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Transitions for radical changes in the european steel industry

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Introduction

- Momentum is growing globally such that action (factor4) to reduce GhG emissions are required…
- However, it is still hard to anticipate how economies will evolve towards a much less carbon-intensive development profile
- Moreover, the use of materials will be profoundly altered in the 30-50 years to come …as major changes in the infrastructures and products that support our many energy dependent services (mobility, shelter, heat, light, etc.) are expected
- And as these changes will be significantly amplified by greenhouse gas emission constraints
- the Steel Research Agenda 2030 identifies "transitions"

Overview of the presentation

A transition is the result of interacting technological, economical, ecological, cultural and institutional developments at different scale levels. (Rotmans e.a. 2004)

Introduction

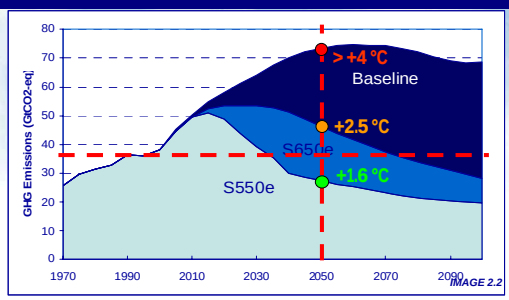
1 – Agenda of the Steel technological regime

2 – Technology development and selection : the ULCOS project

3 – Rationales for public intervention in demand-side policies

Conclusion and perspectives

1. Typical world Greenhouse gas Reduction Profiles



- In 2050, world emissions should be brought back to 2000 level +/- 25%, in place of a doubling in the Baseline (from GRP study for DG-ENV)

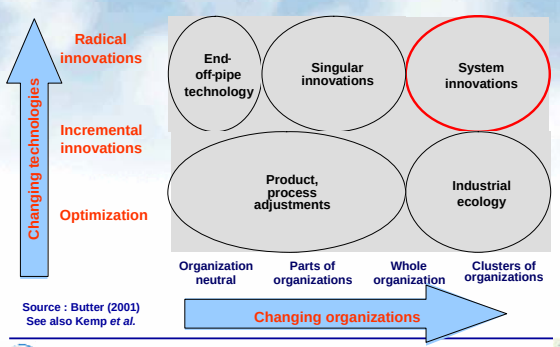
1. Agenda of the Steel Technology Platform

Challenges for the European Steel Industry :

- Conserve core position in high value-added products
- Meet growing technical requirements of developing markets
- …

European steel technology platform: Vision 2030, (March 2004)

1. Innovations for GHG mitigation



Source : Butter (2001) See also Kemp *et al.*

Contents

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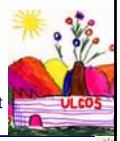
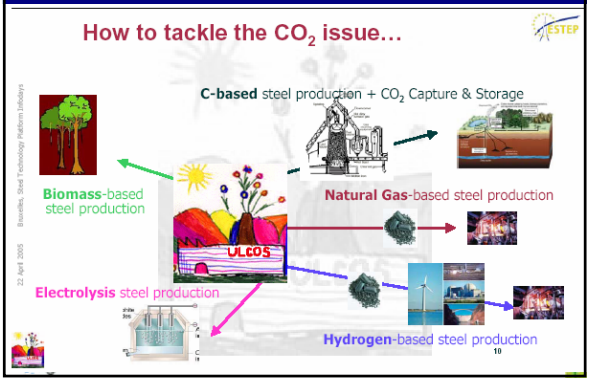
2. ULCOS' objectives & targets within the EU Steel Techplatform

- ULCOS for Ultra Low CO_2 Steelmaking.
  - The IP is a strongly objective driven R&D project focusing on the delivery of new knowledge to produce Steel in the post-Kyoto context of the middle of the 21st century
- Objectives
  - address the post-Kyoto (first CP 2008-2012) situation, from the standpoint of the Steel Industry
  - identify low CO_2 future steel production routes
  - identify synergies with other European industries and society's expectations
- Target on emission reduction
  - high (50-70% of today's emissions of a benchmark Blast Furnace)



2. ULCOS' portofolios



2. SCOT and insights needed from (evolutionnary) economic theory :

What are the conditions of the adoption of new technologies ?

- Schumpeterian patterns of innovations are technology-specific (Malerba et Orsenigo 1996)
- Technology is important in constraining the nature of market competition (Nelson and Winter 1982 ; Sutton 1998)
- Coordination issues will be important as technology co-evolve with the market structure (Nelson and Winter, 1982 ; Flaherty)
- Transition management (Rip and Kemp ; Kemp and Rotmans ; Geels, 2005)

2. Methodology and preliminary findings

- In the next decades, inter-technology competition (and the merit-order) will take place in a much more complex set of economic fundamentals
- The future costs of radical innovation technologies is more uncertain and will depend on Learning by Doing and by Searching
- While the price of final energies will depend on the complex and dynamic interactions between:
  - Resource constraints (for oil and gas)
  - Climate policies and energy policies …
- However, not all the combinations of fundamentals are possible and applied models may help in identifying consistent sets for technology (and investment) planning…
- …with different scenarios of material and steel demand

2. Link with the detailed steel sectoral module

POLES-SIM Output

- **Reference case scenario:**
  - Steel production
  - Steel consumption
  - Technology development
  - Energy consumption and fuel mix
  - CO_2 emissions
- **Emission trading scenarios**

  (national measures vs. international market)
  - Permits trade
  - Compliance costs
  - Benefits (gains and savings)
  - Emission and production leakage

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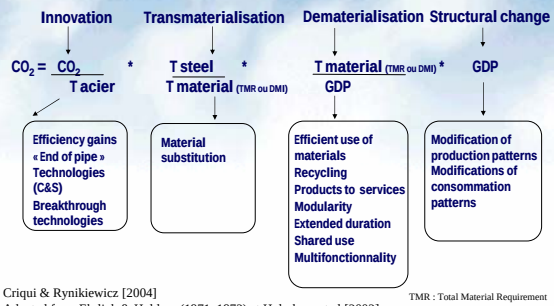
3. Demand side policies : decoupling strategies



Criqui & Rynikiewicz [2004]
Adapted from Ehrlich & Holdren (1971, 1972) et Holmberg et al [2002]

TMR : Total Material Requirement
DMI : Direct Material Input

3. Steel Value-added Chain

3. The Research agenda

One of the challenges is to make the materials dimension explicit in energy and environment modeling

1. The materials content of economic growth

- Link between GDP growth and demand for energy and materials services;
- Potentials for increased materials efficiency and dematerialisation;
- Improved forecasting of technological change

•=>sectoral evolutions

2. The environmental constraints

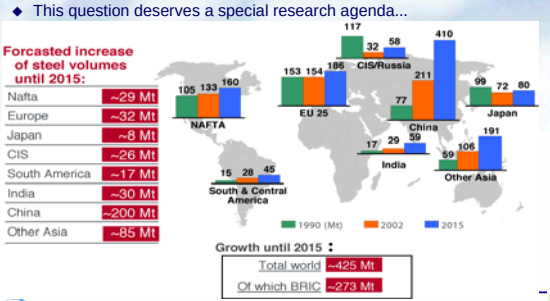
- Impacts of environmental problems such as climate change, waste and land use biodiversity
- Interaction of trade liberalization and environmental policies (carbon leakage …)
- Interaction of biomaterials, bioenergy, food production and globalisation

3. Induced technological change

- Interaction of permit trade regimes and technological change;
- Barriers for new technologies, including public acceptance issues (e.g. nuclear energy, certain types of renewable energy, CO_2 Capture and Seq …)
- Spillover and future availability across world regions

3. Extension of the problematics to DC's

- Steel and material needs and modes of consumption are different in Developing Countries
- This question deserves a special research agenda...



Conclusion

- Uncertainties of the future *"environment of selection"* imply difficulties in the technology (and investment) planning
- Models can help formulating common knowledge on energy futures as energy prices and carbon constraints will impact the dynamics of existing and upcoming ULCOS technologies
- Solutions in the construction/transport sector (and urbanism) consistent with factor4 objective imply a modification of the use of materials
- Futures of material/steel demand are to explored...
- PSS is a promising concept but has to be translated into concrete opportunities in those sectors

Sources

- [1] IEPE, collab. (2003), World energy, technology and climate policy outlook : WETO 2030. Commission européenne. DG Tren,137 p
  http://194.185.30.69/energysite/pdf/weto_final_report.pdf
- [2] IEPE, collab. (2004), GRP : Greenhouse gas reduction pathways in the UNFCCC process up to 2025. DG Environnement,
  http://europa.eu.int/comm/environment/climat/studies.htm
- [3] Rynikiewicz C. (2005), Communication at the 2nd PRIME Doctoral conference, SPRU june 2005, Sussex
- [4] Industrial Transformation Science Plan, (1999),
  http://130.37.129.100/ivm/research/ihdp-it

Thank you for your attention !

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PhD Thesis in Economics (2006)

Global Change and Induced technical change : towards trajectories of radical innovations in the steel industry ?
Supervisor : Patrick Criqui

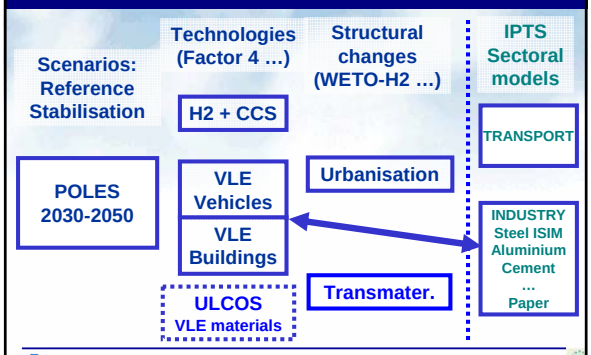
Financial support is acknowledged

Annex

The POLES modeling system
Prospective Outlook for Long-term Energy Systems

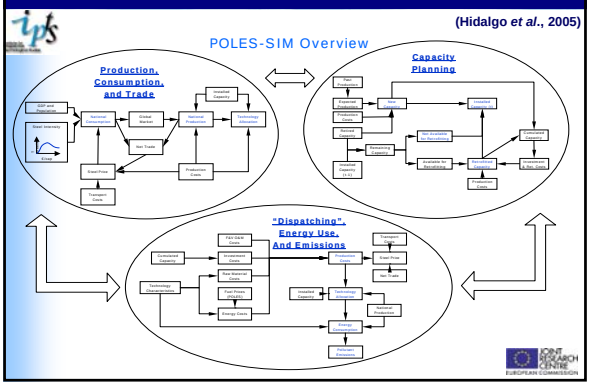
- **POLES has been developed under EU JOULE, FP5 and FP6 research programs at:**
  - ✓ Energy and Environmental Policy Group (LEPII-EPE, Grenoble)
  - ✓ Institute for Prospective Technological Studies (IPTS, Seville)
- **Main Characteristics:**
  - ✓ World partial equilibrium energy model - 46 regions
  - ✓ 2005-2050 time horizon - Year-by-year recursive simulation
  - ✓ Detailed techno-economic characterization of energy technologies
  - ✓ Endogenous international energy prices (oil, gas, coal)
  - ✓ Associated database & modelling tools: TECHPOL, ASPEN, ENDOW, TRANSMAT
  - ✓ Analysis of CO_2 emission reduction options in an international perspective
  - ✓ Impacts of technological change and R&D strategies

POLES modelling system and structural changes



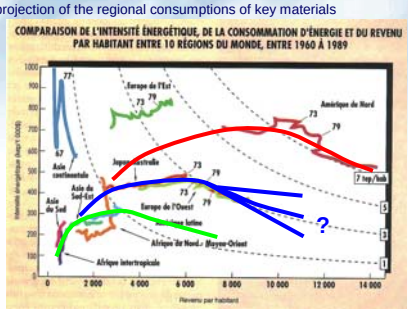
POLES ISIM model

(Hidalgo *et al.*, 2005)

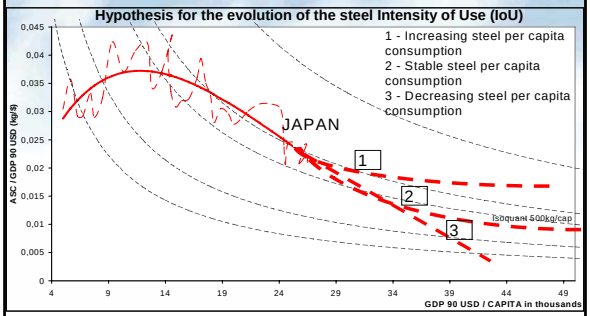


The Energy / Materials intensity profiles

- The "energy intensity profile" approach (P. Criqui, Ecodécision, 1992) as been used for the projection of the regional consumptions of key materials



Dematerialisation and transmaterialisation : The intensity profile applied to steel demand



Economic models for policy analysis:

Predictive ⟷ Normative

	Simulation / forecasting models	Equilibrium / optimisation models
Economy-wide models	1.	2.
Sectoral models (energy, agricult.)	4.	3.

Economic models in Europe

"Biodiversity" is to be safeguarded … in economic models as well as in ecosystems

	Simulation / forecasting models	Equilibrium / optimisation models
Economy-wide models	e.g. HERMES, NEMESIS …	e.g. GEM-E3, IMACLIM …
Sectoral models (energy, agricult.)	e.g. POLES, PRIMES, IMAGE/TIMER …	e.g. MARKAL, EFOM

Research on energy and climate policy with the POLES model

- 2004-2005: World Energy Technology Outlook 2050 (WETO-H2, DG-RTD) with ENERDATA, FPB-Belgium, IPTS (on-going)
- 2003-2004: Emission reduction scenario for France (Factor 4 scenario, Min. of Ind.-F) with ENERDATA http://www.industrie.gouv.fr/energie/prospect/pdf/oe-facteur-quatre.pdf
- 2002-2004: Endogenous technical change in a world energy model (SAPIENT + SAPIENTIA, DG-RTD) with NTUA, IIASA, ECN, KUL …
- 2001-2003: Greenhouse emission Reduction Pathways and international endowments in the post-Kyoto perspective (GRP, DG-ENV) with NTUA, RIVM, KUL http://europa.eu.int/comm/environment/climat/pdf/pm_summary2025.pdf
- 2001-2003: Economic analysis of the linking of the European EQTS with the international market (Kyoto Protocol Implementation, DG-ENV) http://europa.eu.int/comm/environment/climat/pdf/kyotoprotocolimplementation.pdf
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- 2000-2002: Multi-gas assessment of greenhouse gas emission reduction strategies (GECS, DG-RTD) with NTUA, RIVM, KUL, IPTS
- 2000-2001: Economic assessment of climate negotiation options, before and after COP-6 (Blueprints for International Negotiation, DG-ENV) http://europa.eu.int/comm/environment/climat/pdf/blueprints.pdf