Solar Energy, the Citizen's Energy

Acceptance Speech for the 1997 Becquerel Prize

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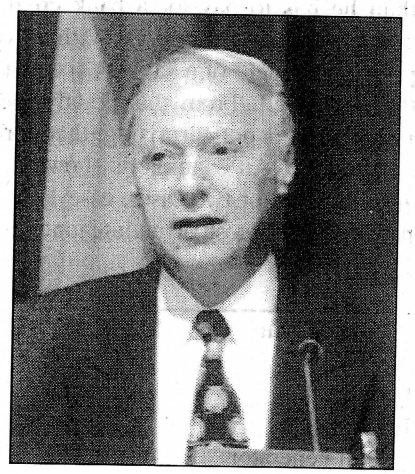
Acknowledgments

First, I want to thank the Bequerel committee for awarding this prize to me and in particular I want to thank my old friend Antonio Luque for his very flattering and thoughtful laudatory remarks. I feel overwhelmed by all the honors that I am receiving and I am still not convinced to deserve so much. Still, I am very grateful. I interpret this award as a recognition for the people at the Fraunhofer Institute ISE who have contributed so much to whatever success we had. I want to mention here particularly a few coworkers who have devoted all their efforts to photovoltaics. These are Armin Räuber, Jürgen Schmid, Wolfram Wettling and Joachim Knobloch. Last, but not least, I owe much to the support of my wife and my family.



1. Why is Solar Energy the Citizen's Energy

Solar energy was always, as it is today, the people's energy. Solar energy is much more popular with the people and to a large extent with the public media than with those who wield economic and political power. The original title of my talk was "Solar Energy, the People's Energy", but that is too reminiscent of the now defunct socialism. People's army, people's democracy, people's assembly, everything was people's but in reality the people had nothing to say. In contrast to socialism solar energy is really the people's energy. Its more correct to call solar energy the *citizens* energy because it is not the energy of the impoverished masses that don't exist any more but of the well educated, well informed and more of less affluent citizen of today. This I will try to show in my talk today.

Why is solar energy the people's energy? One remarkable property of solar energy is its flexibility in scale: Solar energy installations range from very small to very large. I will not refer here to the large solar power plants which will be quite important for the future but I want to stress that today most solar energy, certainly in Europe, is produced by individual homeowners who made a deliberate decision to invest in an environmentally friendly energy source although it costs a little more money. We can see clearly: It is the people who want solar energy while the opposition resides in the large structures of Government, politics and utilities. If I try to look at it from an objective point of view I can understand both sides. The people see the environmental benefits of solar energy and its enormous potential but they underestimate the technical problems and expect too much too quickly. The opponents on the other hand do not understand the market forces driving solar energy and they cannot imagine that solar energy will ever be a viable energy source.

This attitude can be understood from the different time horizons of the groups involved. The citizen has more foresight: He thinks of his children and grandchildren and he has a vital interest to leave them a planet which is just as inhabitable as the one he inherited. The time horizon of the politician reaches as far as the next election which is at maximum four years. That of the executive officer of a company to the next quarterly or yearly financial report. (I am aware that this is a gross simplification because politicians and businessmen are also citizens but unfortunately they suppress this when acting in their official business).

2. How Economical is Solar Energy?

From a strictly business accounting point of view solar energy today is more or less uneconomical, PV more, thermal energy less. But this is not the whole story. I have published a paper some years ago in which I showed that solar energy is much more economical for a private investor than is generally believed. Since solar energy converters require very little maintenance and have no fuel cost, almost the entire cost is dominated by the initial investment. The conventional calculation of rentability assumes that the system is financed by borrowed capital which has to be serviced at going interest rates. This is normally the case for business investments but not for a private investor. He has the choice to invest his capital in different ways but in most cases he receives much lower rates for his money. The worst yield results from a savings account. If he invests in a solar energy installation he should only calculate the interest rate he receives for other investments and this is much lower than he has to pay for a bank credit. The reason is obvious: The difference pays for the cost of the banks, administration and profits. With a realistic interest rate solar energy is of course much more economical. At present the yield of a savings account is about 2% while the interest rate of a commercial credit is 7 - 8%. But this is not all. From the already meager returns one has to subtract income taxes and devaluation through inflation. It is not surprising, therefore, that the realistic interest rate is close to zero, which makes calculations very simple. An example is shown in table 1, where the cost calculation of solar electricity is carried out with zero interest for two cases, case 1 for realistic conditions of today and case two for the goals of the Greenpeace program. (the cost of maintenance has been neglected). For comparison, the cost for 8% interest rate is also given.

Yield per year	0.9 kWh/W_p
Case 1	
Investment	DM 15.-/W_p
Life of generator	25 years
Cost of electricity (at 0% interest rate)	**0.67 DM/kWh**
(at 8%)	1.56 DM/kWh
Case 2	
Investment	DM 12.50/kWh
Life of generator	30 years
Cost of electricity (at 0% interest rate)	**0.46 DM/kWh**
(at 8%)	1.23 DM/kWh

Table 1: Nondynamic Calculation of Electricity Cost

A further consequence is that the longevity of PV-installations is of greater importance as the interest rate decreases. Recently Siemens announced a 25 year warranty for its modules which means that 30 years can be expected. It is worth noting that now PV-modules are among the most durable industrial products manufactured today.

3. Noneconomic Aspects

But non-economic aspects are more important for the solar market. Today's customer is well informed about the impact of energy on the environment and he knows about the advantages of solar energy. Therefore a solar market has developed that is to a large extent detached from the cost of energy. Having a solar collector or a PV generator on one's roof has become fashionable in many countries. The high visibility of solar systems is certainly an important factor: The owner can show that he is concerned about the environment. This marketing aspect is nothing extraordinary because most consumer products are not bought because of their cost effectiveness but for many other reasons. The new solar market is aided by the fact that many customers are affluent enough to afford the little extra cost of solar energy. (We are mainly talking here about homeowners). To put it in perspective: In most families the monthly telephone bill by far exceeds the electricity bill. This solar

market is much more dependent on skillful marketing and on public acceptance than on climatic conditions. Within Europe there are tremendous differences in the m² collectors installed per 1000 persons. At the top of the list is Cyprus with 800 m², Greece with 198 m² and Austria with 72,4 m² while at the bottom we find the United Kingdom with 1,9 m² closely followed by Italy with 3,1 m². Similar differences exist in installed PV capacity.

4. Green Tariffs

This new trend also manifests itself in the many models for green tariffs that are discussed and implemented today. A green tariff in the electricity market means that the customer is willing to pay voluntarily more for a certain amount of kilowatt hours in order to support renewable energy sources. The most equitable solution is the rate based incentive by which the full cost of PV-electricity fed into the grid is refunded and the cost allocated to all customers. This tariff has been introduced in several smaller communities in Switzerland and Germany and it is also favored by most people: Public opinion polls in both Germany and Switzerland have shown that 70 to 80% of electricity consumers are willing to pay more in favor of renewable energies provided the burden is shared by everybody. This solution is vigorously opposed by the large utilities. In order to avoid rate based incentives they are in the meantime experimenting with different versions of green tariffs whereby the customer pays on a voluntary basis for the production of solar electricity by the utility. Many different versions of green tariffs have been introduced with greatly varying levels of acceptance. In terms of specific installed power the green tariffs cannot compete with rate based incentive. In a recent study (Energiestiftung Schleswig-Holstein) the conditions for acceptance of a green tariff have been determined. The main conditions are:

- Credible commitment of the utility to renewable energy
- Financial contribution of the utility is clearly recognizable
- Transparent structure and participation of customers
- Professional marketing is indispensable

5. The two Energy Markets

We observe today a split in the energy market. On one side are the ordinary citizens who are more concerned with using clean and sustainable energy. On the other side of this picture is the traditional market of the big industrial consumers which look only at cost. Even in this world sometimes a PV panel is mounted on a well visible spot at corporate headquarters but this is strictly for public relations.

It seems to me strategically advisable not to fight the market of the big players because those forces are extremely powerful and conservative such that they can stall solar energy for intolerably long time. I personally don't think its wise for industry to have such low prices for energy but its up to them to make that decision. The reason why I say that is very simple: All the new and innovative industries need very little energy. The cost of energy is almost negligible for them. Subsidized energy only keeps obsolete industries alive. Rational use of energy means replacing energy by capital. Doing this would have very positive influence on employment. We should continue to demand inclusion of the external costs in the price of conventional energy even if it is applied to only part of the market. In this connection it is not important to know the external cost exactly. It's more important that governments set a signal that they take the environment seriously.

6. New Developments in USA:

Both in the United States and in Europe the electricity market is being reorganized. This liberalization can have serious disadvantages for renewable energies but it also gives them new chances because the customer will have a choice of his energy supplier and the composition of his energy supply. In the US this "Restructuring", as it is called is already under way and interesting developments can be observed which may also set an example for Europe. The electricity market seems to follow a similar development as the telecommunications market. The changes can be summarized as follows:

Today: Centralized - Interconnected - Monopolistic

Tomorrow: Decentralized - Interconnected - Customer-oriented

The consumer of the future will be able to buy his electricity in a free market. In the US new companies are being organized that will act as electricity retailers. They buy electricity from the producers and offer it to individual customers. Important selling arguments are that they do not distribute nuclear energy and they carry a certain proportion of renewable energy in their product. They even claim they can still be competitive with present electricity prices.

In such a free energy market other rules apply than in the past. The amortization time for capital invested in generating equipment will be much shorter which means that large nuclear and coal fired plants will be uneconomical. A risk that is currently being recognized is that large coal fired plant may have to be closed down in five or ten years when global warming effects can no longer be neglected. It is also remarkable that US utilities try to obtain compensation for "stranded costs" meaning financial commitments from past miscalculations. The highest contribution to stranded costs seem to be existing nuclear plants. In the short term the most economical option will be highly efficient gas fired plants which are economical even in smaller sizes and can be used in cogeneration mode. Furthermore they emit fewer geenhouse gases and other pollutants.

7. Conclusion

At this moment we experience that the people support and maintain the solar energy market, while Governments are more or less abstinent. The involvement of all Governments in solar energy support has been very unsteady and unreliable. The more progressive ones tend to launch big programs which lead to rapid growth of the industry but long before a stable situation is reached the programs are terminated and everything collapses. The genuine market we have now is much more stable but it is also limited because it relies on idealists. In reality solar energy is not only of concern for these idealists but it concerns everybody on this globe. Right now solar energy is only the citizen's energy and this is crucial for its survival but in the end it will have to be more than that; it has to become also the accepted energy for Government, business and utilities.