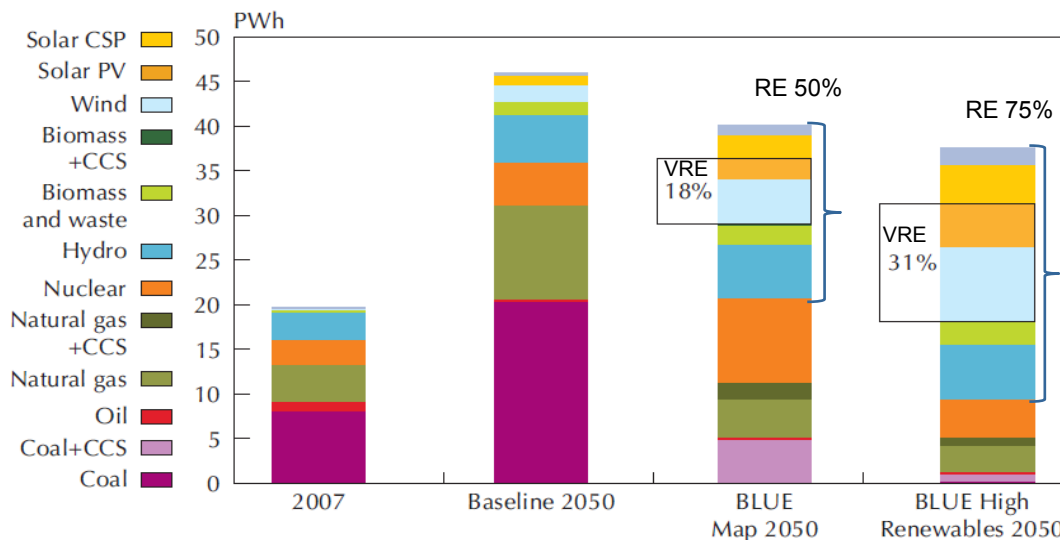


Solar Energy Perspectives

- A new IEA publication launched 1st December
- First RE in-depth technology study
- Support from the French and US governments
- cedric.philibert@iea.org

Building on...

Solar Energy Perspectives



- Solar electricity and other roadmaps
- *Energy Technology Perspectives*
- Also starring...
 - Solar Fuels
 - From PV and CSP, H₂ and liquids
 - Solar heating and cooling
 - Forthcoming IEA Roadmap

In search of synergies...

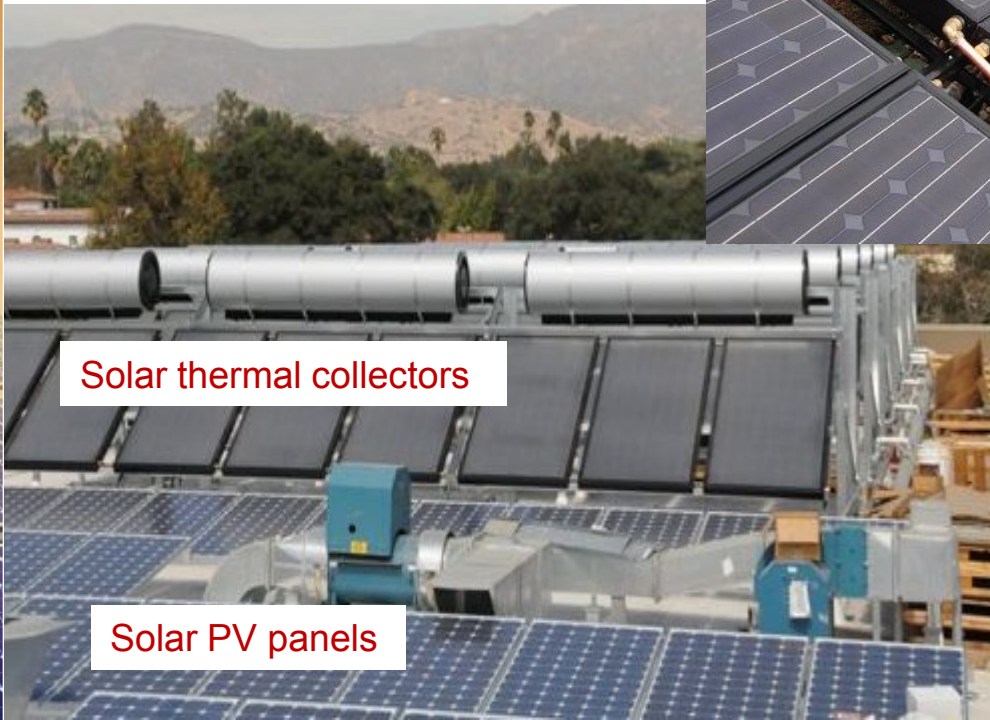
- Between various solar technologies
- With other RE/EE technologies

Source: SunEarth Inc.



Integrated PV-thermal collectors

Source: Solimpeks Solar Energy

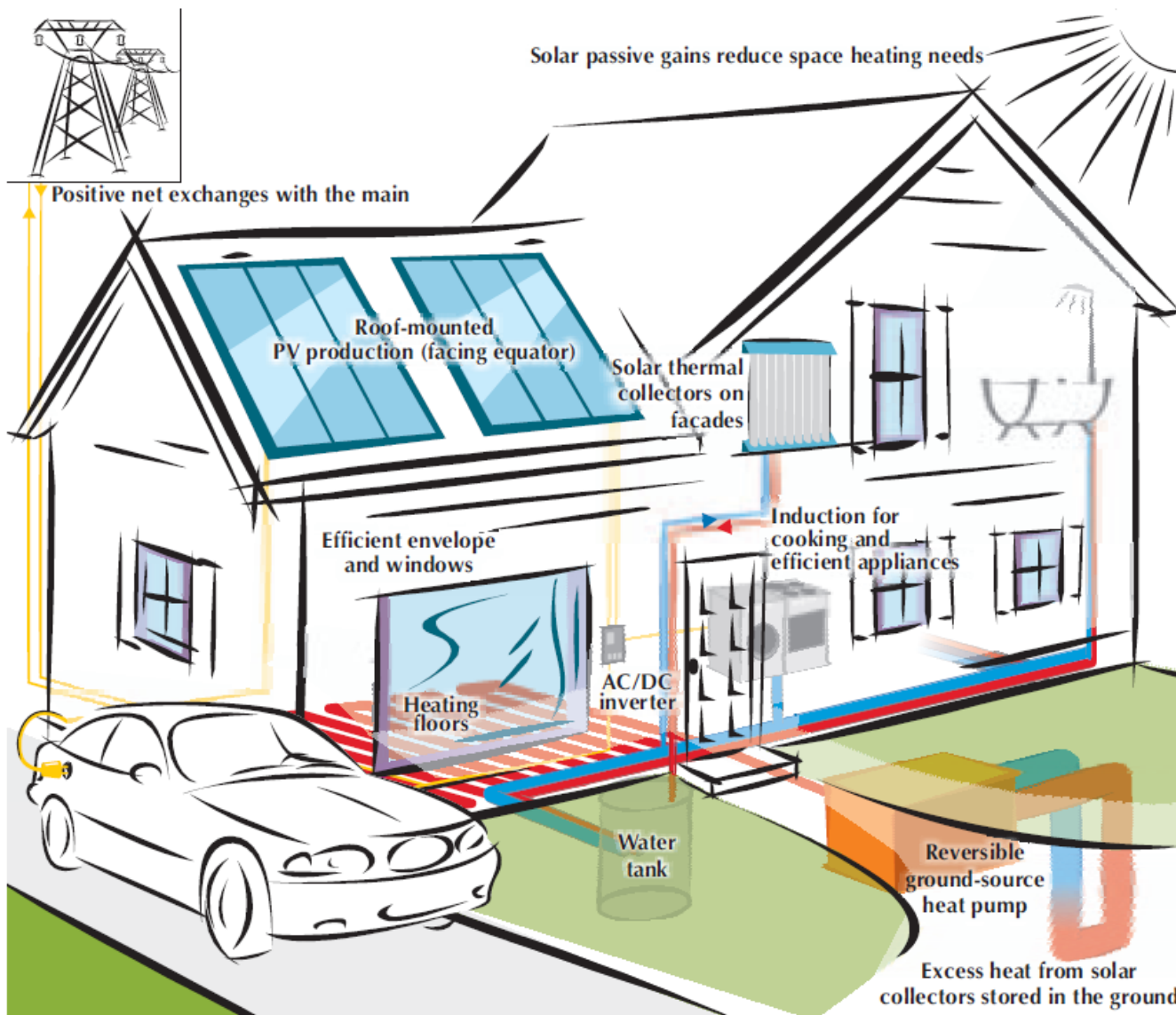


Solar thermal collectors

Solar PV panels

- Driven by analyses of the demand for various uses

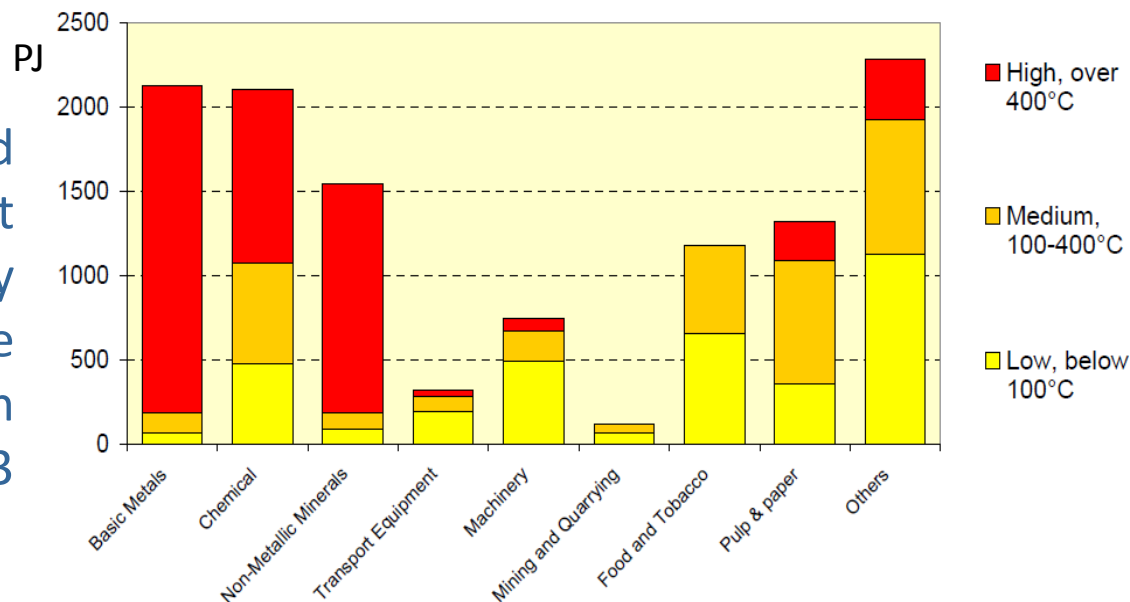
Markets: Buildings



An integrated approach increases efficiency and reduces total costs

Markets: industry & transport

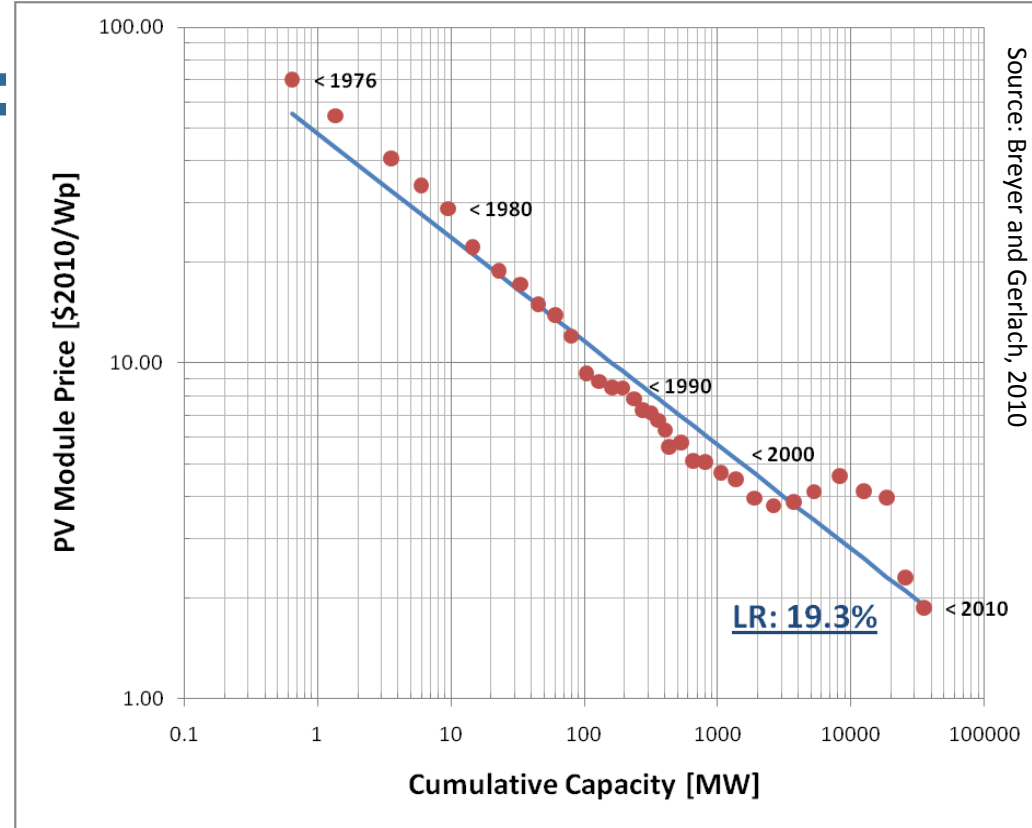
Estimated industrial heat demand by temperature range in Europe, 2003



- Large heat needs at various temperature levels in industry and services; low-temp. solar heat available everywhere, demand all year round
- High-temp. solar heat under hot and dry climates
- But solar electricity and biomass key to reduce the use of fossil fuels in industry and transport

Technologies: photovoltaics

- **Fast growth & cost decline**
- **Important role off grid**
- **Competitive on-grid markets appear: sunny islands and countries with high retail electricity prices, and/or using oil to generate electricity**
- **Incentive-driven growth concentrated in too few (EU) countries, will spread to China, Japan, USA...**



Technologies: solar thermal electricity



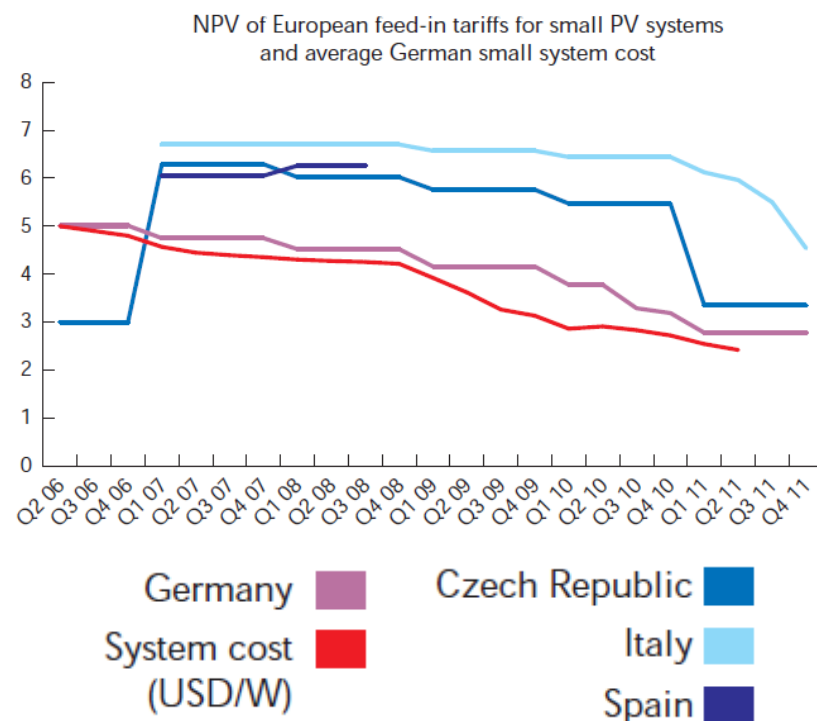
Source: Torresol Energy

- **Key value of STE/CSP is in thermal storage to better match demand**
 - effective and cheaper than electrical storage
- **Concentration requires good direct irradiance**
- **Many different designs and options**

The way forward: costs of policies

Total costs of support policies will build up in the coming years, despite specific unit cost reductions

- This is the price to pay to bring solar technologies to competitiveness with fossil fuels
- Not easy to find right balance between effectiveness and appropriate remuneration
- True annual costs of support must be distinguished from the much larger amounts of investment involved
- Electricity markets based on marginal pricing may not be able to finance required renewable and balancing capacities
 - ◆ Merit order effect reduces electricity spot prices as shares of RE increase



Source: BNEF 2011.

The way forward: testing the limits

- A possible vision, under severe climate constraints, if other low-carbon energy options are not available...
- Where are the technical limits to solar energy?
 - Many electricity technologies converging towards USD100/MWh (incl. CO₂) around 2030 [Roadmaps, ETP]
 - Cost no longer main limit, but footprint, variability and convenience issues
 - Not necessarily least cost, but affordable options:
 - ◆ Sunny and dry climates, where CSP dominates
 - ◆ Sunny and wet climates, with PV backed by hydro
 - ◆ Temperate climates, with wind power and PV backed by pumped-hydro and solar-H₂/NG balancing plants
 - Assuming efficiency improvements as in ETP but further electrification of buildings, industry and transport:
 - Under best conditions, solar energy (mostly electricity) could become a key contributor to the global energy mix
 - Some fossil fuels still needed in transport, industry, electricity

A global approach is needed

- **The bulk of the forthcoming growth of energy demand is in sunny countries**
 - 7 out of 9 billion people, growing economies
- **Solar provides access to modern energy services**
 - Potentially changing the lives of 1.4 billion people
- **Solar energy has the potential to become a key contributor to final energy demand**
 - Under the assumptions of a massive penetration of electricity, efficiency improvements and willingness to decarbonise the energy sector
- **Efforts/benefits need to be shared globally**
 - “Spend wisely, share widely”