

# ***Challenges to Achieving Breakthroughs in New/Renewable Energy Technologies***



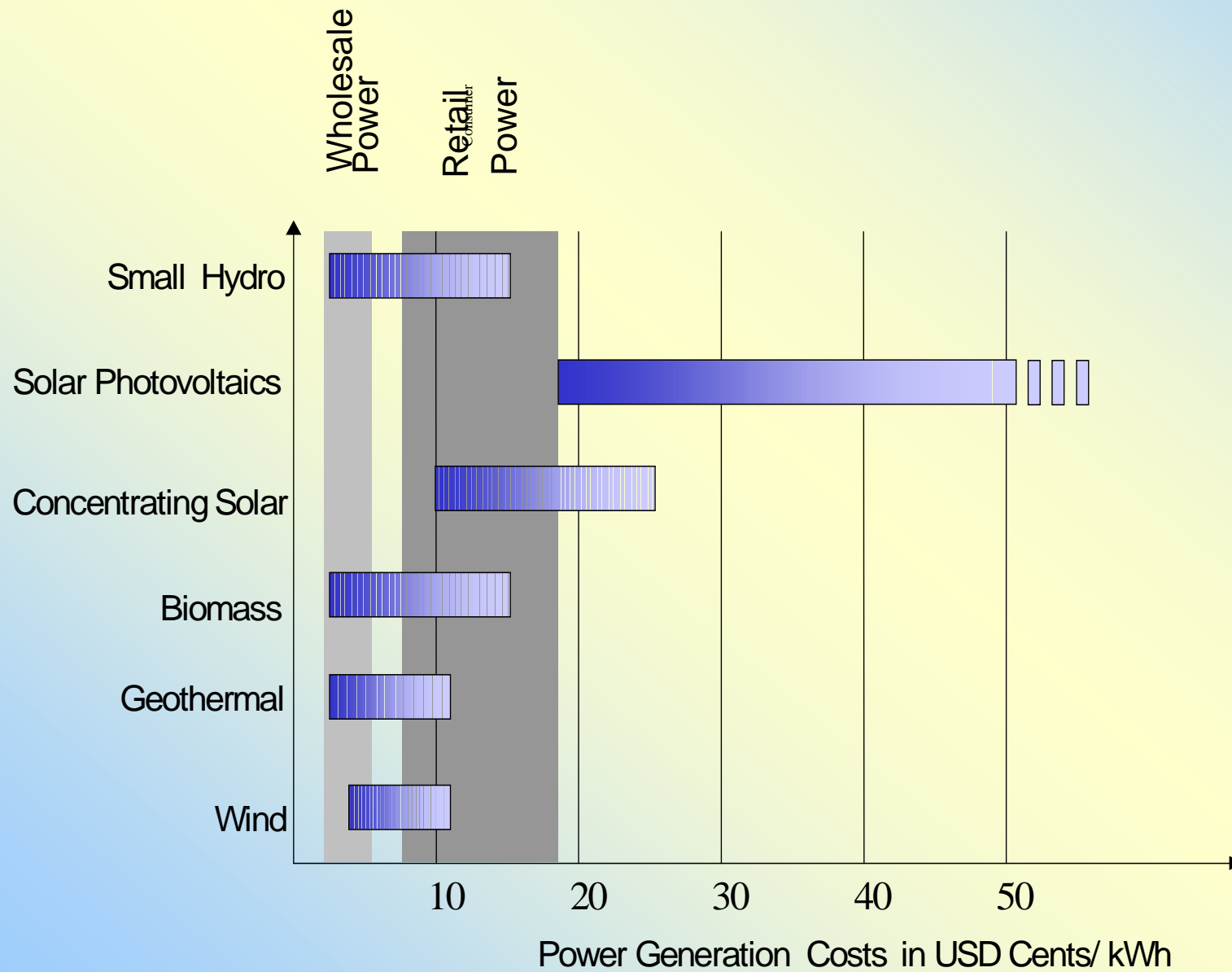
***Renewables 2004, NEDO side event***

**Bonn, June 2**

**MARIANNE HAUG, Director, IEA**

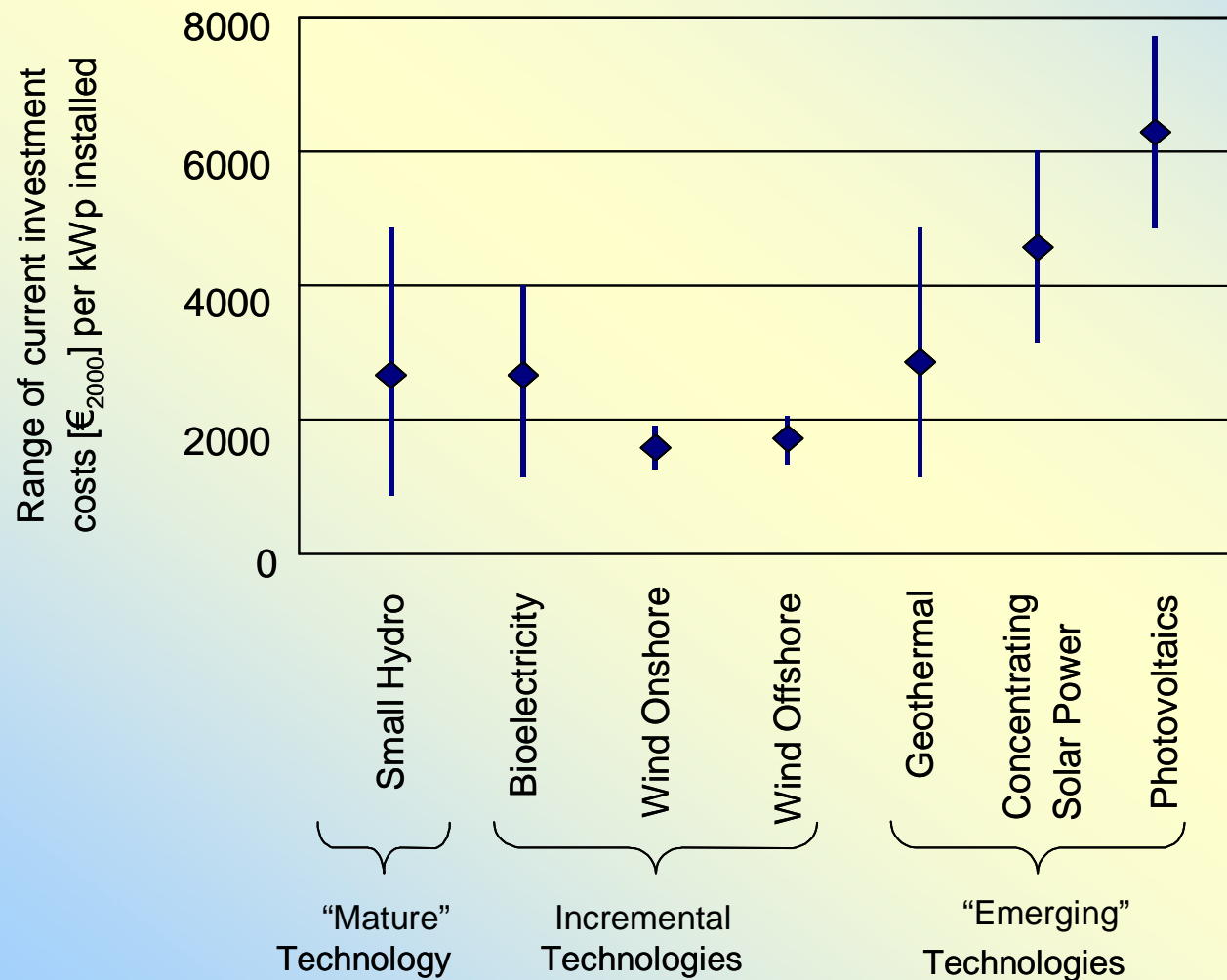


# Reaching Competitiveness



# Investment Cost Challenge

Investment costs in Euro<sub>2000</sub> per kW



# Focus for the Future

**R&D and Innovation**

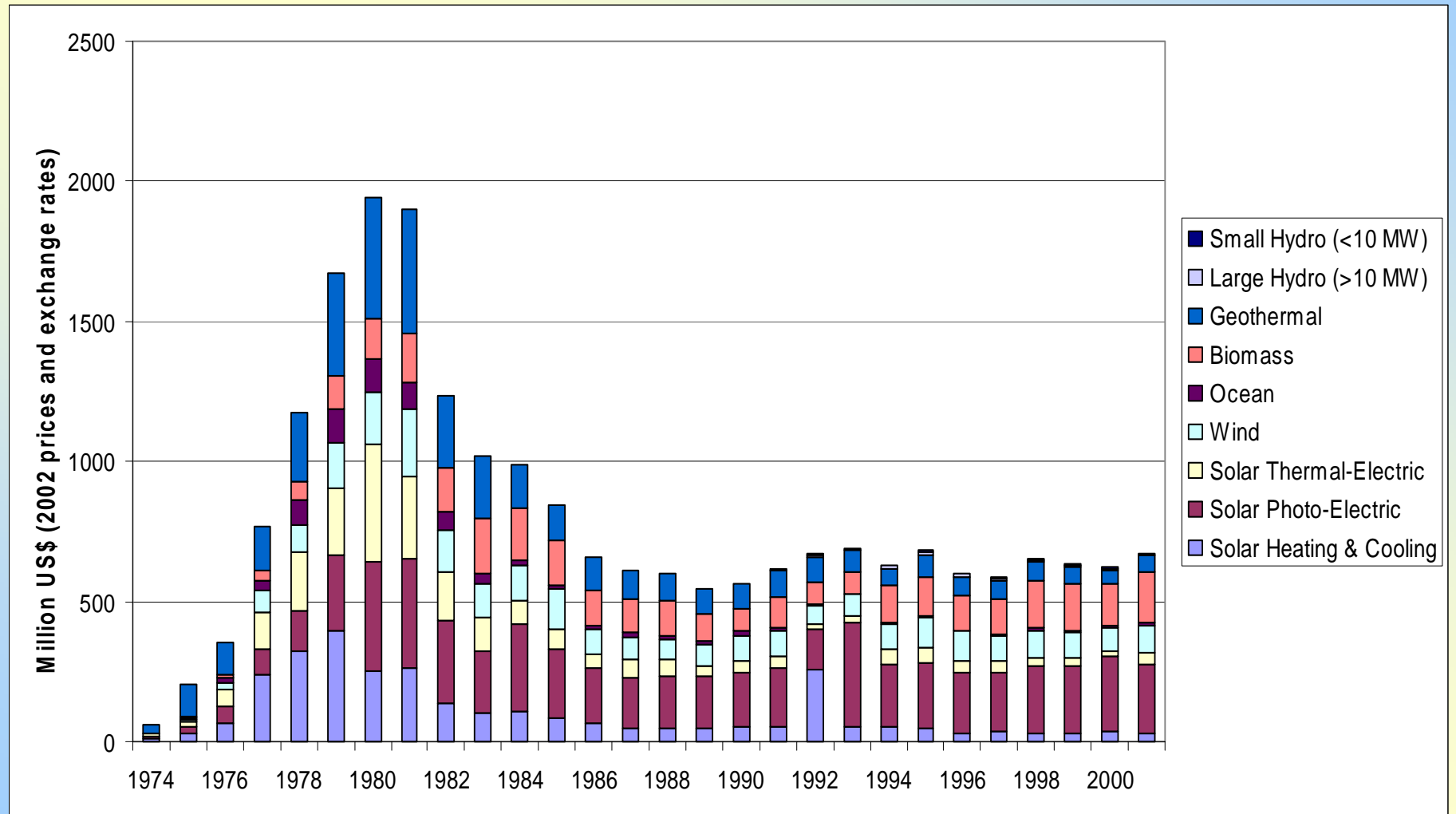
**Technology Deployment**

**Energy Policy – 4 Es**

- **Energy security**
- **Economic development**
- **Environmental protection**
- **Energy Access**



# IEA Government Renewable Energy RD&D Budgets



# Shares of Renewable Energy Technologies in IEA Energy RD&D Funding, 1987 - 2002

<b>Solar photovoltaics</b>	<b>2.7%</b>
<b>Biomass</b>	<b>1.6%</b>
<b>Wind power</b>	<b>1.1%</b>
<b>Geothermal</b>	<b>0.9%</b>
<b>Solar heating and cooling</b>	<b>0.7%</b>
<b>Solar thermal electric</b>	<b>0.5%</b>
<b>Marine energy</b>	<b>0.1%</b>
<b>Large hydro</b>	<b>0.1%</b>
<b>Small hydro</b>	<b>0.04%</b>



# RD&D Priorities for the Future:

## *Photovoltaics*

- **Cost reductions:**  
*crystalline silicon-based cells, thin-film approaches, alternative cell concepts, modules and system electronics/storage.*
- **Materials that are environmentally justifiable.**
- **PV power plants with optical concentration and stacked solar cells.**
- **Module encapsulation technologies for longer module lifetime.**



# RD&D Priorities for the Future:

## *Solar Thermal Power*

- Advances in materials for parabolic troughs turbine and receiver technology for solar towers.
- **Materials suitable for high temperature phase change for energy storage.**
- Fresnel principle as alternative line-focusing technology
- **Use of solar thermal waste heat for seawater desalination.**



# RD&D Priorities for the Future:

## *Biomass/Biofuels*

- **Biopower:**

- **Combustion including co-firing of biomass and fossil fuels and small-scale Stirling CHP systems**
- **Gasification/pyrolysis for gas turbines and fuel cells**

- **Biofuels:**

**advanced processes for conversion of cellulosic crops (grass, wood) and wastes (crop, forestry, municipal).**



# RD&D Priorities for the Future:

## *Geothermal*

- Adaptation of drilling and reservoir management for hydrothermal and exploration of hot dry rock technology.
- **Different thermo–dynamical cycles for generating engines (Organic Rankine Cycle and Kalina Cycle Process)**
- More efficient heat exchangers to handle low temperature geothermal energy



# **RD&D Priorities for the Future:**

## ***Distributed Generation/Grid Optimisation***

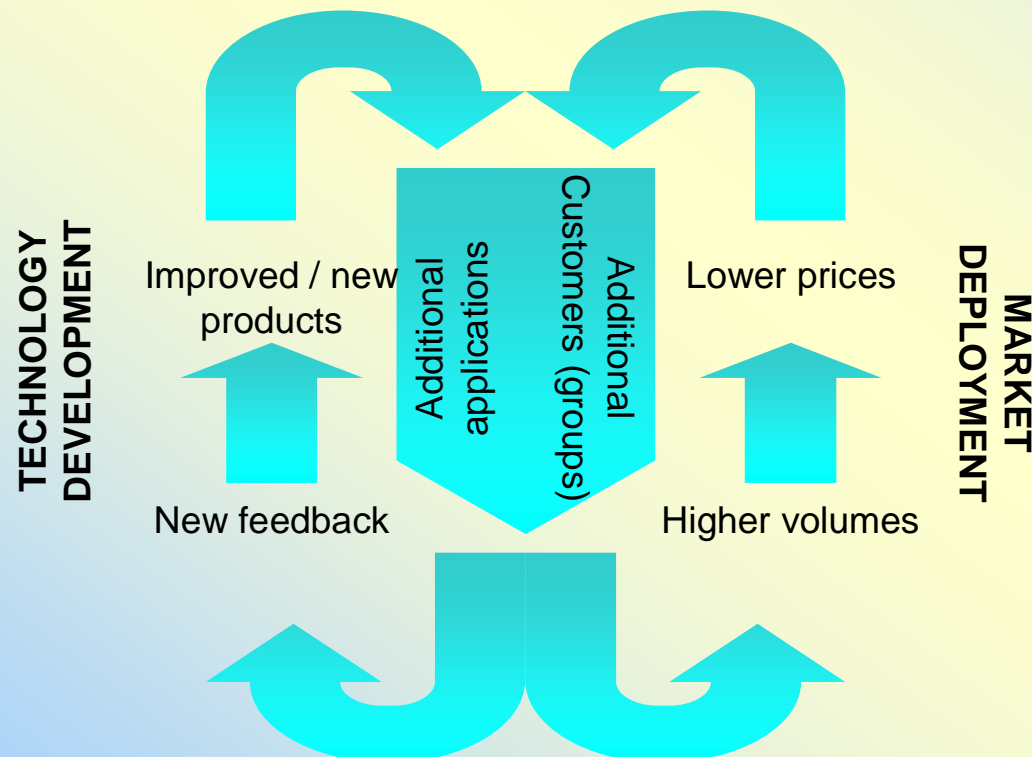
- **Power Quality**  
(bi-directional energy flows, lower voltage grid segment, harmonic levels)
- **Energy Management**  
(intelligent control of generators, storage, load, combined electricity/heat/cold)
- **Electricity and Heat Storage System**
- **'Intelligent' Components and Communications**
- **Safety Concepts and overall Security**



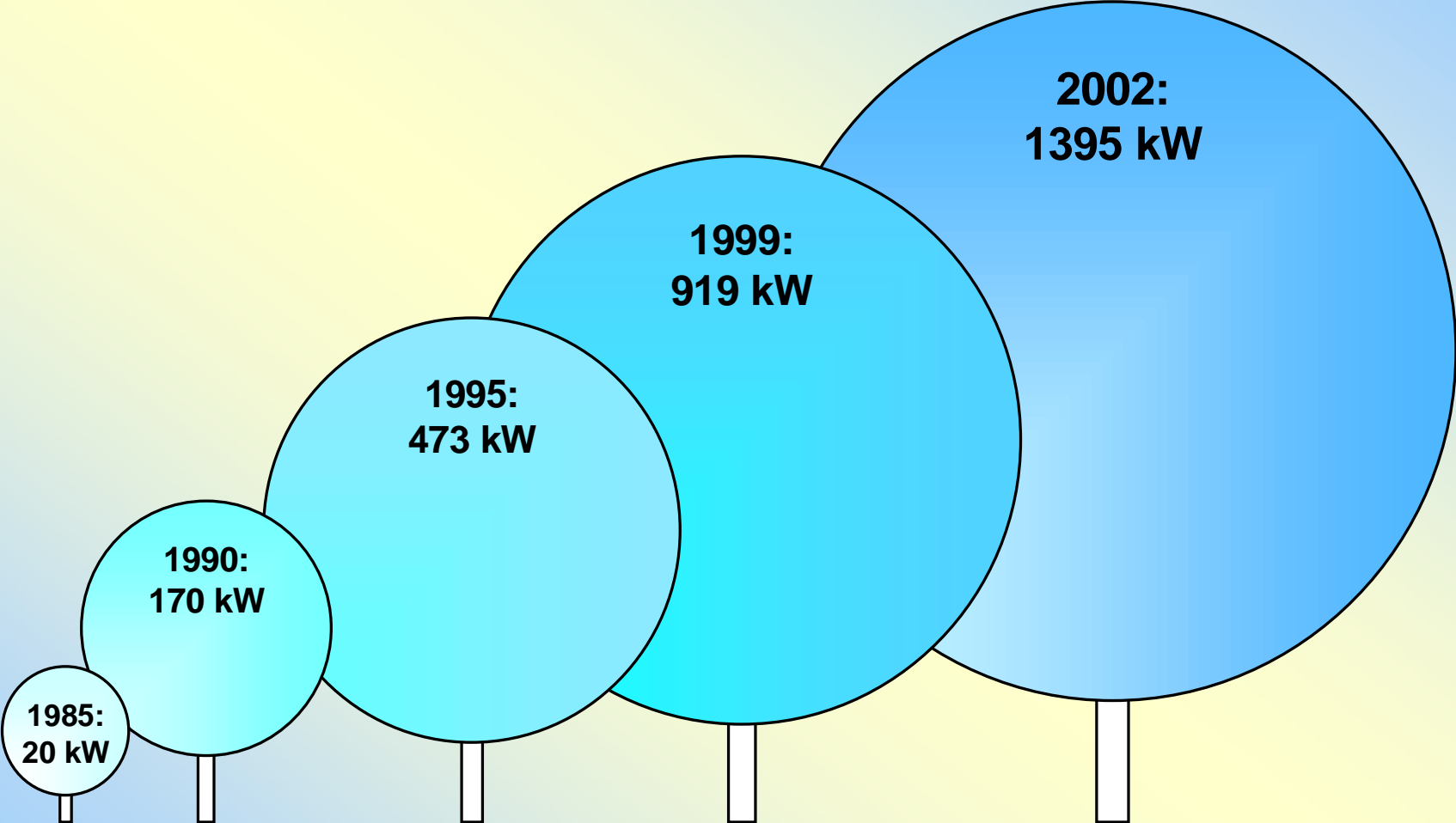
# Techno-economic development

## Technology-market relationship

- Improve performance and develop new designs --> **R&D**
- Optimise size and application --> **economy of scale**
- Open up markets --> increase of **manufacturing volume**



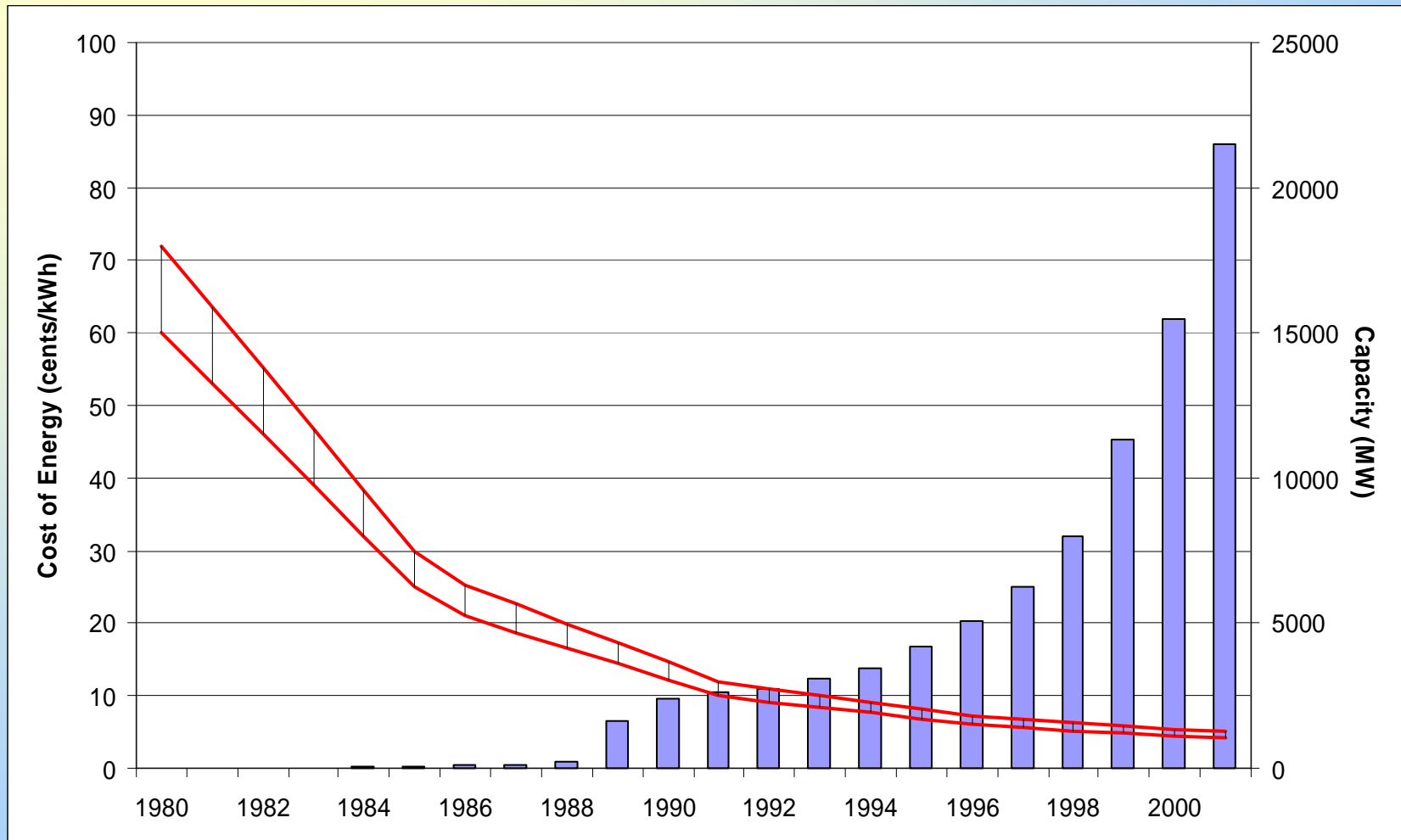
# Average Wind Turbine Size at Market Introduction



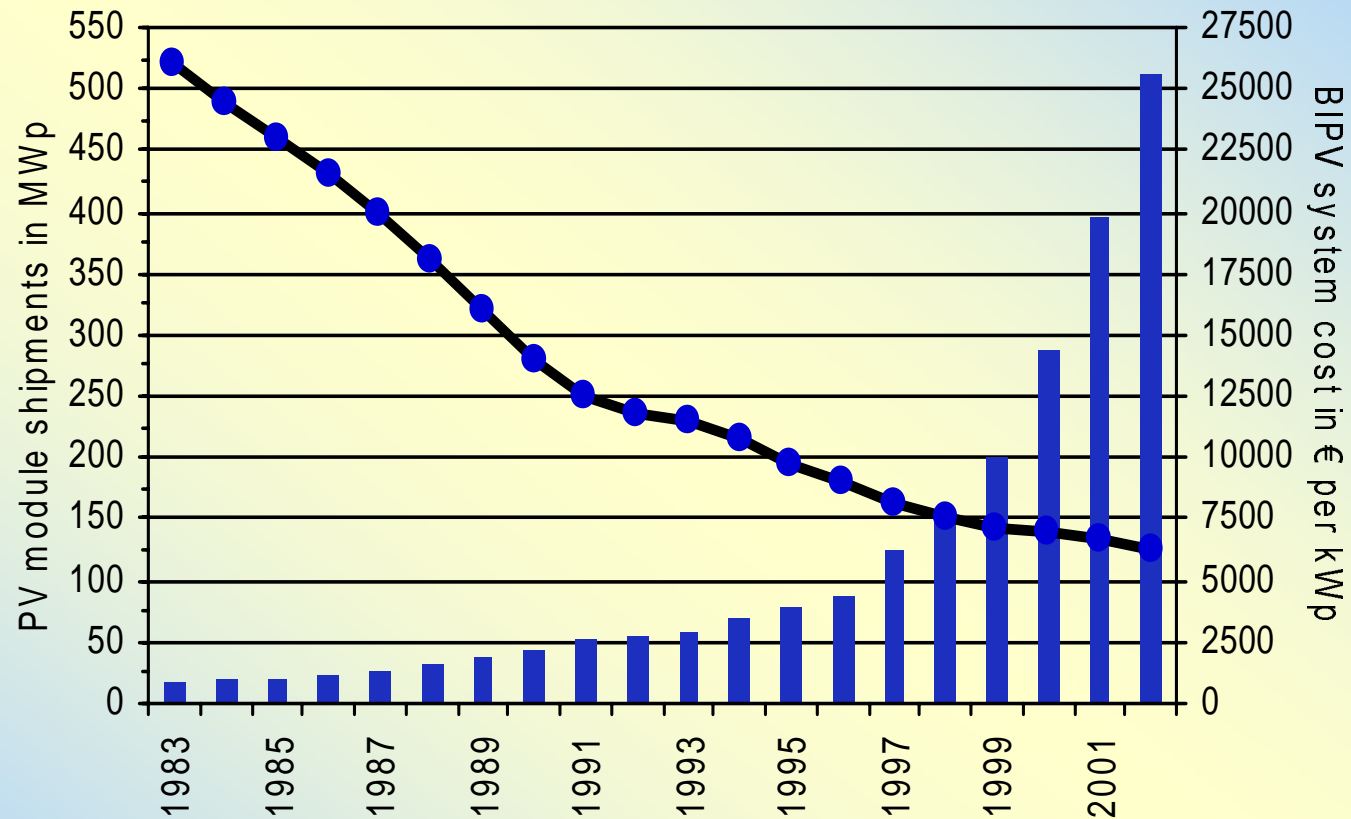
Sources: NET Ltd., Switzerland. Raw data is from Durstewitz (1999) and Systèmes Solaires/EurObserv'ER (2003).



# Cost and Capacity Trends in Wind Power, 1980-2001



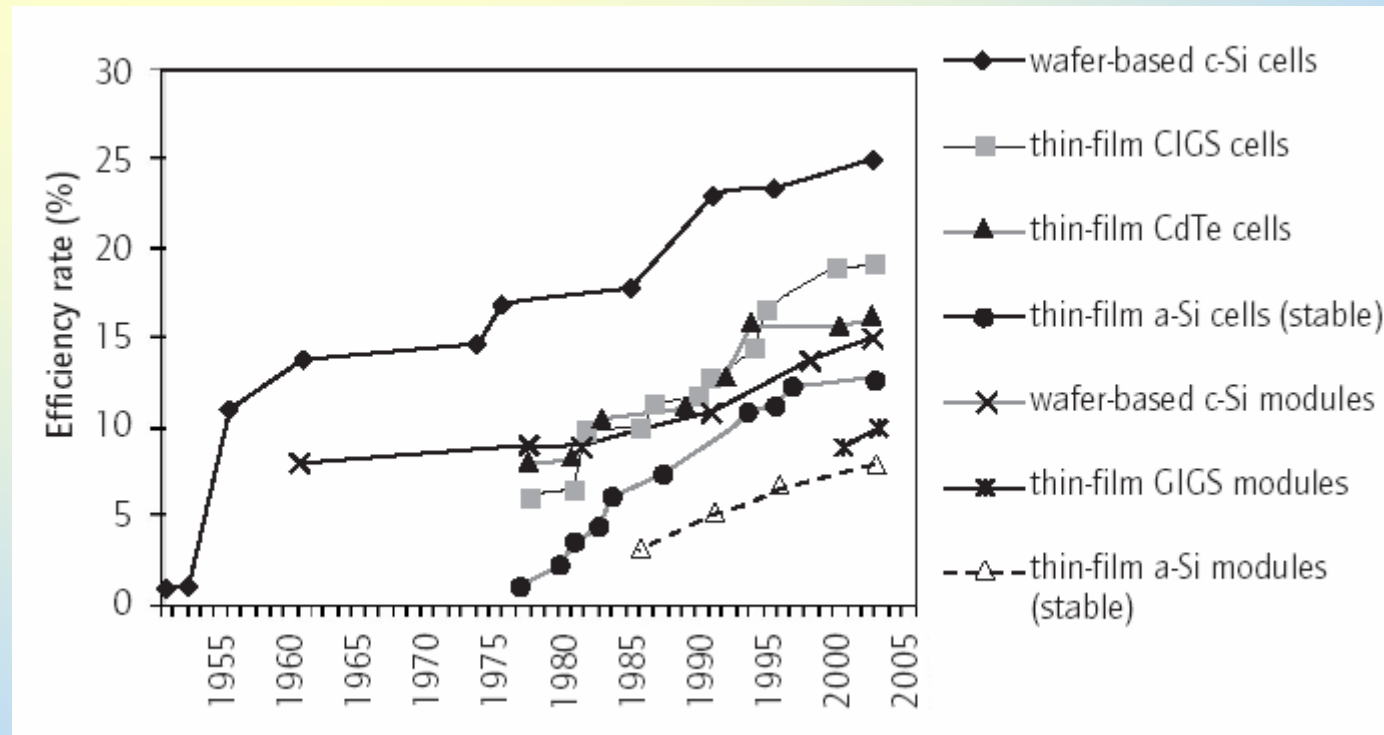
# Annual World PV Module Production and Building-integrated PV System Costs, 1983-2003



Sources: NET Ltd., Switzerland; *PV News*, February 2002.

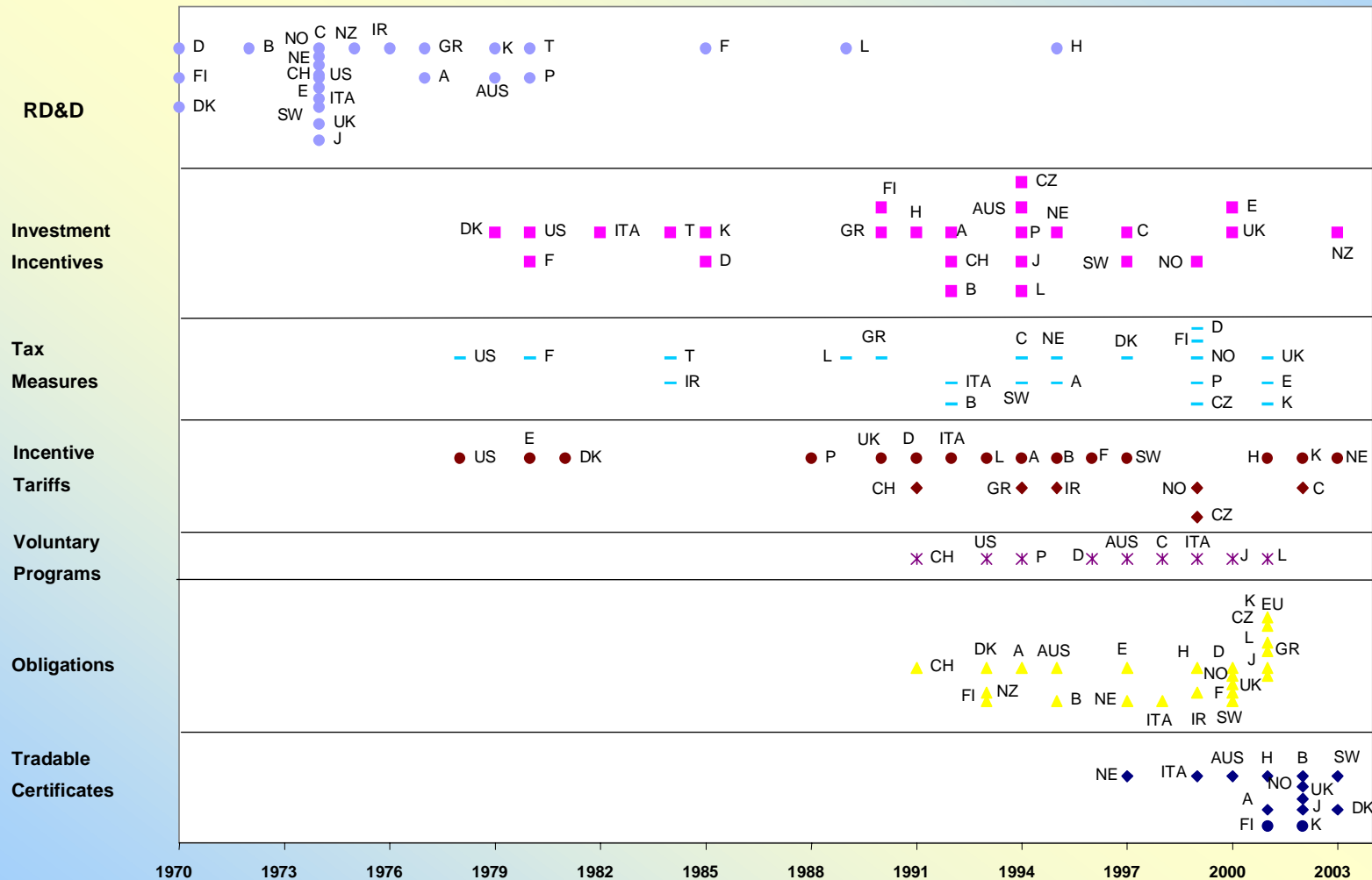


# Evolution of Cell Efficiency



Sources: IEA-PVPS Task 7 (2003), "Education and Training Materials for Architects", Utrecht.

# Evolution of RE Policies in IEA Countries



AUS - Australia C - Canada FI - Finland GR - Greece ITA - Italy L - Luxembourg NO - Norway SW - Sweden UK - United Kingdom  
 A - Austria CZ - Czech RE F - France H - Hungary J - Japan NE - Netherlands P - Portugal CH - Switzerland US - United States  
 B - Belgium DK - Denmark D - Germany IR - Ireland K - Korea NZ - New Zealand E - Spain T - Turkey



# Strategies for Breakthroughs

Intensify public investment  
and Public/Private Partnership for:

- **Long-term R&D**
- **Manufacturing processes**
- **Market “learning” from projects in high-resource locations**
- **Technology deployment policies**

