

TAU Renewable Energy and Beyond

Creating A New Energy Culture

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I wish to thank the Program Committee and Professor Kribus for inviting me to speak today, and also thank the many participants and guests for attending this prestigious conference.

My topic today is “Creating A New Energy Culture.”

I wish to give a feeling for the nature, magnitude, and driving forces behind the change from an energy culture dominated by fossil fuel to an energy culture dominated by renewable energy and supplemented by fossil fuel and nuclear energy. Because my background and proclivity are in the field of solar energy, I have focused my talk on briefly describing why and how I expect solar energy to elevate itself from a negligible factor in the world energy economy to perhaps becoming the single leading renewable energy contributor.

Every day, the earth receives approximately 5,000 times more solar energy than humanity consumes. Within a few hours, the sun delivers more energy than ALL the energy consumed in ALL of human history. The earth has over 100 times as much potential solar energy available as wind energy and many more times as much wind energy as other renewable energy alternatives.

Solar insolation from only 0.5% of the earth’s land surface is adequate for meeting all human energy needs.

If the world is going to make a **transformational reduction** in the consumption of fossil fuel, then many renewable resources will be needed. Solar derived energy is likely to be the largest single renewable resource contributor.

There a desire to generate electricity from solar energy and in so doing create a new energy culture, because:

- Solar energy has no negative impact on global warming or air quality.
- It is essentially free, and with adequate transmission, almost universally available.
- It increases national energy independence, global security, and positively impacts the balance of payments in most countries.
- It is a hedge against disruption in the availability or increase in the cost of fossil fuel.
- It can be transformed into useful heat and electricity through human ingenuity and create large numbers of new jobs in the process.
- It is cost effective in its own right, and its large scale deployment will bring down the cost of fossil fuel.
- It is the most benign, globally positive way to curtail massive petrodollar acquisition of sophisticated armaments.
- Solar energy provides power during the peak day-time hours when it is most needed.

For these reasons each kwhr of solar produced electricity is **intrinsically more valuable** than a kwhr of electricity produced from fossil fuel. With sufficient modern transmission systems and appropriate public policy in place, solar electrical generation plants are ready to become a principal means for electricity production in the highest use energy countries throughout the world.

I will describe three publically discussed Transformational Scale Solar Energy opportunities to illustrate current thinking:

- 1) “**A Solar Grand Plan**” as described in the January 2008 issue of Scientific American. The authors explained how solar electrical generation systems occupying 50,000miles² of US Southwest desert land could supply 69% of US electricity and 35% of US energy needs by 2050. As a person who has spent

much of my adult life studying the potential of solar energy, I think there is a strong basis for the authors' conclusions.

- 2) **The EU has already committed** to a binding target of 20% of its energy coming from renewable sources by 2020. Discussions are in process to reduce Green House Gases by 60% to 80% by 2050. The result is a massive increase in renewable energy demand. In Europe, we are beginning to see the Scientific American scenario taking place.
- 3) **The TREC program** describes the feasibility and value of a 100,000 MW project, or more, of solar produced electricity from North Africa and the Middle East transmitted through underwater cable to Europe.

The solar and transmission technology are available.

Supply disruption risks from North African and Middle Eastern solar power stations can be avoided by maintaining European based gas and coal plants as back-up reserve-capacity.

In this region, and around the world, it is not the technology that is “holding back the roll out of solar energy.” Rather, it is the delivery systems from the highest solar insolation areas to the center of highest use that are not available.

Properly designed solar power plants can deliver consistent, reliable, power day and night.

Concentrating Solar Power (CSP) plants generate power from the sun by focusing sunlight at high concentration onto a surface which heats up a fluid. The heated fluid, directly or indirectly, produces steam which drives a turbine generator to make electricity. CSP plants are capable of working during solar and non-solar hours. During non-solar hours the heat needed to run CSP plants can be provided from thermal storage systems located adjacent to the plants. Thermal storage works well for cloud coverings and day-night fluctuations. For more extended solar outages, bio-fuels produced from micro-organisms grown in nearby closed loop solar bioreactors could provide the needed clean fuel. Bio-fuels produced at low cost from micro organisms are still many years away. In the interim period, natural gas in conjunction with thermal storage can be used to make CSP plants fully dispatchable during non solar hours.

With all the obvious advantages cited, why is the movement to renewable energy, and solar energy in particular not happening at Transformational levels? What is preventing us from “Creating a New Energy Culture?”

Cost and technology availability are most often cited. This assertion is not true. In high solar insolation locations where:

- The negative impact of fossil fuel emissions are monetized
- Time of Delivery and reliable capacity factors are equitably compensated for, and
- Solar energy systems receive competitive tax treatment with fossil fuels.

Solar energy is cost competitive. This cost competitiveness exists without taking into account the added value to national security, geo-political stability, job creation, balance of payments, and taxes derived from created jobs, and other social benefits.

The historic Luz Solar Electric Generation Systems (SEGS) built in California are still efficiently producing electricity after more than 20 years of operation. This experience shows that CSP Solar thermal plants, once paid for, have a long life and very low operating costs because they use very little fuel and produce future electricity at very low cost. On a large scale, this long term, low cost infrastructure will translate into lower energy costs over time instead of the constant spiraling energy costs associated with fossil fuel environments.

Large scale adoption of solar and other renewable technologies, coupled with the implementation of strong regulations encouraging the conversion of transportation systems to plug-in hybrid and electric vehicle technology, will reduce the demand of fossil fuel significantly. The price of fossil fuel would drop to much lower levels and materially reduce the balance of payment deficit, and economic drain on many economies. These economic benefits attained by the substitution of renewable energy should find some way of positively entering into the renewable energy pricing system.

To move these beneficial imperatives forward takes a different kind of power – WILL POWER.

Our Will Power should be directed towards four primary goals in parallel:

- 1) Making transmission resources available at levels of 100s of thousands of MW to solar and other renewable energy project providers;
- 2) On the U.S. model, creating an even playing field by equalizing tax benefits, socializing project costs of transmission and related, charging for the dumping of flue gases, and other hazardous waste into the environment;
- 3) On the European model, providing consistent and predictable tariffs at proper prices, albeit on a larger scale, with longer term planning horizons;

4) Encouraging, rather than discouraging, the dispatchable supply of electricity from hybrid solar plants whose primary source of energy is solar.

In Summary:

With the right political will we can develop comprehensive policies and infrastructure on a national and global scale that will move solar energy power forward, and deliver the highest quality, carbon free energy to the world – where every electron consumed is a positive signal that jobs were created, carbon was avoided, politics was stabilized, and the production was local.

THANK YOU