Green Growth as a new frame for research activities at universities and institutes

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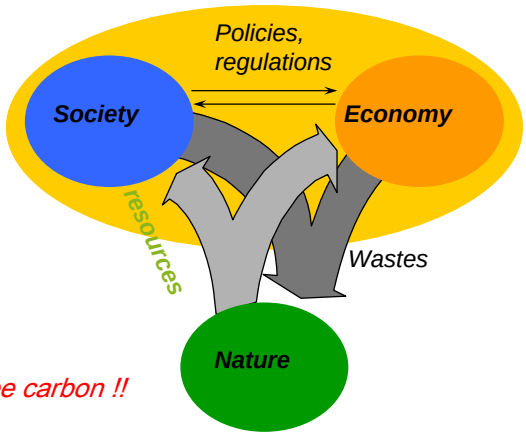
Green growth *is ecologically* ***sustainable*** *economic progress that fosters low-carbon, socialy inclusive development (http://www.greengrowth.org/)*

From Brundtland Commission



Neutral-carbon OK,
No fossil carbon, free carbon !!

Emerging and developing countries

Excess of resources **max**

Policies, regulations

Green growth

tools for decision-support

Economies

Wastes

min

Data !

Technical & organisational innovations

Society

Policies, regulations

Proposals of policies, regulations from other (new ?) stakeholders

Do they fit within previous policies, regulations ? Or do they trigger new ones ?

Nature

Myth of steady state

Main issues for bioenergies and green chemistry (1/2)

- A context shaped by global imbalances (energy, environment …) and by high hopes in a 'renewable carbon-based economy'
- A logical switch from the subsidiary development of plant biomass production for non-food purposes to a diversification of plant biomass uses and to the design of dedicated production systems under strong constraints

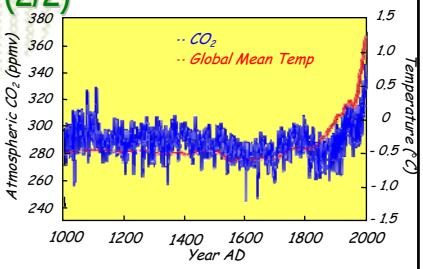
Materials
Housing, transportation, packaging, clothing …

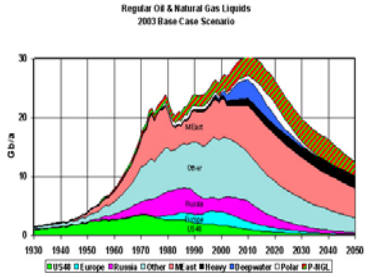
Energy mix
Biofuels, biogaz, …

Chemicals
Lubricants, cleaning agents, solvants, specialties, nano, …

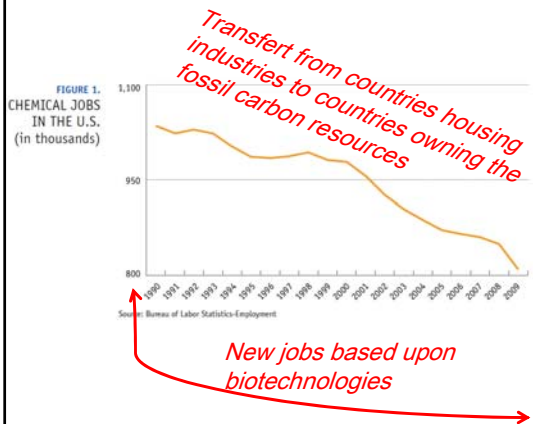
Main issues (2/2)

- Three major global issues …
  - To control, limit and reduce the emissions of greenhouse gases (GHGs) in the atmosphere (*factor four from 1990 to 2050*)
  - To develop substitutes to fossil carbon (and its derivatives), whose reserves, for a given cost, will be increasingly scarce and environmentally critical
  - To increase the energy efficiency
- … and related socio-economic, environmental and geopolitical issues
  - To promote regional energy independence
  - To initiate carbon neutral development
  - To develop agro-industry
  - To ensure the global sustainability (food production, global environment, land uses being at the crossroads)



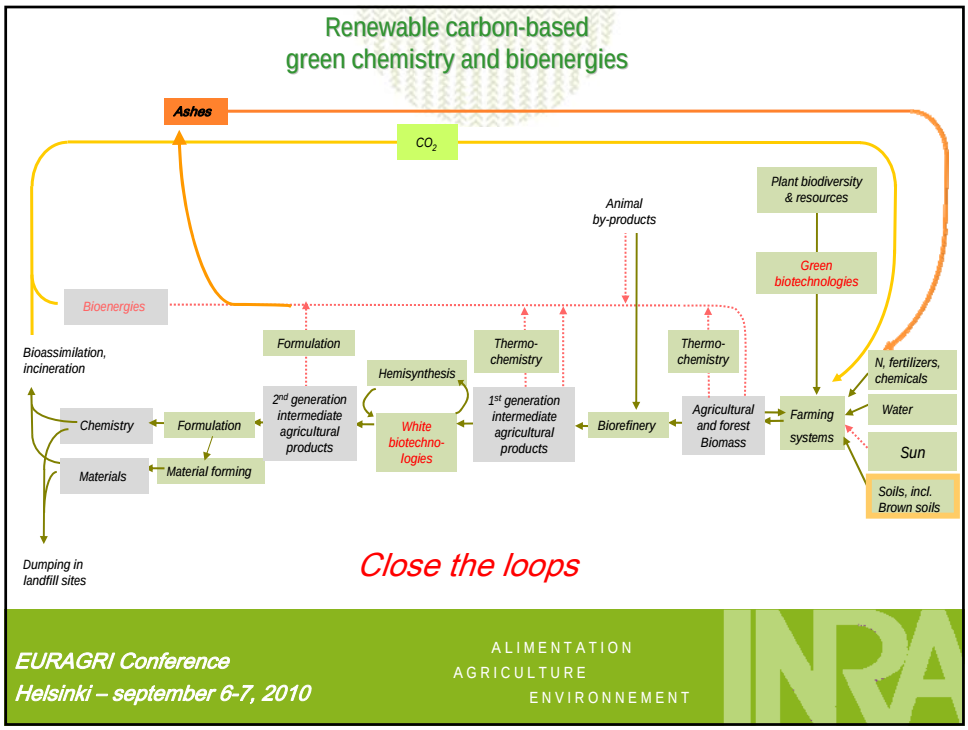


Decline of fossil C industry



Targets

Incorporation of 5.75% biofuels in 2008, 7% in 2010	France
20% renewable energy (solar, biomass, wind) in 2020, 10% biofuels in transport	EU 27 in 2020
Chemistry: 7% renewable feedstock in 2007, 17% in 2015 30% in 2025, 50% in 2050	France NL USA


Renewable carbon-based
green chemistry and bioenergies
Ashes
CO_2
Plant biodiversity & resources
Animal by-products
Green biotechnologies
Bioenergies
Bioassimilation, incineration
Formulation
Thermo-chemistry
Thermo-chemistry
Hemisynthesis
N, fertilizers, chemicals
Water
Sun
Soils, incl. Brown soils
Chemistry
Formulation
2nd generation intermediate agricultural products
White biotechno-logies
1st generation intermediate agricultural products
Biorefinery
Agricultural and forest Biomass
Farming systems
Materials
Material forming
Dumping in landfill sites
Close the loops
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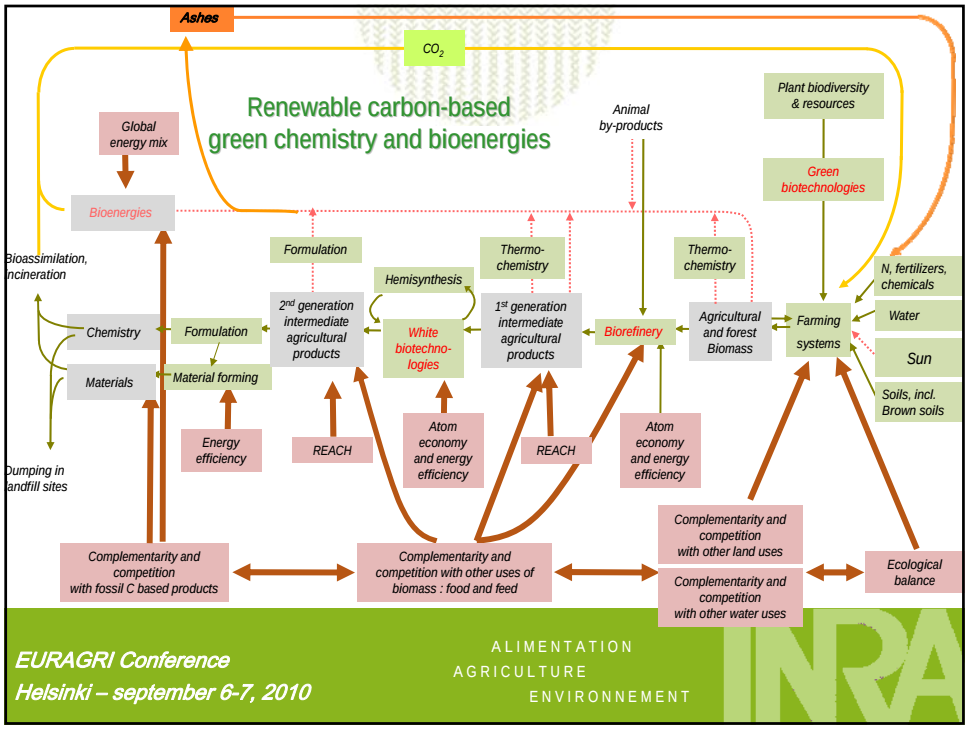
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N, fertilizers, chemicals
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Farming systems
Materials
Material forming
Energy efficiency
REACH
Atom economy and energy efficiency
REACH
Atom economy and energy efficiency
Dumping in landfill sites
Complementarity and competition with fossil C based products
Complementarity and competition with other uses of biomass : food and feed
Complementarity and competition with other land uses
Complementarity and competition with other water uses
Ecological balance
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Energy from wood products (1/2)

- This biomass use is still one third of total primary energy consumption (IEA) for half of humanity.

- In the developped countries, wood chips, charcoal, forestry residues, particularly in countries heavily wooded and with strong wood-processing industries (Scandinavia, Canada).

- In France, wood - energy accounted for 45.7% of the 19 Mtoe of renewable energy in 2008 with a projection to 41% from 36.6 renewable Mtoe in 2020.

- The decisive technological breakthrough in recent years has been the improvement of energy efficiency: ≈ 35% for traditional wood stoves, 80% for modern stoves using pellets for family use, with values around 90% for industrial applications for the joint production of electricity and heat to the individual and collective, with cogeneration of small and large scales.

- Two key technological challenges today : control of air pollution (particulate matter) they generate, and interconnection with electricity power grids.

Energy from wood products (2/2)

- Africa is illustrative of developing countries: 88% consist of wood removals for energy uses, while in North and Central America they account only 13% (FAO, 2009), in favor of the pulp, paper and wood furnishings industries.

- The trend towards increased consumption of fuel wood continues, despite a decline in consumption per capita, due to rising living standards, urbanization and increased use of other alternative energy sources, but also by reduced availability of wood. These trends contribute to the dynamics of deforestation in many parts of the world.

- Globally, about 2.6 billions hectares of forests, of which 2.4 billions of natural forests or semi-natural, are used for the production of wood and a few tens of millions of hectares only mobilized for the production of bioenergy and bioproducts, which covers contrasting situations.

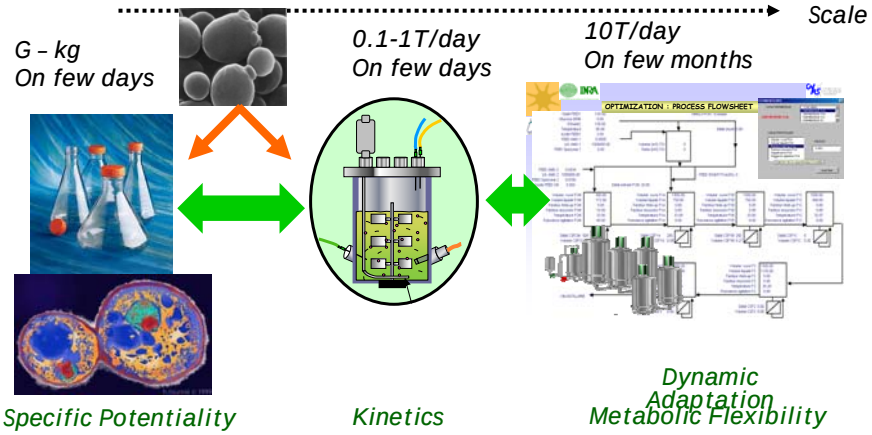
- Two key technological challenges today : better management of forest resources better either in plantations or natural forests, diffusion of energy efficient technologies, the charcoal having very low energy efficiency.

A strong need for research ...

- In various areas and with various angles
  - Green biotechnologies and conception of sustainable production systems to ensure feedstock long-term availability and adequation with transformation technology and uses
  - White biotechnologies, including synthetic biology, and bio-refineries to ensure the efficiency of biomass transformation
  - Data on resources, technical performances and environmental assessments at different scales
- Considering a diversity of feedstock sources
  - From the optimization and engineering of existing sources (eg annual crops or forests) to the exploration of new sources (Jatropha)

From lab sciences (eg in green biotechnologies) to pilots and demonstrators: a broad range of facilities and disciplines

Bottlenecks of the microbial behavior for Very High Performances Process ? Microbial responses to environmental stress conditions and biomass variability ??



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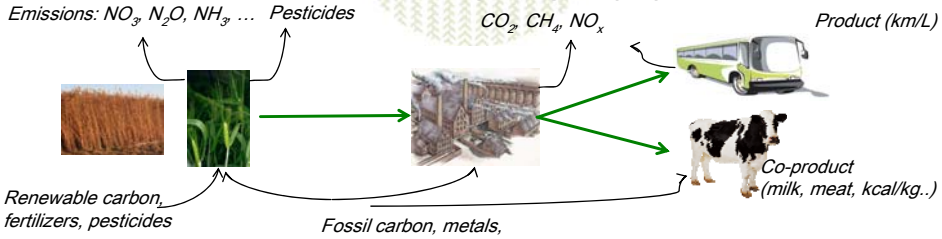
Life cycle assessment: *A product-oriented method for sustainability analysis (1/2)*



- Here a quantitative environmental Life Cycle Assessment of products
- Basically: tool for decision-support
  - Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle
  - ISO-standardised procedure (ISO 14040, created in 1997-2000; revised in 2006)
- Prevent problem shifting
  - to other life cycle stages, to other substances, to other environmental problems, to other countries, to the future => close the loops

Life cycle assessment: *A product-oriented method for sustainability analysis (2/2)*

- Needs to be adapted for a paradigm change from product to service
- Suitability
  - Climate change
    - Emissions form production and use of fossils fuels and fertilizers: suitable
    - Soil carbon stock changes: under development
  - NON-GHG environnemental isues
    - Soil quality preservation : no impact indicator
    - Land use, land use change: partly for land occupation
    - Water management : partly, as water consumed and depleted
    - Air quality : not at local level
    - Biodiversity – ecological balance: no consensus on impact indicator
  - Energy security
    - Partly : consumption of fossil energy

Conclusions

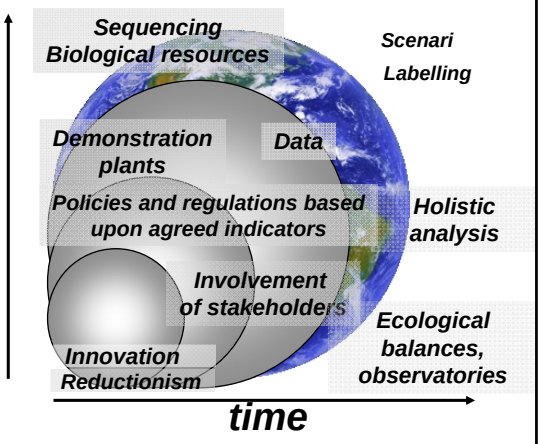
- Agro-food, bioenergy and green chemistry systems are coupled
- Develop backcasting or reverse engineering strategies starting from the expected services and not the products considered (society needs) considering the chain of added values.
- Ensure a holistic approach for the « agro-food-bioenergy-chemistry » industry
  - Define precisely the frontiers of any system, while closing the loop(s)
  - Availability of raw materials => land and water crisis;
  - Labelling Environmental Impact based upon recognized assessment methodologies
  - Ensure coherence and consistency in collection of informations from the different operators in the agro-food supply chain
  - Evaluate the coherence between various policies, inside a country and between countries
  - Involve science at all the scales of the research and development process

Design an environmental and sustainable industrial policy suited to each country

Two major scales: time and space

Scale of decision

	space
World	*global*
Continent	*regional*
Country	
Region, lander	*local*
local	



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