

City of Tucson LED Street & Garage Lighting Project

August 11, 2017



About Tucson

- Arizona's Second Largest City
 - 235 Square Miles
 - One of the toughest Outdoor Lighting Codes in the country
 - Home of the University of Arizona
 - Home to the Headquarters of International Dark Sky Association
 - Kitt Peak National Observatory (70 Miles)
 - Serving Electric Utility is Tucson Electric Power
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Project Goals

- **Energy efficiency**
 - Save energy and dollars through correct sizing and dimming capability
 - Control lighting to maximize city benefits
- **Reliability/maintainability**
 - 10 year parts and labor warranty
 - Capability to minimize lumen loss and maximize fixture life through controls
- **“Provide the right amount of light”**
 - Meet applicable codes and Dark Sky requirements
 - Account for pedestrian conflict levels and safety
 - Minimize light pollution and “Blue” light output
 - Provide dimming capability to improve efficiency and further lower light pollution

Challenges

- 80% of Lighting System was 480v, 20% were 240/120v
 - Unknown which fixtures were which
- Tucson Electric Power owns and operates approximately 3500 dusk to dawn lights inside city limits
 - Could or would not provide data on which ones they own
- Brand new Light Rail System that was funded through Federal Grants
 - New lighting had to match the color and look of existing fixtures exactly
- Over 1500 pedestrian decorative lighting fixtures of which 25% are historically protected
 - Had to engineer non-intrusive method to add photocell control per pole

Technical Project Scope

- Convert all City owned street lighting to high efficiency, high CRI LED technology
 - Includes 21,264 fixtures with a mix of cobrahead, decorative, and specialty types
 - Includes multiple voltages and technologies (HPS, LPS, MH, Etc.)
 - Install Adaptive Controls on all cobrahead and compatible decorative fixtures for control and dimming
 - Upgrade over 2450 garage fixtures to LED with occupancy and daylight sensing dimming controls
 - Convert all 480v wiring services in Residential areas to 240v to facilitate energy efficient conversion
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Roadway Lighting Design

- Performed a detailed GIS audit of all City owned fixtures and separated all Utility owned and neighboring municipality fixtures from inventory
- Performed a detailed photometric analysis of roadway pole/fixture configurations
- Identified 21 configurations that account for over 93% of city roadway lighting
- Collaboratively worked with City to identify and determine scope of work for each fixture type as well as any specialty area lighting
- Determined process to identify and convert 480v Residential circuits to 240v

Proposed Fixture Aesthetics



ATB260B Major Intersection Fixture



ATBS and ATBM Roadway & Collector Fixtures



Light Rail
Pendant Bell Retrofits



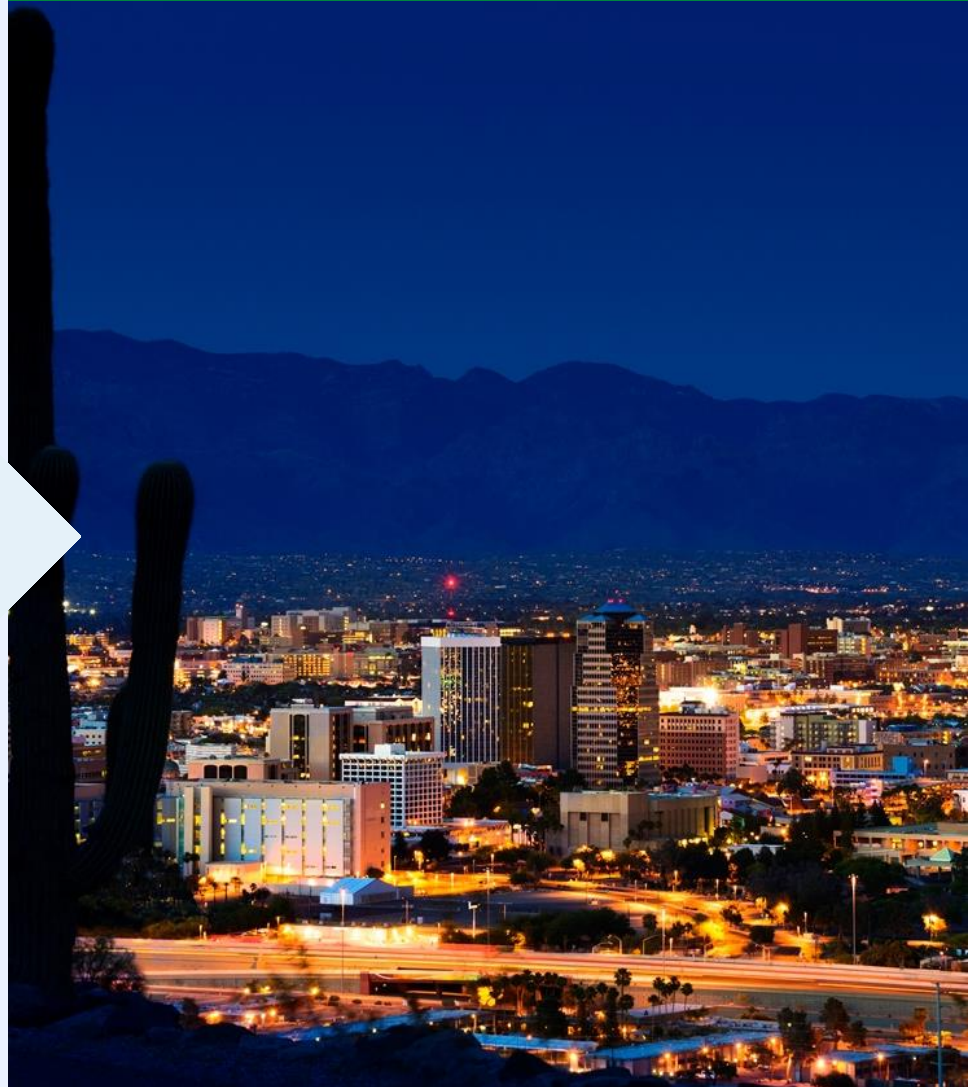
Adaptive Control Strategy and Dimming

- ROAM control system will provide monitoring and dimming capability for compatible fixtures
- All ROAM compatible fixtures will have an initial dimming level of 10% for future lumen maintenance
- All ROAM compatible fixtures on roadways that are rated low pedestrian conflict will be dimmed an additional 30% from midnight to dawn
- All ROAM compatible fixtures in Downtown Entertainment District, 4th Avenue Entertainment District and around the University of Arizona will be dimmed an additional 30% from 3:00 AM to dawn
- Intersection fixtures have dimming capability, however, that capability will not be used except for the initial 10% dimming

What does Success look like

- Overall energy consumption reduced by over 70%
 - Debt Service fully covered under 10-year financing with over **\$64,000 per month** excess energy savings generated for City contingency fund
 - 10 Year Parts & Labor Warranty:
 - \$2.6 million in estimated maintenance savings over 10-year financing period
 - Quality of white LED lighting and color rendering improves pedestrian and bicyclists' ability to see and be seen
 - Roadway lighting's contribution to Sky Glow reduced by 20% compared to pre-retrofit conditions
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Q & A



City Wide Roadway Lumen Comparison

Current Condition

| HPS Wattages | Initial Lamp Lumens | Luminire Eff | Quantity | Total Fixture Lumens |
|-----------------|------------------------|-----------------|----------|-------------------------|
| 50 | 4,000 | 0.75 | 28 | 84,000 |
| 100 | 9,500 | 0.75 | 1,022 | 7,281,750 |
| 150 | 16,000 | 0.75 | 818 | 9,816,000 |
| 250 | 29,000 | 0.75 | 1,889 | 41,085,750 |
| 400 | 50,000 | 0.75 | 10,366 | 388,725,000 |

Total HPS **14,123** **446,992,500**

| LPS Wattages | Initial Lamp Lumens | Luminire Eff | Quantity | Total Fixture Lumens |
|-----------------|------------------------|-----------------|----------|-------------------------|
| 90 | 13,500 | 0.70 | 2,806 | 26,516,700 |
| 135 | 22,500 | 0.70 | 27 | 425,250 |
| 180 | 33,000 | 0.70 | 48 | 1,108,800 |

Total LPS **2,881** **28,050,750**

| LED Wattage | Initial Lamp Lumens | Luminire Eff | Quantity | Total Fixture Lumens |
|----------------|------------------------|-----------------|----------|-------------------------|
| 53 | 4,049 | 1.0 | 924 | 3,741,276 |
| 81 | 6,044 | 1.0 | 38 | 229,672 |
| 83 | 6,120 | 1.0 | 2 | 12,240 |
| 117 | 9,117 | 1.0 | 32 | 291,744 |
| 185 | 18,710 | 1.0 | 33 | 617,430 |
| 215 | 18,562 | 1.0 | 49 | 909,538 |

Total LED **1078** **5,801,900**

Grand Totals **18,082** **480,845,150**

Projected Project

| New LED | Lumens | Luminire Initial Dim | Quantity | Total Fixture Lumens |
|-------------|--------|-------------------------|----------|-------------------------|
| ATB260B E85 | 19,152 | 0.90 | 390 | 6,722,352 |
| ATBM D R3 | 11,689 | 0.90 | 9,388 | 98,762,699 |
| ATBM E R3 | 13,415 | 0.90 | 1,385 | 16,721,798 |
| ATBS E R2 | 3,962 | 0.90 | 3,215 | 11,464,047 |
| ATBS F R3 | 4,477 | 0.90 | 331 | 1,333,698 |
| ATBS H R2 | 6,249 | 0.90 | 1,213 | 6,822,033 |

Total New LED **15,922** **141,826,627**

New LED Intersections

| | | | | |
|-------------|--------|------|-------|------------|
| ATB260B E85 | 19,152 | 0.90 | 2,160 | 37,231,488 |
|-------------|--------|------|-------|------------|

Grand Totals **18,082** **179,058,115**

Total Environmental Lumen Reduction **62.76%**

- Preliminary analysis of current environmental lumen levels of the existing roadway lighting (cobrahead and shoebox) fixtures vs. post retrofit LED lighting shows a significant reduction in lumens
- Further reductions in environmental lumen emissions will occur during the dimmable hours noted previously

Project Cost and Financing