

Light as the key to global ecological sustainability

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Presentation of the results of the study on high-tech PHOTONICS solutions for protecting the environment and resources

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Photonics offers solutions for the future

Background to the study

- As a key technology, photonics provides key solutions for social challenges and trends – although few people are aware of this.
- Using the solution's contribution towards ecological sustainability as an example, the wide range of applications and the innovative nature of this advanced technology will be shown.

Publishers and study partners







CO₂ avoidance and examples of cutting-edge German technologies

Study content

- Development of photonics, its areas of use and its contribution towards ecological sustainability,
- Eight example calculations for selected technological fields which make clear the reduction in CO₂ emissions already achieved and the potential for CO₂ avoidance in the future,
- Presentation of German high-tech solutions from industry and research which show in detail how broad photonics is and why it is an important link between efficiency and environmental protection.

Contents **Executive summary** Photonics as an "enabler" for climate and environmental protection 3 billion tons less CO₂ How photonics contributes to global climate protection Example applications for German high-tech solutions aimed at ensuring ecological sustainability... ... in the area of environmental protection and recycling ... in urban development ... in the area of mobility ... when generating and storing energy ... in industrial production ... in agriculture and forestry The authors, publishers and study partners **Picture credits** Imprint





Example calculations only show a selection, the actual potential is greater

Notes regarding the calculations

- Only technologies, which are not yet or only partially exploited (as regards prevalence/market penetration), are looked at. The use of the technology in the relevant year is compared with a situation where this technology does not exist.
- The examples only show a selection of the ways in which photonics contributes towards ecological sustainability as shown by the many other example applications in the study. The actual potential is enormous and very much greater but it is not possible to make exact predictions.
- The French consultancy firm TEMATYS carried out the calculations on the basis of numerous studies, other publications/sources and discussions with experts.

Detailed information regarding the calculation process can be found here: www.spectaris.de/fileadmin /download/greenphotonics









Energy generation, lighting, communication via fiber optic networks and in data centers

The solution's contribution as seen in the example calculations (1)

- Photovoltaics: Thanks to solar cells, solar energy can be converted into electricity very efficiently. In the laboratory, the efficiency level of solar cells has already reached 45 percent.
- Energy-efficient lighting: Photonics has developed white LEDs which are just as bright as a light bulb yet use less than a tenth of the electricity.
- Optical communication via fiber optic networks: Signals in fiber optic cables can be transmitted 100 km with no need for amplification. In contrast, electrical signals can only be transmitted 2 km. The fiber optic network therefore requires much less energy for data transmission than a copper network.
- Optical communication in data centers: Integrated photonic circuits in data centers avoid the high-loss conversion of optical signals into electrical signals and back again.







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Early warning systems for forest fires, metal recycling, displays and 5G mobile communications

The solution's contribution as seen in the example calculations (2)

- Optical early warning systems for forest fires: Distant (smoke) signals can only be detected contactlessly, quickly and sensitively with the help of photonics,
- Laser-assisted metal recycling: Optical analytics allows materials in the recycling process to be identified extremely quickly, selectively and contactlessly,
- Energy-efficient displays: Photonics is revolutionizing screen technologies, modern active OLED displays are increasingly replacing LEDs,
- Optical communication in 5G mobile communications networks: Very large amounts of data can be transmitted in parallel via fiber optic cables – an important requirement when linking 5G network nodes.



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How photonics contributes towards climate protection: 3 bill. tons less CO₂ in 2030



CO₂eq avoidance (mill. t/year)	2019	2025	2030
Photovoltaics	569	1,426	2,130
Lighting	526	671	503
Fiber optic networks (FTTH)	13	25	39
Data centers	0.2	0.6	1.1
Forest fire detection	8	16	81
Metal recycling	6	39	90
Displays	0	1.7	6.3
5G	3	35	66

At the moment, photonics solutions in the eight technological fields described can help to avoid 1.13 bill. tons of CO_2 eq/year either directly or indirectly.

It is expected that this figure will rise to almost 3 bill. tons by 2030.





In 2030, photonics could make an 11 % contribution towards the 1.5 degree target in the Paris climate agreement

2030, PHOTONICS WILL MAKE A CONTRIBUTION OF AT LEAST 11% TOWARDS THE 1.5 °C CLIMATE PROTECTION TARGET



2030 is an intermediate point on the way to climate neutrality which should be achieved by 2050. The goal of the Paris climate agreement is as follows: to limit global warming to 1.5 degrees compared to the start of the industrial age. 11 % of the CO_2 reduction to be achieved by 2030 could result directly or indirectly from photonics applications.





Photonics leads to greater sustainability in many areas of society











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Light as the key to global evironment sustainibility Link to the full study

German: bit.ly/3ym5GK0



English: bit.ly/3wclmOa









"Photonics makes it possible to combine efficiency and environmental protection constructively."

Prof. Dr. Reinhart Poprawe

Thank you for your attention!





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