

THE WORLD PV MARKET TO YEAR 2010

0. SUMMARY

0.1 SCOPE

The world PV market assessment presented in this volume provides a quantification and characterisation of the PV market during the period from 1982 to 1994 both in terms of supply side characteristics, i.e. annual shipments, manufacturing capacities, market shares of PV industries and related geographical areas of origin, as well as the demand side in terms of installed PV generator capacities subdivided into the principle application market segments and geographical areas of destination.

An integrated computer based world PV market model has been developed for the purpose, incorporating the correlations between interdependent market parameters, such as between shipments and manufacturing capacities, installed PV generation capacities, market shares, investments required for manufacturing capacity increases, generated employment, etc. This model has allowed first to check for and to detect inconsistencies between available market figures and estimates given by literature, and at the same time to create a sound knowledge base for the estimate of unknown market parameters and for the development of market scenarios and extrapolations to year 2010.

0.2 RESULTS

Outcomes and results of the world PV market investigation are presented for the four main geographical areas of interest, namely Europe, USA, Japan and the rest of the world (ROW).

Objectives, strategies and specific PV incentive programmes being (or having been) implemented by the related governmental and international authorities are presented for the investigated geographical areas and countries, as well as the technical regulations and standards being adopted by the PV sector and related areas of conflict.

A detailed quantification and characterisation of the supply side of the PV market, i.e. of the PV industries of the presented areas is given including the list of all manufacturers, adopted technologies, manufacturing capacities and the historic trends of annual shipments for the period from 1982 to 1994.

The demand side of the investigated geographical area is presented by quantifying the historic evolution of PV shipments per main application segment. Specifically the grid-connected market is presented subdivided into the larger-scale utility bulk power market segment and the small-scale rooftop/building integration market segment. The stand-alone market is subdivided into its main market categories, namely remote industrial, remote rural and consumer/leisure, which in turn are further subdivided into their specific sub-market segments down to the level of communication applications, Solar Home systems, PV pumping, village power, etc.

For each of these market segments, the shipments and the presently installed capacities are quantified and characterised, as well as the geographical areas of destination. Furthermore an

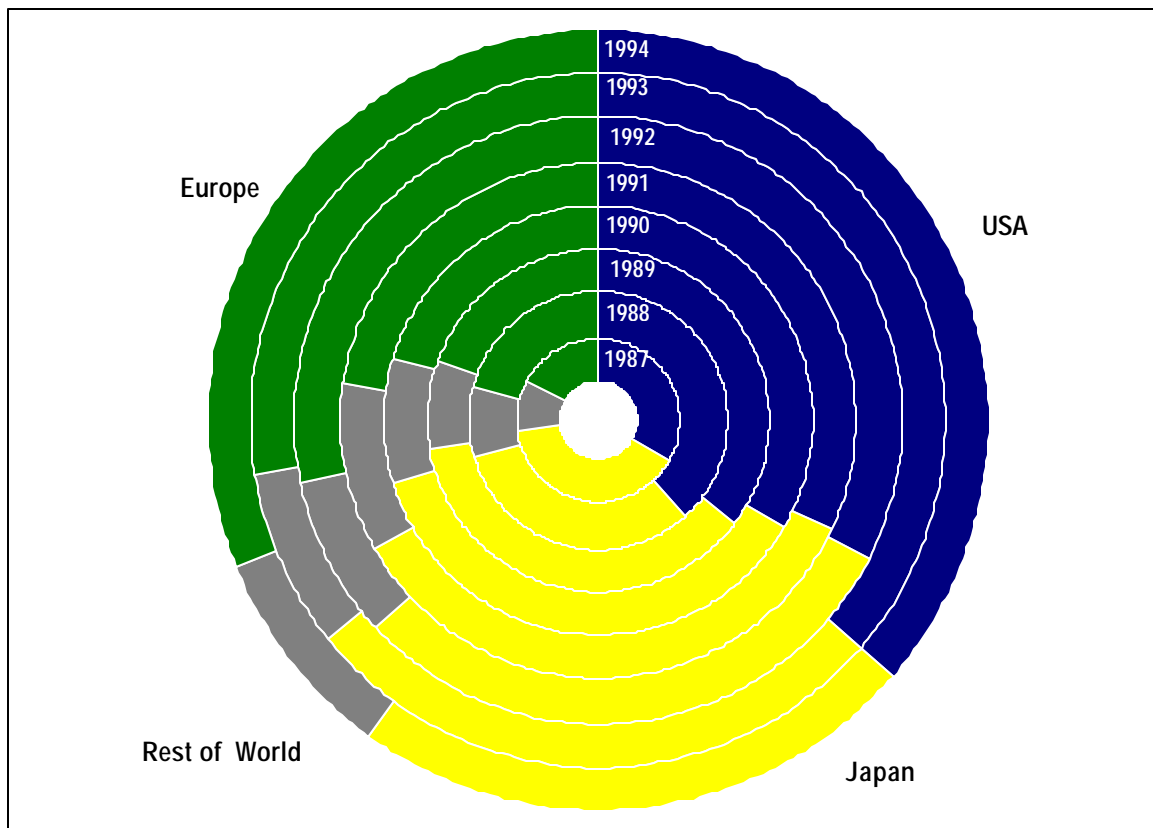
estimate for the related demand potential is given, and the specific market barriers are identified and discussed.

0.3 AS IS MARKET SITUATION

The outcomes of this PV market investigation for the period from 1982-1994 may be summarised as follows:

- **Annual PV shipments** have grown average 15%/year and reached world-wide nearly 70 MWp in 1994 (of which 31% from European manufacturers). In the early eighties, the PV market had been strongly dominated by the large-scale market segment. Since then the Communications market segment, and generally all stand-alone applications have clearly taken the lead.

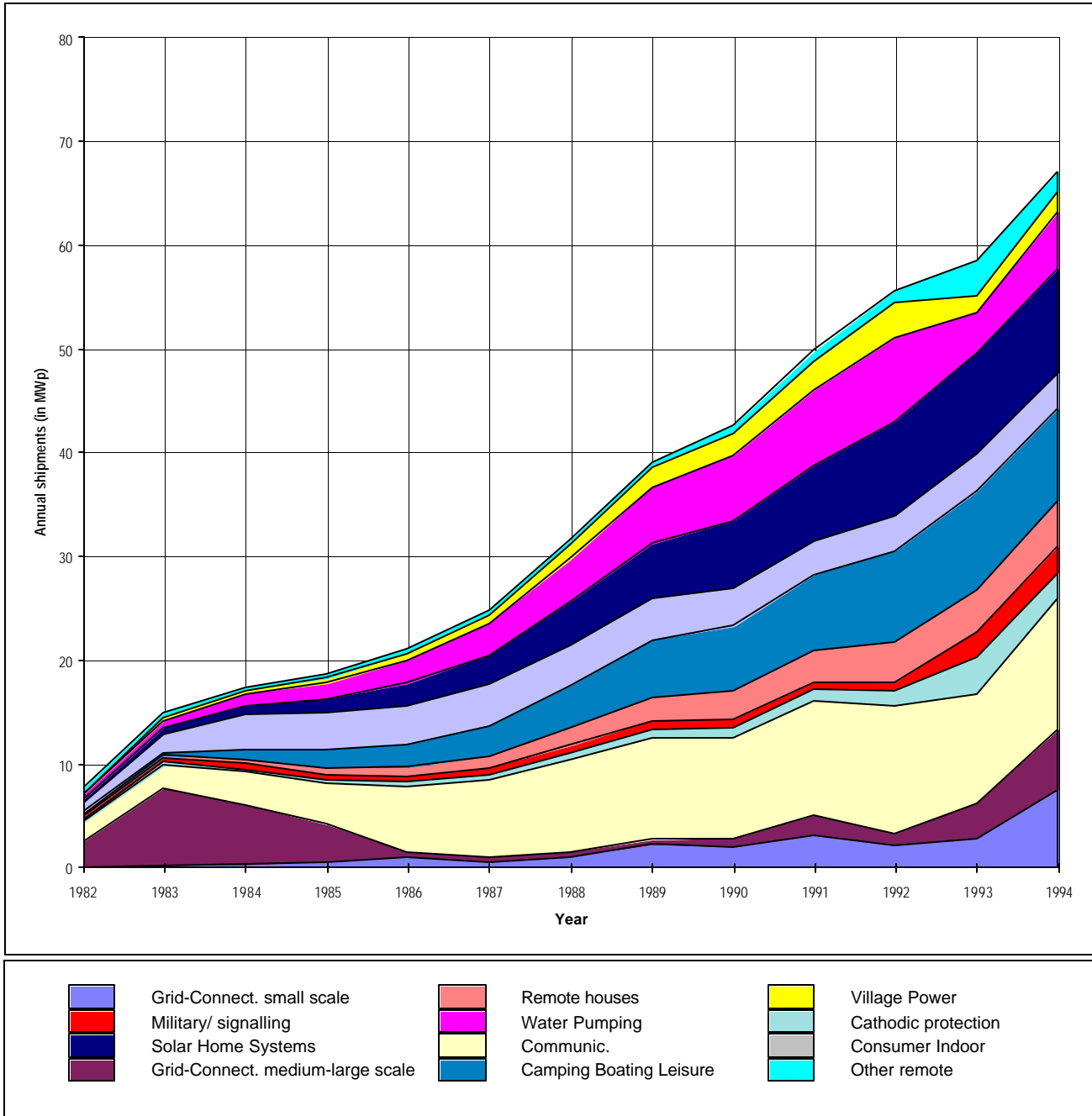
Behaviour in time of market shares of PV producers per geographical area



The presently largest four PV application market segments are (in order of decreasing importance):

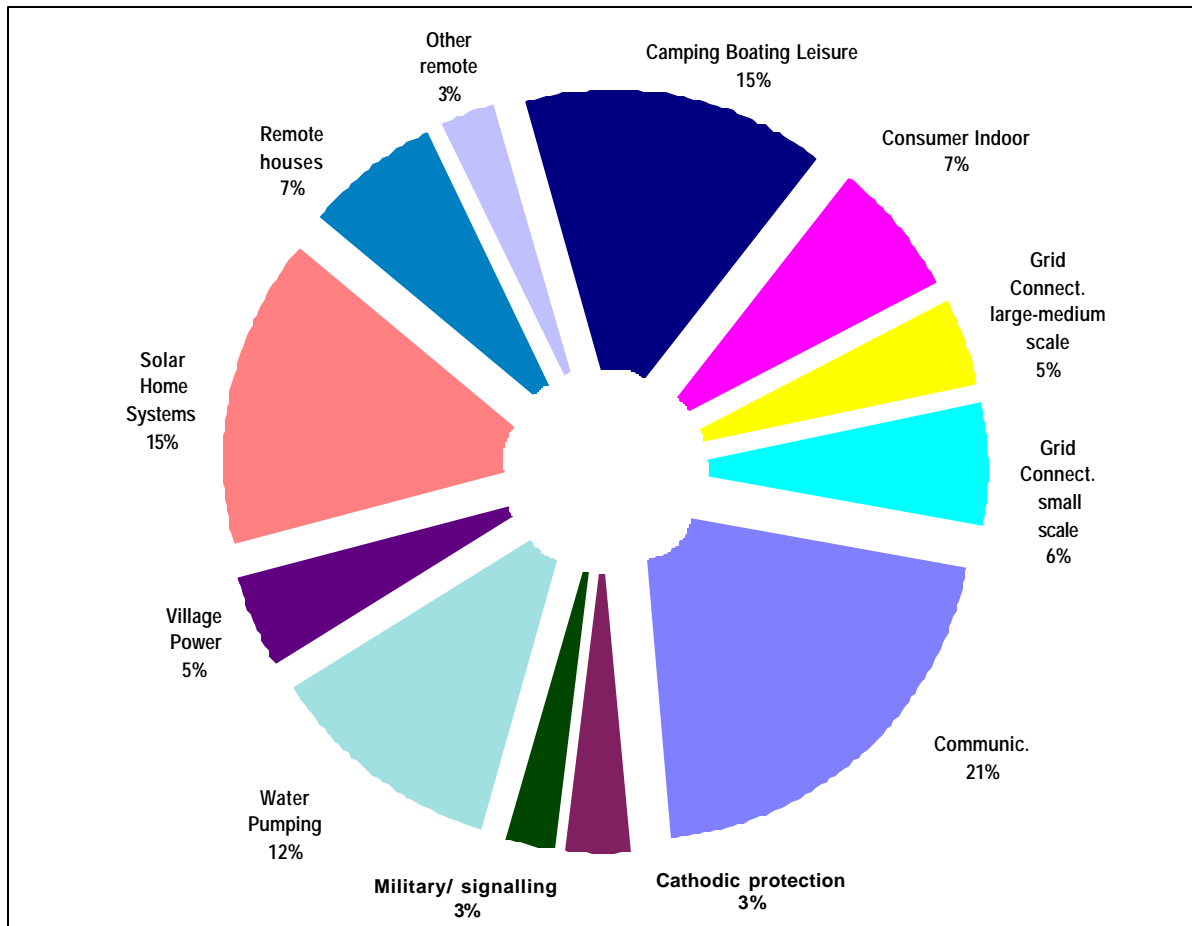
- * Communications;
- * Leisure, boating and caravaning (mainly industrialised countries);
- * Solar home systems (major part in developing world);
- * Water pumping (developing world);

Actual World PV market development for commercial modules (1982-1994)
 (Average market growth rate has been 15% per year)



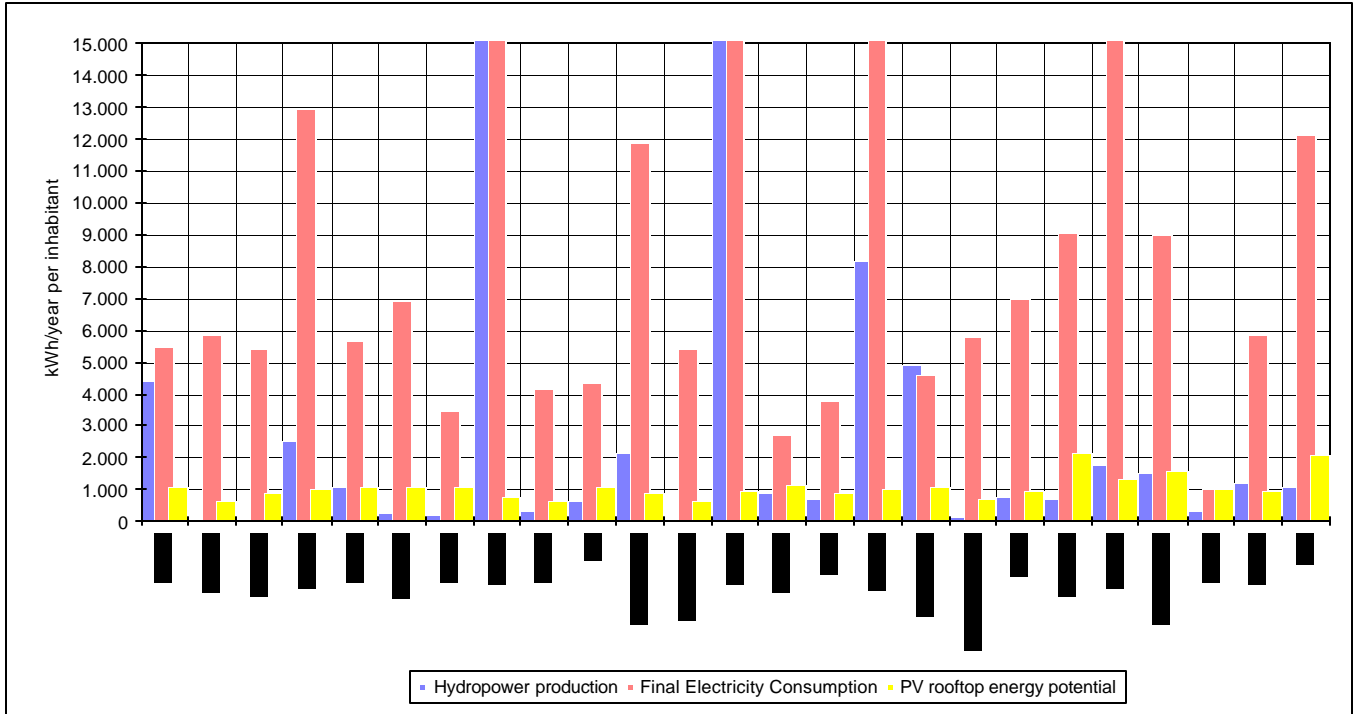
- The **grid-connected market segment** (both large-scale and diffused small-scale together) represents today roughly 10% of the world market demand, but in industrialised countries and specifically in Europe its share in sales is significantly higher and, what is more, it is expected to grow strongly in the next decade as a result of widespread building integration and rooftop applications.

PV Industry shipment shares for main application segments (average 1990-1994)

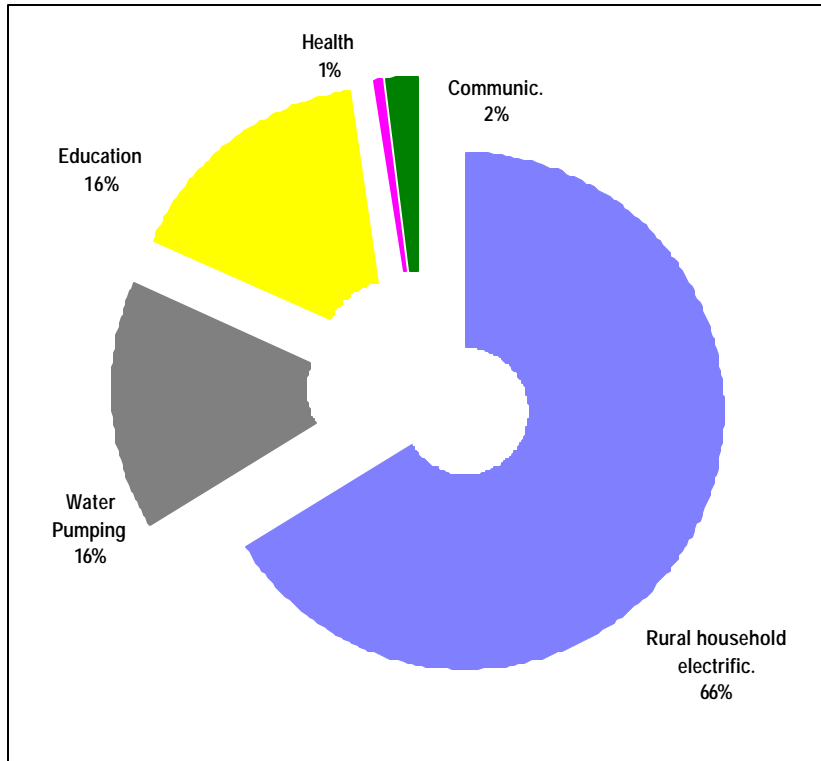


- The **installed world PV generator capacity** (systems, not PV manufacturing capacity) is estimated for 1994 to total roughly 350 MWp, of which 70 MWp (20%) in Europe. As regards larger scale PV plants, the presented figures are not estimates but calculated analytically from the sum of all known (and listed) large-medium PV generator plants.
- The main **demand potentials** for PV applications have been quantified as follows:
 - * The effectively available net rooftop and building facade surfaces in OECD countries allow to install an average of more than 1 kWp of PV capacity per inhabitant (in Europe 450,000 MWp) and to produce thereby more than 1,000 kWh/year per inhabitant of PV energy corresponding to nearly the entire residential electricity consumption.
 - * The **demand potential in the developing world** has instead been calculated on the basis of the minimal electrification requirements of unelectrified rural populations for safe drinking water, rural education, health care, telecommunications and SHS household electrification. A total of only 15 Wp per inhabitant (17,000 MWp for 1,100 million of unelectrified population) would be sufficient to provide these populations with all the mentioned basic needs.

Comparison between PV rooftop potential, final electricity consumption and hydropower share in Europe (1990)



PV stand-alone applications market potential in the World



0.4 BY YEAR 2010 MARKET SCENARIOS

Extensive extrapolations of different market scenarios to year 2010 have been developed by means of the mentioned integrated computer based world PV market model.

The “business as usual” world market scenario has been based on the same average PV market growth rate of 15%/year as experienced during the last decade from 1984 to 1994, since the PV market is expected to continue growth at the same (or even higher) pace also for the next decade.

Other market technologies, such as PC personal computers and the mobile (cellular) telephony have proven that much higher market growth rates (25% to even 50% per year) are possible under favourable circumstances.

The presented business as usual PV scenario assumes, obviously, that there will be no marked changes in policies and general conditions external to the PV market, which means that also subsidies and public financial support will continue to flow “as usual”.

Given market figures make evident, that the PV sector tends slowly to outgrow its dependency from public support, since PV shipments (and sales) have grown significantly faster than public financing support.

On the other hand, Europe, to maintain and to strengthen its market position, needs to outweigh effectively focused public support actions launched recently by USA and Japan to favour their own PV industries, since otherwise the European PV industry will not be able to keep pace.

0.4.1 Business as usual market scenario year 2010

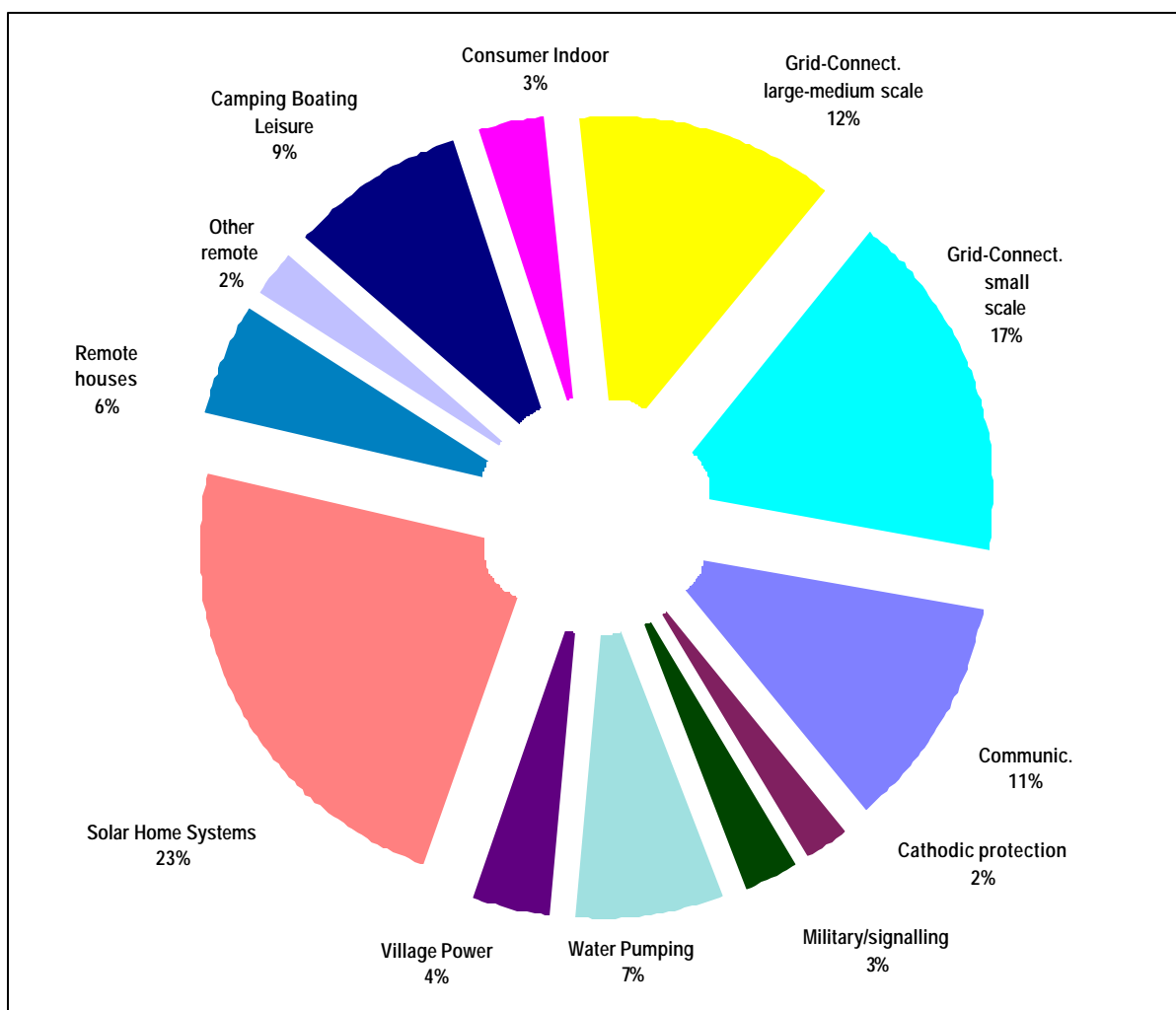
The outcomes of the “business as usual” scenario extrapolated to year 2010, i.e. the one, which most probably will develop more or less spontaneously, may be summarised as follows:

- **Annual world PV shipments** will reach 630 MWp in year 2010. The today market dominating applications such as communications, leisure, camping, boating and indoor will diminish their importance in time.

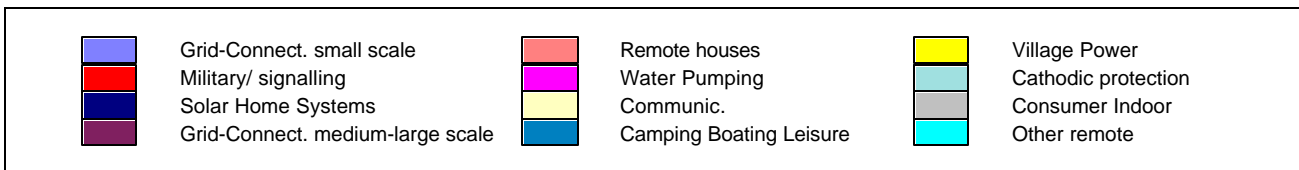
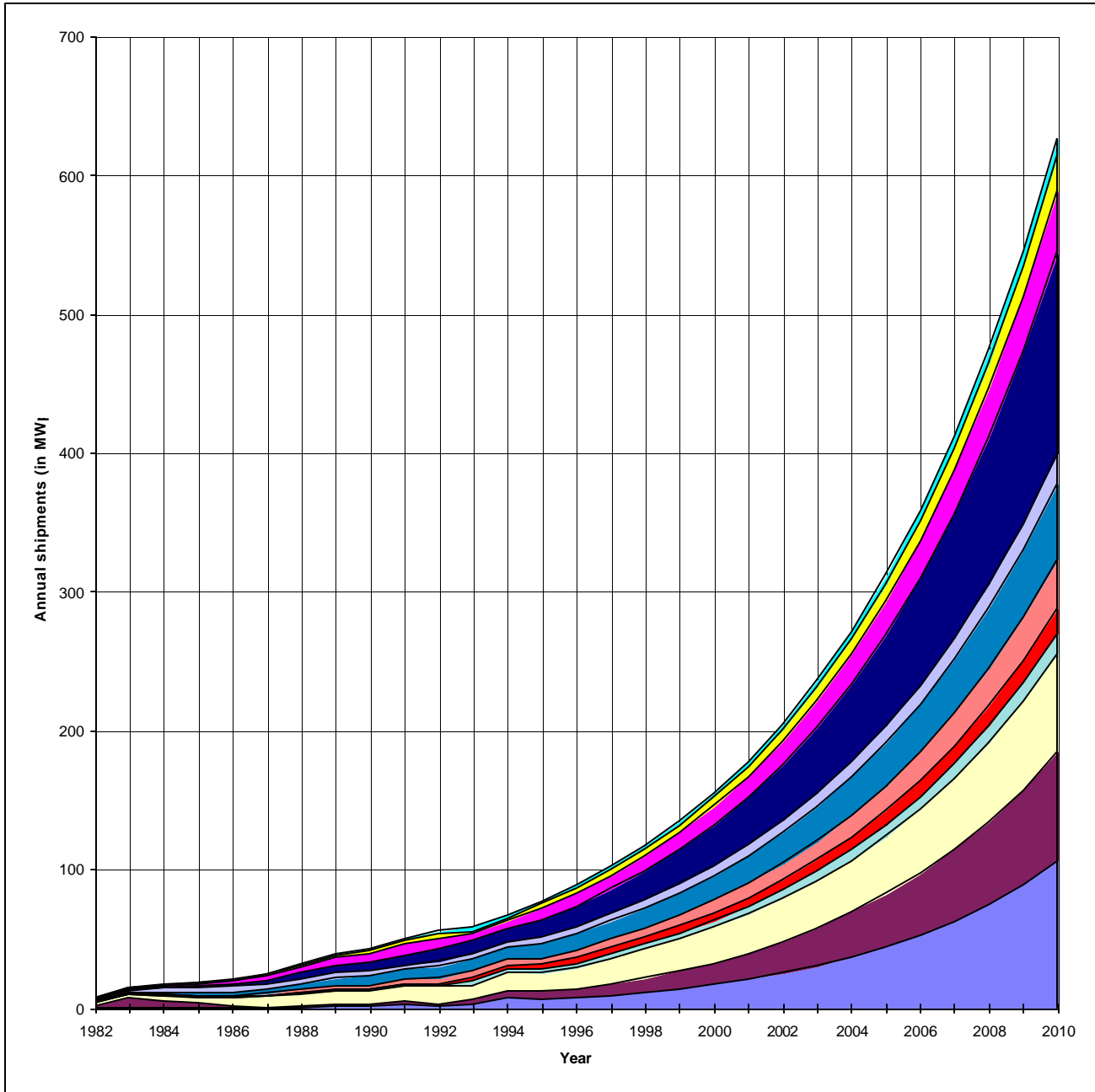
The four largest PV market segments in year 2010 are expected to be (in decreasing order of importance):

- * Solar home systems (major part in developing world);
- * Grid-connected small-scale (mainly in industrialised countries);
- * Grid-connected large-medium PV (in industrialised countries);
- * Communications (both in developing and in industrialised world);

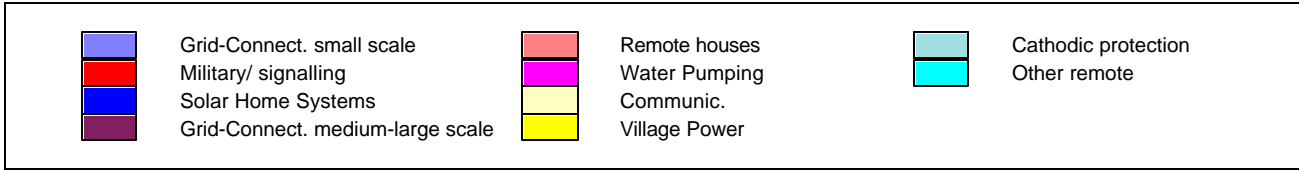
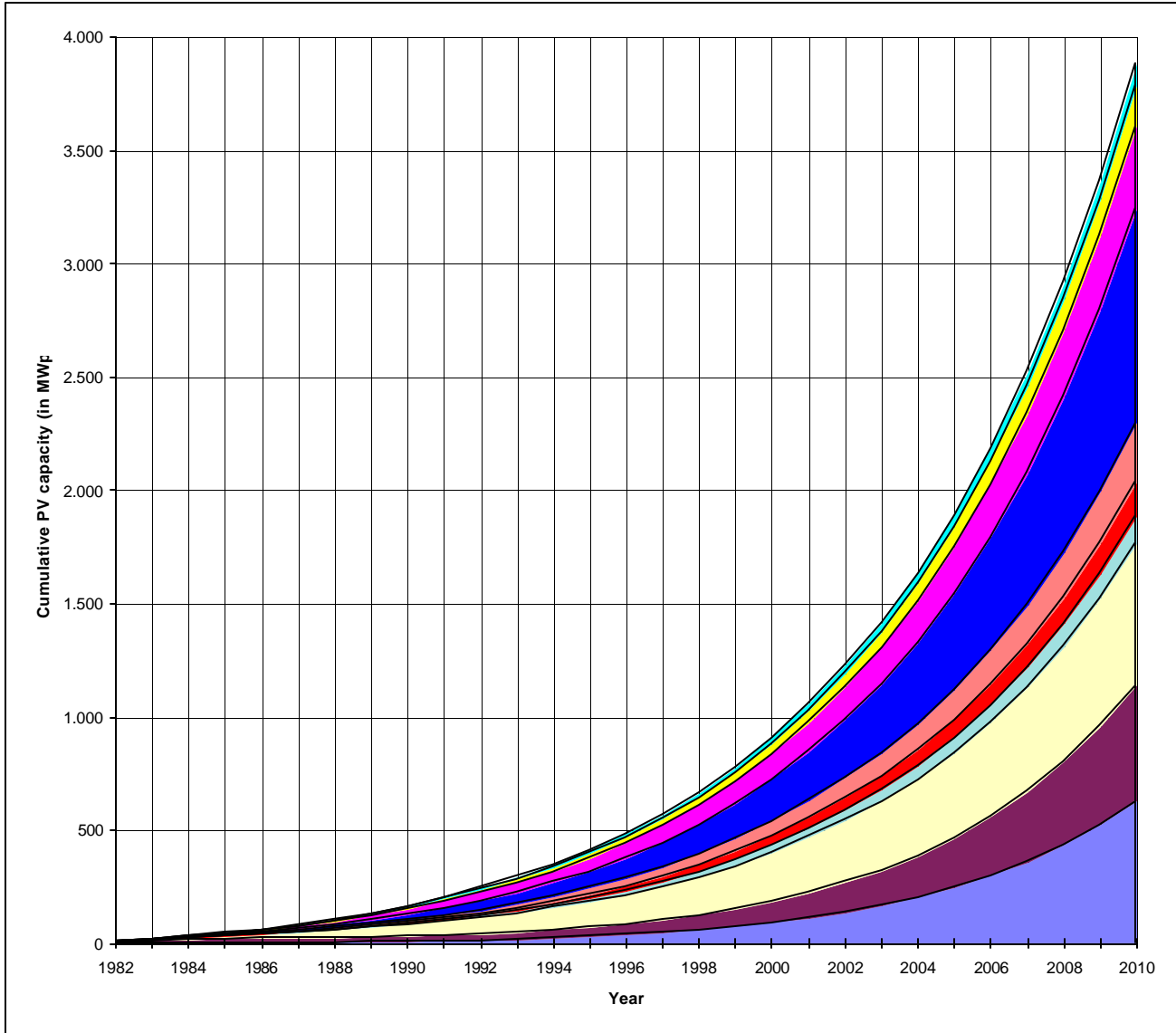
Year 2010 World PV market forecast per application



World PV market forecast up to year 2010
 (Figures beyond 1994 extrapolated by assuming overall market growth rate = 15% per year)

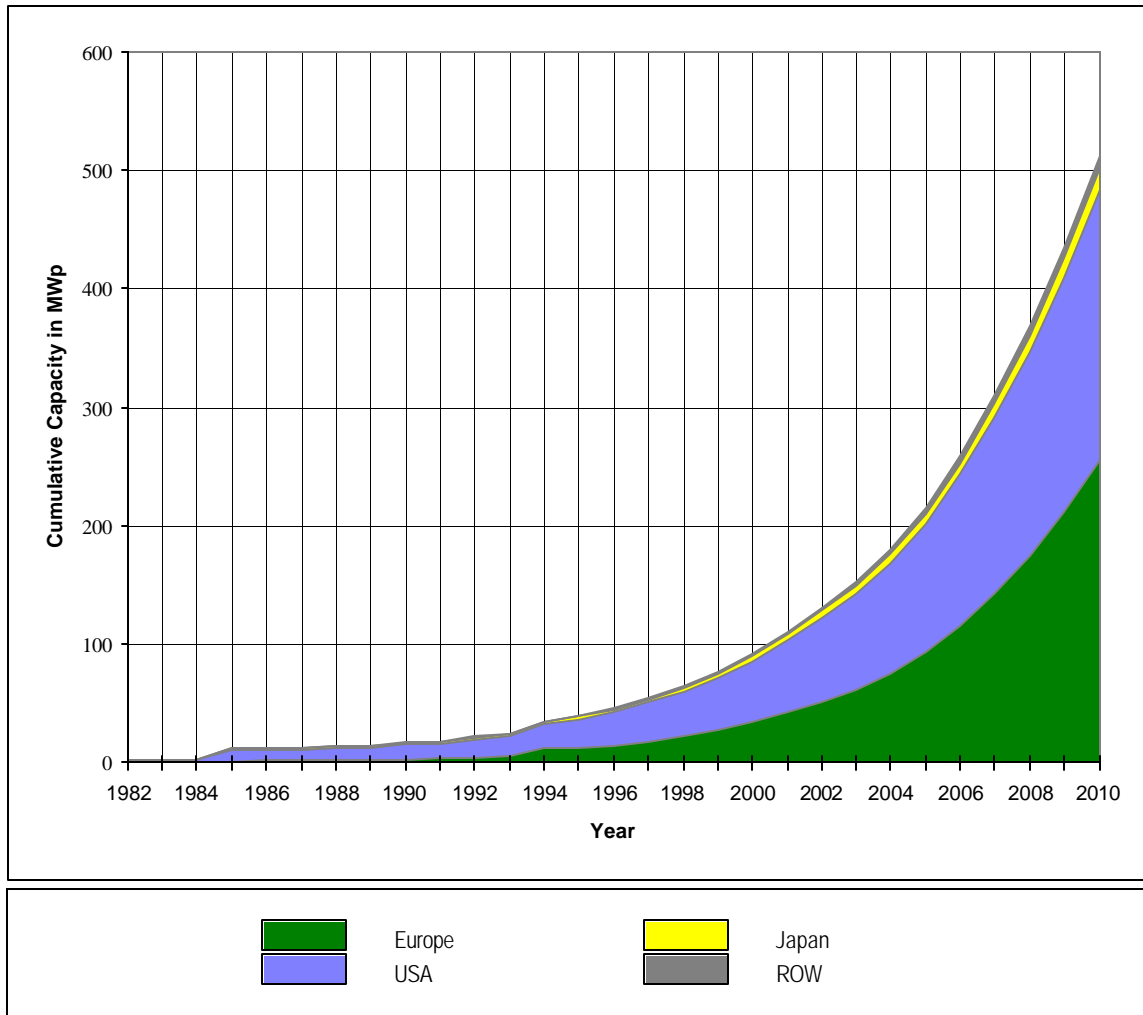


Installed world PV capacity forecast until year 2010
 Figures beyond 1994 extrapolated by assuming overall shipment growth rate of 15% per year
 (more than 20 years old PV capacities subtracted since assumed dismantled)



Large-medium PV plants capacity forecast

Figures beyond 1994 extrapolated by assuming overall shipment growth rate of 15% per year
(more than 20 years old PV capacities subtracted since assumed dismantled)



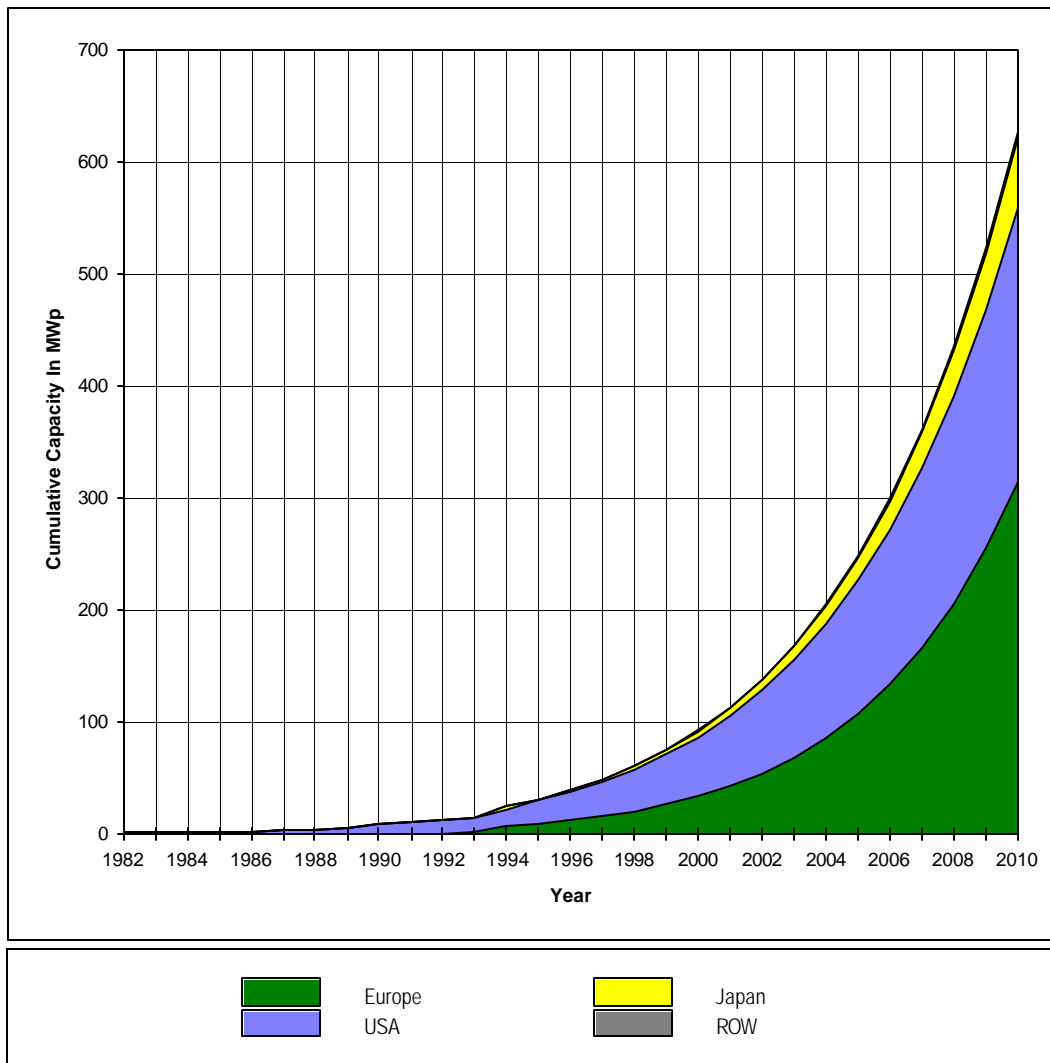
- The installed world PV generator capacity is reasonably to be expected to reach nearly 4.000 MWp for year 2010.

Only if Europe succeeds to strengthen its market position and to have a significantly higher growth rate than the rest of the world, the European installed PV generator capacity in year 2010 may reach 32% of the world total and exceed 1.200 MWp of installed PV generator capacity.

- The investments required from PV industries to increase PV manufacturing capacities, and just to keep pace with “business as usual” market developments have been quantified in at least 7%-8% of annual sales.

Grid-Connected Small-Scale PV Capacity Forecast

Figures beyond 1994 extrapolated by assuming overall shipment growth rate of 15% per year
(more than 20 years old PV capacities subtracted since assumed dismantled)



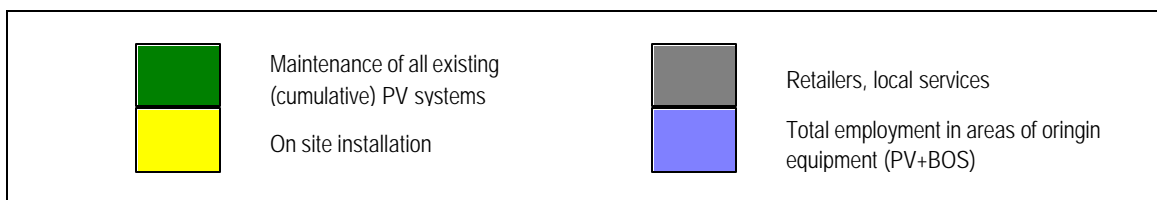
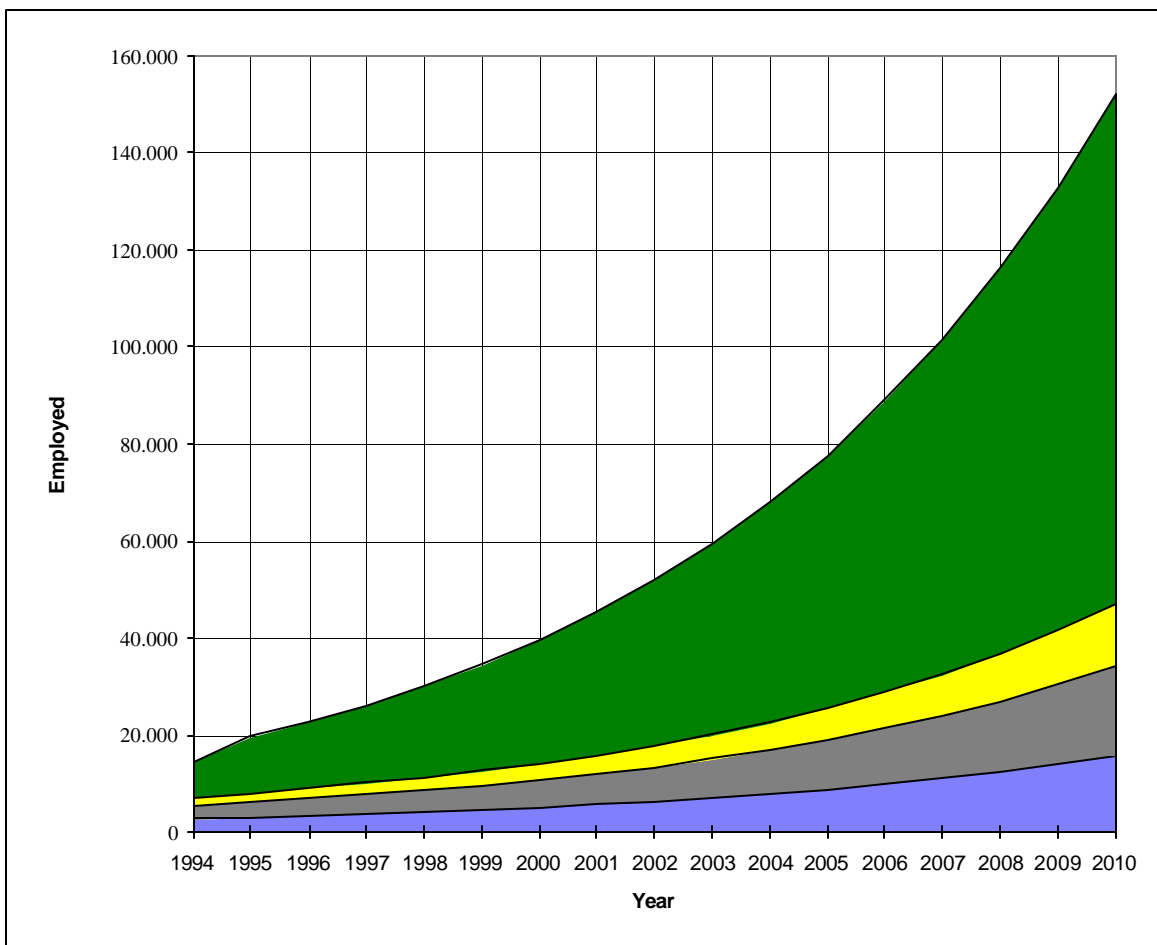
- The employment generated by the PV sector has been estimated separately for the areas of origin of PV equipment (PV+BOS manufacturing, services and wholesales) and for the areas of destination (local retailers, installation, maintenance) and will total in year 2010 more than 150.000 employed (of which 32.000 in Europe).

The employment model has clearly made evident, how PV technology will produce in time a marked multiplier effect on employment, since the large majority of PV employment will be generated in the areas of destination of PV equipment, and mostly by the demand for maintenance and servicing activities arising from the accumulation in time of long-lasting small-scale PV installations. Furthermore, PV employment has resulted to be particularly beneficiary to economy since:

- * entirely additional, no employment in other sectors is substituted, since PV technology does not replace other conventional technologies;

- * distributed over the territory, since linked to the diffusion of PV systems, and not to some concentrated power generation facility;
- * it ensures continuity in time and presents no seasonality;
- * employment is created precisely in those areas, which mostly need economic development stimulation, i.e. the remote rural areas in the developing world as well as in less developed areas of the industrialised world.

Employment forecast for world PV sector - Business as usual scenario (15% annual market growth)



Annual market growth rate and investments required during period until year 2010
to reach certain world market goals

What is required		to reach in year 2010 a whole world PV market scenario of:				Europe (assuming 32% of capacity installed in EU)	
World PV market growth rate	Investment for manufacturing capacity increase	Annual shipments	Cumulative installed capacity	PV sector Employment	Remarks	Cumulativ e installed capacity	PV sector Employment
% year	% of sales	MWp/year	MWp	Employed		MWp	Employed
15%	7,2%	630	3.900	152.000	Business as usual, will develop spontaneously	1.200	32.000
20%	9,3%	1.240	6.300	261.000	Achievable by eliminating market barriers	2.000	56.000
25%	11,1%	2.380	10.200	453.000	Requires consistent market stimulation	3.300	98.000
30%	12,8%	4.460	16.700	783.000	Requires breakthrough in technology and costs	5.300	170.000
35%	14,4%	8.160	27.300	1.345.000	Extreme scenario	8.700	294.000

0.4.2 Enhanced market growth scenarios

The results of different enhanced market growth scenarios depend on the average annual world market growth rate and the related PV industry investments necessary to keep pace with the required manufacturing capacities. Since relevant graphs present strong similarities with the “business as usual” scenario (only the scale changes) they are here omitted and results are summarised in a tabular form.

For all five scenarios presented in the table (from the “business as usual” to the 35%/year extreme growth scenario) the PV generator capacity installed in Europe has been assumed to equal 32% of the world total, which means that, to reach such European goal, the market share (and the manufacturing capacity) of the European PV industry will have to be significantly higher to allow for exports to other parts of the world.

The action plan developed in the frame of the present work and presented in the "Strategic Plan for Europe" proposes a 10 year transitional market enablement programme including a 100.000 PV rooftop programme (average 3kWp, total = 300 MWp), a 2.000 PV building facades programme (average 50 kWp, total = 100 MWp) and a large scale power plant programme of at least 100 MWp.

The successful implementation of these programmes will allow Europe to reach in year 2005 an intermediate “milestone” goal of totally 500 MWp and make it realistic to reach, for year 2010, a European target of 2,000 MWp of installed PV generator capacity.