gavita Pro 600e SE             | 1.5  |
| 1000-W magnetic                | 1,004                | PARsource GLXI                 | 1.1  |
| 1000-W electronic              | 1,026                | PARsource GLXII                | 1.3  |
| 1000-W electronic double end   | 1,033                | Gavita Pro 1000 DE             | 1.7  |
| <b>LED</b>                     |                      |                                |  |
| Red + White + Blue             | 304                  | LumiGrow Pro 325               | 1.3  |
| Red + White                    | 279                  | Illumitex NeoSol NS            | 1.4  |
| Broad spectrum                 | 133                  | Valoya Model R150 NS1          | 1.4  |
| Red + Blue                     | 384                  | LSG GrowAdvantage Violet       | 1.7  |
| Broad spectrum                 | 600                  | Heliospectra LX601G            | 1.7  |
| Red + Blue + Green             | 515                  | Fluence Bioeng. VYPRx PLUS     | 2.0  |
| Red + Blue (+White) (+Far red) | 190-200              | Philips GreenPower Toplighting | 1.9-2.5  |


Nelson J.A. and B. Bugbee. 2014 (Updated 2016). PLoS ONE 9(6):e99010.  
C. Wallace and A.J. Both. 2016. Act Hort. 1134:435-444.

### Fixture Lifetime & Maintenance

- If not provided, ask about the expected lifetime of a fixture. Many fixtures are rated at 50,000 hours, which is the time that the intensity is expected to decrease to 80% of the original output
- Consider maintenance costs of HPS lamps (bulbs changed every 12,000 to 15,000 hours)

### Light Spectrum & Distribution

- Most horticultural fixtures emit "pink" light, which is primarily red (75-85%) and blue (15-25%) LEDs. Others exist too, for example:
  - Only white
  - Red+white
  - Red+white+far red



### Light Spectrum & Distribution

- White LEDs are blue LEDs with a coating
- Generally, use lamps that emit at least 10% blue
- How much light is lost to non-growing areas? Generally, LEDs are more directional than HPS lamps, so less light is "lost" through the side walls with LEDs.
- If people will be working under the LEDs, especially at night, strongly consider fixtures that include white LEDs

### Operating costs

- Know your electricity rate(s) and estimate how many hours you anticipate using the lights each year
- For example, if operate the lamps an average of 12 hours/day for 12 weeks = 1,008 hours. Typical values for young plant growers are 1,000 to 1,500 hours. Values are 2-3 times that for vegetable growers.

### Impact on temperature & heating

- Plants under HPS lamps are typically 2-3 °F warmer than under LEDs (depending on intensity), so plants can grow slightly faster under HPS lamps
- The inefficiency of HPS lamps (compared with LEDs) serves to heat the greenhouse, but it's also an inefficient heating method

### Utility rebates?

- In some situations, rebates are available for improved energy efficiency, which can dramatically influence the economics of lighting options
- Unfortunately, these seem less available now than before

### Calculate the Costs

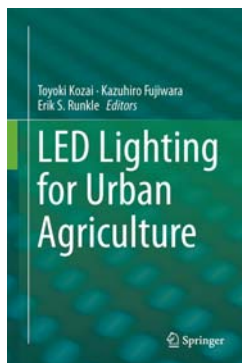
- Several lighting companies have developed spreadsheets to estimate return on investment and payback time
- Ensure values are appropriate for your company (electricity price, hours of operation, etc.) and lighting application, and that comparisons to other lighting options are appropriate

### The LED "X" Factor

- In some situations, plant growth can be improved under LED lighting, and these improvements are sometimes referred to as the X Factor (the unknown)
- Although there will be some improvements in growth for some crops, these have not been well quantified and are likely situational
- Therefore, when making lighting investment decisions, generally don't consider claims that LEDs will improve growth or reduce production time unless/until that's better understood

### New Book on Lighting for Urban Ag

- 450 pages in 32 chapters written by plant scientists and engineers in Japan, U.S., China, and Taiwan
- Edited by Kozai, Fujiwara, and Runkle
- Published by Springer
- Available now in print and digital versions



### New Book on Horticultural Lighting

- Updated and expanded from 2004 *Lighting Up Profits* book edited by Fisher and Runkle
- 18 chapters, 20 chapter authors, edited by Lopez and Runkle
- Published by Meister Media (parent company of *Greenhouse Grower*)
- Available in print and digital versions soon!



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