NCHRP 17-113 COUNTERMEASURES

Replace Incandescent Traffic Signal Bulbs with Light Emitting Diodes

INTERSECTIONS

Light Emitting Diodes (LEDs) improve driver awareness and visibility of signals and signs at intersections.

Implementation Strategy

How and Where to Apply

- Replace incandescent bulbs with LEDs at signalized intersections on urban roads to improve visibility, reduce maintenance needs, and cut energy consumption.
- LED signal heads are typically installed during routine maintenance, signal upgrades, or as part of broader energy efficiency or safety initiatives.
- Best for busy intersections with complex lane use, offering brighter visibility and lower maintenance. In low-volume rural or cold areas, unnecessary use may cause lens frosting and reduced signal clarity.

Use in a Safe System Approach

Upgrading to LEDs aligns with the Safe System Approach by enhancing visibility and signal clarity. It supports human vulnerability and error reduction, helping drivers respond more reliably and reducing angle and rear-end crashes in poor conditions.

Key Stakeholders

State DOTs, MPOs, traffic signal engineers, utility companies, safety advocacy groups.

Proactive Implementation

Agencies should proactively retrofit existing incandescent signal bulbs with LEDs during signal maintenance, upgrades, or energy-efficiency programs. Prioritize intersections with high crash rates, poor visibility, or high energy and maintenance costs. LED conversions typically yield rapid cost savings and crash reductions, and bulk or corridor-based implementations can increase efficiency.

Countermeasure Overview

Objective: Improve driver awareness of intersections and signal control.
Strategy: Improve visibility of signals and signs at intersections.

Targeted Solution

CONTRIBUTING FACTORS	▪ Reduced visibility
TARGET CRASH TYPE	▪ Angle ▪ Rear-end ▪ Turning
ROAD FACILITY TYPE	▪ N/A
AREA TYPE	▪ Urban

Safety Linkage

NCHRP 500 Series
Intersection

AASHTO'S TOWARD ZERO DEATHS
Safer Infrastructure

SAFE SYSTEM APPROACH
Safe Roads

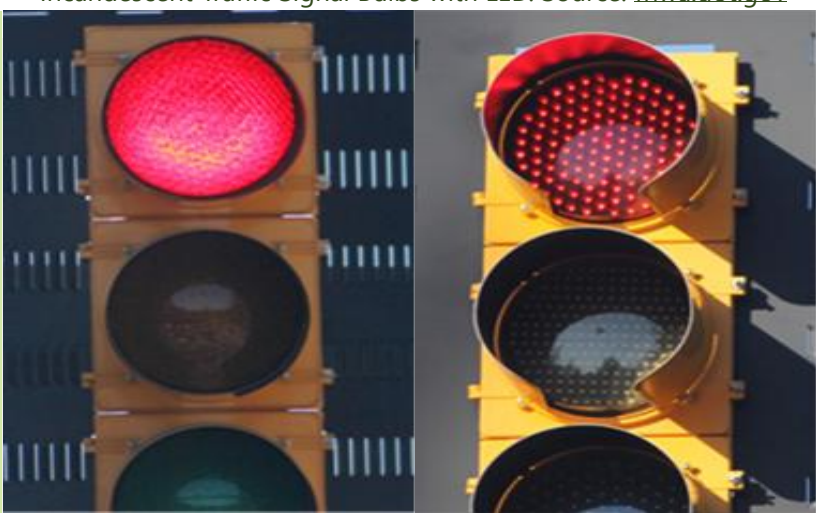
SAFE SYSTEM ROADWAY DESIGN
TIER 1
TIER 2
TIER 3
TIER 4
Tier 4

Selected Related Countermeasures

- CM1 LED-enhanced STOP signs or warning beacons
- CM2 Backplates with retroreflective borders
- CM3 Automated Traffic Signal Performance Monitoring

Cost: $ (Low)
Service Life: 5 years
Benefit-Cost Ratio:

Incandescent Traffic Signal Bulbs with LED. Source: fhwa.dot.gov



Safety Benefits

17% Reduce rear-end crashes all severity levels on urban roads (CMF ID: 4901)

04% Reduces angle, head-on, and left-turn crashes across all severity levels on urban roads (CMF ID: 4904)

Resources

- LED Traffic Signal Lifespan and Replacement Assessment
- LED Traffic Signal Management System