

**House Science Committee  
Subcommittee on Energy  
Hearing on Renewable Energy Technologies  
August 2, 2006**

**Testimony by Ron Swenson**

I appreciate the opportunity to speak today about international renewable energy education. I especially appreciate the thoughtful questions which have been raised by yourselves and your staff.

**1. My Renewable Energy Projects in Developing Countries**

Since 1992, I have been involved in renewable energy education projects, primarily applications of solar electricity, in Mexico, Uganda, Bolivia, Ecuador, Bhutan and Peru. (I am providing a list as Attachment 1.)

Coincidentally, just yesterday in Quito, Ecuador, the United Nations Development Programme announced that SolarQuest® (our non-profit arm) has been given responsibility for planning a Renewable Energy Applications Laboratory in the Galapagos Islands. We call it the “REAL-Lab.” Since 2002 we have been providing human capacity building for renewable energy in the Islands –installing wireless internet, working with secondary school students to assess energy conservation, install solar with hands-on training, and monitor the performance of solar and diesel generators there.

In the next phase of our work, we are integrating international initiatives to transform energy in the islands to renewables, reducing the risk of oil spills that threaten the unique endemic wildlife there. With guidance from the UNDP, Ecuador’s Ministry of Energy, the Galapagos National Institute, and the e8 Network, we are teaming with universities in the US to serve as our capacity partners. Each university will bring unique skill-sets in renewable energy research and education into partnership with universities in Ecuador. When we open the lab to broader membership, other nations will also enjoy these benefits.

**2. Unique Challenges for Renewable Energy in Developing Countries**

Renewables face many of the same obstacles in developing countries as in the USA and other OECD countries. Some differences come into play:

- **Money:** In the USA there is capital but the market has been slow to embrace the technology. In developing countries the market is eager but capital is scarce. Ironies persist in our complex world!
- **Skills:** In all large cities around the world, it is possible to find skilled technicians, engineers and scientists. Cities can’t work without commercial

forms of energy and personnel trained in the field. Throughout the remote parts of the world, however, understandably there are few people with significant education in modern science or engineering.

Nor can core competencies (e.g., the three R's) be taken for granted. En route to building capacity in solar energy, a student can't leap from reading simple hand-me-down texts to understanding physics and engineering concepts.

Blending education in core competencies with specific skill-sets applicable to renewables, our students excel. Not surprisingly, when offered access to tools and tangible opportunities to serve their communities, young people respond intelligently and enthusiastically to our initiatives. We call this *productivity centered service learning*.

- **Subsidies:** Fossil fuel subsidies penalize the economics of renewable energy. In the Galapagos Islands, a national fairness doctrine makes electricity the same price as on the mainland, even though diesel-electric costs twice as much. According to the International Energy Agency, energy subsidies add up to \$200 billion per year. What if we invested that much to build lasting solutions instead of propping up the failing fossil fuel infrastructure?

### 3. Renewable Energy Education in Developing Economies

As warnings of global warming are increasingly validated by catastrophic events, human capacity building in the energy sector is becoming essential for the rapid substitution from carbon-based energy to carbon-neutral sources. If banks, industry and governments continue to favor carbon-based energy over carbon-neutral solutions, it may ultimately fall upon youth to educate their elders. It's like, if your computer isn't working, get your teenager to fix it for you!

#### How to Structure Renewable Energy Education in Developing Economies

Structuring renewable energy education in developing countries could make a crucial impact on international relationships for the USA government.

- **Markets Lost:** The potential for USA industry to capture renewable energy markets worldwide is enormous. But time is against us: even though most renewable technology has been developed in the USA, our advantage has been lost. Europe and Japan took the lead by encouraging commercialization in their own domestic markets, and that prepared them for dominance in the international markets.
- **Creating Market Potential:** Just as Apple Computer developed a loyal following by supporting computers in schools, we are matching up universities in the USA with universities in the REAL-Lab member countries.

The member nations joining our Renewable Energy Applications Laboratory will designate their own universities to partner with our US university capacity partners. Markets for US solar energy products will accelerate when ten universities in the USA are matched with ten universities in ten member countries. Their intellectual strengths will be coupled with American strengths to develop robust human capacity.

- **Hands-on:** In the USA, because of liability issues, it has been very difficult for us to provide opportunities for young people to learn by doing. On the other hand, in developing countries we have been able to bring together teams of young people with little experience and teach them the basics of electricity, solar energy, satellites and computers in short order. Hands-on experience has been the key to motivation and knowledge retention.
- **Large-Scale:** Taking this one step further, consider the 100,000 schools in Latin America with no electricity. The US government could sponsor solar systems to be installed on every one of those schools. Even \$100 million for a small solar system on each of these impoverished schools would be a huge improvement over nothing. We would motivate future scientists and engineers who appreciate Americans when we combine this hardware investment with curriculum delivered by our University capacity partners. A government-industry-education partnership would bring huge benefits to the US economy and our political welfare.

#### 4. Advantages of Distributed Renewable Energy in Developing Economies

- **Bite-Sized and Ubiquitous:** Solar can be started on a small scale and grown as resources become available. Coal or nuclear power requires a huge investment, but one family or village can start with solar on a very modest scale. We installed 2 kW at a village school in Bolivia – only 4 watts per capita for 500 people. It made a huge difference. Anywhere in the world, a family with one solar panel can have basic communications and lighting.
- **Grid Independent:** Renewable energy can be installed where no grid exists. In the USA and other developed economies, copper was mined and laid out in wires across the entire landscape many decades ago. In less developed nations the electricity grid is far weaker – where it even exists. The grid is non-existent for roughly a third of the human population. With more pressing priorities and limited buying power, less developed nations are unlikely to be able to mimic our sophisticated grid infrastructure in the foreseeable future.

## Political and Economic Impacts

Political and economic implications for renewable energy in the international arena are enormous.

- **Solar facilitates fairness; Oil breeds conflict:** Coal, oil and natural gas are unevenly distributed but solar energy can be distributed equitably to the entire human population.
- **Carbon Neutral:** As demand for electricity and transport grows around the world, the threats to developing nations from carbon-based energy sources are unfathomable. My flight to Bhutan in 2002 landed in Dhaka, the capital of Bangladesh. I was shocked to find myself in a *Water World*. Already surviving on a thin margin between land and ocean, Bangladesh and many other countries will suffer massive dislocations if the pace of global warming isn't stopped soon. While the USA has so far suffered the highest profile losses from global warming, there are numerous developing countries that have suffered as well. Hurricane Mitch devastated Honduras when the role of global warming was less obvious. Ironically, Chinese and Indian energy policies threaten their own highly developed low-lying coastal regions as they engage in the madness of coal-fired economic growth.
- **Nuclear Free:** The threats to developing nations from nuclear-based energy are as foreboding as climate change. The day may come when political regimes are sufficiently orderly and stable to control weapons-grade nuclear materials, but humanity has not mastered this talent yet. Small nations use valid concern for their energy future to justify nuclear, and they get persistent encouragement from the ambitious nuclear power industry (if not from the US, then from Russia, France and others). If the USA and its responsible G8 partners were to offer these nations a large-scale and lasting renewable energy solution, the energy deficiency argument for nuclear would fail and the world would be a far safer place.

## Government and Industry Willingness to Encourage Renewables

We hear talk of energy independence, and of course people are increasingly concerned about the high price of gasoline. But there are serious implications if responses to these concerns ignore other concurrent challenges.

- **Peak Oil and Carbon Intensive Responses:** Do rising oil prices derive from political instability and economic challenges or do they represent early signs of reaching the intrinsic limits to physical oil supplies? There are ominous signs that natural limits are contributing to the challenge to find more oil. Extraction is declining rapidly from the North Sea and from Cantarell, Mexico's largest field. Indonesia recently became a net importer of oil. New discoveries replace only a fraction of annual consumption.

While it is a laudable goal, the quest for energy independence so far has led to policies that encourage carbon-intensive forms of energy, including coal-to-liquids, tar sands, oil shale, corn ethanol and nuclear power. (Some of these energy forms are erroneously represented as carbon-neutral, which further complicates the debate. [www.energycrisis.com/nuclear](http://www.energycrisis.com/nuclear))

- **Global Warming:** There are credible warnings that glaciers in Greenland and the Antarctic will continue melting, leading to a significant rise in sea level, even if we act quickly. In the face of this and other climate catastrophes, we can only hope to minimize impacts by immediately exploiting alternatives to carbon-based energy sources. We also need to understand the potential costs and environmental impacts that such catastrophic events may impose on the global economy and to compare those costs against profound investments in carbon-neutral renewable technologies.

The challenge is acute in China, where coal-fired power plants are coming online at an alarming rate and renewable energy, especially solar water heaters and solar electricity, are also growing rapidly.

### **Export Opportunities**

- **Exporting bridges of understanding:** In light of all these concerns, renewable energy is the unique unifying principle for rational energy exports. We have a mandate to re-power the Galapagos with renewables. Through education, we are exporting bridges of understanding, packaged with energy solutions.
- **Linked to Energy Efficiency:** An integrated approach to energy is a key strategy to differentiate US solar initiatives from those of competing interests. With low energy appliances – skipping light bulbs altogether in villages getting electricity for the first time and going directly to LEDs, for example – literally could make all the difference. Electricity alone doesn't do the job; it's the foundation for services that need to be integrated from the start. We can point to all kinds of failures – tractors that can't be repaired for lack of parts inventories, refrigerators delivered to places with no electricity. Electricity in combination with efficiency can build strong markets for a broad array of American products.
- **Rapid Deployment:** We need rapid deployment of renewables to meet the environmental challenges we face. We need to stimulate the renewable energy business in every sector, from finance to manufacturing to operations and maintenance, to intensive capacity building.

My team has a mandate to re-power the Galapagos with renewables. What if the National Science Foundation were to invest \$100 million in education to re-power developing nations worldwide? The USA would get an enormous return.

- **Renewables are mature:** Coal and nuclear power may be valid as measures of last resort but they are at best temporary measures with potentially dire consequences. The sun is delivering 120,000 Terawatts for us to meet 13 Terawatts of demand. We have a lot of margin to work with.

I invite you to join us in the Galapagos Islands to see the *REAL-Lab* and *productivity centered service learning* in action.

For additional information, visit my website at <http://www.SiliconEnergy.org/us/>.

**Attachment 1**

**Renewable Energy Projects in Developing Economies**

**R B Swenson**

Country	Date	Affiliates, Sponsors		Technologies
Mexico	1992-1996	MX	Universidad Nacional Autonoma de Mexico	Solar race car (photovoltaics)
		US	USDOE EERE	
		AU	SA Development Authority	
Uganda	1999	US	White House Millenium Council	100 small thin film photovoltaic systems
		UG	Office of First Lady	
Bolivia	2000-2001	US	White House Millenium Council	Crystalline Photovoltaics, Solar-powering satellite-based internet and computer lab, Distance Learning
		US	American Electric Power	
		US	New Mexico State University	
		UK	British Petroleum	
		BO	Fundacion Amigos de la Naturaleza	
Bhutan	2002	US	American Electric Power	Micro-Hydro, Micro-Solar
		JP	Kansai Electric (Kyoto)	
		BT	Ministry of Energy	
Peru	2004-2005	US	Private Donor	Thin flim Photovoltaics, powering micro- computer lab
		PE	Plan Puyhuan (NGO)	
Ecuador	2002-...	US	US Universities	Crystalline Photovoltaics, Satellite remote monitoring of climate, hybrid diesel, wind and solar
		US	American Electric Power, Global 3 E, UN Foundation	
		EC	Ministry of Energy and Mines, Galapagos National Institute ("Ingala")	
		Intl	UN Development Programme	