Photonics21 Press Release

New Report Shows Only Photonics Can Satisfy AI's Insatiable Appetite for Compute Power

Brussels – November 2025.

As artificial intelligence expands, its soaring electricity use is putting unprecedented pressure on power grids, driving up costs and threatening to slow Europe's energy transition. But a new report shows that only light-based computing can keep AI's ever-expanding power demands at bay without triggering a surge in emissions.

The study, published today by Photonics21 and compiled by market intelligence agency TEMATYS, finds that as electricity use from AI rises sharply, and conventional silicon chips struggle to keep pace with the twin pressures of ever-larger models and expanding data centres, Europe risks undermining its clean-energy goals and increasing reliance on fossil fuels.

Entitled "AI Desperately Needs Photonics," the report concludes that photonics, which uses light rather than electricity to move and process information, offers the only viable pathway to scale up AI computing while dramatically reducing energy consumption. The study reveals that integrating photonic technologies into data-centre and chip architectures can help AI growth remain compatible with Europe's climate commitments.

A Growing AI Problem

AI is scaling faster than the world's power grids can handle. Each new generation of larger, more complex models demands exponentially greater computing power, sending data-centre energy use soaring.

The International Energy Agency puts global consumption at roughly 415 TWh in 2024, and TEMATYS warns it could more than double by 2030 as AI workloads dominate digital infrastructure.

Sébastien Bigo, Nokia Bell Labs Fellow and Photonics21 Work Group Leader for Digital Infrastructure, said, "Photonics can provide the infrastructure that will determine whether AI becomes cleaner and more competitive or simply costlier and dirtier. Europe has the research base to lead; what it lacks is coordinated investment and industrial scale."

The report shows that bringing photons much closer to the compute (whether through co-packaged optics or other emerging photonic integration approaches) and using light to handle increasing parts of data movement or specific acceleration tasks can considerably improve the carbon and cost profile of AI. While photonics is not a replacement for CPUs or GPUs, it can become a critical complement that eases the pressure on them. If Europe wants sovereignty in future AI hardware and to meet its climate commitments, the report stresses that Europe's policy and investment decisions in the coming years will be decisive.

Photonics is Already Essential

The report finds that photonics is already indispensable to the digital world. Fibre optics underpins today's internet and data-centre infrastructure, and the next step of integrating light directly into chip architectures through co-packaged optics is already underway.

These advances, however, will not be enough on their own. Even with industry claims of 3.5 times greater power efficiency, TEMATYS concludes that these gains cannot fully offset the surge in energy demand driven by AI's rapid expansion.

The study also shows that optical computing is no longer theoretical. Laboratory breakthroughs and start-up prototypes, including MIT's 2024 demonstration of an integrated photonic chip performing neural-network computations entirely with light, reveal a clear technical path towards fully photonic processors.

Finally, the report warns that Europe has the expertise but not yet the scale. World-class research and promising start-ups exist across the continent, but without faster investment, large-scale manufacturing, and workforce development, Europe risks surrendering this strategic market to competitors abroad.

The report urges European institutions, national governments and private investors to treat photonics as strategic infrastructure for AI. Recommended actions include: dedicated funding for pilot manufacturing, incentives to scale photonics start-ups, inclusion of photonics in Chips/AI/Green tech funding streams, and skills initiatives to build a manufacturing workforce. Without these steps, Europe risks ceding critical parts of the AI hardware value chain to overseas competitors while facing higher energy bills and emissions.

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Notes to editors:

- Report: AI Desperately Needs Photonics - TEMATYS for Photonics21, July 2025.
- Data highlights: global data-centre electricity consumption ≈ 415 TWh in 2024 (IEA); TEMATYS projects a likely doubling by 2030 under current trends driven by AI.
- Definitions: Co-packaged optics = optical interconnects brought into the chip package; Photonic processors = chips that use photons to perform key computations used in neural networks.

About Photonics21

Photonics21 is the European Technology Platform (ETP) for photonics, a technology encompassing all products and processes related to the emission, manipulation, and detection of light. Photonics is integral to a wide range of industries, including the medical, healthcare, transport, manufacturing, and telecommunications sectors.

"Photonics21" was established in December 2005 to bring together the photonics research community and industry. The European Commission defined photonics as one of five European

Key Enabling Technologies (KETs) in September 2009. Shortly after, the European Research & Innovation Program "Horizon 2020" invited Photonics21 to become a "Public-Private Partnership". The "Photonics 21 Association", a legal entity under Belgian law, became the private contract partner in November 2013 as part of a public-private partnership with the EU Commission.

Today, Photonics21 represents over 4,300 personal members from across Europe and beyond. Our members are experts in the photonics industry, as well as research organisations and universities, who actively engage with us to develop a joint photonics strategy for future research and innovation in Europe.

Photonics is one of the few critical technologies for which Europe remains a global powerhouse in research and business. Several Nobel Prizes have been awarded to European scientists for their achievements in photonics over the past two decades. Approximately 5,000 European SMEs are considered hidden champions and world market leaders in their respective photonics markets. Europe ranks number two in the world in terms of production volume and market share. With more than 400 start-ups, Europe is one of the most thriving and innovative photonics regions in the world. Leadership in the development of photonics components and systems provides a competitive advantage in numerous key markets and policy areas, including the quantum internet, quantum computing, next-generation microelectronics, autonomous vehicles, Industry 5.0, virtual worlds, fusion energy, and many more.

As of 2022, the global photonics market was worth $ 864.6 billion. The European photonics industry grew from €103 billion in 2019 to €124.6 billion in 2022. With a 6.5% CAGR between 2019 and 2022, the European Photonics Growth exceeds the EU's GDP. The European photonics industry has considerable global leadership positions and employs more than 430,000 people directly.

With a positive growth forecast of €175 billion by 2027, current industry trends, such as digitalisation, resource efficiency, and individual and zero-failure production, will continue to drive the photonics industry forward.

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