How will the industry evolve?

- Introduction: The world of steel has already changed profoundly
- Trade: OECD still a net exporter: import vigilance and export prom.
- Excess capacity in OECD: Where is it?
- Energy and Environment challenges = Scrap + Shale Gas/DRI
- Strategy, governance and social relations: Accelerate evolution.
- Implications for organisations, governments and associations.
The world of steel has changed profoundly

- Since 2000, global steel demand is growing at a rate of 6%; 80% of that growth is due to the phenomenal expansion of the Chinese economy, which today represents 46% of global steel production and consumption, that is more than twice its share of the global population.
- Globally, steel is the largest construction material (market value over USD 1 trillion) and is substituting far more for traditional materials (wood, brick) than it is losing share to lighter products (aluminium, plastics). For many applications steel simply has no substitutes.
- Steel technology keeps changing and, in OECD countries where demand is stable, the traditional blast furnace integrated plants are challenged by more nimble minimills that recycle scrap. Having captured the long product market, they are now attacking the flat product sector.
- Large integrated companies keep closing plants and loose jobs, a painful and inevitable evolution that result in a poor perception of the industry in economic and political circles as well as in the media.
- It is therefore important to distinguish between the future of steel, which is bright, and the future of the integrated sector, which is more cloudy in Europe and North America.

Since the beginning of this century, the steel industry has entered a new era
In 12 years, China production has sextupled, while OECD was stable and ROW grew slowly

China rate of steel development is much faster than the rate of more mature economies
China has known regular five years cycles for capital investment, hence steel production.

Shanghai, Beijing and Tianjin are both the richest areas and the most steel intensive.
Raw material prices are the “canary in the coal mine”: Is steel heading in a new bearish direction?

Evolution of iron ore fine prices (LHS) and coking coal (RHS) ($/t)

Source: Steel Business Briefing, Bluestone, Laplace Conseil analysis

The iron ore cost curve is very steep with many high cost producers, leading to price instability

Cost Curve for Iron ore fines (US$/t CIF China equivalent basis)

Source: Macquarie Research March 2012, Laplace Conseil analysis
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Until 2008, international trade has grown steadily in the OECD countries

![Graph showing import, export, and net export of OECD countries from 1990 to 2012.](image-url)
Japan and Korea are large net exporters, mostly to ROW. NAFTA is the only net importing region.

Global trade disputes have been recurrent, but OECD has usually fared fairly well.

- Since 1990, OECD was always a net exporter of steel, except when the industry was running practically at full capacity due to strong domestic demand (for example from 6/2006 to 6/2008).
- Moreover, exports were usually for high value added products, while imports were for semis and common grades steel.
- Nevertheless, import pressure often had a negative impact on price and profitability, particularly in the US.
- With the advent of shale gas, the US has all the ingredients to become low cost producers and can become net exporters as well.
- Import vigilance remains « de rigueur » for risk of unfair trade, but focus should shift on export promotion.
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Except in 2008, when the industry was running at full capacity, OECD was always a net exporter.

A sharp price increase in S1 2008 shows that the industry was running at full practical capacity.

Crude Steel output (China, OECD, ROW) versus World price tracker.

In OECD, the production level achieved in S1 2008 can be used as a measure of practical capacity of the industry. The current overcapacity can be measured against that level.

Based on 2012 production level, integrated mills represent 85% of OECD overcapacity.

Share of Capacity and excess capacity by process and region (Mt)

2012 Capacity in OECD
Total = 520 Mt

Europe BOF 105
NAFTA BOF 48
Asia BOF 133
Europe EAF 105
NAFTA EAF 75
Asia EAF 54

2012 estimated overcapacity in OECD
Total = 51 Mt

Europe BOF 28
NAFTA BOF 8
Asia BOF 7
Most of the current OECD overcapacity is concentrated in integrated mills in Europe and USA

Rate of overcapacity by process and region (% of installed capacity)

Source: Worldsteel, Laplace Conseil analysis

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The OECD steel industry is facing severe energy and environmental challenges

• For integrated mills, energy (including coking coal) is the highest cost item; for minimills it is the second highest. Even allowing for the recent coal price decline, energy is the cost component that has grown the fastest.

• The industry has made very impressive efficiency improvements in the last decades, but with current processes, the technological limits are almost reached or uneconomical to overcome.

• Environmental pressures are also mounting: CO₂ taxation and air pollution, specifically for integrated plants that produce steel with by coking and sintering plant, blast furnaces and BOF shops.

• Laplace Conseil believes that (part of) the solution to these challenges is technological: replace (part of) virgin iron ore by recycled scrap and (part of) coking coal by shale gas. This means going « DRI and EAF » wherever possible.

For many decades, the share of EAF steel has grown steadily in Europe and NAFTA

EAF share in crude steel production, by region (%)
The environmental advantages of scrap recycling over traditional BF/BOF smelting are important

Environmental comparison of minimills and integrated mills in OECD countries*

In EU and US, production costs of BOF are usually above EAF, particularly when steel demand is low
The EU and US scrap “mines” each have a proven and probable reserve of 3 billion tonnes

Size of the scrap “mine”, proven, probable and inferred, Mt*

* Computed as the difference between steel consumption (including indirect imports) and scrap collection. An estimate is made for unrecoverable scrap due to current use rust or uneconomic recovery.

US and EU are large net exporter of scrap, primarily to Turkey; OECD is a small net importer
Shale gas is redefining the US energy landscape: prices are at the lowest since 2002

Evolution of natural gas prices across OECD countries (US$/MBTU)

Source: EIA, BP, Laplace Conseil Analysis

US mills are located over huge shale gas plays

Location of US steel mills and shale gas plays

Source: EIA, AISI, USGS, Laplace Conseil analysis
In 2012, natural gas prices provide a competitive advantage to DRI compared to scrap, over $100/t

Cost comparison, DRI, Scrap, Pig Iron and Hot Metal
Average cost Q2 2012, United States, $/t

Note: Yield, carbon value and copper penalty are not included

Source: SBB, EIA, Steelonthenet, UBS, Nucor, Laplace Conseil analysis

Nucor, already technology leader is the first to capitalize on the game changing shale/DRI strategy

- Nucor is the world leader in EAF/TSC (thin slab caster) technology for hot rolled coils production with 6 minimills in operation in the US and a combined capacity of 12 Mt of hot rolled coils (not including plates).

- Nucor is building a DRI plant in Alabama (2 modules for 5 Mt) in addition to its 2 Mt plant in Trinidad and has signed a 20 years contract for shale gas with Encana Oil and Gas Inc. to drill at “cost plus carried interest” all the gas needed for Nucor operations.

- Nucor flat product expertise coupled with its DRI experience will be used to enter the automotive sheet market and other high grade steel.

- Nucor has an unbroken record of 156 quarterly dividends, has the best return of capital employed of the industry and has never lay-off a “teammate” throughout the steel cycles.
Minimill technology drawing on DRI, EAF and TSC costs one fourth of the same integrated mill

Comparison between Integrated and minimill philosophies for investment (Billion US$)

<table>
<thead>
<tr>
<th>Hot strip mill</th>
<th>Cold rolling Mill</th>
<th>Galv lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.8</td>
<td>11.8</td>
<td>0.75</td>
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</table>

Comparison of Scrap/DRI/EAF vs iron ore/coal/BF/BOF
- Iron ore and scrap: 200 - 250% of integrated route
- Total Energy cost (coal vs nat gas): 50% of integrated route
- CO2 emissions: 30% of integrated route
- Dust and other emissions: 20 - 40% of integrated route
- Labor cost: 35 to 45% of integrated route
- Maintenance cost: 25% of integrated route
- Total transports to client cost: 30 - 50% of integrated route
- Financial cost: 20% of integrated route

Total cost comparison: minimill is 20 – 30% lower cost

In NAFTA, DRI/EAF production will grow from 9 to 39 Mt, replacing imports and half the BF/BOF

NAFTA market supply by origin (Mt crude steel)

2011, 100% = 130 Mt
- Steel net imports: 10%
- EAF DRI: 7%
- EAF Scrap: 47%
- BOF/ BF: 36%

Forecast 2020, 100% = 139 Mt
- EAF DRI: 28%
- EAF Scrap: 53%
- BF in use / available: 25 / 39
- BF in use / available: 15 / 21

Source: WorldSteel, AISI, Midrex, Laplace Conseil analysis
With the advent of DRI, nearly half of the NAFTA integrated mills will be threatened by closure

NAFTA Integrated mills utilization forecast by 2020

Source: Worldsteel; Laplace Conseil analysis

In Europe, shale gas are apparently abundant but exploration/exploration is still very prudent

Europe non conventional gas resources

Source: Kuuskraa et al
In Europe, integrated plants will probably shift to more EAF production, some DRI could be imported

EU-27 + TK, SWI, NW production, by origin (Mt crude steel)

By 2020, the European integrated capacity could be reduced by one third
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We believe that “Changes” will continue to characterise the OECD steel industry evolution

• The integrated sector will continue to bear the brunt of the effort, in particular the two or three largest integrated companies.
• While restructuring is currently more important in Europe, it is probable that North America will soon join in the process as more modern producers increase their presence in the market thanks to shale gas DRI.
• Consequently, strategy, governance and social relationship will need to evolve
  – The strategy of the large integrated companies will need to change so as to take into account the impact of cheaper scrap and DRI, especially in the US.
  – The governance of these companies will also need to change to find solutions at the shop floor level and not just in boardrooms. (Mitbestimmung or co-determination as practiced in Germany and many neighbouring countries)
  – The social relationships will need to improve to reduce confrontation, share decisions and flatten hierarchical pyramids for better workers empowerment.
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Implications for international organizations, governments and industry associations

• Focus assistance on the remaining unrestructured integrated producers where the bulk of the overcapacity is concentrated.

• Encourage OECD trade of high grade steel as well as technology and best practices; Relax but remain vigilant for "unfair" imports.

• Promote recycling (collectors, processors, EAF steelmakers).

• Encourage use of gas as substitute for coal wherever possible. Anticipate replacement of older BF/BOF by DRI/EAF.

• Encourage modern social relationships and local management.

• Promote steel as best material for the future.
Thank you for your attention

Metal and mining Consultant

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