

Solar Energy and Sustainability

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How long it comes



Refrigerador solar, João Pessoa 1983

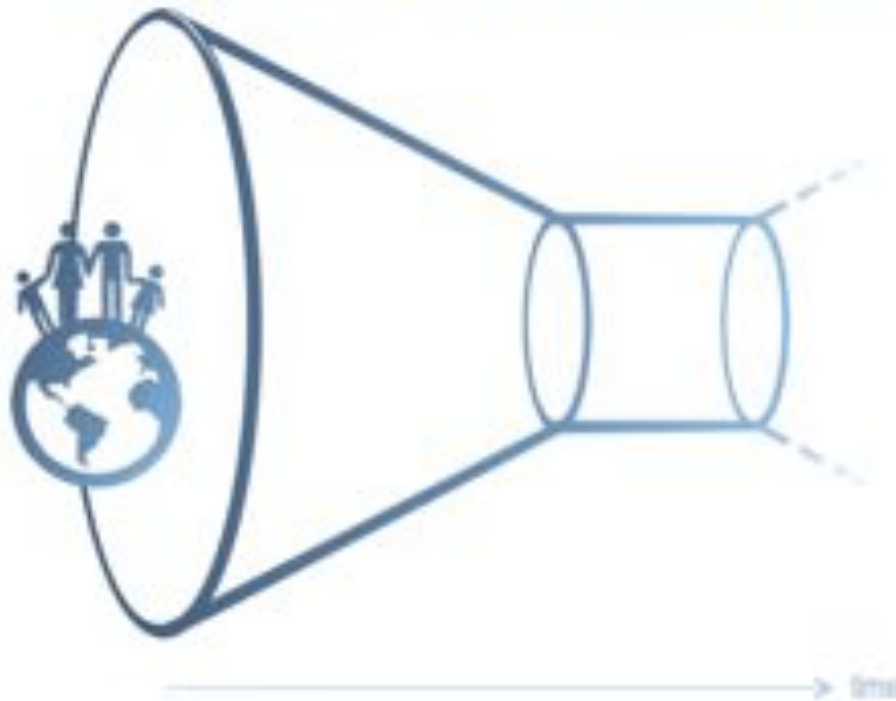


Coletor a adsorção para A/C
Medellín 2010

Sustainability, a dynamic challenge



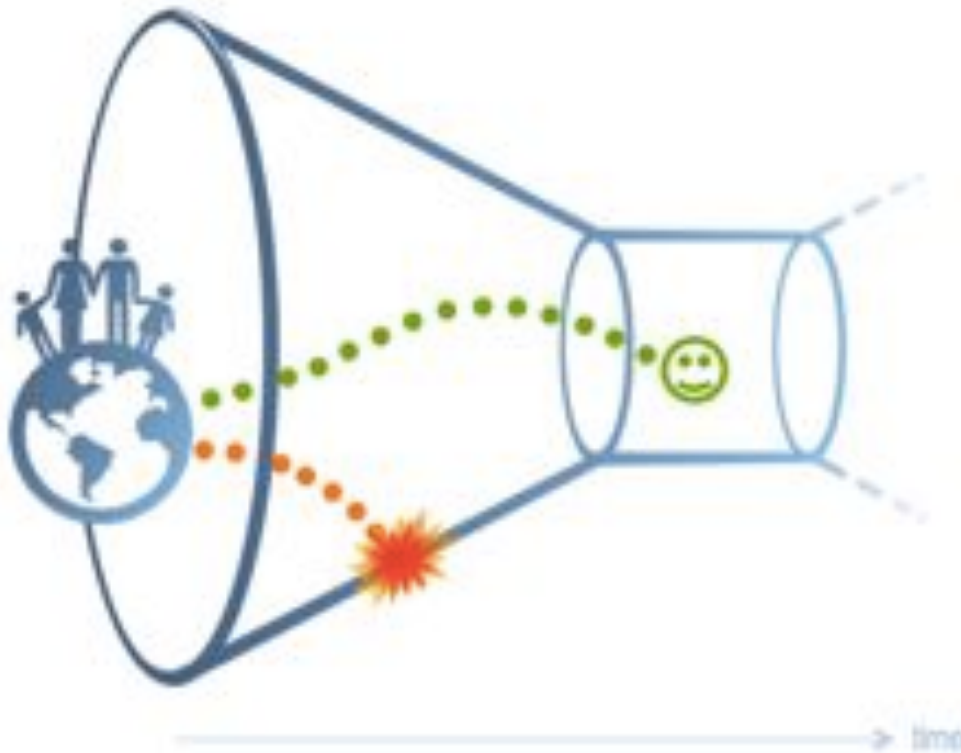
The 'funnel' of declining potential to sustain human civilization



Systematic decline

- Forests
- Agriculture
- Fisheries
- Ground water
- Climate
- Metals
- POP's
- Eutrophy
- Hormones
- Loss of trust
- Loss of diversity
- Segregation
- Corruption
- Epidemias
- Poverty
- ...

... and the greatest opportunity for economic success



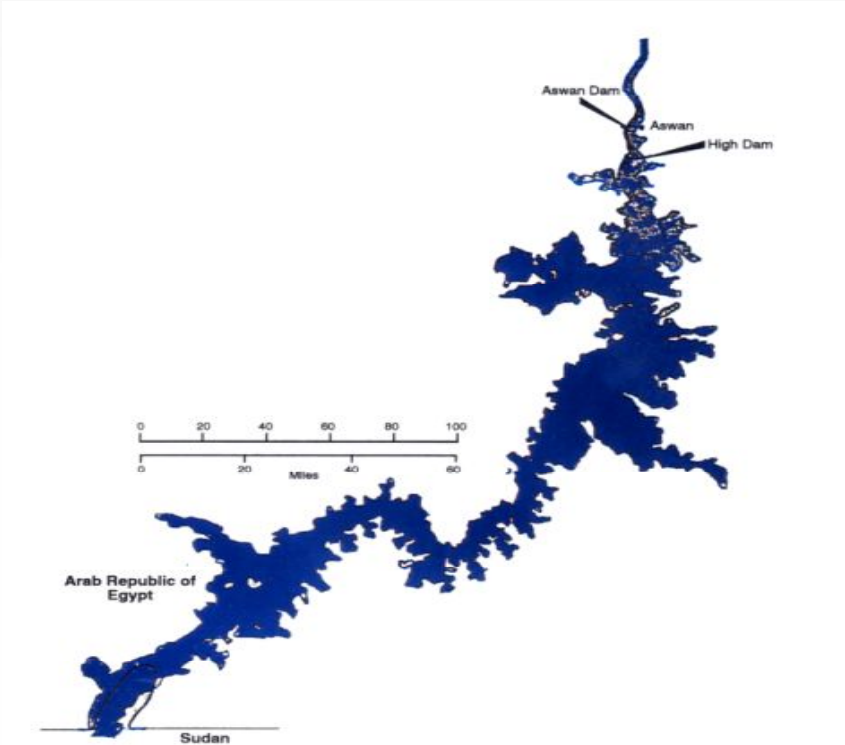
Opportunities

- Resource management
- Waste management
- Tax, legislation, insurance, loans
- New markets
- Innovation/design
- Trust
- Productivity,
- Transaction costs
- Brand
- Stories of meaning
- Team building
- Community
- ...

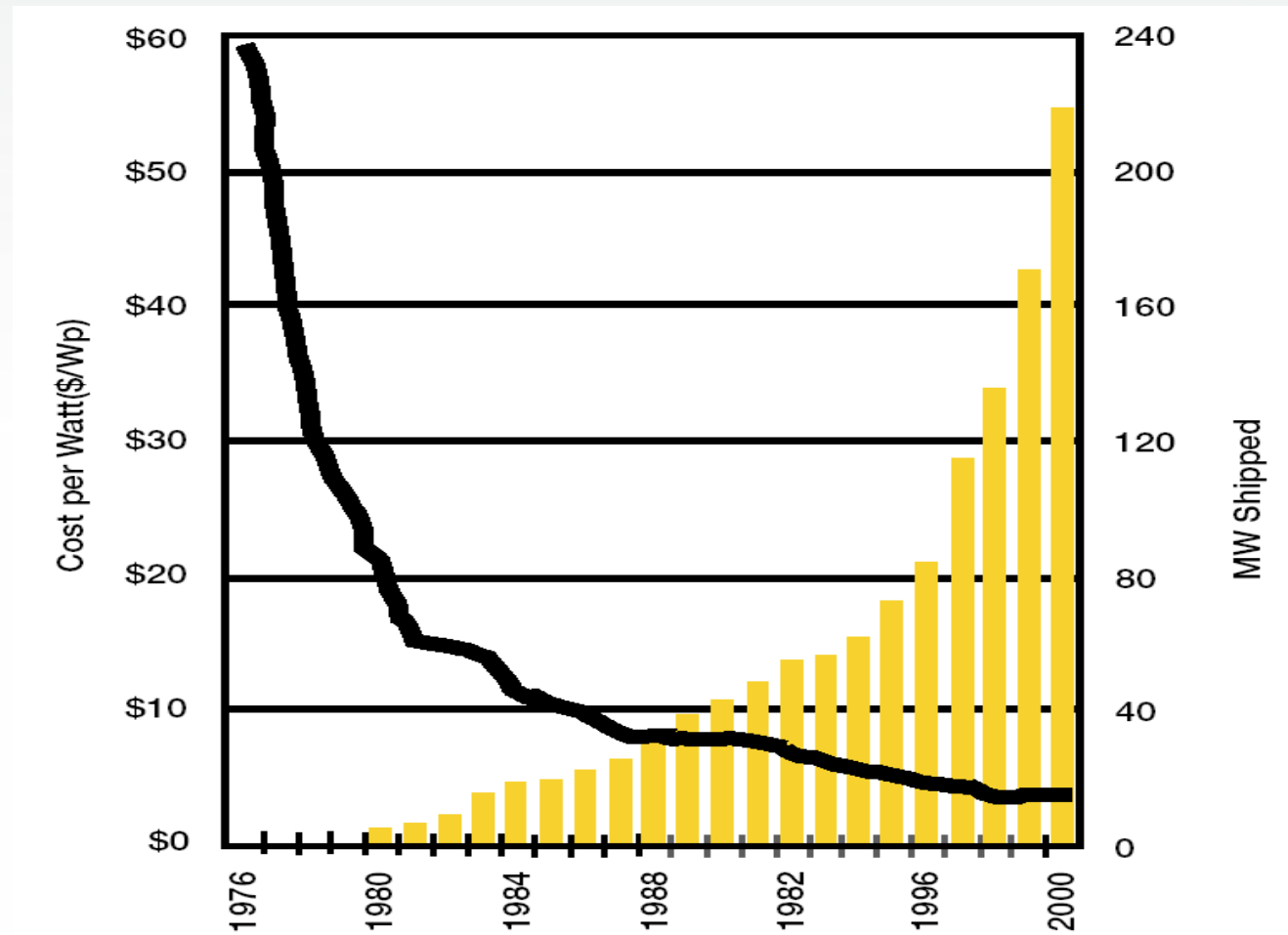
Value growth under reduced flows:
solar energy as an example of decoupling



Land use by PV versus hydro dam

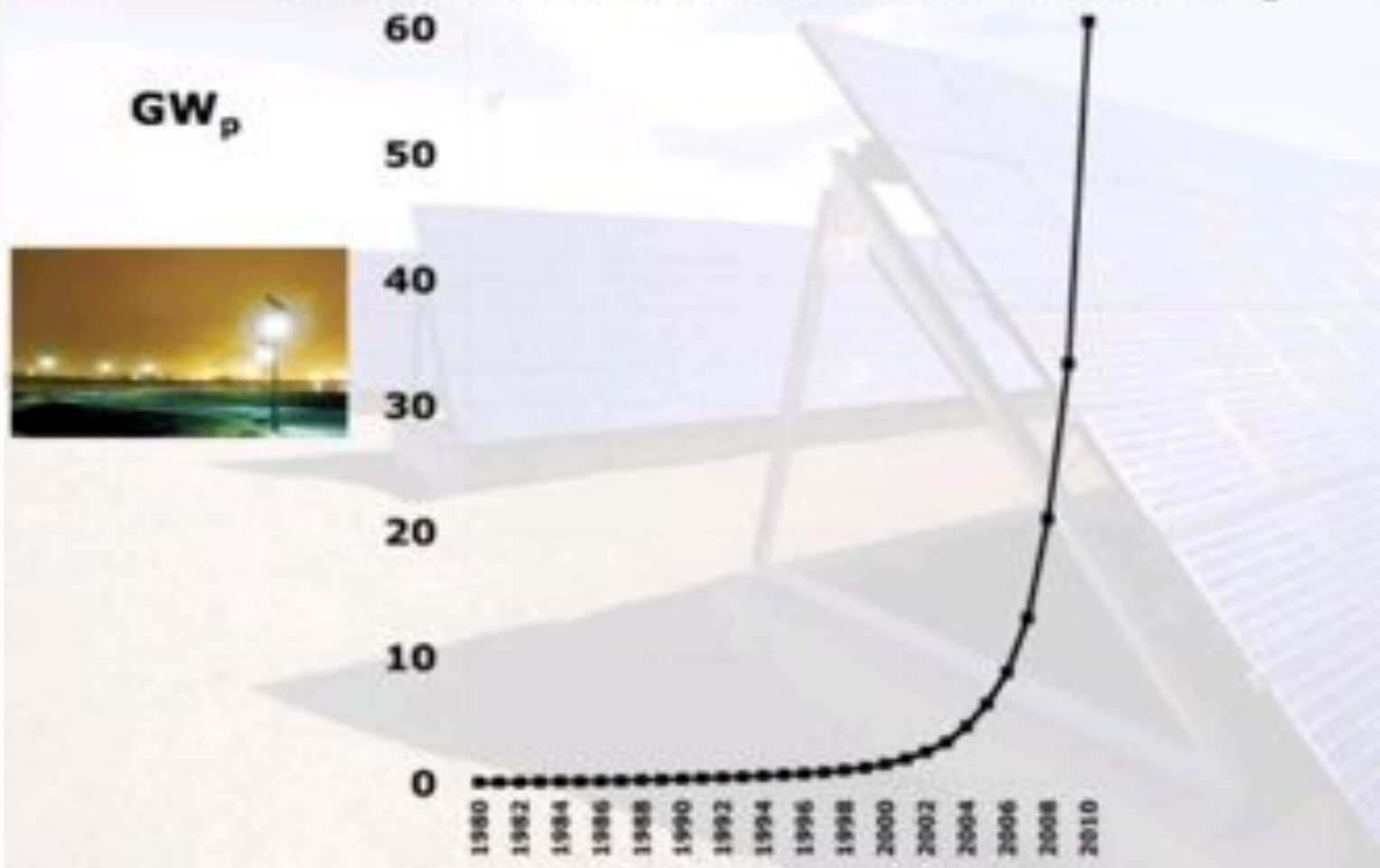


PV learning curve, Europe



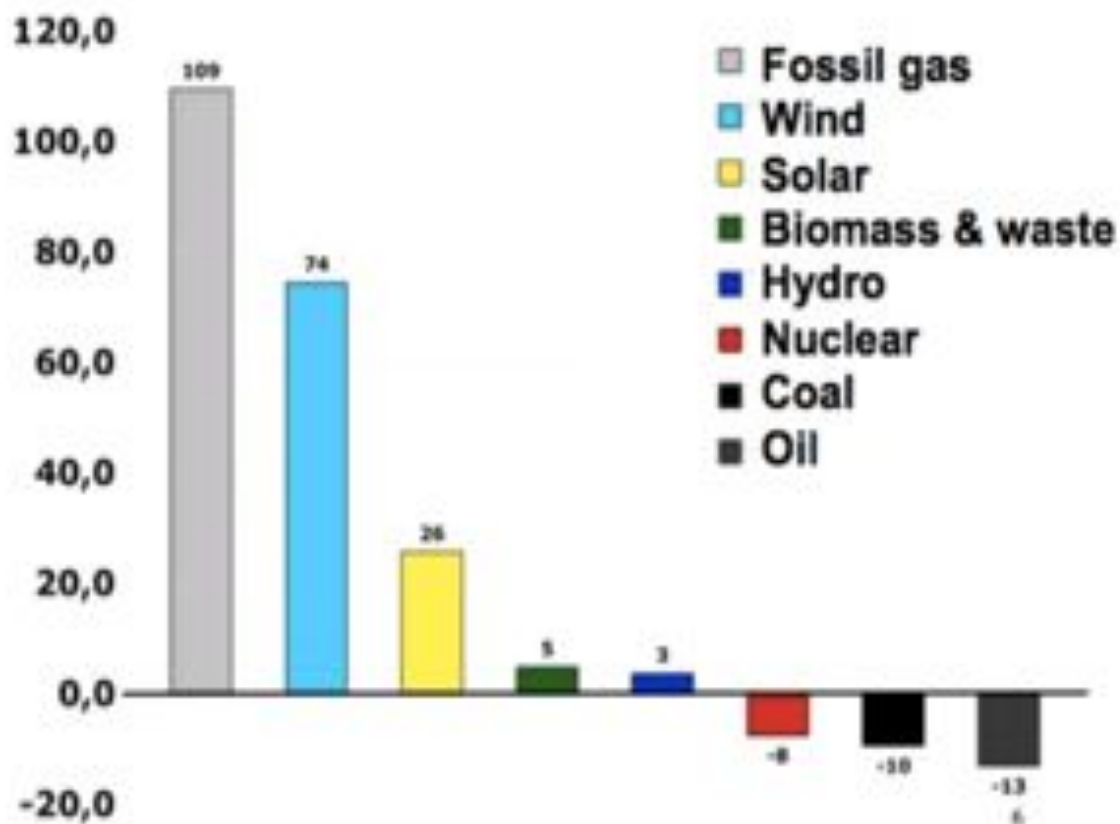


Accumulated Solar PV, Globally





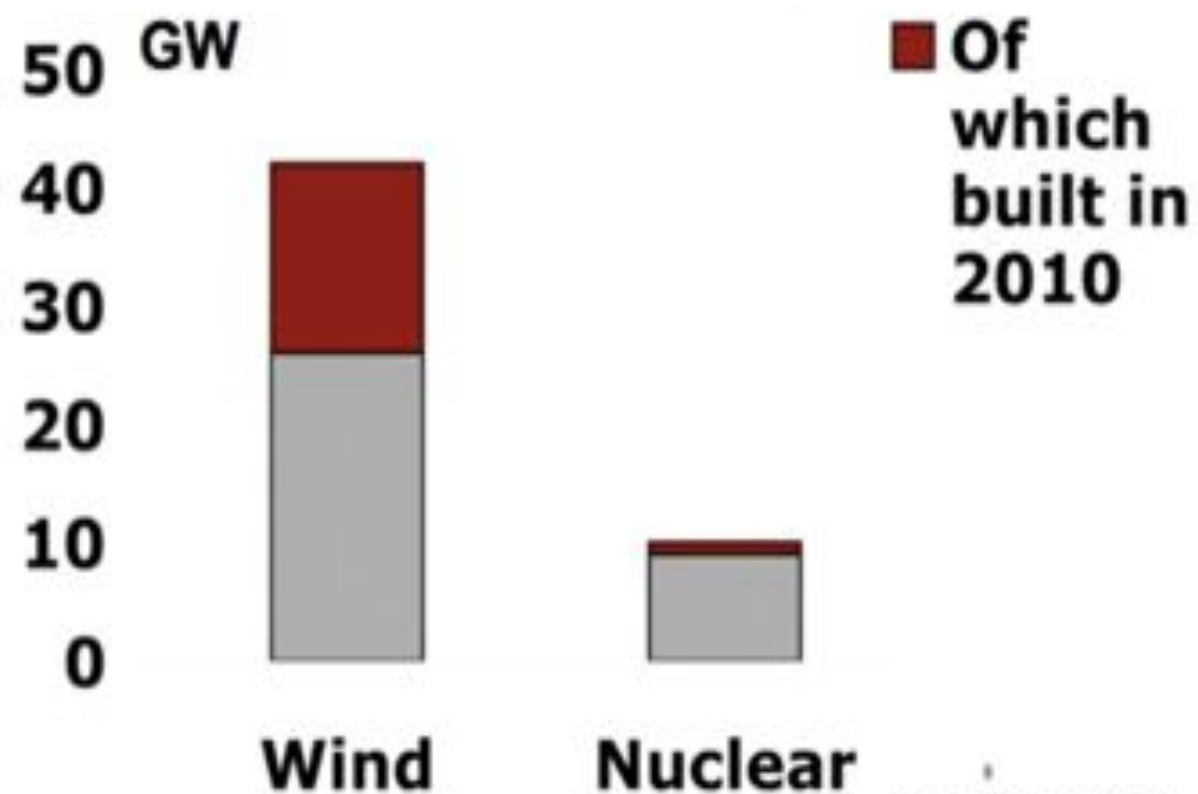
New production capacity in EU 2000-2010



Förberikat ut data från Purts via EYREA 2009, 2010



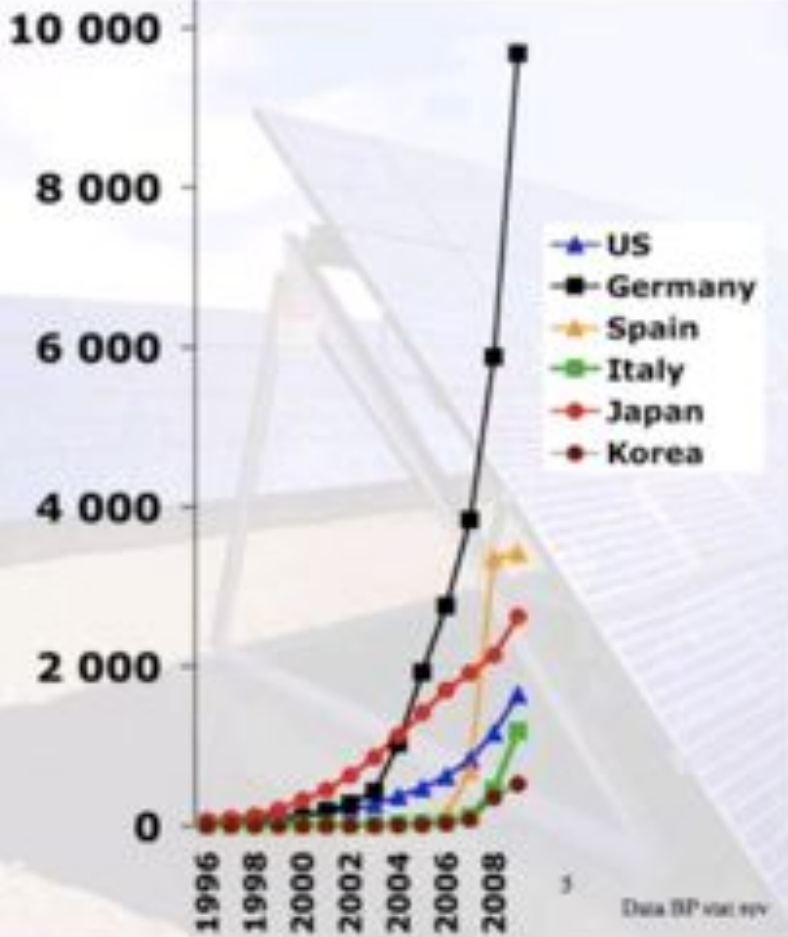
Power production capacity in China end of 2010



Data from IAEA Pils and GWEC



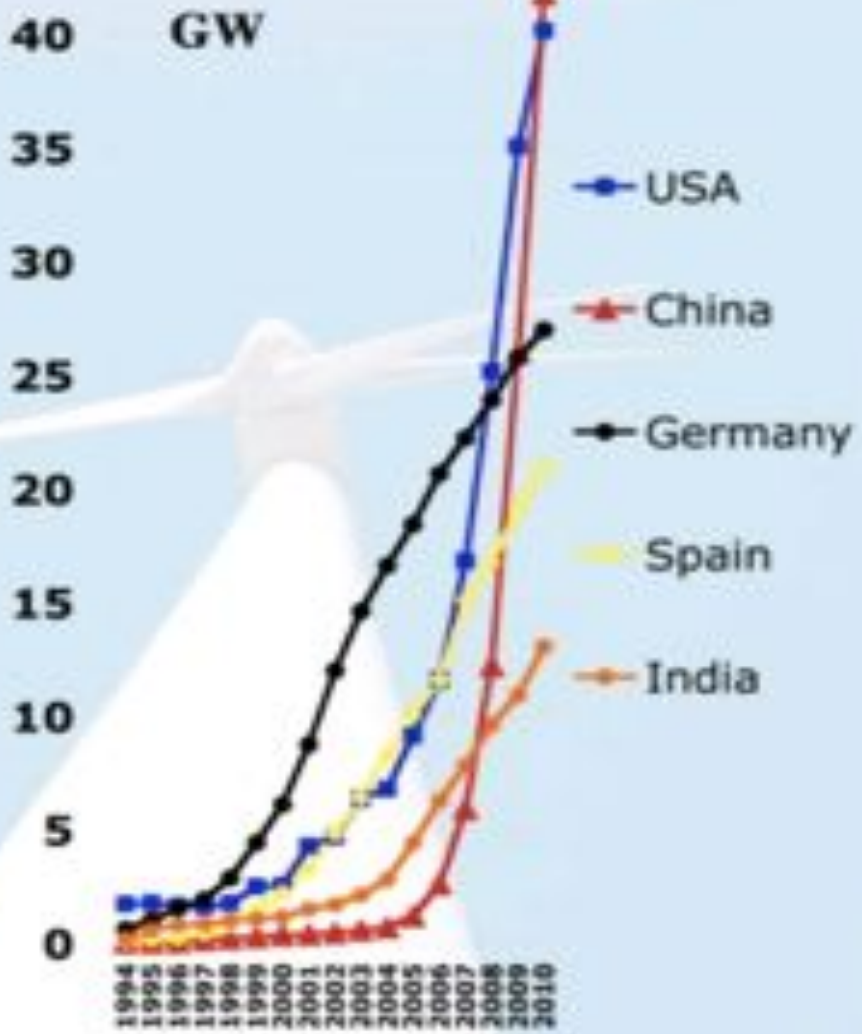
Solar PV leading countries MW



Data BP vici evv



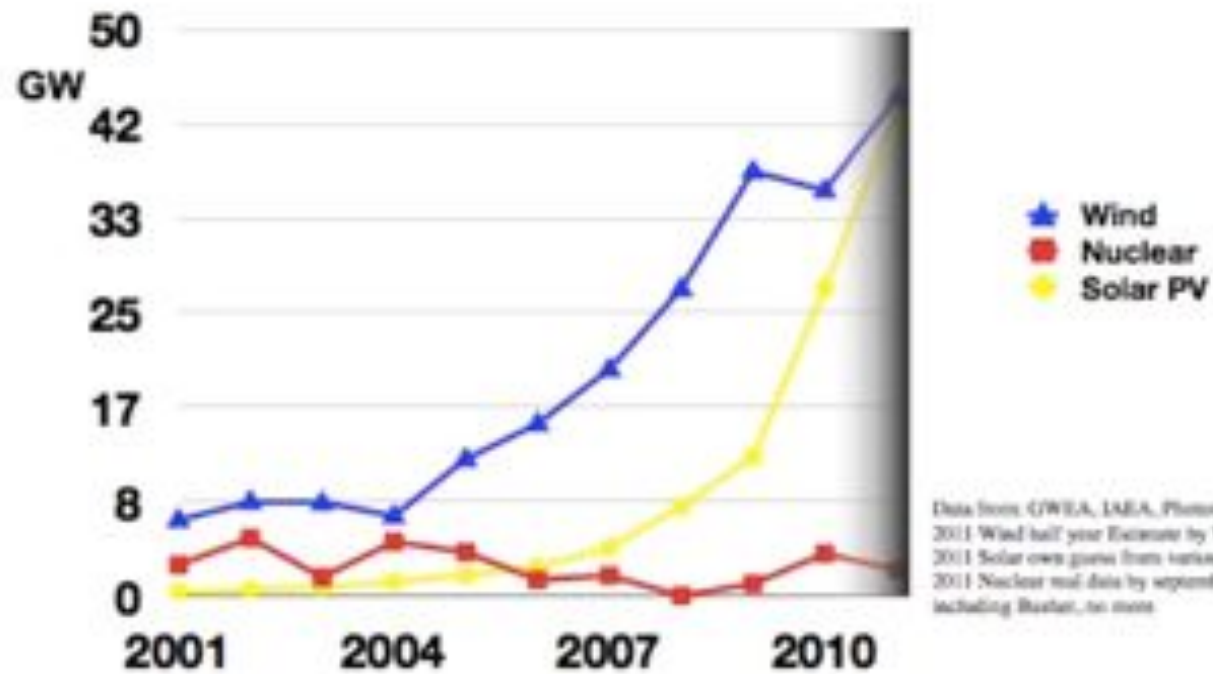
Wind power in leading countries



Data from GWEC



Global capacity increase 2001-2011

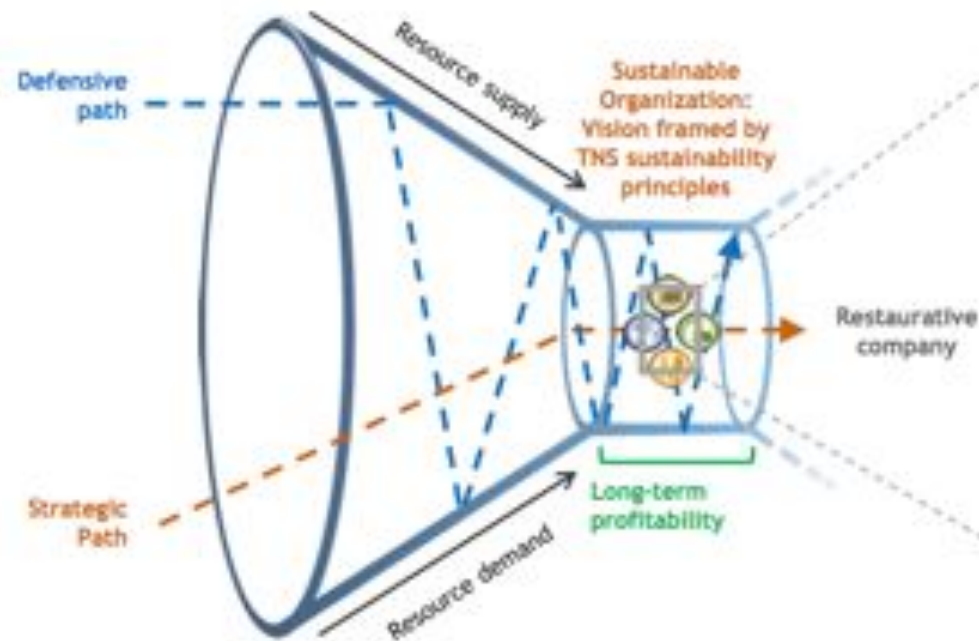


Data from: GWEA, IAEA, Photon, Platts,
2011 Wind half year Estimate by WWEA
2011 Solar own guess from various sources
2011 Nuclear real data by september
including Baskin, to most

The four system conditions






Investing in the future: Strategic moves guided by environmental limits




TNS four System Conditions defining Sustainability

In a sustainable society, nature is not subject to systematically increasing...






-  ... concentrations of substances extracted from the Earth's crust,
-  ... concentrations of substances produced by society,
-  ... degradation by physical means,

and, in that society...

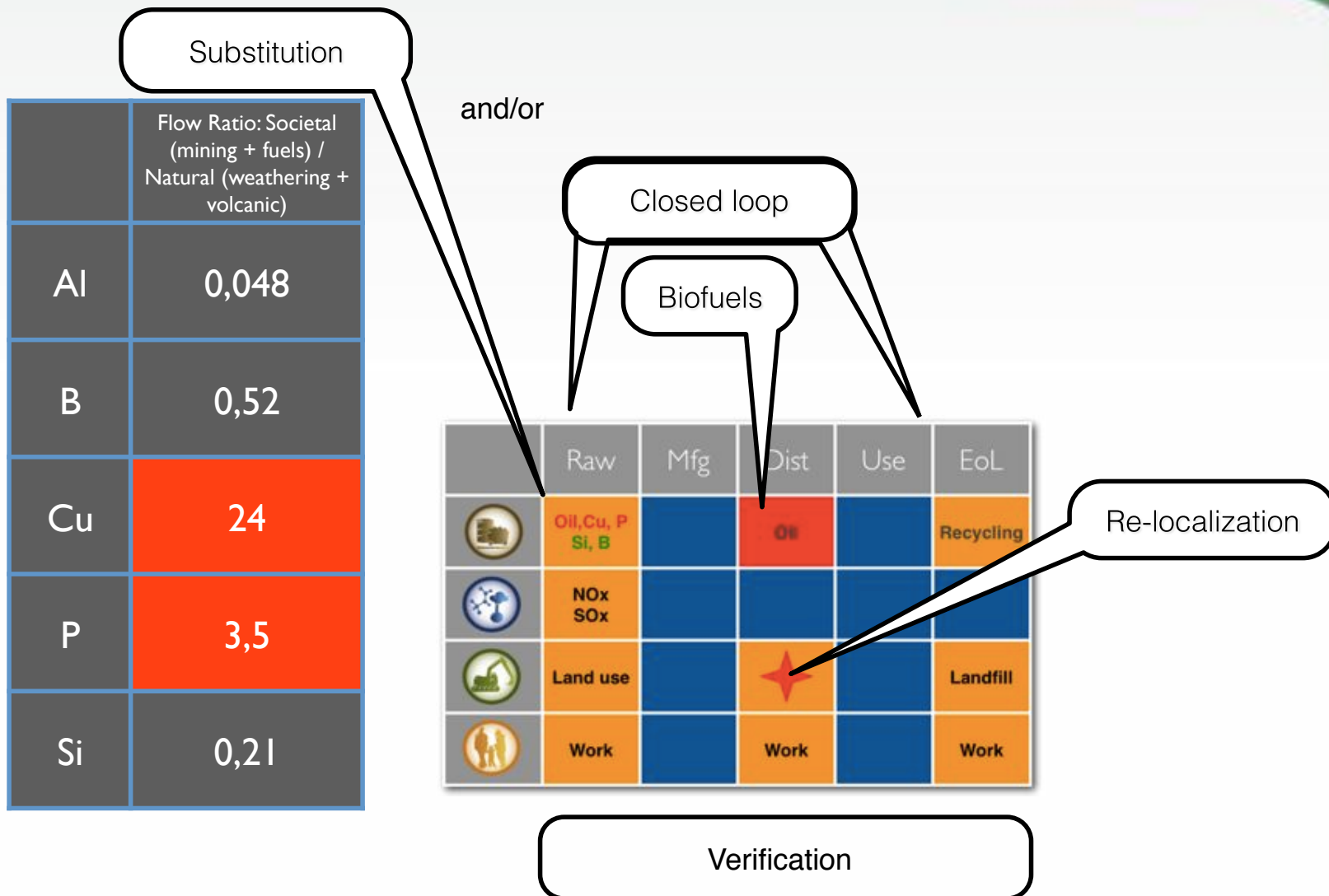
-  ... people are not subject to conditions that systematically undermine their capacity to meet their needs.

SLCA – Sustainability Life Cycle Assessment applied to a PV array



	Raw	Mfg	Dist	Use	EoL
	Oil, Cu, P Si, B		Oil		Recycling
	NOx SOx				
	Land use				Landfill
	Work		Work		Work

How to increase PV sustainability... even more



Substitution

Closed loop

Biofuels

Re-localization

Conclusions



- Solar energy plays a fundamental role for a sustainable future
- Brazil is far from demonstrating a strategic move towards it as done by China and E.U. countries
- Although "green", solar technology is still not "sustainable"
- Sustainability Cycle Assessment is a useful tool to get visibility on how consistency of any technology, including solar energy applications, can be improved towards a robust definition for sustainability