

Photonics for Health & Earth

As part of this month's special issue on photonics in Europe, here we look at some ways photonics could help solve major challenges facing Europe and the world by 2030—challenges such as keeping an aging population healthy and productive, making efficient use of resources, and providing safe and nutritious food for a growing population. These areas and several others are outlined in a vision document by the European technology platform Photonics21 (<http://bit.ly/photonics21-vision-paper>).



Every year, an estimated **12.6 million** people die as a result of living or working in an unhealthy environment.

World Health Organization

Worldwide, the number of people age 60 years or older will rise from **900 million** to **2 billion** by 2050.

World Health Organization



A CLEAN ENVIRONMENT

Green photonics

2030 MISSION: A truly circular economy with zero emission and less waste

PLAN: Design products with reuse in mind; use photonics technology for zero-defect, high-precision production, and to sort materials and parts for reuse.

MOVING TOWARD ZERO WASTE: **Multispectral** and **hyperspectral imaging** systems will help separate industrial and household waste. **Laser-induced plasma spectroscopy** will also help precisely identify materials. **Fluorescent tagging** of objects during production will allow sorters to identify them at the moment of disposal. **Laser-based** disassembly lines will be able to separate complex products into components for further use.



LIVING LONGER & HEALTHIER

Healthcare photonics

2030 MISSION: Instant diagnosis of major diseases

PLAN: Use next-generation photonics to make “theranostics” possible—precision medicine that combines diagnostics with therapy to treat diseases earlier and faster.

TREATING CANCER: Surgeons will use **multimodal imaging** (including fluorescence and molecular imaging) to identify cancerous tissues and individual cells, and **high-precision lasers** to immediately remove the identified pathological cells.

BEYOND CANCER: This “**smart laser scalpel**” could be deployed in future robotic surgery and applied to other medical conditions.



FEEDING THE WORLD

Agriphotonics

2030 MISSION: Safe, nutritious and affordable food for all

PLAN: Use precise sensors and measuring devices to monitor and certify the safety, quality, content and origin of food at any step in the process.

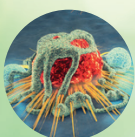
ON THE FARM: Sensitive imaging will detect earliest onset of pests and disease, reducing the need for chemicals. **Spectrometry** and **laser scanning** will detect produce ripeness and determine the best time to harvest and ship.

IN FOOD PROCESSING: **Hyperspectral imaging** will identify and remove defects and foreign matter. **Fluorescence spectroscopy** will monitor amino acids, vitamins and allergens.

AT RETAILER/CONSUMER LEVEL: **Spectrometers** connected via smartphones will be able to pinpoint the likely origin of produce based on information like sugars, phenols, amino acids and antioxidants.

An estimated **600 million** people in the world fall ill after eating contaminated food every year.

World Health Organization



In 2015, **8.8 million** people died from cancer—nearly 1 in 6 global deaths.

World Health Organization