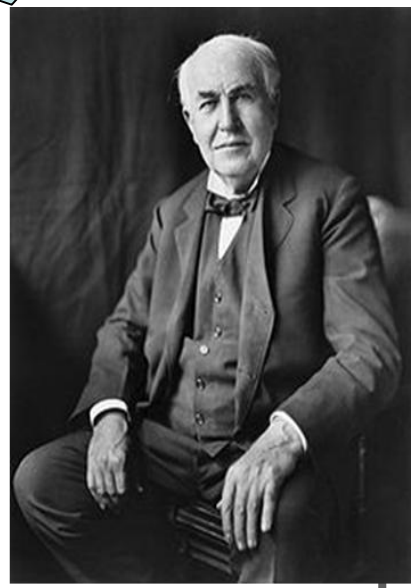
Solar energy a good idea between the past and the future!

"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait 'til oil and coal run out before we tackle that." *- Thomas Edison (1847-1931)*

Solar implulse 2 first fly around the world: started on March 2015

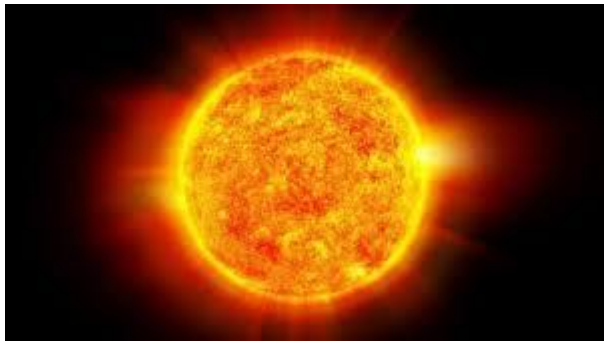


Why the increase of the renewable energy is important for the governments and citizens?

- To improve energy security (photovoltaic is not “localized”)
- To encourage economical development of:
  - Rural areas
  - High-tech sectors (new employments)
- To protect climate and environment by the impact of fuels coming from the fossil sources

IEA INTERNATIONAL ENERGY AGENCY, Information Paper, 2011 Simon Müller, Adam Brown, and Samantha Ölz

How much energy comes from the sun?



Petrol: the ultimate source of petrol available would provide
1.7×10^{22} joules.

This quantity is provided by the Sun in **1.5 giorni**

G.W. Crabtree and N.S. Lewis, Physics Today, March 2007

The quantity of energy that humans consume in 1 year is **4.6×10^{20} joule**
This quantity is provided by the Sun in **1 hour**

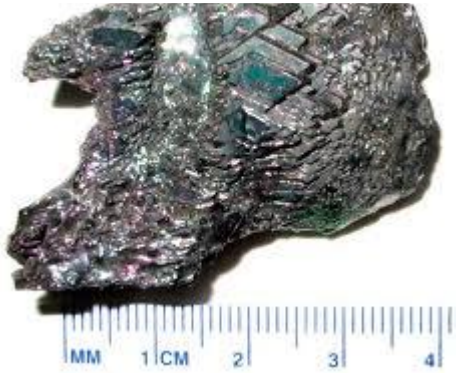
Photovoltaic energy, some remarks

• COSTS

How much energy (and money) for producing the converter (NOT FREE)?

• MATERIALS

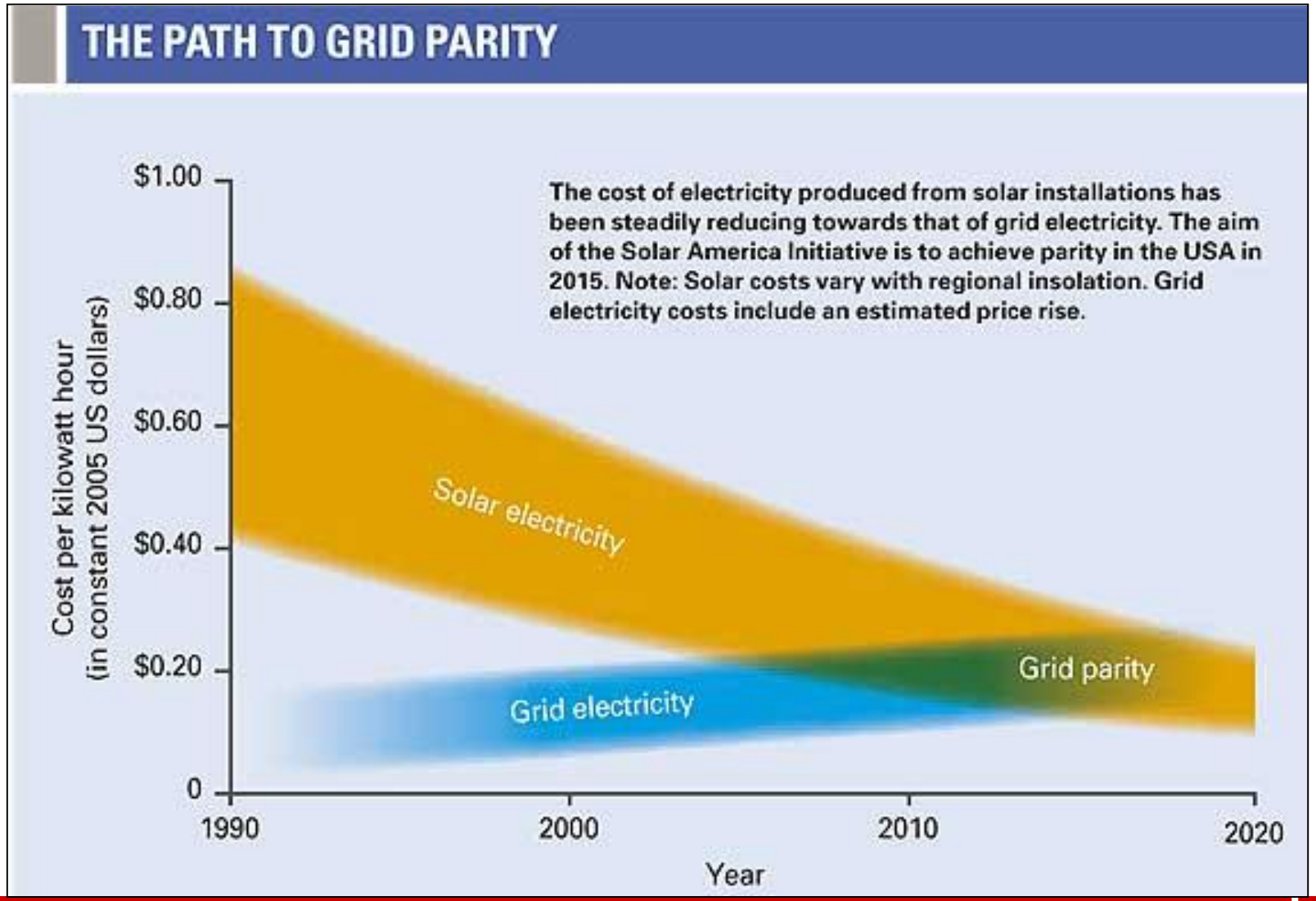
Which ones are suitable (diffused on a global scale, not toxic). NOT COMPLETELY CLEAN



•EFFICIENCY

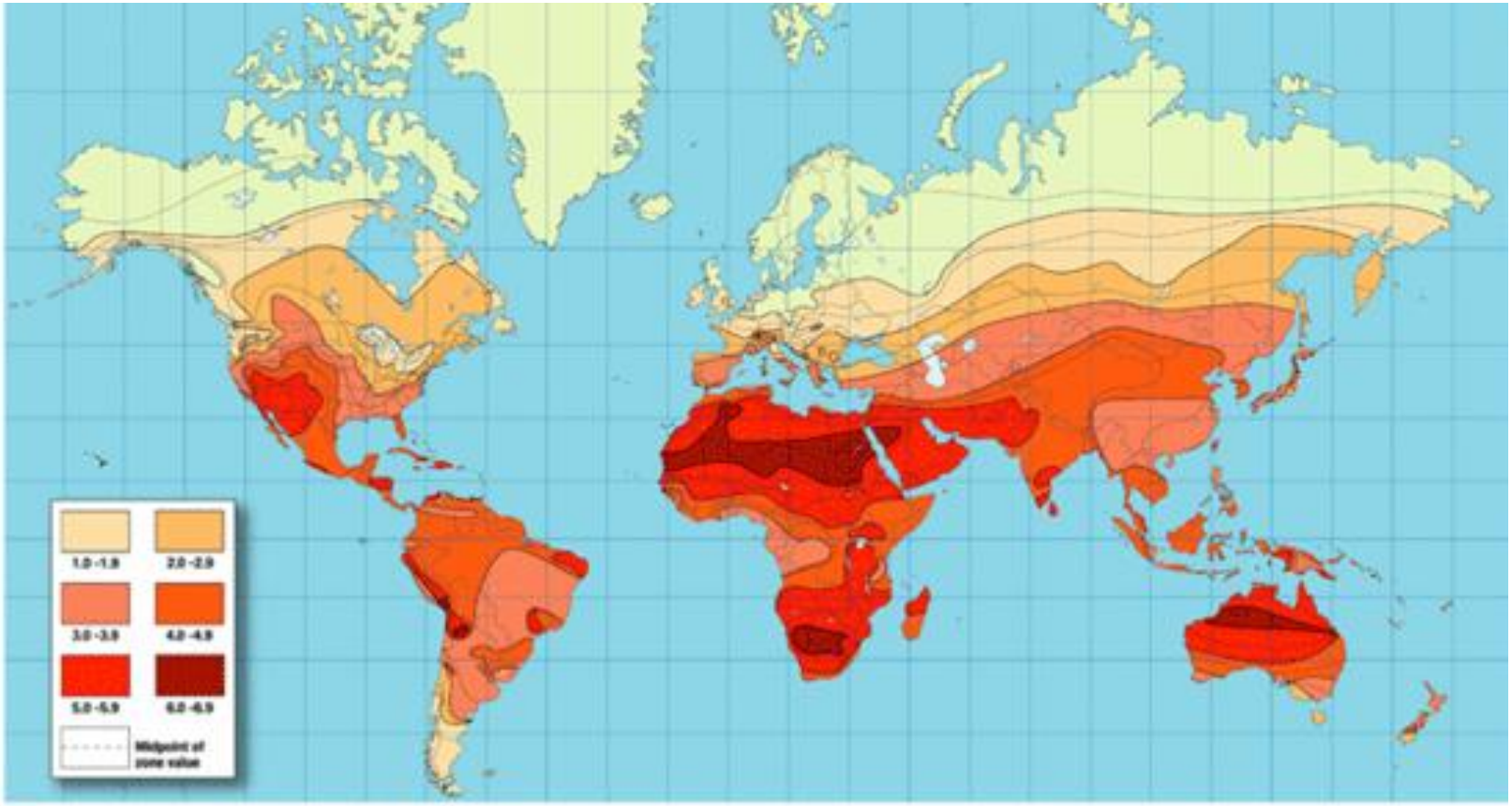
Does the converter produce more energy than what is needed for its construction?

GRID PARITY


THE PATH TO GRID PARITY
The cost of electricity produced from solar installations has been steadily reducing towards that of grid electricity. The aim of the Solar America Initiative is to achieve parity in the USA in 2015. Note: Solar costs vary with regional insolation. Grid electricity costs include an estimated price rise.
Cost per kilowatt hour (in constant 2005 US dollars)
$1.00
$0.80
$0.60
$0.40
$0.20
0
Solar electricity
Grid parity
Grid electricity
1990
2000
2010
2020
Year

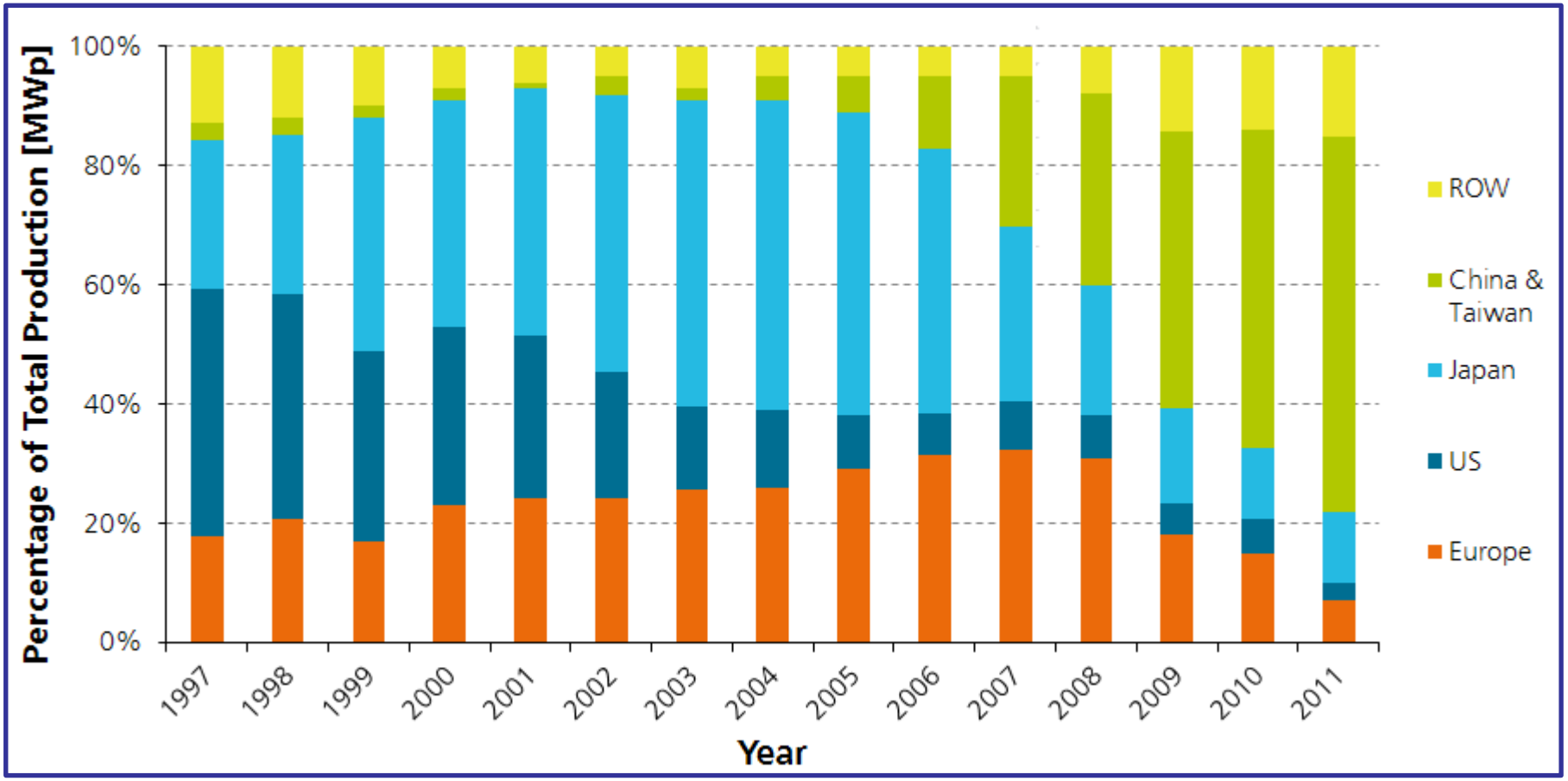
PV parity

http://www.youtube.com/watch?v=JPUHgnEFJvY&list=PLmo6OBXJcmO375xT1DcYQzF9z4q0ZFC5o

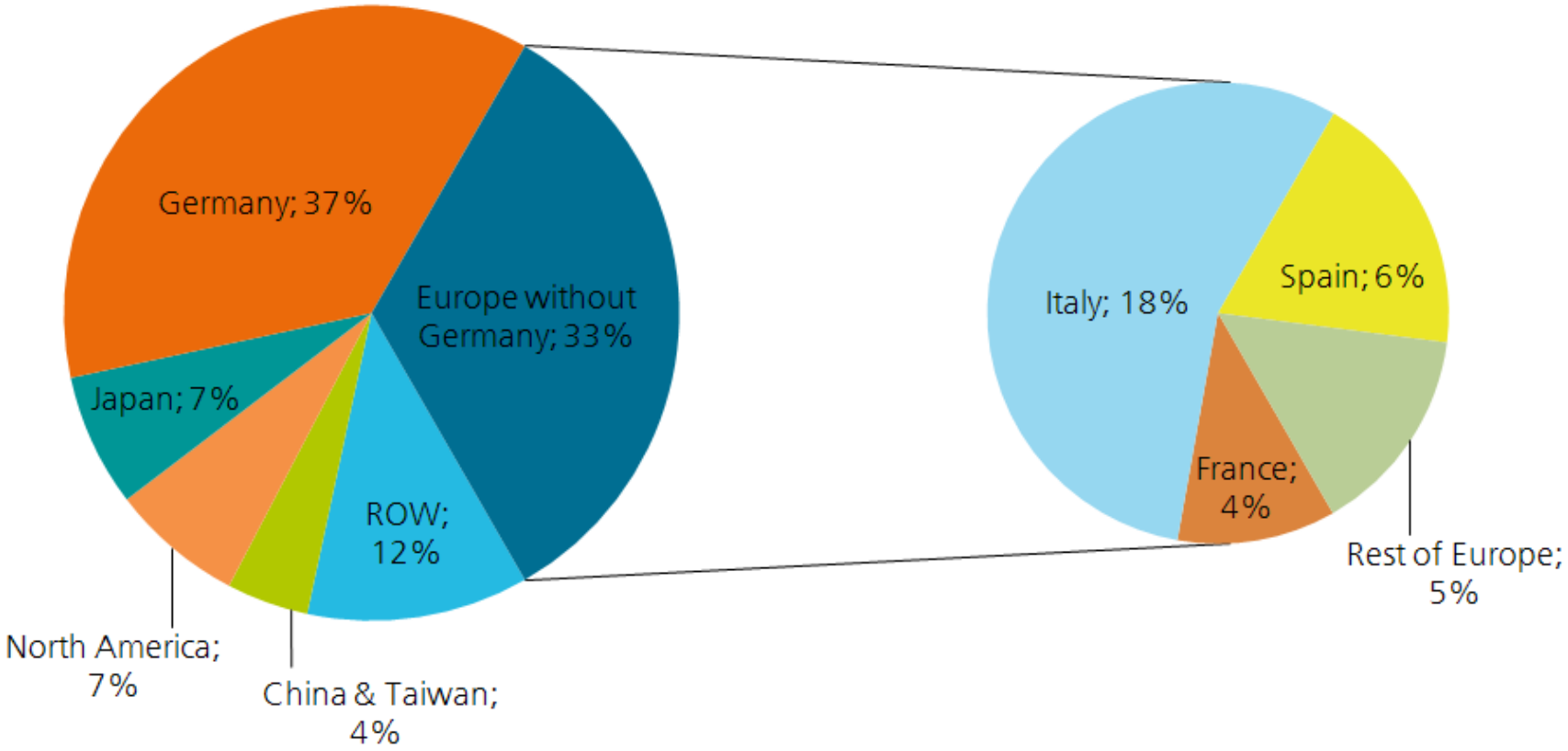


http://www.pvparity.eu/

How much the low price costs? Where is it produced?



Where is it installed?

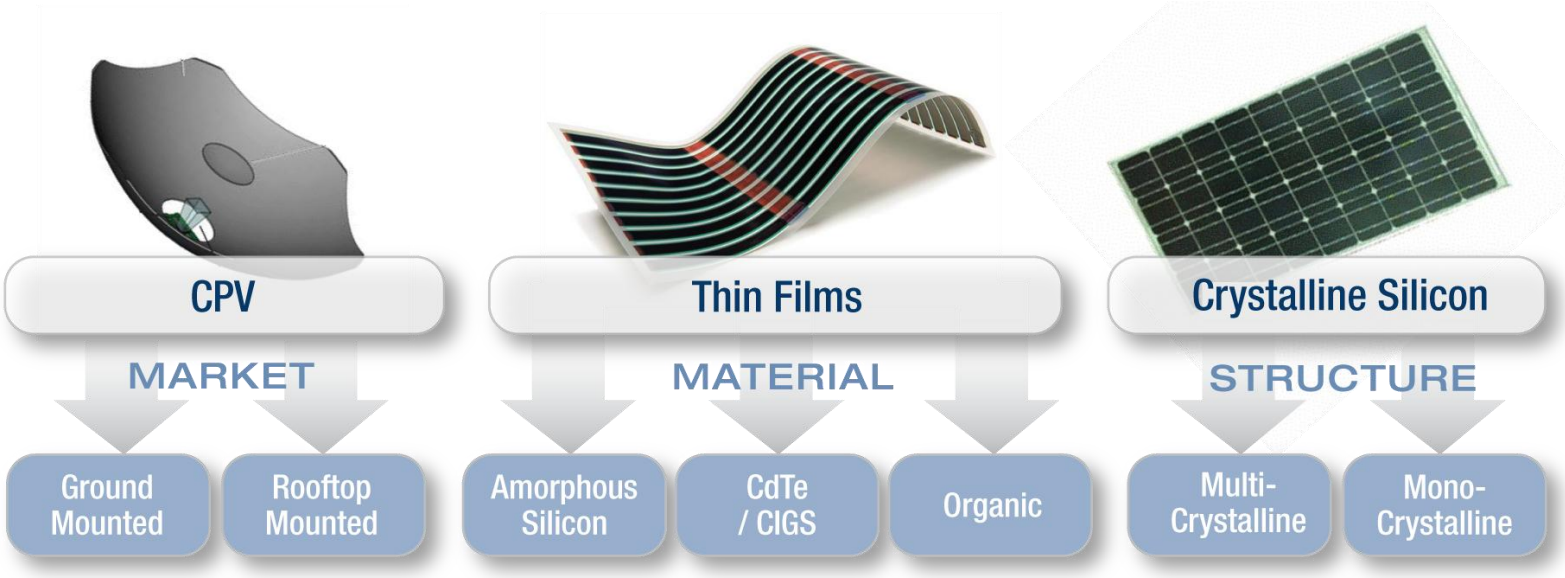


Has the costs issue been solved?

- The low costs of photovoltaic is related to the low price of energy and work in Asian Countries
- European industry has failed with job losses
- How to solve the problem??

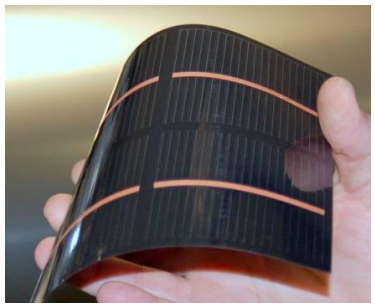
Innovative materials, new structure of the cells

Which is the “ideal” material? High efficiency and low prices?

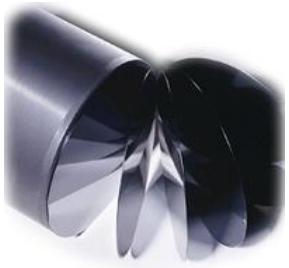


20x-100x

500x

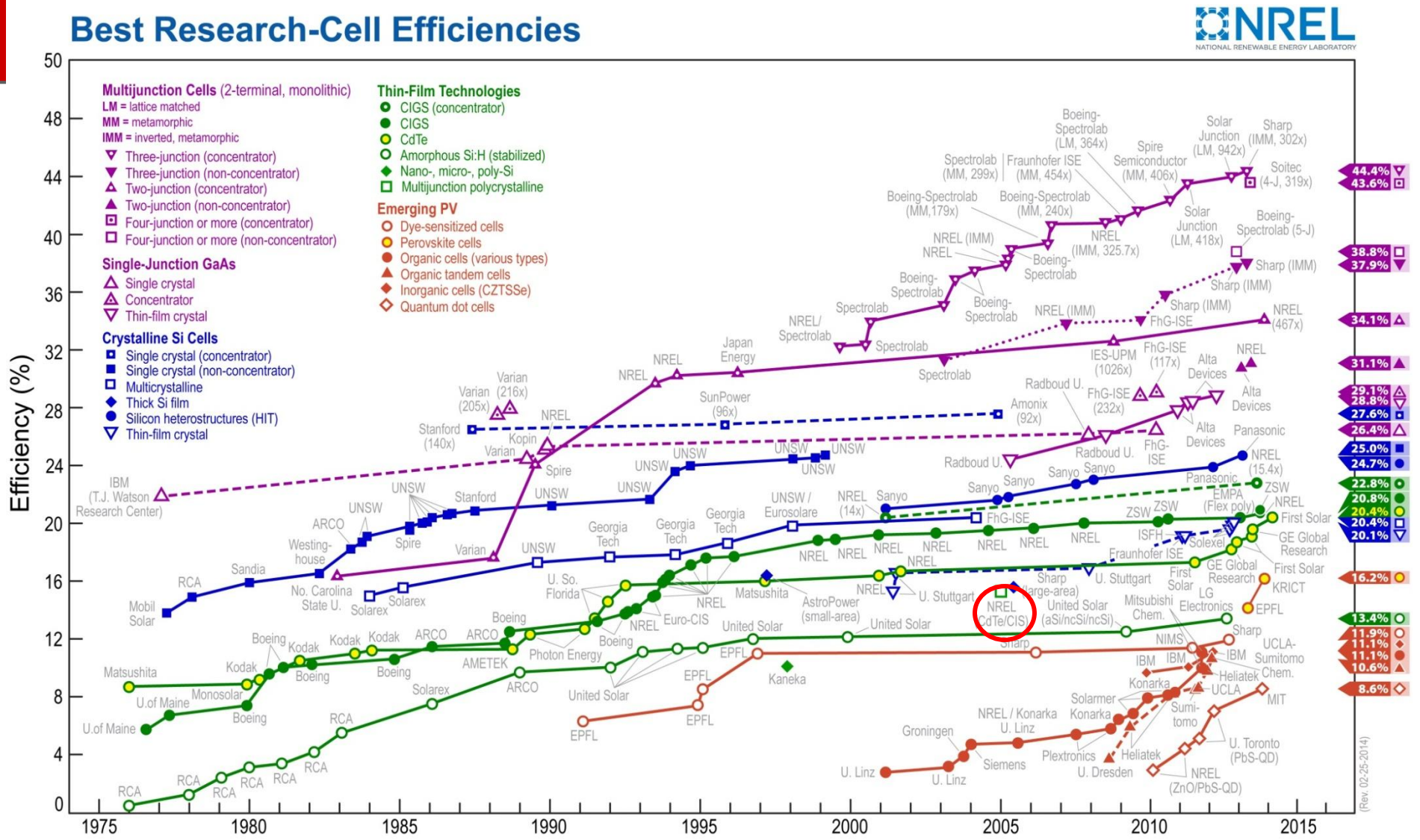


Cu(In,Ga)Se_2 ~ 1-2 um



c-Si ~ 180 um

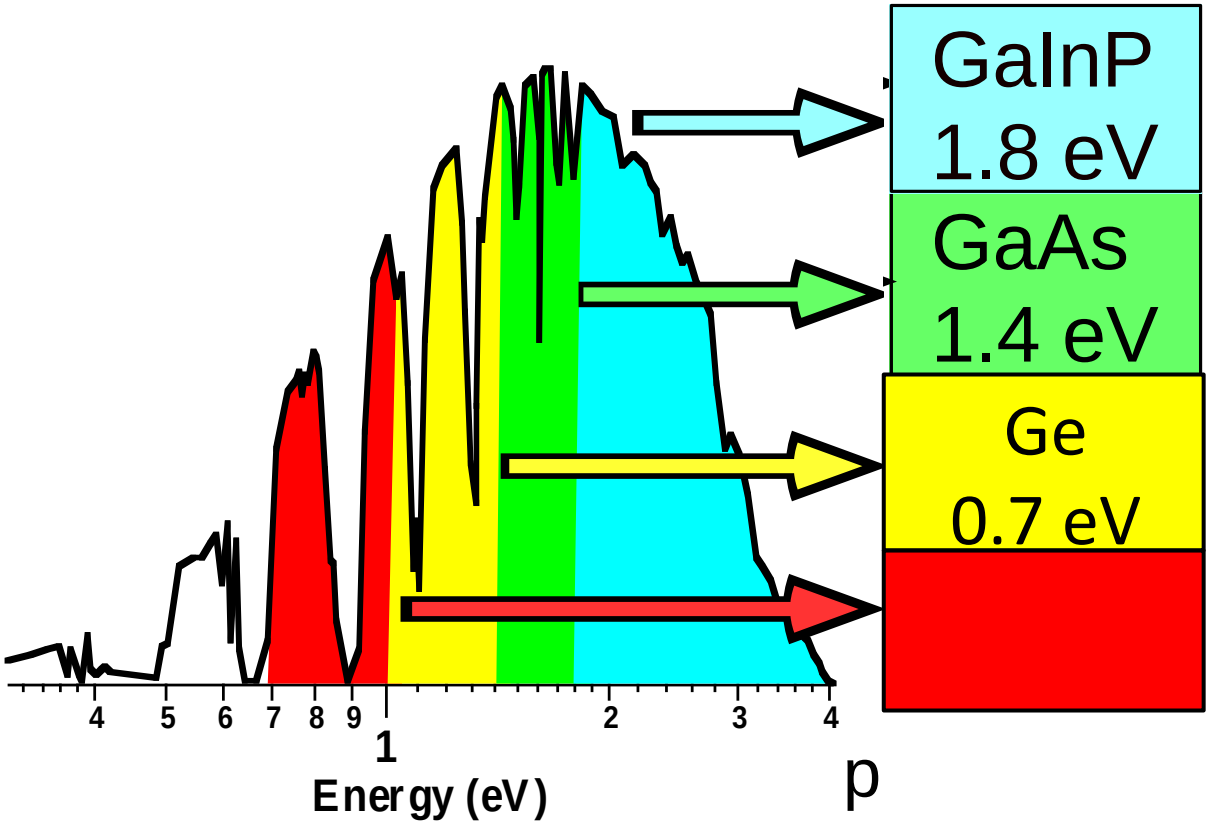
Efficiency?



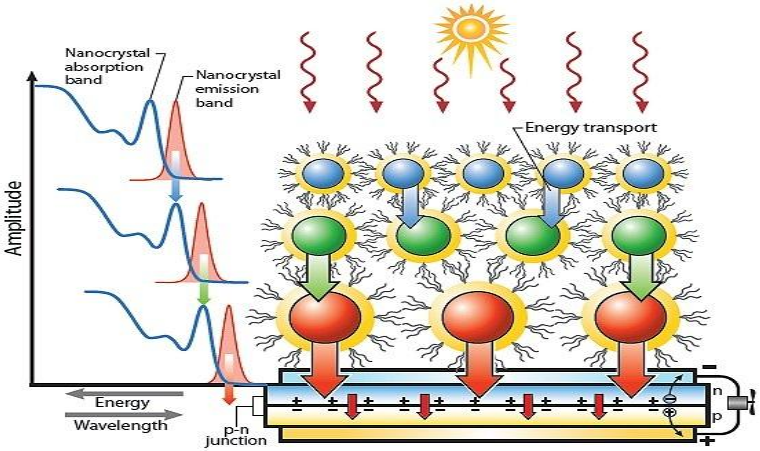
Efficiency Records Chart available at: http://www.nrel.gov/ncpv/images/efficiency_chart.jpg. The chart above was downloaded on 2/27/2014.

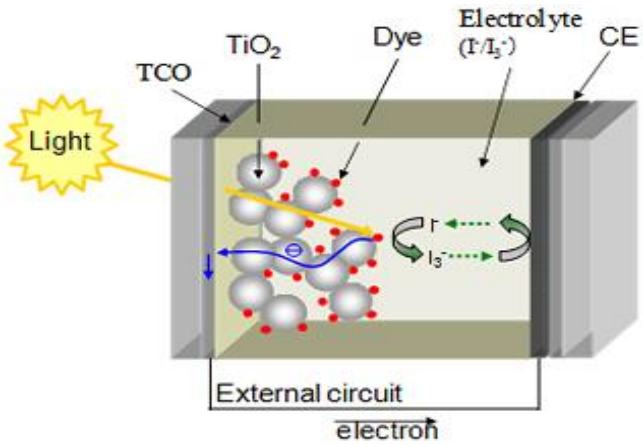
Tandem cells

- Each region of the solar spectrum is absorbed by a different material



Modifying the material: **NANOTECHNOLOGIES.**





Examples are:

- Quantum Dot cells: the storing of energy depends on the dimensions of nanocrystals within the materials

- Graetzel cell: the storing of energy occur by means of processes which remind the natural photosynthesis

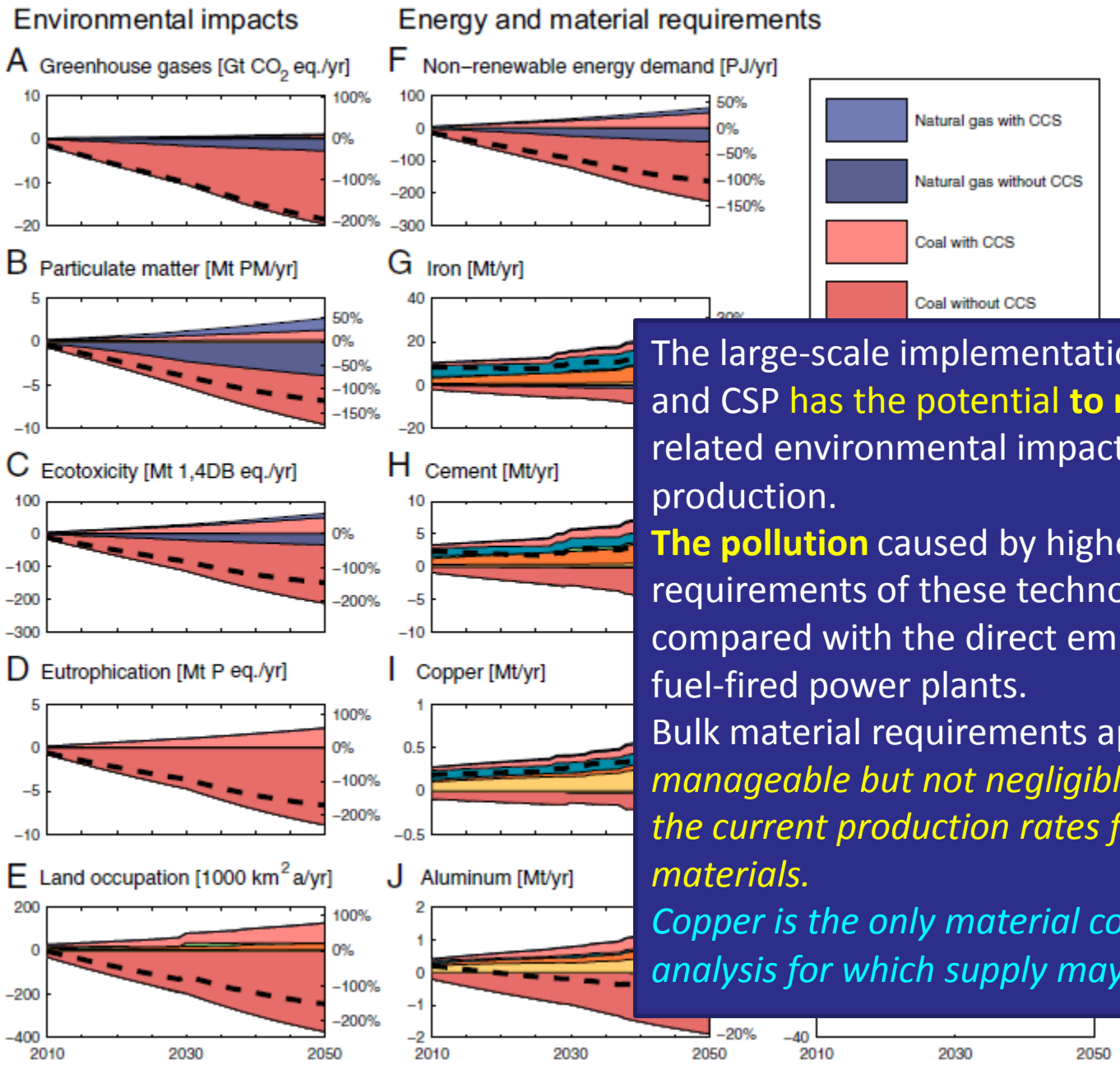
Energy supply and possible solution

- *For the 79% of European citizens, the price of photovoltaic is lower than the price of residential energy*

- Transition toward a **LCE** *Low Carbon Economy*

- Which will be the best solution?
  - Energy-mix (renewable: solar, eolic, geotermic, etc.)

- Which the instruments for evaluation?
  - LCA *life cycle assessments are used for analyzing benefits and costs coming from the various sources*



The large-scale implementation of wind, PV, and CSP has the potential **to reduce** pollution-related environmental impacts of electricity production.

The pollution caused by higher material requirements of these technologies **is small** compared with the direct emissions of fossil fuel-fired power plants.

Bulk material requirements appear *manageable but not negligible compared with the current production rates for these materials.*

Copper is the only material covered in our analysis for which supply may be a concern.