Jenny Stanford Series on Renewable Energy — Volume 11

Wolfgang Palz

# The Triumph of the Sun in 2000–2020

## How Solar Energy Conquered the World

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# About the Author

Dr. Wolfgang Palz is a German physicist. For over 50 years, he has been one of the global leaders of the development of solar energy and all the renewables. After obtaining a PhD from the University of Karlsruhe, Germany, he became an official at the French National Space Administration (CNES) with responsibility for the development of solar PV. In 1977, he became head of division at the EU Commission in charge of the development of solar energy and renewables for Europe and the world. He kept that position for 20 years before moving to the EU Commission's Directorate of Aid. From 2000 to 2002, he was a member of an "Enquête Commission" of the German Parliament on the German energy perspective on the horizon 2050. Later, he worked under consultancy with the EU Commission on PV programmes for the underprivileged in Latin America. He was also involved in various French national programmes, including one on investments for the future, which was just recently completed. Dr. Palz has received numerous awards, including the International Solar Energy Society (ISES) Global Leadership Award in Advancing Solar Energy Policy (2011). He is a bearer of an Order of Merit of the German Republic.

# Preface

With the turn of the century in 2000, the world started to turn its back on the wrong-headed developments of the past with global pollution and the misery it entails, a climate getting out of control, the threat of a nuclear war, all of which was a result of the unsustainable use of fossil and atomic resources.

Not everybody may have realised it, with the 21st century, we have resolutely engaged ourselves again on the route towards a life in harmony with nature, with the Sun. This book is not about ecological dreams and wishful thinking for a better world. It is simply a report about what happened, in facts and figures.

Going definitely now with the Sun and its benefits, everybody is a winner, not only the climate. Thanks to innovation and mass production, the power derived from the Sun now beats the conventional world with its own strength: socio-economy. In our new world, solar energy has become cheaper than the conventional ones. We got a booming economy that is sustainable, with millions of new jobs for everyone.

The book starts from fundamentals and discusses the key role of the Sun for nature and our lives. It reports what happened when the foundation for a cleaner world was laid towards the beginning of the new century, detailing the efforts of the people who brought about the change.

This edition has been considerably extended to include the many developments on solar energy from 2018 and 2019. It focuses on the accelerating growth of solar PV and wind power in the global markets and their new independence from financial support schemes. The book is a new demonstration of the leadership of solar in all known energy markets. It lays renewed emphasis on the question of the solar energy's role in combating climate change and pollution, an essential concern in the political arenas of today.

The book is dedicated to a key figure who spearheaded this change to a better world, a solar world: the late Hermann Scheer.

The author, Wolfgang Palz, is an independent expert on energy matters and the economy. The book provides a summary of his global views on a solar revolution to which he contributed, his satisfaction that eventually the pioneers' aspirations were crowned with success.

# Acknowledgements

**The author expresses his sincere thanks to Arvind Kanswal of Jenny Stanford Publishing for his tremendous contribution in the preparation of this book. The author is also grateful to his friend Peter Varadi for his continuous encouragement.**

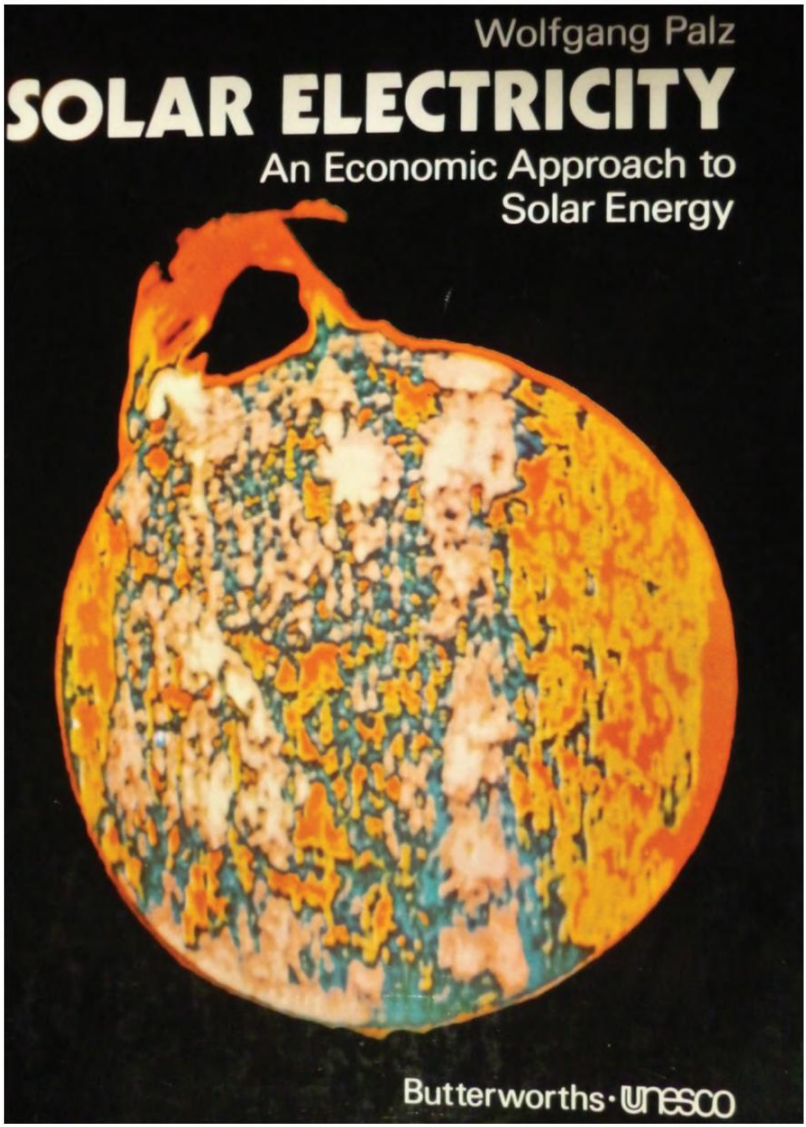
# Prologue: A Vision of the Future from the 1970s

Nuclear power and coal had their heyday in the second half of the last century. In particular, since the oil-price shock of 1973, industrialised countries were anxious to preserve energy independence. Hundreds of nuclear power stations were set up in a record time.

Yet solar electricity and wind power had their adepts looking back to a long tradition in Europe. Interest had arisen in particular in the administration of the United States, too. President Carter did his best to support the new solar technologies, but in vain. While hundreds of Gigawatts of new atomic power was installed around the globe, solar PV was kept down at best to a few megawatts. "Too expensive," they said.

In 1977–1978, I published with UNESCO in Paris the book *Solar Electricity: An Economic Approach to Solar Energy*. It intended to summarise the understanding and mood of the solar experts in the field in Europe and the United States. The US administration had done a lot of investigations. A "Project Independence Report" had been looking in all detail into the prospects of the renewables. But it was kept unpublished for the general public. Hence, the book I published with UNESCO in English and a few other languages was for many a first encounter with solar energy. Following are a few excerpts of that farsighted book.

"There is only one way to diminish the various types of pollution brought about by man's large-scale consumption of energy, namely: direct use of the energy that dominates Earth's climate. Useful energy can be produced from Solar radiation in such a way that neither thermal nor chemical pollution whatsoever is caused".




The author's book on solar energy published in 1977 with UNESCO in Paris.

"All the known ways in which the Sun's radiation can be converted into useful power are discussed. Attention is focused on the direct conversion of light into electricity by means of Solar cells".

"The energy available in the form of Solar energy is evenly distributed. Thus, every country owns more potential energy it would ever need, renewed every year by the Sun. Solar energy is a homemade reserve".

"The development of Solar energy applications does not mean the beginning of a new economic world. On the contrary, the new energy systems must first win their place in the overall energy market, they must be made competitive with oil, coal, or nuclear energy, whether for reasons of depletion of conventional resources, thermal or chemical pollution of the natural environment, greater independence from foreign suppliers or simply lower cost".

"The technical and economic problems associated with the large-scale use of Solar energy are explored". "Assessment of Solar energy's large-scale potential for the future: Evidence is given that the "present" high cost of solar cells is by no means inevitable and that a large-scale reduction of manufacturing costs down to the level required for cost-effective central power plants can be expected in the next 10 to 15 years". "Economy of scale". "Progress in industrialisation".

"In 1975 PV terrestrial market was only 100 kW against a yearly installation rate of conventional power of hundreds of MW".

"PV large-scale production volume of 10 GW leads to a cost of $0.20 to $0.50". "The cumulative production volumes associated with a reasonable learning curve can in fact be achieved".

"If central PV power plants are integrated in an extensive power grid no special problem will occur since the situation is the same as for conventional power plants". "Only as an independent power generator it is preferable to add an electrical storage device".

"PV power generators employing very low-cost Solar cells will be cost effective at almost any power level, even at some Watts or kW. Thus it is possible to envisage individual generators for homes, community plants for villages, shopping centres, industrial production plants, agricultural processing and farms—as well as central power plants".

"Solar generators installed close to the consumers may prove to be attractive because they avoid excessive transmission costs, and when mounted on roof tops or other available structures

eliminate the need for land purchasing, site preparation, and supports".

"An array of 45 $m^2$ would fit on the roof of most family houses in the United States. If a lead acid battery is used for storage it would have a capacity of about 200 kWh, its volume would be 4 $m^3$. Such a system would give complete autonomy to the house".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