



Tucson, Arizona, is lit by environmentally sensitive, modern lighting that saves energy.  
Photo by Bettymaya Foott

## LIGHTING

---

*Can a lighting retrofit in a growing metropolitan city save energy, maintain safety standards, and protect the starry night sky?*

# NIGHTS OVER TUCSON:

## How the Tucson, Arizona, LED Conversion Improved the Quality of the Night

Tucson, Arizona, is a major metropolitan city in the southwest United States. The city has a long-standing commitment to best lighting practices that protect the night. In fact, people who move to the area often remark on how bright the stars appear to shine. But as the city has grown, so has its light pollution. With major astronomical observatories within close range, city leaders enacted an outdoor lighting ordinance in 2012 that requires fully shielded lighting and sets limits on the total light produced at night, especially in natural areas and areas

close to astronomy sites.

In 2016, Daryl Cole, the Director of Transportation for the city of Tucson, in consultation with IDA member, Christian Monrad, of Monrad Engineering, and Ameresco, a global energy management firm, developed a plan to convert nearly 20,000 street lights from high-pressure sodium to energy-efficient LEDs with adaptive controls. The plan projected savings of \$180,000 per month in energy consumption and a sixty percent reduction in lumen output from street lighting.

The conversion plan was approved by

***“The cost savings and the dimming capability – which also saves money on electrical usage – should be enough for any jurisdiction to consider LED conversion with dimming.” –Jessie Sanders, city of Tucson***

the Tucson city council in February 2016 and completed in 2018. In total, 19,561 fixtures were replaced with 3,000K LED lights. To prolong the life of the lights and reduce lumen output, the lights are operated at ninety percent capacity from the hours of sunset until midnight. After midnight, most of the lights are further reduced to sixty percent of capacity until they are extinguished thirty minutes after sunrise.

The results of the conversion are encouraging. The city of Tucson is saving millions of dollars in annual energy costs. The total lumen output from street lighting was reduced from ~481 million to ~181 million lumens during the early nighttime hours. When the streetlights are dimmed to sixty percent after midnight, the total lumen output is further reduced to ~134 million, a seventy-two percent reduction.

City officials tell IDA that they have received few comments about the change in lighting. But the differences are meaningful to wildlife, the environment, and for night sky protection. The lower lumen output results in a reduction of blue light emissions of approximately thirty-four percent, which is an important factor in making the city safer for nocturnal wildlife. Recent measurements made by IDA indicate that total measured

## THE TUCSON RETROFIT AT A GLANCE:

**19,561 lights retrofit to 3,000K LED lighting with adaptive controls**

**Lights operate at 90% power until midnight**

**Lights are further dimmed to 60% between midnight and sunrise**

light emissions from the city of Tucson have been reduced by seven percent.

Best of all, the benefits realized by Tucson’s lighting retrofit can be applied anywhere in the world. Tucson’s project manager, Jessie Sanders, told IDA, “The cost savings and the dimming capability – which also saves money on electrical usage – should be enough for any jurisdiction to consider LED conversion with dimming.”

Has your city recently undergone or considered a street lighting retrofit? We’d love to hear about your experience. Contact IDA at [contact@darksky.org](mailto:contact@darksky.org) with the subject line: Lighting Where We Live.

## THE RESULTS

**~\$2.16M in annual energy savings**

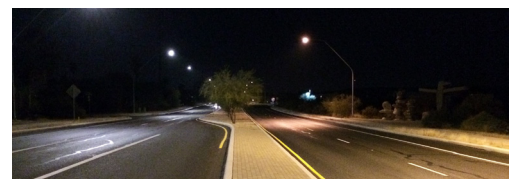
**Expected lifetime of luminaires extended from 8 to 25 years\***

**63% reduction of total lumens emitted by street lights**

**Blue light emissions were reduced by ~34%**

**7% reduction in total light emissions from the Tucson metro area**

*\*High-pressure sodium luminaire lifetime is approximately eight years. LEDs with the adaptive control measures implemented by the city of Tucson have an expected lifetime of twenty-five years.*



*High-pressure sodium lights on the right were replaced with 3,000 Kelvin LED lights, shown on the left. Image by John Barentine.*