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Talk of the town

The sun is setting on fossil fuels. With the dawn of a new, clean-energy era comes new responsibilities, challenges and opportunities. Those in the photonics community will certainly help to forge the path we take in the coming years.

Talks and discussions at major photonics conferences reflect how hot a topic energy has become in optics today. As Lester Brown sets forth in his book *Eco-economy*[1], the past few decades have witnessed a shift from coal, a heavily polluting fossil fuel with a severe impact on climate, to oil, which is less environmentally disruptive, and natural gas, which is the cleanest of the three options. A growing army of people now agree that the world's energy economy is on the verge of a major transformation: from a carbon currency to a solar/hydrogen-based one, in which sunlight is used to generate electricity and hydrogen is used to store it.

There are several strands involved in making this transition. First, clean energy sources have to be identified and harnessed effectively, the Sun being a major consideration. Second, we must use the energy we have at our disposal more efficiently. And third, we have to sell all of this in the most persuasive way to policymakers and those holding the purse strings.

Fortunately, there is significant momentum behind all of these movements, and progress has been faster than many would have predicted, say, ten years ago. Oil companies have finally begun to take the threat of global warming seriously. Companies such as the Californian utility behemoth the Pacific Gas & Electric Company (PG&E) recognize that energy saving can actually be profitable. Not only is PG&E heavily subsidizing compact fluorescent light bulbs for consumers, making them almost as cheap as their inefficient, incandescent counterparts, but it is also increasing the renewable energy portion of its portfolio and buying

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up more and more wind, geothermal and solar power. In July this year, it agreed to purchase 553 MW of power from a solar park that is planned to be built in the Mojave Desert by 2011. The energy will power 400,000 homes.

Research into solar energy technology has gone from strength to strength. According to Applied Materials, a major semiconductor industry supplier, the size of the world's photovoltaic market grew by 19% in 2005, adding 1,738 MW to its power output in that year. The solar industry now uses more silicon than the integrated circuit industry, and globally the combined power output of photovoltaic installations is now 3,689 MW. This is a drop in the ocean compared with the world's roughly 1.7-TW demand for electric power, but is not to be sniffed at, especially bearing in mind recent R&D progress.

Solar-cell manufacturer Spectrolab raised the bar in December 2006 when it set a world record with its concentrator photovoltaic technology: a sunlight-to-electricity conversion efficiency of over 40%. In concentrator cells, sunlight is focused onto a small area of semiconductor material, making the device a lot cheaper to fabricate. Spectrolab's record-breaking device is based on a III–V semiconductor, multijunction design with a metamorphic structure. Within a few years it could hit efficiencies of 45%.

Solar thermal electricity offers a complementary solution. In this approach, the Sun's energy is focused to a point using a large parabolic mirrored trough, and is used to drive the evaporation of water into steam, which then drives a turbine and generates electricity. Because the heat can be stored, solar thermal plants can generate power as and when needed, regardless of whether it is day or night, sunny or not. Although this approach is not really cost-effective for domestic installations, growth is being fuelled by commercial rooftop systems that can offer economies of scale. At present, solar thermal energy produces about 0.1% of the USA's electricity needs.

There are a number of other areas in which photonics is contributing to energy research. Some people are focusing on the development of photoelectrochemical cells that use sunlight to split water and produce hydrogen. Others are turning to nanowires to improve the efficiency of solar cells. And one of the grandest laser experiments of all time, the National Ignition Facility in the USA, once operational, may offer researchers unique insights into fusion energy. Even microscopic green algae might be brought on board to help harness more solar power (page 618 of this issue)[2]. No-one wants to miss the alternative-energy train. And, arguably, photonics has a real chance to be at the front, helping to drive it along.

References

1. Brown, L. R. *Eco-Economy: Building an Economy for the Earth* (W. W. Norton, New York, 2001).
2. Jenkins, A. *Nature Photon.* **1,** 618–619 (2007).