

**THE VALUE OF RENEWABLES FOR
SUSTAINABLE ECONOMIC DEVELOPMENT**
Mission, Vision and Strategy
of the Working Party on Renewable Energy Technologies, REWP/IEA/OECD

Gerhard Faninger,¹
Institute for Interdisciplinary Research and Continuing Education, iff,
University of Klagenfurt, Austria

Keywords: Energy Situation and Prospects, Energy Policies, The IEA/OECD, Benefits and Impacts of Renewables, Commercial Markets for Renewables, Why Renewables? Strategies for Market Deployment

1. Energy Situation and Prospects

With the development of energy supply based on fossil energy resources human life has changed rapidly; Fig. 1.

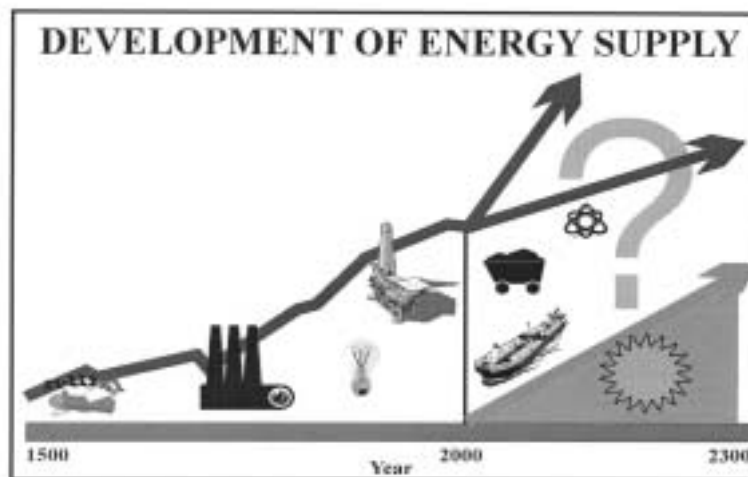


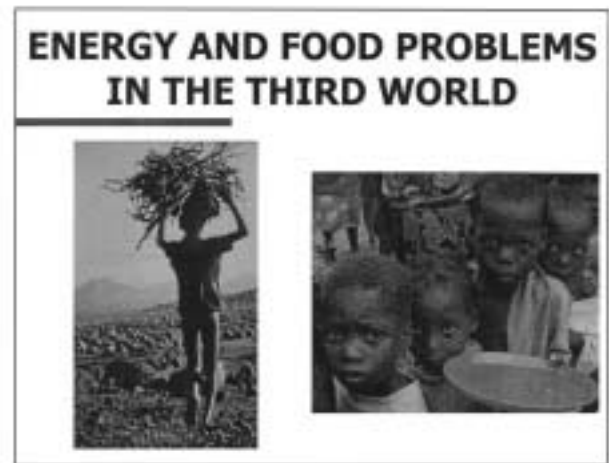
Fig. 1: Development of energy supply and economic development

The reliability of energy resources has not solved all problems. More than 70% of the energy resources are used by only 30% of the world population. More than 85% of the energy carriers are temporarily limited fossil resources; Fig. 2. The energy consumption of today has a high potential to disturb the environment by greenhouse gases and toxic emissions. Global warming and increasing natural disaster are clear indications for change in climate; Fig. 3.

¹ Vice-Chairman of REWP

UNBALANCED ENERGY CONSUMPTION

More than 70% of the energy resources are used by only 30% of the world population.



LIMITED ENERGY RESOURCES

More than 85% of the energy carriers are temporarily limited fossil resources.

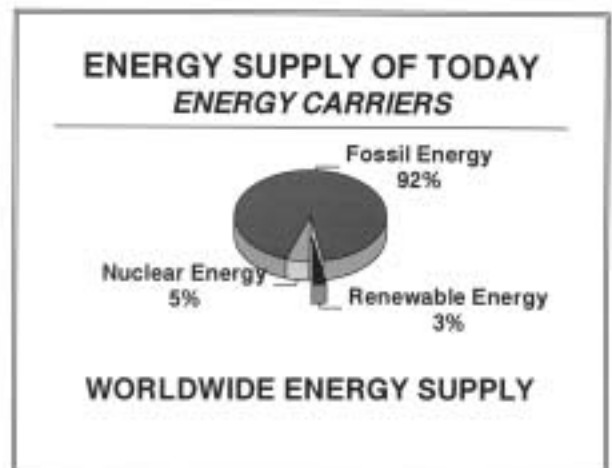


Fig. 2: The problems of world energy supply

There are serious open questions to guarantee future energy supply:

- ☞ Additional energy demand in the Third World.
- ☞ Increasing world population.
- ☞ Time problem for market introduction of alternative energy sources.
- ☞ The present World Economy does not meet the goal of *Sustainability* and has therefore no future prospects.
- ☞ We have to change the Energy Economy also because of environmental protection.
- ☞ Further industrial development needs environmentally benign renewable energy carriers.

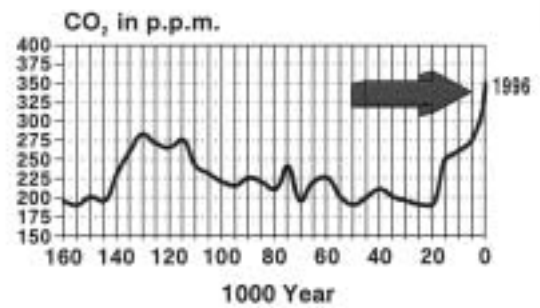
A solution for long-term **sustainable development** requires - in all sectors of consumption (*Industry and Commerce, Transportation and Buildings*) - :

- ☞ Firstly, to reduce the energy demands within energy saving measures.
- ☞ Secondly, to use locally available renewable energy sources, like solar energy, bio-energy, wind, hydropower and other sustainable energy sources.
- ☞ Thirdly, we have to combine efficient energy use with renewable energy sources.

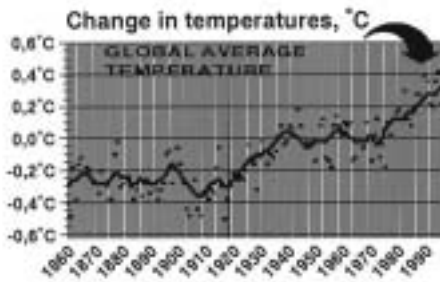
ENERGY AND ENVIRONMENT

The energy consumption of today has a high potential to disturb the environment by greenhouse gases and toxic emissions.

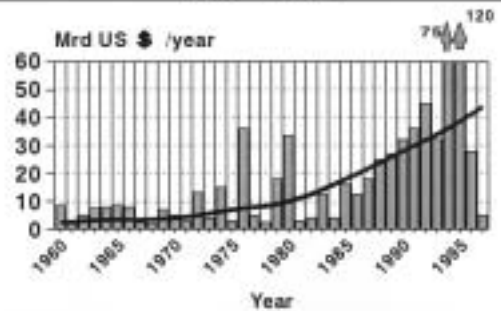
CARBON DIOXIDE CONCENTRATION IN THE ATMOSPHERE



FIRST INDICATIONS FOR CHANGE IN CLIMATE CHANGE IN AVERAGE GLOBAL AIR TEMPERATURES



GLOBAL ECONOMICALLY DAMAGE BY NATURAL DISASTER 1960 - 1997



HOW WILL ANSWER OUR PLANET THE CHANGE IN CLIMATE ?



HOW ANTARKTIS WILL ANSWER CLIMATE CHANGE?



Fig. 3: Energy consumption and environment

2. Future Prospects for World Energy Supply

In the very long term, world energy demand can only be supplied by resources which can be considered as inexhaustible or by permanent influxes. The first category comprises the D-D nuclear fusion, the second solar radiation; Fig. 4. Whether the nuclear fusion will be realized by man for energy supply is - *with our knowledge of today* - uncertain, the dominant part of natural resources is the solar energy which can be converted in many ways and by various technologies into heat, electrical and chemical energy; Fig. 5.

There is a growing acceptance that fossil fuel resources are finite, and there are serious indications that *Renewable energy sources* become significant by 2020.

Scientific American, March 1998 -- “Global production of conventional oil will begin to decline sooner than most people think, probably within ten years.”

Science magazine, August 21, 1998 -- cites six sources predicting oil supply problems in the early 21st century.


Shell U.K. -- “There is clearly a limit to fossil fuels. Fossil fuel resources and supplies are likely to peak around 2030, before declining slowly. Far more important will be the contribution of alternative renewable energy supply.”

**FUTURE PROSPECTS
FOR WORLD ENERGY SUPPLY**

- In the very long term, world energy demand can only be supplied by resources which can be considered as inexhaustible or by permanent influxes.
- The first category comprises the D-D nuclear fusion, the second solar radiation.

**OPTIONS FOR THE FUTURE
ENERGY SUPPLY**

SOLAR ENERGY AND NUCLEAR FUSION



**Sustainable Economic
Development**

- Expanded energy supplies are needed to support global economic development
- Today's energy system cannot be projected into the long-term future
- Renewable resources are capable of supplying most of the world's energy needs



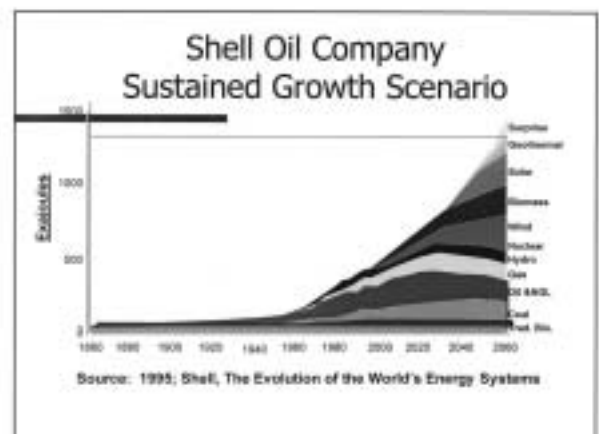


Fig. 4: Future prospects for world energy supply

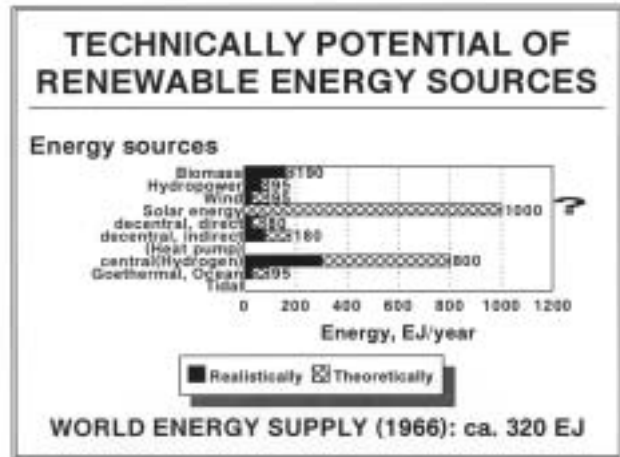
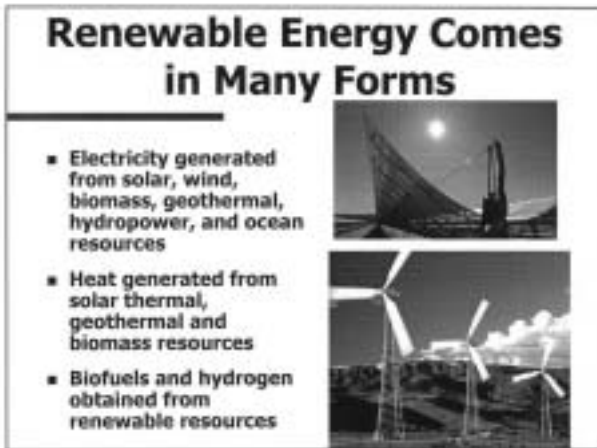


Fig. 5: Potential for renewable energy sources

The Final Solution ?

The conversion of solar energy into the chemical binding energy of a fuel offers the possibility to arrive at a utilization independent of the annual variation of solar energy availability.

Solar-hydrogen has been proposed as a candidate for a solar-based world energy economy; Fig. 6. Hydrogen could be produced through electrolysis by PV-cells or directly by photochemical cells. Such an energy system would be ideal as it is driven by renewable solar energy, it does not produce any pollutants and it is totally closed, i.e. hydrogen fuels are produced from water, and the conversion of hydrogen into various forms of final energy produces only water.

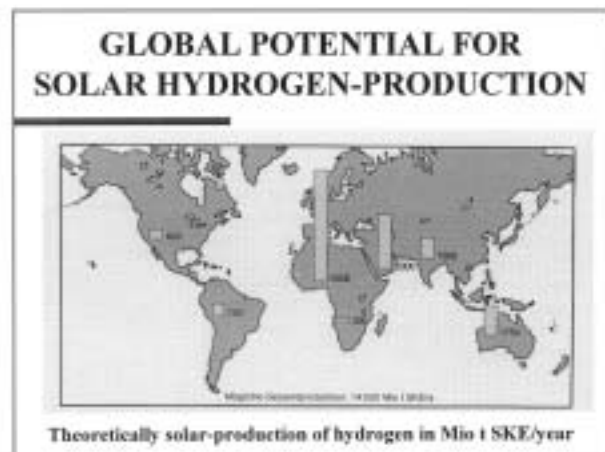
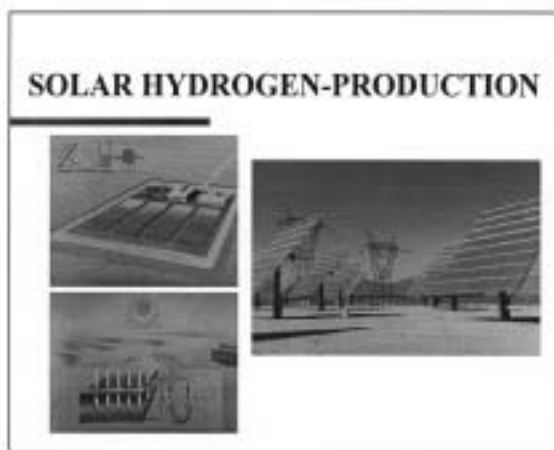


Fig. 6: Solar-hydrogen as a candidate for a future-oriented world energy economy

3. Energy Policies

National Energy Policies in *IEA-Member Countries* are co-ordinated in the framework of international organisations:

- ↳ The International Energy Agency, *IEA/OECD* and
- ↳ the European Commission.

As a reaction to the oil-crises in 1973, the goals for Energy Policies in IEA-Member Countries have changed from energy saving measures towards environmental protection and sustainable development.

*** Phase 1: 1973 to 1985**

Initiatives to reduce the dependency of imported energy carriers within energy saving measures and substitution of fossil energy sources by Renewables.

*** Phase 2: 1985 to 1999**

Initiatives for environmental protection: Reduction of energy-relevant CO₂-emissions on local and global basis, Co-operation with Non-IEA-Member-Countries, especially developing countries. Market introduction of energy-efficient systems and renewable energy technologies.

*** Phase 3: 1999 to**

Sustainable Development: Minimizing the energy supply and environmental impacts in all sectors of applications without loss of comfort.

The **International Energy Agency (IEA)** is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme. The IEA a board of National Governments and serves as a forum for discussion of energy matters among its 24 Member countries and, increasingly, between Member- and Non-Member-countries. Its role derives from its convening power - its ability to bring countries together to share experiences and work together toward common goals - and its analysis power, as well as its ability to engage the private sector. The IEA carries out a comprehensive programme of energy co-operation among twenty-four of the OECD's twenty-nine Member countries in all areas of energy production and energy use:

- ↳ Energy Policy: Strategies and measures.
- ↳ Research, development, demonstration and dissemination (*RDD&D*).
- ↳ Co-operation with Non-IEA-member countries.

Primary IEA commitments are:

- ↳ Take joint measures to meet oil supply emergencies.
- ↳ Share energy information.
- ↳ Co-ordinate their energy policies.
- ↳ Co-operate in the development of rational energy programmes.

The primary mechanism for co-operation on technology matters thus far has been the co-operative Research-, Development- and Demonstration- (*RD&D*) programmes carried out under the *Implementing Agreements*, which have proven their value as forum for:

- ☞ Co-operation on RD&D tasks.
- ☞ Information exchange between governments and researchers.
- ☞ Co-operation on information dissemination.
- ☞ Support of technology deployment.

Currently there are some 40 Implementing Agreements which provide a framework for more than 75 collaborative projects. The IEA research work is overseen and co-ordinated by three *Working Parties* covering:

- ☞ Renewable Energy Technologies.
- ☞ End-Use Technologies.
- ☞ Fossil Fuel Technologies.
- ☞ For the research work in the area of Fusion Power a *Co-ordinating Committee* is responsible.

The **Renewable Energy Working Party (REWP)** is a subsidiary, advisory body of the IEA's Committee on Energy Research and Technology (CERT). It is comprised of delegates from all IEA Member countries. The REWP is „Reference Body“ for Renewables issues within the IEA. As such, the REWP responds on matters related to Renewables to all IEA offices and committees, and similarly represents the IEA to outside parties. The REWP is supported by the *Renewable Energy Unit (REU)* of the IEA Secretariat.

4. Goals of Energy Policies and Their Implementation

Energy efficiency policies and measures in European countries are increasingly recognised as the cornerstone of a sustainable energy system, and as such as key elements of countries efforts to meet their **Kyoto Protocol Commitments**; Fig. 7.

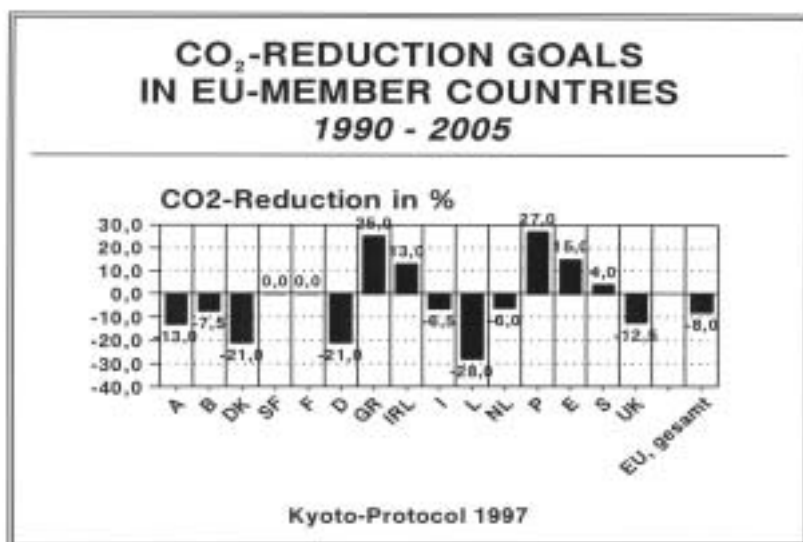


Fig. 7: CO₂-reduction goals for EU-member countries

There is a continued growth in adoption and implementation of energy efficiency standards for buildings as well as for household appliances and equipment designed to encourage the development, marketing and purchase of energy-efficient products; Fig. 8.

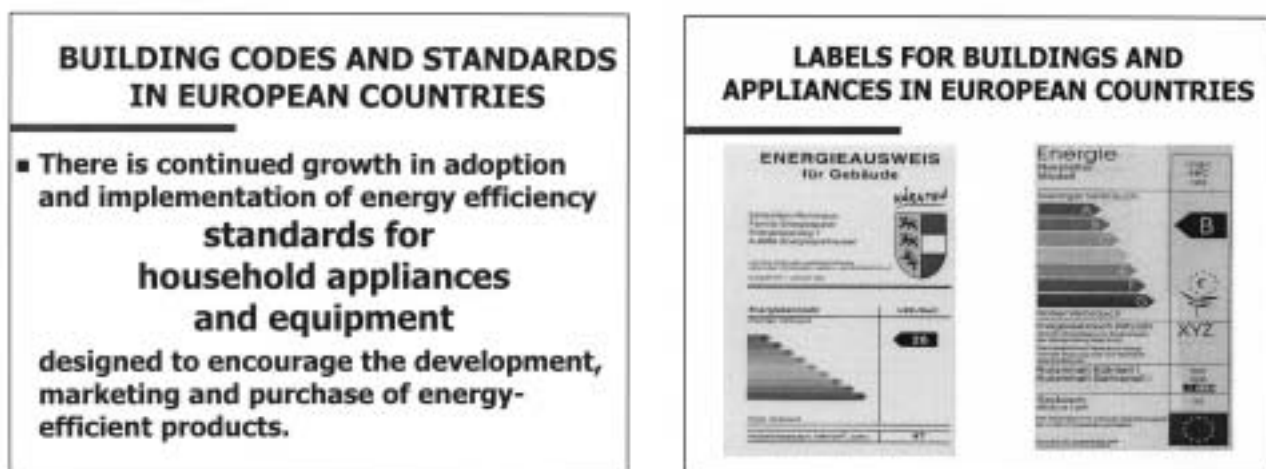


Fig. 8: Energy standards and labels for buildings and household appliances

There is a strong and growing political consensus to promote the development of Renewables. All IEA countries have established, or are planning, measures to increase share of Renewables in their energy markets. The *Directive* adopted by the European Union as a Member of IEA - is an example of this political will: the target is to increase the share of Renewables – as an average for all EU-Member countries – in energy consumption/energy supply from its present level of 6 % to 12 % in 2010.

Renewables are also high on the agenda of developing countries, and expanded renewable energy deployment is one of the key goals of the World Bank. Renewable energy technologies are perceived by IEA-Non-Member Countries to provide solutions to many of their development challenges, including energy supply, diversity of the energy mix, local environmental problems, and rural development.

The IEA Ministers in 1999 called for the IEA to play an appropriate role in facilitating the *increased deployment of clean energy technologies*, including Renewables. This is reflected by national agencies in many IEA countries that have established goals and targets for increasing Renewables market share. The Renewables' value is not only seen in the energy it produces, but in the economic, energy security and environmental benefits that it provides, and its critical role in sustainable development.

Greater confidence in Renewables ultimate market competitiveness has led to an increase in public sector investments in Renewables, compared to a few years ago, the impact of which can be measured by recent market analyses. At the same time, the potential renewable energy market in IEA-Non-Member Countries is even greater than in the IEA itself.

The **G8 Heads of State** endorsed a strategy of increasing the market up-take of Renewables at their meeting in Okinawa in July, 2000. In part, their communiqué stated:

“...the increased use of renewable energy sources in particular will improve the quality of life, especially in developing countries. We therefore call on all stakeholders to identify the barriers and solutions to elevating the level of renewable energy supply and distribution in developing countries. We invite stakeholders to join in a Task Force to prepare concrete recommendations for consideration at our next Summit regarding sound ways to better encourage the use of Renewables in developing countries.”

This growing interest in Renewables’ market success will become realised only with an increased commitment to further improve market confidence in the continued, strong growth of Renewables by creating supportive and consistent policy frameworks in leading market countries, and by stimulating significant scale in those markets through public sector investments. This commitment will draw together both public and private sectors, in both IEA and IEA-Non-Member Countries (NMC), to work collaboratively toward Renewables’ market significance.

The IEA Ministers have also continued to advocate for a strong R&D effort to develop a new generation of Renewables. The new (2000 - 2003) *REWP Strategy* advises a balanced commitment toward continued RD&D, and toward market support. The ongoing significant fluctuation in international oil prices in the fall of 2000 re-emphasises that energy supply cost and security are very relevant factors in addition to the environmental dimension.

5. Commercial Markets for Renewables

Commercial markets for Renewables are today: Hydropower, Bio energy, Solar heating and cooling, Solar thermal power plants, Photovoltaics, Wind energy and Geothermal energy; Fig 9.

Hydropower market focus can be seen in two discrete areas. The first and most important is in the mid-sized power scale of plants ranging from 100-300 MW. New technology developments have allowed the efficiency of these plants to rise, while the environmental impact of them has been significantly reduced. Of particular note is the minimization of reservoir size to power relationship. The second focus is on projects in the 30-100 MW scale. These plants are now possible as run of the river, or with very small reservoirs, and therefore quite reduced environmental impact. These smaller plants can be used competitively as distributed or captive power where there is sufficient resource, or as bulk power. There may be significant potential in developing countries to build micro grids. A key market issue is how to qualify for “green certificates”.

The present principal market targets of the bio-energy community are in the area of residential heating, co-firing bio-fuels with coal, gasification for electricity and transportation. Bio-energy is already cost competitive in certain regions where waste streams, residue or dedicated resources provide free or inexpensive inputs. However, more advanced technologies that might develop considerably larger markets, are not thought to be cost-competitive until the price of oil rises to \$50-\$60 per barrel.

The present market of solar thermal utilisation focus on hot water systems, which have great near-term potential, but which markets are slowly growing (and shrinking in some regions). Technology and cost barriers are relatively small for add-on systems, but greater for integrated systems. The most significant barriers are institutional, financial, and the credibility of the potential. International market work focuses on standardisation, and pre-normalisation to

1999 Worldwide Hydroelectric Capacity

- 667,000 MW installed
- 19% of world generating capacity
- 2,558 billion kWh generated in 1997
- 20% of electricity generation
- Many new projects underway, especially in the developing world



1999 Worldwide Non-Hydro RE Capacity

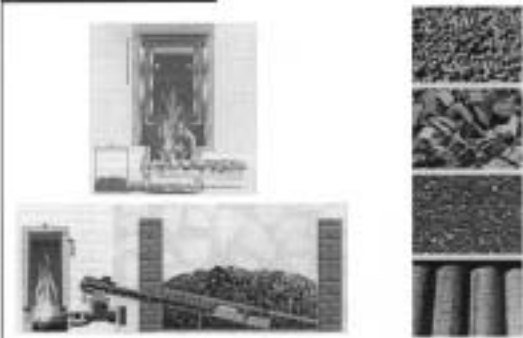
Technology	Installed Capacity (MW)
Biomass *	35,000
Geothermal	8,250
PV *	800
Solar Thermal	350
Wind	10,000
Total	54,500

* Figures are rounded and approximate. Many biomass and PV generators are off-grid. PV capacity figures are taken from industry reports of cumulative sales.

BIOENERGY FROM FOREST INDUSTRY



BIOMASS-HEATING



ACTIV SOLAR ENERGY USE IN THE BUILDING SECTOR



SOLAR HEATING SYSTEMS



Fig. 9/1: Commercial markets for renewable energy technologies Hydropower, Bio-energy, Solar Heating

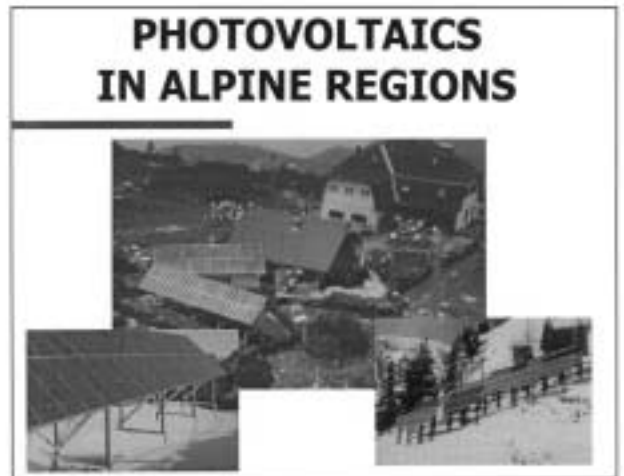
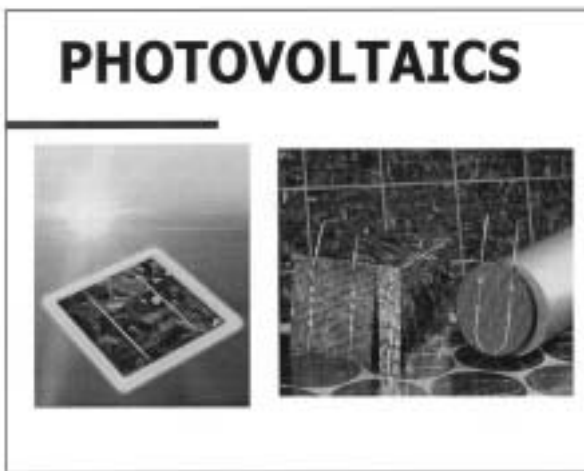
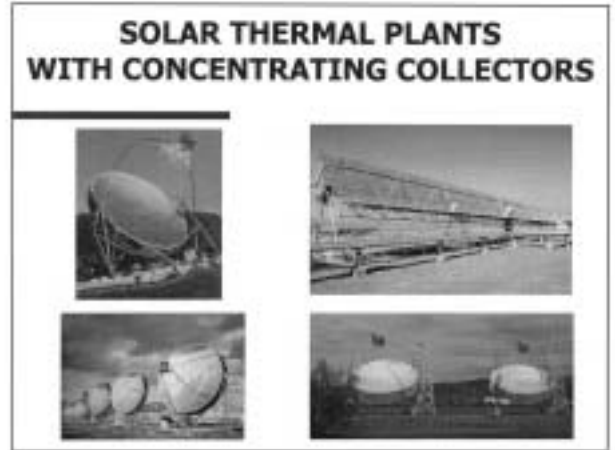


Fig. 9/2: Commercial markets for renewable technologies: Solar thermal power plants, Photovoltaics

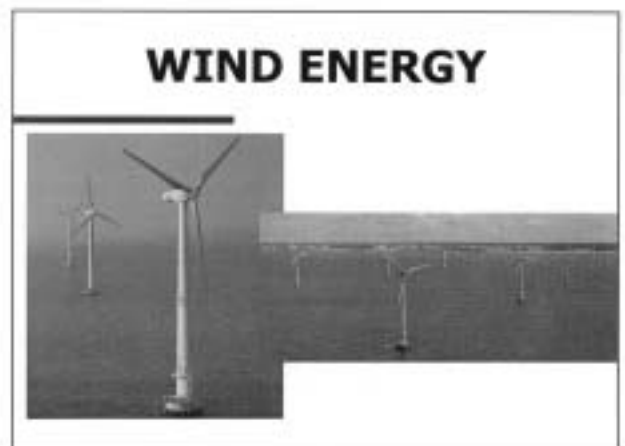
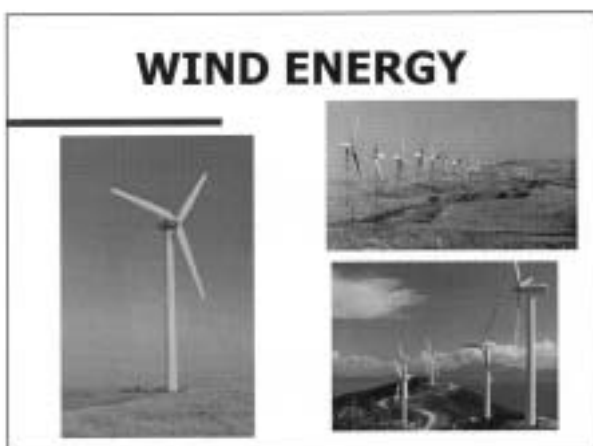


Fig. 9/3: Commercial markets for renewable energy technologies: Wind energy

establish market confidence in the systems. Needs are in the areas of developing recommendations for the best policy frameworks, and establishing public or political commitment.

Central Solar Thermal Plants are thought to be near to cost competitive, and could reach that goal with the deployment of modest number of systems. Market focuses are in the larger scale projects (80-300 MW), as well as in smaller systems (10-50 MW). The larger systems are thought to be appropriate for bulk power, and would be developed as fossil hybrids (generally natural gas). The smaller systems have a variety of potential sub-markets, including captive industrial power, distributed generation, or small independent grids. In some situations, these, too, would be hybrids.

For photovoltaics there exist a number of market targets for near-term, and large scale opportunities. These include PV as rural, sustainable development, and PV as distributed generation, both in building-integrated configurations, and in utility support configurations. A further market focus is PV in large-scale power configurations.

The market of today for Wind Energy is bulk grid power. This focus results from the increasing size of the machines, which has come from the drive for increased efficiency, as well as increased power output per installation. The most significant market opportunity in Europe is thought to be to move the machines off shore. However, in developing countries, the challenge is for larger scale on-land projects.

Geothermal power plant are arguably cost-competitive with conventional power in regions where the field resource is well-documented, and where fossil resources are relatively expensive. However, geothermal power markets are retarded, due to the extremely high field development costs, as well as the expensive process of establishing a supportive policy framework. Left to its own resources, the geothermal industry is not able to invest these substantial “transitional overheads” alone. This may be the key market acceleration issue.

6. Why is Renewable Energy of Interest?

Expanded energy supplies are needed to support global economic development. Today’s energy system cannot be projected into the long-term future. Renewable Energy comes in many forms, and renewable resources are capable of supplying most of the world’s energy needs.:

- ☞ Electricity generated from solar, wind, biomass, geothermal, hydropower, and ocean resources.
- ☞ Heat generated from solar thermal, geothermal and biomass resources.
- ☞ Bio-fuels and hydrogen obtained from renewable resources.

Renewable energy technology costs are continuing to decline, as production and markets expand. The energy sector, itself, is in the phase of dynamic change, creating new opportunities for Renewables.

Renewables are now viewed as cost-effective solutions to many of consumer needs, as systems are developed for specific applications. As a result, market growth is robust, and has resulted in an industry of significant size and capability.

Recent scenarios of future market potential for Renewables indicate a continued, and perhaps accelerated growth, as the recognition of Renewables benefits translates into market investment. The pathways that each of the technologies will follow are unique, but each is likely to achieve a point in the near future where government intervention to achieve competitiveness with conventional technologies is no longer necessary. This "take-off" market can be seen as the transition point to broad acceptance of Renewables applications.

Renewables potential contribution to IEA countries is emerging, as the technologies approach competitiveness and the markets approach significance. Renewables add to the diversity of the energy supply portfolio, and reduce the risk of energy price fluctuations, as well as constraints on supply. Distributed Renewables provide options to consumers not otherwise available. And Renewables are the most environmentally benign of the options available in current and near-term markets.

Finally, Renewables contribute to a healthy economy, both in their contribution to the efficiency of the energy system, and in the employment and investment opportunities that arise from continued rapid market growth.

Renewables' benefits to both IEA and non-IEA countries are:

- ☞ In urban areas, Renewables contribute to energy supply diversity and to local economic development.
- ☞ In rural areas, Renewables can be the key to aspirations for development, and can contribute to agricultural productivity, health, education, communications, and home quality.
- ☞ Also, Renewables offer benefits to the national environment, as well as the local environment.
- ☞ In this regard, Renewables can support aspirations for social equity.

7. Strategies for Wide-spread Market Deployment of Renewables

Strategies and measures for accelerating wide-spread market deployment of renewable energy technologies have been receiving greater attention in recent years as renewable energy markets accelerate in developed countries and show greater promise in developing and transition economies. Many international and national organisations are in a position to contribute to these strategies and some are already doing so. Strategies and actions must be designed to increase the scale of deployment and to create confidence in technologies and markets.

To facilitate more rapid deployment of Renewables, it is important that people understand the advantages of using more Renewables in the context of the full range of their benefits, in contrast to the environmental and other consequences of using energy derived from fossil fuels because of their apparently lower cost. The costs of emerging renewable energy technologies will decline in the future at a higher rate than the capital costs and efficiencies of fossil fuel technologies. This is due to the nature of technologies that improve in cost as a result of manufacturing scale, rather than project size.

The strategy is to optimise the way from *Lab to Market*:

Technology R&D ⇒ Learning Investments ⇒ Commercial Deployment; Fig. 10.

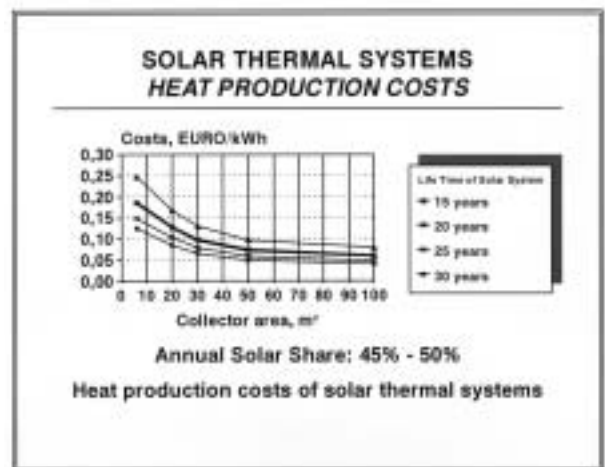
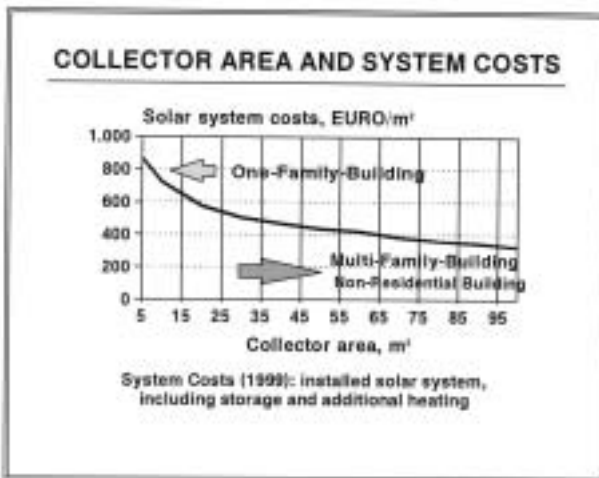


Fig. 10: Strategies for wide-spread market deployment

Strategies and actions must be designed to increase the scale of deployment and to create confidence in technologies and markets.

Renewable energy markets can be accelerated in both IEA-Member- and IEA-Non-Member countries by working with governments and the private sector in five basic ways:

- ☞ Clarifying and adopting the right policy frameworks.
- ☞ accelerating “learning investments”.
- ☞ increasing demand and confidence.
- ☞ Strengthening “national systems of innovation” to link RD&D with markets.
- ☞ Understanding economic, energy, and environmental benefits and potential adverse impacts.

The Right Policy Framework

In utility power markets, renewable energy technology scale-up and sustained market share can be greatly facilitated by establishing a transparent framework and rules governing competition and support during the market entry phase, and then competition within the mature market (i.e., through dispatch and pricing). For renewable power technologies, utility

regulatory frameworks that allow fair competition for electricity generation by independent power producers, including power purchase agreements and a transparent and stable tariff-setting regime, are an essential first step towards creating private markets for renewable energy. Of course, if conventional generation remains subsidised, renewable energy may never compete at all.

Besides utility-regulation and power-purchase mechanisms, other categories of policies which can be assessed to help governments encourage Renewables projects include:

- ↳ Carbon taxes (notable in Sweden).
- ↳ Air emissions taxes (some U.S. states).
- ↳ Investment tax credits (adopted in India; led to a boom in the wind power industry there and over 1000 MW installed in just a few years).
- ↳ Production tax credits.
- ↳ Wheeling policies allowing small power producers to wheel renewable energy-based power to third parties at reasonable wheeling fees (adopted in India).
- ↳ Green labelling/certificates and green power marketing. (Netherlands, some U.S. states).
- Voluntary agreements by utilities to install renewable energy capacity (Japan).
- ↳ Mainstreaming Renewables into national energy policy.
- ↳ Technology testing and certification procedures and institutions.

Learning Investments

“Learning investments” represent the deployment expenditures that need to be made to bring a new technology to the point of commercial competitiveness. Learning investments lead to reduced costs through the accumulation of hands-on experience (“*learning by doing*”). As individuals and industries gain experience with technologies through a competitive market, they learn to improve technology and implementation costs. For example, the experience with wind turbine deployment over the past two decades shows that cost-per-installed-kilowatt has decreased dramatically. Manufacturers have improved their designs. In addition, costs per produced kilowatt-hour have decreased even faster (increasing capacity factors), as developers have learned how to better identify good wind farm sites, optimise turbine micro-siting, perform maintenance, and manage power production. The installation of solar thermal systems was facilitated through the development of *large-scale collectors* with up to 15 m² of absorber area. With this development not only the costs for the collectors and for the installation were decisively reduced but also the problems arising when connecting the pipes by means of prefabricated collector modules. Estimates for renewable energy markets are encouraging; Fig. 11.

The key issues are understanding and confidence: governments, financiers and industry must understand the technologies and have confidences in them. Developing nations in particular need to be provided with more information on how to make their market prosper.

Experience curves demonstrate that investment in the deployment of emerging technologies could drive prices of many technologies down to the point of commercial competitiveness.

Learning investments are the commitments by governments and industries to accelerate the progression to market competitiveness of a technology.

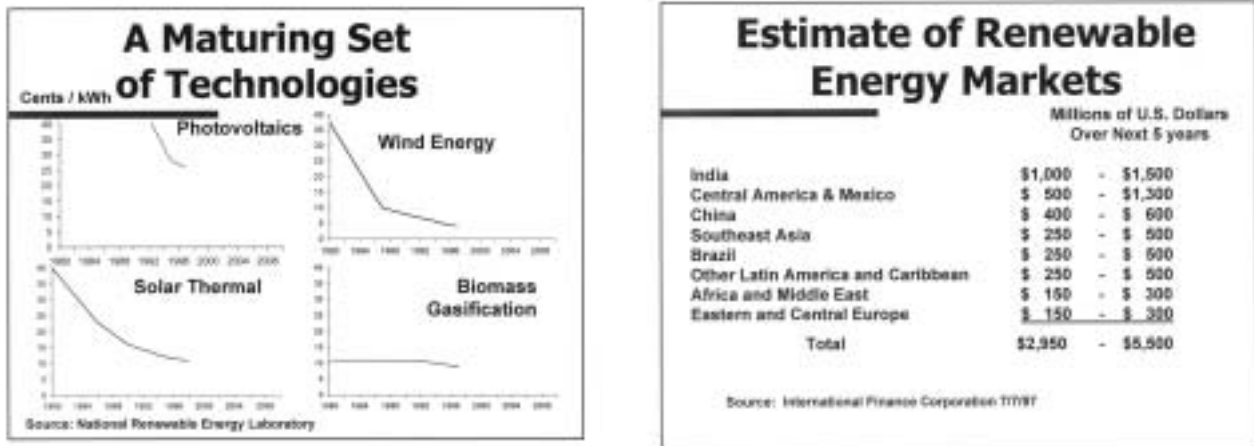


Fig. 11: A maturing set of renewable energy technologies

Understanding and Confidence for Renewables

Fundamentally, there is a challenge to create a clear “market position” for renewable energy technologies, so that their benefits and the ways in which they fit well into local markets are manifest to all concerned. The key issues are understanding and confidence: governments, financiers and industry must understand the technologies and have confidence in them. Developing nations in particular need to be provided with more information on how to make their markets prosper. There is a need to analyse and quantify the benefits and impacts from large-scale market deployment. Although many existing studies quantify these benefits, there is a need for application-specific and sector-specific information presentable to policy-makers and other decision-makers that can be used to justify specific policies and decisions.

Benefits generally include some combination of the following:

- ☞ Energy security: reduced dependence on foreign energy imports.
- ☞ Environment: mitigating global climate change, regional acid rain, local air pollution, and indoor air pollution.
- ☞ Employment: technology development, manufacturing, installation and maintenance services.
- ☞ Technological development and competitiveness: rise of new domestic industrial bases.
- ☞ Rural development: improved energy services and income-generation opportunities.
- ☞ Reliability: greater energy availability and/or reliability in areas where service from electric power grids may be intermittent or unreliable.

The benefits of Renewables are:

- ☞ Low environmental impact.
- ☞ Increased energy security through diversity of supply and reduced dependence on imported fuels.
- ☞ Low or zero fuel cost, with little or no risk of price escalation.
- ☞ Modularity provides social and technological flexibility.
- ☞ Strong public support in many countries.
- ☞ Significant potential for job creation.
- ☞ Lowest cost for many applications.

An important additional argument for the use of local available renewable energy sources: Renewable Energy Technologies mean not only reduction of kWh and minimizing of environmental impacts but also creation of new opportunities for local industries and new jobs.

Converging Forces for Renewables are:

- ↳ Electricity market liberalization and privatization.
- ↳ Need to reach un-served populations.
- ↳ Finite fossil fuel availability.
- ↳ Climate change and other environmental concerns.
- ↳ Growing maturity of renewable energy technologies.

Major challenges facing Renewable Energy are:

- ↳ Limited public information and experience.
- ↳ Competitive disadvantage of high initial cost.
- ↳ Expectation of continuing low fossil fuel costs.
- ↳ Integration of intermittent generation into grid operations.
- ↳ Erosion of regulatory protections in liberalized markets.

The **IEA/REWP-message for Renewable Energy Technologies** is:

- ↳ Renewable energy technologies offer substantial benefits to consumers and to nations.
 - ↳ Investing in the further development and use of Renewables will lead to their increased contribution to society.
 - ↳ Renewable energy technology costs are continuing to decline, as production and markets expand.
 - ↳ The energy sector, itself, is in the phase of dynamic change, creating new opportunities for Renewables in the market.
 - ↳ Renewables are now viewed as cost-effective solutions to many of consumer needs, as systems are developed for specific applications.
 - ↳ As a result, market growth has resulted in an industry of significant size and capability.
 - ↳ Recent scenarios of future market potential for Renewables indicate a continued, and perhaps accelerated growth, as the recognition of Renewables benefits translates into market investment.
 - ↳ The pathways that each of the technologies will follow are unique, but each is likely to achieve a point in the near future where government intervention to achieve competitiveness with conventional technologies is no longer necessary.
 - ↳ This take-off” market can be seen as the transition point to broad acceptance of **Renewables** applications.
 - ↳ Renewables potential contribution to IEA countries is emerging, as the technologies approach competitiveness and the markets approach significance.
 - ↳ Renewables add to the diversity of the energy supply portfolio, and reduce the risk of energy price fluctuations, as well as constraints on supply.
 - ↳ Distributed Renewables provide options to consumers not otherwise available.
 - ↳ Renewables are the most environmentally benign of the options available in current and near-term markets.
 - ↳ Renewables are the key for sustainable economic development in the Third World;
- Fig. 12.

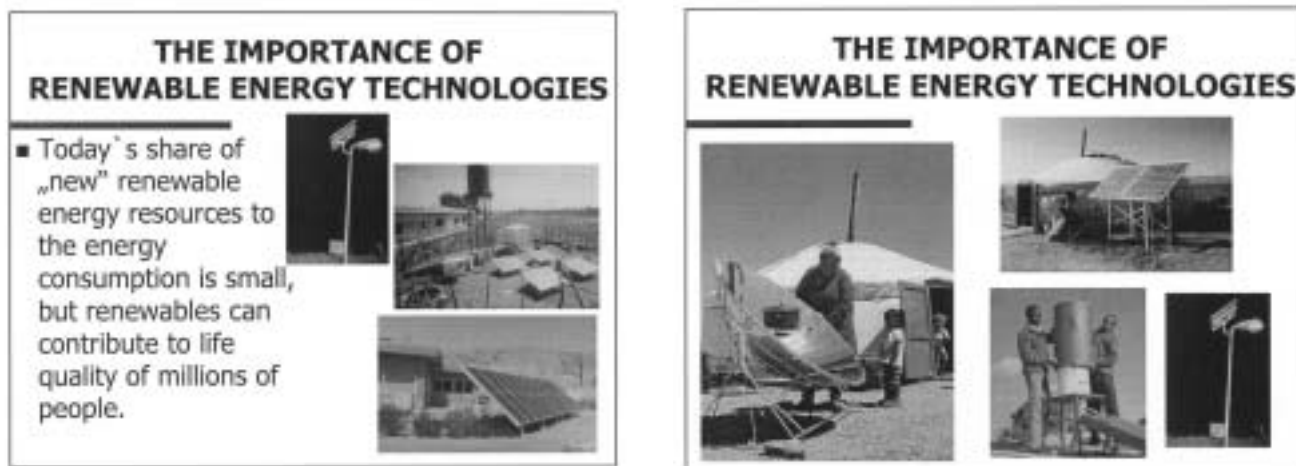


Fig. 12: The importance of renewable energy technologies in developing countries

- ↳ Finally, Renewables contribute to a healthy economy, both in their contribution to the efficiency of the energy system, and in the employment and investment opportunities that arise from continued rapid market growth.

The Vision of REWP is that renewable energy technologies will continue to improve in cost and performance, and recognition of their benefits will increase, so that by the middle of the 21st century, Renewables will supply half of the world's energy; Fig. 13.

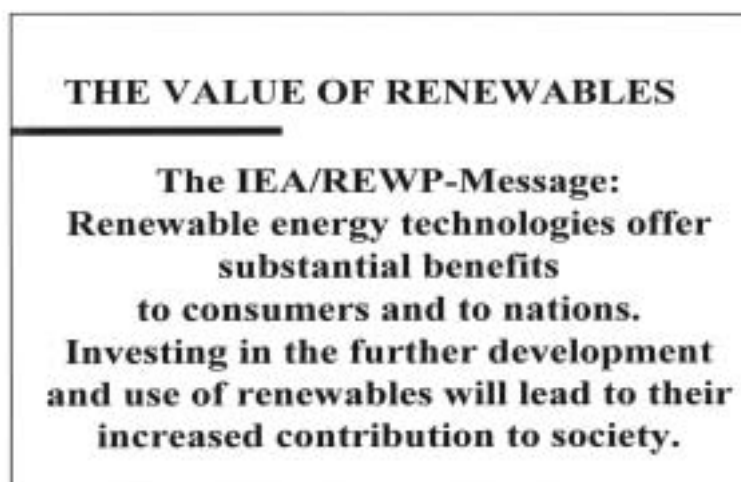


Fig. 13: The value of Renewables

The realisation of this vision will require:

- ↳ Increased public awareness of the values and benefits of Renewables, and of the gains to be made by their significant market success.
- ↳ Continuing innovation and research programmes to reduce costs, improve performance and establish market confidence.

- ↳ Significant investment by Member country governments to support development of appropriate policy frameworks, market infrastructure and consumer demand, leading to confidence by the private sector in the stable and rapid growth of renewable markets.
- ↳ Significant investment by the private business and financial sectors in technology, manufacturing, and supporting businesses, as well as projects, to improve performance and costs, and to provide necessary infrastructure, thus hastening the point where commercial competitiveness is achieved.
- ↳ Voluntary policy and market co-ordination among nations, to improve the environment for investments and to accelerate renewable energy market development.
- ↳ IEA collaboration with a variety of international organisations, providing support of Non-IEA- Member Countries and their aspirations for rapid growth of renewable markets.
- ↳ IEA leadership, providing added value through its power to convene, and to analyse technology, policy and market conditions.

References:

Internal documents of IEA/REWP

World Energy Outlook, International Energy Agency, IEA/OECD, 1998 Edition

Renewable Sources of Energy, International Energy Agency, IEA/OECD, Paris 1997

Energy and Climate Change, International Energy Agency, IEA/OECD, Paris 1997

Experience Curves for Energy Technology Policy, International Energy Agency, IEA/OECD, Paris 2000