Introduction to CSM

Steelmaking energy demand:
  A) Data about Italian energy production and utilization
  B) Steel production and energy consumption
  C) EAF energy demand

Efficiency improvements

Technological trends
Diversification and Globalization

Privatization

Corporate R&D Finsider

Building up of Corporate Know-How for Italian Steel Making Industry

1963 Start Up

Integration in the Rina Group

1963 Start Up

1973

1983

1993

2003

2013

2014 On

Key player in the Technological Transfer, Innovative Solutions for the Industry

Start selling of Know How to New Clients and Markets
CSM KEY FACTS

- Researchers: 100
- Laboratory technicians: 100
- Laboratories and Full Scale Pilot Plants: 25
- Patents: 160
- Publications/year: 40
- Running projects: 300
- M Euro sales/year: 20
- Policentric Structure Headquarters in Rome (Italy), 5 sites in Italy, Offices in China

Ending 2015
CSM APPROACH FOR INNOVATION & RESEARCH

Technology Readiness Level (TRL)

1 2 3 4 5 6 7 8 9

RESEARCH
- Idea Developing
- Idea Generation

DEVELOPMENT
- Prototype/Demo Development
- Conceptual Design

INDUSTRIAL APPLICATION
- Development & Engineering
- Demo & Performance
- Mature Product & Processes

CSM APPROACH FOR INNOVATION & RESEARCH

Academy

CSM

Industry
CSM has both high level technical skills and state of the art laboratories which allows to assess product/process/plant performances as well as to develop new solutions.

- **ASSESSMENT**
  - Study of customer needs
  - Market benchmarking
  - Lab analysis

- **IDEA**
  - Complementary technical competences
  - Positive experience from similar cases
  - New solutions

- **VERIFICATION**
  - Fit for purpose analysis and lab testing
  - Experimental check at real scale

- **SOLUTION**
  - Product/process suitable for the application/market
  - New product/process with better performances/cheaper
  - Support to implementation
Italian energy production and utilization

Electricity utilization divided per different sectors

Industry accounts of 20% of energy consumption

Electricity utilization divided per different industrial sectors

Metal sector is about 25%
Steel production in Italy

78% of Italian steel production is via EAF route

39% of European steel production is via EAF route
Steelmaking energy demand

Electrical energy consumption
20,000 GWh annual consumption (2012)
(3 740 000 TOE)
(1GWh=187TOE*)

Natural gas consumption
2,000 M m$^3$ annual consumption (2012)
(1 650 000 TOE)
(1Mm$^3$=825ToE*)

Delibera
AEEG 9/11 EEN, Allegato A
Steelmaking energy demand

Electric arc furnace

- High current connection
- Electrodes
- Gap for air to enter
- Natural gas burner
- Purified steel
- Molten steel scrap
- Slag
- Refractory lining
- Slag removed from surface through door

Chemical energy

Electrical energy
Steelmaking energy demand

EAF energy balance

Average consumption:
0.1TOE/t steel
~12 TOE/heat (~1hour) typical furnace size
Steelmaking energy demand

EAF Technological evolution and consumption reduction

- Oxygen blowing
- Ladle metallurgy
- Watercooled walls
- UHP furnaces
- Computerized monitoring
- Foamy slags
- Watercooled roofs, oxy fuel
- Bottom tapping
- Hot heel practice
- Ladle furnace
- EBT
- Scrap preheating
- DC furnace
- Bottom stirring
- Lance manipulator
- Cooling blocks in slag zone, Co-jet technology
- High voltage

Electric energy consumption:
- 630 kWh/t
- 345 kWh/t

Tap-to-tap time:
- 180 min
- 40 min

Electrode consumption:
- 6.5 kg/t
- 1.1 kg/t

Years:
- 1965
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
Recent improvements in EAF steel production and future trends
How to increase energy efficiency?

- **Reduction of energy demand**
  - operating practice optimization
  - more flexible use of fuels and materials

- **Increase of steel weight at tap**
  - reduction of metallic losses

- **Reduction of energy losses**
  - higher insulating materials
  - reduction of water cooling

- **Increase the rate of energy recovered**
  - energy recovery from off gas and other hot by-products
Efficiency improvements

Scrap pre-heating and scrap continuous charging allows energy reduction

1. Shaft furnaces, operating with continuous or semi-continuous charging
2. Consteel, operating with a tunnel conveyor for continuous charging

Increase the rate of energy recovered
Scrap pre-heating

ORI Martin
Tenova Consteel

Siemens
## Efficiency improvements

<table>
<thead>
<tr>
<th>Producer Product</th>
<th>Charging technology</th>
<th>Charge</th>
<th>Electrical Energy (kWh/t)</th>
<th>CH4 (m3STP/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference situation</strong></td>
<td>Conventional Top charge</td>
<td>Bucket</td>
<td>~380</td>
<td>~8</td>
</tr>
<tr>
<td>Siemens VAI Primetals Quantum</td>
<td>Shaft</td>
<td>3-4 batches</td>
<td>~280</td>
<td>~4</td>
</tr>
<tr>
<td>Fuchs COSS</td>
<td>Shaft</td>
<td>3-4 batches</td>
<td>~300</td>
<td>~2</td>
</tr>
<tr>
<td>CVS EPC</td>
<td>Shaft</td>
<td>3-4 batches</td>
<td>~300</td>
<td>~3</td>
</tr>
<tr>
<td>JPSP EcoArc</td>
<td>Shaft</td>
<td>12-13 batches</td>
<td>~280</td>
<td>~2</td>
</tr>
<tr>
<td>Tenova Consteel</td>
<td>Continuous charging conveyor</td>
<td>continuous</td>
<td>~350</td>
<td>~0</td>
</tr>
<tr>
<td>Tenova Consteel evolution</td>
<td>Consteel</td>
<td>continuous</td>
<td>~310</td>
<td>~8</td>
</tr>
</tbody>
</table>

**Increase the rate of energy recovered**

**Scrap pre-heating**

...
Efficiency improvements

Energy recovery

Increase the rate of energy recovered

Development of systems for maximization of energy transfer from hot gases at 1500-1700 °C with high content of dust without drawback in the micro-pollutant emissions

Development of systems for energy transfer from slag to high temperature fluid with high efficiency not detrimental for slag quality

Intelligent optimization system for energy storing and distribution
From the single plant approach ...

- Up to now the efforts for higher energy efficiency have been focused on the single plant

- The EAF, which represents the 70% of Italian steel production is an emblematic case

- Large efforts of process optimization lead in the last 40 years to a significant reduction of energy consumption (50% of reduction of electrical energy)

- Further savings are still possible from optimization of operating practice, reduction of losses, utilization of waste heat

- These efforts are bringing to the absolute limits.
... toward a cross-sectorial approach

- A further improvement is only possible with a new approach, based on a cross-sectorial vision.

- Energy saving can be seen in an integrated view according to the logic of circular economy, where waste heats and waste materials are used inside and outside the steel plant.
Conceptual design of steel industry based industrial symbiosis: Piombino case

Material flow
- Scrap
- Iron ore
- Ships dismantling

Energy flow
- Solar station
- Smart grid

Power plant
- DRI
- EAF
- Gasifier
- Syngas, char
- Hot metal
- Dust
- Slag, scale,

Dedicated plasma furnace

Steelmaking plants

INDUSTRIAL DISTRICT
- Algae cultivation
- CO2 utilization

AGRICULTURAL DISTRICT
- Biomass
- Gasifier

Valuable products (ballast)

ENERGY GENERATION AND DISTRIBUTION

HARBOR

STEELSHOP
Conceptual design of steel industry based industrial symbiosis: Piombino case

Material flow
- TRL9
  - Scrap
  - Iron ore
- TRL7
  - Gas
  - Syngas, char
- TRL9
  - Ships dismantling
- TRL7
  - Power plant
  - Solar station
  - Smart grid
- TRL7
  - Energy generation and distribution
- TRL5
  - Steelmaking plants
  - Slag, scale, ...
- TRL9
  - HARBOR
- TRL3
  - INDUSTRIAL DISTRICT
- TRL3
  - AGRICULTURAL DISTRICT
- TRL3
  - Agroindustry
- TRL8
  - Valuable products (ballast)
- TRL6
  - Biomass
  - Gasifier
- TRL3
  - CO2 utilization
  - Algae cultivation
- TRL9
  - Steelmaking plants
Thanks for your attention

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