

# THE POWER OF THE SUN

Nobel Laureates Walter Kohn and Alan Heeger

And John Cleese

Present a new documentary on solar electricity for the  
2005-2006 classroom



*San Francisco's Moscone Center*

*"The Power of the Sun"* consists of two films on a single DVD: "The Power of the Sun-The Science of the Silicon Solar Cell" (S), is a 20-minute animated educational film for 12th grade High School students, or freshman College/University students with interests in physics and/or chemistry, materials science, engineering. (The silicon solar cell is currently the most important generator of solar electricity).

*"The Power of the Sun"* (G) is a 56-minute film, telling the story of photovoltaics -Light; History and Science; Implementation; and Future. It is designed for general public with interest in science, its history and its current and future applications to the world's energy needs, as well as for policy-makers and opinion leaders in the field of energy. It is also highly recommended for students who are using the 20-minute science film (S), to provide them with a broad perspective.

The film is a scientific morality tale: how, starting from the most pure and basic science, through stages of brilliant applied science and engineering, there emerges one of the most promising multi-billion dollar technologies to help deal with one of the great challenges of our time: energy. That is, finding economically realistic, clean and safe energy sources to replace diminishing cheap fossil fuels, while energy demands of the developing world continue to grow rapidly.



*East Africa - Solar-cooled vaccine delivery (photo courtesy of Shell Solar)*

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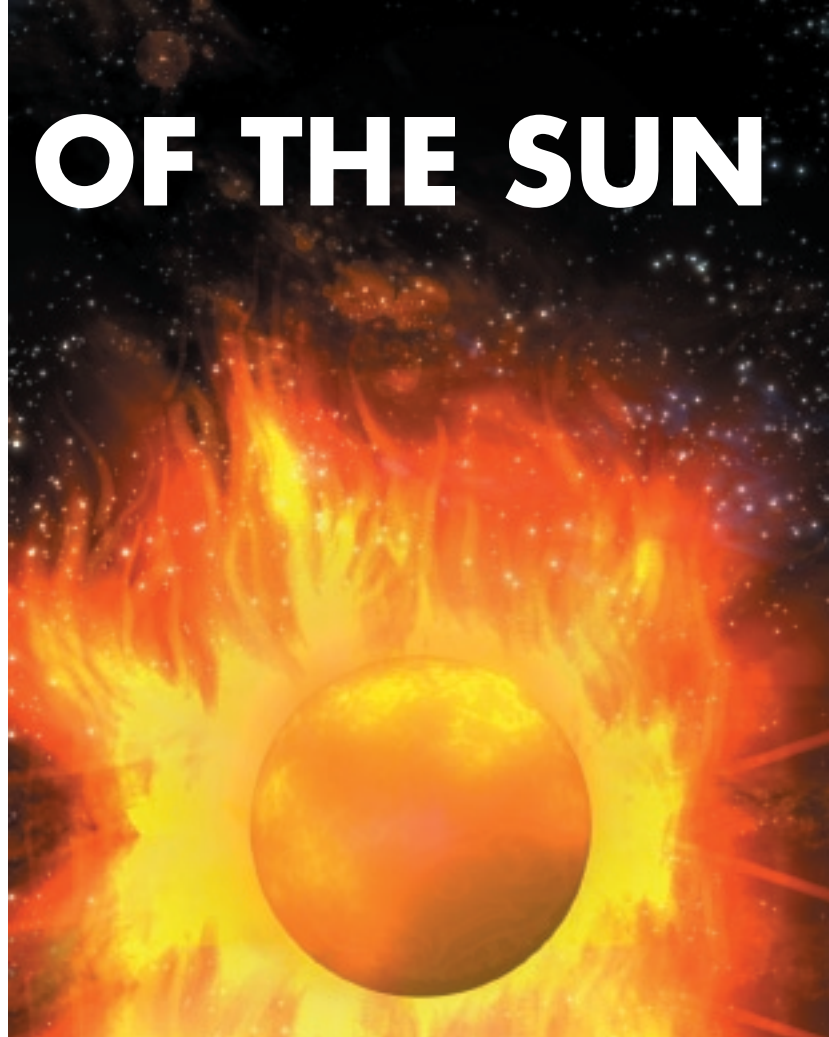
From *Convergence*, 2005, Tom Gray

A century after Einstein's photon and 50 years after the invention of the first practical device to draw electricity from sunlight, two Nobel laureates at UCSB are pushing photovoltaics forward with research and a video project.

Some anniversaries call for a party. For physics professors Walter Kohn and Alan Heeger, the anniversaries of the solar cell and Einstein's photon theory of light are the occasion for something more ambitious – an outreach program for students, teachers, policy-makers and the public. At its heart is a planned documentary on the past, present and future of solar electric power.

Kohn, who was awarded the Nobel Prize in Chemistry in 1998 for his seminal work on the electronic structure of materials, is the executive producer for the project. Heeger, whose 2000 Nobel in Chemistry recognized his role in the discovery of conductive polymers – plastics that have properties of metals and semiconductors – is on the project's board of scientific experts, along with UCSB Physics Chair James Allen and Stanford University Physics Professor Z. X. Shen. Their mission, as Kohn explains, is to tell a "kind of morality tale" about how science works and, in particular, why solar electricity is a scientific project whose time has come.

"We use these anniversaries to provide a case history of how science, beginning with the most fundamental questions – the nature of light, the quantization of light – evolved into another stage, in which theoretical and materials science had advanced to where it could produce a practical solar cell," Kohn says. Then they will turn to the future and explain how



solar energy will help the world cope with what Kohn calls "a whopping global energy problem in 20 or 30 years."

Kohn has lined up the services of producer/director David Kennard, whose credits include such major series as "Cosmos" with Carl Sagan, "The Ascent of Man" with J. Bronowski and "Unforgivable?" with The Dalai Lama. The centerpiece of the project will be a 50-minute documentary titled "The Power of the Sun: A Century Since Einstein's Photon, Half a Century of Modern Solar Electricity." It will be filmed in the U.S. and abroad, featuring interviews with scientists and depictions of photovoltaics in action. Another video, 20 minutes long, will be shot to present "more advanced photovoltaic science for classroom use," Kohn says. He expects to distribute 15,000 DVD copies to high schools, community colleges, colleges, universities and science museums. A Web site with live streaming video is also in the works, along with plans to submit the video for airing on public television and the Discovery Channel.

The dual anniversary that Kohn wants to commemorate with his film refers to two breakthroughs, one in theory and the other in application. The first was the publication, in 1905, of Einstein's paper introducing the concept that light acted as discrete bundles of energy – photons – as well as waves. The second was the 1954 invention by Bell

Laboratories researchers of the first practical silicon solar cell, which converted photons from sunlight directly into electrical energy.

Kohn now sees solar electricity at another pivotal point, where it is ready to take off as one of the world's primary sources of power. Its role up to now has been significant, especially in underdeveloped regions where solar cells help make up for the lack of a power grid. But converging economic trends – solar electricity is getting cheaper to produce while fossil-fuel prices are rising – have been pushing photovoltaics into the energy mainstream. “Solar energy is quite realistically estimated, in two or three decades, to contribute perhaps something in the vicinity of 25% of total electricity consumption,” he says.

**"Solar energy is estimated, in two or three decades, to contribute perhaps 25% of total electricity consumption," says Kohn.**

One reason for solar power's rise is the development of new technology that brings down the per-watt cost. One of the leaders in this area, on both the theory and practice sides, is Heeger. His research in semiconductors and metallic polymers not only earned him his Nobel prize but also helped spark the creation of new materials for photovoltaics. He is currently working in conjunction with Lowell, Mass.-based Konarka Technologies (where he is a director and the firm's chief scientist) to develop low-cost solar cells using semiconducting polymers that can be molded like plastics and printed onto flexible surfaces. “They are, in fact, inks with functionality,” he says.

Heeger says these plastics are not currently as efficient as silicon solar cells. The most efficient commercial silicon cells convert more than 30% of light energy into electric power. The materials Heeger is working currently to develop convert only about 5%. “We see many opportunities for improvement” Heeger says. “If we got 10%, it would be a revolution.” Solar cells based upon conducting polymers are potentially more cost-effective than silicon cells because they can be produced more cheaply per unit of area. Heeger explains: “Area and cost are the two issues here. If the cost is sufficiently low, implementing large areas would be cost effective.” He hopes to see “plastic” solar cells reach commercial viability within two years. “The experiments done so far on these polymer photovoltaic cells are good enough to give us confidence that they could be used economically on roof tops; that's the Holy Grail.”

In these ways, Kohn and Heeger are covering the bases of solar-energy science – research, development and teaching, to students and to both the wider public and policy makers. Their project also goes beyond the specific cause of promoting photovoltaics, as important as that may be. Kohn says he hopes the outreach makes the case not only for solar electricity but for science as a career: “We want to motivate young people and show them what wonderful opportunities science can bring.”

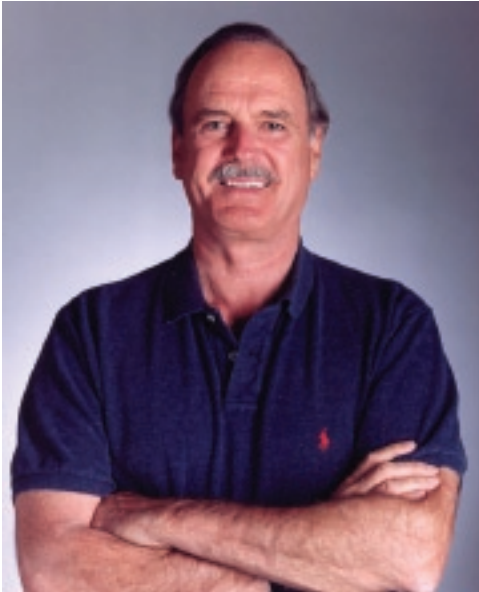


*Movie directors – and Nobel Laureates – Alan Heeger and Walter Kohn*

**Executive Producer:** Walter Kohn, University of California, Santa Barbara

**Produced by:** David Kennard (The Ascent of Man, Cosmos) InCA, Victoria Simpson

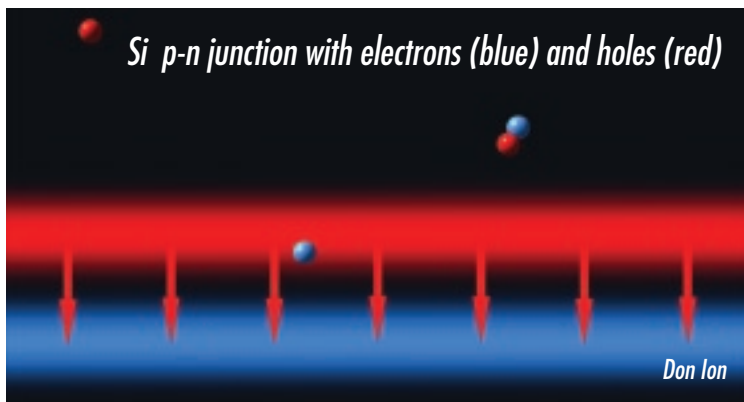
**Written by:** John Perlin (From Space to Earth: The Story of Solar Electricity), David Kennard



**Host and Narrator:** (56 minute film) John Cleese

**Narrator:** (20 minute film) Melissa Woods, Santa Barbara High School

**Scientific Advisors:** James Allen, Alan Heeger, and Walter Kohn (UCSB) Zhi-Xun Shen (Stanford University)



**Scientific Animations:** Don Ion, Santa Barbara City College

**Music Composed and performed by:** Marc Capelle and Monte Vallier

**Major Funding:** California Energy Commission; The Camille and Henry Dreyfus Foundation Special Grant Program in the Chemical Sciences; U.S. Office of Naval Research; The David and Lucille Packard Foundation