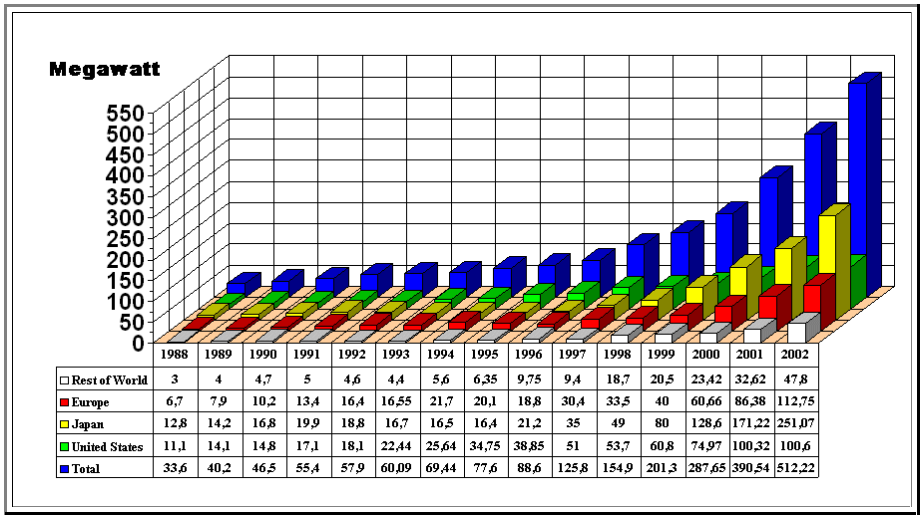
Solar Cells - some Data

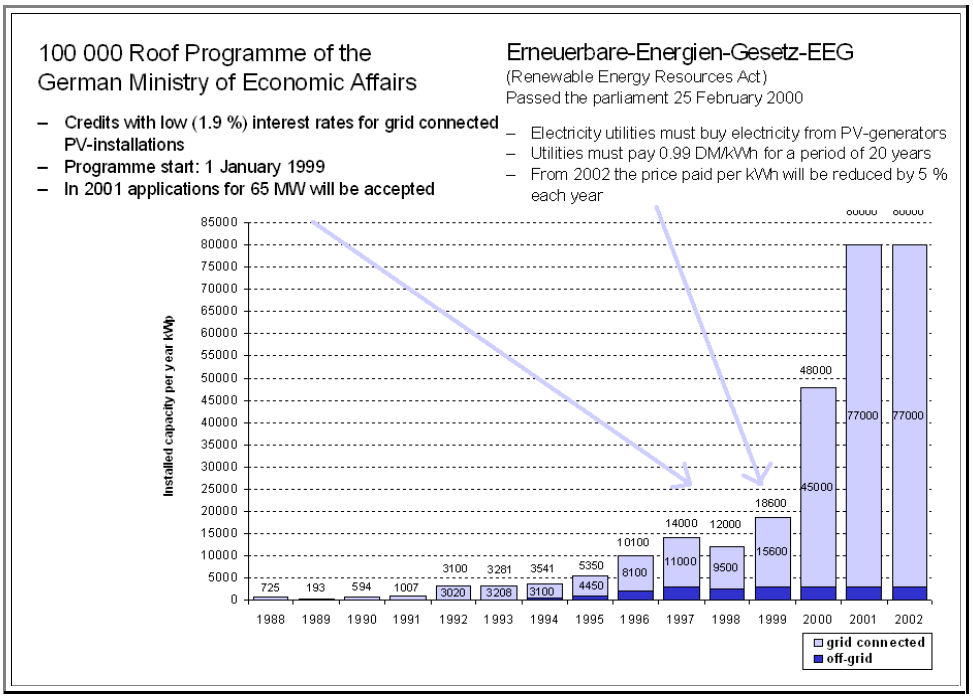
Illustration

- Here are some graphics that were compiled by Dr. Michael Powalla, Zentrum für Sonnenenergie- und Wasserstoff-Forschung (ZSW) Baden-Württemberg, Industriestrasse 6, D-70565 Stuttgart; www.zsw-bw.de
  - First the world production of solar cells / modules im Megawatts. Interestingly, Japan surpassed Europe in **1997**, and the **US** in **1999**. The total capacity produced in **2002** is about **500 MW**, which nominally is about half of a nuclear power plant.

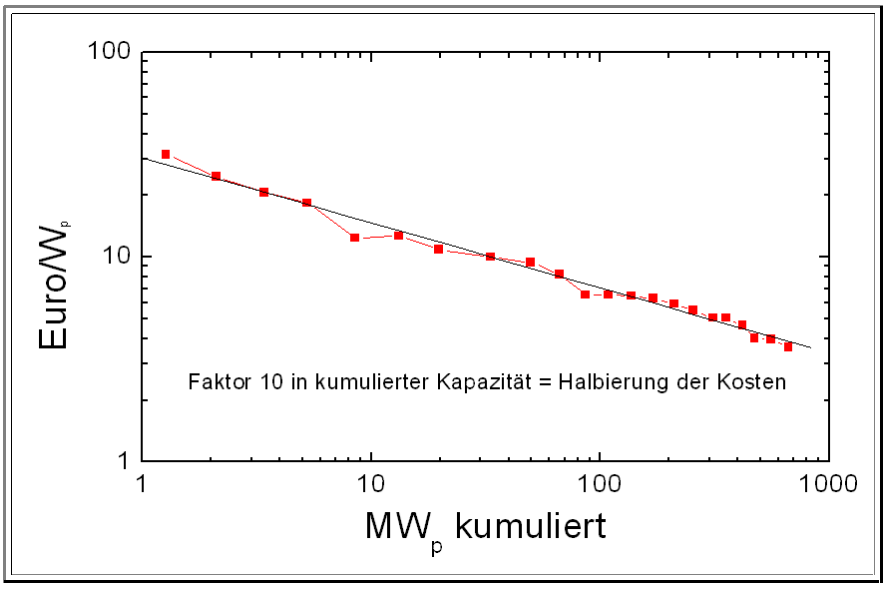


	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Rest of World	3	4	4,7	5	4,6	4,4	5,6	6,35	9,75	9,4	18,7	20,5	23,42	32,62	47,8
Europe	6,7	7,9	10,2	13,4	16,4	16,55	21,7	20,1	18,8	30,4	33,5	40	60,66	86,38	112,75
Japan	12,8	14,2	16,8	19,9	18,8	16,7	16,5	16,4	21,2	35	49	80	128,6	171,22	251,07
United States	11,1	14,1	14,8	17,1	18,1	22,44	25,64	34,75	38,85	51	53,7	60,8	74,97	100,32	100,6
Total	33,6	40,2	46,5	55,4	57,9	60,09	69,44	77,6	88,6	125,8	154,9	201,3	287,65	390,54	512,22

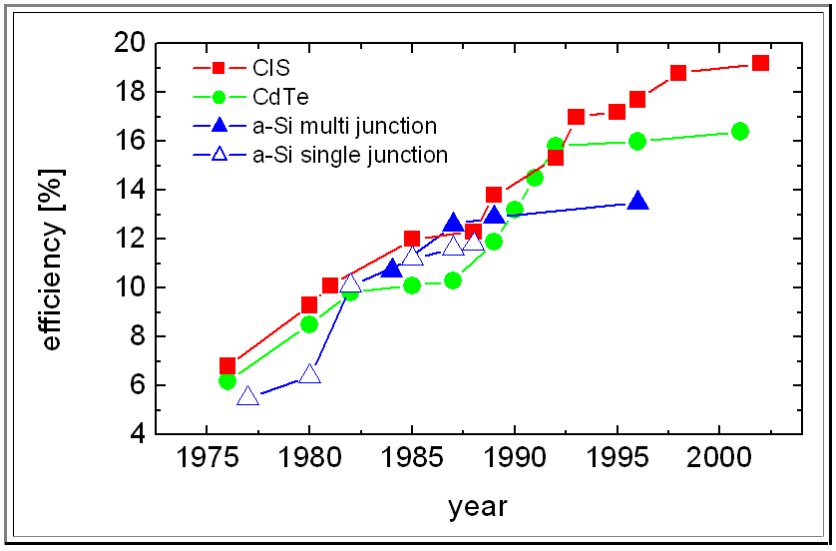
- In Germany, like in most other industrialized countries, progress depends on subsidies as shown below.



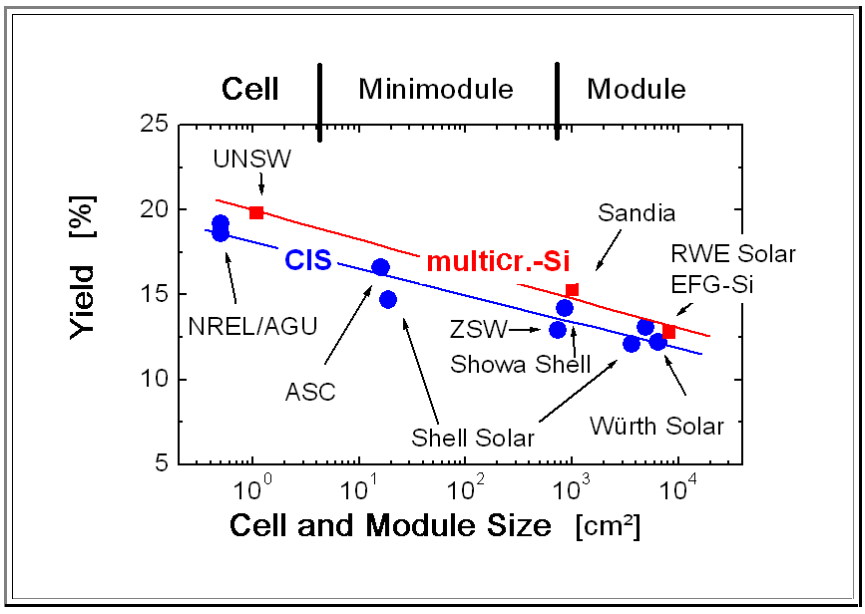
- With increasing volume of solar cells produced (not just with increasing time fiddling around!), we learn how to operate large scale production more efficiently and cheaply.
  - Costs come down on a learning curve, following rather general economic "laws".
  - The next picture shows how much **€** per Watt you must pay not over "linear" time, but over cumulated "experience" measured in total output in (peak) megawatts.



- The overwhelming parameter of any solar cell is its conversion efficiency η. Silicon is still dominating the market, but **$CuInSe_2$** (***CIS***) is now the major contender.
  - The following pictures compares efficiencies of **CIS** and amorphous **Si** (**α-Si**) , and demonstrates that **CIS** has a large potential, indeed.



  - "Yield" in this picture is the maximum efficiency for the technology listed achievable today. it is clear, but unfortunate, that large-area technologies are always behind small area Lab-scale cells.



- An often controversial issue is the "energy pay-back time" (**EPBT**), meaning the time you have to run your solar cell just to generate the energy it took to make it.

- Obviously, EPBTs in excess of the expected life times of a solar cell or module (say **20** years) are idiotic (an economist might oppose that statement, however). Equally obviously, the EPBT of any energy generating devices are hard to assess, too:
- How much energy does it take to produce a oil / coal burning powerplant? Including the energy needed to dig the coal, transport it etc.? The energy needed to dismantle the thing eventually? The energy needed to repair the damage from the emissions? The energy neede to keep, e.g. the city of Essen in Germany from being flooded for the next several 100 years or foreever, since all the coal dug out under it caused it to sink below the ground water level?
- Anyway, as far as it can be done, the following graph shows the EPBT of solar cells. No matter how you look at it: Harnessing solar energy with *modern* solar cells does make sense!