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Lighting Transformation in Commercial Buildings

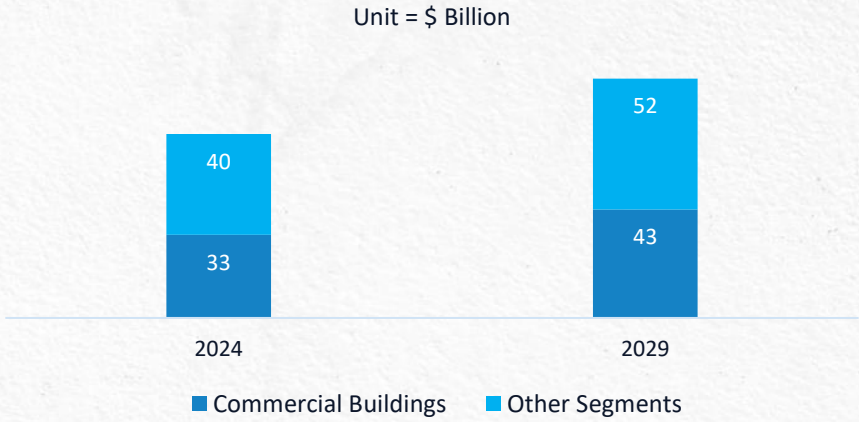
Redefining Light for the Next Generation of Buildings

KEY 2025 HIGHLIGHTS

AI-Powered Adaptive Lighting Systems	AI-powered lighting systems optimize brightness using occupancy, daylight, and traffic data, reducing energy use by 70%. Retail environments benefit from density-based adjustments, enhancing customer experience and boosting sales.	1
Solar-Powered and Off-Grid Lighting	Hybrid solar-LED systems are increasingly deployed in warehouses, smart cities, and remote areas, reducing grid dependence by 40%, lowering installation costs, and supporting sustainability goals through renewable energy integration.	2
Ultra-Efficient COB LEDs and Modular Designs	COB LEDs now deliver 196 lm/W with lifespans over 100,000 hours. Modular 3D-printed fixtures enable sustainable retrofits, cutting carbon footprint by 50% and simplifying upgrades in commercial buildings.	3
Human-Centric Lighting Goes Mainstream	Tunable white LEDs and circadian syncing are now standard in offices and hospitals, enhancing wellness. Studies show human-centric lighting boosts productivity by 18% and significantly reduces fatigue and stress.	4
Focus in Commercial Buildings	AI and IoT lighting personalize retail experiences, while LiFi boosts engagement. In hospitality, circadian lighting enhances wellness, and cordless luminaires offer flexible, guest-controlled ambiance in rooms and wellness zones.	5

COMMERCIAL LIGHTING ON A GROWTH TRAJECTORY

LED Lighting: Revenue Forecast by End User, Global, 2024 and 2029



OBSERVATIONS:

Frost & Sullivan estimated the global LED lighting market in the buildings sector at approximately $73 billion in 2024, with expectations to grow to $95 billion by 2029. Commercial buildings (offices, architectural installations, hospitality venues, and retail spaces) accounted for 45% of the market in 2024. This segment is projected to retain its leading position throughout the forecast period.

Quick Trends

- LED takes 65% of the total lighting market in 2024; 75% in 2029
- Commercial lighting segment to grow at 5.9% CAGR (2024-2029)
- Quantum Dot LEDs (QLEDs) expanding in commercial lighting
- Retail mood lighting that changes with the weather
- Office lighting that knows when occupants are stressed
- Hospitality venues using LED for scent activation

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Source: Frost & Sullivan

3 PILLARS DRIVING LIGHTING TRANSFORMATION

Sustainability Pressures and ESG Commitments

- Corporate ESG goals and stricter carbon reporting standards pushed companies to adopt durable, modular, and recyclable lighting systems.
- Circular economy principles gained traction, with lighting designs emphasizing repairability, reuse, and material recovery.
- Green building certifications (LEED, WELL, BREEAM) increasingly required lifecycle transparency and low-impact lighting solutions.

Smart Infrastructure and Data-Driven Operations

- AI-powered lighting systems became standard, optimizing illumination based on occupancy, daylight, and traffic patterns.
- Integration with IoT platforms and building management systems (BMS) enabled real-time control, predictive maintenance, and space utilization analytics.
- Human-centric lighting synced with circadian rhythms, improving wellness and productivity in offices, hospitals, and hospitality.

Flexible Financing and Service-Led Delivery

- Organizations are shifting from capital-heavy lighting investments to subscription-based models that provide access to advanced technologies without upfront costs.
- Customer-centric business models like Lighting-as-a-Service enables predictable budgeting, scalable deployment, and faster modernization.
- Performance-linked contracts ensure energy savings and compliance, while remote diagnostics and digital twins support proactive maintenance and system optimization.

LIGHTING TRANSFORMATION FRAMEWORK

Revitalizing 3 Growth Pillars to adapt to market shifts and redefine lighting strategy:

- **Lighting Circularity**
- **Lighting Connectivity**
- **Lighting Business Model**

	Process Flow	KPIs	Stakeholders	Value Proposition
1 CIRCULAR LIGHTING LAYS THE FOUNDATION Durable, reusable, and environmentally conscious lighting, forming the baseline for sustainable building design	Design → Material Selection → Lifecycle Management	% of reused components, product lifespan, energy savingsc	Product designers, sustainability officers	Lower environmental impact
2 SMART LIGHTING DELIVERS ADAPTIVE INTELLIGENCE Anchors intelligent buildings through responsive control, real-time data, and seamless system integration	Sensor Integration → Data Collection → Optimization	System uptime, data accuracy, user engagement	IT teams, facility managers	Smarter, more efficient operations
3 LIGHTING-AS-A-SERVICE REDEFINES LIGHTING DELIVERY Flexible financing and recurring revenue through scalable solutions that drive efficiency, compliance, and long-term value	Financing Options → Service Packaging → Scaling	Revenue growth, customer retention, ROI	Sales, finance, strategy teams	Flexible and cost-effective solutions

PILLAR 1: LIGHTING CIRCULARITY

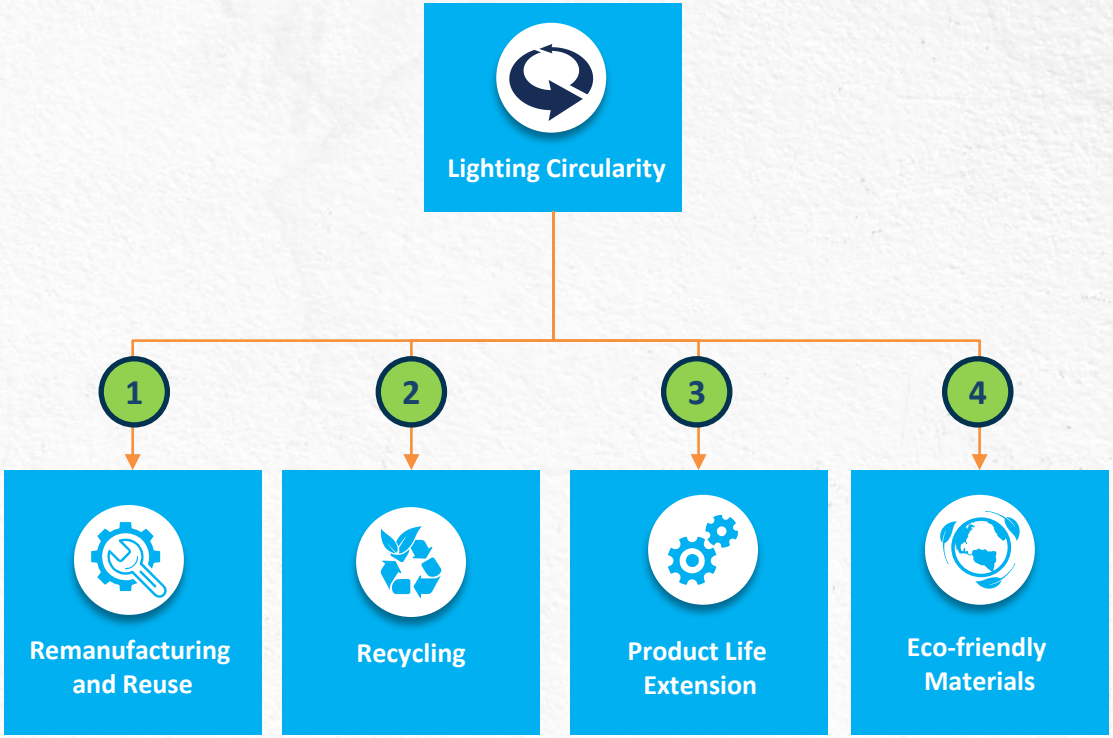
Importance of the Circular Economy for Lighting

Manage e-Waste 	1.2 mt	• Lighting waste accounts for ~2% of 60M tons of global e-waste, highlighting the need for circular design and responsible disposal
Reduce Life Cycle Emissions 	15% 5%	• Lighting uses 15% of global electricity and causes 5% of emissions, accelerating LED adoption offers major climate and cost benefits
Create More Eco-friendly Practices 	30 million 1,400 mt	• 30M lights landfilled yearly in the UK; global LED shift could cut 1,400M tons of CO_2, making lighting key to sustainability
Generate Energy Bill Savings 	$120 billion	• Global shift to efficient lighting could save $120B annually, cut emissions, and boost energy efficiency
Meet Stricter Environmental Regulations 	2050	• Net-zero targets by 2050 drive OEMs to adopt circular practices and greener supply chains under global climate regulations

Source: US DoE; UNEP; Frost & Sullivan

PILLAR 1: LIGHTING CIRCULARITY

Central Practices



1. Lighting **remanufacturing and reuse** extend product life, cut waste, conserve resources, and support circular economy goals.
2. Lighting **recycling** recovers materials from EOL products to reduce waste, conserve resources, and support sustainable production.
3. **Extending lighting product life** through maintenance, upgrades, or refurbishment to reduce waste and boost resource efficiency.
4. **Eco-friendly lighting** uses recyclable, non-toxic materials to lower environmental impact and support sustainable production and recovery.

Source: Frost & Sullivan

PILLAR 1: LIGHTING CIRCULARITY

Remanufacturing and Reuse

Outline

Restoring components to their original state and reusing them

Example

Disassembly, cleaning, inspection, repair, and reassembly of used lighting fixtures; Light source replacement

Outcome

Refurbished lights; upgrading fluorescent systems to LEDs

Impact

Extending lighting product life cycles to ease landfill burden

	Case Study: Remanufacture	Case Study: Reuse
OEM	EGG Lighting	Signify
Objective	Upgrade of lighting systems at Edinburgh, Scotland	Retrofit tunnel lighting systems at Dublin, Ireland
Outcome	• 40 lighting systems upgraded by reusing existing fittings and integrating LED technology • Achieved **40% cost savings** compared to full replacement with new LED luminaires • Saved **20.8 kg of embodied carbon per unit** • Reduced annual energy costs by approximately **£15,000**	• **1,800 light points** retrofitted with LED technology using existing luminaire housings • Achieved **60% reduction in electricity consumption**, equivalent to the usage of ~300 Irish households • **€3 million saved** by reusing existing fittings instead of full replacement • **€4 million in electricity cost savings** projected over 5 years

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Source: Frost & Sullivan

PILLAR 1: LIGHTING CIRCULARITY

Recycling

Outline

Breaking down lighting products into raw materials for reprocessing

Example

Sorting of lighting components (e.g., metals, plastics, glass); safe disposal of hazardous materials like mercury; material recovery for new manufacturing

Outcome

Recycled materials used in new lighting products or other applications

Impact

Reducing resource extraction and energy use; minimizing environmental pollution and landfill waste

Recycling—Importance to Lighting		
Manage eWaste	600 million	600M mercury lamps discarded annually in the U.S., posing environmental and health risks due to poor disposal and limited recycling
Save Energy	6 hours of TV	Recycling one fluorescent bulb prevents mercury release and recovers components, saving energy equal to 6 hours of TV use or 1 gallon of gasoline.
Recover Mercury	1,000 mt	Recycling one ton of fluorescent tubes can recover ~20g of mercury, according to ELIA (European Lighting Industry Association)
Reduce Emissions	4 Mt	Proper CFL disposal in the U.S. prevents ~4 Mt of mercury emissions annually, according to the EPA
Create More Eco-friendly Practices	50%	Over half of mercury emissions from waste come from improper disposal of mercury lamps, per UNEP

Source: Frost & Sullivan

PILLAR 1: LIGHTING CIRCULARITY

Product Life Extension

Outline

Enhancing the durability and performance of lighting products to delay end-of-life

Example

Using higher-quality components, modular designs for easy upgrades, and proactive maintenance strategies

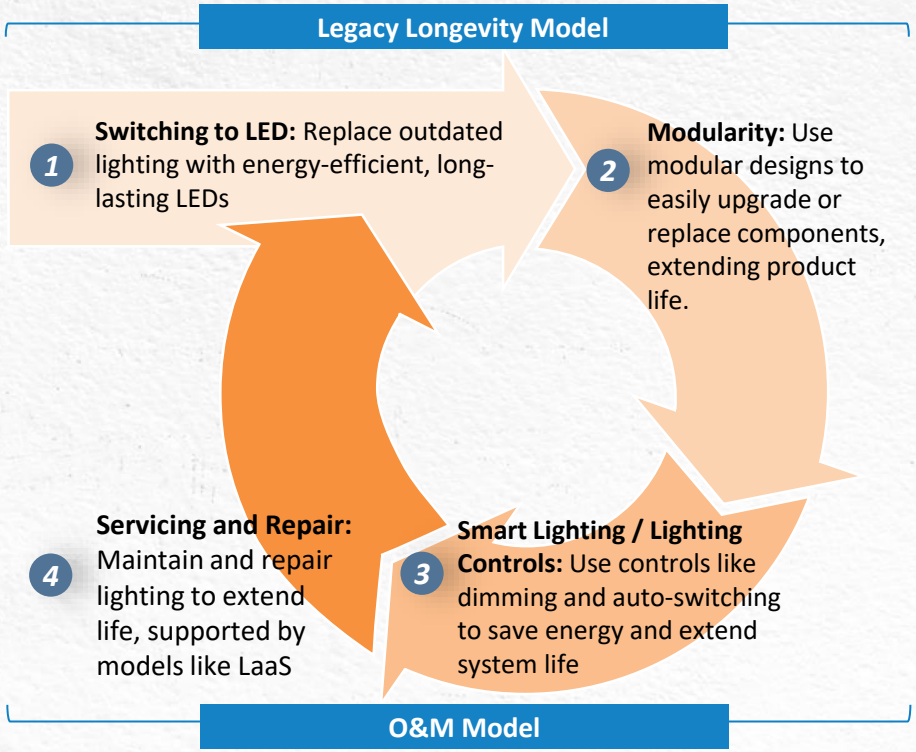
Outcome

Longer-lasting lighting systems with reduced need for replacement

Impact

Lower environmental footprint through reduced material use and waste; cost savings over time

A logical **sequence for extending the life and sustainability of lighting systems** could be structured as follows:



Source: Frost & Sullivan

PILLAR 1: LIGHTING CIRCULARITY

Eco-friendly Materials

Outline

Using sustainable, recyclable, and low-impact materials in lighting products

Example

Incorporating bioplastics, recycled metals, and non-toxic finishes in luminaire design

Outcome

Environmentally responsible lighting products with reduced ecological footprint

Impact

Minimized resource extraction and pollution; supports circular economy and green building standards

Examples of Best Practices

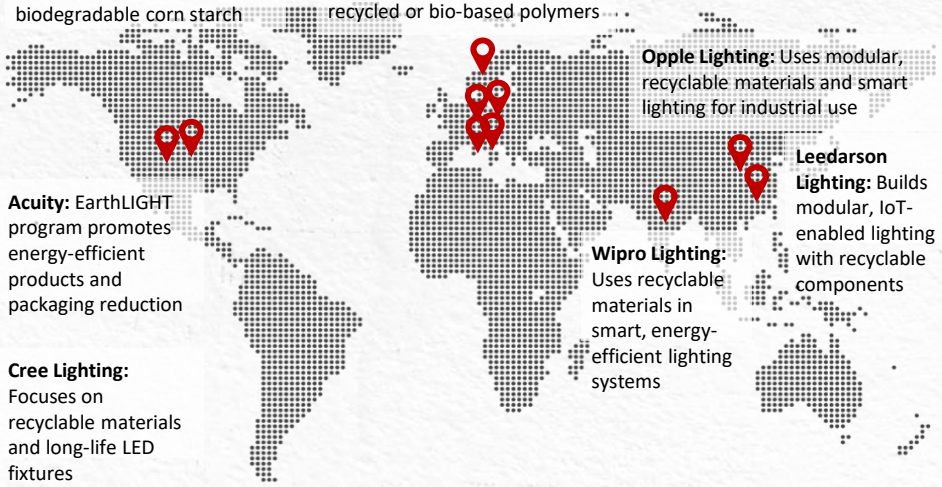
Niteko Illuminazione: Makes recyclable luminaires from industrial and household plastic waste

Signify: Uses recyclable materials and packaging; offers 3D-printed and bio-based lighting products.

Glamox: Uses recycled aluminum in LED luminaires, cutting virgin material use by 300 tons/year

Trilux: Offers 3D-printed LED luminaires made from biodegradable corn starch

Artemide: Designs pendants using certified wood waste and recycled or bio-based polymers



Acuity: EarthLIGHT program promotes energy-efficient products and packaging reduction

Cree Lighting: Focuses on recyclable materials and long-life LED fixtures

Opple Lighting: Uses modular, recyclable materials and smart lighting for industrial use

Leedarson Lighting: Builds modular, IoT-enabled lighting with recyclable components

Wipro Lighting: Uses recyclable materials in smart, energy-efficient lighting systems

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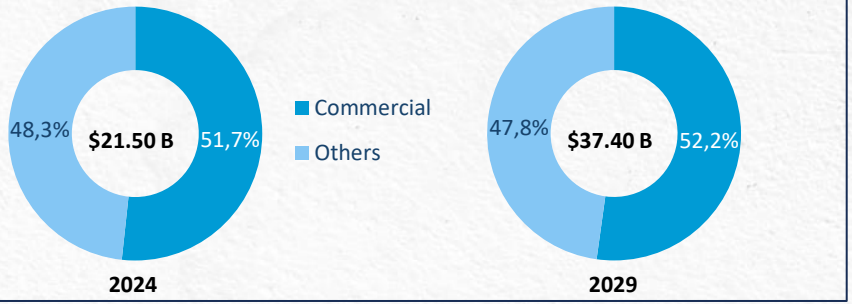
Source: Frost & Sullivan

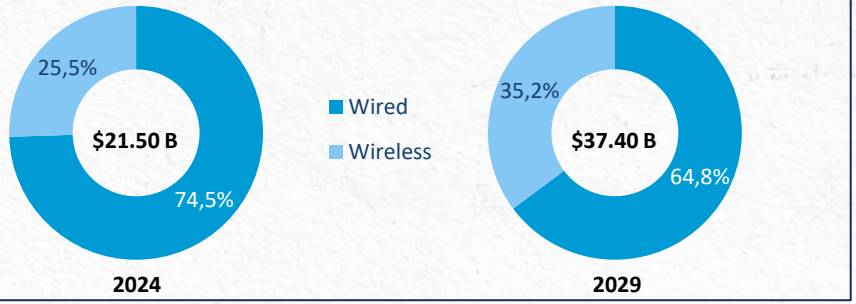
PILLAR 2: LIGHTING CONNECTIVITY

Market Snapshot

Smart Lighting: Revenue Breakdown by End User, Global, 2024 and 2029



Smart Lighting: Revenue Breakdown by Communication Type, Global, 2024 and 2029



Total Market CAGR (2024 – 2029)	11.7%
Commercial CAGR (2024 – 2029)	11.9%
Key Commercial Type	Office, Retail
Emerging Commercial Type	Hospitality
Fastest Growing Region	APAC
Control Mechanism by Cloud, % Installation, 2024	11.5%
Control Mechanism by Cloud, % Installation, 2029	21.8%

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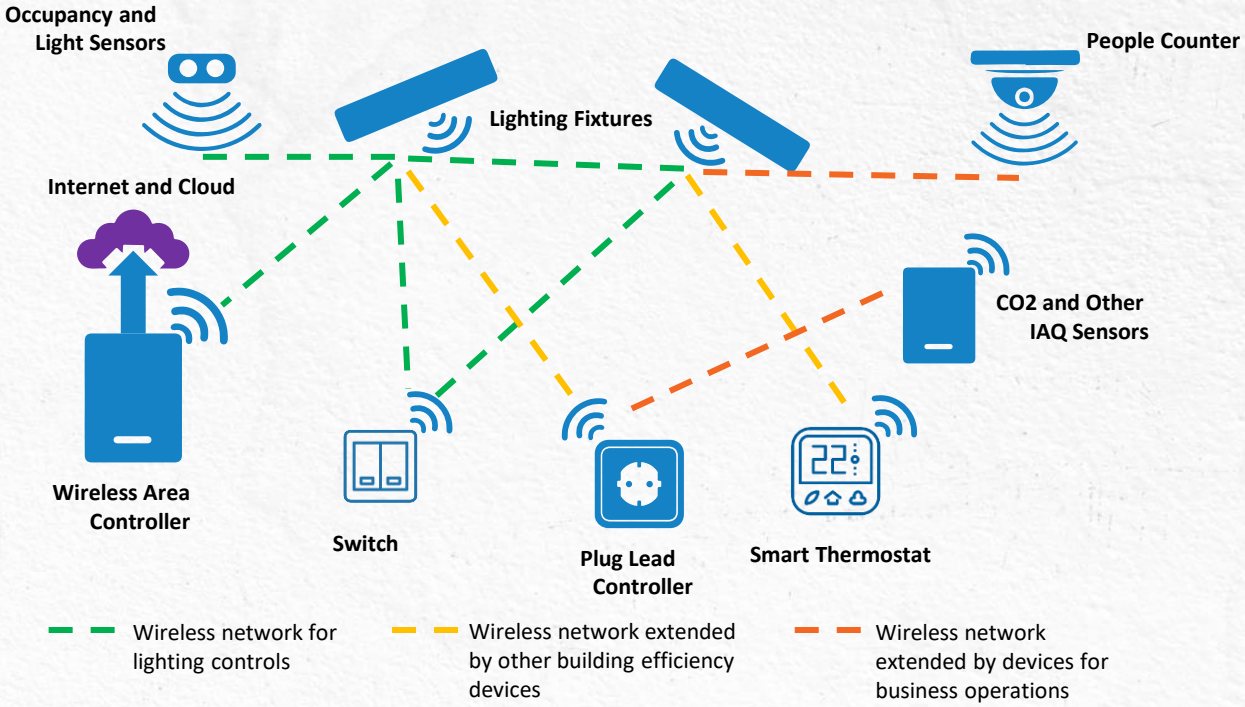
Source: Frost & Sullivan

PILLAR 2: LIGHTING CONNECTIVITY

Integration with Other Building Equipment

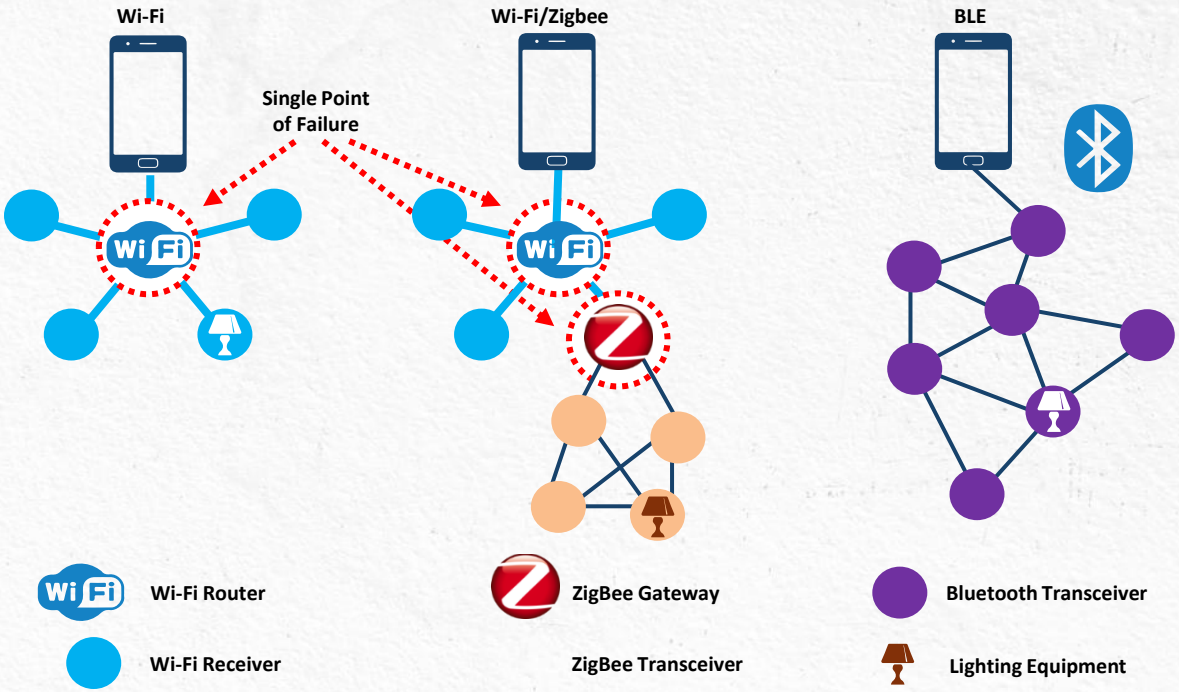


- **Lighting controls** are increasingly integrated with HVAC, access, and shading systems for energy efficiency and occupant comfort.
- **Wireless communication** enables devices to interact seamlessly using protocols like Zigbee and Wi-Fi.
- **Cloud platforms** centralize data for performance monitoring, predictive maintenance, and remote management.
- **System integration** ensures smooth operations, enhances user experience, and reduces manual intervention.
- **Cybersecurity** and data governance are critical to protect building systems and ensure compliance.
- **Open standards** and interoperability allow flexible upgrades and avoid vendor lock-in.

Source: Frost & Sullivan

PILLAR 2: LIGHTING CONNECTIVITY

Connectivity of Wireless Protocols



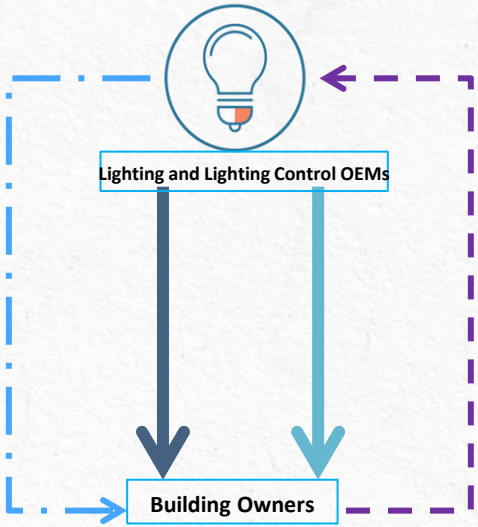
- **ZigBee** is a long-standing protocol with wide adoption in smart buildings.
- However, ZigBee's **single point of failure** risk can disrupt the entire network.
- **Wi-Fi,** while common, shares similar vulnerability in centralized setups.
- **Bluetooth Low Energy (BLE)** addresses this by using a mesh network, connecting devices directly to each other.
- BLE's mesh architecture **eliminates central failure risks**, enhancing reliability.
- Mesh-based protocols like BLE offer **scalable, resilient, and decentralized** connectivity ideal for smart environments.

Source: Frost & Sullivan

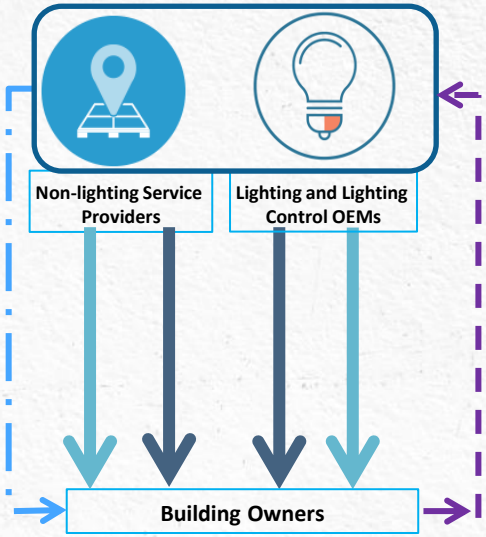
PILLAR 2: LIGHTING CONNECTIVITY

Business Model Trends

Smart Lighting: Single Service (Illumination), Global, 2020



Smart Lighting: Bundled Service (Integration with Non-illumination), Global, 2020



Single Service Model (Illumination Only)

- Lighting OEMs deliver standalone illumination services directly to building owners, covering installation, maintenance, and performance-based subscriptions.

Bundled Service Model

- Lighting OEMs collaborate with non-lighting providers (e.g., HVAC, security) to offer integrated smart building solutions, enhancing overall system value.

Shared Features

- Both models use monthly subscriptions and performance guarantees to ensure service quality and customer retention.

Key Difference

- Bundled services require multi-party collaboration, while single services are vendor-led and simpler to deploy.

Project Scale Matters

- Smaller projects often opt for single services; larger, complex buildings benefit more from bundled integration.

Strategic Implications

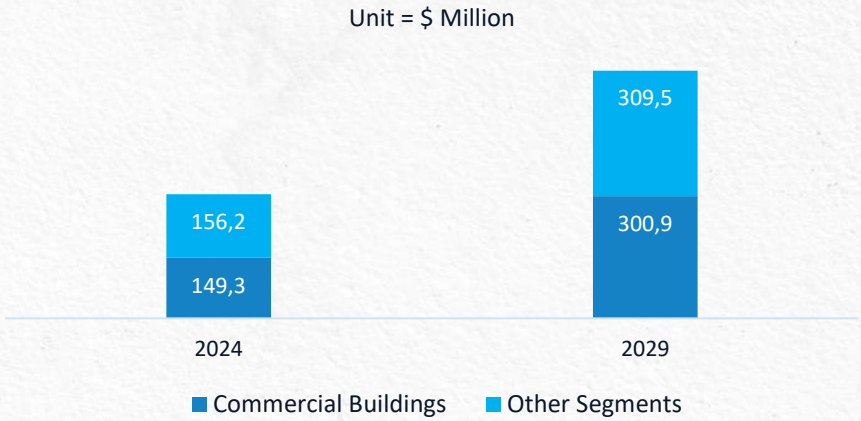
- OEMs must decide between operating independently or forming partnerships to stay competitive in evolving smart building ecosystems.

Source: Frost & Sullivan

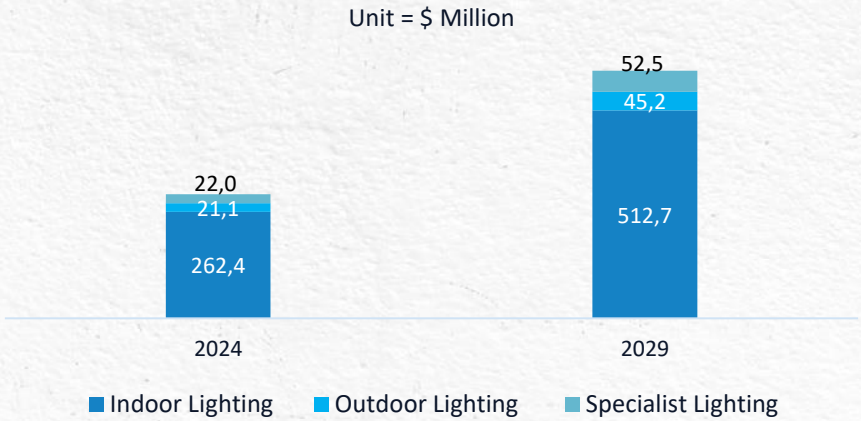
PILLAR 3: LIGHTING BUSINESS MODEL

LaaS Market Snapshot

LaaS: Revenue Forecast by End User, Europe, 2024 and 2029



LaaS: Revenue Forecast by Applications, Europe, 2024 and 2029



OBSERVATIONS:

Revenue from LaaS is projected to nearly double by 2029, with Commercial Buildings slightly outpacing Other Segments. The Renovation Wave Strategy is a crucial driving factor for buildings in different end-user verticals to implement energy-efficiency projects, including LED and lighting digital solutions

OBSERVATIONS:

Indoor lighting applications, including LED retrofits and new installations, dominate LaaS due to a higher installed base. **Outdoor lighting** includes city, smart street, and energy-efficient LED retrofit projects. **Specialist lighting** will grow faster with increased UV-C uptake in buildings.

PILLAR 3: LIGHTING BUSINESS MODEL

LaaS Distribution Structure

Lighting and Lighting Control Manufacturers

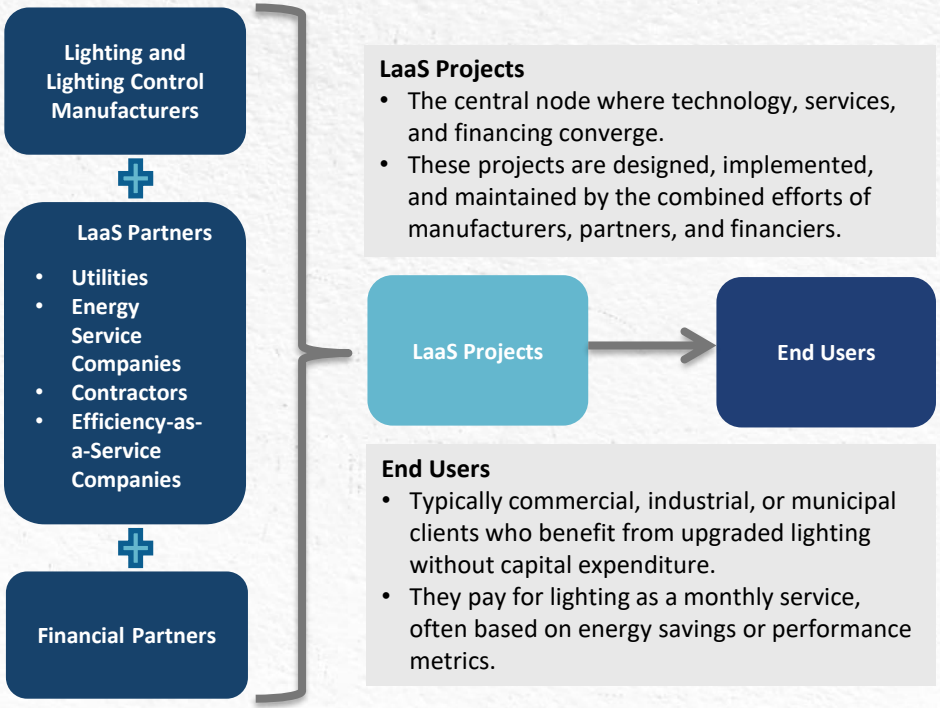
- These are the technology providers who supply the core hardware (LEDs, smart lighting systems, sensors).
- Their role is foundational, they enable the technical feasibility of LaaS.

LaaS Partners

- These entities act as intermediaries or service integrators:
  - Utilities: May offer LaaS as part of energy efficiency programs.
  - Energy Service Companies (ESCOs): Provide turnkey solutions including installation, maintenance, and performance guarantees.
  - Contractors: Handle physical installation and retrofitting.
  - Efficiency-as-a-Service Companies: Bundle lighting with other energy-saving services.

Financial Partners

- Provide capital to fund LaaS projects, often through leasing, performance-based contracts, or third-party ownership models.
- Their involvement reduces upfront costs for end users.



LaaS Projects

- The central node where technology, services, and financing converge.
- These projects are designed, implemented, and maintained by the combined efforts of manufacturers, partners, and financiers.

End Users

- Typically commercial, industrial, or municipal clients who benefit from upgraded lighting without capital expenditure.
- They pay for lighting as a monthly service, often based on energy savings or performance metrics.

PILLAR 3: LIGHTING BUSINESS MODEL

Lighting Digital Services to Accelerate LaaS Model

	COMMERCIAL BUILDINGS		
LIGHTING DIGITAL SERVICES	**Office**	**Retail**	**Hospitality**
Workspace management			
Light monitoring			
Energy monitoring			
Traffic monitoring and optimization			
Parking space management			
Indoor positioning and asset tracking			

Key:

- Most Important
- Important
- Somewhat Important
- Not Important
- Least Important

Workspace management and lighting monitoring dominate priorities; energy matters too. Traffic is secondary, while parking space management holds minimal relevance in offices.

Retail values workspace and lighting highly, with energy monitoring essential. Traffic and parking are moderately important for customer experience optimization.

Hospitality emphasizes workspace and lighting; energy is key. Traffic matters somewhat, but indoor positioning ranks lowest in operational importance.

Source: Frost & Sullivan

TOP LIGHTING OPPORTUNITIES IN 2026

GROWTH OPPORTUNITIES	INNOVATION AREAS	OPPORTUNITY SIZE (APPROX.)
Lighting Digital Services and Analytics	Workplace analytics, integration with ESG reporting tools, AI-optimized tools	$1B to $5B
Expansion in Commercial Buildings	Tailored solutions by building types (offices, retail, hospitality)	$60B – $80B
Integration with Renewables and Energy Storage	Integration with building-level microgrids, smart dimming	~$35B
Human-Centric and Wellness Lighting	Tunable white lighting and circadian rhythm support, integration with wellness and environmental sensors	$7B – $10B
Retrofitting and Upgrade Services	Plug-and-play smart retrofit kits, financing models for retrofits (e.g., performance contracting)	~$150B
AI-Driven Design and Simulation Tools	AI-powered lighting design and simulation, integration with architectural and engineering workflows	$10B – $15B

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Source: Frost & Sullivan

KEY TAKEAWAYS

Lighting is evolving from product to platform and service

enabling recurring revenue and alignment with operational outcomes

Sustainability is no longer optional

embracing green manufacturing, modular design, and carbon-neutral strategies to stay competitive and compliant

Digitalization unlocks efficiency, insight, and value

enabling data-driven decision-making, occupant wellness, and ESG reporting

New business models and services are driving market expansion

catering to diverse customer needs and open doors to SMEs and sector-specific applications

Commercial lighting market is on a strong growth trajectory

requiring innovation across technology, sustainability, and service delivery

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