

Lighting the Path to a Sustainable Future

How Light Technology Is Driving Global Sustainability

Zahid H. Khan

Introduction

Light is one of nature's most powerful gifts. It sustains life on Earth, shapes weather and climate, and enables us to explore and understand the world around us. Beyond the narrow band of visible light lies a vast spectrum—stretching from microwaves to X-rays—that powers communication, healthcare, industry, and scientific discovery.

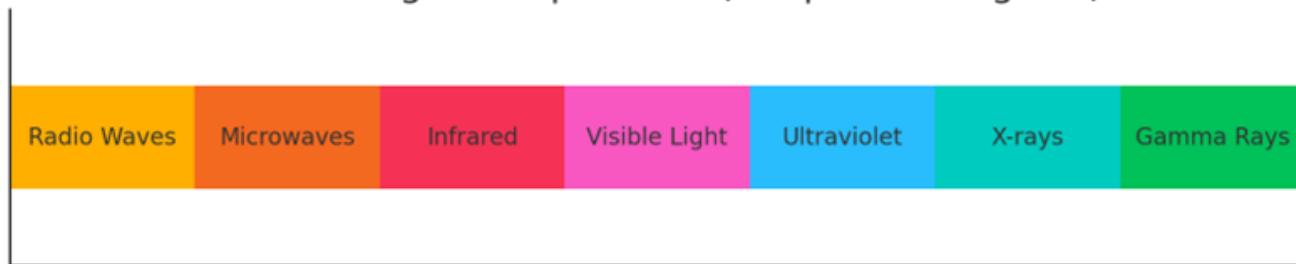
As the world faces urgent challenges such as climate change, healthcare accessibility, energy security, and equitable education, light-based innovations are delivering smarter, cleaner, and more sustainable solutions.

Recognizing the vital role of light in advancing society, the United Nations declared 2015 the “International Year of Light and Light-Based Technologies (IYL 2015)”. Building on its success, UNESCO established the “International Day of Light (IDL)” in 2018 to celebrate how photonics science and technology improve lives—enhancing connectivity, supporting cultural preservation, strengthening environmental protection, and driving economic development.

Reflecting its strong alignment with the “UN Sustainable Development Goals (SDGs)”, the IDL emblem incorporates the colours of all 17 SDGs, symbolizing how light contributes to ending poverty, reducing inequalities, and building a resilient planet. The theme for IDL 2026, “*Light for a Sustainable Future*,” reinforces this vision.

This article introduces, in clear and engaging language, how light and light-based technologies are shaping a better future for humanity. It is aimed at learners, educators, science enthusiasts, and anyone planning IDL-related outreach activities.

Electromagnetic Spectrum (Simplified Diagram)



Light for Clean Energy and Climate Stability

Every day, the Sun delivers vast amounts of free energy to Earth. Solar photovoltaic (PV) technology converts this sunlight directly into electricity—without smoke, pollution, or greenhouse gases. As costs decline and performance improves, solar power is lighting up homes, schools, industries, and remote villages. In areas beyond the electric grid, solar mini-grids and lamps offer clean power for the first time, reducing dependence on kerosene and diesel.

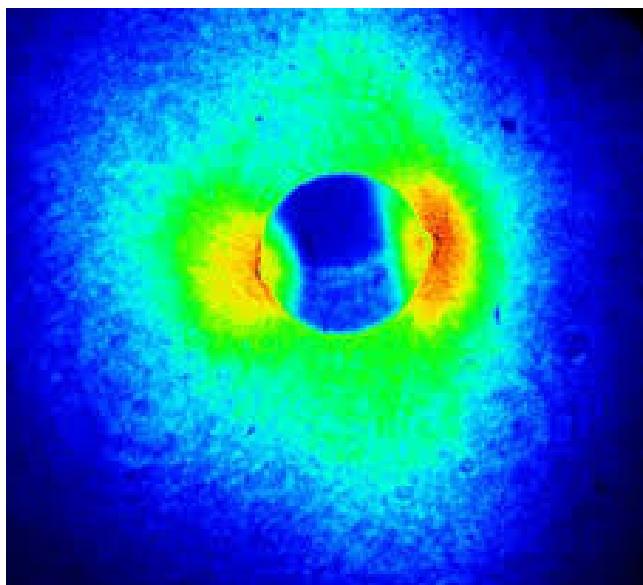
SUSTAINABLE DEVELOPMENT GOALS



Lighting innovations also support climate action. LEDs use a fraction of the electricity required by older bulbs. When combined with smart controls that dim or switch lights off automatically, cities and households can significantly reduce energy waste. These advances show how the right use of light helps eliminate darkness while safeguarding Earth's environmental balance.

Light for Better Healthcare and Well-Being

Optics and photonics are revolutionizing medicine. Laser tools allow surgeons to perform precise procedures with minimal discomfort and faster recovery. Optical imaging techniques—including



X-rays, CT scans, MRI, and endoscopy—enable earlier detection of disease, saving millions of lives. Light-based therapies are used to treat skin disorders, certain cancers, and mood-related conditions such as seasonal depression.

Good lighting also contributes to safety and well-being. Well-lit streets prevent accidents and deter crime. Proper indoor lighting supports learning, productivity, and healthy sleep rhythms—reminding us that sustainability includes not only technology but also quality of life.

Light for Communication and Knowledge Sharing

Each time we join an online class, send a message, or participate in a video call, we rely on pulses of laser light traveling through fibre-optic cables. These hair-thin strands of glass carry data across continents and oceans at nearly the speed of light.

By connecting hospitals with patients, teachers with students, and communities with opportunities, optical communication is helping ensure that information access becomes a right for all—not a privilege for a few.



Led Lightings



Solar Lights

Light for Water, Food, and the Environment

Earth-observing satellites equipped with optical sensors provide invaluable insights on climate change, forest health, agricultural conditions, and ocean ecosystems. This knowledge supports disaster preparedness, environmental protection, and sustainable resource management.

Ultraviolet (UV) systems disinfect drinking water without harmful chemicals—a boon for rural and disaster-affected regions. In agricultural innovation, smart LED lighting in greenhouses enables year-round food production with less land, reduced pesticide use, and lower water consumption.

In every case, light supports a healthier planet and improves human resilience.

Light for Education and Equality

For millions of students worldwide, daylight defines their learning hours. Solar lighting extends study time into the evening and enhances safety, especially for young children and girls traveling after sunset. When paired with digital education technologies and optical internet connectivity, it opens transformative learning opportunities.

Here, light becomes a tool of empowerment—expanding access, reducing inequality, and fulfilling core SDG goals.

Responsible Use of Light

While artificial lighting is essential, excessive or poorly directed light creates light pollution, washing away the

night sky, disrupting ecosystems, and affecting human sleep. Sustainable lighting designs—shielded fixtures, warmer colours, motion sensors, and timers—ensure light is used only where needed.

Protecting the night sky saves energy, supports wildlife, and preserves humanity's connection with the cosmos.

Towards a Brighter Future in the Quantum Technology Era

Quantum technology—spanning computation, communication, cryptography, sensing, and advanced healthcare—is expected to reshape the world in the coming decades. Reflecting its significance, the United Nations has proclaimed **2025 as the International Year of Quantum Science and Technology**.

Photonics will be central to this transformation: from ultra-secure quantum communication systems to next-generation photovoltaic devices that harvest more energy from sunlight. These new advances promise tangible benefits—addressing climate challenges, boosting global connectivity, and safeguarding ecosystems.

Conclusion

Light has guided human progress for centuries—as a symbol of knowledge, a source of life, and a catalyst for innovation. Used wisely and shared equitably, light-based technologies will continue to illuminate our path toward a sustainable, inclusive, and prosperous future for all. ◆

Dr Zahid H Khan is an advisor at the Zaheer Science Foundation in New Delhi and a former Professor of Physics at Jamia Millia Islamia, a Central University in New Delhi. He can be reached via email at zhkhan1948@yahoo.com

