

Italian contributions in R&D on innovative materials

*“Natural resources and climate.
The european actions for the
20-20-20 target in the
steel industry”*



Fiera di Hannover 21 April 2010
Industry Day Seminars

Roberto BRUNO
(CHAIRMAN - *Centro Sviluppo Materiali SpA*)



- ✓ **Climate change**
- ✓ **Shortage of resources**
- ✓ **Overexploitation of the fresh water reservoirs**
- ✓ **Reduction of agricultural usable areas**
- ✓ **Overexploration of the oceans**
- ✓ **Accumulation of harmful substances in the food chain**
- ✓ **Decrease in biodiversity and natural habitat**

Consequences of the extensive use of natural resources



The 21st century strategy for resource efficiency

“Decoupling” of economic growth and resource consumption i.e. reduction of negative ecological effects caused by the usage of natural resources in an increasing economy



The major challenge for the coming decades will therefore be to satisfy the needs of the world's population while using existing resources in a sustainable manner. To address this challenge, the 21st century must become an era of sustainability in all regions of the world. In no case will it be acceptable to meet human needs by continuing to exploit resources in the way this was done in the first two hundred years of the industrialized age.



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The SET-Plan

The SET-Plan is the technology pillar of the EU's energy and climate policy

It sets out a vision of a Europe with world leadership in a diverse portfolio of clean, efficient and low-carbon energy technologies (20-20-20 target) as a motor for prosperity and a key contributor

to growth and jobs. It proposes joint strategic planning and more effective implementation of programmes.

Steering Committee
Luxembourg, March 3rd 2010



The SET PLAN Initiatives

- Six new European Industrial Initiatives (EII):
 - European Wind Initiative
 - Solar Europe Initiative
 - Bio-energy Europe Initiative
 - European Electricity Grid Initiative
 - European CO₂ capture, transport and storage initiative
 - Sustainable fission initiative (Gen IV)
- A seventh European Industrial Initiative:
 - Smart cities (energy efficiency rather than energy production)
- Two illustartive examples:
 - Joint Technology Initiative on Hydrogen and Fuel Cells
 - ITER (Fusion)



The European Steel Platform



Steel is today a key material for Europe's economy and competitiveness (Automotive, Construction, Mechanical Engineering, Metal Goods, Domestic appliances, Tubes, etc...).

The European steel industry is the one of the world leaders in its sector with a turnover of over €160 billion and direct employment of 430 thousand people producing over 200 million tons of steel per year. *However, steel related activities and steel independent industries currently represent a turnover of around €3.000 billion and 23 milion employees.*



The European Steel industry will remain an important partner in the future low-carbon economy.

Steel will continue to be a very important industry in the future: All surveys predict an important growth of steel production and consumption.

Accommodating such a growth in a sustainable way will require the steel industry to focus on important process and product innovations.



In that context, minimizing environmental impact is a key consideration. It should also be noted that steel as a material can be recycled without loss, and that the use of steel products. Therefore also helps to minimize resource consumption



“In 1955, some 2.45 tonnes of ore, scrap and alloys were needed to produce one tonne of rolled steel. Today, 1.55 tonnes are sufficient. This has been made possible by new technologies, use of closed cycle management, and recycling of scrap”



Improvements of resource efficiency by the steel industry is possible by two ways:

→ *Improved use of resources during steel production, e.g.*

- Further process optimization (limits nearly achieved)
- Development of new processes for production and manufacturing

→ *Further development of the material steel for improved use of resources during production and usage of products made of steel, e.g.*

- High strength steels and new manufacturing techniques for weight reduction
- Consideration of recycling and disassembling of products
- High creep resistant materials for improved efficiency of power plants

Potentials of the steel industry



The European Steel Platform (“ESTEP”) was created in 2003 with the long-term ambition to maintain a competitive and sustainable European steel industry and to contribute to Europe’s economic and environmental challenges through research and innovation.



Five RTD programmes and a horizontal programme to meet the ESTEP's ambition



- **Safe, clean and energy-efficient technologies**
- **Rational use of energy & residues management**
- **Appealing steel solution for end-users: Automotive**
- **Appealing steel solution for end-users: Construction**
- **Appealing steel solution for end-users: Energy**
- **Attract & retained qualified people: horizontal programme**



Energy consumption and recycling of end products are two ways of efficiently decreasing the global CO₂ emissions of a process.

Both have been extensively used in the past in our industry, leaving little room for further improvement.

Therefore, the steel industry launched very ambitious breakthrough projects to completely redesign its process, in particular, using Carbon Capture and Storage (CCS).



Energy consumption and CO₂ generation have decreased by 50% and 60% respectively over the past 40 years. There is still room for improvement but only 10 to 15%.



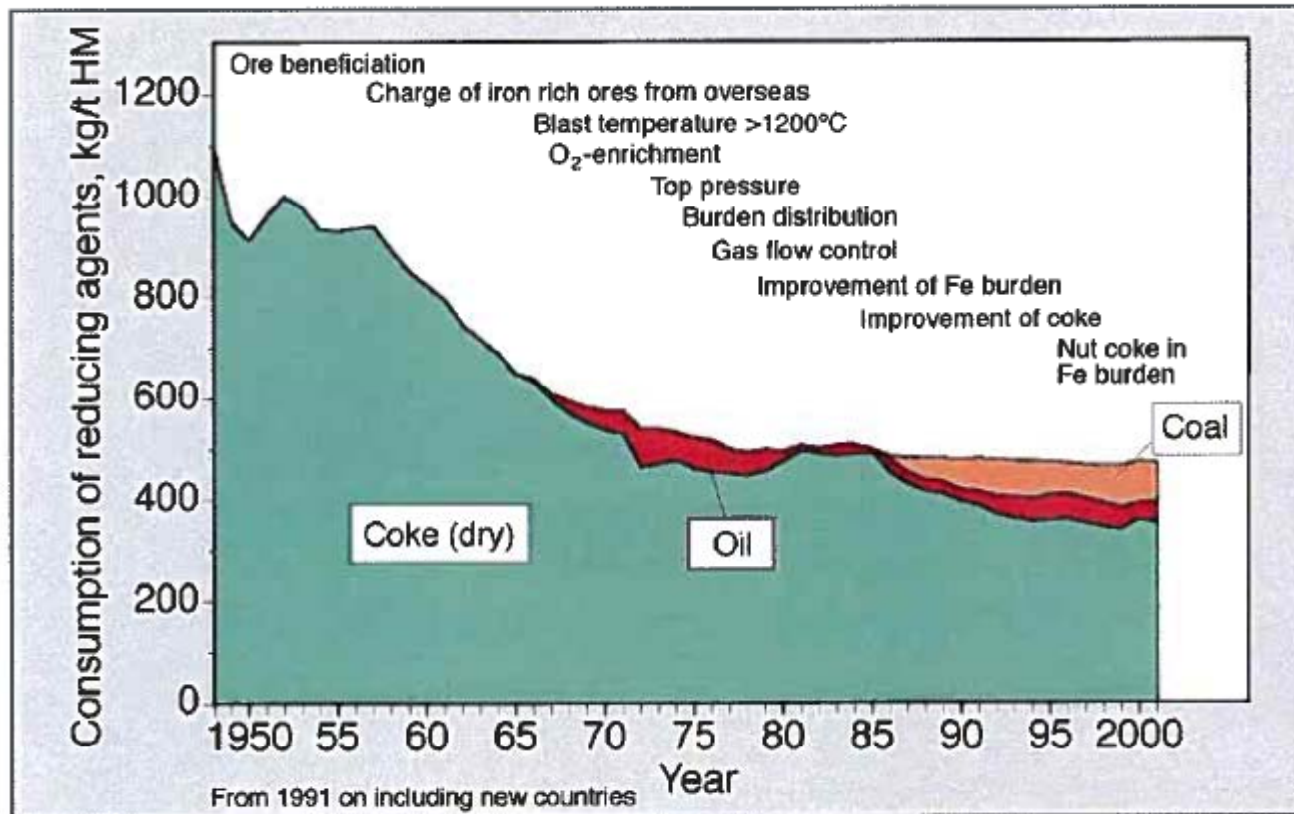
Energy in the steel industry today is coal, electricity and natural gas, in this order; it might be noteworthy to stress again that fuels are used as reducing agents and not simply as energy.

The energy consumption of the best operated steel Mills in Europe is now close to thermodynamic and physical limits and the margin for *improvement in term of energy savings is therefore small but not negligible, at the level of 10-15%*. Progress will be driven by energy integration and optimization and by the recovery of Waste heat, including low temperature heat.

Saving energy, along all the technical paths given above, is a very important target in the Strategic Research Agenda (SRA) of ESTEP.

A significant part of steel making potentials for heat recovery will be effective outside plant itself. An example is off-heat capture, which can be used in district heating grids.

Significant progress can also be made through innovative management of the energy demand and supply of the different shops in the plant. More generally, **a very interesting technology of the future is the use of “intelligent manufacturing” which will result in a global optimization of energy production and usage alongside other environmental benefits.**



Drastic reduction of consumption of reducing agents over the past decades



In addition to the significant reduction of CO₂ emissions over the past decades, Europe has recently demonstrated its leadership by launching the most ambitious programme worldwide for exploring breakthrough process concepts for drastically cutting CO₂ emissions (the ULCOS programme). The first phase of this programme has brought together 48 partners from the steel industry, the steel supply chain, research centres and universities.

As a result of research in this first phase, four technologies out of 80 possible routes have been selected for a further demonstration phase ("ULCOS II") which was decided at the Steering committee of the ESTEP platform in February 2008. Over the past four years, approximately €80 million have been invested in the research with a major contribution of private funding.



4 ULCOS technologies...

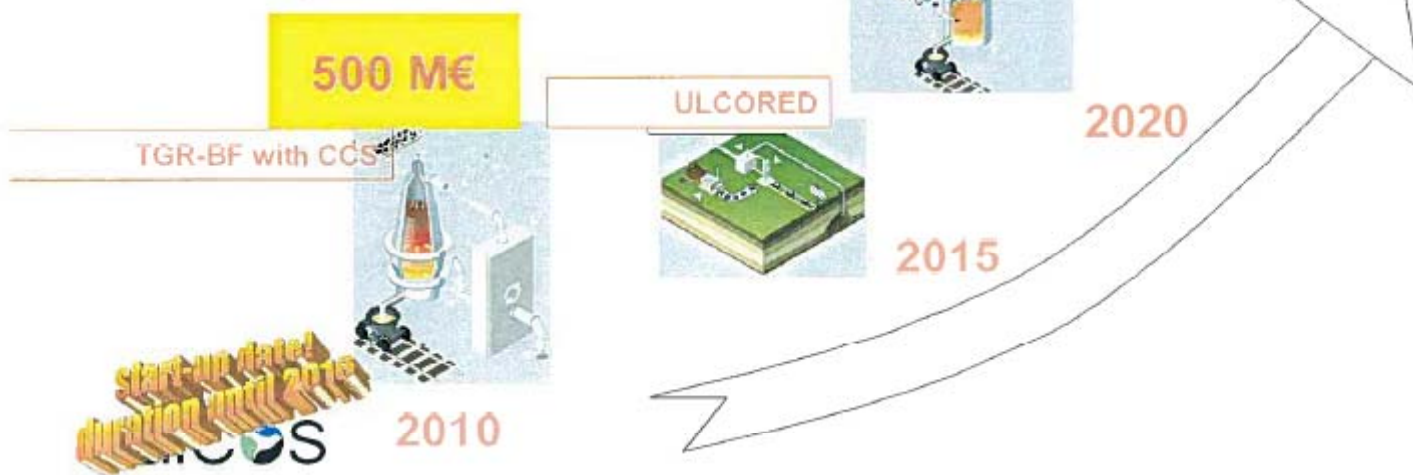
- three are based on fossil fuels and a customized "in-process" implementation of **CCS**:
 - ➔ • the **ULCOS BF**, with pure O₂ operation, recycling of the top gas after separating CO₂, which is sent to geo-storage
 - ➔ • **ULCORED**, a direct reduction process, which also operates on pure O₂ and separate CO₂ after a shift reactor, for further geo-storage
 - ➔ • **Hlsarna**, a direct reduction concept involving also pure O₂ operation and CO₂ capture & storage
- one is based on the **direct use of electricity**:
 - ➔ • electrolysis of iron ore (**ELECTROWIN & ELECTROLYSIS**)



Timeline - 1



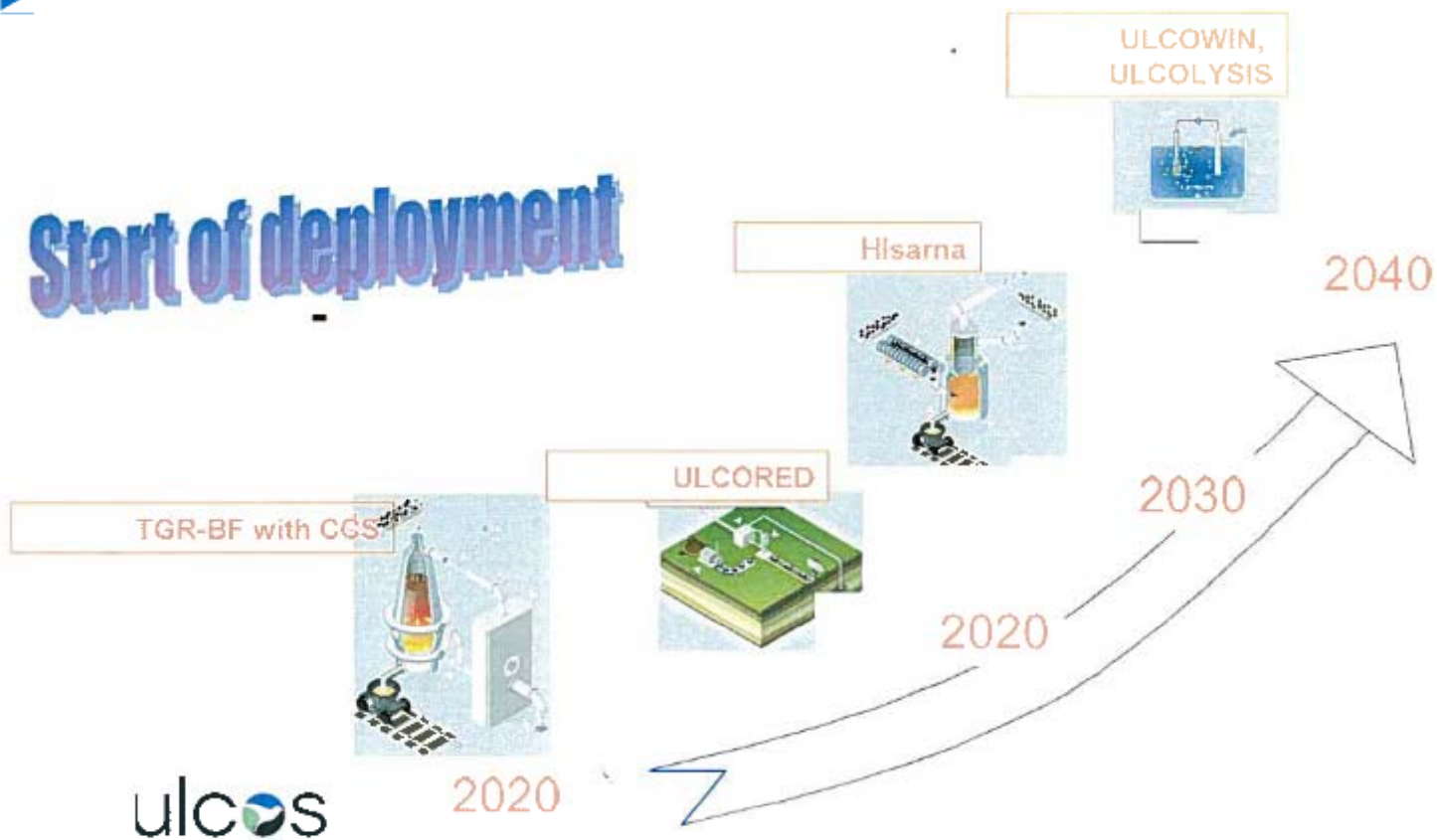
Demonstrators



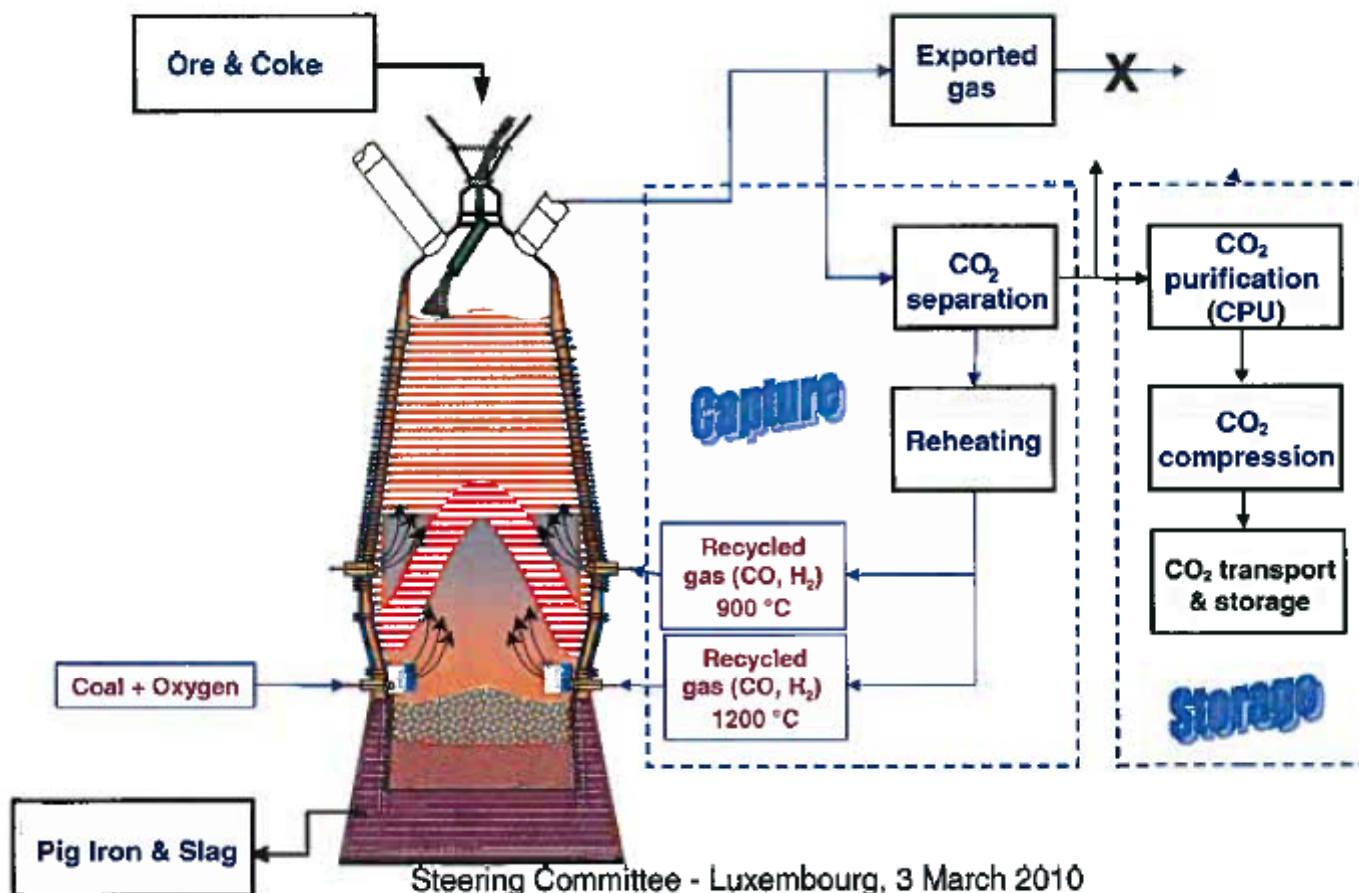


Timeline -2

Start of deployment



BF with Top Gas Recycling





ULCOS-BF aim & targets



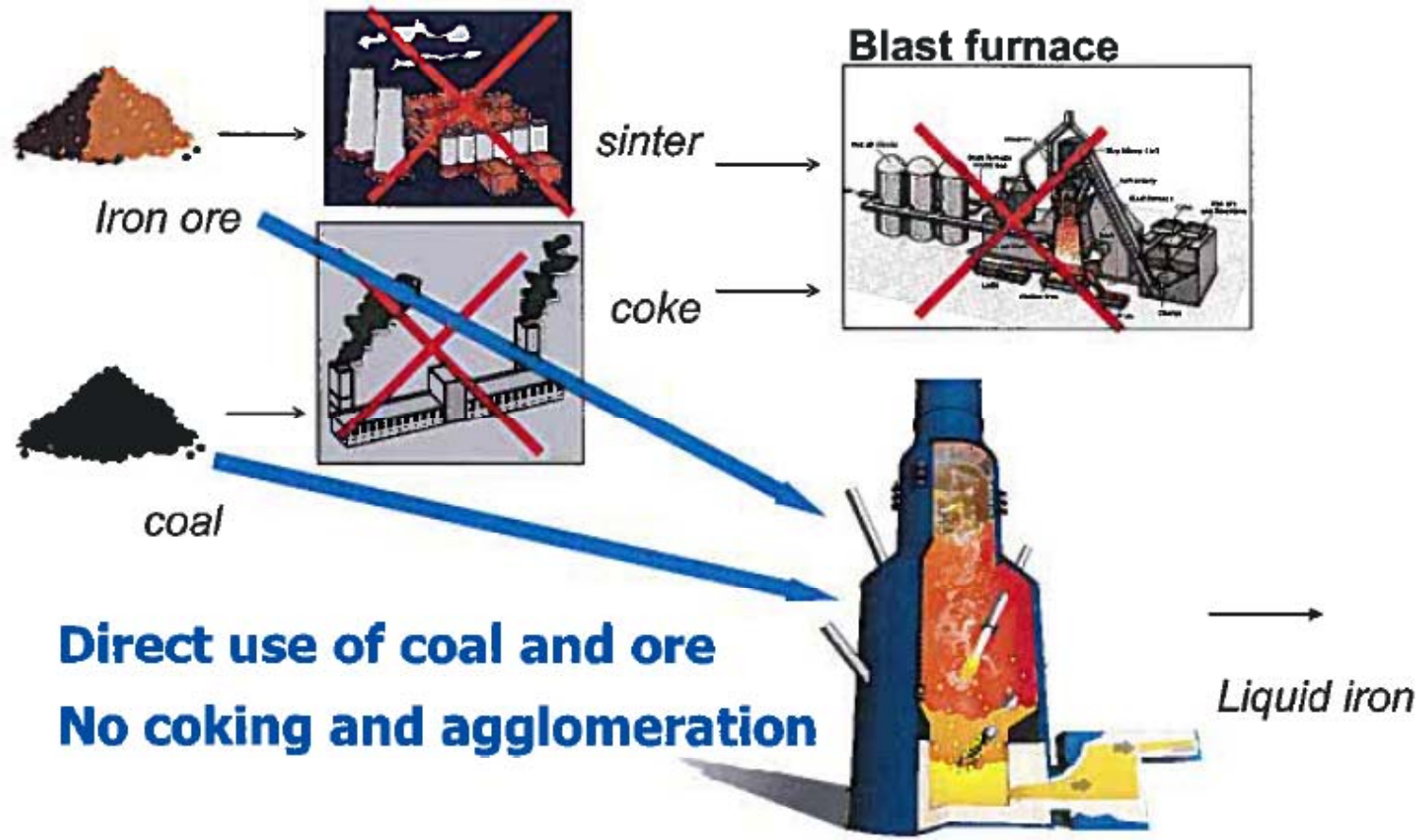
The project should demonstrate the feasibility of the TGR technology on an industrial sized BF situated in Florange (France) with a reduction of 18% CO₂ emissions coupled with savings in coke and energy consumption.

Combined with the CO₂ storage in the Lorraine region, this project should reduce the global CO₂ emissions from the Florange TGR-BF by more than 50% in medium to long term.

The industrial CO₂ storage has to be operational at the end of 2015 in order to fulfill the funding conditions defined by the EU ETS Directive.



1. Hlsarna vs Blast Furnace





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Community Research



2. Expectations Hlsarna

Environmental

Well suited for CO₂ storage (no CO₂ scrubbing stage needed)

Without CCS: 20 % reduction of CO₂/t HRC

With CCS: 80 % reduction of CO₂ t/HRC

Strong reduction of other emissions

Energy

20 % reduction primary energy consumption

Economical

Lower CAPEX and OPEX

Increased flexibility raw material usage



Intelligent Manufacturing (IM): Towards the process industry of the 21st century

Increasing the use of intelligent technologies in manufacturing is one of the 3 major partnerships initiatives in the Recovery Plan of the European Commission. It is also a major R&D theme of the ESTEP platform and its objectives have recently been updated.



- For steel, intelligent manufacturing is the progressive building of an **integrated control of manufacturing chains** including all **technological aspects** (utilization of sensors, process control loops, IT systems, production scheduling...) with the **addition of intelligence** provided by modelling, advanced control, diagnostic tools, advanced maintenance concepts, optimization and simulation, expert knowledge, artificial intelligence. **This concept mainly developed in discrete manufacturing is being extended to high energy intensive process industries.** IM will lead to the global control of the whole production chain supporting the sustainable manufacturing deployment. High-Tech SMEs will be associated to develop new innovative functions.

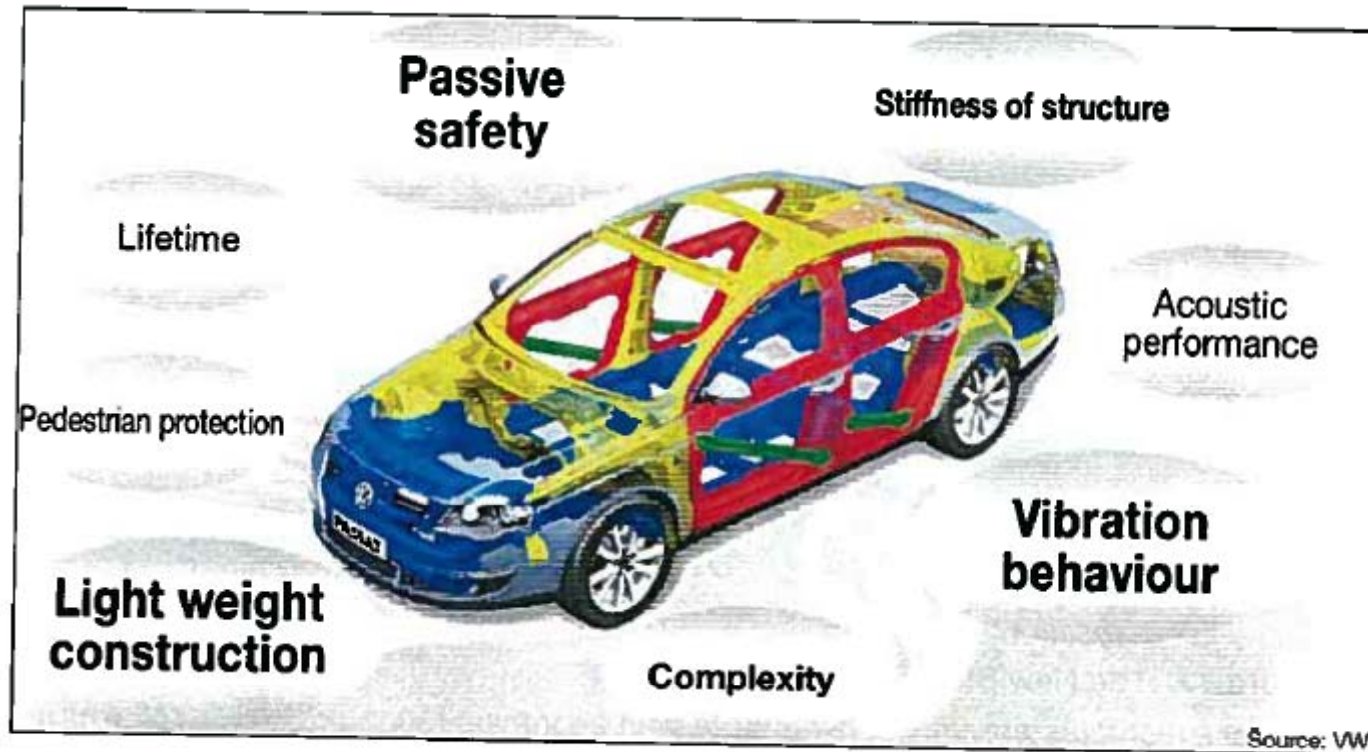


- Moreover, the steel sector has discovered the benefit of more compact lines with very short response times and extended ranges of capability. These shorter production routes, integrating the operations from liquid stage up to final shape whilst avoiding the most oxidizing processes, are being considered and investigated (towards scale free processes). Beside important savings in energy and rough materials, great flexibility is needed in the whole production chain to cope with the expanding range of products that will have to be supplied at low cost. Intelligent manufacturing technology should contribute to developing these more flexible and lower raw material and energy consumption processes.



The steel industry contributes to CO₂ reduction in collaboration with its customers

- **Through its new and innovative products, the steel industry also plays an important role in helping its customers to respond to climate change challenges in key sectors such as (i) building and construction, (ii) transportation and (iii) energy production (oil and gas, power generation, renewables).**



Steel innovations in cars: material requirements