The Future of Nickel Markets - Why Nickel will Outperform

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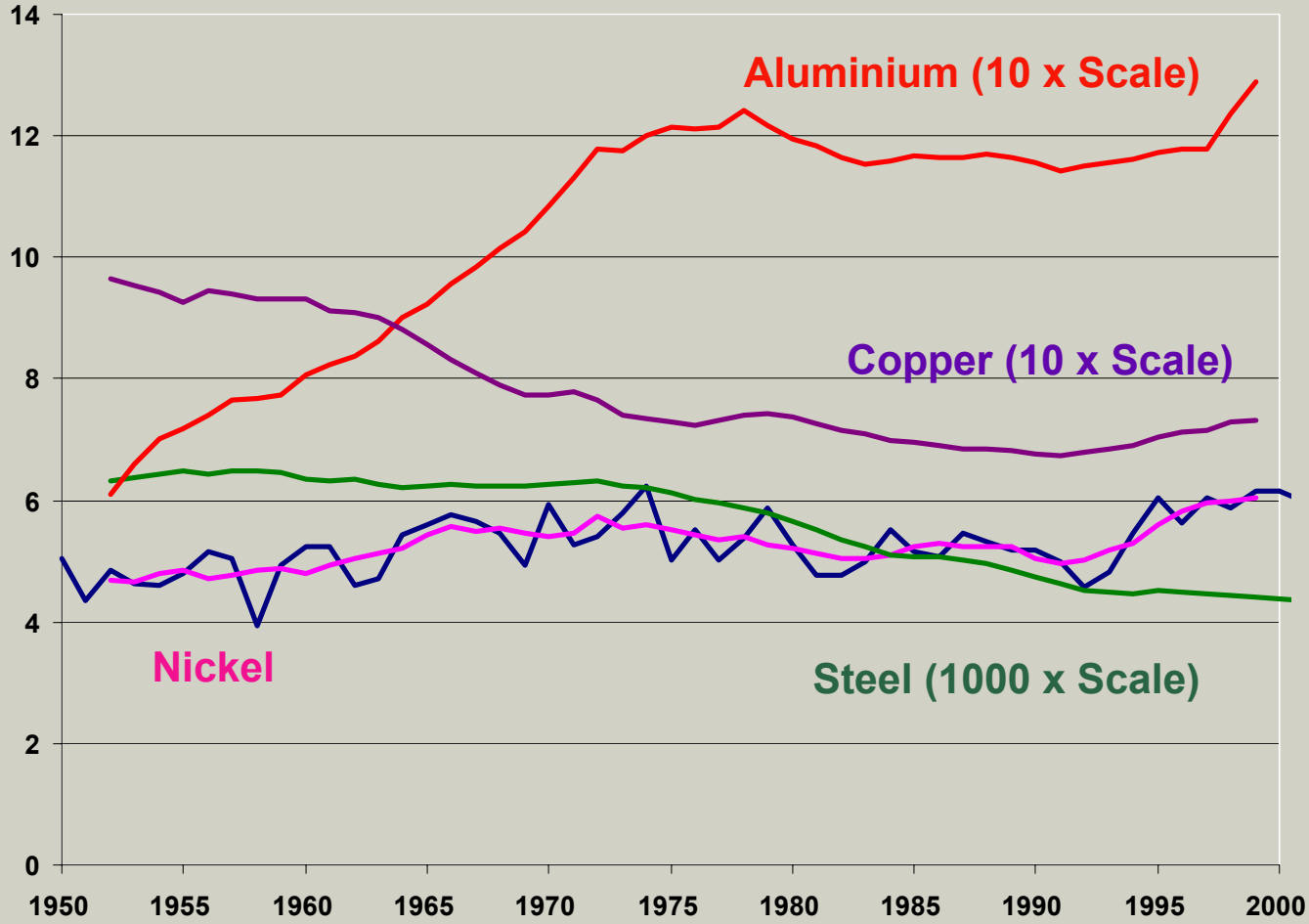
Nickel Intensity of Use



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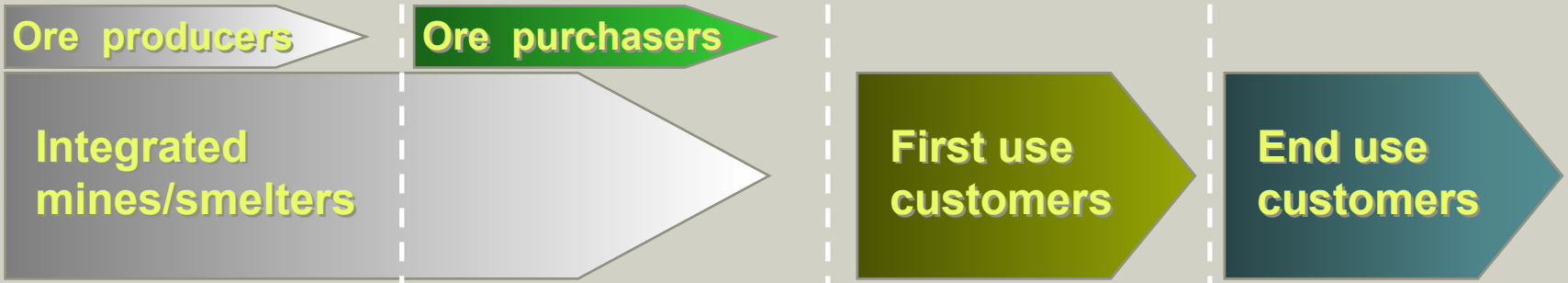
Nickel Industry Structure



Two thirds sulphide mainly underground

One third is oxide all open pit

88% integrated

Integrated ship intermediates to own refineries

Purchased sulphide concentrate 3% (temporary excess smelting capacity)

Purchased oxide ore 9% (Yabulu, Japan)

65% stainless steel

35% other uses

30% process plant

25% transport

15% consumer

10% construction

20% other uses

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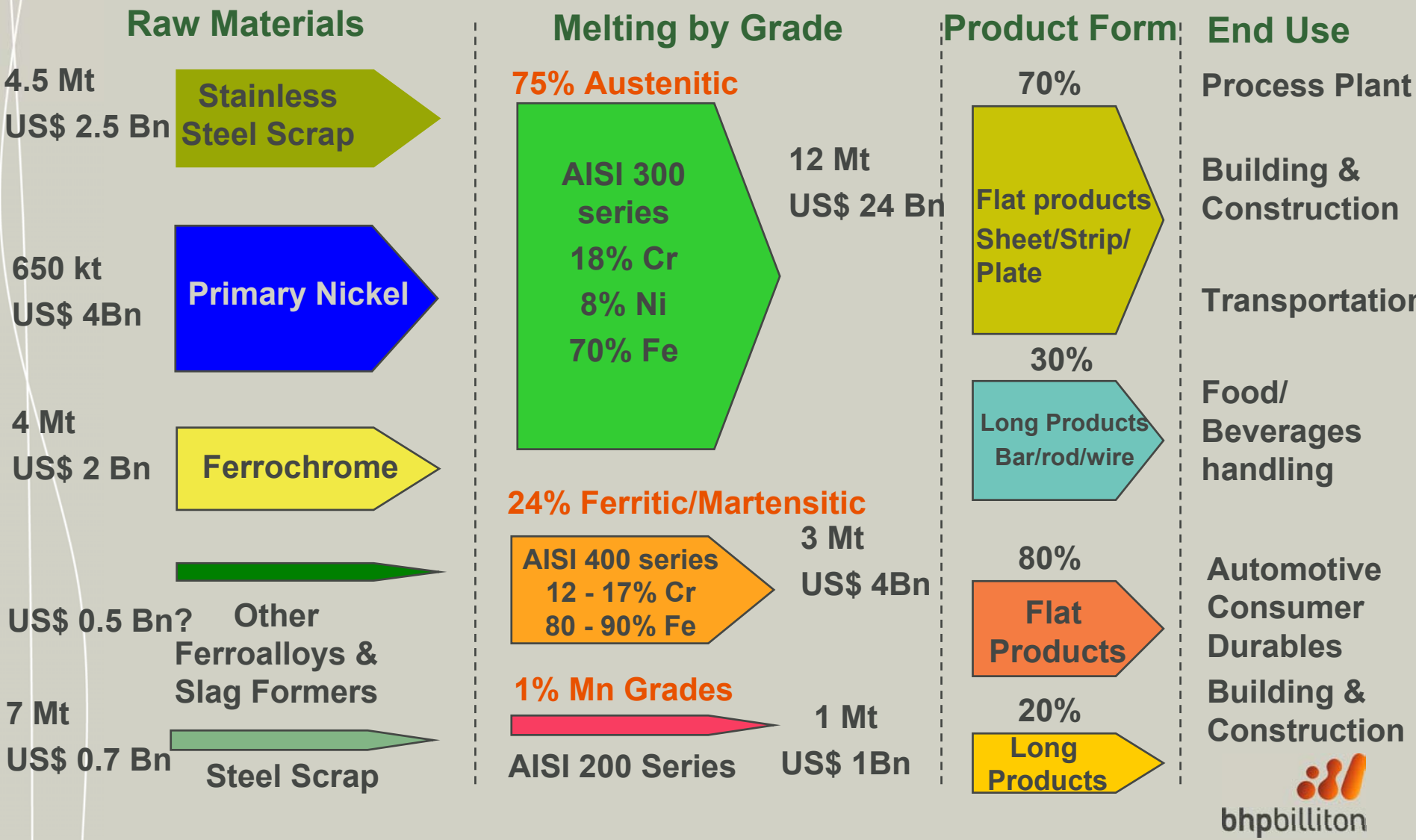
Stainless Steel Value Chain



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Nickel Properties in Use

Properties nickel brings to stainless steels and other alloys:

- **strength and other properties at high temperatures**
- **prevents oxidation**
- **resists corrosion by alkalis and acids**
- **confers ductility e.g. for deep drawing**
- **controlled expansion**
- **forms alloys readily, both as solute and solvent**
- **nickel also**
  - **is readily deposited by electroplating**
  - **exhibits catalytic behaviour**

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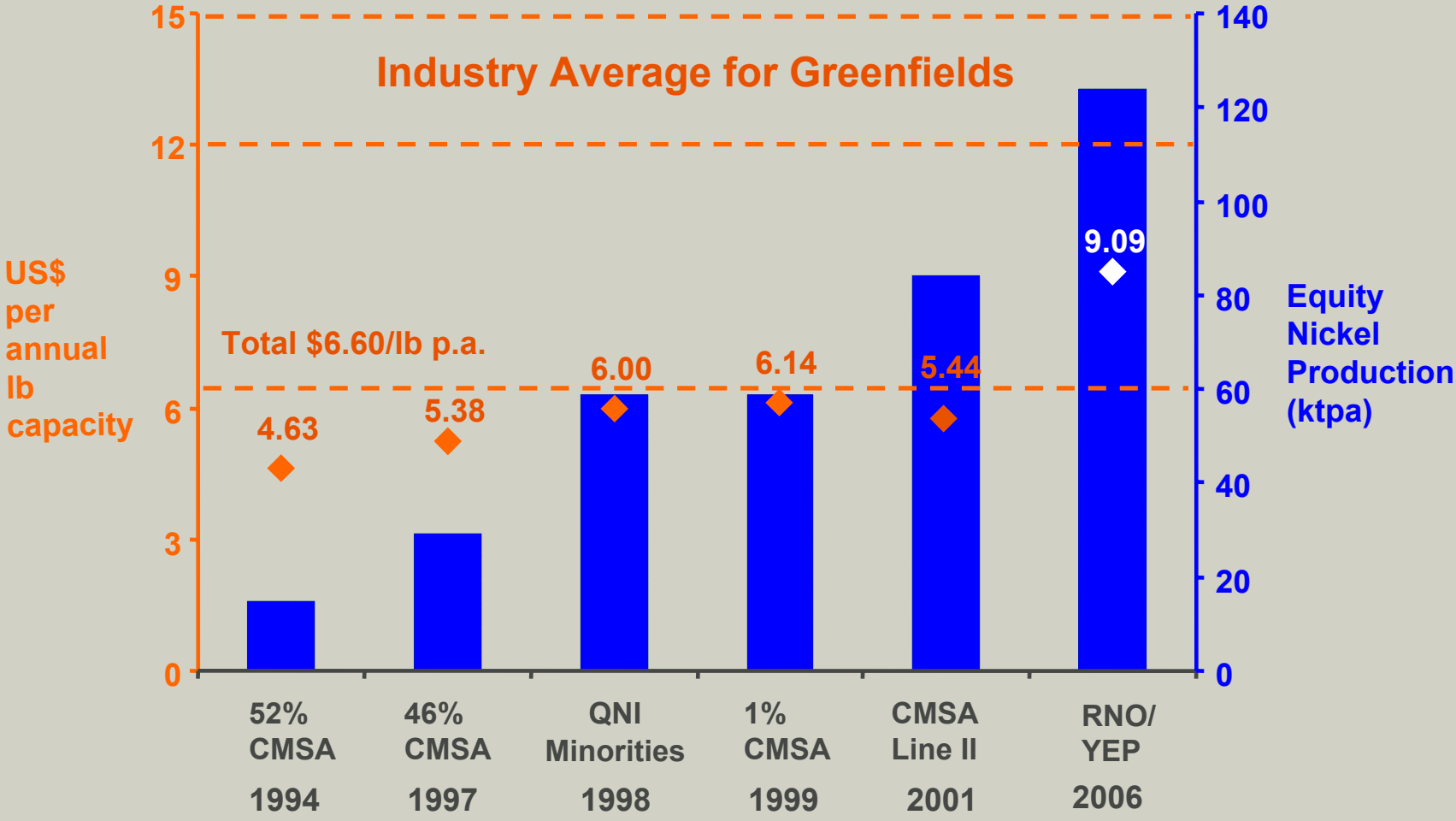
Capital Efficient Growth



Nickel must be available at "reasonable cost"

High capital costs and poor project discipline have destroyed value for investors in nickel

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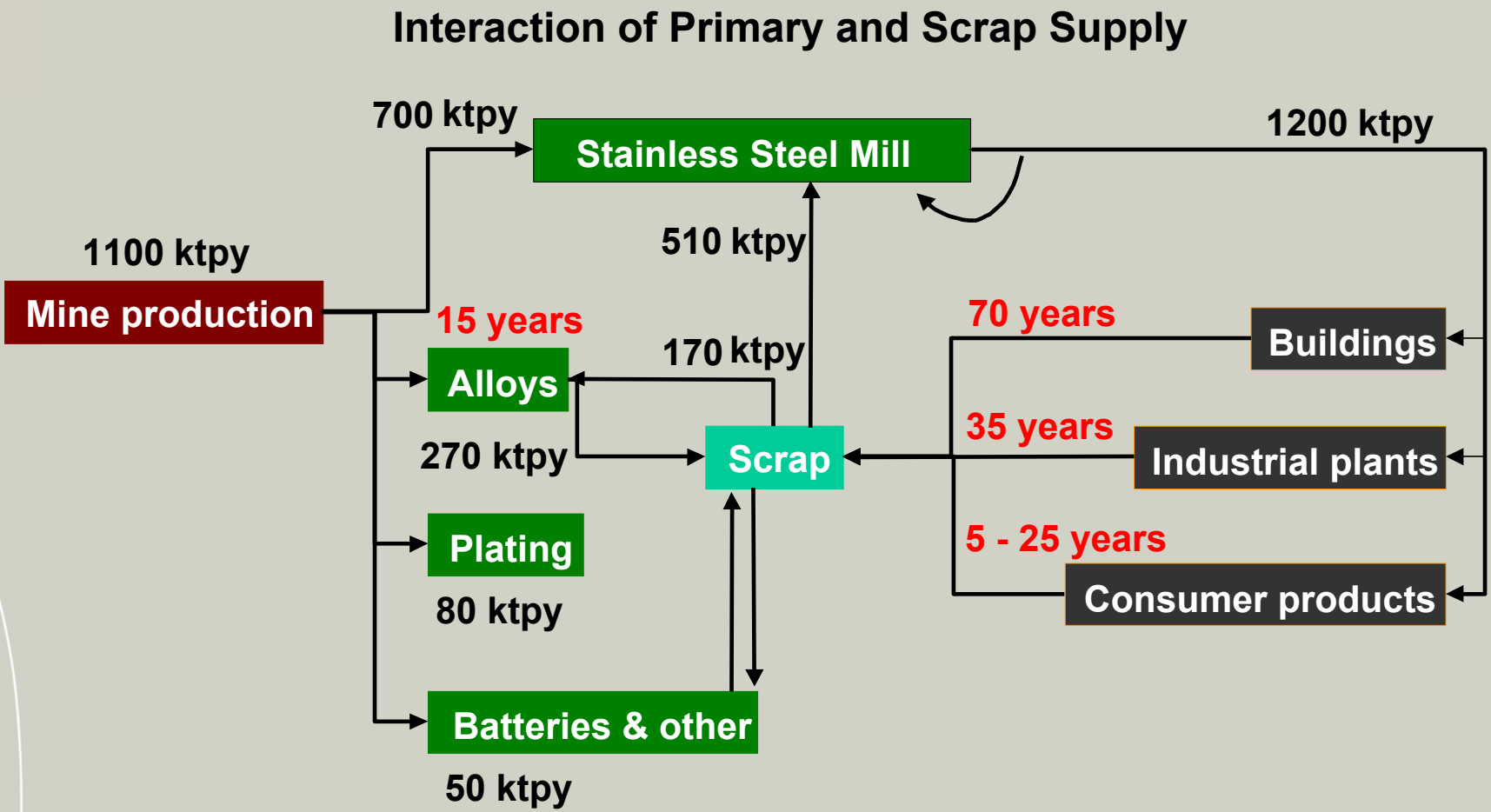
Nickel is Used not Consumed



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Sustainable Development with Nickel

Nickel brings many benefits to society:

- Clean water
- Better and safer public transportation
- Safer, cleaner cars and light vehicles
- Less pollution
- Cleaner food
- Cleaner electricity
- Lower life-cycle costs

There is a risk that poorly informed regulators could deprive society of these benefits

Nickel producers must work with our customers towards responsible use of nickel for the benefit of society

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Growth Markets - Water treatment

Problem:

- **There is insufficient clean drinking water**
- **The infrastructure to treat and distribute drinking water has to be created or replaced**

Solution:

- **Stainless steel will not taint or contaminate the water**
- **Stainless steel materials used in plants to kill bacteria with UV or ozone**
- **Stainless pipes replacing cast iron from mains to consumer**
- **Trench-less technology to reline existing pipes without digging up the roads**

A sustainable solution, strongly preferred on a life cycle *cost* basis

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Growth Markets - Sewage treatment

Problem:

- **A highly corrosive environment for galvanised carbon steel, the traditional material for such plants**
- **Public sector ownership favoured low initial investment**

Solution:

- **Focus, especially in private sector operators, switched to outstanding maintenance cost savings due to stainless steels**
- **Stainless replacing galvanised steel and performing very well**

Stainless steels and nickel alloys provide demonstrably superior economic performance on a life cycle cost basis

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Growth Markets - Food Processing

Problem:

- **Recent food contamination scares have raised consumer concerns about food safety**
- **Food contact materials must be inert and must resist aggressive sterilising chemicals**

Solution:

- **Stainless steels and nickel alloys are resistant to oxidation, acid and alkali attack.**
- **They do not taint or otherwise harm food quality.**

Material of choice for food and beverage handling is stainless steel, use of which may be mandatory under health regulations

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Growth Markets - Public Transportation

Problem:

- **Weight saving needed to reduce costs and carbon emissions**
- **Recent rail accidents in Europe highlight safety issues**

Solution:

- **Austenitic stainless steels e.g. for railcars have excellent safety performance with high impact and fire resistance and high energy absorption due to high work hardening rate**
- **Stainless Steel widely used in other parts of the world and performs well**

A stainless solution for improved safety and end of life recyclability

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Growth Markets - Automotive

Problem:

- **Weight saving needed to improve fuel efficiency and reduce carbon emissions**
- **Passenger protection is now paramount**

Solution:

- **Austenitic stainless steel space frames have high energy-absorbing capability**
- **New generation "common rail" turbo- diesel engines combine high performance and high operating temperatures**
  - **these need Ni-Resist cast irons (18% Ni) and Ni-base alloys to achieve required operating temperatures**

Nickel alloys help to reduce fuel consumption and emissions - and are easily recyclable at end of life

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Growth Markets - Automotive

Problem:

- **Personal transportation (cars) incompatible with ultimate goal of zero emissions, unachievable using conventional engines**

Solution:

- **Hybrid electric vehicles using nickel metal hydride (NiMH) batteries provide greatly-increased fuel efficiency**
- **Ultimate goal may be achieved with fuel cell systems which employ nickel-containing materials**

Nickel will be a key component in sustainable personal transportation

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Growth Markets - Power Generation

Problem:

- California brown outs, under-investment in generating capacity
- There is a need for more and cleaner power generation

Solution:

- Structural shift to smaller gas turbine or combined cycle generating plants located near to demand
- The shorter distribution via grid reduces power losses
- Gas turbines are enjoying record orders and are heavy users of nickel-base alloys

Nickel-base alloys are essential to distributed power generation

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Growth Markets - FGD Plants

Problem:

- **Power generation and other processing plants emit SO_2 forming acid rain**

Solution:

Flue Gas Desulphurisation (FGD) plants remove SO_2 from boiler exhaust gases by spraying limestone slurry

S. Korea will install 76 FGD units by 2015, of which 33 already installed in 9 power plants

Linings are solid 6 mm thick in super austenitic stainless steels (15-20% Ni) and nickel base alloys (57% Ni)

Nickel alloys have a big role to play in pollution control, and are recyclable at end of life

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The inside of an absorber

Growth Markets - Civil Engineering

Problem:

- **30 years on, many N. American road bridges and other reinforced concrete structures are degrading where exposed to salt**

Solution:

- **Stainless rebar has proven over decades to perform without failures under extreme conditions**
- **Life cycle costing indicates corrosion resistant reinforcing materials deliver significant economic benefits**

Where corrosion is a serious issue stainless rebar is a superior solution on a life cycle cost basis

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Growth Markets - Architecture

Problem:

Conventional building materials limit design innovation and can have high maintenance costs

Solution:

- **A 140 metre duplex stainless bridge (500t with 23% Cr and 4% Ni) will span river to Guggenheim museum in Bilbao**
- **A resin-coated stainless dome in type 304 stainless will cover the new Nagoya Dragons baseball stadium in Japan**
- **The Detroit airport expansion will use type 304 for stainless for the convex and concave curves of the roof**

Fully recyclable stainless steel enables architects to apply exciting new designs to enhance appearance and functionality at competitive cost

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The Future - Sustainable markets

- Nickel, when appropriately used, brings great benefits to the health and well-being of society
- The nickel industry must be responsible in ensuring an appropriate use of its products

Nickel producers and their customers will have to demonstrate product stewardship and gain regulatory support for value-adding use of nickel

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The Future - Sustainable value creation

- Nickel has enormous growth potential
- Nickel production is capital intensive and needs to be available at reasonable cost
- recent industry history has many examples of value destruction

Through technical innovation and a rigorous approach to capital projects, the nickel industry must create value for investors at “sensible” nickel prices

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