

# **Tomorrow's Photovoltaics: The New Technology Revolution**

**ESOF2010 Torino (IT)  
2010-07-06**

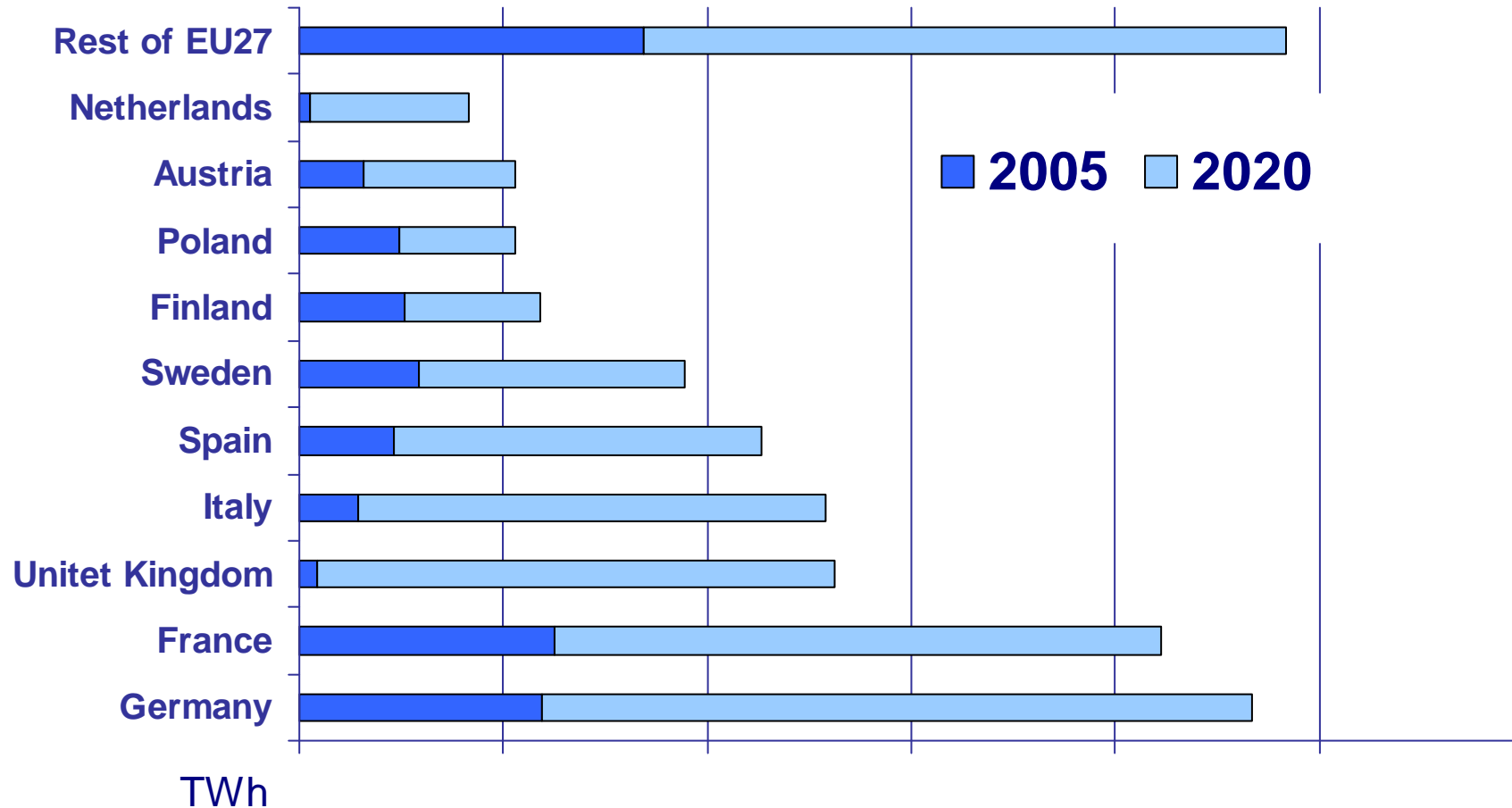
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Joint Research Centre**

- **The European Renewable Energies Directive**
- **European PV Markets**
- **Role of PV in European Electricity Generation**
- **European Strategies for Deployment**

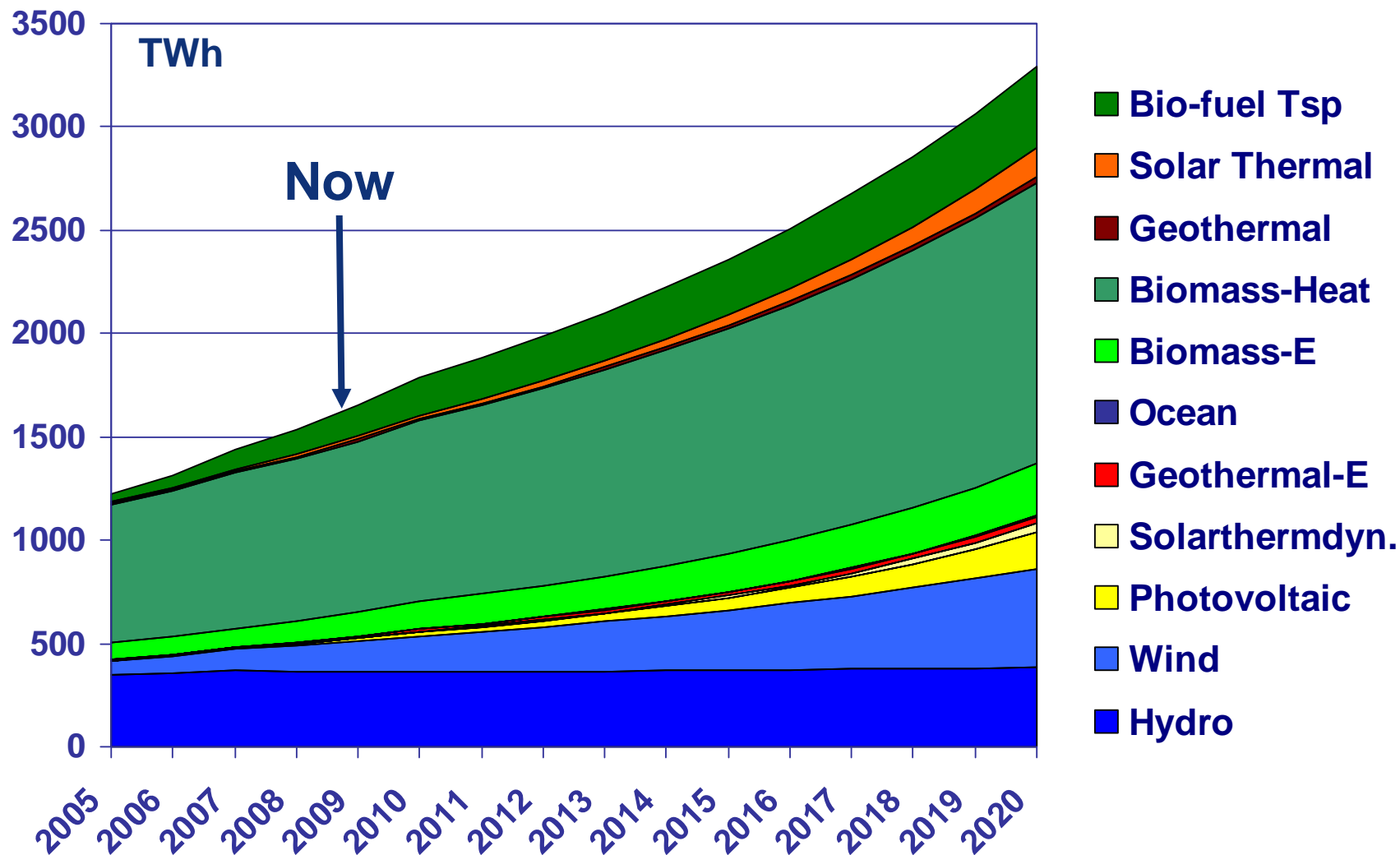
# Major Content of Directive

- **Mandatory 2020 Targets**
- **Memberstate Targets**
- **“Burden Share” Possible**
- **Trajectory towards 2020**
- **Biofuels for Transport:**
  - **Replaced proposed 10% Biofuel**
  - **By 10% Renewable Sources**
    - Sustainability Certification
    - Land Use Change Assessment
    - GHG accounting

## Memberstates Contribution to 20% Renewables Total 3300 TWh

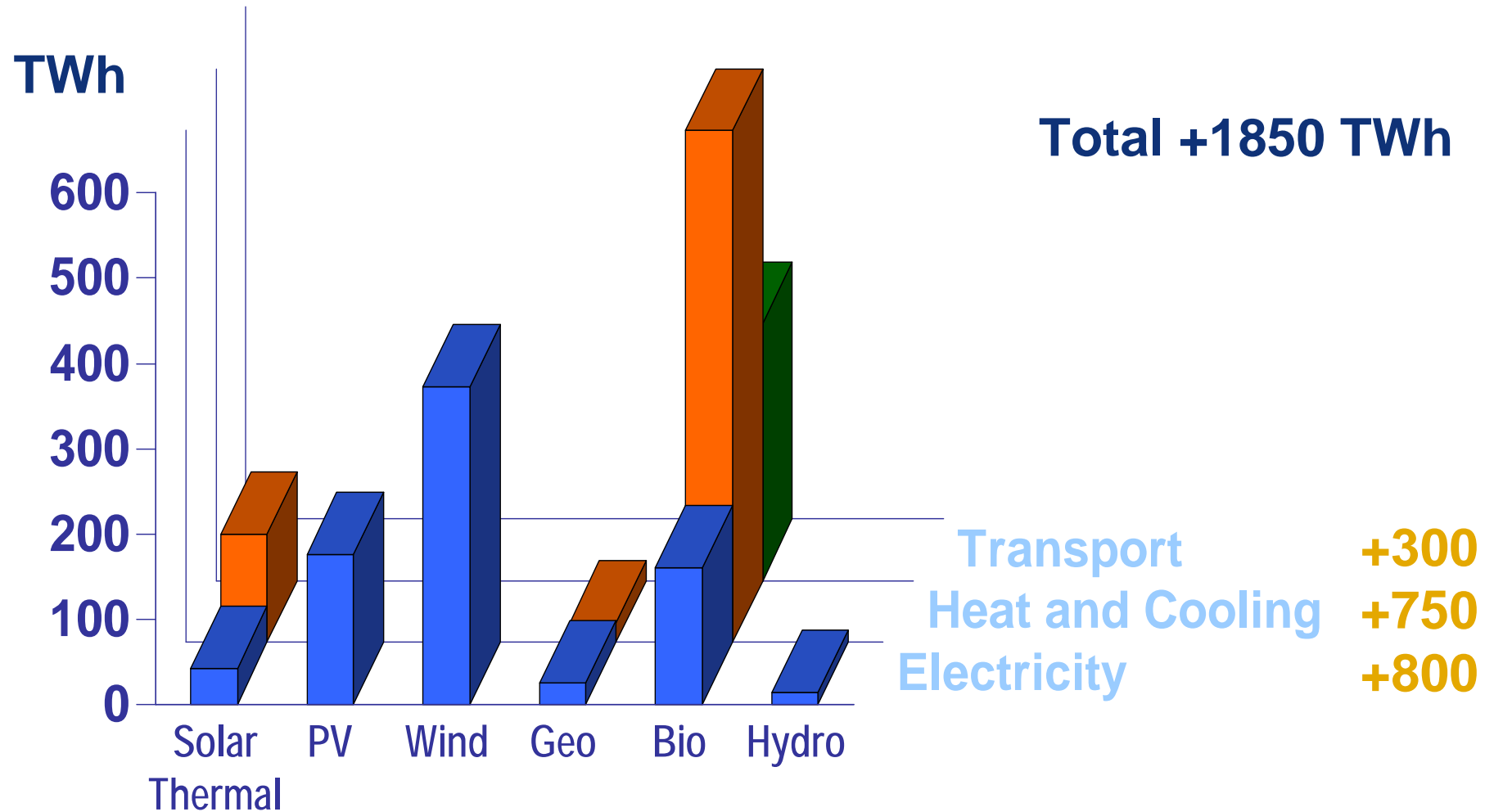


# 20% Share of Renewable Sources: **3300 TWh**

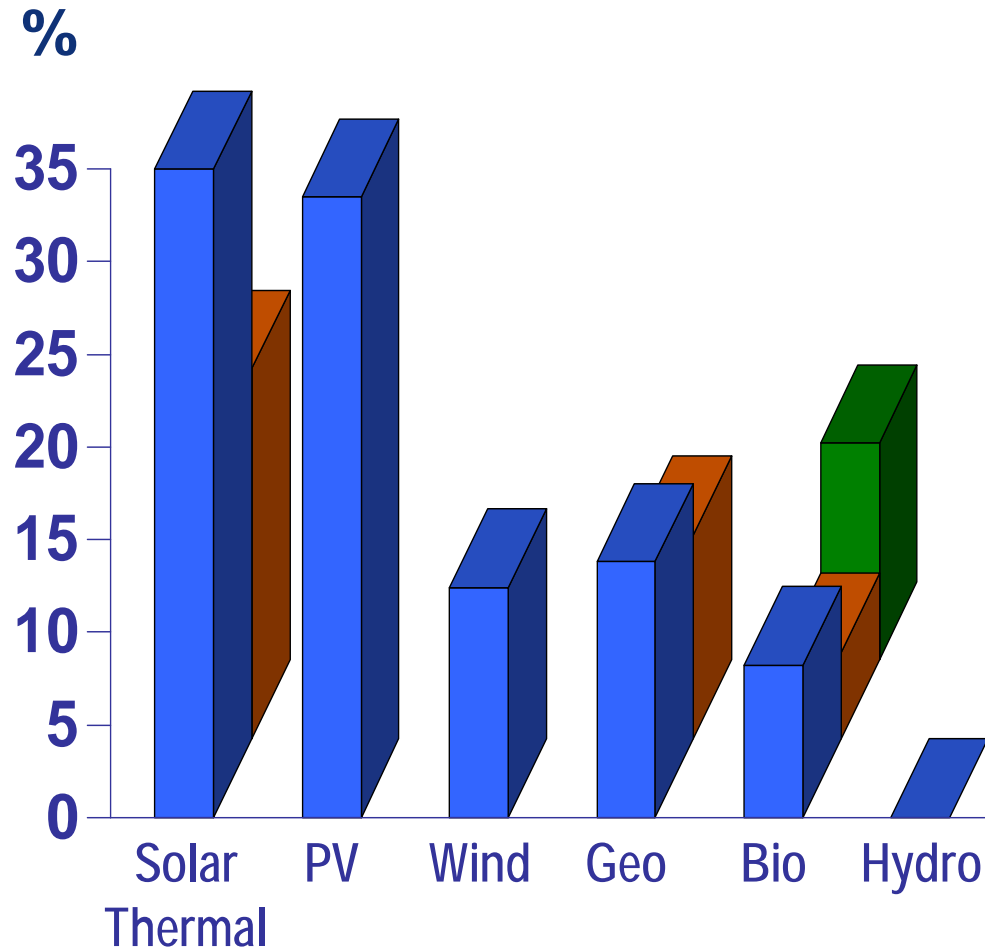


Source: EREC

# Renewables Add-on 2007-2020 by Sector



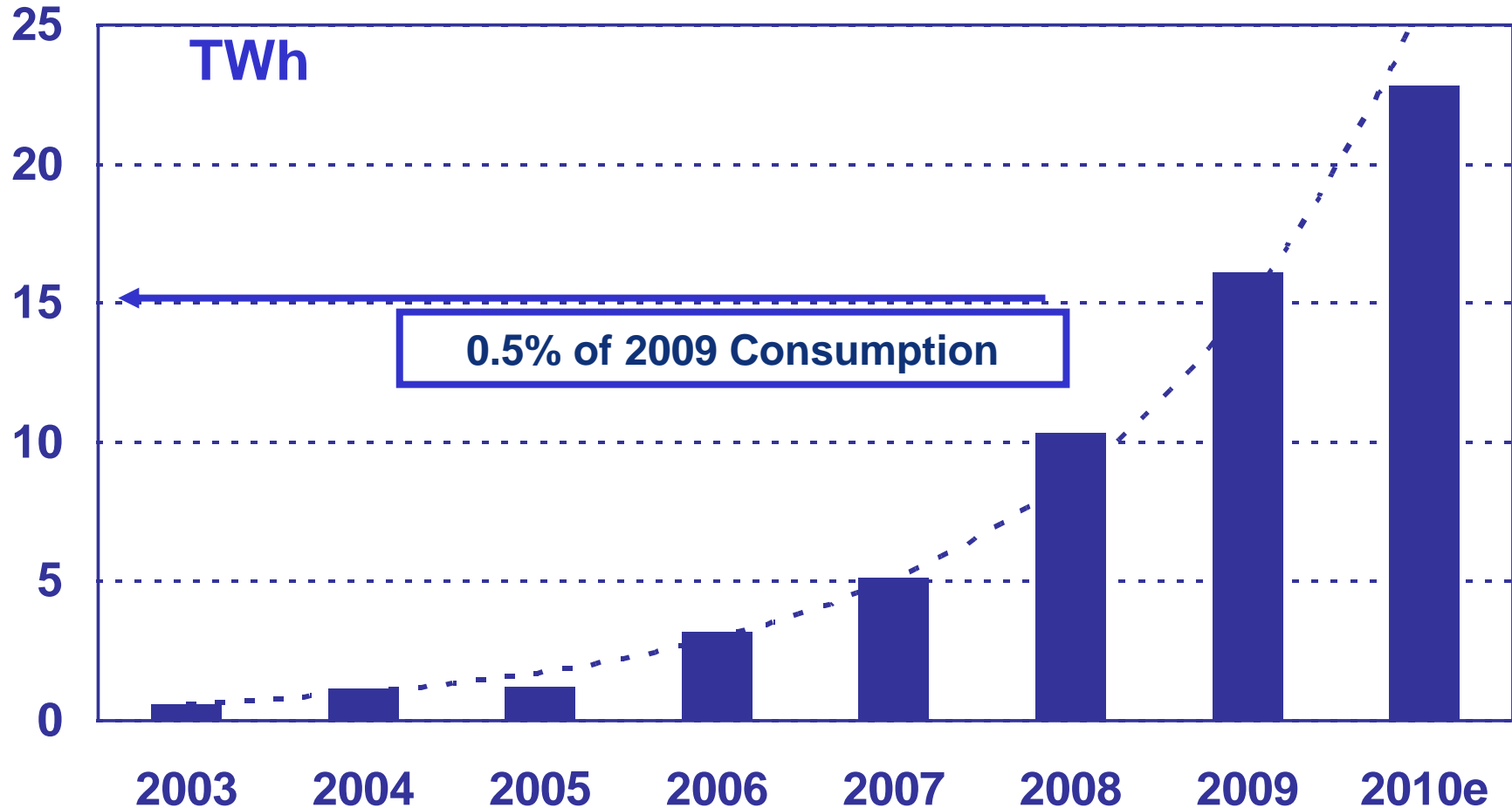
## Average Required Growth Rate per year



**2007-2020 by  
Technology**

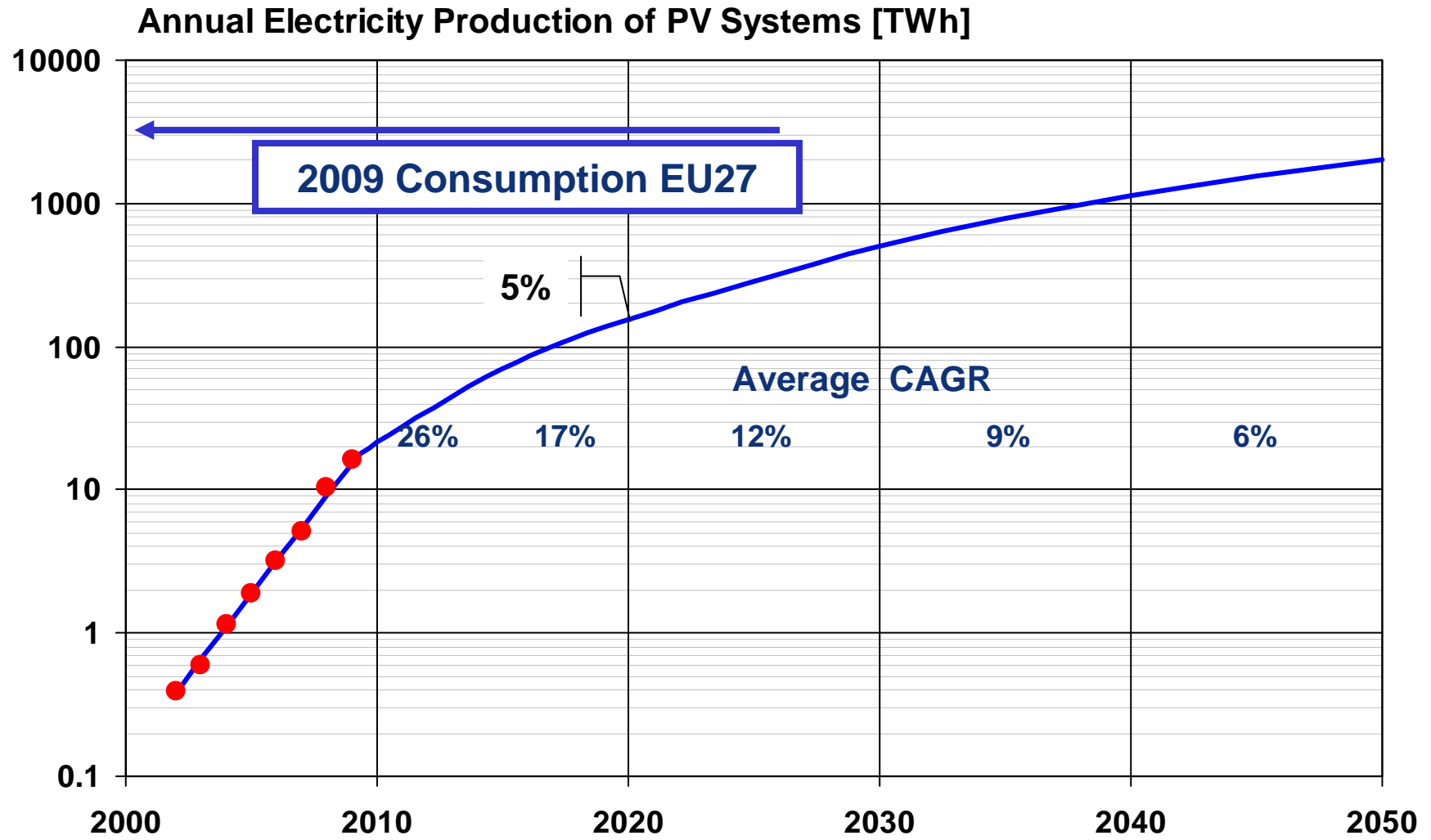
Transport  
Heat and Cooling  
Electricity

# Photovoltaic Electricity Generation EU-27



5% Target for 2020: **180 TWh**

## And If PV Growth Continues?



CAGR: Compound Annual Growth Rate [1/year]

## Shift of Energy Expenditure

### Simplified example:

Expenditure to generate  
80 Mio.kWh in 20 years

10 MW Diesel Fuel Plant  
VS  
25 MW PV plant

Investment Cost:

Diesel: 1500 €/ kW

PV: 4500 €/ kW

Full Load Hours

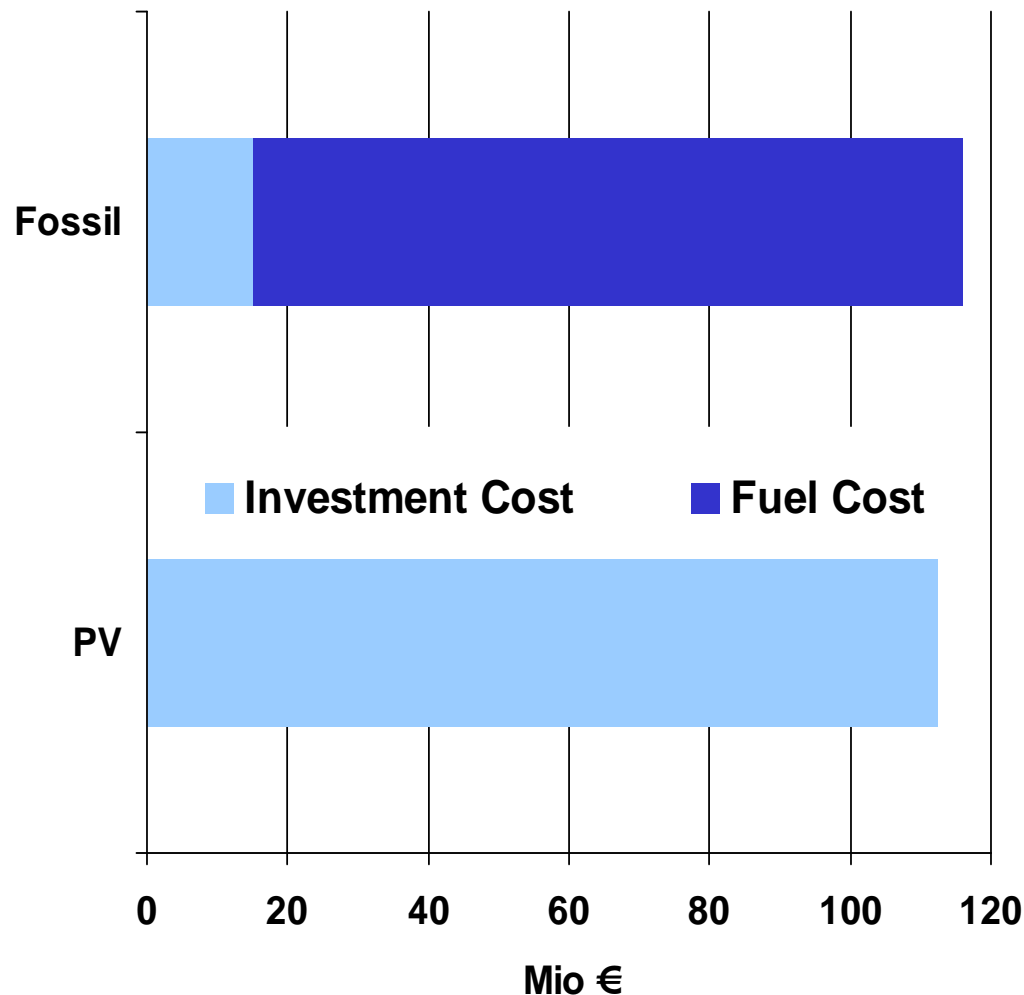
Diesel: 4000 hrs/year

PV: 1600 hrs/year

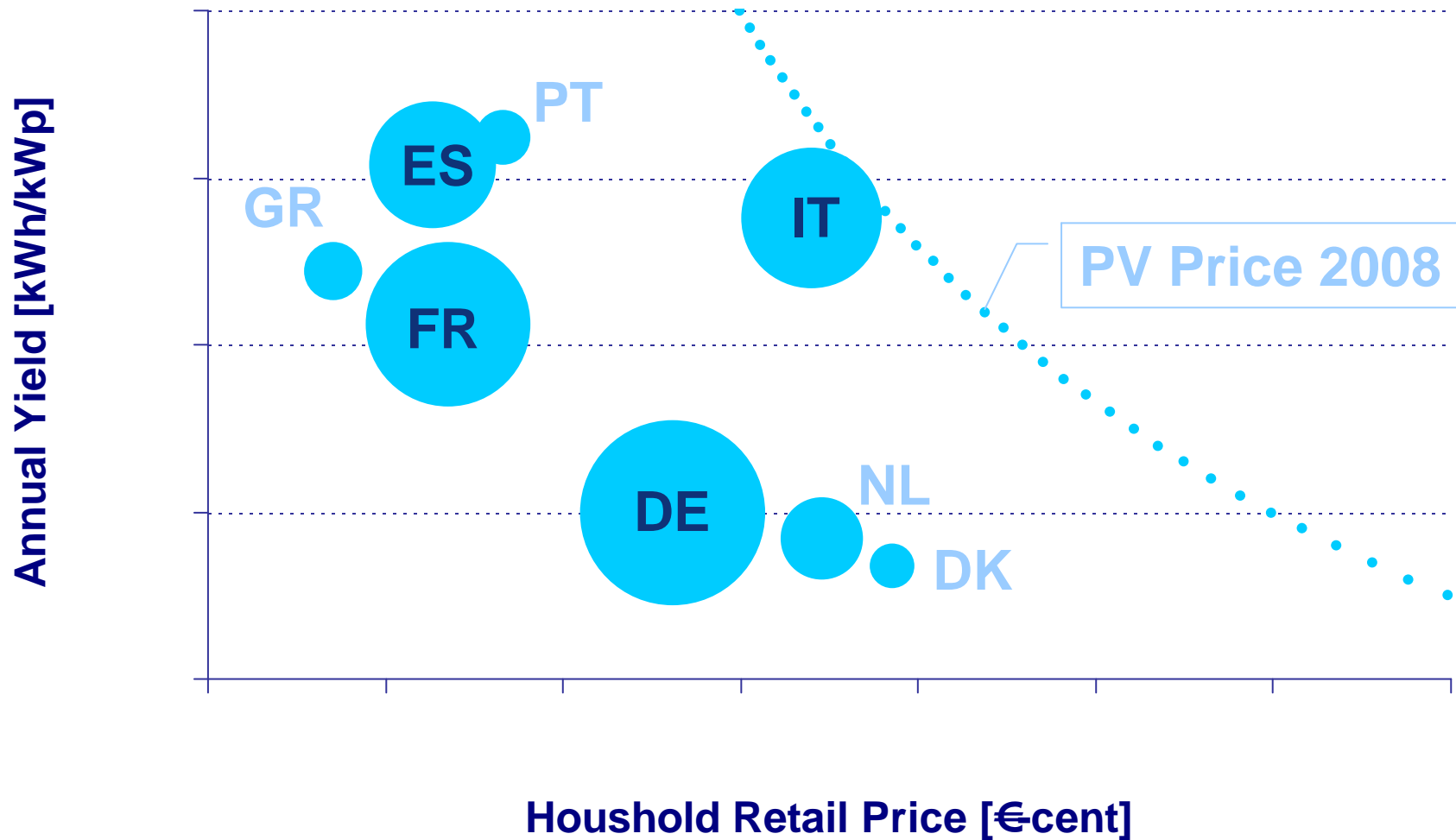
Fuel Cost 0.5 €/kg

No Capital Cost, No O&M cost,  
Constant Fuel Costs

(12.5 c€/kWh)



## PV Grid Parity with Household Retail Prices (2008)



## Where is the economic profit made?

### Conventional:

#### from Fuels and other financing sources

Value added from extraction to  
final product (“Well-to-Wheel”)

### And as consequence:

Resource and dependent, limited  
availability and geographical  
distribution

Value added in the Fuel Supply  
Chain

### Photovoltaics:

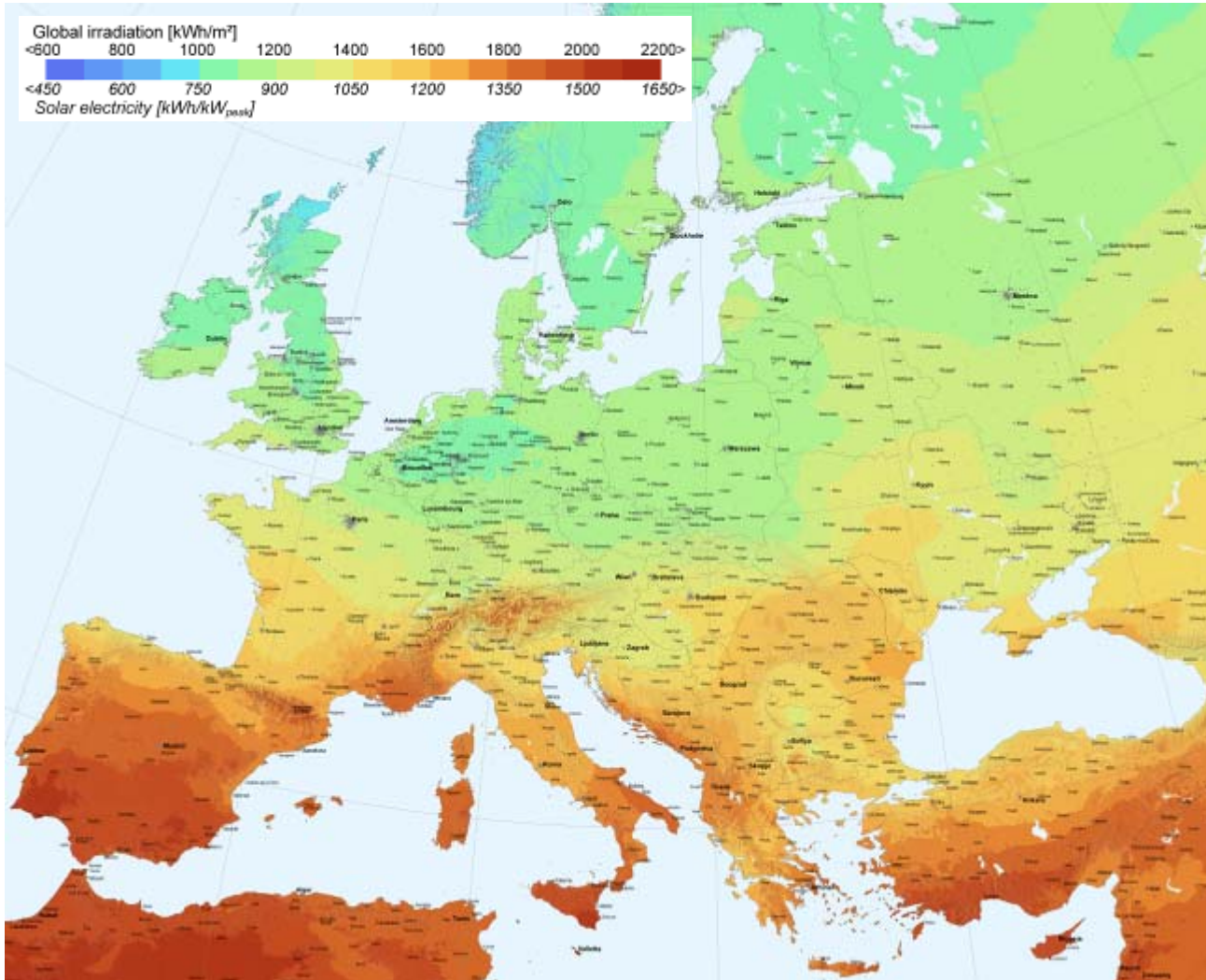
#### from Power Plant Technology

Value added from manufacturing  
of PV products and their  
installation

Resource independent, illimited  
availability with wide  
geographical coverage

Value added in Industrial  
Innovation Chain

- **PV: Technology, made from recent technologies:  
Semiconductors, Optoelectronics, Vacuum Systems,  
Nanotechnology**
- **But also: Assembly, Siting, Installing, Wiring**
- **As much as electronics has changed our life, PV will  
change our energy system**



**What can  
Memberstates  
contribute in  
Photovoltaic?**

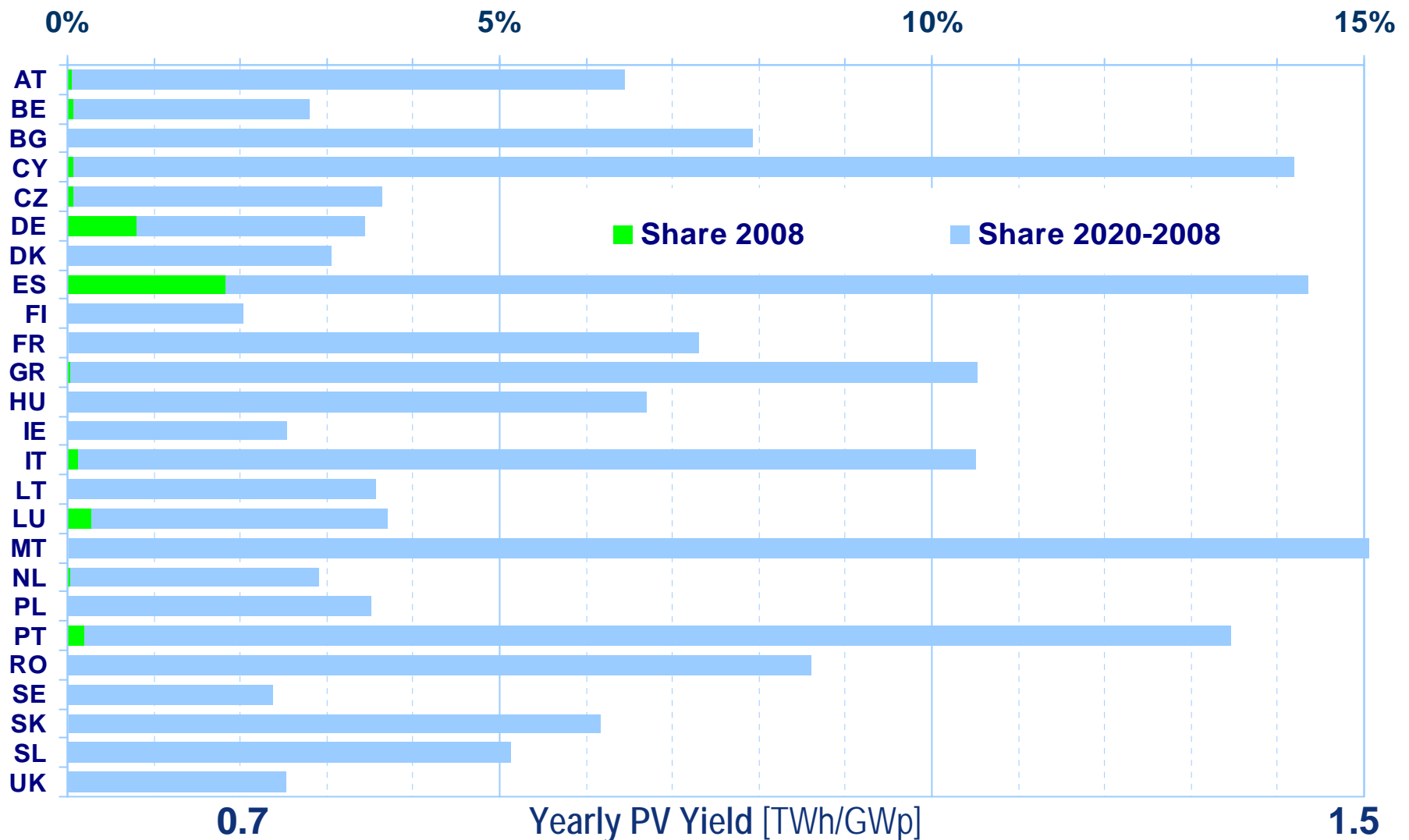
**PV Electricity  
Yield  
[kWh/kWp]**

## What can we realistically expect?

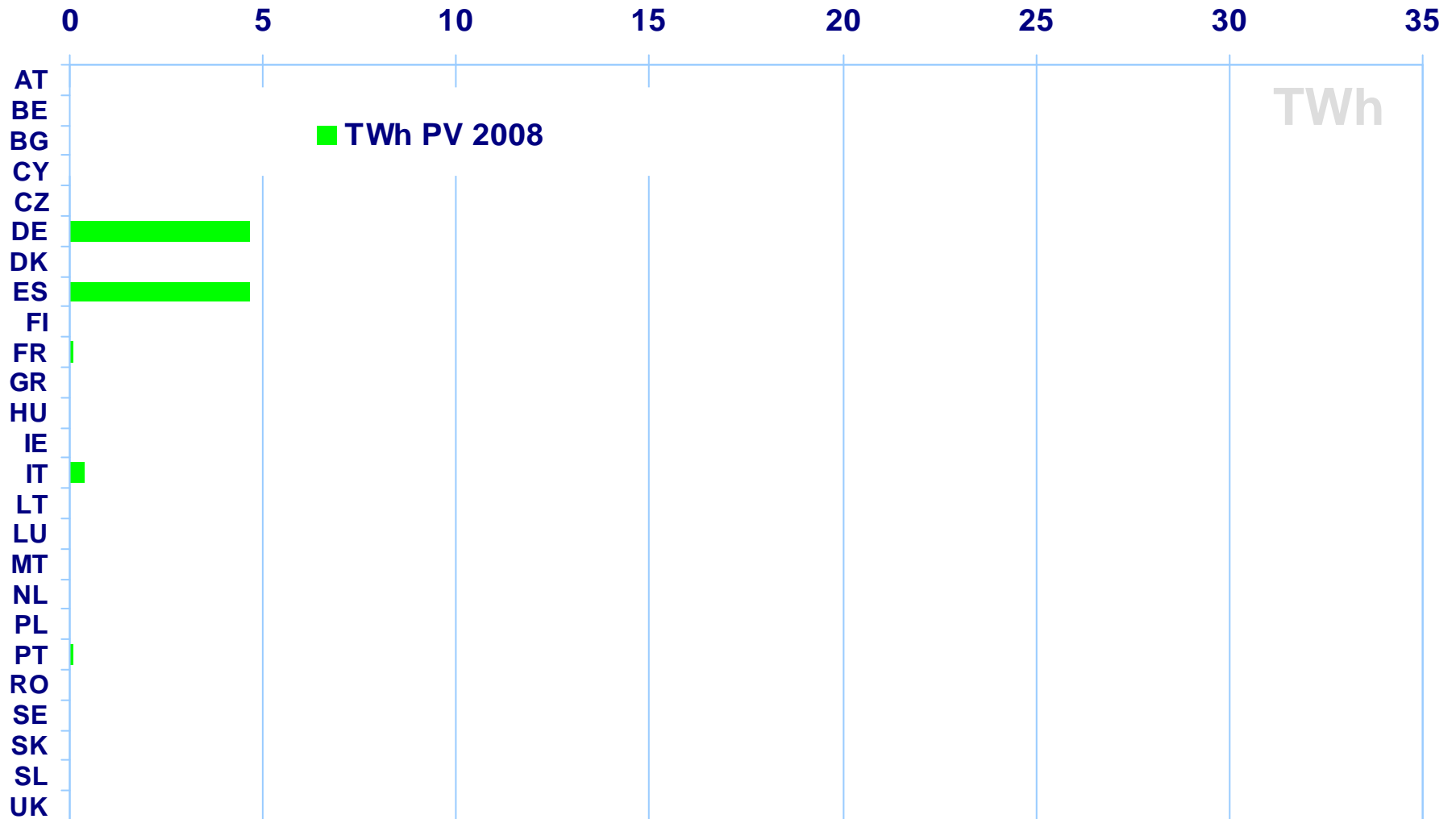
- **Major issue:**
- **PV share in the national electricity grid**
- **Assumption:**
- **Sunny Countries with higher Penetration:**

- **700 kWh/kW<sub>p</sub>: 2.5%**
- **· · ·**
- **1600 kWh/kW<sub>p</sub>: 15 %**

# National PV Electricity Share 2020

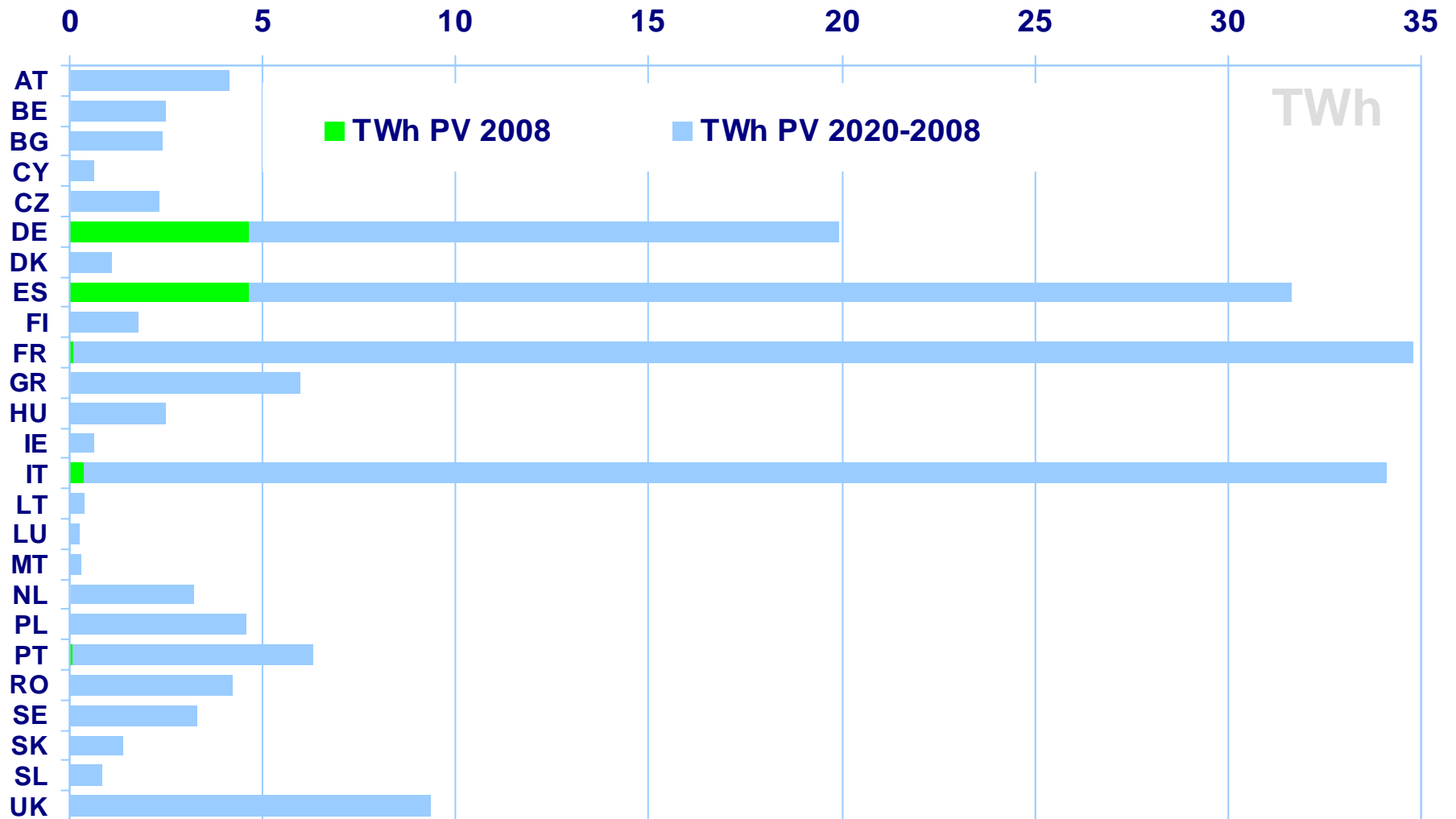


# National PV Electricity Production 2008



2008 **0.33%** Electricity **10 TWh**

# National PV Electricity Production 2020



2020 **5%** Electricity Target **180 TWh**

## Issues PV

- **Technology: Silicon? Thin Film?**  
**Concentrators?**
- **Costs: Grid-parity, Learning Curve**  
**Degression**
- **Utilities: Large (>100 MW) Power Plants**
- **Grid Access: Daily Peak, Penetration depth**
- **Effective & Stable Incentives:**
- **Artificial “Caps”, limiting growth**
- **Administrative Delays > year**
  
- **Amount of Energy Efficiency 2020, European Consumption**
- **16000 TWh or 12800 TWh?**
- **Renewable Electricity: 21% or 26% ?**

## European Initiatives

- **5% Share is feasible, Sunny Countries up to 15%**
- **European Strategic Energy Technology (SET) Plan:**
- **Industrial Initiative “SET for 2020” :**
- **Goal:           12% Share of PV Electricity**  
**~400 TWh / year**
- **Requires Major Grid Investments**
- **National Renewable Action Plans, due June 2010**