A systems approach to energy policy design and implementation

Semida Silveira
Energy and Climate Studies

STandUP for energy systems
20 October 2011

Changing landscape in the energy sector

- from utilities to multiple actors in competitive markets
- from centralized to decentralized generation/fuel production
- from sectoral segmentation to synergy in generation and uses
- from transmission and distribution grids to smart grids
- technological convergence is evolving
- new institutional requirements are taking shape
- new legal frameworks are needed
- new cost structures require innovative business models

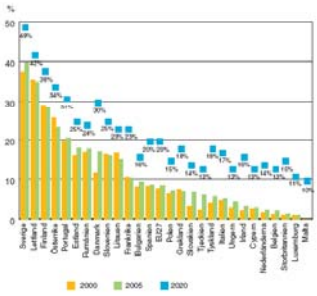
Active planning these changes is important to capture the potential of renewable technologies and promote efficiency

A sustainable energy path requires:

- less fossil fuels / more renewable technologies
- improved resource and energy efficiency
- lower carbon intensity
- effective energy markets able to deliver reliable services
- wider access of modern energy
- convergence of energy use per capita
- security of energy supply
- better integration of human and natural systems (lower impacts on environment and health)

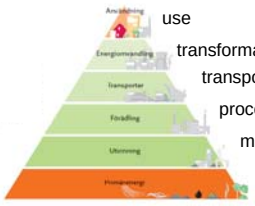
Energy policies are being designed to transform the energy sector

Renewables for EU 27
2000, 2005, and target for 2020



Source: Eurostat, Swedish Energy Agency

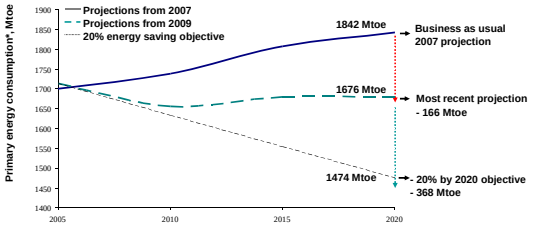
Making energy systems more efficient



Innovative mechanisms to promote sustainable energy systems

- Electricity certificate system
- Emissions trading
- Standardization (i.e. of biofuels)
- Flexible mechanisms to Kyoto Protocol
- Well-functioning electricity market
- Local and regional energy offices
- Municipal eco-energy programme
- Voluntary activity with industry
- Research programs (incl. pilot plants)

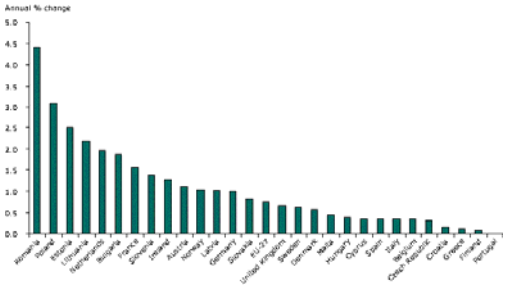
EU är inte på rätt spår avseenden energieffektivitet



* Gross inland consumption minus non-energy uses

Fler insatser behövs för att nå 20% målet till 2020

Change in energy efficiency index by country in the period 1997-2007



Thermal efficiency of power stations, 2005

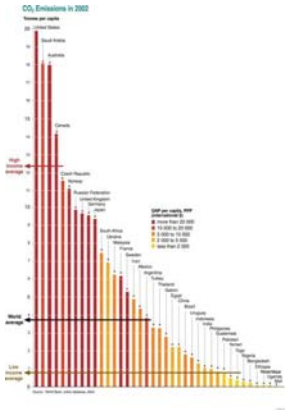
Source: Eurostat

Environmental degradation economic manifestations

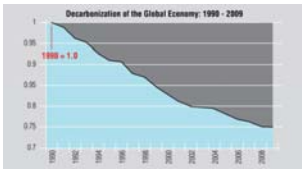
- waste and inefficiency side by side with scarcity
- renewable resource used as extractive resource
- single/inferior use of a resource instead of multiple use
- lack of protection and enhancement of the resource
- failure to recycle
- unique sites and habitats are lost

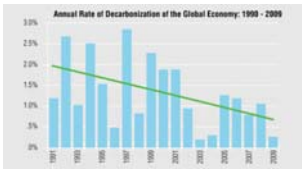
The underlying causes to environmental degradation are policy and market failures

CO2 emissions per capita



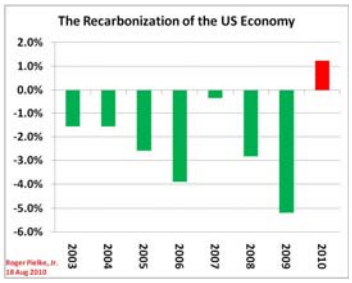
Decarbonization of the global economy is slowing down!





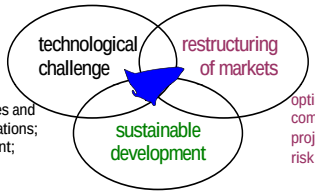
Source: Pielke Jr., Roger, 2011.

Recarbonization of the global economy?



Searching for synergies

- resource management
- multiple use of resources
- structural changes in exchange flows between natural and human systems
- energy, climate and development policy

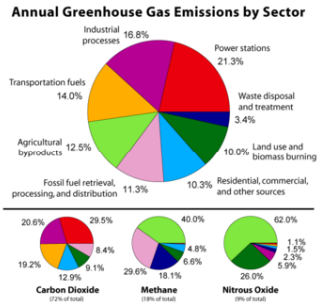


conversion processes and performance; applications; resource management; improved efficiency

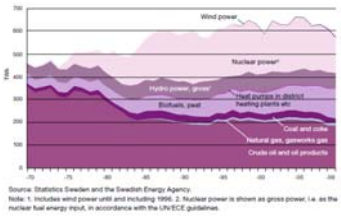
optimize applications in competitive markets; project structure and finance; risk management; institutions

biodiversity; socio-economic development in rural areas; economic robustness of local and global systems; climate change mitigation and adaptation

Transforming the energy system is not enough; we need to reinvent infrastructure systems, as well as cities and rural areas

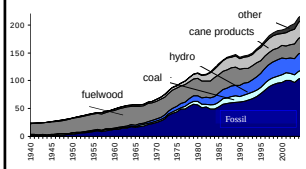


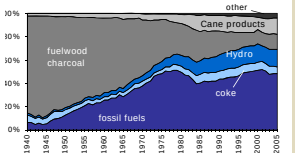
Total energy supply in Sweden, 1970-2009
568 TWh supply - 376 TWh useful energy



Excludes electricity exports
568 TWh supply - 376 TWh useful energy

Energy transition in Brazil, 1940-2005
the profile of a young and dynamic economy



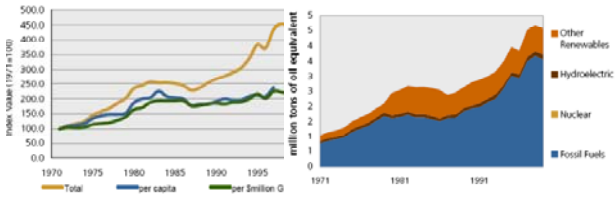


2481 TWh (213.4 million toe)

Total biomass today = 663 TWh

¼ of the Brazilian total energy use

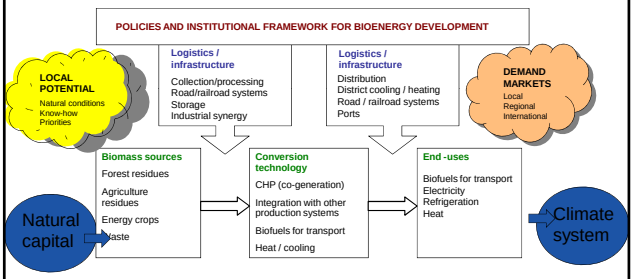
Energy trend, Bolivia 1971-1999



Source: earthtrends.wri.org

Rapid urbanization with slow development in many parts of the world

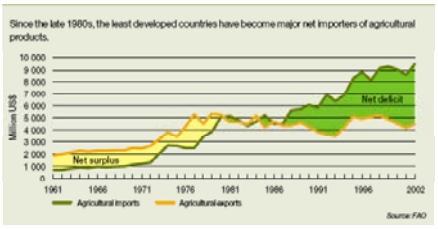
Sizing the bioenergy potential in a systems perspective



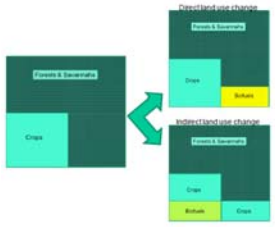
Agricultural commodity prices, 1961-2002

Source: FAO.

Agricultural trade balance of least developed countries, 1961-2002

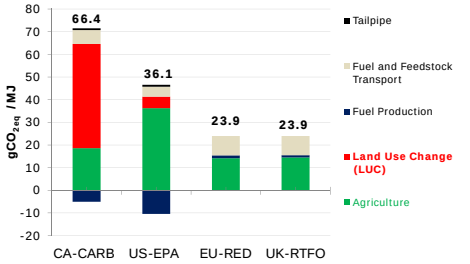


Indirect land-use change?



Source: Bauen and Howes in Woods, 2009

Comparison of GHG emissions in different regulation schemes



- CA-CARB: credit for surplus electricity with no mechanical harvesting, direct Brazilian pathway
- US - EPA : direct Brazilian pathway and no trash collected for process energy.

26

Reinventing rural areas

Reinventing rural areas will be key to development of bioenergy and to achieve sustainable development

To reinvent rural areas, we need improved resource efficiency and an integrated approach to agriculture and forestry with a role to both energy and food production.

Market challenges when searching for new solutions to satisfy energy needs

- established solutions and behaviour
- competition among various energy sources
- investments to establish new alternatives
- transaction costs (logistics, land use, stakeholders)
- social acceptance
- formation of critical demand
- fiscal issues – incentives / policies

sustainable energy solutions need to be motivated beyond their technical performance, environmental benefits and economic efficiency,

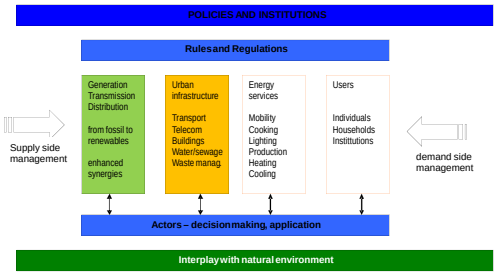
and become attractive in the context of regional development and multiple societal benefits

Energy and Climate Studies (ECS)

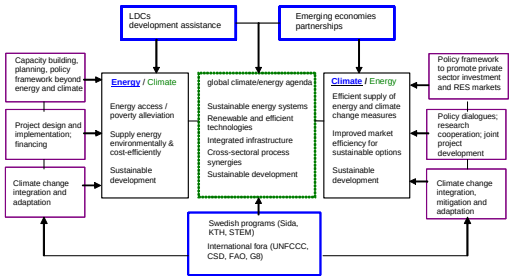
www.ecs.kth.se

Promoting energy transitions

Energy planning for the urban environment



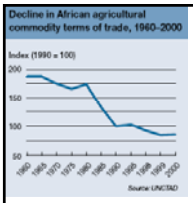
Differentiating cooperation with developing countries



Untapped potential in agriculture

	Sub-Saharan	S America	N America	China	World
Cereals prod change since 1979-81	54%	60%	12%	47%	32%
Per capita production (tons per person)	135	309	1224	331	343
Percent change since 1979-81	-11%	12%	-9%	15%	-4%
Average crop yield (kg per ha)	1 221	3 004	5 525	4 869	3 096
Percent change since 1979-81	9%	69%	40%	61%	41%

Source: Earthtrends 2003



Untapped potential in agriculture

	South Africa	Zambia	Uganda	Tanzania	Mozambique	Sub-Saharan	S America
Cereals prod change since 1979-81	-22%	6%	88%	26%	54%	54%	60%
Per capita production (tons per person)	257	na	na	108	91	135	309
Percent change since 1979-81		-40%	1%	-32%	65%		12%
Average crop yield (kg per ha)	2 334	1 437	1 605	1 273	929	1 221	3 004
Percent change since 1979-81	11%	-14%	3%	20%	54%	9%	69%
% GDP generated from agriculture 2000	3%	27%	43%	45%	24%	17%	7.5%

Source: Earthtrends 2003