Discussion of SEI 1/93: Population Explosion, Energy and Environment

In SEI 1/93, Prof. Jörg Schlaich states that countries with the lowest per capita energy consumption also have the lowest per capita Gross National Product and the highest rate of population growth. He argues that the population growth will only slow down when much more energy is available in these countries. The answer is not nuclear energy, but the use of renewable energy sources such as solar energy. Governments of industrialised nations do not see the need for investing in research in renewable energy technologies appropriate to Third World countries. Many do not see the interrelationship between the population explosion, living standards, energy and the environment. Jörg Schlaich makes a plea for engineers to use their expert knowledge in solving the greatest challenge mankind has ever faced.

Another View

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Population Growth and Energy

Prof. Jörg Schlaich's article in the February 1993 issue of Structural Engineering International calls for a reply. There can be little disagreement with Schlaich's formulation of the problem – the growing economic and technological gap between the Western industrialised countries and the less-developed countries (LDCs, the so-called Third World), and the population explosion in the latter. Disagreement begins as soon as an attempt is made to identify the causes of the problem, and deepens when specific remedies are proposed.

Schlaich points to the high correlation between per capita energy consumption and per capita gross national product (GNP), and the inverse correlation between the latter and rate of population growth. He concludes that a rise in per capita energy consumption is a necessary and sufficient condition for a decline in population growth. This conclusion is not warranted by the evidence. Population growth in a number of oil-exporting countries has not declined despite major increases in per capita energy consumption. The first European fertility decline took place in the period 1870–1920, when energy consumption was low by today's standards, the majority of the population was poor, and infant mortality was higher than in most LDCs today. The second European fertility decline began around 1970, though no changes in the rates of growth of per capita energy consumption or GNP occurred at the time. We simply do not know the determinants of the time of onset or rate of progress of a fertility decline.

Energy Technologies

Let us grant that a substantial increase in per capita energy consumption in the LDCs is desirable, regardless of its effect on fertility. Schlaich mentions the problems connected with increasing consumption of fossil fuels and fuelwood, and holds that nuclear energy would be inappropriate for these countries. Therefore, renewable energy must be the solution. Unfortunately, the problem is not so simple. Schlaich urges an immediate increase in research and development allocations for new renewable energy technologies. But why has relatively little research and development been carried out in this sector? The answer can only be that it is considered unlikely that these technologies can become competitive with fossil fuels within the next few decades. It is no use asserting that they will inevitably become competitive when the prices of oil and natural gas rise due to resource depletion, because no one has any idea of when this price rise will begin or how steep it will be.

Solar Energy

Of the renewable energy sources, Schlaich favours the direct conversion of solar energy to electricity. He mentions the power tower, which consists of a circular array of flat plate collectors with a chimney at the centre. Air heated under the collectors flows up the chimney, in which turbines have been installed. It is true that the power tower may be capable of supplying electricity at an acceptable cost. It is also true that the theoretical potential of solar energy is much greater than those of all other renewable energy sources combined. But the problem with all forms of solar power is that electricity demand does not coincide with daily insolation. This means that solar power plants must either be equipped with a fossil-fuel turbine to cover demand when the output of solar electricity is insufficient (the solution adopted in Californian solar power plants), or be provided with energy storage installations in which electricity is converted to hydrogen and reconverted to electricity (prohibitively expensive), or they must be connected to a grid in which a substantial fraction of the electricity is supplied by a source capable of producing electricity whenever it is required. If this source is to be renewable, it would have to be a hydroelectric dam, the only practical form of large-scale energy storage.

The most favourable locations for solar power plants are in arid regions, and hydroelectric plants are generally

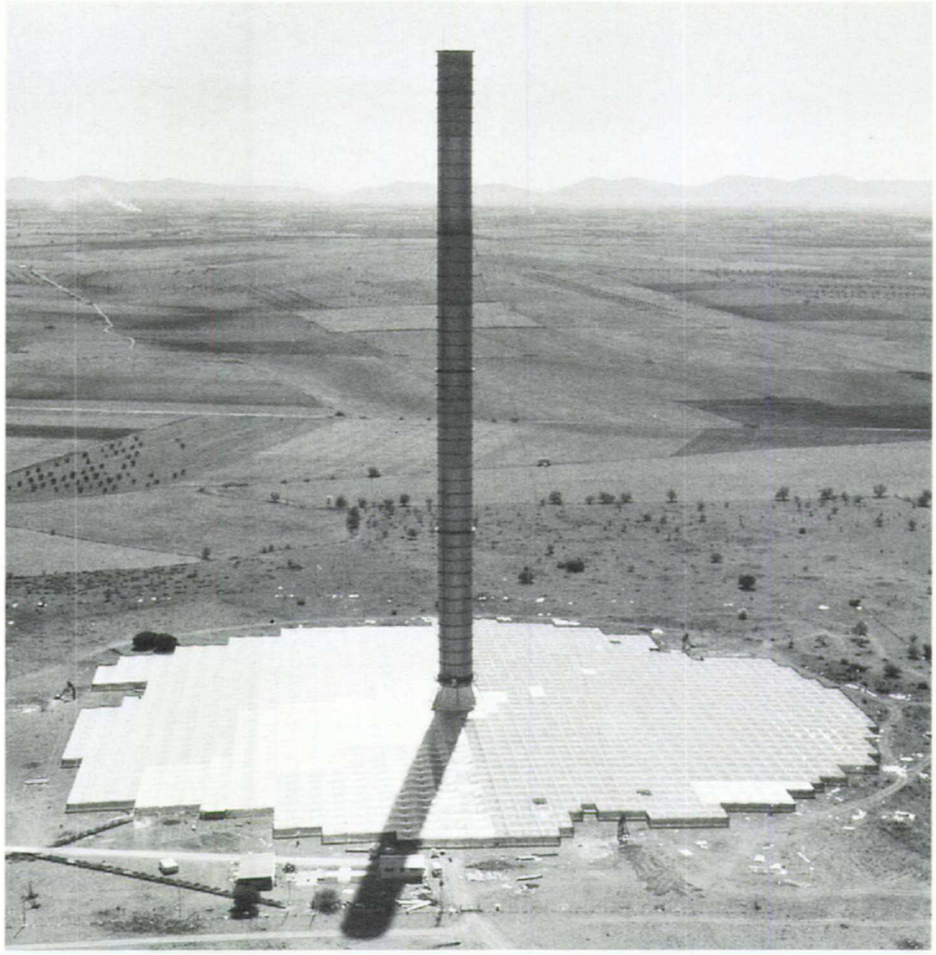
located in humid regions (there are exceptions, such as the Aswan Dam). Linking solar and hydro energy production would thus involve long high-voltage transmission lines, often crossing several countries. Construction of a solar-hydro grid would therefore face political as well as economic problems. Furthermore, even if these problems were solved, the ultimate potential of solar power would be limited by the hydropower potential of the tropics and subtropics (approx. 7 trillion kWh/year). The combined solar-hydro potential (roughly double the hydro potential), if it were fully developed, could provide the future 10 billion inhabitants of the LDCs with 1500 kWh per capita per year. The average electricity consumption of the industrialised countries is over 6000 kWh per capita and still rising.

Conclusion

Schlaich criticises parliamentary democracy because it is "incapable of tackling long-term problems" and vulnerable to lobbying by "irresponsible pressure groups". He attributes these weaknesses to "limited legislative periods". During the debate preceding the adoption of the Constitution of the United States, Alexander Hamilton proposed that the Senate and President be elected for life; if Hamilton could not convince the majority in 1787, what chance would such a proposal have today?

Schlaich condemns the rich countries for devoting their energies to the competitive production and export of ever-increasing amounts of consumer goods. What else should they do? We live, for better or worse, in a technological/utilitarian society. Why should the rich countries make sacrifices aimed at mitigating crises that may lie decades ahead, especially at a time when they are themselves beset by growing social problems?

It is impossible to avoid the conclusion that the global population-resource-development-environment problem cannot be solved by political intervention and technological innovation. The conflicts which will undoubtedly arise in the 21st century will be "solved" by the same means witnessed throughout history. In war, there is no problem about making sacrifices. As General Patton put it, war makes all other forms of human endeavour pale into insignificance.



Solar chimney prototype, Spain

Author's Reply

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Concerning the first part of Mr. Gilland's comments, I completely agree with him, that my one-paper-statement on such a complex issue certainly contains some simplifications. So it is true that a fertility decline does not result only from an increase in the standard of living, but must include education, women's emancipation and other factors as well. And, of course, the per capita GNP does not depend on energy supply alone. But what I said is basically true: Without a minimum amount of energy, a decent life is impossible and poorer people use children as a remedy. There are, unfortunately, sufficient statistics for proof.

A discussion of the second part on energy technologies and solar energy would need more space than available here and would have to cover such issues as the present advanced state of the art of high voltage direct current transmission and of closed circuit pump storage without water loss. I think that we engineers are here to provide solutions for such problems.

However, in view of the last part of Mr. Gilland's comments, I doubt whether he cares at all for a human approach to the problem, because he in fact has the ideal solution: Keep going as we are, despoil this planet and fortify the walls of our ivory tower against those who happen to be born outside. And if they do not want to starve by order, show them our carefully engineered weapons, which above all have the nice side-effect of stimulating our lame economies, thus safeguarding us from any sacrifices. I can only pray that I either misunderstood Mr. Gilland or that he stays alone with his opinion.