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Alexandra Feathers

LEGAL AVENUES FOR PROTECTING ACCESS TO STARRY SKIES

Alexandra Feathers*

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ABSTRACT

In the millennia before the creation and adoption of electric lighting, night skies drenched in stars were the inalienable inheritance of humanity. Electric lighting threatens this birthright by emitting star-blocking light—also known as light pollution—into night skies. Left unaddressed, light pollution will restrict access to dark, starry skies so that many in future generations will only know the stars secondhand. Yet despite the many benefits of dark skies, little scholarship has considered the problem of light pollution limiting the accessibility of starry skies, or how law can address this problem.

This Article balances the hope of a future without light pollution against the impracticability of eliminating electric lighting by offering a workable definition of redressable light pollution. After discussing proven ways to reduce light pollution, it recommends solutions for implementing these best practices using available legal avenues.

* University of Denver Sturm College of Law, J.D. expected 2022. B.S., University of Alabama. The author would like to thank Nancy Leong for her mentorship involving this Article.

INTRODUCTION

In the summer of 1889, Dutch artist Vincent van Gogh painted his world-renowned masterpiece *The Starry Night*.[1] The scene is lit by swirling celestial bodies in the night sky above and gas lamps in the town below.

The Starry Night, Vincent van Gogh (1889).[2]

Van Gogh painted the dreamy landscape while residing at a private asylum in the French village of Saint-Rémy-de-Provence.[3] He had voluntarily checked himself into the asylum following bouts of hypomania beginning with a harrowingly violent episode on Christmas Eve of 1888 during which he infamously cut off a piece of his left ear.[4] For the

[1] *Vincent van Gogh: The Starry Night,* MUSEUM OF MODERN ART, http://www.moma.org/collection/works/79802 (last visited Apr. 22, 2022) (excerpting GLENN D. LOWRY, MOMA HIGHLIGHTS: 375 WORKS FROM THE MUSEUM OF MODERN ART (2019)).
[2] Vincent van Gogh, *The Starry Night* (1889).
[3] RONALD PICKVANCE, VAN GOGH IN SAINT-RÉMY AND AUVERS 103 (John P. O'Neill et al. eds., 1986).
[4] Robert E. Hemphill, *The Illness of Vincent Van Gogh*, PROC. ROYAL SOC'Y MED. 1083, 1085 (1961).

remainder of his life, van Gogh cycled through phases of clarity and dark delirium. In an attempt to end his misery, van Gogh committed suicide in the summer of 1890.[5]

There is speculation as to the cause of van Gogh's troubled mind. His deeply concerned brother wrote that van Gogh had showed "symptoms of that most dreadful illness, of madness."[6] Some scholars believe van Gogh suffered from depression complicated by epilepsy and an excess intake of the hallucinogenic and alcoholic drink absinthe.[7] Despite his turbulent mental state, van Gogh created hundreds of paintings during his lifetime.[8] Posthumously, van Gogh's work rose from obscurity to international fame.[9]

In the fall prior to his relocation to the asylum in Saint-Rémy-de-Provence, van Gogh lived in Arles, a city on the Rhône River in southern France.[10] While there, van Gogh rented the right wing of a yellow house a block away from the riverbank of the Rhône.[11] As summer transitioned into fall, van Gogh set up his easel overlooking the riverbank at night and painted *The Starry Night Over the Rhone*.[12] Similar to *The Starry Night*, the night scene in *The Starry Night Over the Rhone* is lit by celestial bodies hanging in the sky above and gas lamps connected to the land below.

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[5] *Id.* at 1085-86.

[6] *Biography, 1888-1889: South of France*, VAN GOGH MUSEUM, http://www.vangoghmuseum.nl/en/art-and-stories/vincents-life-1853-1890/south-of-france (last visited Apr. 17, 2022).

[7] Hemphill, *supra* note 4, at 1086-87.

[8] Hemphill, *supra* note 4, at 1087.

[9] David Sheward, *7 Facts About Vincent van Gogh*, BIOGRAPHY (June 17, 2020), https://www.biography.com/news/vincent-van-gogh-biography-facts.

[10] *The Starry Night Over the Rhone, 1888 by Vincent van Gogh,* VINCENT VAN GOGH, http://www.vincentvangogh.org/starry-night-over-the-rhone.jsp (last visited Apr. 17, 2022) [hereinafter *The Starry Night Over the Rhone*].

[11] *The Yellow House, 1888 by Vincent van Gogh,* VINCENT VAN GOGH, https://www.vincentvangogh.org/the-yellow-house.jsp (last visited Apr. 17, 2022).

[12] *The Starry Night Over the Rhone*, *supra* note 10.

The Starry Night Over the Rhone, Vincent Van Gogh (1888).[13]

Both paintings are a tribute to van Gogh's powerful attraction to the night sky. During the fall he painted *The Starry Night Over the Rhone*, he wrote to his sister:

> It often seems to me that the night is even more richly colored than the day, colored in the most intense violets, blues, and greens. If you look carefully, you'll see that some stars are lemony, others have a pink, green, forget-me-not blue glow...it's clear that to paint a starry sky it's not nearly enough to put white spots on blue-black.[14]

More than 130 years later, admirers of van Gogh's work can still visit the same riverbank in Arles where he painted *The Starry Night Over the Rhone*. However, onlookers are not greeted by the same picturesque night sky van Gogh immortalized in his paintings. Instead of a starry, "richly colored" night sky, onlookers are affronted by a sky deprived of stars.[15] Specifically, the stars above Arles are obscured by what is called

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[13] Vincent van Gogh, *The Starry Night Over the Rhone* (1889).

[14] Annemarie Iker, *Vincent van Gogh*: *Dutch, 1853-1890*, MUSEUM OF MODERN ART (2000), http://www.moma.org/artists/2206 (citing VAN GOGH MUSEUM, *Vincent van Gogh to Willemien van Gogh*, Arles, 9 and c.14 (Sept. 1888), https://vangoghletters.org/vg/letters/let678/letter.html).

[15] *The Starry Night Over the Rhone*, *supra* note 10.

skyglow, which manifests as bright night skies that mask celestial bodies.[16] From far away, skyglow appears as a glowing dome over cities. In the below photograph you can see skyglow in the upper right corner, above the clouds.

The Rhone River (2008).[17]

Skyglow is the result of light from the electric lighting sources of urbanized areas.[18] Some of the emitted light directly penetrates the night sky, while some of the light first reflects off of the ground or nearby buildings and then travels into the night sky. Once in the sky, the light bounces off of small debris, particles, and water molecules in the atmosphere. Some of the light bounces from there back toward us on the ground.

Skyglow is one of four recognized components of light pollution. While the term "light pollution" is somewhat ambiguous, generally speaking, light pollution is defined as "unwanted or excess artificial lighting at night" and describes "the negative effects artificial

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[16] Paul Bogard, *Why We Need Darkness*, TEDxBratislava, (Oct. 5, 2016), https://www.youtube.com/watch?v=F55wBS2kNNQ&t=3s; *Light Pollution*, Int'l Dark-Sky Ass'n, http://www.darksky.org/light-pollution/ (last visited Apr. 17, 2022).

[17] This photograph was taken 120 years later at the same riverbank of the Rhone River where van Gogh set up his easel to paint *The Starry Night Over the Rhone* in 1888. Anne Jacko, Flickr, (Sep. 24, 2008) http://www.flickr.com/photos/33725200@N00/3167578454/in/photostream/.

[18] *Light Pollution*, *supra* note 16.

illumination can have on humans and the living environment."[19] These negative effects include the disruption of wildlife, impediment of astronomical observations, adverse effects on human health, and losing sight of starry skies.

The other components of light pollution are glare, light trespass, and clutter.[20] Glare is often defined as intense and excessive brightness that can cause visual discomfort and reduce visibility.[21] Light trespass is light that intrudes into the physical property of others.[22] Clutter as related to light pollution is often defined as over-illumination caused by excessive groupings of light sources.[23] All four components of light pollution are interconnected. Both glare and clutter contribute to skyglow, and both often commit light trespass. Because of the interconnectedness of the components, the term light pollution is appropriate—and often more convenient—to use when referring to one or more of the components.

Most light pollution comes from outdoor electric lighting. A study on light pollution published in 2020 categorized outdoor electric lighting into eight major lighting types:

> (1) Street and area lighting; (2) building and nonbuilding structure lighting; (3) industrial and commercial lighting; (4) sports field facility lighting; (5) advertisement lighting; (6) park and garden lighting; (7) safety and security lighting[;] and (8) event lighting.[24]

As areas become more urban, prevalence of the outdoor electric lighting types across these categories increases, and clarity of starry night skies diminishes.[25]

Currently, most nations do not have laws addressing light pollution at a national level, if at all. Rather, the protection of dark skies is left to organizations, individuals, and scattered local lighting laws. Alone, such measures are not enough to combat light pollution and ensure dark skies for future generations. I offer the photograph of the starless night sky over the Rhône River in Arles as support, but I easily could have done

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[19] Nona Schulte-Römer et al., *Lighting Professionals versus Light Pollution Experts?; Investigating Views on an Emerging Environmental Concern*, 11 SUSTAINABILITY 1696, 1696 (2019).
[20] *Light Pollution*, *supra* note 16.
[21] Karolina Zielińska-Dabkowska et al., *Assessment of Citizens' Actions against Light Pollution with Guidelines for Future Initiatives*, 12 SUSTAINABILITY 4997, 5004 (2020).
[22] *Id.* at 5002.
[23] *Light Pollution*, *supra* note 16.
[24] Zielińska-Dabkowska et al., *supra* note 21, at 5008.
[25] *Id.*

the same for hundreds of thousands of developed cities around the globe. Moreover, while legal scholars have examined various aspects of light pollution, no article has yet framed light pollution as a problem of accessibility while offering a comprehensive examination of light pollution and the legal avenues available to address this problem.[26]

This Article takes up the important project of analyzing how to best protect access to starry skies through legal avenues. I argue that, while light pollution has been a consequence of social progress, legislators can and should implement laws to ensure that the stars will remain accessible to all generations. In Part I, I provide a brief history of lighting to explain the rise of electric lighting. In Part II, I discuss the positive and negative effects of electric lighting to encourage critical consideration of light pollution and emphasize the need for action against this pollutant. In Part III, I describe the best lighting practices to reduce light pollution. Then, in Part IV, I discuss the merits of various legal avenues for implementing these best lighting practices.

I. A HISTORY OF LIGHTING

The history of lighting begins with fire. Strong evidence suggests our distant ancestors, the *Homo erectus*, were the first to control fire at least 250,000 years ago, and possibly, as much as 800,000 years ago.[27] Within that time frame, humans began managing fire—"meaning they could capture it, contain it, and supply it with fuel to keep it going within their living areas"—as campfires inside caves.[28]

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[26] D. Eric Lystrup, Comment, *The Dark Side of the Light: Rachel Carson, Light Pollution, and a Case for Federal Regulation*, 57 JURIM. J. 505 (2017) (discussing federal regulation as a means of addressing light pollution); Andrea L. Johnson, Comment, *Blinded by the Light: Addressing the Growing Light Pollution Problem*, 2 TEX. A&M J. OF PROPERTY L. 401 (2015) (addressing light pollution through the lens of property law); Yuen Yiu, *To Light, Or Not to Light the Skies?*, INSIDE SCIENCE (Apr. 16, 2021), https://www.insidescience.org/news/light-or-not-light-our-skies (discussing the impacts of light pollution and best lighting practices); Chadwick A. Moore et al., *Finding Inspiration in the Face of Endangered Starry Skies*, 441 ASTRONOMICAL SOC'Y PAC. 451 (2011) (discussing inspiration as a means to generate interest in dark skies); Travis Longcore et al., *Ecological Light Pollution*, 2 FRONTIERS IN ECOLOGY AND THE ENVT. 191 (2004) (exploring the consequences of light pollution on the environment); Ron Chepesiuk, *Missing the Dark: Health Effects of Light Pollution*, 117 ENV'T HEALTH PERSP. 20, 20-27 (2009) (discussing the health impacts of light pollution); Franz Hölker et al., *The Dark Side of Light: A Transdisciplinary Research Agenda for Light Pollution Policy,* 15 ECOLOGY AND SOC'Y 13 (2010) (discussing light pollution policy).

[27] Richard W. Wrangham & Rachel Naomi Carmody, *Human Adaptation to the Control of Fire*, 19 EVOLUTIONARY ANTHROPOLOGY 187, 196 (2010).

[28] Dennis Sandgathe & Harold L. Dibble, *Who Started the First Fire?*, ANTHROPOLOGY MAG. (Jan. 26, 2017), http://www.sapiens.org/archaeology/neanderthal-fire/.

The first "primitive" lamps were made from rocks or shells with shallow depressions and used moss drenched in animal grease for fuel.[29] As the world's ancient societies formed, lamps became a necessity for adequate lighting in the built environment, including homes, markets, workshops, temples of worship, and palaces.[30]

Despite serving similar functions, lamps differed greatly in both technical and artistic design by region and age. Some lamps were made of metal, others clay or glass.[31] Some were ergonomic, others were intricately decorated with iconography of religion, sports, nature, and erotica.[32] Some used animal fat as fuel, others used beeswax or olive oil.[33] Because of their widespread use and diversity, lamps subtly recorded the culture of their makers over time—a gift to historians.[34]

Notably in lighting history, Ancient Egyptians created the rushlight by dipping rush stalk wicks into tallow[35] some 5,000 years ago.[36] Later, Babylonians and Assyrians used lamps with linen wicks and expensive olive or sesame oil fuel as lighting within temples and spawned the first notable lighting fuel market.[37] Around this time, Romans created the first modern candles from thick layers of hardened tallow.[38] Tallow candles smelled better, smoked less, burned brighter, and lasted longer than Egyptian rushlights.[39] Following the invention of the tallow candle around year 100, lighting technology made little progress until the Industrial Revolution.[40]

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[29] William D. Nordhaus, *Do Real-Output and Real-Wage Measures Capture Reality? The History of Lighting Suggests Not*, *in* THE ECONOMICS OF NEW GOODS 29, 32 (Timothy F. Bresnahan & Robert J. Gordon eds. 1996), available at http://www.nber.org/system/files/chapters/c6064/c6064.pdf; Atthar Mirza, *The Iridescent History of Light*, ATLANTIC (May 17, 2018), http://www.theatlantic.com/video/index/560585/visual-history-light/.

[30] Timothy Potts, *Director's Foreword* to JEAN BUSSIÈRE & BIRGITTA LINDROS WOHL, ANCIENT LAMPS, J. PAUL GETTY MUSEUM, http://www.getty.edu/publications/ancient lamps/foreword.

[31] MILWAUKEE PUBLIC MUSEUM, *Description and History of Oil Lamps*, http://www.mpm.edu/research-collections/anthropology/anthropology-collections-research/mediterranean-oil-lamps/description-and-history-oil-lamps (last visited Apr. 20, 2022).

[32] *Id*.

[33] *Id.*

[34] Potts, *supra* note 30.

[35] "A hard fatty substance made from rendered animal fat." *Tallow*, OXFORD ENGLISH DICTIONARY (2nd ed. 1989).

[36] Mirza, *supra* note 29.

[37] *Id.*; Nordhaus, *supra* note 29, at 33.

[38] Mirza, *supra* note 29.

[39] *Electrifying: The Story of Lighting Our Homes*, SCIENCE MUSEUM (Jan. 28, 2020), http://www.sciencemuseum.org.uk/objects-and-stories/everyday-wonders/electric-lighting-home [hereinafter *Electrifying*].

[40] Nordhaus, *supra* note 29, at 33; Mirza, *supra* note 29.

As technological progress idled, some of the first recorded lighting laws emerged in Europe. In 1417 London, the mayor passed a law that ordered residents to hang lighted lamps outside of their homes during winter nights.[41] A Parisian law passed in 1524 required street facing homes to have a light in the window to illuminate the streets at night.[42]

Toward the end of the 1700s, lighting technology finally saw progress again, spearheaded by Scottish mechanic genius William Murdock.[43] At the age of 23, Murdock walked 300 miles to request employment at the Soho Manufactory because he wanted work on the cutting-edge steam engines the plant manufactured.[44] He was immediately employed.[45] Years later, Murdock experimented with using gas instead of oil as a fuel source for lamps and eventually lit his home and offices with gas lamps.[46]

Gas lighting technology steadily spread throughout Europe and America in the form of streetlights and factory lights.[47] London first used gas lights as streetlights in 1807.[48] About 10 years later, Baltimore became the first American city to use gas streetlights.[49] Gas lighting eventually made its way into homes, although its use was discouraged in bedrooms because of the "unfortunate downsides of choking fumes, smoke, blackened walls and the risk of the odd explosion."[50]

Just as gas lighting gained momentum throughout the world, along came the advent of electric lighting. Humphrey Davy, a British chemist, invented the first electric lamp–the arc lamp–in the early 1800s.[51] Arc lamps ignite when two electrodes connected to a battery are touched together, sparking an electrical arc. The electrodes are then slowly separated, and the current maintains a bright arc of electricity across the gap. While innovative, arc lamps required massive amounts of battery power; were costly to operate; and generated intense noise, heat, and

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[41] *History of Street Lighting*, HISTORY OF LIGHTING, http://www.historyoflighting.net/electric-lighting-history/history-of-street-lighting/ (last visited Mar. 5, 2022).
[42] *Id.*
[43] *A Portrait of William Murdoch*, REVOLUTIONARY PLAYERS, http://www.revolutionaryplayers.org.uk/a-portrait-of-william-murdoch/ (last visited Apr. 20, 2022).
[44] *Id.*
[45] *Id.*
[46] *William Murdock*, ENCYC. BRITANNICA, http://www.britannica.com/biography/William-Murdock-Scottish-inventor (last visited Apr. 20, 2022).
[47] *Electrifying*, *supra* note 39.
[48] *History of Street Lighting*, *supra* note 41.
[49] *Id.*
[50] *Electrifying*, *supra* note 39.
[51] Mirza, *supra* note 29.

light.[52] The combination of these characteristics made arc lamps impractical for most uses.

About 60 years later, Russian electrical engineer Pavel Yablochkov dramatically modified the arc lamp, rendering it useful for outdoor applications.[53] Paris utilized the modified arc lamps as streetlights in 1878.[54] The electric streetlight trend spread throughout other European cities and reached American cities shortly thereafter.[55]

Meanwhile, from about the 1840s to the 1880s, the discrete efforts of scientists and inventors across the globe culminated in the creation of the incandescent light bulb.[56] American inventor and businessman Thomas Edison ultimately patented and commercialized his version of the light bulb.[57] With funding from American finance tycoon J.P. Morgan, Edison helped launch General Electric ("GE") in 1882 to better commercialize the technology.[58] In the fall of the same year, Edison opened Pearl Street Station in Manhattan, New York, the first electric power plant in America.[59] Pearl Street connected residential and commercial buildings to a bank of generators through a network of buried copper wire.[60] The Pearl Street centralized power plant eliminated the need for individual on-site generators previously required to use electricity and created the blueprint for a widespread power industry.[61] With convenient access to power from the up-and-coming electrical grid, light bulbs quickly became the ideal lighting option.[62]

From the 1900s to the 1930s, GE pushed to consolidate local power plants spread throughout locations in America and eventually established an economy of scale with a few, highly centralized power providers.[63] This centralized model is still used for the electrical grid in America

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[52] *December 20, 1900: Nature Reports on William Duddell's "Musical Arcs,"* 19 AM. PHYSICAL SOC'Y PHYSICS 1, 2 (2010), available at https://www.aps.org/publications/apsnews/201012/upload/December-2010.pdf.
[53] *Pavel Nikolayevich Yablochkov*, ENCYC. BRITANNICA, http://www.britannica.com/biography/Pavel-Nikolayevich-Yablochkov (last modified Mar. 27, 2022).
[54] *Arc Lamp*, ENCYC. BRITANNICA, http://www.britannica.com/technology/arc-lamp (last visited Apr. 20, 2022).
[55] Mirza, *supra* note 29.
[56] Elizabeth Palermo & Callum McKelvie, *Who Invented the Lightbulb?*, LIVESCIENCE, (Nov. 23, 2021), https://www.livescience.com/43424-who-invented-the-light-bulb.html.
[57] *History of Electricity*, INSTITUTE FOR ENERGY RESEARCH, http://www.institutefor energyresearch.org/history-electricity/ (last visited Apr. 20, 2022).
[58] *Id.*
[59] *Id.*
[60] *Id.*
[61] *Id.*
[62] *Electrifying*, *supra* note 39.
[63] *History of Electricity*, *supra* note 57.

today. Europe also engineered a centralized electrical grid. As of 2020, 35 European countries are members of the European Network of Transmission System Operators for Electricity which operates the synchronous grid that provides power to much of continental Europe.[64]

In addition to the momentous construction and standardization of the power grid, the 1900s are notable in lighting history because of the numerous types of lights and applications that were conceived during the century. The new lights and applications included neon signs, cathode ray tubes used for early televisions, infrared cameras used for night vision technology, laser beams, light-emitting diodes ("LEDs"), liquid-crystal display ("LCD"), fiber optic cables used for high-speed internet, and organic light-emitting diodes ("OLED") that would later be used for screens in smartphones and computer monitors.[65]

Now, night skies are brighter than ever.[66] Floodlit billboards beg for attention. Jutting skyscrapers twinkle with office lights. Glowing strings of streetlights adorn meandering highways. Austere spotlights illuminate stoic monuments. These lights bleed into the night sky, blocking the stars.

II. LIGHT AT NIGHT

In 2001, in response to the rising levels of light at night, amateur astronomer John E. Bortle created a scale that classifies night skies based on darkness.[67] The nine-level numeric scale ranges from the pristine, dark skies of Class 1 to the bright inner-city skies with little to no stellar visibility of Class 9.[68] Bortle published this scale, now known as the Bortle Scale, to help amateur astronomers evaluate the light quality of observing sites, a useful tool as night skies become brighter. [69]

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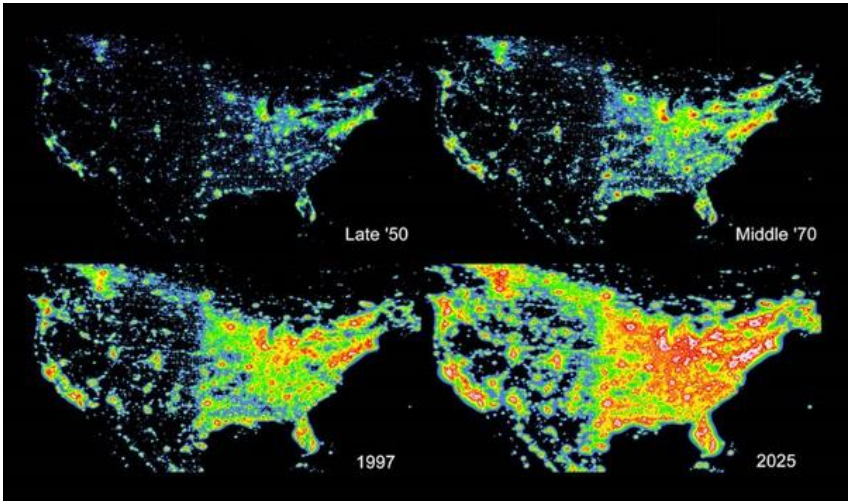
[64] *Systems Operations Committee*, ENTSO-E, http://www.entsoe.eu/about/system-operations/ (last visited Apr. 20, 2022).
[65] Mirza, *supra* note 29.
[66] Fabio Falchi et al., *The New World Atlas of Artificial Night Sky Brightness*, 2 SCI. ADV. 1, 4 (2016).
[67] John E. Bortle, *Gauging Light Pollution: The Bortle Dark-Sky Scale*, SKY AND TELESCOPE (July 18, 2006), http://skyandtelescope.org/astronomy-resources/light-pollution-and-astronomy-the-bortle-dark-sky-scale/.
[68] *Id.*
[69] Bortle, *supra* note 67.

The Bortle Scale[70]

Amateur astronomers are not the only ones affected by light at night. Researchers found that about one-third of humanity can't see the Milky Way because of light pollution.[71] This means that one-third of humanity lives under skies ranking anywhere from a Class 5 to a Class 9 on the Bortle Scale.

[70] *The Bortle Scale*, *in Skyglow*, SKYGLOW PROJECT, https://skyglowproject.com/#light-pollution (last viewed Mar. 5, 2022).
[71] Falchi et al., *supra* note 66, at 4.



Night Sky Illumination in North America[72]

Available to all in generations past, starry skies are now turning into a scarce, location-specific amenity.[73] As light at night increases, dark sky locations become attractive and lucrative for governments and businesses able to capitalize on the economic opportunities provided by astronomers and stargazing astro-tourists.[74] The result is the commodification of dark skies by the individuals and groups who interact in this microeconomy.

Should the commodification of dark skies trouble us? Scholar Michael Sandel offers guidance.[75] Sandel observes humanity trending toward a market-based society, with "markets, and market-oriented thinking" reaching into "aspects of life traditionally governed by

[72] P. Cinzano, F. Falchi & C. D. Elvidge, Maps Showing the Increase in Artificial Night Sky Brightness in North America, *in* Yuen Yiu, *To Light, Or Not to Light the Skies?*, INSIDE SCIENCE (Apr. 16, 2021), https://www.insidescience.org/news/light-or-not-light-our-skies.

[73] To economists, amenities "include all of those location-specific public good characteristics of a place that increase that place's attractiveness as a residential or business location." Thomas Michael Power, *The Supply and Demand for Natural Amenities: an Overview of Theory and Concepts*, *in* AMENITIES AND RURAL DEVELOPMENT: THEORY, METHODS AND PUBLIC POLICY 63 (2012).

[74] *Id.*; Marissa Kozma, *A Dark Sky Tour is Coming to Colorado that Includes Remote Towns with Starry Skies*, 303 MAGAZINE (Dec. 6, 2019), http://303magazine.com/2019/12/dark-sky-tour-colorado.

[75] MICHAEL J. SANDEL, WHAT MONEY CAN'T BUY: THE MORAL LIMITS OF MARKETS 7 (2012).

nonmarket norms."[76] Sandel believes this trend is concerning for two reasons: inequality and corruption.[77]

Inequality, Sandel argues, becomes concerning when money can buy not only luxuries, but also fundamental things like good medical care, an education, or a home in a safe neighborhood.[78] When money can buy fundamental things, "having money makes all the difference in the world."[79] Should access to dark, starry skies be considered a luxury, or is there something that makes inequal access to starry skies concerning? In 2007, leading international organizations and academics attended the International Conference in Defense of the Quality of Night Sky in the Canary Islands of Spain.[80] The concept of a "right to starlight" proposed by the resulting *Declaration in Defence of the Night Sky and the Right to Starlight*, indicates access to starry skies is more than an inconsequential luxury.[81]

Corruption is the more amorphous concern. Sandel argues markets have a "corrosive tendency" because markets "don't only allocate goods; they also express and promote certain attitudes toward the goods being exchanged."[82] For example, a $50 ticket to an astro-tour may corrode the experience of seeing a starry night sky by assigning a price of admission. Instead of a priceless, transcendental experience, viewing the night sky becomes quantifiable, thus cheapening the experience.

Under Sandel's method for determining whether commodification of a thing is concerning, there is at least an argument that both the inequality and corruption prong are met for dark skies. But there are other methods for determining the answer to the question "should the commodification of dark skies trouble us?"

Doing a cost-benefit analysis is one of these other methods. In economics, a cost-benefit analysis is a "technique for measuring whether the benefits of a particular action are bigger than the costs, judged from the viewpoint of society as a whole."[83] Economists often use this technique to make recommendations on whether to introduce a

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[76] *Id.*
[77] *Id.* at 8.
[78] *Id.*
[79] *Id.*
[80] These organizations included the United Nations Educational, Scientific and Cultural Organization and the International Astronomical Union. *Symposiums Overview*, DARK SKY PARKS, http://darkskyparks.org/sympusium-2011-overview (last visited Apr. 22, 2022).
[81] *Id.*
[82] SANDEL, *supra* note 75, at 9.
[83] NICK HANLEY & EDWARD B. BARBIER, PRICING NATURE: COST-BENEFIT ANALYSIS AND ENVIRONMENTAL POLICY 1 (2009).

government policy, to reform an existing government policy, or to begin a project.[84] These recommendations are used to advise decision makers on courses of action with extensive consequences.

The cost-benefit analysis offers a useful initial structure for the debate on whether the commodification of dark skies should trouble us, however, cost-benefit analyses are based on quantified financial costs and benefits, and I believe this method should be complemented by Sandel's qualitative considerations. In an effort to combine the best of both methods, I discuss the positive and negative effects of light at night while noting both the quantifiable and the qualitative effects of lighting where appropriate.

In Subpart A, I discuss positive effects of lighting. In Subpart B, I discuss negative effects of lighting and emphasize that, *yes*, the commodification of dark skies should trouble us. In Subpart C, I offer a workable definition of redressable light pollution.

A. *The Good*

As noted earlier, the eight major outdoor electric lighting sources are:

> (1) Street and area lighting; (2) building and nonbuilding structure lighting; (3) industrial and commercial lighting; (4) sports field facility lighting; (5) advertisement lighting; (6) park and garden lighting; (7) safety and security lighting[;] and (8) event lighting.[85]

Each of these eight major sources have the positive effect of enabling or enhancing modern life.

In 2015, the United Nations ("UN") General Assembly designated the year as the International Year of Light and Light-based Technologies ("IYL 2015").[86] One topic of IYL 2015 specifically focused on the positive effects of "light in the built environment," noting that "lighting provides safety and security, provides access to education, enhances architecture, and improves quality of life."[87] One way we may expect

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[84] *Id.*

[85] Zielińska-Dabkowska, *supra* note 24, at 5006.

[86] *About the Year of Light*, INT'L YEAR OF LIGHT AND LIGHT-BASED TECH., http://www.light2015.org/Home/About.html (last visited Apr. 22, 2022).

[87] Isabella Creatura, *Public Lighting and the Urban Wealth Gap*, BROWN POL. REV. (Feb. 22, 2017), http://brownpoliticalreview.org/2017/02/public-lighting-urban-wealth-gap (quoting the United Nations' International Year of Light website).

lighting to provide safety and security is through crime prevention. Dark alleyways have become synonymous with danger. But does outdoor electric lighting actually help prevent crime? Signs point to yes; lighting does provide the intuitive benefit of crime prevention.[88] However, *how* lighting prevents crime may not be intuitive.

A report prepared for the Swedish National Council for Crime Prevention detailed the two main theories of how street lighting reduces crime.[89] The first theory suggested improved street lighting increases surveillance and deters potential offenders from committing crimes.[90] For this theory, case study locations were predicted to experience a reduction of crimes committed during night.[91]

The second theory suggests improved street lighting "signals community investment" and leads to "increased community pride, community cohesiveness, and informal social control."[92] For this theory, case study locations were predicted to experience a reduction of crimes committed during both day and night.[93] The results favored the second theory: night crime did not decrease more than day crime, indicating street lighting may help reduce crime by fostering community pride, not by surveilling the community.[94]

The findings of the Swedish National Council for Crime Prevention report support the UN's assertion that lighting both provides safety and security and improves quality of life. Policy makers would do well to recognize the comingled benefits of light at night. A Staff Writer for the Brown Political Review poignantly remarked on the inclination to install bright floodlights in crime-prone, low-income communities to reduce crime:

> City governments need to understand that public lighting is an important aspect of building the cityscape, instead of a means of controlling behavior. Projects should be designed with the user and usage in mind; only then will the disparity between the lighting of different neighborhoods be decreased. Poorer neighborhoods should not be aesthetically — and therefore socially — alienated from the rest of the city. Lighting needs to

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[88] BRANDON C. WELSH & DAVID P. FARRINGTON, IMPROVED STREET LIGHTING AND CRIME PREVENTION 8 (2007).
[89] *Id.* at 1.
[90] *Id.* at 7.
[91] *Id.*
[92] *Id.*
[93] *Id.*
[94] *Id.* at 8.

> be recognized as a tool of social integration, not an aesthetic right reserved only for the wealthy.[95]

Her remark emphasizes the positive social effects lighting can have if wielded correctly, with both tangible results like a reduction of crime and intangible results like social integration.

Another example of the positive social effect outdoor electric lighting can have on members of a community comes from Greece. In the wake of the 2008 financial crisis, many residents in the low-income neighborhoods of Athens turned off the lights outside of their homes and businesses to reduce expenses.[96] The lights stayed off for years; a visible symptom of the degradation of spirit caused by experiencing the brunt of a financial crisis. Kypseli, one of the darkened neighborhoods, saw a resurgence of illuminated streets in 2015 after volunteers created a group called *Foteini Kypseli*, "Light in Kypseli."[97] The group aimed to bring back civic pride in Kypseli through well-lit streets. The idea behind the group was that "simple changes can give back big returns in people's everyday quality of life – far more than we often realize."[98] The positive effects of the volunteers' efforts were "clear to see," as the streets, playgrounds, and people of Kypseli experienced a resurgence.[99]

As mentioned earlier, lighting and the resulting skyglow have also created the novel astro-tourism market. As more places have bright night skies, places with dark, starry skies have an opportunity to economically benefit from their amenity.[100] Flagstaff, Arizona has "achieved worldwide recognition" for its dark skies and has become a haven for research and recreational observatories.[101] As more stargazers and astronomers come to the city, the more Flagstaff benefits economically.

The Dark Sky Tour of Colorado is an excellent example of the economic benefits dark night skies can bring. In 2019, the tour won $25,000 from the Colorado Tourism Office to create a map of dark sky locations around the state.[102] Lindsey Diamond, one of the marketers behind the tour, explained that one rural Colorado town saw a 20%

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[95] Creatura, *supra* note 87.
[96] Feargus O'Sullivan, *A Bright Idea to Revive a Neighborhood*, BLOOMBERG (Oct. 17, 2017), http://www.bloomberg.com/news/articles/2017-10-17/how-street-lights-can-revive-a-struggling-neighborhood.
[97] *Id.*
[98] *Id.*
[99] *Id.*
[100] Kozma, *supra* note 74.
[101] *International Dark Sky*, CITY OF FLAGSTAFF, http://www.flagstaff.az.gov/4042/international-dark-sky (last visited Apr. 20, 2022).
[102] Kozma, *supra* note 74.

increase in lodging tax after marketing the town as a stargazing hotspot.[103] Diamond articulated how dark skies can bring economic benefits to rural locations:

> The thing with stargazers is they have to spend the night. They're putting money into local economies because they're getting hotel rooms or Airbnbs and they're spending money on dinner…Our ultimate goal is to promote tourism in these rural areas. The big towns in Colorado are doing just fine. These rural communities — their economies are struggling. If we can get [stargazers] to just spend the night, they have a day that they can fill with activities.[104]

From economic growth to safety to community well-being, outdoor electric lighting has so many positive effects. However, it would be remiss to focus solely on the positive effects when electric lighting also has substantial negative effects.

B. *The Bad*

As electric lighting becomes brighter and more prolific, researchers have identified planetariums and astro-tours as the main options individuals will have to experience dark skies.[105] Those unable to afford travel or entrance expenses will only experience the stars secondhand, through media and art like IMAX shows, paintings, and poems. If the possibility of only ever experiencing the stars secondhand seems like an exaggeration, it is not. In 1994 Los Angeles experienced a massive earthquake that knocked out power throughout the city.[106] That night, emergency responders received phone calls from uneasy residents reporting a "giant silvery cloud" in the sky.[107] That "giant silvery cloud" was the Milky Way.[108]

Seeing starry skies is important for the soul, the metaphysical, the spiritual, the imagination.[109] As these aspects of a person degrade,

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[103] *Id.*
[104] *Id.*
[105] Moore et al., *supra* note 26.
[106] Joe Sharkey, *Helping the Stars Take Back the Night*, N.Y. TIMES (Aug. 30, 2008), https://www.nytimes.com/2008/08/31/business/31essay.html
[107] *Id.*
[108] *Id.*
[109] Moore et al., *supra* note 26, quoting: Immanuel Kant ("Two things fill my mind with ever increasing wonder and awe, the more often and more intensely reflection dwells on

culture, art, and humanity degrade over time. Without starry skies, it's almost certain Van Gogh would have never painted *The Starry Night*. As Van Gogh wrote to his friend and fellow artist:

> I'm still living off the real world. . . I exaggerate, I sometimes make changes to the subject, but still I don't invent the whole of the painting; on the contrary, I find it ready-made—but to be untangled—in the real world.[110]

The "real world" is now starless for many because of light pollution. This disproportionally affects those who cannot afford to see the stars—those who cannot afford to go on the Dark Sky Tour of Colorado—and creates problematic inequality because seeing the stars isn't a luxury under Sandel's analysis.[111] Yes, people can live without the stars, but people can also live without a good education and a safe neighborhood. People can live without all these things; but their lives will be less enriched. To lose sight of starry skies is a tragedy. As Immanuel Kant said:

> Two things fill the mind with ever new and increasing admiration and awe, the more often and steadily we reflect upon them: the starry heavens above me and the moral law within me.[112]

Electric lighting threatens humanity's ability to "reflect upon . . . the starry heavens above" by over-illuminating night skies. For this reason alone, under Sandel's analysis, *yes*, the commodification of dark skies should trouble us.

More tangibly, electric lighting can negatively affect health. Melatonin is a hormone that induces sleep.[113] When light levels decrease, melatonin production increases.[114] When light levels increase, it signals

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them–the starry heavens above, and the moral law within me"); Plato ("Astronomy compels the soul to look upward and leads us from this world to another"); Walt Whitman ("I believe a leaf of grass is no less than the journey-work of the stars"); and Llewelyn Powys ("No sight that human eyes can look upon is more provocative of awe than is the night sky scattered thick with stars").

[110] Iker, *supra* note 14.

[111] SANDEL, *supra* note 75, at 8.

[112] *Kant's Tombstone in Kaliningrad*, COLUMBIA COLL., https://www.college.columbia.edu/core/content/kant%E2%80%99s-tombstone-kaliningrad (last visited Jan. 19, 2022).

[113] Mayo Clinic Staff, *Melatonin*, MAYO CLINIC, (Mar. 3, 2021), https://www.mayoclinic.org/drugs-supplements-melatonin/art-20363071.

[114] *Id.*

the body to wake up and decrease the production of sleep-inducing melatonin.[115] Over time, this creates a sleep-wake cycle and corresponding circadian rhythm within the body.[116] Skyglow and trespassing light disrupts the circadian rhythm and causes a desynchronization over time.[117] A desynchronization of circadian rhythm can negatively affect mood, behavior, cognitive performance, mental health, energy levels, depression, fatigue, insomnia, blood pressure, and metabolism, all of which may contribute to a slew of other health problems.[118]

While light pollution prevents many from fully experiencing the stars or getting proper sleep, light pollution also hinders the work of astronomers.[119] To conduct research on stellar objects millions of kilometers away, scientists must use extremely precise telescopes, and skyglow is fantastic at obstructing the desired object of observation.[120] Why do we care about astronomical research? One astrophysicist says, "we support astronomy – along with all science in general – because it's an expression of our underlying human curiosity."[121] In an extreme example, astronomical observations can also mitigate safety concerns.

Consider what happened in Russia on February 15th, 2013, when an asteroid 17 meters in diameter and 10,000 metric tons exploded over Chelyabinsk.[122] The shock wave generated by the asteroid extensively damaged buildings and injured about 1,200 people.[123] The incident in Chelyabinsk ignited an interest in mitigating threats from Near-Earth Objects ("NEOs").[124]

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[115] *Id.*

[116] *Circadian Rhythms*, NAT'L INST. OF GEN. MED. SCIS., http://www.nigms.nih.gov/education/fact-sheets/Pages/circadian-rhythms.aspx (last visited Apr. 21, 2022).

[117] *Id.*; Hector Lamphar & Miroslav Kocifaj, *Light Pollution in Ultraviolet and Visible Spectrum: Effect on Different Visual Perceptions*, 8 PLOS ONE 1, 2 (2013).

[118] Ruthra Tharumalay et al., *The Effects of Circadian Rhythm Disruption Towards Metabolic Stress and Mental Health: A Review,* 18 MALAYSIAN J. OF HEALTH AND SCIS., 47, 49 (2020).

[119] Dave Kornreich, *How Does Light Pollution Affect Astronomers?*, CORNELL, http://curious.astro.cornell.edu/people-and-astronomy/116-observational-astronomy/stargazing/professional-observers/712-how-does-light-pollution-affect-astronomers-intermediate (last visited Jan. 19, 2022).

[120] *Id.*

[121] Paul Sutter, *Why Astronomy Remains Relevant Today*, SPACE.COM, (Dec. 29, 2020), https://www.space.com/why-astronomy-is-important-today.

[122] Elizabeth Howell, *Chelyabinsk Meteor: A Wake-Up Call for Earth*, SPACE.COM (Jan. 9, 2019), https://www.space.com/33623- chelyabinsk-meteor-wake-up-call-for-earth.html; D.W. Dunham et al., *A Concept for Providing Warning of Earth Impacts by Small Asteroids*, 47 SOLAR SYSTEM RSCH. 315 (2013).

[123] Dunham et al., *supra* note 122, at 315.

[124] *Id.* at 316.

The current protection system for NEOs relies on telescopes and astronomers to identify NEOs that may collide with Earth.[125] Most NEOs are initially detected by powerful survey telescopes located in Arizona, Hawaii and New Mexico; remote areas—for now—far from skyglow.[126] Once a survey telescope detects a new NEO, a global network of support telescopes observes the NEO to determine orbit and assess the threat posed to Earth.[127] Early identification of NEOs is critical to modifying the NEOs' trajectory and preventing a destructive collision.[128] The threat from NEOs is infrequent but real and skyglow reduces the effectiveness of the protection system in place.[129]

Prime observation locations with little to no skyglow are rare and desirable to scientists—so much so that scientists are willing to fight for these locations. Consider how scientists identified the Mauna Kea Mountain summit in Hawaii as an ideal location for astronomical observation. The summit has an altitude of 4,200 meters (13,800 feet) and is nestled away from the skyglow of Hawaiian cities.[130] Plans were made to construct an enormous thirty-meter telescope on the summit in the Mauna Kea Observatory in 2019.[131] However, the mountain is sacred in traditional Hawaiian culture and many Hawaiians fervently protested the intrusive telescope.[132] Native Hawaiians call the mountain Mauna a Wakea, the place where the sky god met the earth goddess and created the islands of Hawaii.[133] As of early 2022, construction of the telescope has been stalled by protests and the pandemic, and has still not started.[134]

Electric lighting is also extremely disruptive for many types of wildlife by causing "physiological and behavioral alteration[s]" that can

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[125] *NEO Search Program*, NASA CTR. FOR NEAR EARTH OBJECT STUDIES, http://cneos.jpl.nasa.gov/about/search_program.html.
[126] *Id.*
[127] Tricia Talbert, *Planetary Defense*, NASA PLANETARY DEF. COORDINATION OFF., (Mar. 28, 2019), http://www.nasa.gov/planetarydefense/neoo.
[128] *Id.*
[129] Dunham et al., *supra* note 122, at 316-317.
[130] *Hiking to the Summit*, MAUNAKEA VISITOR INFO. STATION, http://web.archive.org/web/20210425200032/http://www.ifa.hawaii.edu/info/vis/visiting-mauna-kea/hiking.html.
[131] Megan Miner Murray*, Why Are Native Hawaiians Protesting Against a Telescope?,* N.Y. TIMES, (July 22, 2019), http://www.nytimes.com/2019/07/22/us/hawaii-telescope-protest.html.
[132] *Id.*
[133] *Id.*
[134] Megan Moseley*, Hawaiian Elders Awaiting Trial for Protesting the World's Largest Telescope,* THE GUARDIAN (Feb. 7, 2022), https://www.theguardian.com/world/2022/feb/08/hawaii-elders-awaiting-trial-for-protesting-worlds-largest-telescope-mauna-kea; Timothy Hurley, *Construction of Thirty Meter Telescope delayed at least 2 years*, YAHOO! (Oct. 11, 2021), https://www.yahoo.com/video/construction-thirty-meter-telescope-delayed-160700381.html.

affect "reproduction, predation and orientation habits."[135] Sea turtles hatch at night, and when they do, they immediately orient themselves to go towards the ocean.[136] Bright lights from beachfront homes and streetlights disorient sea turtle hatchlings, leading them away from the ocean and increasing mortality rates.[137] Young birds are often disoriented by outdoor electric lights and get hurt or die when they crash into human structures.[138] Horrifyingly, researchers at the University of Notre Dame found mosquitoes bite twice as much when exposed to light at night.[139] For us humans, this means an increased chance of suffering from mosquito bites; bites that could form an inconvenient itchy welt or transfer severe diseases carried by mosquitos.

C. *The Truth*

So, is light really a pollutant? Pollution has been defined as "an alteration and contamination of the natural conditions in the environment due, for example, to physical, chemical, or biological factors."[140] So, when strictly applying light to definitions of pollution, it seems light qualifies. Other sources have come to this conclusion as well, including the Encyclopaedia Britannica, which states light pollution is "in the same league" as air and water pollution because light pollution "disperses energy, and this energy disrupts the environment, [and thus] can legitimately be considered a form of pollution."[141]

Many of the technologies or materials used in modern life pollute.[142] Labeling pollutants as pollutants brings awareness, and awareness

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[135] Lamphar & Kocifaj, *supra* note 117, at 2.
[136] *Sea Turtle Conservation*, INT'L DARK-SKY ASS'N, https://www.darksky.org/our-work/sea-turtle-conservation/ (last visited Apr. 20, 2022).
[137] *Id.*
[138] Adam Rodriguez et al., *Factors Affecting Mortality of Shearwaters Stranded by Light Pollution*, 15 ANIMAL CONSERV. 519, 519 (2012).
[139] Erika P., *Study Shows Light Pollution Increases Night Activity of Disease-Carrying Mosquitoes*, SCI. TIMES (Oct. 21, 2020), http://www.sciencetimes.com/articles/27810/20201021/study-shows-light-pollution-increases-night-activity-disease-carrying-mosquitoes.html.
[140] Fabio Falchi*, Light Pollution,* URBAN POLLUTION: SCIENCE AND MANAGEMENT 147, 147 (Susanne M. Charlesworth & Colin A. Booth eds., 2019).
[141] John P. Rafferty, *Is Light Pollution Really Pollution?*, ENCYC. BRITANNICA, https://www.britannica.com/story/is-light-pollution-really-pollution (last visited Apr. 10, 2022).
[142]Jonathan Watts, *Concrete: The Most Destructive Material on Earth*, THE GUARDIAN, (Feb. 25, 2019), http://www.theguardian.com/cities/2019/feb/25/concrete-the-most-destructive-material-on-earth (noting concrete "destroys natural infrastructure"); *Frontier*

beckons change.[143] During the 1960s and 1970s, a series of work-related chemical incidents throughout America concerned the public and members of government.[144] This concern ultimately led to the passage of the Toxic Substances Control Act of 1976 ("TSCA").[145] The TSCA lost much of its bite after a "landmark case" in 1991, *Corrosion Proof Fittings v. EPA*, but remains a testament to what advocacy efforts can achieve.[146] Optimistically, widespread recognition of light as a pollutant will encourage lasting change.

The leading adversary against bright night skies, the International Dark-Sky Association, defines "the inappropriate or excessive use of artificial light" as light pollution.[147] I like this definition; it is workable. It simply identifies the excess light needlessly pumped into the night sky as light pollution. For the purposes of this Article, this is how light pollution will be defined.

So, is light a pollutant? Yes. However, if we adhere to the International Dark-Sky Association's definition of light pollution, we need only concern ourselves with redressable light pollution; the useless, excess light produced by electric lighting. Fortunately, light pollution is much easier to 'clean up' than other pollutants. According to the Institution of Lighting Engineers, "Light pollution, whether it keeps you awake through a bedroom window or impedes your view of the night sky, is a form of pollution, [that] could be substantially reduced without detriment to the lighting task." [148]

Technologies for Addressing Plastic Pollution, UN DEP'T. OF ECON. AND SOC. AFF. ECON. ANALYSIS (Sept. 26, 2019), http://www.un.org/development/desa/dpad/publication/frontier-technology-quarterly-september-2019-frontier-technologies-for-addressing-plastic-pollution (describing how discarded, non-biodegradable plastics contaminate landfills and oceans); *See generally*, Carolyn Wilke*, Materials of the Last Century Shaped Modern Life, but at a Price*, SCI. NEWS, (Jan. 28, 2022), https://www.sciencenews.org/article/materials-science-history-modern-daily-life-environment.

[143] *TSCA: From Inception to Reform,* SCI. HISTORY INST. https://www.sciencehistory.org/tsca-from-inception-to-reform (last visited Apr. 20, 2022) ("After a series of pesticide and worker-related chemical scares in the late 1960s and early 1970s, the American public and government leaders became increasingly concerned with chemical safety," which led to the Toxic Substances Control Act of 1976).

[144] *Id.*

[145] *Id.*

[146] *Id.*

[147] *Light Pollution*, *supra* note 16.

[148] *Declaration in Defence of the Night Sky and the Right to Starlight (La Palma Declaration)*, THE STARLIGHT CONF. 2007 (Apr. 19, 2007), https://cds.cern.ch/record/1481596/files/978-1-4614-3822-9_BookBackMatter.pdf [hereinafter *Declaration in Defence*].

III. BEST PRACTICES FOR REDUCING LIGHT POLLUTION

Understanding best lighting practices and standards is an important step towards reducing light pollution. As one researcher notes, "Astronomers do not argue for *no* light, but for *good* lighting."[149] Luckily, there are more than a few ways to reduce the amount of harmful light congesting the night sky. To adequately explain the available means to reduce light pollution, we first need to know more about light itself. What is light exactly?

Light is a form of electromagnetic radiation.[150] Electromagnetic radiation is just "one of the many ways that energy travels through space."[151] X-rays, light emanating from the sun, and radio waves are all forms of electromagnetic radiation. The term electromagnetic denotes the electric and magnetic components of the radiation. Waves of electromagnetic radiation consist of a magnetic field and an electric field oscillating perpendicular to one another as the waves travel through space.[152]

Electromagnetic waves are classified according to their wavelength and frequency along the electromagnetic spectrum.[153] Fast moving waves with high amounts of energy are shown on the left side of the spectrum.[154] Slow, low energy waves are on the right.[155] From left to right, the waves are classified as follows: gamma rays, X rays, ultraviolet rays, visible light, infrared rays, microwaves, radio waves.[156]

The electromagnetic waves humans can optically observe are further classified along the visible spectrum, a subsection of the electromagnetic spectrum. I specify humans because many different creatures can naturally observe a broader spectrum of waves than humans. *Heliconius erato* butterflies can see ultraviolet colors and have ultraviolet-yellow coloring on their wings to attract mates.[157] Other creatures that can peer

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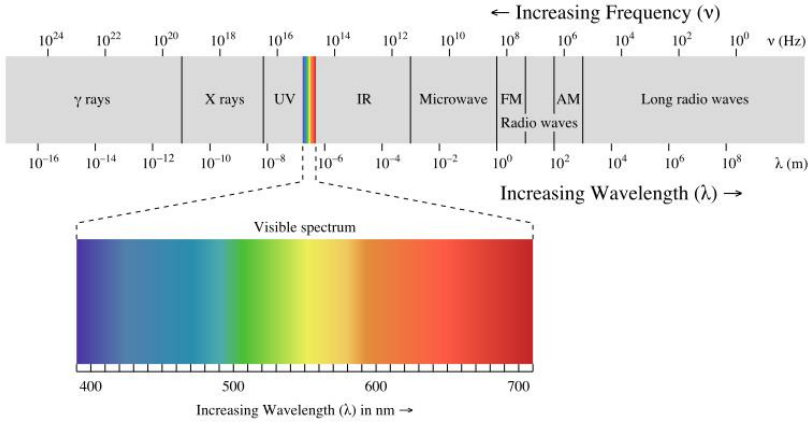
[149] David L. Crawford, *Light Pollution: Changing the Situation to Everyone's Advantage,* 196 PRESERVING THE ASTRONOMICAL SKY, PROCEEDINGS OF IAU SYMP. 33, 36 (2001), http://articles.adsabs.harvard.edu//full/2001IAUS..196...33C/0000036.000.html.
[150] *Light: Electromagnetic Waves, the Electromagnetic Spectrum and Photons*, KHAN ACADEMY, http://www.khanacademy.org/science/ap-chemistry/electronic-structure-of-atoms-ap/bohr-model-hydrogen-ap/a/light-and-the-electromagnetic-spectrum (last visited Apr 20, 2022).
[151] *Id.*
[152] *Id.*
[153] *Id.*
[154] *Id.*
[155] *Id.*
[156] *Id.*
[157] *Butterflies Evolved UV-Vision to Help Find Mates*, LIVE SCIENCE (Feb. 21, 2010), http://www.livescience.com/9807-butterflies-evolved-uv-vision-find-mates.html.

into the ultraviolet include cats, dogs, and bees.[158] Boas, pythons, and pit vipers have organs that function as eyes that allow the snakes to see into the infrared spectrum.



The Electromagnetic Spectrum[159]

On the visible light spectrum, the light colors span from violet to red. Within the lighting industry, the amount of red color (warmness) or blue color (coolness) of a light source may be indicated in a few different ways. Using the Kelvin scale is one of these ways.

In 1848, mathematician and scientist Lord Kelvin proposed what would later become the Kelvin temperature scale.[160] Unlike the Celsius and Fahrenheit scales, the Kelvin scale is not tied to the freezing and boiling point of water.[161] The Kelvin scale is an "absolute temperate scale" where zero is the lowest number on the scale and indicates the

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[158] Tanya Lewis, *Cats and Dogs May See in Ultraviolet*, LIVE SCI. (Feb. 18, 2014), http://www.livescience.com/43461-cats-and-dogs-see-in-ultraviolet.html.

[159] Diagram of the Electromagnetic Spectrum, *in Chemistry of Vision,* CHEMISTRY LIBRETEXTS, (Jul. 10, 2016), https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_(Biological_Chemistry)/Photoreceptors/Chemistry_of_Vision.

[160] Sarah Wild, *What is Temperature? Facts about Fahrenheit, Celsius and Kelvin Scales*, LIVE SCIENCE (Mar. 22, 2021), https://www.livescience.com/temperature.html; Kim Ann Zimmermann, *Kelvin Temperature Scale: Facts and History*, LIVE SCI. (Sept. 27, 2013), http://web.archive.org/web/20141003054650/http:/www.livescience.com/39994-kelvin.html.

[161] Wild, *supra* note 160. On the Celsius scale, zero indicates the freezing point of water and 100 indicates the boiling point of water. On the Fahrenheit scale, 32 indicates the freezing point of water and 212 indicates the boiling point of water.

point where "all motion ceases."[162] For context, zero on the Kelvin scale is about -273.15 Celsius and -459.67 Fahrenheit.[163]

In relation to lighting, the Kelvin scale came to be used to denote the color an object radiates at a related physical temperature in units of Kelvins ("K").[164] For example, the surface of the sun is about 5800 K, so lighting labeled "daylight" usually has a correlated color temperature ("CCT") around 5800 K.[165] The color temperature of most lights on the market span from an amber 2700 K to a sky-blue 6500 K.[166] A way to remember that cool-colored light is higher on the Kelvin scale than warm-colored light is to think of a flame. The white-blue center of a flame has a higher temperature than the red-yellow outer edges.

Other times, light color is simply expressed as the wavelength of the light measured in nanometers or "nm." Cool, blue-rich light starts at about 380 nm, where ultraviolet transitions into visible violet.[167] Warm, red-rich light ends at about 780 nm, when visible light transitions into the infrared.[168]

No matter how the light color is measured, Rayleigh scattering[169] causes cool, blue-rich lights to contribute more to skyglow than warm, yellow-rich lights.[170] As a result, reducing blue-rich light emissions is an effective way to reduce light pollution. The International Dark-Sky Association recommends only using outdoor lighting at or below 3000 K.[171]

What is the best type of lighting technology to use? Low-pressure sodium, high-pressure sodium, metal halide, and LEDs are commonly

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[162] *Id.* (quoting Julia Scherschligt at the National Institute of Science and Technology).
[163] *Id.*
[164] *What is Kelvin and CRI?*, SUPRABEAM, https://suprabeam.com/technology/what-is-kelvin/ (last visited Apr. 8, 2022).
[165] *Kelvin: Introduction*, NAT'L INST. OF STANDARDS AND TECH., http://www.nist.gov/si-redefinition/kelvin-introduction (last updated June 2, 2021).
[166] NAT'L LIGHTING PROJECT INFO. PROGRAM, *Light Sources and Color*, 8 LIGHTING ANSWERS 1, 10 (2004), available at https://www.lrc.rpi.edu/programs/NLPIP/lighting answers/pdf/print/lightSources.pdf.
[167] Jeffrey R. Brownson*, Basic Rules of Light Quantification*, PENN. STATE E-EDUCATION, http://www.e-education.psu.edu/eme810/node/455 (last visited Apr. 20, 2022).
[168] *Id.*
[169] "The blue color of the sky is caused by the scattering of sunlight off the molecules of the atmosphere. This scattering, called Rayleigh scattering, is more effective at short wavelengths (the blue end of the visible spectrum). Therefore, the light scattered down to the earth…is predominantly in the blue end of the spectrum." R. Nave, *Blue Sky*, GA. STATE U. HYPER PHYSICS, http://hyperphysics.phy-astr.gsu.edu/hbase/atmos/blusky.html.
[170] Kevin J. Gaston et al., *Reducing the Ecological Consequences of Night-Time Light Pollution: Options and Developments,* 49 J. OF APPLIED ECOLOGY 1256, 1260 (2012).
[171] *LED: Why 3000K or Less*, INT'L DARK-SKY ASS'N, http://www.darksky.org/our-work/lighting/lighting-for-citizens/3k/ (last visited Apr. 20, 2022).

used lighting types, but each varies as to the amount of blue light in their spectrum, cost to operate, and brightness, among other characteristics like heat emitted while in use.[172] Unfortunately, no one lighting technology scores top marks across all attributes. We must enter the real world of tradeoffs and decisions when deciding the type of lighting technology is best to use.

LEDs have become particularly prolific in recent years. In November 2020, the former Governor of New York, Andrew Cuomo, announced that the city of Syracuse, New York completed a $16 million project to install LEDs in streetlights throughout the city.[173] LEDs are desirable light sources for a few reasons, one being their energy efficiency. Per year, the switch to LEDs is expected to save Syracuse $3.3 million and to reduce greenhouse gas emissions by 8,500 tons.[174]

The project in Syracuse was part of Governor Cuomo's statewide Smart Street Lighting program.[175] The goal of the program was to replace hundreds of thousands of streetlights with LEDs.[176] Some New York residents were not thrilled with the new LEDs. As Jolanta Benal, a New Yorker whose window faces one of these LED lights, put it: "It feels like I'm in a strip mall in outer space . . . I don't want to come off as melodramatic, but it really is horrible."[177]

What could be done to help Jolanta Benal? Curious about the viability of a warm light LED, I did some research and found a 2016 patent for "System and Methods for Warm White Led Light Source."[178] A webpage for the International Dark-Sky Association also mentions similar technology: "Manufacturers now produce LEDs with 'warm' color qualities at high energy efficiency, rendering old arguments about the perceived inefficiency of warm white LEDs moot. These same LED options also provide accurate color rendition without emitting excessive

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[172] *Outdoor Lighting Basics*, INT'L DARK-SKY ASS'N, http://www.darksky.org/our-work/lighting/lighting-for-citizens/lighting-basics/ (last visited Apr. 20, 2022).
[173] Public Information Officer, *Governor Cuomo Announces Completion of $16 Million Project,* OUR CITY, (Nov. 18, 2020), http://ourcity.syrgov.net/2020/11/governor-cuomo-announces-completion-of-16-million-project-to-install-smart-energy-saving-streetlights-in-syracuse/.
[174] *Id.*
[175] *Id.*
[176] *Id.*
[177] Matt A.V. Chaban, *LED Streetlights in Brooklyn Are Saving Energy but Exhausting Residents*, N.Y. TIMES (Mar. 23, 2015), http://www.nytimes.com/2015/03/24/nyregion/new-led-streetlights-shine-too-brightly-for-some-in-brooklyn.html. The article contains a photograph of Jolanta Benal's Bedroom by Andrew Renneisen.
[178] Zequn Mei, Xiantao Yan & Wu Jiang, *System and Methods for Warm White LED Light Source*, U.S. Patent No. 9,269,697 B2 (granted and published Feb. 23, 2016), http://patents.google.com/patent/US9269697B2/en.

amounts of potentially harmful blue light."[179] Alternatively, one study suggests pigmented filters placed over cooler light sources can alter the light to more desirable warm-light levels.[180]

To be fair, even if the light beaming into Jolanta Benal's bedroom suddenly turned into warmer colored light, the light would still be incredibly intrusive and contribute to skyglow because of how bright the light is. But another way to reduce light pollution is by decreasing the brightness of lights, lighting should "be no brighter than necessary."[181] However, this still does not help Jolanta Benal much. To a certain extent, streetlights need to be bright to properly light the streets below. Luckily, using "effective placement of well-designed fixtures" is an "excellent" way to reduce light pollution even if the lighting needs to be bright. [182]

A fully shielded light describes light fixtures "that shield the light source to minimize glare and light trespass and to facilitate better vision at night."[183] This means most shielded lighting directs the light downward, preventing the light from directly shining into the windows of nearby homes or the unsuspecting eyes of pedestrians and drivers.

Light Fixture Shielding[184]

[179] *LED Practical Guide*, INT'L DARK-SKY ASS'N, http://www.darksky.org/our-work/lighting/lighting-for-citizens/led-guide/ (last visited Apr. 21, 2022).
[180] Gaston et al., *supra* note 170 at 49.
[181] *Outdoor Lighting Basics*, *supra* note 172.
[182] Crawford, *supra* note 149, at 37.
[183] *Outdoor Lighting Basics*, *supra* note 172.
[184] Illustration of Light Fixture Shielding, *in* Rosemarie Russo, *Moab City's Dark Sky Initiative*, MOAB HAPPENINGS (Sept. 2019), http://www.moabhappenings.com/Archives/sustainability201909.html.

In the "very bad," "bad," and "better" lighting designs in the image above, much of the emitted light never hits the intended target of the street below. In addition to needlessly contributing to light pollution, poorly designed, unshielded light fixtures waste energy and money. The *Declaration in Defence of the Night Sky and the Right to Starlight* notes:

> Dark sky friendly lighting fixtures cost no more than traditional outdoor lighting fixtures. The big difference is you can use less power to run these fixtures than traditional lamps. Your cost savings on your utility bill will pay for the fixture within the year. By shielding the fixture. . . a lesser wattage lamp can now be used because you don't have to light the night as well as your steps. . . Wasted light at night in the United States alone costs $1.74 billion annually.[185]

Another way to reduce light pollution is to limit the amount of time lights are on.[186] For homes or storefronts, turning off outdoor lighting at the end of the day is a great place to start. For those installing new lighting or those having the ability to retrofit existing fixtures, using lighting with timers or motion sensors can be especially helpful for reducing light pollution.[187]

To recap, some of the best ways to reduce light pollution are: (1) minimize the amount of blue light; (2) use light at an appropriate brightness level; (3) use fully shielded lighting; and (4) turn off lights not in use. By following these best practices, we can help people with situations like Jolanta Benal's—the New York resident who feels that she lives on a strip mall in outer space—while reducing light pollution and protecting access to starry skies.

IV. IMPLEMENTING BEST PRACTICES

What are the legal avenues to encouraging the implementation of these best practices? Specifically, how do we motivate or even compel individuals, businesses, and municipalities to implement best lighting practices?

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[185] *Declaration in Defence*, *supra* note 148.
[186] *Outdoor Lighting Basics*, *supra* note 172.
[187] Nadia Drake, *Our Nights are Getting Brighter*, NAT'L GEOGRAPHIC (Apr. 3, 2019), https://www.nationalgeographic.com/science/article/nights-are-getting-brighter-earth-paying-the-price-light-pollution-dark-skies.

One legal avenue to consider is a regulatory pricing scheme. Currently, pricing schemes are not applied to light pollution, but are applied to greenhouse gas emissions.[188] One of the two main types of pricing schemes is "emissions trading," also referred to as "cap and trade" programs.[189] Cap and trade programs function as regulated marketplaces for emissions.[190]

At the beginning of the cap and trade process, the appropriate regulating authority announces the maximum quantity of a pollutant that may be emitted during a compliance period.[191] This is the "cap." The cap is then divided into allowances which represent an "authorization to emit a specific quantity of [the] pollutant."[192] Allowances are distributed to different companies.[193] Throughout the compliance period, companies must track their emissions. To avoid penalties for unauthorized emissions, companies that "pollute more" may buy allowances from other companies. [194] This is the "trade." [195]

Cap and trade programs have proved effective for reducing greenhouse gas emissions. In the European Union's Emissions Trading System, emissions from buildings dropped by 29% in the thirteen years following the program's launch in 2005.[196] The Environmental Defense Fund states that cap and trade programs have the potential to become even more effective when countries "cooperate" with each other.[197]

The United States' Environmental Protection Agency ("EPA") states that cap and trade programs are "best implemented" when three elements are met: (1) the concerns prompting the program occur over a "relatively large geographic area"; (2) a "significant number of sources are responsible" for the pollution; and (3) the "[e]missions can be consistently and accurately measured."[198] With regard to light pollution,

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[188] *Pricing Carbon*, WORLD BANK, https://www.worldbank.org/en/programs/pricing-carbon (last visited Feb. 6, 2022).
[189] *Id.*
[190] *What is Emissions Trading?*, ENVTL. PROTECTION AGENCY, https://www.epa.gov/emissions-trading-resources/what-emissions-trading (last visited July 8, 2021).
[191] ENVTL. PROTECTION AGENCY, TOOLS OF THE TRADE: A GUIDE TO DESIGNING AND OPERATING A CAP AND TRADE PROGRAM FOR POLLUTION CONTROL 1-2 (June 2003), available at https://www.epa.gov/sites/default/files/2016-03/documents/tools.pdf.
[192] *Id*.
[193] *Id.*
[194] *How Cap and Trade Works*, ENVTL. DEFENSE FUND, https://www.edf.org/climate/how-cap-and-trade-works (last visited Feb. 6, 2022).
[195] *Id.*
[196] *Id.*
[197] *Id*.
[198] *What is Emissions Trading?*, *supra* note 191.

the first two elements are easily met. Whether the third element is met is less evident.

When, for example, a company needs to measure carbon emissions, the company can use a carbon management app to track their carbon footprint.[199] At a very high level, these apps track how much energy is used which can then be used to determine the amount of carbon emissions.[200] This enables companies or other sources to measure their emissions with consistency and accuracy.

In contrast to carbon emissions, the amount of light pollution emanating from a specific source isn't discernable based on power bills. This is because the electricity used for lighting at night would only constitute a portion of the total bill. Further, even if a light pollution management app could identify electricity used specifically for outdoor lights at night, other factors, such as the fixture design, would need to be taken into account.

Light pollution emanating from a specific source could be measured on site, but this is an extensive process. One researcher explains how light pollution can be measured on site:

> Light trespass on windows can be verified by vertical illuminance, glare can be identified by luminaire intensity, sky glow can be determined by the upward light ratio of a lighting installation, and a building's brightness can be perceived by the observer via its luminance.[201]

For now, there is not a readily accessible way to consistently and accurately measure light pollution emanating from a specific source. As such, light pollution fails the EPA's third element and is not a good candidate for a cap and trade program.

The second type of regulatory scheme used to reduce emissions via pricing is a tax.[202] The World Bank describes a carbon tax as one that "directly sets a price on carbon by defining a tax rate on greenhouse gas emissions or–more commonly–on the carbon content of fossil fuels."[203] Again, applying this scheme to light pollution proves difficult because there is no accessible means of consistently and accurately determining

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[199] *Why Tracking Carbon Emissions is Suddenly a Billion Dollar Opportunity*, CNBC (Sept. 14, 2021), https://www.youtube.com/watch?v=X11xoGeX0s8&t=148s.
[200] *Id.*
[201] Zielińska-Dabkowska, *supra* note 21, at 5011.
[202] *Pricing Carbon*, *supra* note 189.
[203] *Id.*

the amount of light pollution a specific source is emitting. Therefore, there is no means of fairly administering a tax.

In contrast to the theoretical pricing of light pollution, litigation is one legal avenue that has actually been taken in an attempt to reduce light pollution. That being said, lighting-related litigation is still a predominately undeveloped area of law in the United States. Most states have at least some case law but many states have only one or two cases to look to for precedent.[204] Cases involving the preservation of starry skies are even more rare. A recent study commissioned by the International Dark-Sky Association found only three cases where "damage to the quality of the night sky" was mentioned.[205]

When light pollution claims are brought, they are usually brought as one claim in a cluster of other nuisance claims.[206] Nuisance claims involve an "an activity or physical condition that is indecent or offensive to the senses or interferes with another person's reasonable use and enjoyment of life or property."[207] The other nuisance claims frequently brought alongside light pollution claims involve "increased noise, vibration, traffic, and parking problems."[208]

Plaintiffs who bring light pollution claims against municipalities are often suing for "too much light" as a result of development projects.[209] Discouragingly, these lawsuits "tend to fail".[210] For example, in *Ronald L. Newell v. Ohio Department of Transportation*, the plaintiff-farmer alleged excessive lighting coming from highway lights installed by the Ohio government caused about 7 acres of his bean corp to fail.[211] Despite losing this large portion of his bean crop, the court held the farmer had not suffered a compensable harm from a government taking.[212] Precedent stated that for a taking claim to be successful, a plaintiff's harm must be "different in kind" and not just "a greater degree" than harm suffered by

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[204] Memorandum from Iris Zhou, Harvard Law Sch. Intern to Scott Feierabend, Exec. Dir. of Int'l Dark-Sky Ass'n 2 (Jan. 19, 2018), available at https://darksky.app.box.com/s/c1qkr35m99wcj8gnenv0xiqsk6vo1ixq [hereinafter Zhou Memorandum].
[205] *Id.*; Laubenstein v. Bode Tower, LLC, 392 P.3d 706 (Okla. 2016); EDF Renewable Energy v. Foster Twp. Zoning Hearing Bd., 150 A.3d 538 (Pa. 2016); In re Stokes Commc'ns. Corp., 164 Vt. 30, (Vt. 1995).
[206] Zhou Memorandum, *supra* note 205, at 2.
[207] Ann O'Connell, *Private vs. Public Nuisance Claims Against Property Owners*, ALL LAW, http://www.alllaw.com/articles/nolo/personal-injury/private-public-nuisance-claims-property-owners.html (last visited Feb. 7, 2022).
[208] Zhou Memorandum, *supra* note 205, at 2.
[209] *Id*. at 3.
[210] *Id*. at 6.
[211] *Id*.; Ronald L. Newell v. Ohio Dep't of Transp., 2007 WL 2401849 (Ohio 2007).
[212] *Id.*

other affected members of the community.[213] The court in *Ronald L. Newell v. Ohio Department of Transportation* found the harm to the farmer's bean crop only differed in degree to any harm suffered by the community as a result of the highway lights.[214] Therefore, the farmer's claim failed.[215]

In another example, in *Cunningham v. City of Grosse Pointe Woods*, the plaintiff-homeowners brought an action against their city for installing bright lighting on a public recreation field.[216] The court weighed the public benefit of the lighting against the harm the lighting caused the homeowners, and ultimately determined the lighting was not a nuisance.[217]

Current case law shows that while litigable, light pollution claims are not an effective way to meaningfully reduce light pollution. Especially given the "time, expense, and annoyance of litigation, this should be a last resort."[218] One of the most notable lawyers in the history of the United States, President Abraham Lincoln, agreed with this sentiment: "Discourage litigation. Persuade your neighbors to compromise whenever you can. Point out to them how the nominal winner is often a real loser—in fees, expenses and waste of time."[219] As Voltaire poignantly summarizes, "I was never ruined but twice: once when I lost a lawsuit and once when I won one."[220]

Laws concerning lighting, or lighting laws, are the most promising legal avenue to reduce light pollution. Lighting laws can regulate things such as "hours of operation, maximum illumination levels, amount of required shielding, color temperatures, light trespass, and the characteristics of illuminated signs."[221] Lighting laws can also designate

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[213] *Id.*
[214] *Id.*
[215] *Id.*
[216] Zhou Memorandum, *supra* note 205, at 6; Cunningham v. City of Grosse Pointe Woods, No. 212642, 2001 WL 716882 (Mich. Ct. App. Mar. 13, 2001).
[217] *Id.*
[218] Brian Farkas, *Dealing with Light Pollution from a Neighbor*, NOLO, http://www.nolo.com/legal-encyclopedia/dealing-with-light-pollution-from-neighbor.html (last visited Feb. 8, 2022).
[219] Joseph G. Bisceglia, *ADR and the Image of Lawyers: Lawyer-Warrior or Lawyer-Peacemaker - What's the Better Public Image for Our Profession?*, 96 ILL. B.J. 8 (2008).
[220] *Id.*
[221] Jeremy Bryson & Amanda Cooley, *Dark Sky Compliance: Measuring the Effectiveness of Outdoor Lighting Ordinances in Ogden Valley,* 95 UTAH ACAD. OF SCIS., ARTS, & LETTERS 271, 273 (2018), available at http://www.utahacademy.org/wp-content/uploads/2019/03/JUASAL-2018-full-text-final.pdf.

zones, with different requirements depending on the functions of the zones.[222]

France, home to Paris, the City of Light, enacted one of the world's most progressive and robust lighting laws on New Year's Day in 2019.[223] The purpose of the law is "to prevent, limit and reduce light pollution, including excessive disturbance to persons, fauna, flora or ecosystems, causing energy wastage or preventing observation of the night sky."[224] The law prohibits light trespass "regardless of its source," sets limits for the amount of glare and brightness, and stipulates that lights must not exceed a CCT of 3000 K, with stricter requirements for protected zones.[225] Light pollution in France fell by 6% following the law's passage.[226]

In the United States, lighting laws have sprung up in local jurisdictions throughout 19 states.[227] For example, in May of 2020, legislators in Jekyll Island, Georgia unanimously passed a lighting ordinance in an effort to protect hatching baby sea turtles from disorienting beachfront light pollution.[228] The ordinance states lights during nesting season must be directed downward, properly shielded, and emit red or amber light.[229] As the ordinance was enacted to protect baby sea turtles, the ordinance is located in the "Environment" chapter of the Jekyll Island code.[230] The authority to enact the lighting ordinance came from the legislators' general authority to promulgate ordinances "deem[ed] necessary."[231]

Other municipalities have adopted lighting ordinances as land use or zoning ordinances. For example, in March of 2021, the city of Fort Collins, Colorado adopted a lighting ordinance to "[m]inimize glare,

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[222] *Lighting Zones,* INT'L DARK-SKY ASS'N, https://www.darksky.org/our-work/lighting/public-policy/model-lighting-laws-policy/lighting-zones/ (last visited Apr. 8, 2022); *see, e.g.*, FORT COLLINS, COLO., LAND USE CODE § 3.2.4(H).

[223] John Barentine, *France Adopts National Light Pollution Policy Among Most Progressive in the World*, INT'L DARK-SKY ASS'N (Jan. 9, 2019), http://www.darksky.org/france-light-pollution-law-2018/.

[224] *Id.*

[225] *Id.*

[226] Laura Paddison, *The Argument for Switching Off Lights at Night*, BBC (July 19, 2021), http://www.bbc.com/future/article/20210719-why-light-pollution-is-harming-our-wildlife.

[227] *States Shut Out Light Pollution*, NAT'L CONF. OF ST. LEGISLATURES, (May 23, 2016), http://www.ncsl.org/research/environment-and-natural-resources/states-shut-out-light-pollution.aspx.

[228] JEKYLL ISLAND AUTHORITY, GA., CODE §§ 10-80, 10-81.

[229] *Id.*

[230] *Id.*

[231] JEKYLL ISLAND AUTHORITY, GA., CODE § 2-2.

obtrusive light, sky glow, and light trespass."[232] The lighting ordinance falls under the Land Use Code and may be enforced by requiring building permits, inspections, orders to remove violations, and criminal and civil proceedings.[233]

Some towns in Colorado have passed lighting ordinances even more ambitious than Fort Collins' ordinances, in an effort to earn recognition as a Dark Sky community from the International Dark-Sky Association.[234] The efforts have not been in vain: as of the time of writing, Colorado has ten parks and five communities formally recognized as Dark Sky Places.[235]

[232] *Development Review*, CITY OF FORT COLLINS, https://www.fcgov.com/development review/lighting-regulations (last visited Feb. 8, 2022).
[233] FORT COLLINS, COLO., LAND USE CODE § 2.14.1.
[234] Leslie Vreeland, *'Dark Sky-friendly' Lighting Ordinance Adopted by Ridgway Town Council*, TELLURIDE DAILY PLANET (Sept. 22, 2019), https://www.telluridenews.com/ news/article_b648bb9c-dbf5-11e9-9fd8-43e42a5dec3b.html.
[235] *Dark Sky Places*, INT'L DARK SKY ASS'N, https://idacolorado.xyz/our-work/dark-sky-places/ (last visited Feb. 9, 2022).

CONCLUSION

The illumination of night skies is an unavoidable consequence of modern life, but light pollution is avoidable. By implementing simple best practices through lighting laws, people generations from now—no matter their life situation—will be able to see "that the night is even more richly colored than the day, colored in the most intense violets, blues, and greens," and that, "[i]f you look carefully, you'll see that some stars are lemony, others have a pink, green, forget-me-not blue glow…"[236]

Turret Arch, Arches National Park[237]

[236] Iker, *supra* note 14.

[237] Bettymaya Foott, *Turret Arch, Arches National Park*, *in Arches National Park Certified as an International Dark Sky Park*, INT'L DARK-SKY ASS'N, (July 5, 2019), https://www.darksky.org/arches-national-park-certified-as-an-international-dark-sky-park/.