

The Last Great LED Hunt

Observations from the End of Residential Lighting

Background

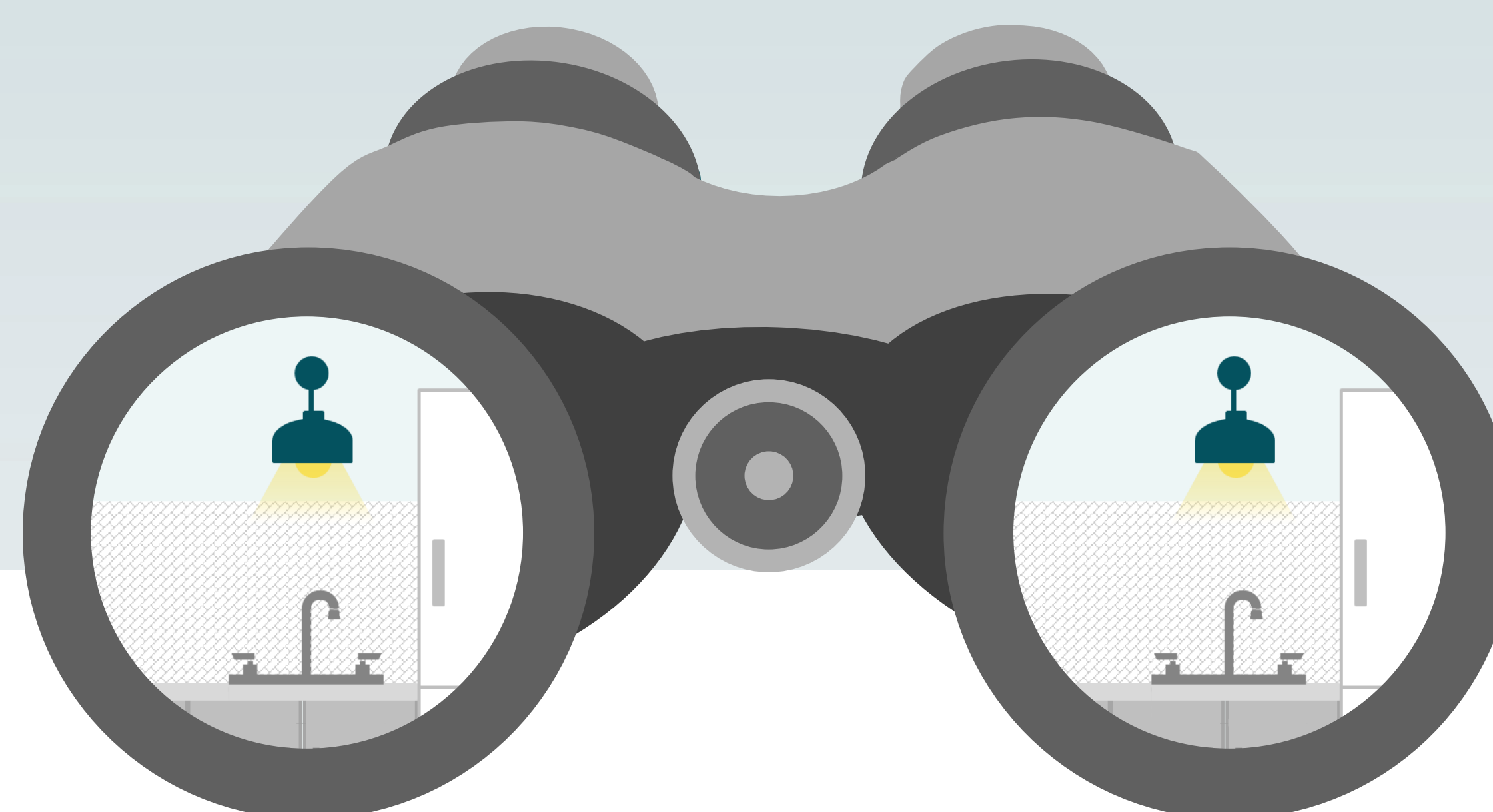
Residential lighting has historically accounted for the largest share of all residential energy savings, but recent developments are likely to diminish the effectiveness of traditional upstream programs.

- From 2007 to 2019, NMR conducted annual on-site lighting inventories of homes in Massachusetts and portions of New York
- We used data from these inventories to help understand the current lighting market and forecast market adoption
- Massachusetts has lighting programs that support ENERGY STAR® LEDs
- New York ended essentially all upstream incentives in 2014
- LED saturation in Massachusetts has increased steadily since 2013, and at a much faster rate than in New York

2019 LED Saturation



- The percentage of sockets filled with LEDs was significantly higher in Massachusetts than in New York
- Between 2009 and 2019, Massachusetts' saturation increased from 2% to 34%, while New York's increased from 1% to 22%
- ENERGY STAR® LEDs are the only type of LEDs supported by the Massachusetts program and accounted for the entire difference in LED saturation between Massachusetts and New York

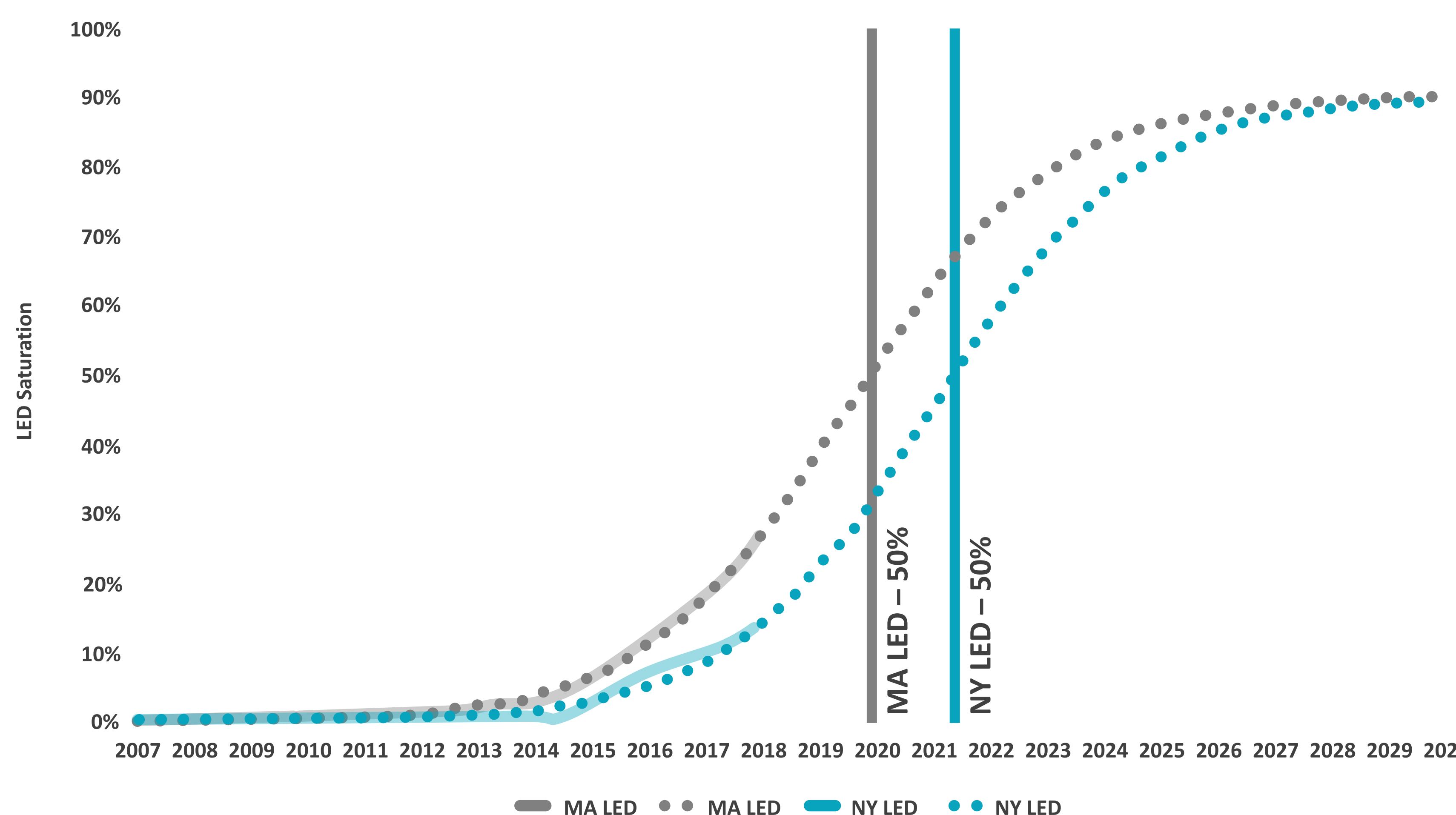


Since 2014, MA's residential lighting programs have substantially increased the state's LED saturation. Using the comparison area of NY, we are able to theorize what would have happened in the absence of these programs. Through 2018, this analysis showed an increasing gap in saturation between MA and NY. In 2019, for the first time, we did not observe an increase in the gap.

Adoption Curve

- We developed and fitted adoption curves to estimate future LED saturation
- Using observed changes in LED saturation, we used a simplified logistic function to forecast LED saturation for Massachusetts

$$f(t) = \frac{M}{1 + e^{-\alpha(t-T)}}$$
 - M = the maximum expected saturation for LEDs (we assumed that LED saturation would reach an M of 90%)
 - Manipulated α (the rate at which efficiency is increasing over time) and T (the point in time where we expect saturation to reach 50%) to match 2009 and 2018 observations
- Massachusetts is 1.5 to 2 years ahead of New York
- We predict that the gap in saturation will start to diminish in 2021 and converge by 2029



Why is the Gap Reducing?

Natural adoption of LEDs in New York

- LEDs gaining market share
- CFLs and some incandescents exiting market

New federal standards, which reduce the availability of inefficient lighting options

Energy Independence and Security Act of 2007 (EISA) Phase I: implemented in stages from 2012 to 2014

- Increased the efficacy requirements of the most common GSLs by about 28-30%
- Manufacture and import
- Allowed for sell through

Phase II: 2020 (EISA backstop and proposed rulemaking)

- Standard set to 45 lumens per Watt
- GSL definition expanded to include 7 previous exemptions
- 90% of previously exempt lamps now covered
- Implementation uncertain

Program Conclusions

- The lighting programs we studied positively influenced LED adoption in the residential market, which has reduced electricity bills for customers in Massachusetts
- Rough estimates of savings to individuals include:
 - \$600 million 2019 -2021
 - \$1 billion 2013-2020
 - \$1.5 billion 2013-2030
- These programs cost \$40 - \$50 million per year to operate
- The economic rationale for maintaining these programs may diminish as individuals naturally adopt LEDs and federal standards evolve