Stainless steel and sustainability

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The paper focuses on the Sustainability of Stainless Steels.
It first analyses the growth of stainless steels over the last years. Then it focuses on sustainability and gives an evaluation of the CO_2 emissions of Stainless Steels from cradle to gate. It gives as well an evaluation of the recycling rates of stainless steels according to the market applications and an evaluation of the overall cycle of manufacturing and scraps in 2005 on a world wide basis. It concludes with a presentation of some remarkable applications focusing on green energy and future growth markets.

INTRODUCTION

My presentation demonstrates the sustainability of stainless steels, not only taking into account its remarkable characteristics, but also through its long life and high recycling rate. This makes stainless the material of choice for the 21st century, ensuring its sustainable growth in the future.

After providing some important facts and figures, I will focus on the Life Cycle Inventory and emissions studies for stainless steel. I will then demonstrate the high recyclability of stainless steels and finish with some case studies on Life Cycle Costing.

STAINLESS STEEL GROWTH: A MYTH OR A REALITY?

Compared to other materials, stainless steels have enjoyed an unprecedented growth until 2007, much faster than any other metallic material (fig. 1). However taking the recent years since 2000, this growth has been concentrated in one country, China, and on two types of grades 200 and 400 series (fig.2).

The crisis of 2008-2009 has had the same effect on stainless steels than on other materials but already in 2010 we passed the 30 Mio T threshold, which were 10 Mio T more than in year 2000.

So what is the real future of our material? Following the raising concern over the future of our planet, only industries and materials showing competitive advantages in sustainability will survive in the long term.

Sustainability is the key for the future.
Knowing the enormous potential of growth in emerging countries, there is still a large potential for stainless steel markets. In more advanced countries, stainless steel applications will develop in more sophisticated applications dedicated to environment & sustainability.

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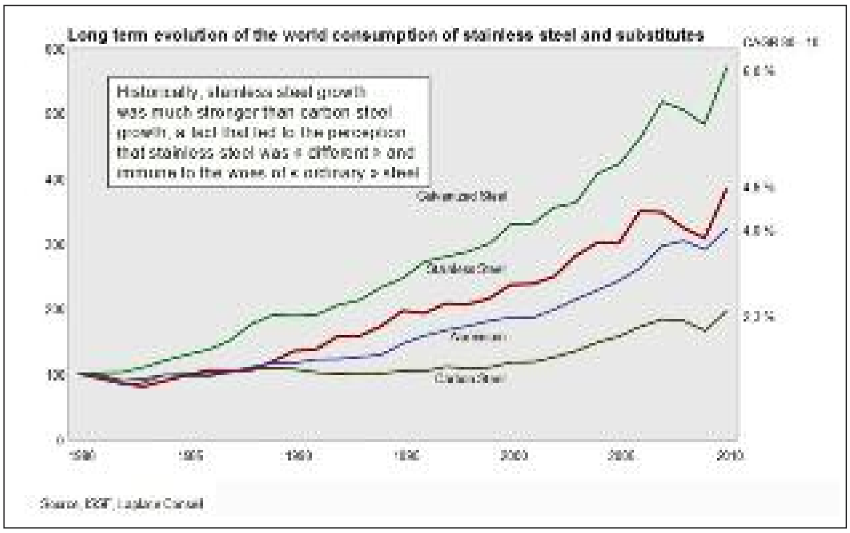

Fig.1 – Since 1980 stainless steel has grown faster than most metallic materials.

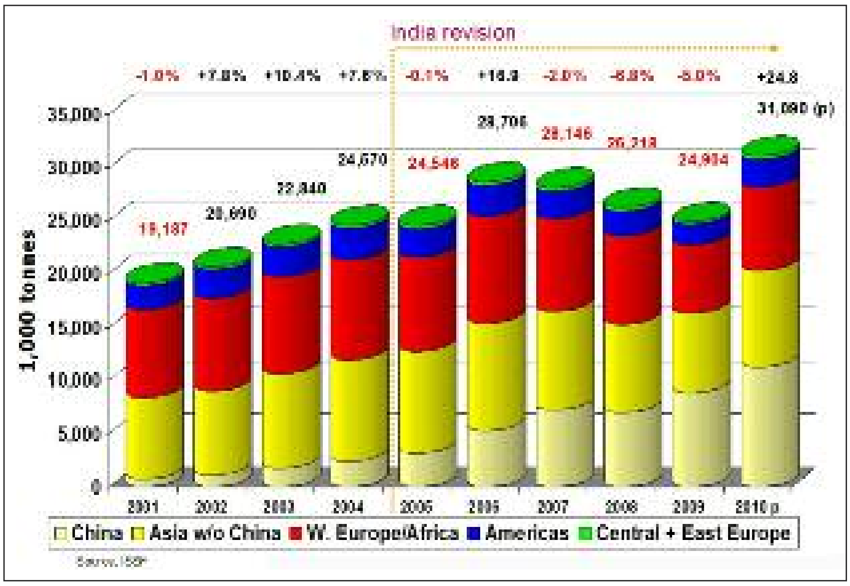

Fig. 2 – Stainless crude steel production.

SUSTAINABILITY: THE NEXT SOURCE OF GROWTH?

In looking at its future and the challenges faced by our planet, the stainless steel industry has put sustainability at the top of its agenda. In Rio, in May 2010, the ISSF members committed themselves to a Sustainability Charter, an important milestone on the journey toward a better world, recognizing that only industries showing an edge on these matters will survive on the long term.

But what is sustainability?

The classical definition relates to People, Planet and Profit. In looking at these different topics, Stainless steels shows definite advantages and progresses over the last years.

In taking the safety of our employees we show progress which our industry put as a benchmark.

The safety of our products and customers is also a first priority. This is why in 2010, we have asked the reputed FIOH (Finland Institute for Occupational Health), an independent research institute, to look at all that has been published the last 20 years about stainless steels and their usage in all possible applications ranging from medical to food storage and household appliances. Their conclusion was clear that stainless steels are harmless to the human beings [2].

Renewable energies and preservation of resources are key for the future of our planet. In these markets, especially in biomass and water treatment, stainless steels are demonstrating their edge over other materials through durability, low maintenance, and high corrosion resistance together with high mechanical properties. Markets in those applications are growing very fast.

SUSTAINABILITY: FACTS AND FIGURES

Regarding stainless steel, we have studied the complete cycle from cradle to grave, including the different contributions of the supplying industries as well as the inputs from the utilities and ancillary materials.

On a world wide basis and averaging all different grades of stainless steels (ferritics, austenitics etc..) we found a total CO_2 foot print of around 3,8 T of CO_2 per tons of stainless steel.

In comparison with other metallic materials, stainless steels are showing lower than average values as reported by different sources [5 to 9].

The main conclusion is that the stainless steel industry itself contributes directly for less than 10 % of total emissions [1](fig. 5).

Most of the emissions are coming from upstream industries: raw materials for the largest part (70 %) and electricity generation for around 17 %. As far as raw materials are concerned the two main contributions are coming from the chromium industry in the first place through the supply of Ferrochromium and the Nickel industry.

Electricity is counted from data provided by the International Energy Agency.

Since the stainless steel industry itself is only a small part of the C-footprint of the whole supply chain, recycling is a key factor and is indeed very high.

Due to their high intrinsic value, stainless steels are easily collected and do not require any subsidies from governments to encourage recycling. The high value of its intrinsic ingredients ensure that over 70% of all stainless steel is reused to produce new stainless. This greatly reduces the environmental footprint of stainless steel. Even when stainless does find its way into

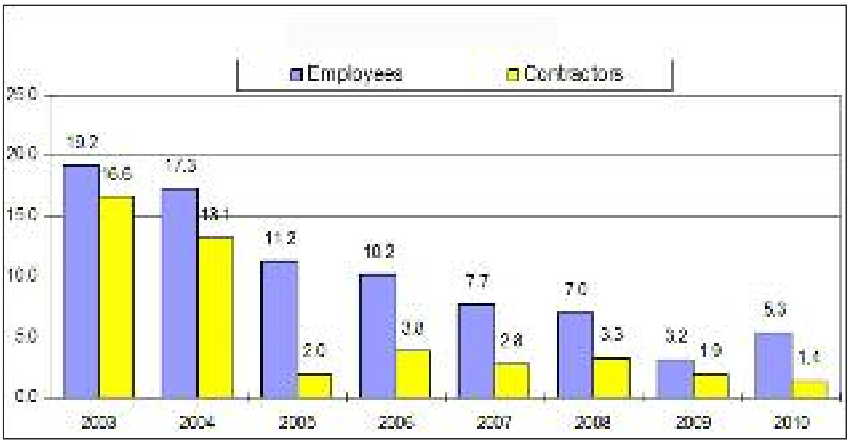

Fig. 3 – Lost-time frequency rate.

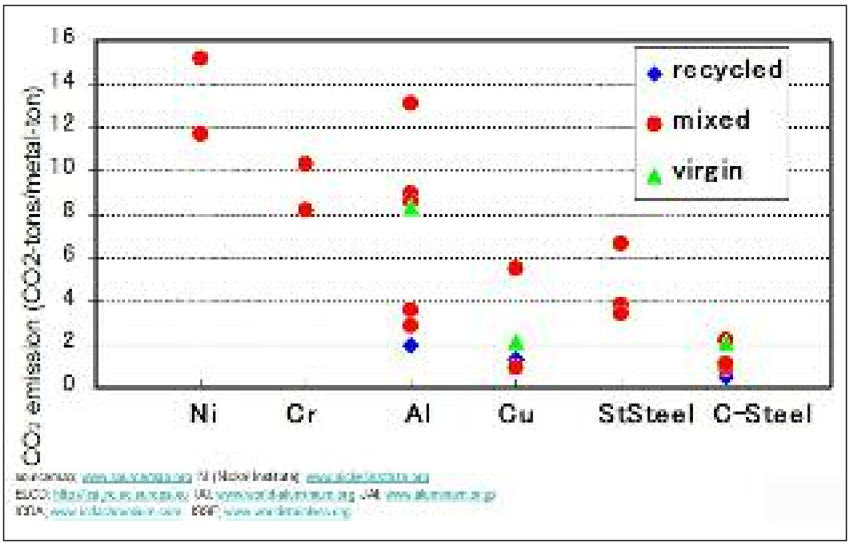

Fig. 4 – LCI facts and data.

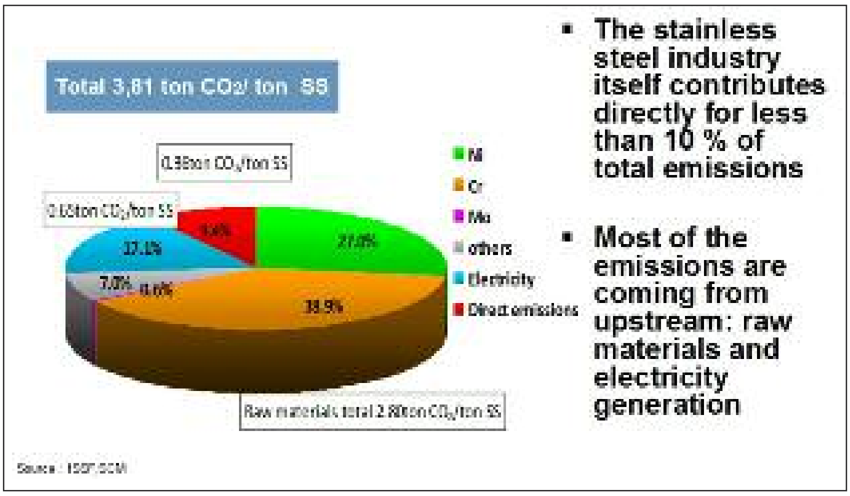

Fig. 5 – CO_2 emission from cradle to grave.

landfill sites, it does no harm to the environment.
The graph in fig. 6 illustrates the lifecycle of stainless steel in 2005, a year in which 25 million tons of stainless was produced. After fabrication and manufacturing, about 13 million tons, just over half the total, goes into goods at the consumer level. These goods include cars, household appliances, industrial equipment, all of which are recycled much later.
Table I comes from a study conducted by Yale University and ISSF [10]. It shows the recycling rate for stainless steels in different application sectors on a global basis. The study found that 82% of stainless steel is recovered at the end of the product's life (22 years on average), and that 90% of the collected stainless is used to make new stainless steel (the remaining 10% goes to making carbon steel products).
These rates are among the highest for any metallic material and clearly demonstrate the high sustainable value of stainless steel.
What is recycled today was produced more than 20 years ago when the production level was much lower and is quite in accordance with previous graph of the stainless steel cycle (fig. 7).
It shows also that to day, the inventory of stainless steel accumulated in the goods represents an enormous reserve of energy and value.
In the likely hypothesis of a lower growth in the future, these scraps reserves will be an extremely powerful way to reduce the CO_2 emissions from stainless steels since the emissions of stainless steels made of recycled material are only a small portion of the one from virgin material.
It is like having a forest where every year you plant more trees than you cut.
By the same way, the large inventory of stainless steels goods - which are increasing each year - acts like a potential low C-footprint reserve.
At the EoL this reserve will be used to produce stainless steels with an extremely low C footprint. Without going into complicated mathematics, it is estimated that taking into account EoL recycling credit, the C foot print of stainless steels is reduced by 1 to 1,5 T of CO2/ T of stainless steel . It reduces then the CO_2 footprint – and also all other related environmental footprints – very substantially.
This is why if we take in consideration this recycled potential, the C footprint of stainless steels of 3,8 T of CO_2 / T is greatly reduced by about 1 T to 1,5 T of CO_2 /T.
There are numerous studies on Life Cycle Cost; this one refers to a roofing application in Japan.
Thanks to the extremely low maintenance costs, stainless steels demonstrate a lower cost over any other solution after 20 years against hot dipped galvanized steel. Other studies on bridges, architectural goods or street furniture objects deliver the same results (see Sorbonne University study [12 to 18]).

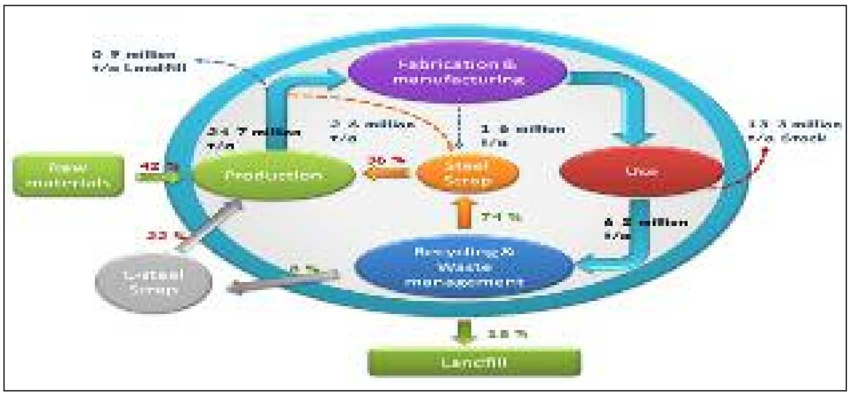

Fig. 6 - lifecycle of stainless steel in 2005.

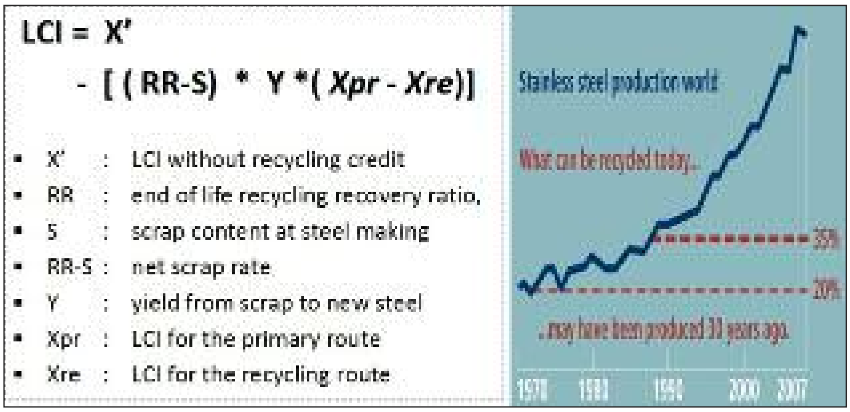

Fig. 7 – Stainless Steel Recycling – What is recycling credit?

CONCLUSIONS
Sustainability has been recognized by the stainless steel industry as a major challenge for the future
Progress has been made to reduce its footprint to the environment by increasing recyclability and improving processes all along the supply chain, including raw materials.
Stainless steel with its unique properties:
- Recyclability
- Long life
- Low maintenance costs
- Neutrality and Hygienic

is it a perfect material to offer sustainable solutions in many different markets and applications?
Stainless steel is not the problem...
But can be part of the solution.

Main application sectors steel	Use of finished SS in manufacturing	Average life (in years)	To landfill	Collected for recycling Total	Collected for recycling As stainless
Building	16%	50	8%	92%	95%
Transportation	21%	14	13%	87%	85%
Industrial machinery	31%	25	8%	92%	95%
Household appliances	6%	15	18%	82%	95%
Electronics	6%	-	40%	60%	95%

Table I

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Fig. 8 – Case study (life cycle cost in Japan).

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