URBAN TRANSITIONS MISSION

IN COLLABORATION WITH signify

Connected lighting for resilient, inclusive and decarbonized cities

Urban Transitions Mission & Signify join forces to accelerate urban lighting transition

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The challenges for Cities

Cities account for more than 75% of global energy consumption, 70% greenhouse gas emissions, more than half of the world's population is urban and this figure is expected to rise [1].

Between 2024 and 2050 the share of the urban population is expected to increase from 56% to around 70%, with the number of urban inhabitants increasing by around 1.8 billion [1]. Projections show that urban land areas are expected to expand by around 1 million km^2 up to 2050, equivalent to the total land area of Japan, Germany and Italy combined [1].

The climate and energy challenge is a key urban issue, and city leaders and administrators play a crucial role.

Cities around the world aim at being places that are enjoyable, safe, affordable, clean, sustainable, as well as stimulating and full of opportunities for their communities.

Investments in areas such as urban infrastructure, transport, public spaces, education, healthcare, and environment are required to achieve that goal. Citizens and local businesses should be part and join in on their city's vision.

In a time of never-enough capital, energy sufficiency is key unlock further resources for renovations that enable fair and just

- energy transition,
- better use of resources,
- creation of livable and healthy places.

Energy savings, while avoiding the waste of precious environmental, energy, and financial resources, can significantly contribute to securing more sustainable energy systems.

Improving lighting is one of the simplest and fastest ways to enhance energy efficiency. This process is often straightforward and easy to implement. In most cases, upgrading lighting systems involves merely replacing old technology with new, more efficient options. This switch usually doesn't require extensive infrastructure changes. Lighting improvements are also highly effective, thanks to a wide range of advanced lighting technologies already available on the market. Savings flow in immediately after the new lights are installed and turned on.

Connected lighting helps digitalize buildings by integrating smart sensors and Internet of Things (IoT) technologies that collect and share data on occupancy, energy usage, and environmental conditions, enabling real-time insights and optimizing performance.

Similarly, connected outdoor lighting can be integrated with sensors providing the city administration with key data on street usage and enabling peak management and flexibility for events or emergency.

This guide, dedicated to city and local government practitioners, aims to shed light on the potential benefits of sustainable lighting solutions and how to leverage them.

Public street and area lighting account for

- up to 25% of electricity consumed by municipalities [2]
- for up to 1% of total electricity demand worldwide [2]
- EU27 countries have more than 56 million street lighting luminaires in operation and an estimated electricity consumption of 35 TWh [3]

Buildings

- Building floor area has grown by about 60% in the past two decades and is set to increase by another 20% this decade, adding a total floor surface area of nearly 45 billion m^2, equivalent to about five times the floor area in Indonesia today [4]
- 34% of global energy is consumed by buildings [5]
- Lighting is responsible for 7% of the embodied carbon of a building during its entire life cycle (from product to end of life) [6]

"The role of energy efficiency as the first fuel as a key pillar in the global energy transition towards net-zero GHG emissions in 2050"

G7 Ministers' Meeting on Climate, Energy and the Environment under Japan's Presidency

Chapter 1

Pursue efficiency, connectivity, decarbonization

Efficiency measures how effectively resources are used to achieve the best possible results. It indicates performance: you are efficient if you can achieve the desired outcomes with minimal resource expenditure. When discussing the efficiency of a lighting system, three key aspects should be considered.

Firstly, light efficacy of the light source, measured in lumens per watt ensures the efficient use of energy. Talking about LED technology might hide inefficiencies as LED's efficacy ranges from 100 lm/W up to 210 lm/W. You can double your efficiency if you select the best solutions available in the market.

Secondly, sensors and controls ensure lighting is activated only when needed. Even if you use the most efficient solution, you can still waste energy (and money and resources) if lights are left on unnecessarily. Why keep lights on in empty roads or classrooms when no one is around or there is still enough natural light?

Finally, connected and integrated solutions further enhance efficiency by enabling monitoring, remote management, customization, and adaptation to usage conditions, reacting in real time to changes. Adjusting lighting levels for different events or seasonal changes in natural light is possible through smart communication between intelligent systems. This automation reduces the complexity of programming and scheduling, following an initial user setting.

Efficiency also means optimizing operations, reducing direct costs for downtime and indirect costs for out-of-service periods, and using resources wisely.

Every holistic strategy for sustainability should start with energy efficiency, which is the first, quickest, and easiest way to decarbonize cities and preserve the environment. Savings from efficiency gains can free up resources to fund less bankable investments for long-term solutions or to support the mitigation of climate change.

Energy saving and efficiency contribute directly to meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Several Building Codes have been released or are under review to enforce the system efficiency of public building mandating new buildings to be zero-emissions, the renovation of worst performing existing infrastructure, the use of automation and controls.

Utilizing natural daylight within buildings is analogous to using renewable energy sources directly, as both harness the sun's light without the need for storage. In combination with artificial lighting, managed by

Switching all conventional light points in the Cities across the world to energy efficient LED, would save [7]

- 193.000 GWh electricity consumption
- 86 $MtCO_2$ emissions annually
- 175 $ billion electricity costs

In doing so, we would free up more than enough electricity to charge [7]

- 57 million electric cars for one year, or
- 857 million electric bikes for one year, or
- 2 million electric buses for one year.

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control systems, it can save up to 60% of energy, being a great contribution to wellbeing for people at the same time [8].

Connectivity of the lighting systems into the smart infrastructure presents many benefits for a local government, who can save more energy as well as manage multiple objectives with an interconnected group of sensors. As a reference, the conversion of a lighting system from conventional bulbs to standard LED saves 40% of electricity costs , while the conversion to a connected LED system increased the savings to 70% of electricity costs [8].

Furthermore, wireless lighting control systems can be installed 70% faster than wired control solutions, on average [9].

A switch and a sensor can be installed in as little as 15 minutes on a lighting pole, and wireless devices can be mounted to any surface without cutting holes or running wires [9].

In short, efficiency, connectivity, and sustainability form a self-propelling virtuous circle that cities can ignite to advance their climate transition journey.

Gran Canaria, Spain

The Cabildo (Council) of Gran Canaria has upgraded the lighting system of the island's most important highway GC-1, to achieve substantial energy savings while enhancing safety for users.

Chapter 2

Use less, use longer, use again

For a sustainable world, the transition from a linear "consumption driven" economy to a circular economy is essential. A circular economy seeks to minimize the dependence of economic growth on natural resources consumption by maximizing efficiency, reuse, and recycling.

This transition is crucial not only to support a future population of 9 billion but also to foster economic growth, provide environmental benefits, and improve social well-being.

The lighting industry is leading the way as a next frontier beyond the adoption of connected LED lighting. Already today, the principle of circularity is embraced by ensuring that lighting solutions are designed and managed to minimize waste, extend product lifetimes, and maximize resource efficiency. Lighting solutions use less energy, less materials, less non-virgin content.

Less energy, by having increased the luminous efficacy from 20 lm/W to 210 lm/W in almost half century thanks to amazing innovations from discharge and compact fluorescent lamps to LEDs. The evolution of efficiency has not yet reached the tableau; instead, it continues to rise year by year to unprecedent levels.

Less material and less non-virgin content, by designing products using recycled materials which most of the time come directly from recycled lamps and luminaires. 3D-printed lighting fixtures are not anymore prototypes or start-up initiatives; they have become a well-established, mass-production industrial process using recycled or bio-based material.

Thanks to the evolving regulations and innovation, luminaires are built to last longer and increasingly designed with serviceable, recyclable components.

Extended lifetime can be achieved by continue innovation in the diodes production, in the thermal preservation of the sources and by extremely precise semiconductors manufacturing. Nowadays, products can last up to 100,000 hours, providing years of continuous illumination.

As a result, keeping light bulbs in stock for urgent replacement is no longer necessary. Long-lasting solutions are designed to be upgradable, preventing the risk of stranded assets management and allowing for easy integration of the latest components through simple modular steps. The extended lifespan enhances the repeatability and

A circular economy can unlock new value and growth in a world of limited resources [10]

- new sources of economic growth: + $4.5 trillion in additional global economic output by 2030, +$1.8 trillion for the EU
- holistic environmental impact: - 39% of GHG emissions by 2050 globally
- Advanced resource: efficiency - 28% material use for the same outcomes, + $3.6 trillion in value preservation of resources by 2030,
- 3D printed lighting lower by 47% the carbon footprint

"Now that lighting is no longer a product, but a service, we should never worry about lamps and luminaires again. This also gives us access to the very best LED lighting on the market. We would never have been able to finance such a product with our own resources, and I think that is the case for many governments"

Sebastien Lefebvre, Purchasing and Technology Manager, City of Kortrijk

serviceability of products, ensuring convenient maintenance in case of exceptional failure or performance adjustment. As in the case of efficiency, the extension of the lifespan should be also applied to the entire systems. Intelligent asset management in connected solutions maximizes usage time by preserving the components through continuous monitoring, strategic planning, and remote access. Ultimately, less downtime translates to fewer citizen complaints and faster response for issue resolution. Finally, lighting products can be dismantled and partially or entirely reintroduced into the manufacturing cycle at the end of their life. The lighting sector is one of the most advanced industries, with manufacturers forming consortia to collect and recycle lamps and luminaires, in collaboration with distributors and specialized infrastructure for professionals.

Roskilde, Denmark

The iconic luminaire, co-designed in cooperation with the Copenhagen's Office of City Architecture in the 1960s, now boasts a significantly reduced environmental impact. Its canopy is made from bio-based plastic derived from sugarcane, and the main metal components are crafted from recycled aluminum.

Chapter 3

Make it better, safer, more attractive

None of the above achievements come at the expense of light quality. On the contrary, well-designed, efficient lighting technology offers real co-benefits for people, wildlife and the environment.

A city illuminated with the latest technology solutions significantly enhances livability, safety, security, accessibility, identity, and attractiveness for its residents and workers.

Outdoor lighting can reduce crime rates, boost the sense of security, improve traffic flow, increase pedestrian safety, and promote a healthier lifestyle.

Allowing citizens to shape public spaces to suit their needs fosters a deeper connection to their cities, increasing the liveliness and vibrancy of public spaces.

However, brighter lighting doesn't necessarily equate to safer spaces. Safe environments for social interaction and enjoyment are created by layering light and managing contrast to connect adjacent spaces. Happier people engaging in outdoor activities contribute to a thriving nighttime economy – not just for tourists but for citizens too.

Given that we spend up to 90% of our life indoors, with 36% of that time spent at work, the right lighting is essential for helping people see, feel, and perform better [11]. Lighting can also influence recovery speed from illness by stimulating the natural production of hormones or improve focus at school and work.

Better-lit workplaces, including natural daylight, have a proven benefits on employee performance: mental and memory performance increases by 25%, call processing by 12% and productivity rises by 23% [12]. This becomes even more significant as 10% of the world population is predicted to experience high levels of myopia [13].

Innovative dynamic lighting in schools has shown impressive results. A study by Universitätsklinikum Hamburg-Eppendorf, involving 166 pupils and 18 teachers, found that reading speed increased by nearly 35%, error rates dropped by almost 45% and hyperactive behavior decreased by 76% [14].
Light has a profound impact on emotions and physiological processes, affecting the human circadian rhythm, sleep quality, hormone levels, and cognitive performance.

Energy efficient and improved lighting design comes with many co-benefits such as [15]

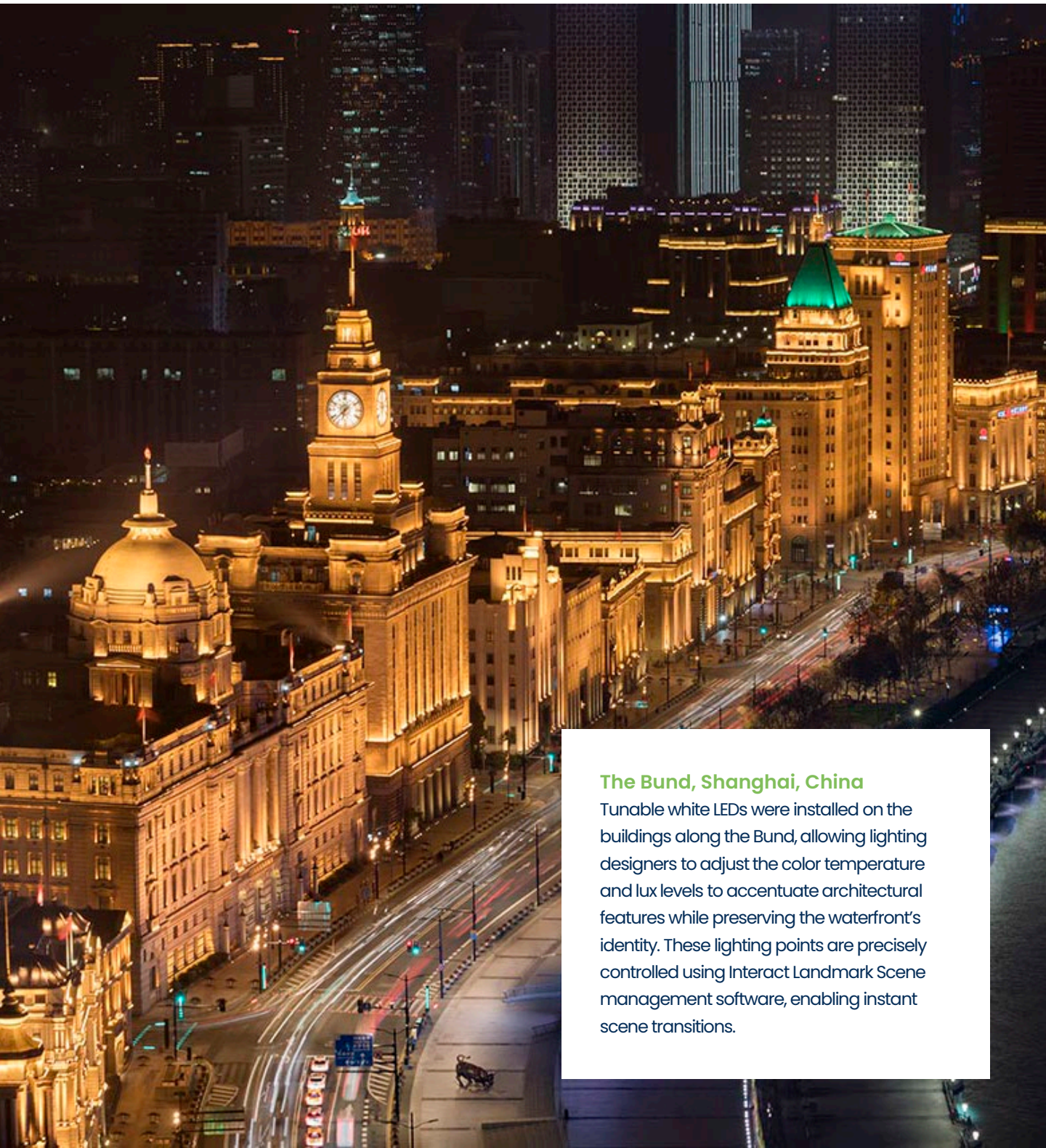
- improved street lighting can reduce nighttime crime by 10-36% crime and decrease road accidents with injuries by 30%
- properly tuned lighting has been shown to increase reading speed by 35% and reduce errors by 45%
- one third of nurses waste at least one hour per shift searching for missing equipment.
- optimized lighting can reduce decrease traffic congestion by 15 - 31%
- healthy buildings enable office employees to perform up to 12% better and boost workers productivity by up to 18%
- enhanced lighting helps students achieve up to 14% higher scores, and increase retail sales by up 25%

"If we illuminate public spaces better and bring light to where it is actually needed, this directly increases the quality of stay and is a key factor in a smart city."

Florian Fuchs, Smart City Expert, Stadtwerke Düsseldorf AG

Dynamic lighting supports the body's natural rhythms, boosting productivity and well-being. Lighting technology providing melanopic light, which stimulates non-visual responses to light in the body, helps synchronize the internal body clock, plays a crucial role in managing these non-visual effects of light. It can help regulate our circadian rhythms and, when applied to office environments, it can increase productivity by up to 12% [16].

A stabilized circadian rhythm can help regulate the biological clock, reducing stress, supporting cognitive performance, and improving mood..
Research shows that improving indoor environments in schools, hospitals, and offices can boost productivity across the EU by up to 12%, potentially contributing 455 $ billion to the economy and saving 38 $ billion in health costs annually [17].



The Bund, Shanghai, China

Tunable white LEDs were installed on the buildings along the Bund, allowing lighting designers to adjust the color temperature and lux levels to accentuate architectural features while preserving the waterfront's identity. These lighting points are precisely controlled using Interact Landmark Scene management software, enabling instant scene transitions.

Act now!

Make your city more competitive

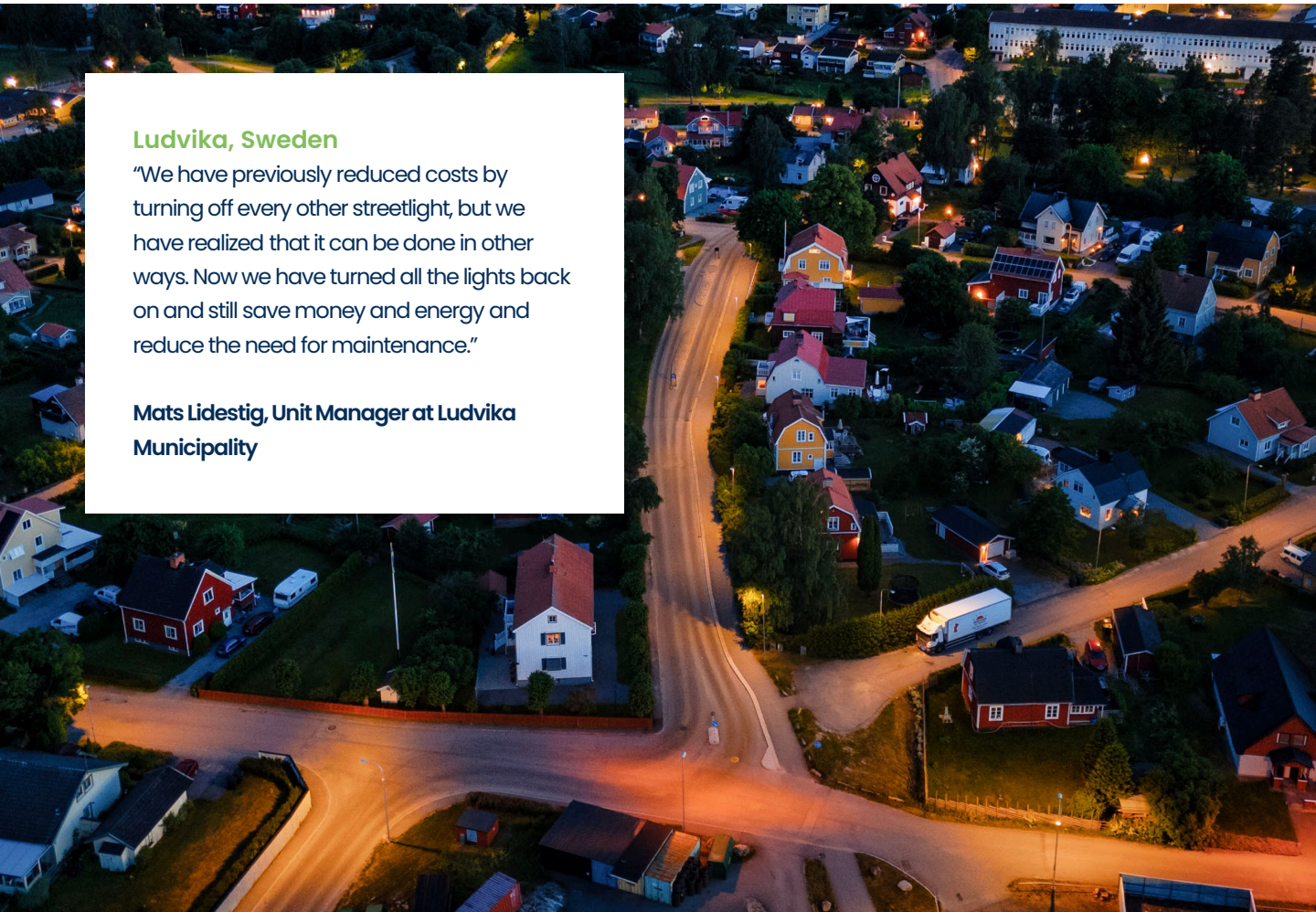
The challenges faced by cities today—rising populations, limited resources, and the urgent need for sustainable solutions—demand immediate and impactful action. Efficient, sustainable, and connected lighting systems represent an unmissable opportunity to tackle these challenges hands-on, helping cities to significantly reduce energy consumption, cut emissions and energy costs, and create environments that are safer, healthier, and more engaging for their residents.

Through the integration of intelligent lighting solutions, a city is able to respond dynamically to changing needs, whether in public spaces, offices, or schools. From increasing comfort and safety, to improving cognitive performance, the impact of well-designed lighting systems is profound and far-reaching.

By embracing these innovations, cities can unlock significant savings and ensure that their infrastructure meets the needs of today while planning for a sustainable future. Collaboration among city officials, designers, suppliers, and system integrators is key to making these changes a reality.

The question is not whether these changes should be made, but how quickly we can implement them to create a better, brighter future for all.

Let's begin the journey of transforming our cities, ensuring that every step taken is one towards a smarter, more sustainable world.



Ludvika, Sweden

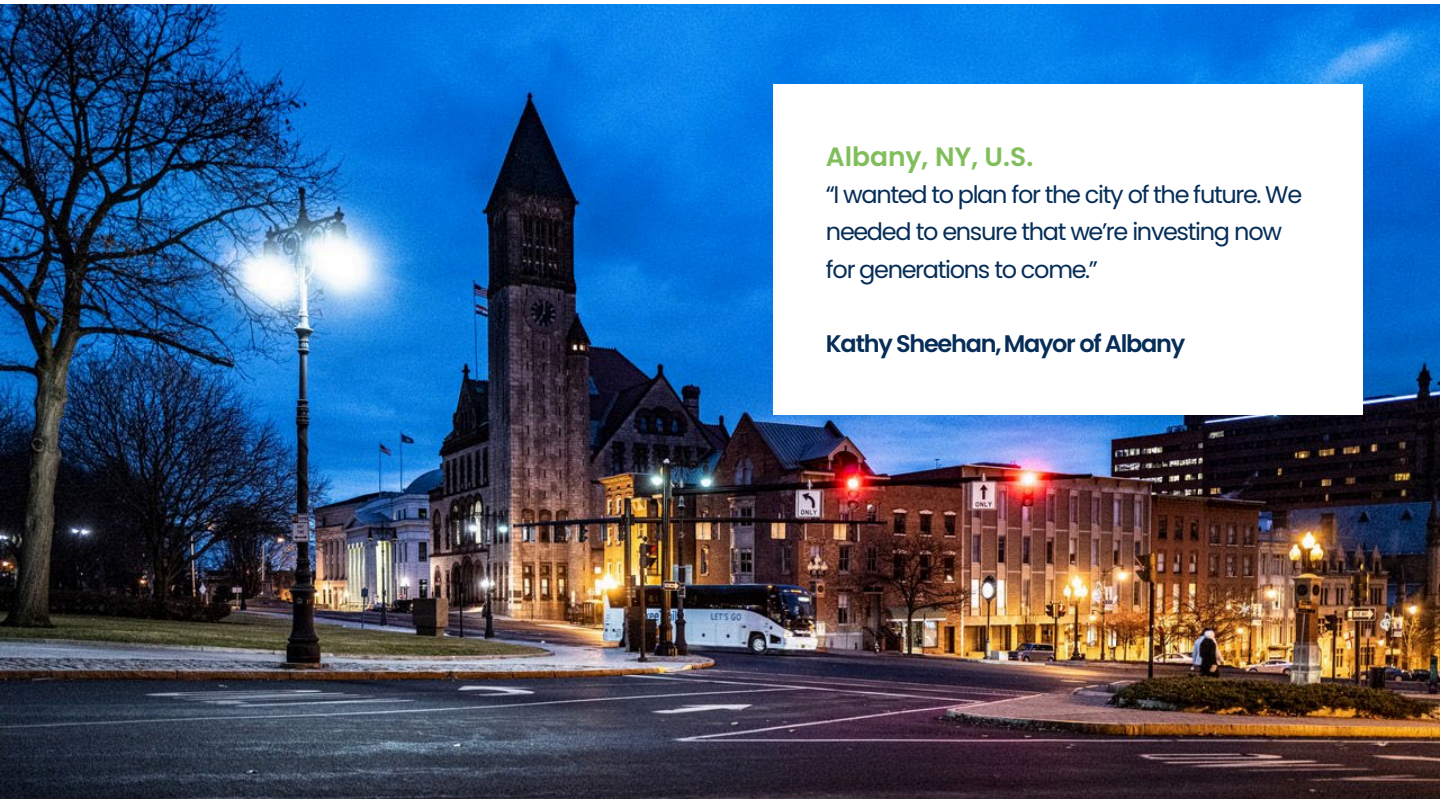
"We have previously reduced costs by turning off every other streetlight, but we have realized that it can be done in other ways. Now we have turned all the lights back on and still save money and energy and reduce the need for maintenance."

Mats Lidestig, Unit Manager at Ludvika Municipality

Getting Started

Guiding checklist for renovation

1. **Design for the right light at the right place and at the right time**
   - Optimize the number of light points while maintaining the required uniformity of lighting
   - Use time-schedules, sensors and daylight detection to reduce lighting hours
   - Control light distribution to enhance performance and minimise discomfort, such as glare
   - Dim lighting to adjust levels based on specific tasks and circumstances
   - Select the appropriate light spectrum, color temperature and color rendering for optimal results
2. **Design for system efficiency**
   - Implement energy-efficient LED solutions
   - Maximize the use of sensors (e.g. daylight, movement, space occupancy, and traffic sensors)
   - Utilize efficient monitoring and controls systems to manage energy use
3. **Select the right partners**
   - Engage with top-tier partners across the entire value chain and ecosystem (designer, manufacturer, contractors, ESCOs, installers, system integrators)
   - Foster collaboration to simplify process and reduce bureaucracy
   - Take advantage of available financing options (Government Stimuli, Public-Private Partnership, Energy Performance Contracts, Private Sustainable Financing)
   - Explore advanced solutions, such as Light-as-a-Service, to share financial risks



Albany, NY, U.S.

"I wanted to plan for the city of the future. We needed to ensure that we're investing now for generations to come."

Kathy Sheehan, Mayor of Albany

Self-assessment

Are you ready for the transition?

Use this self-assessment questionnaire to evaluate your city's preparedness for a cost-effective, human-centric and sustainable lighting future. If the answer is "yes," you get 1 point; if "partially," you get 0.5 points; and if "no," you get 0 points.

- Does your city use LED light points?
- Does your city have a public lighting plan in place?
- Has your city developed a public building renovation plan?
- Does your city organization have a designated lighting manager?
- Do public buildings in your city use building automation and controls?
- Are lighting sensors with occupancy detection used in public buildings?
- Are all public buildings in your city mapped by energy performance classes?
- Does your city dim road and street lighting using time schedules?
- Are road and street lighting in your city monitored and controlled via a central system?
- Are lighting sensors used for road and street lighting?
- Does your city have a smart/digital lighting infrastructure?
- Is lighting integrated into your city's climate transition plan?
- Does your city use dedicated funding instruments for lighting?
- Is your city part of a network of municipalities for best practice sharing?
- Does your city own or directly manage the lighting points?
- Does your city collaborate with ESCOs or utilities for outdoor lighting infrastructure?
- Does your city collaborate with ESCOs or utilities for lighting in public buildings?

Scoring:

- 14+ points - you are a leader in urban lighting innovation,
- 10-13 points - you're ready to begin the journey toward smarter, sustainable lighting,
- 5-9 points - consider seeking support from lighting experts to accelerate progress,
- up to 4 points - significant opportunities for improvement exist, and action is needed immediately.

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About Urban Transitions Mission

The Urban Transitions Mission (UTM) mobilizes decision makers across all levels of government to prioritize climate neutral and net-zero pathways enabled by clean energy and systemic innovation across all sectors and in urban governance. By accelerating capacity-building and closing the gap between research, development and deployment, the Mission will empower cities to adopt innovative solutions and help reach tipping points in the cost and scale of those solutions for urban transitions.

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About Signify

Signify is the world leader in lighting. Signify unlocks the extraordinary potential of light for brighter lives and a better world. Signify advanced products, systems and services for professionals and consumers make homes, workplaces and communities safer, more comfortable, and connected. Signify innovations in materials and technologies enhance our environment and reduce the demands on our earth's resources. Scan the QR code below to estimate how much your city can save.

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