Global Energy Perspectives and the Role of New Technologies

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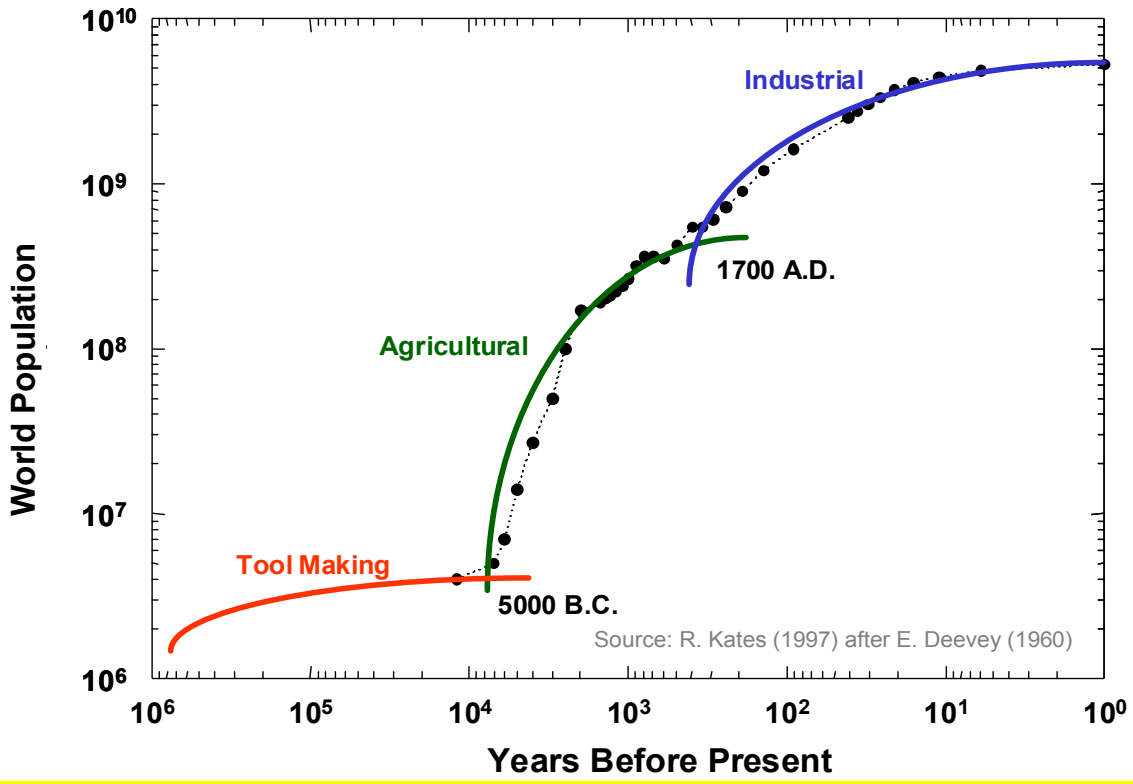
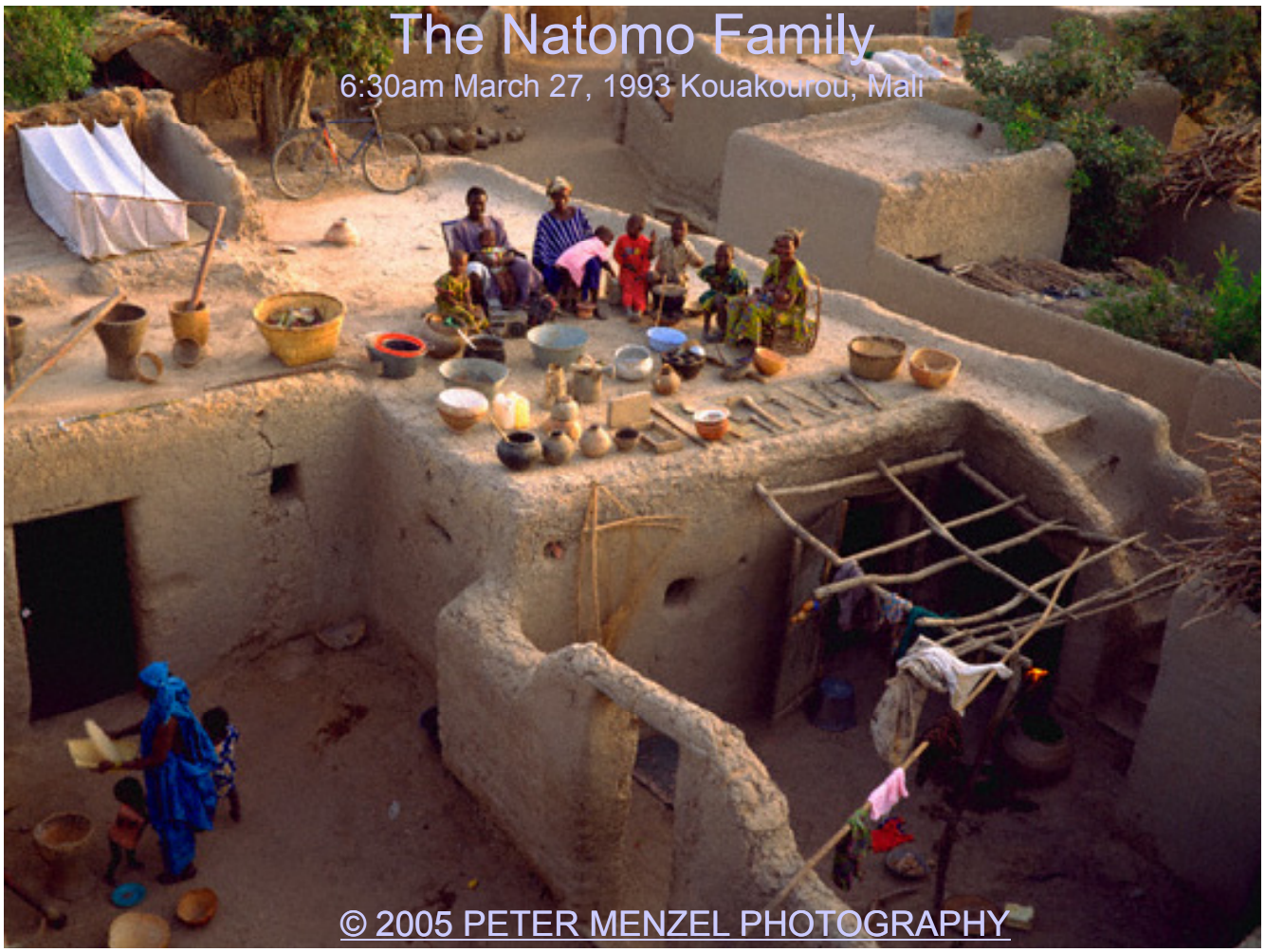
New Worlds: Grand Transformations



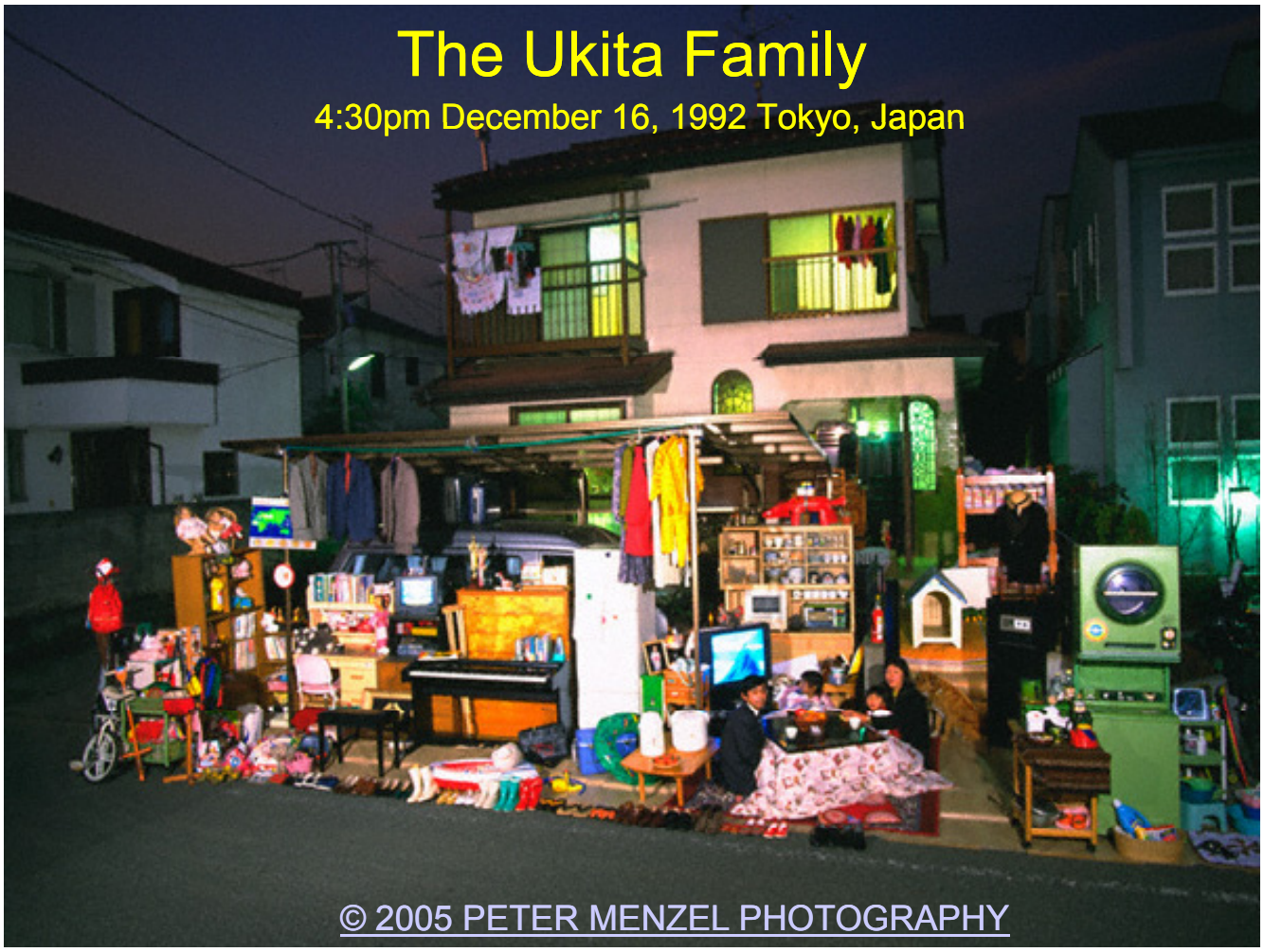
Global Energy Transformations

- Access to energy and ecosystem services (a prerequisite for MDGs & wellbeing)
- Vigorous decarbonization for mitigating climate change brings multiple co-benefits
- Energy transformations require R&D and rapid technology diffusion & deployment
- Sustained energy investments are needed and would result in multiple co-benefits



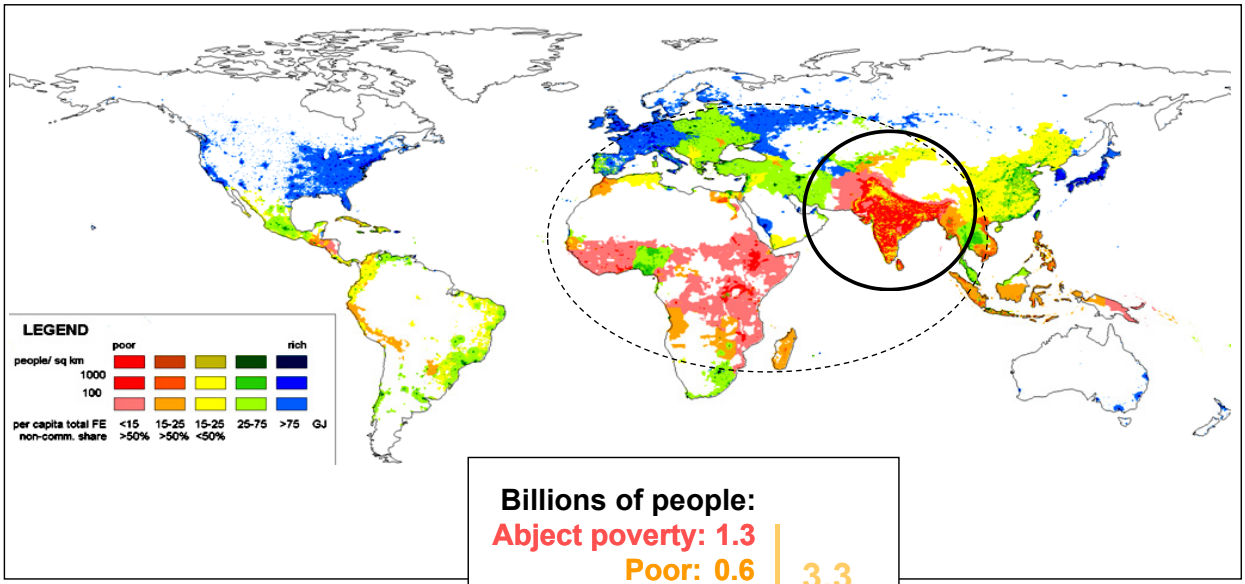
The Ukita Family

4:30pm December 16, 1992 Tokyo, Japan



Mapping Energy Access

Final energy access (non-commercial share) in relation to population density



Billions of people:

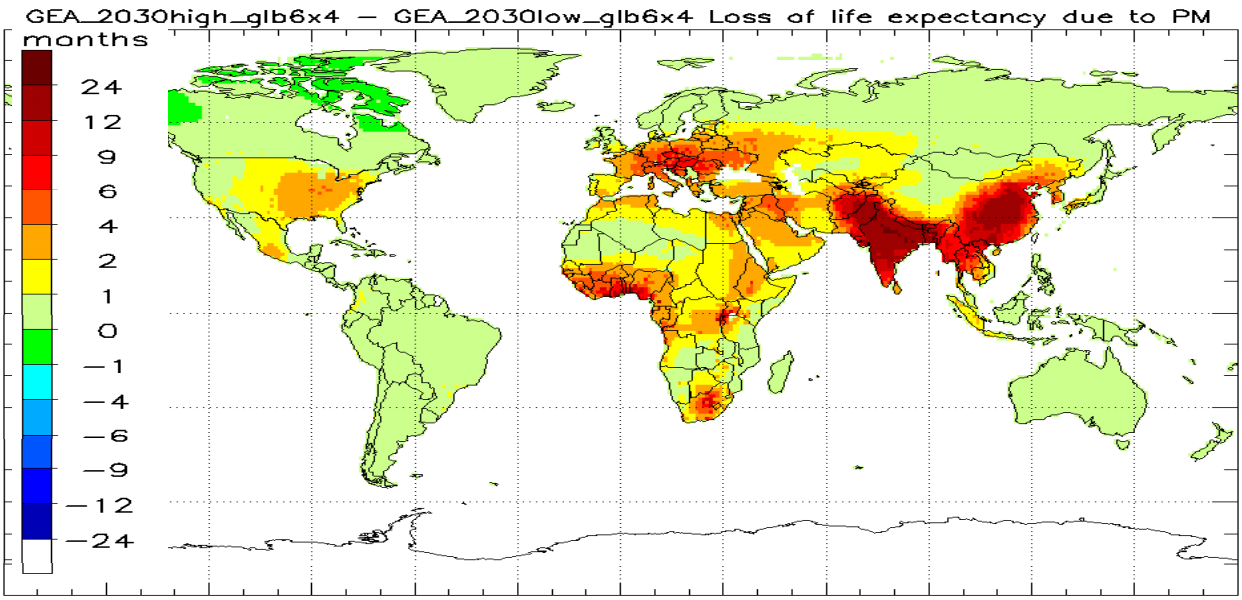
Abject poverty: 1.3
Poor: 0.6
Less poor: 1.4
3.3

Middle class: 1.4
Rich: 1.2
2.8

Source: Gruebler et al, 2009

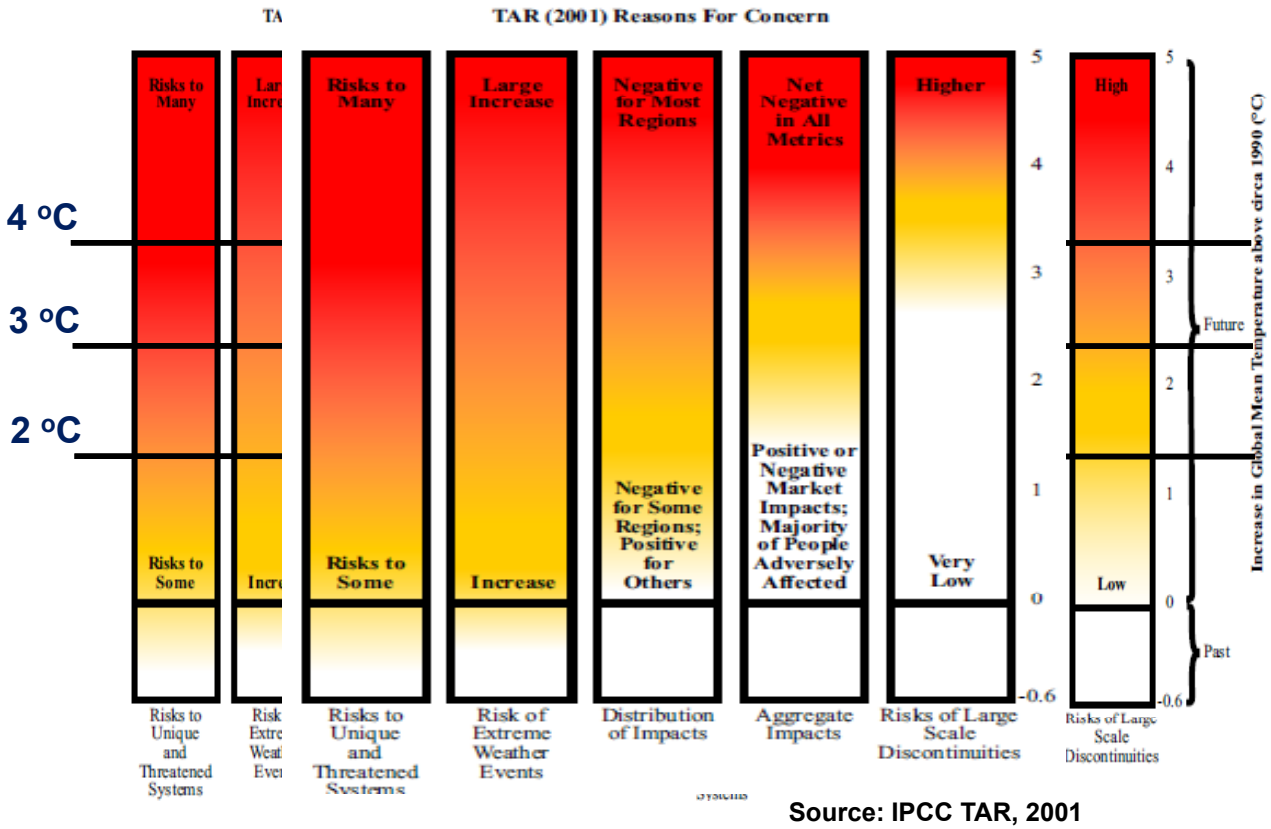
Health Benefits of Pollution Control

(loss of stat. life expectancy - PM)



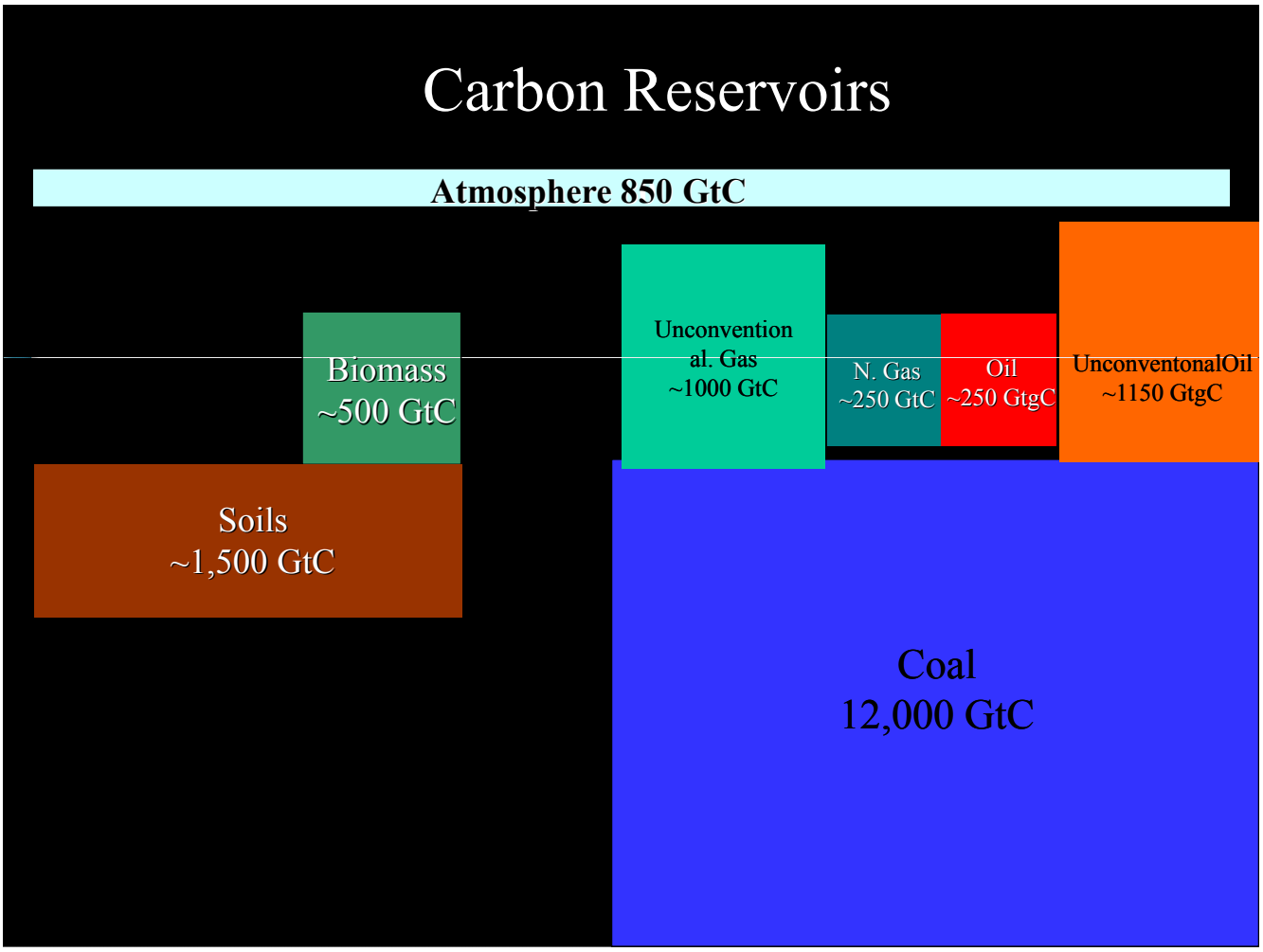
Source: Smith et al, 2009

Reasons for Concern – "Red Amber"

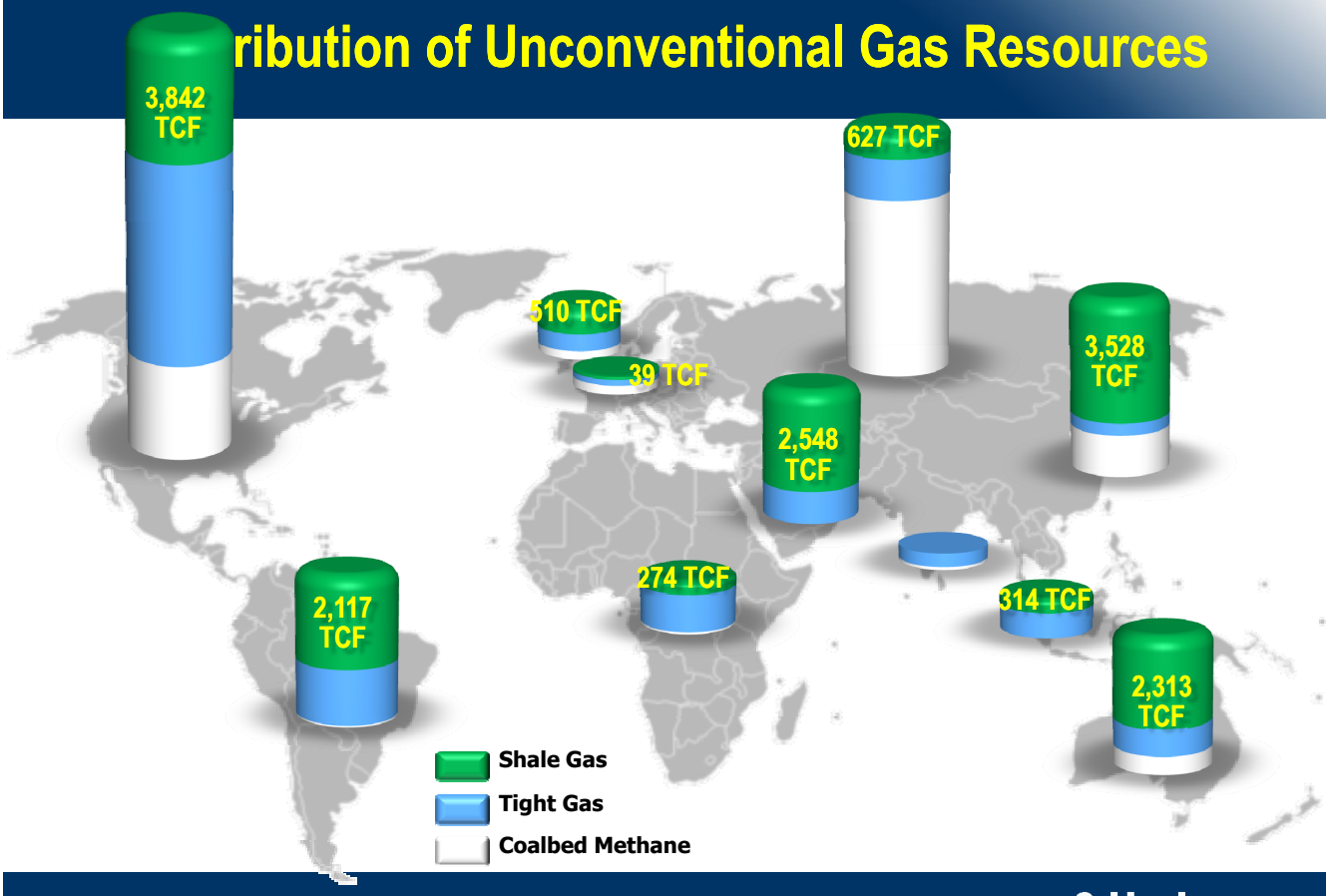


Source: IPCC TAR, 2001

Carbon Reservoirs



ribution of Unconventional Gas Resources

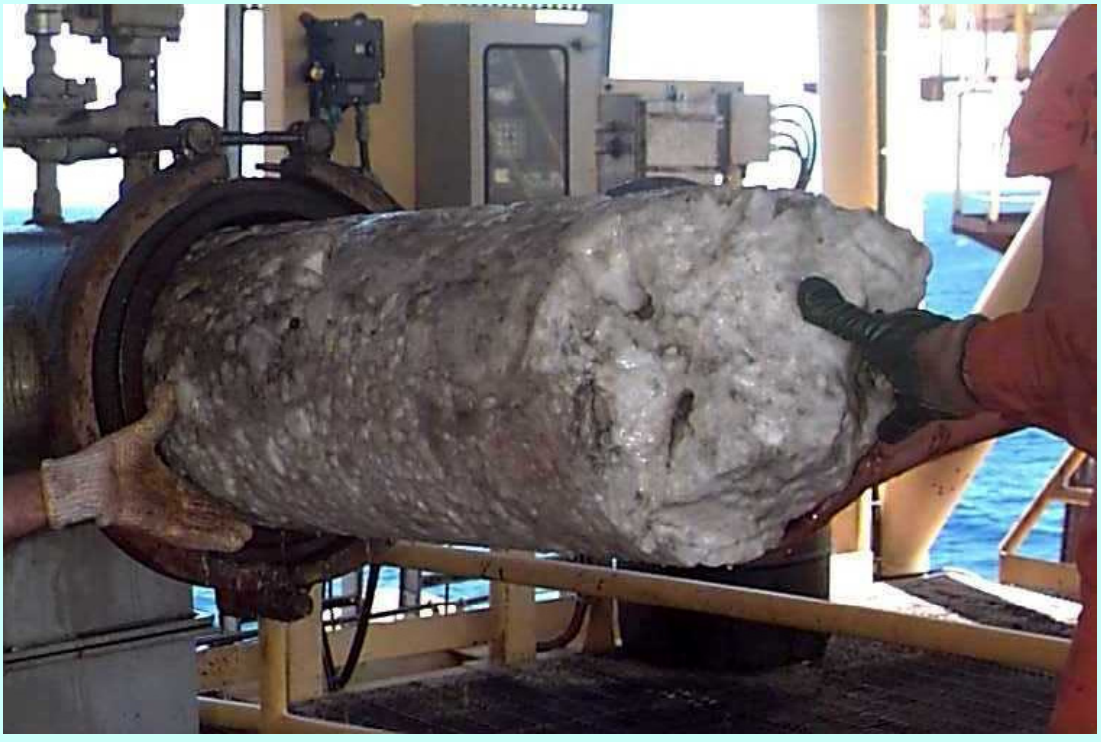


16,112 TCF ≈ 17 ZJ

Source: SPE Paper 103356, USGS

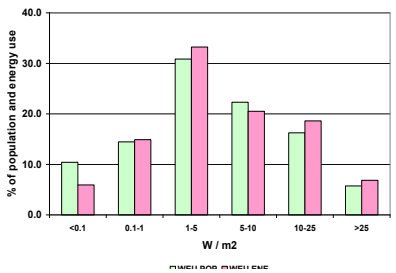
Schlumberger

Methane Hydrate



Europe Population vs. Energy Demand Density

Note in particular renewable supply density threshold of maximum 0.5-1 W/m^2

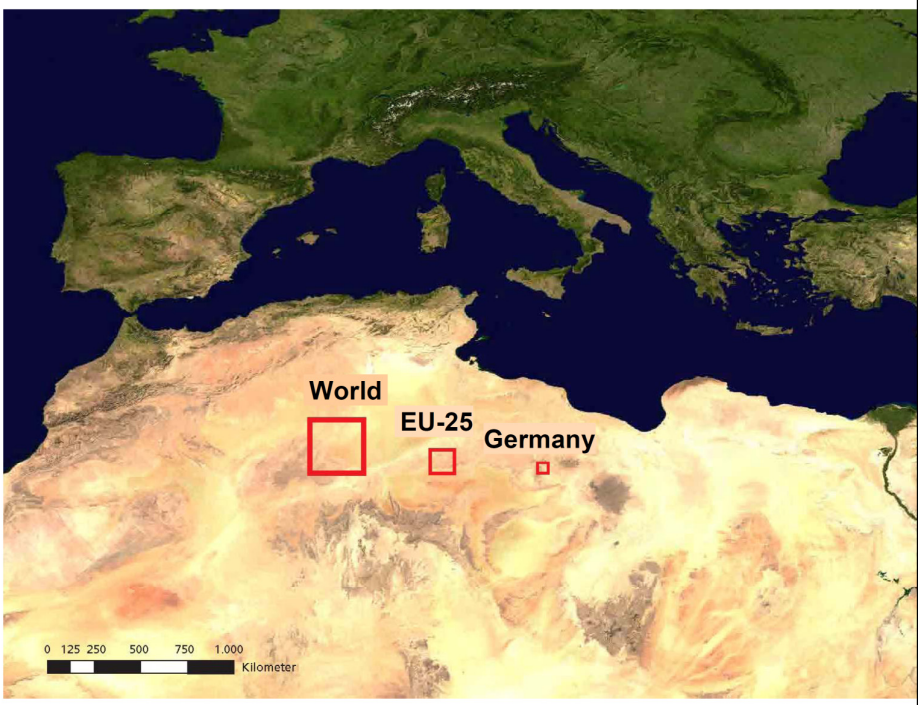


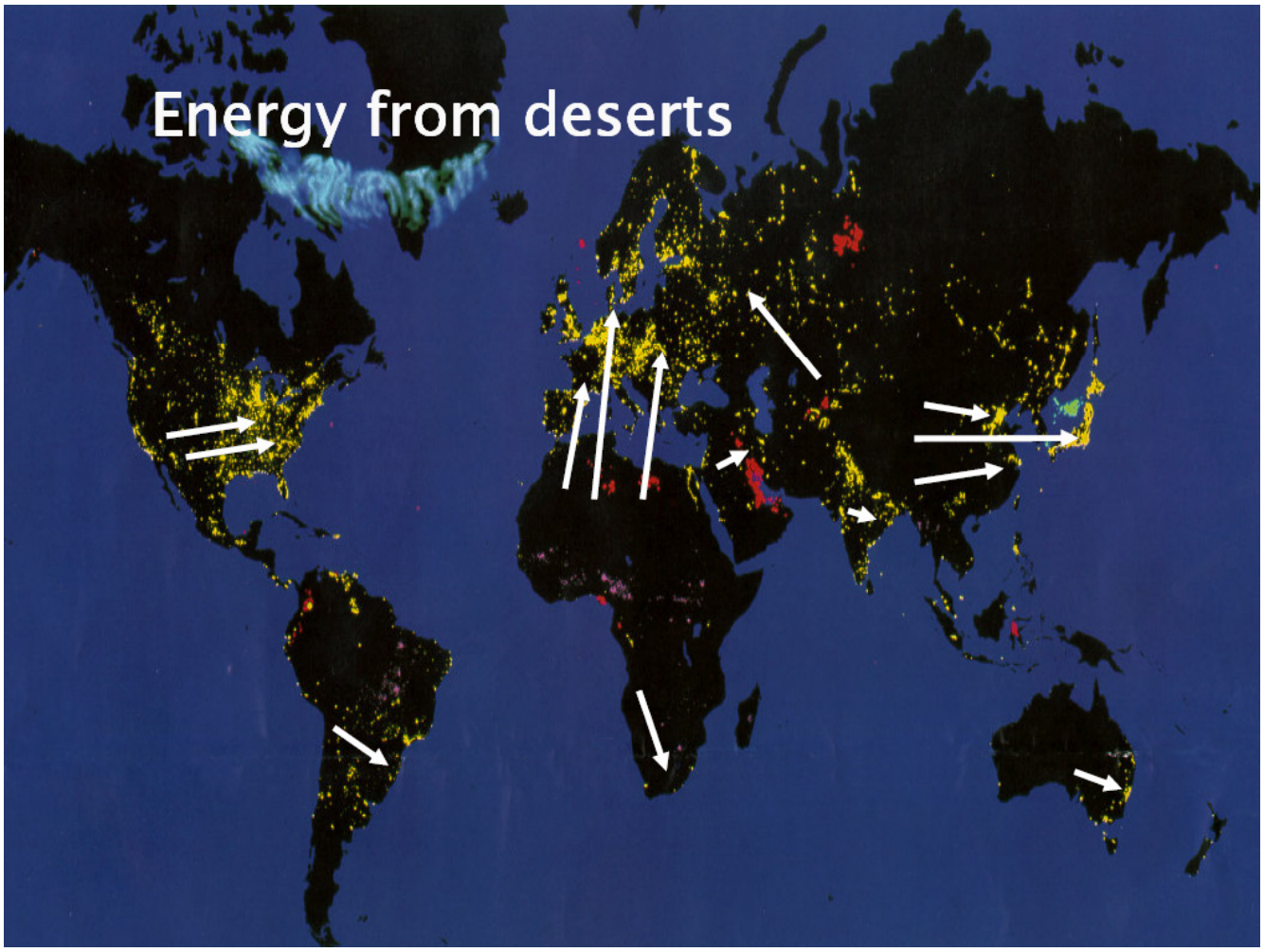
WEU: 21% of demand below renewable density threshold

EEU: 34% of demand below renewable density threshold

Required desert area for the sustainable supply of electricity

World 300 x 300 km^2
EU-25 150 x 150 km^2
Germany 50 x 50 km^2





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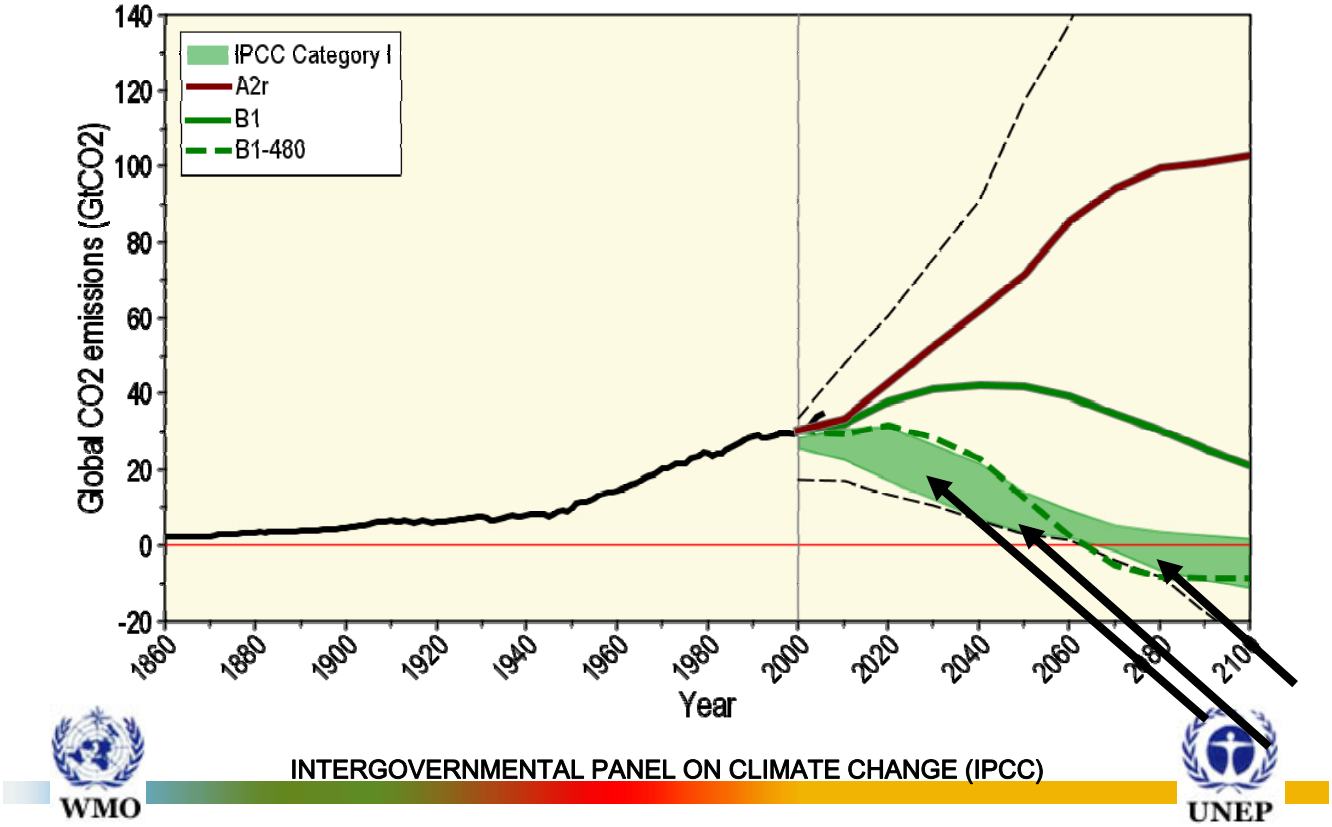
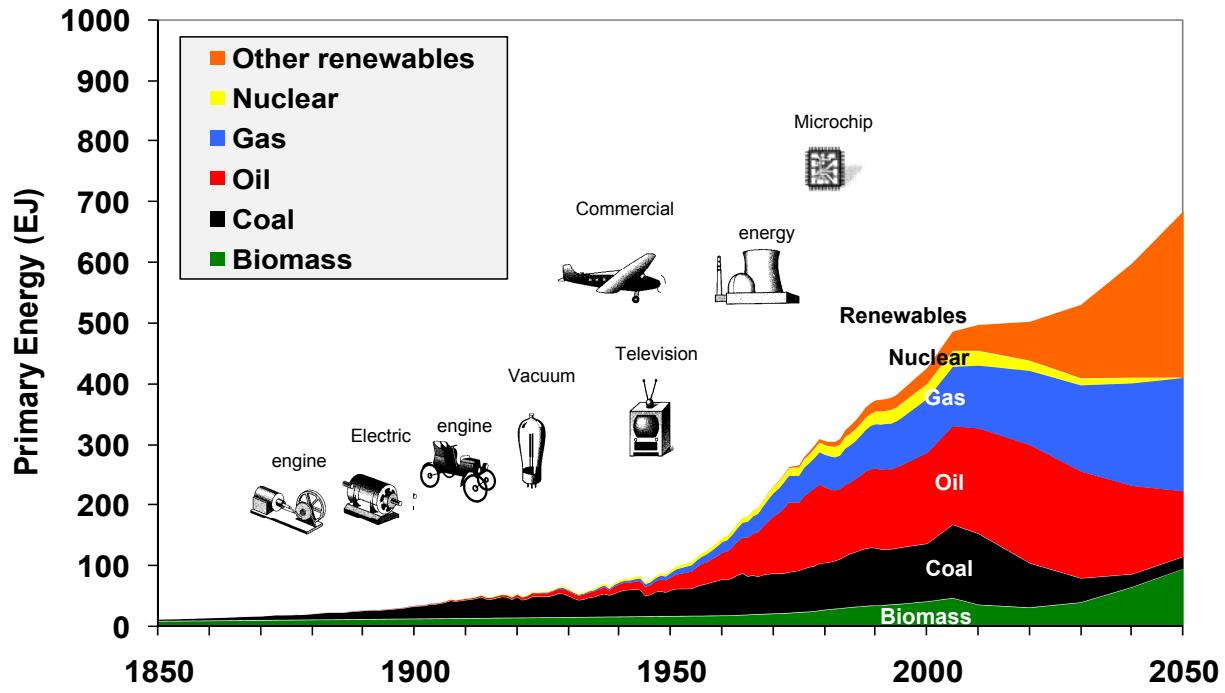
Global CO_2 Emissions



Global Primary Energy



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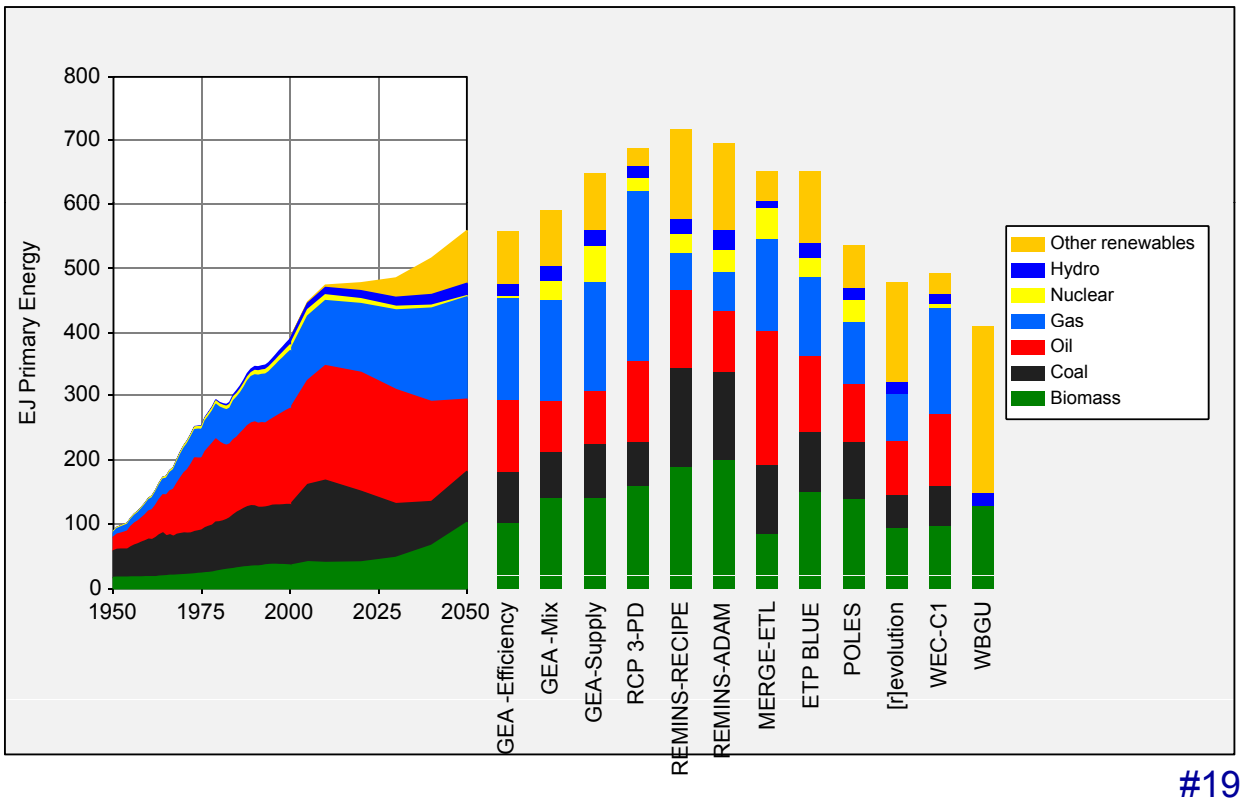

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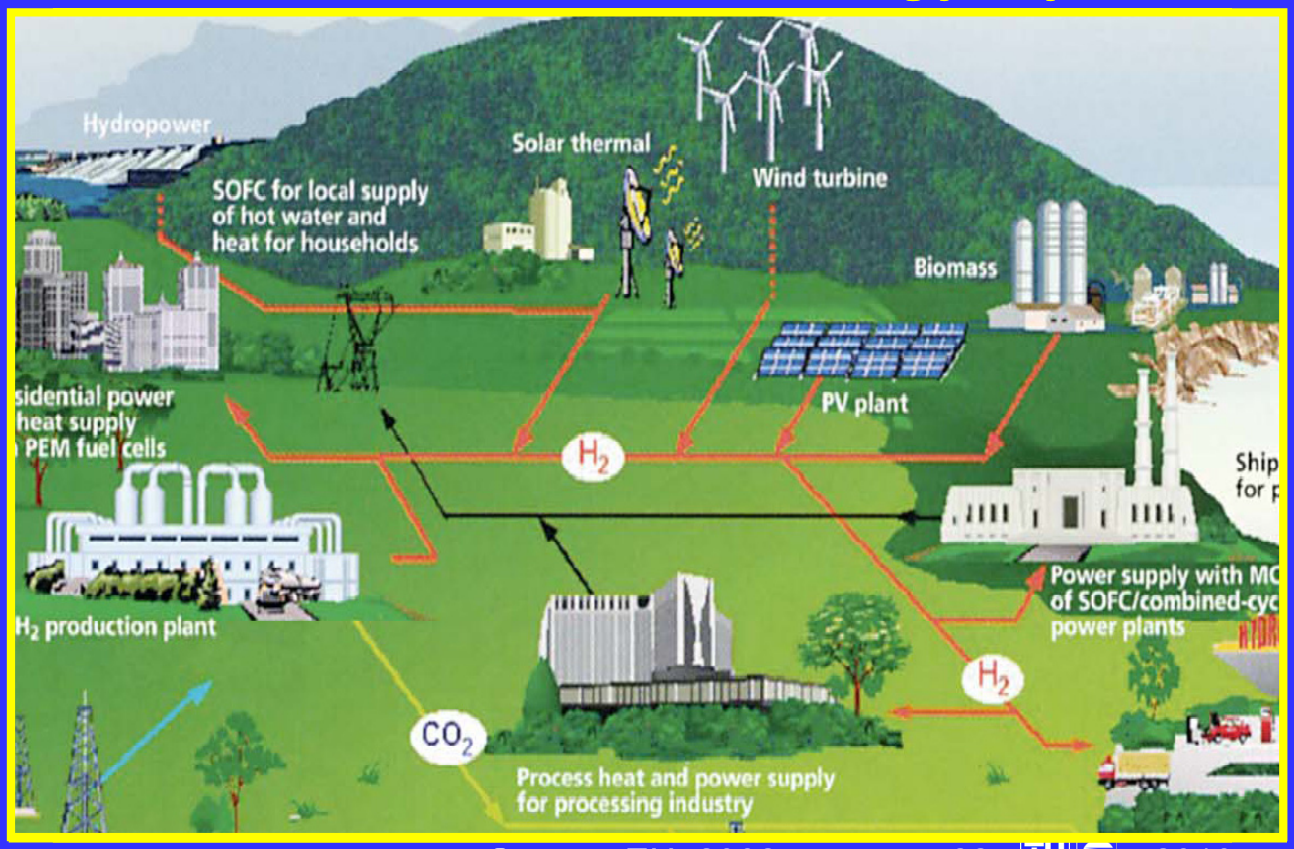
Mitigation Portfolios (which technologies we need) *versus* R&D (which technologies we develop)

All IEA countries

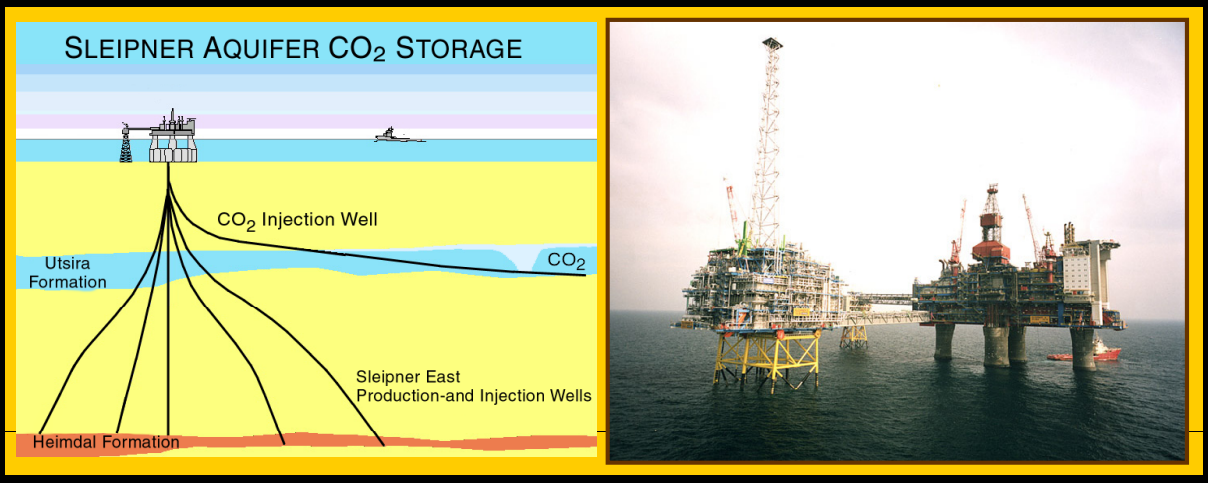
	cumulative emission reduction 2000-2100 (mean of all scenarios)		cumulative R&D (1974-2007)		current R&D 2007	
	GtC	%	10^9 US$2007	%	10^9 US$2007	%
Energy efficiency	1662	*57.5*	38	*8.9*	1.6	*13.0*
Fossil Fuels	171	*5.9*	55	*12.8*	1.4	*11.3*
Renewables	537	*18.6*	37	*8.7*	1.5	*12.3*
Nuclear	269	*9.3*	236	*54.8*	4.6	*38.0*
Others	252	*8.7*	64	*14.8*	3.1	*25.4*
Total	**2890**	*100.0*	**431**	*100.0*	12.0	*100.0*

A Vision of a Future Energy System



Existing and Planned Projects

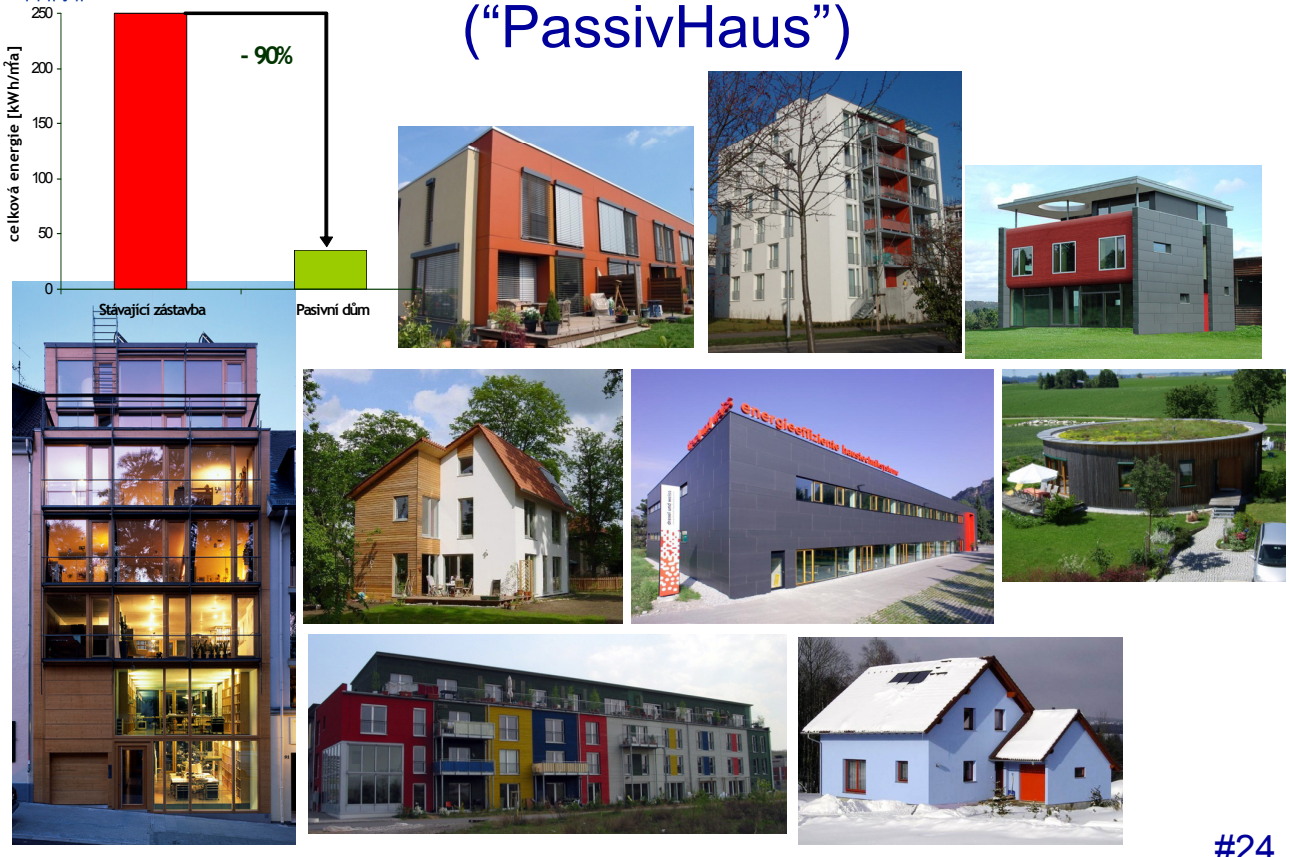
- Sleipner Project, saline formation, North Sea
- Weyburn, EOR, Saskatchewan, Canada
- In Salah, gas reservoir, Algeria (development)
- Snohvit, off-shore saline formation, North Sea
- Gorgon, saline formation, Australia (planning)



Nakicenovic #23

Source: Sally Benson, 2003

Buildings utilizing passive solar construction ("PassivHaus")



Source: Jan Barta, Center for Passive Buildings, www.pasivnidomy.cz

Example of savings by reconstruction

Before reconstruction

Reconstruction according to the passive house principle

over 150 kWh/(m²a)

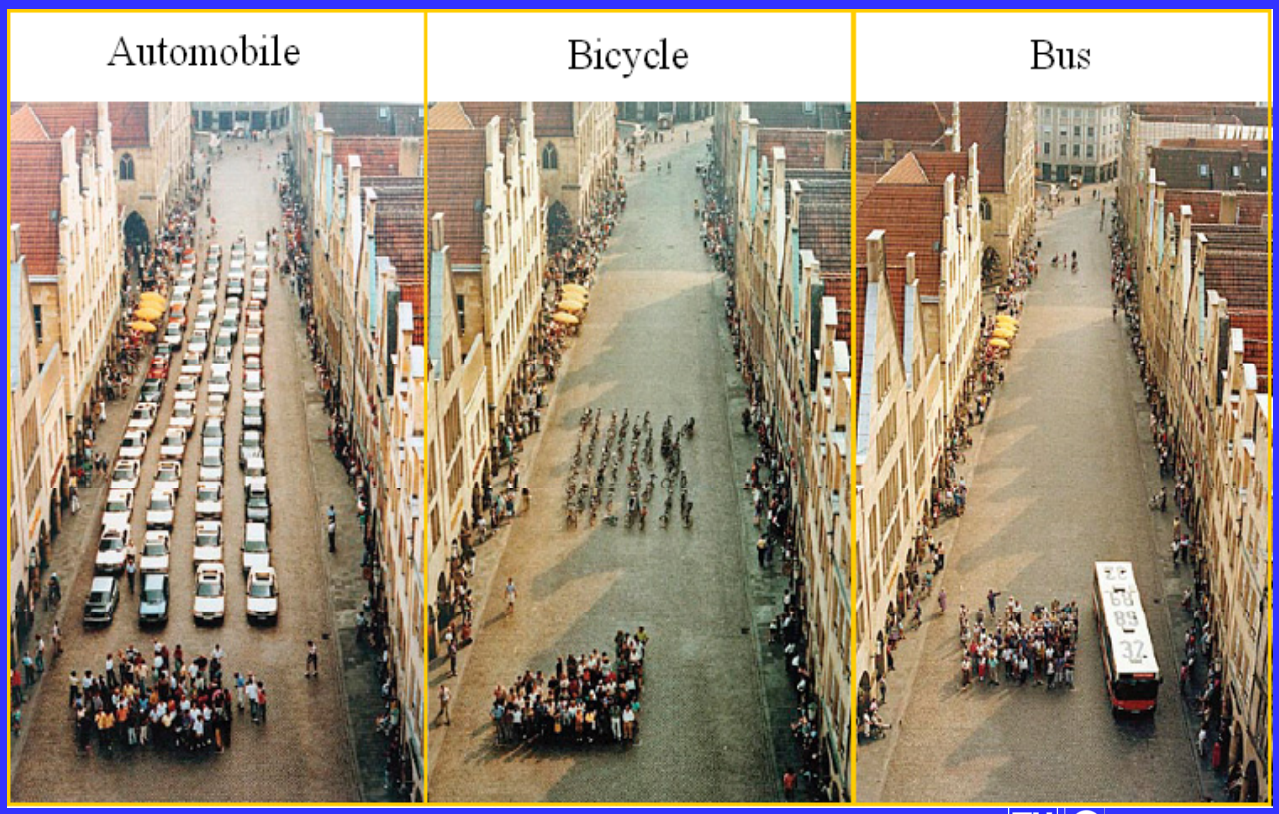
-90%

15 kWh/(m²a)

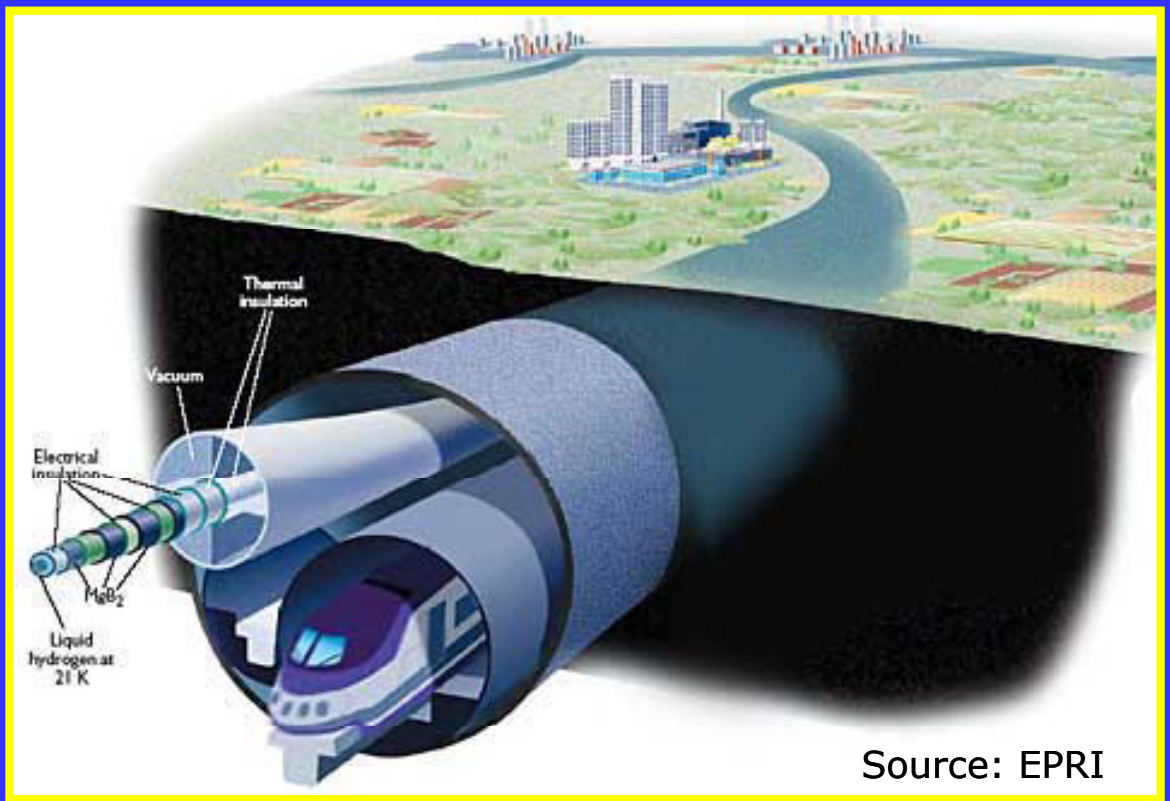
Source: Jan Barta, Center for Passive Buildings, www.pasivnidomy.cz, EEBW2006

CITARO H_2 Fuel Cell Bus

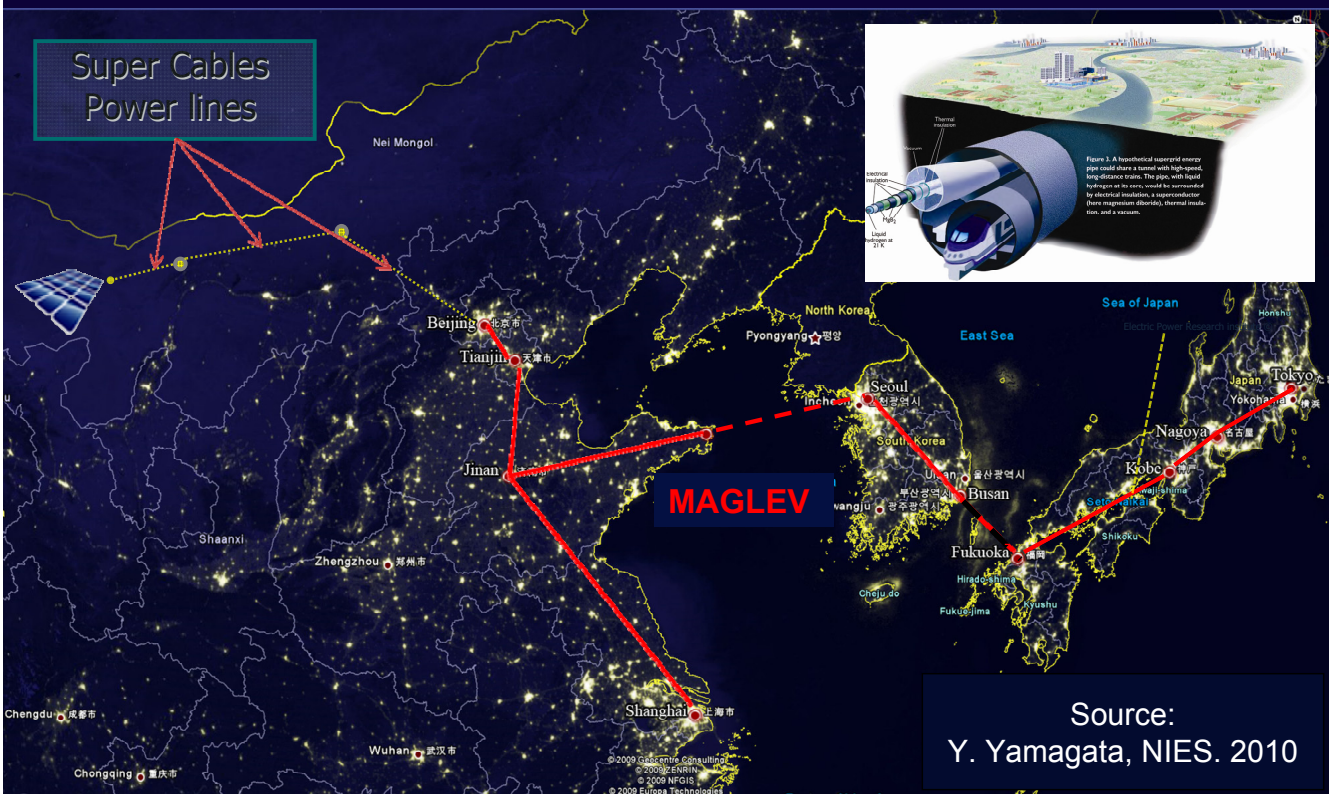
Area Occupied by Various Transport Modes



Energy SuperGrid and MagLev Trains



Potential Synergies between New Energy and Transport Infrastructures: Asian "Supergrid"



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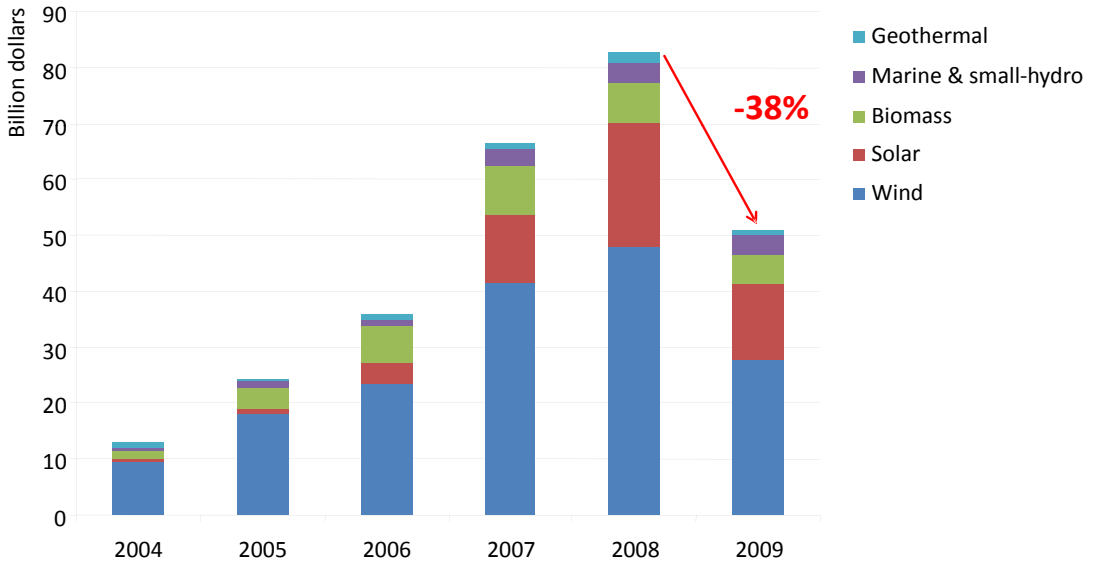
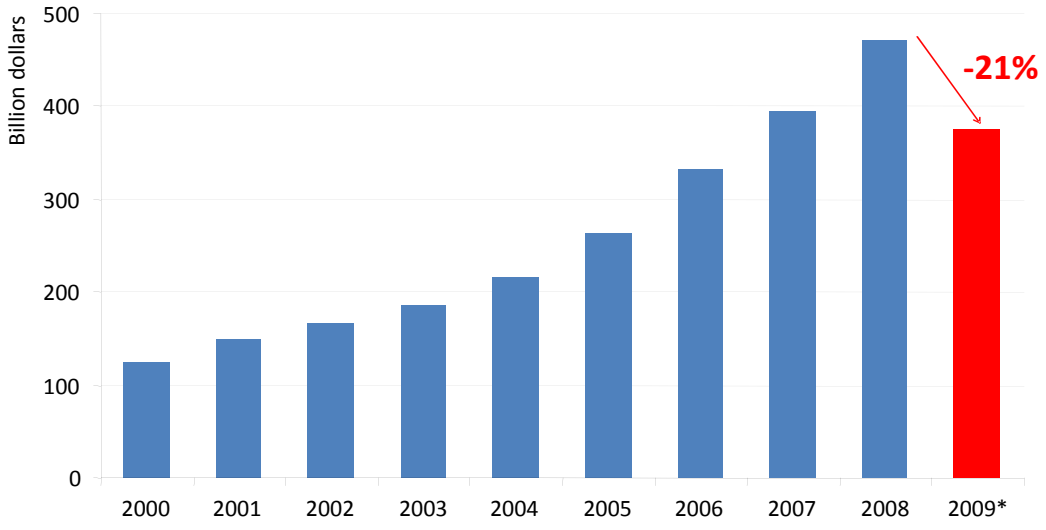
Global Investments in New Renewables



Source: IEA, 2009 #31

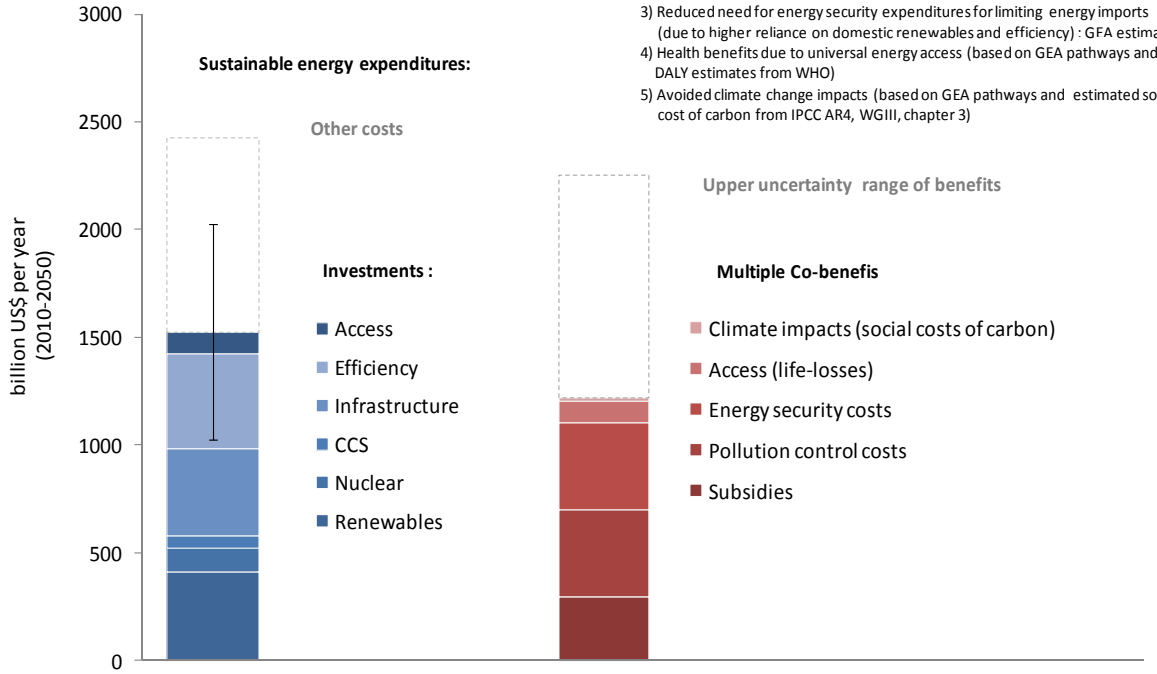
Global Investments in Upstream Oil and Gas



Source: IEA, 2009 #32

Co-Benefits of Energy Investments

Based on IIASA-GEA: Riahi et al, 2010



Multiple benefits include:

1) Avoided subsidies
2) Avoided costs of pollution control due to application of zero-polltion technpologies and efficiency enhancements (GEA)
3) Reduced need for energy security expenditures for limiting energy imports (due to higher reliance on domestic renewables and efficiency) : GFA estimate
4) Health benefits due to universal energy access (based on GEA pathways and DALY estimates from WHO)
5) Avoided climate change impacts (based on GEA pathways and estimated social cost of carbon from IPCC AR4, WGIII, chapter 3)

www.GlobalEnergyAssessment.org
Towards a more Sustainable Future

- The magnitude of the change required in the global energy system will be huge
- The challenge is to find a way forward that addresses simultaneously climate change, security and equity issues.
- Paradigm change is needed: radical improvements in energy end-use efficiency, new renewables, advanced nuclear and carbon capture and storage.