Investment for sustainability: The potential of Solar generation

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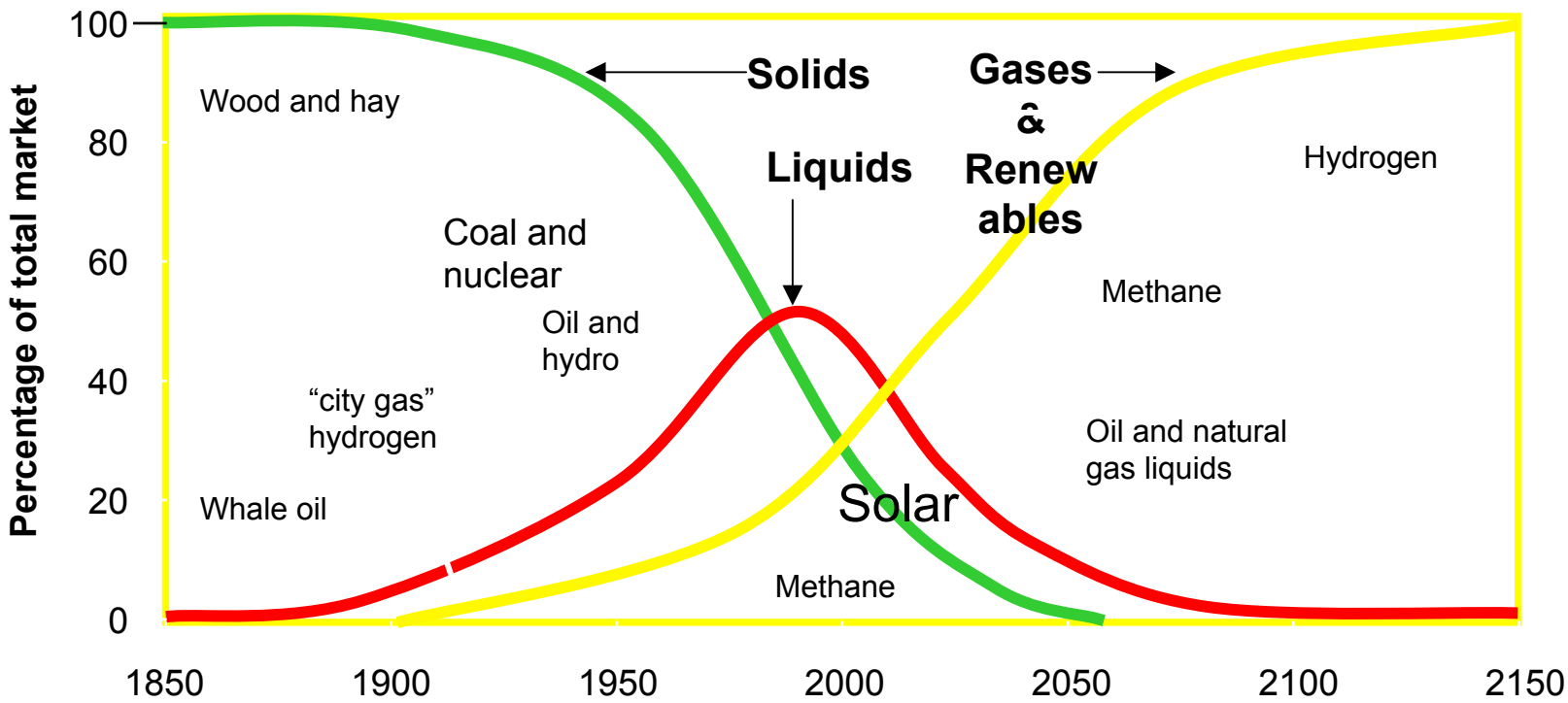
Energy scenario

Beyond petroleum?



Source : WorldWatch Institute

Toward lower carbon: the unique solution

Energy Efficiency

Reduce Flaring & Venting

CO2 Capture

Novel Low Energy Processes

Energy & Emission Efficiency

Gas replacing Coal

Hydrogen Economy

Decarbonisation of Fuels

Wind

HI-Temp. Solar thermal

PV Solar

Renewables

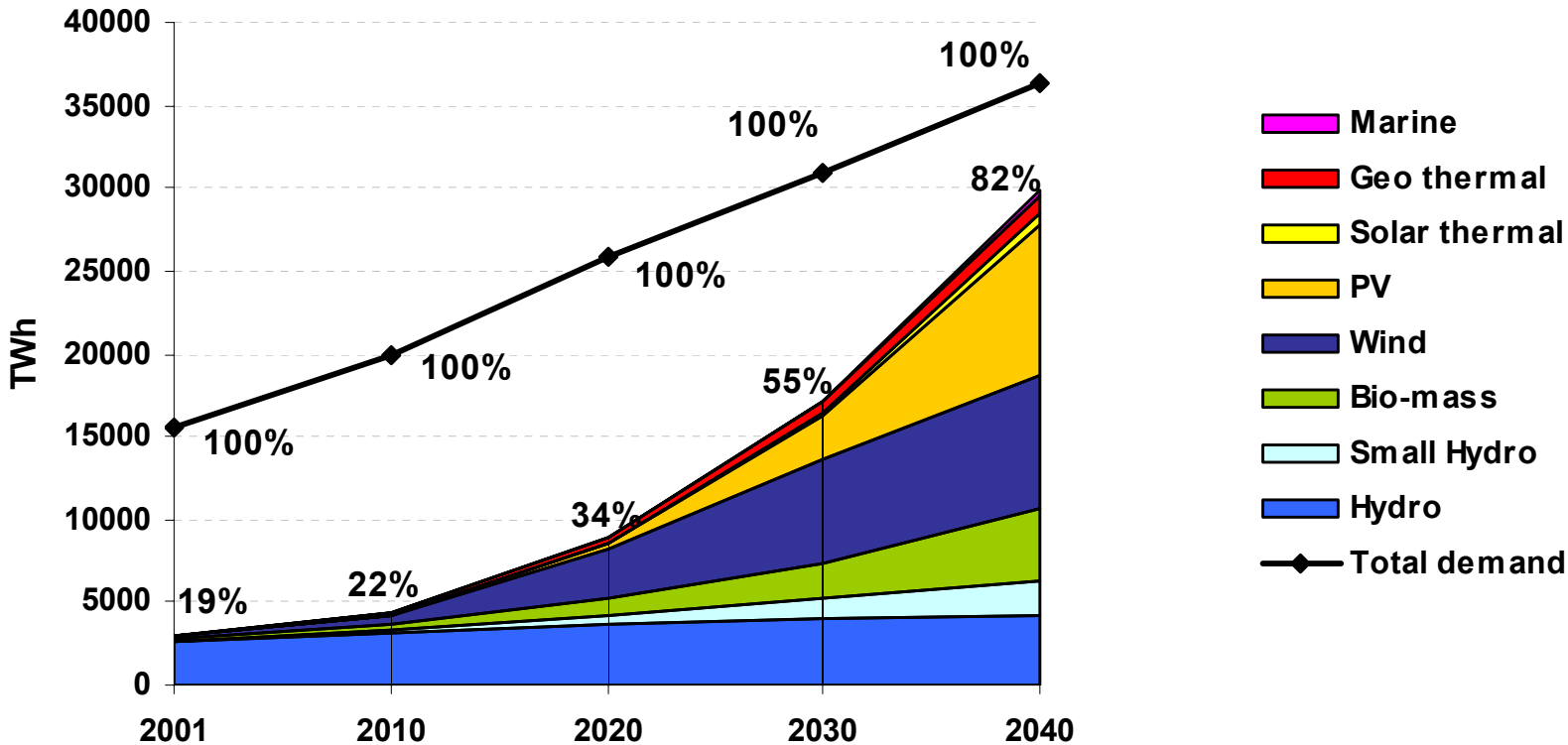
Past

Present

Future

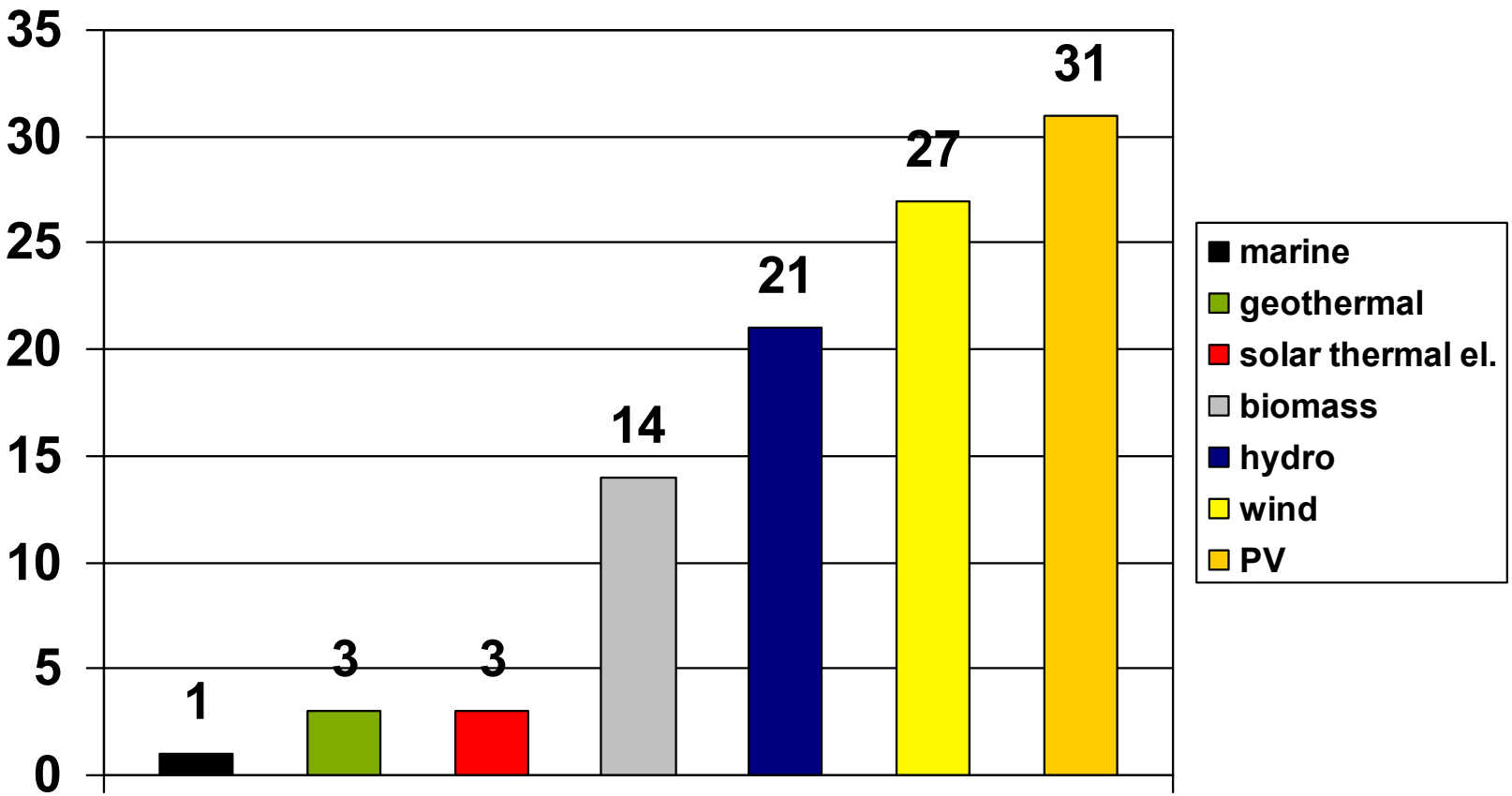
Electricity generation

Electricity generation: 2001-2040



Source : IEA

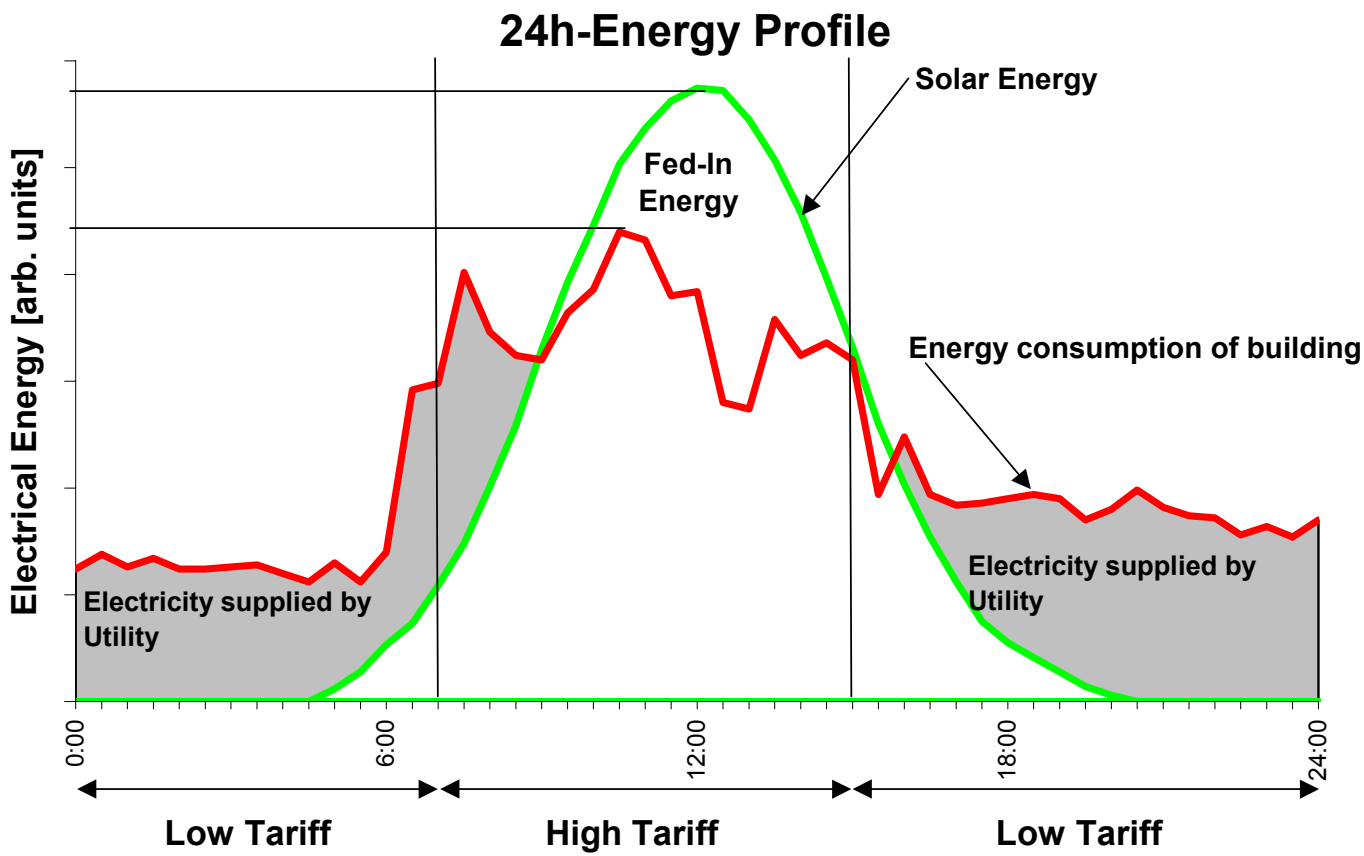
Electricity generation: 2040 scenario



Source : IEA

Solar electricity

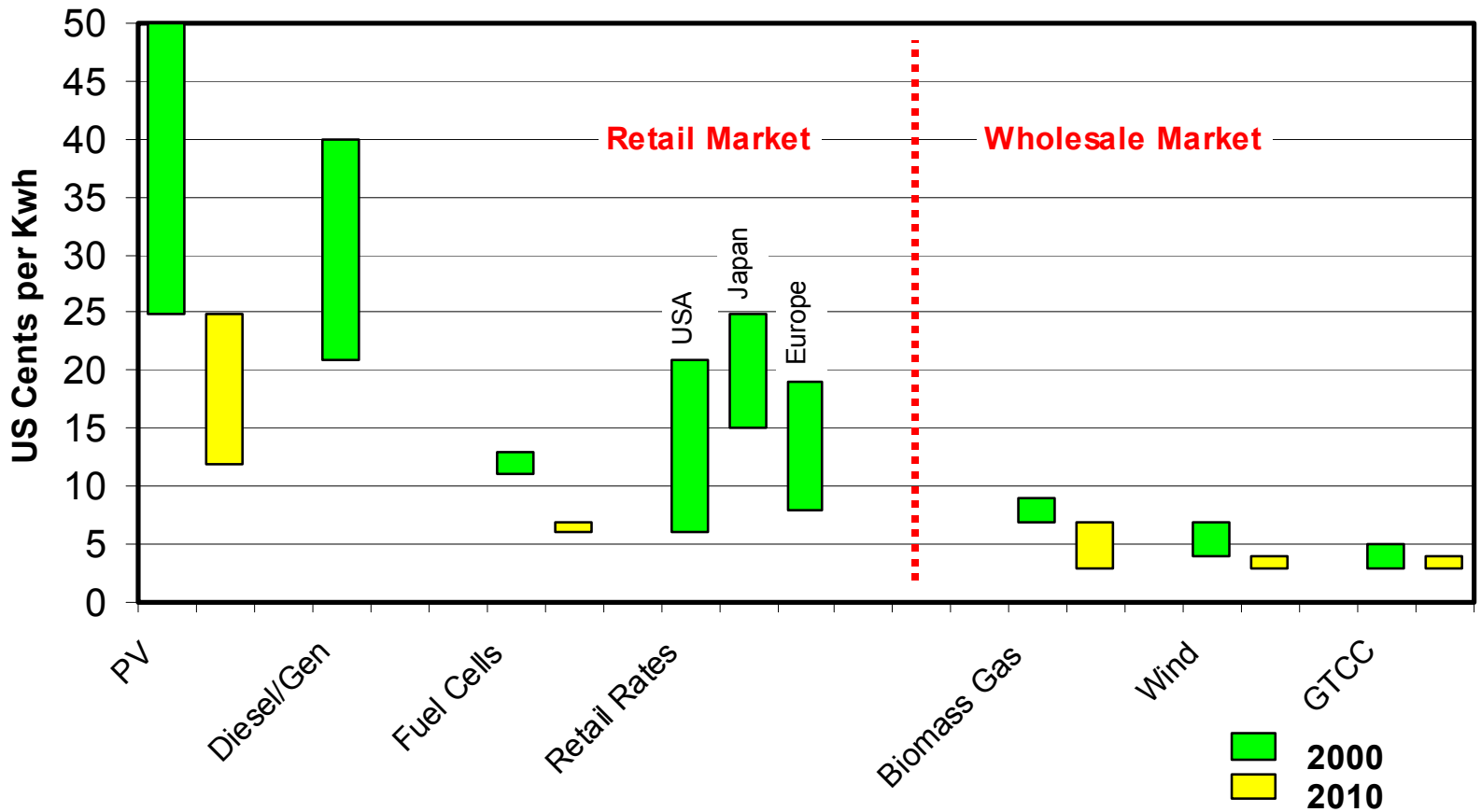
Daily solar generation profile



Source:

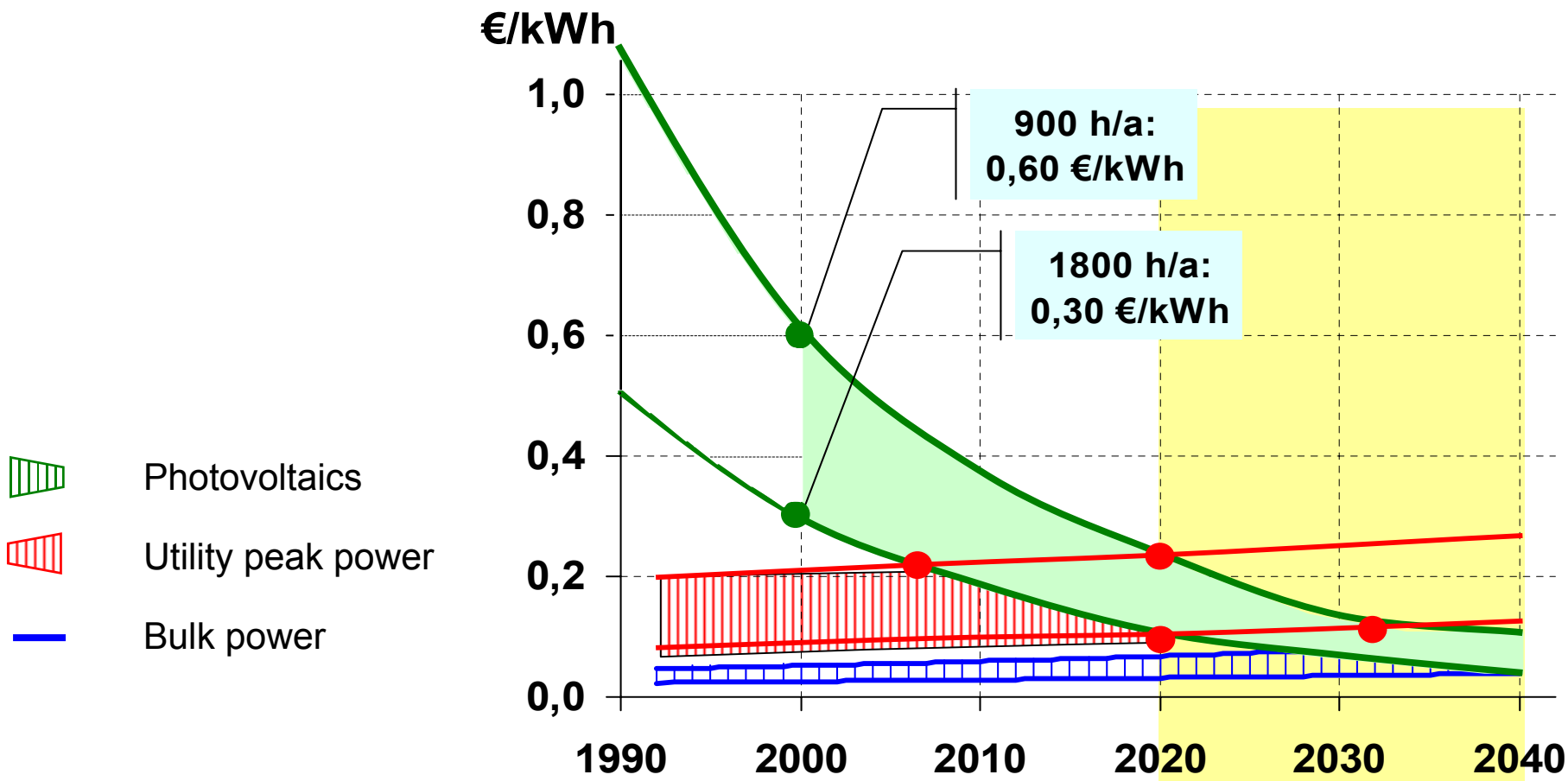
Fraunhofer Institut Solare Energiesysteme

Cost comparison for different technologies



Source: AD Little

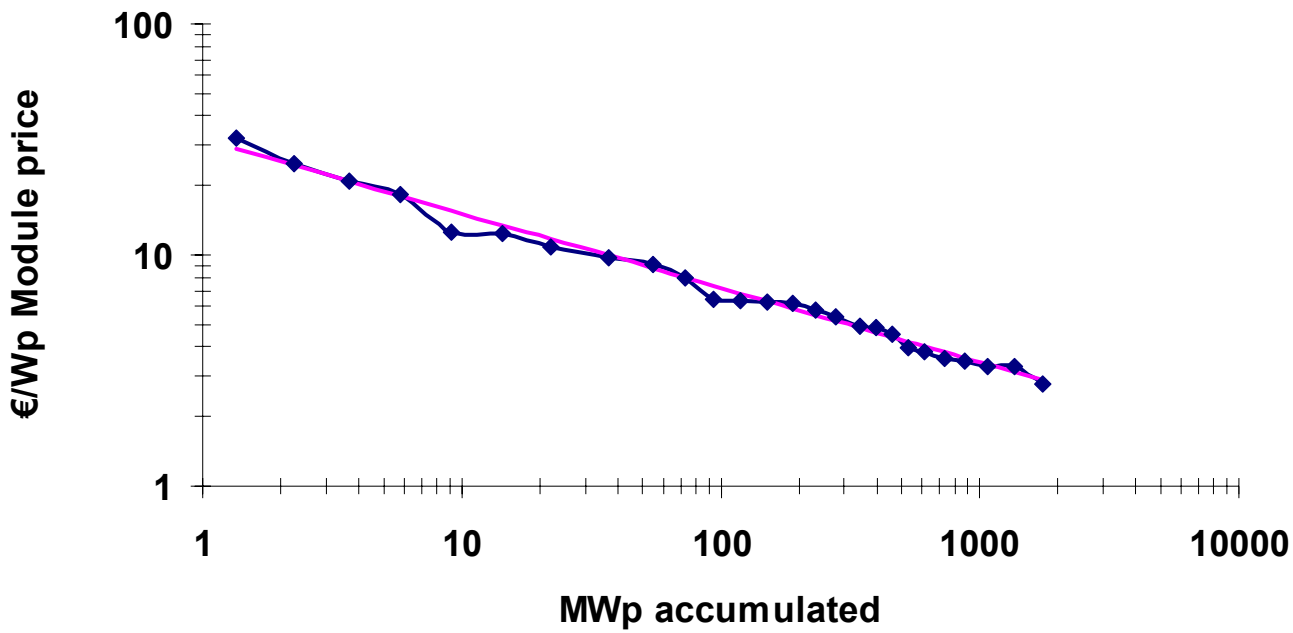
Solar electricity prices: Costs are decreasing



Source: EPIA and BP Solar

PV module experience curve

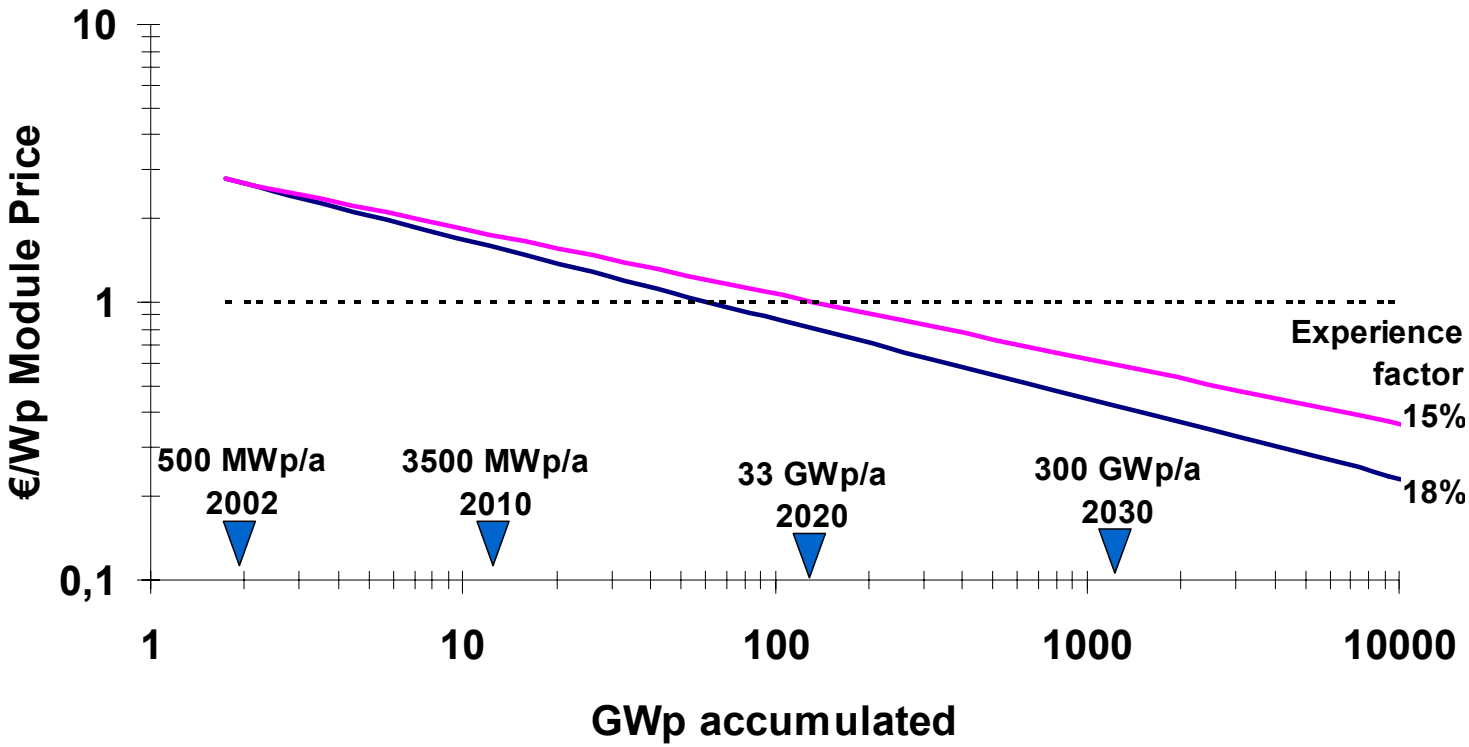
History: 20 % price decrease by doubling cumulative volume



Source: EPIA

PV module experience curve (II)

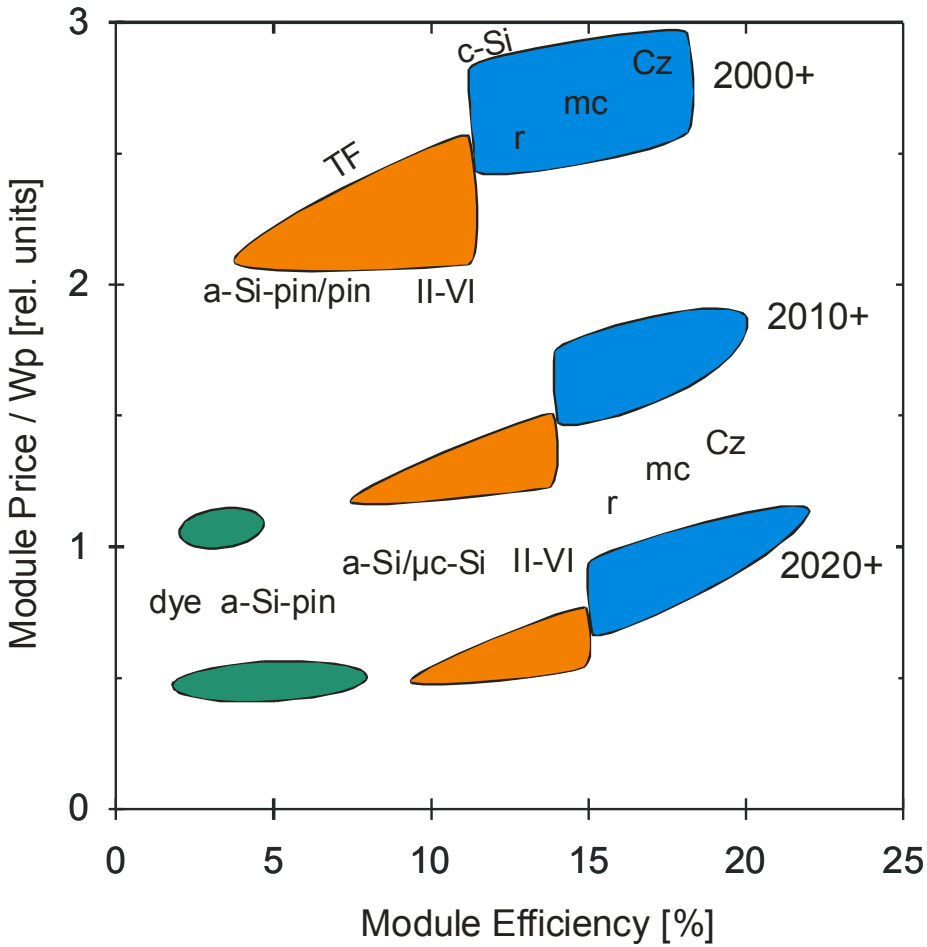
Forecast



Source: Strategies Unlimited

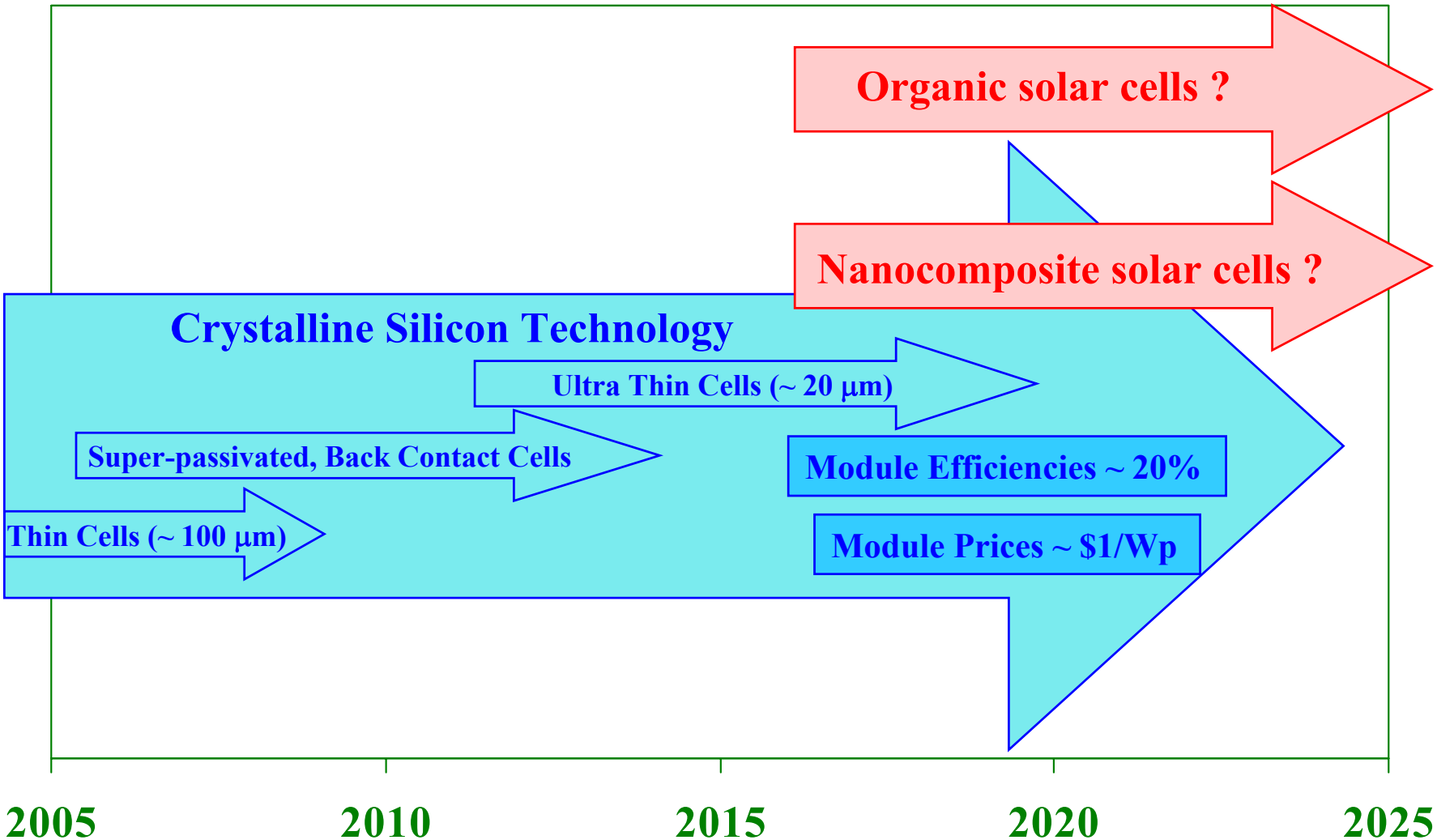
PV technology evolution

Evolution PV technology



Source: EPIA & BP Solar

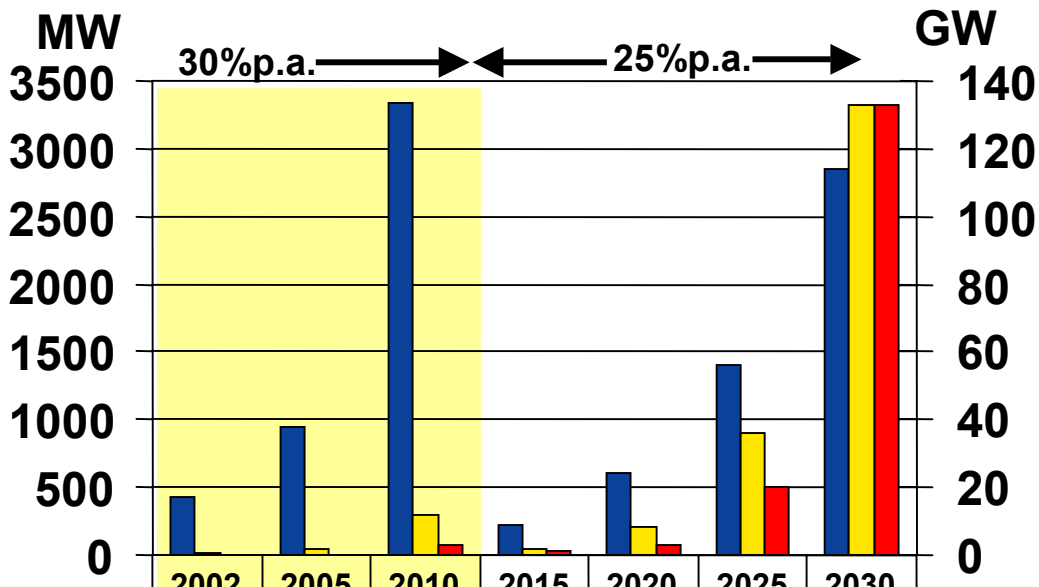
Commercial technology evolution



2010 technology forecast & shipments

2010 scenario

Jp	1.200
EU	1.000
US	500
SOA	500
ROW	500
Σ	3.700



	2002	2005	2010	2015	2020	2025	2030
c-Si	430	950	3340				
thin film	20	50	290				
"New Concepts"			70				
c-Si				9	24	56	114
thin film				2	8	36	133
"New Concepts"				1	3	20	133

Commercial impact

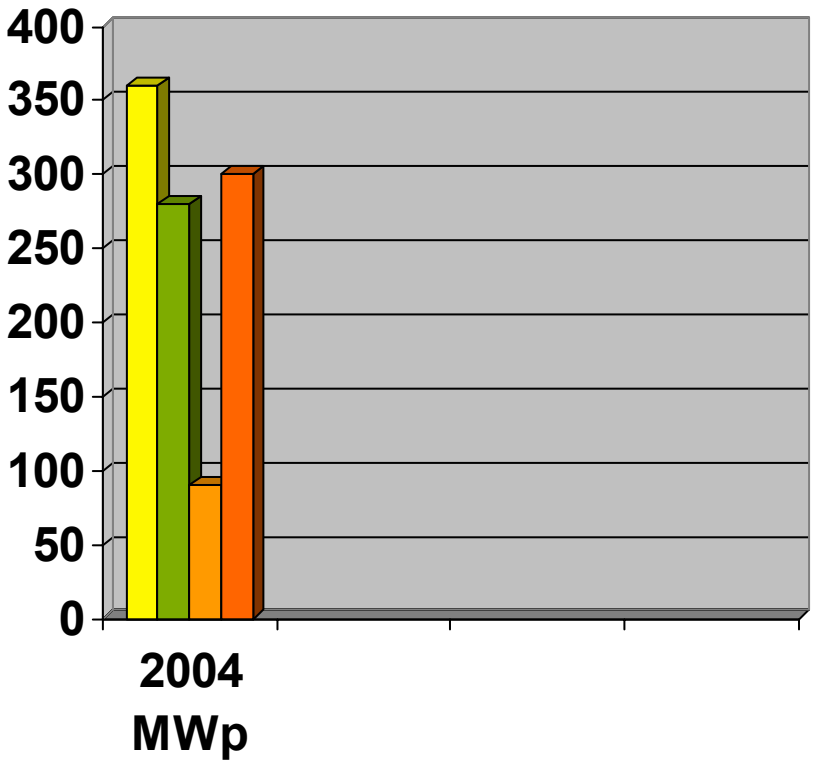
- Crystalline PV module efficiencies should increase to about 20% over the next years.
- Selling price in 2020 should be less than 1 $/Wp and around $0.32/Wp by 2030.
- PV should become a major energy source within 25 years
- Organic solar cells and nanocomposite solar cells have the potential to be disruptive since theoretical efficiency limits are ~ 60% (as compared to ~ 30% for crystalline silicon)
- 3000 GWp of solar electricity will reduce carbon emissions by about 1 Gton per year (7 Gtons of carbon were emitted as CO_2 in 2000).
- PV should start to play a major role in reducing carbon emissions by 2030.

C-Si technology roadmap

	2000	2010	2020	
Feedstock price [€/kg]	25	20	15	Medium term horizon
Wafer thickness [µm]	300	200	100	Ribbon or Cz/mc with 200 → 100 µm kerf loss
Cell efficiency [%]	14-17	17-22	19-24	Efficiency (special Cz and fz up to 3 % (abs) more)
Module	Long term stable and low cost/m² technology			

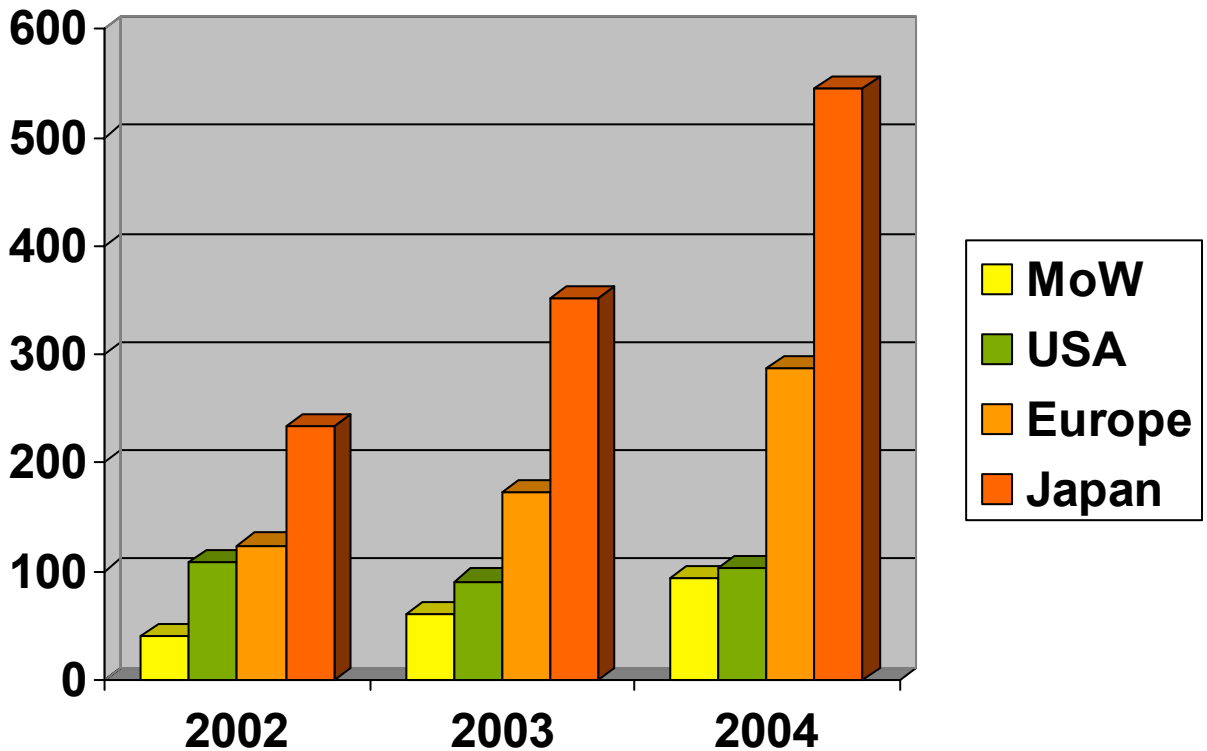
→ integrated manufacturing of thinner (100 µm and less) wafers and subsequent cell and laminate is probably the most effective route.

PV installed power 2004: Over 1 Giga ¡



BP Solar 4 MW solar farm
Geiseltalsee, Germany

PV Regional shipment growth: 02-04



Source: Strategies Unlimited

Summary

- Crystalline silicon technology is the core one in the next 10 years.
- C-Si technology has track records in reducing cost and improving efficiency over the last 25 years.
- PV support schemes are needed to guarantee ROI and attract new stakeholders.
- Feed-in-tariff (Fixed price) schemes are key to consolidate the technological developments in R+D+I, bringing costs down and achieve economies of scale.
- PV has the potential to play a key role in energy security and reducing GHG emissions in EU.
- PV has showed: technology evolution, cost reduction and job creation