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CCUS - A challenge for the Iron and Steel industry

Henk Reimink 5-7 November 2013 Tokyo

Five key messages for the global steel industry

KEY MESSAGE 1

Steel is a key indicator of the world's economy

KEY MESSAGE 2

Sustainable steel

KEY MESSAGE 3

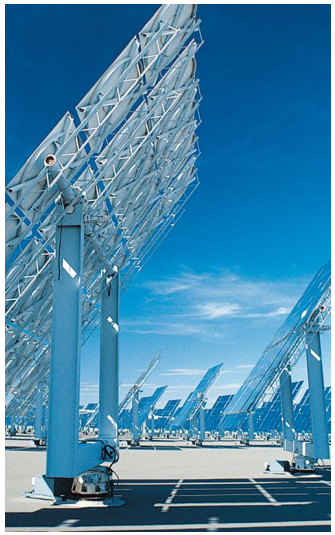
Steel is everywhere in your life

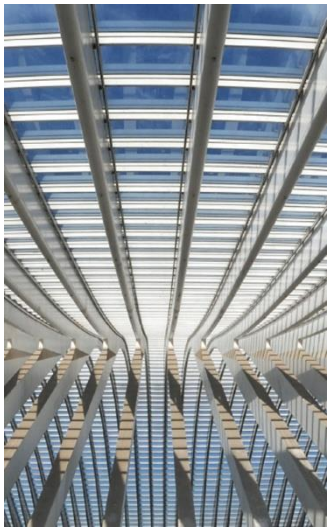
KEY MESSAGE 4

Safe, innovative and progressive steel

KEY MESSAGE 5

Life Cycle Assesment, new solutions for new times





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Steel is everywhere in your life

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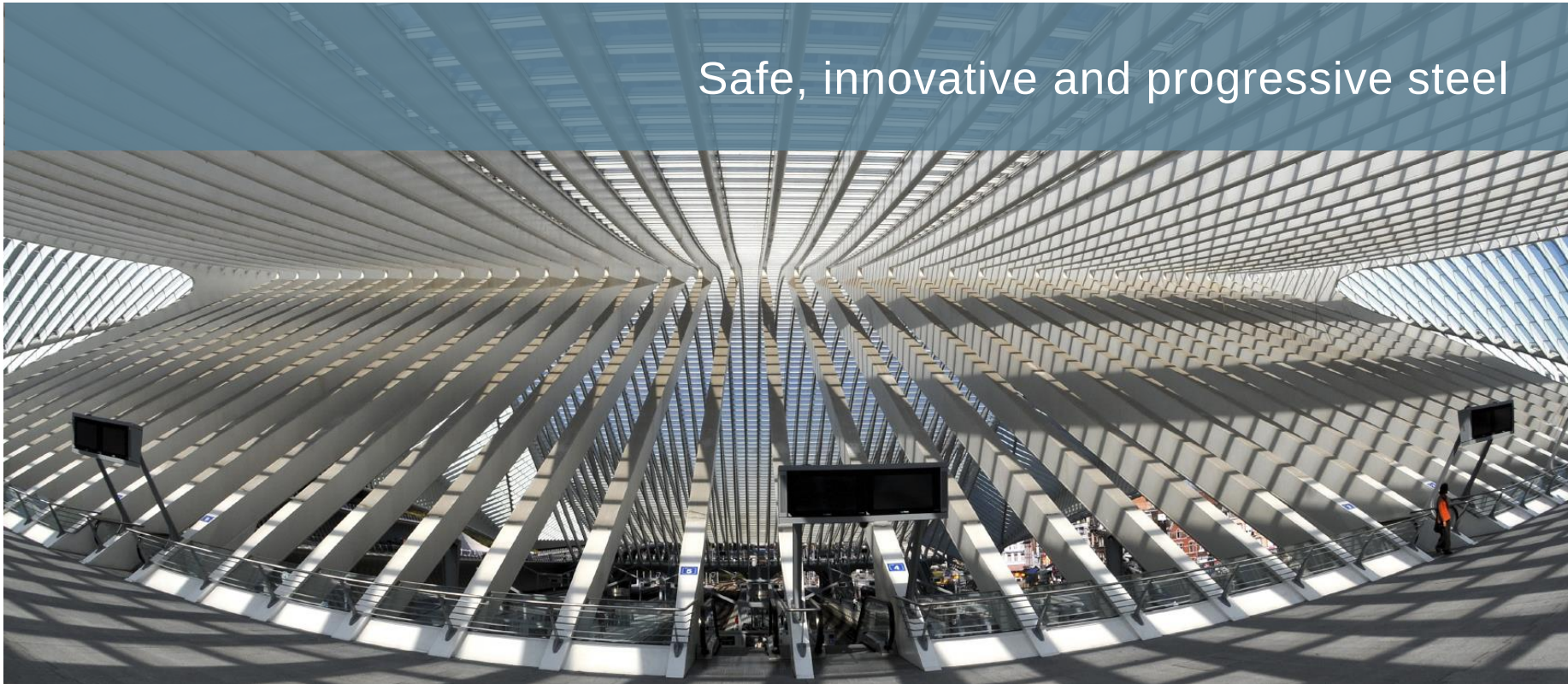

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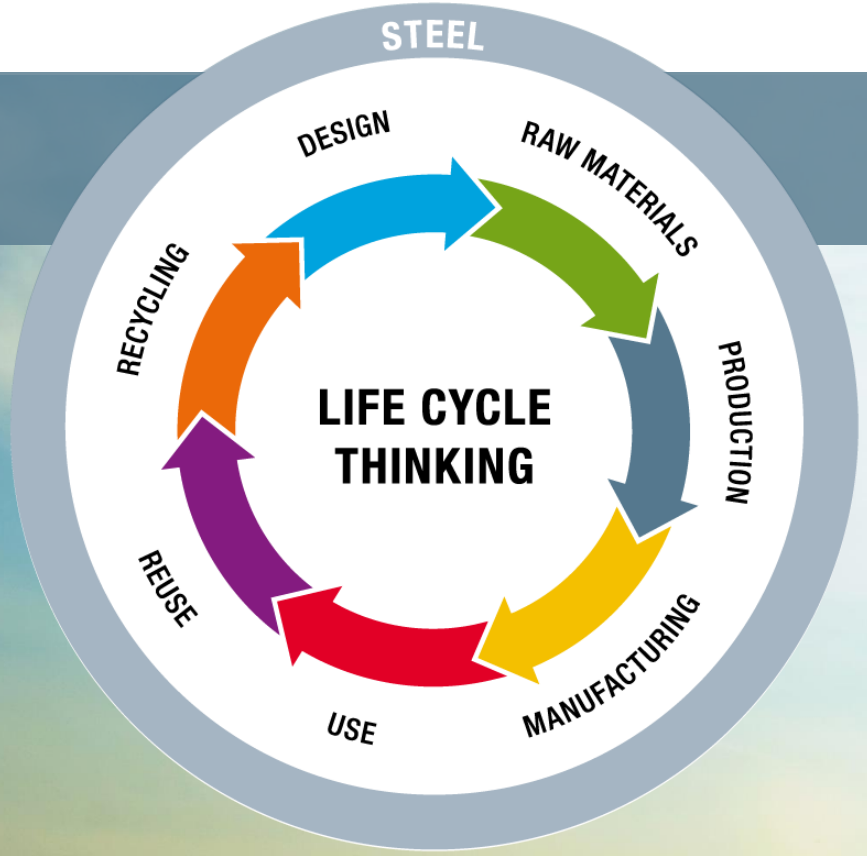
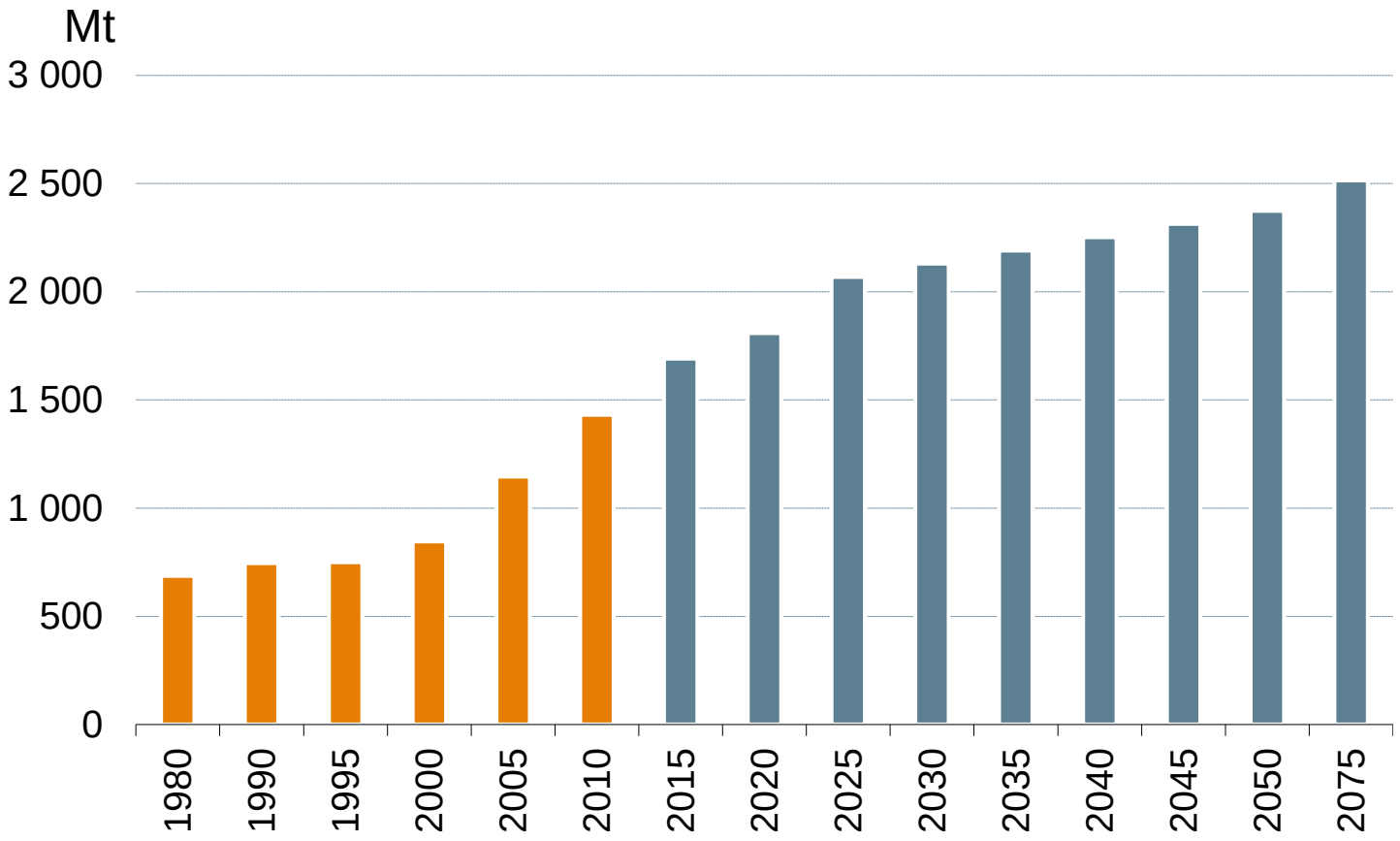
Steel: Life Cycle Thinking



Presentation content

- Potential Crude steel and Iron production - 2050 - 2075
- Global Iron and Steel industry impact on emissions
- 2D Scenario – allowance (50% on 2009 emitted level)
- Scrap uprising scenario and impact on CO2 storage
- Iron and steel industry activities on technology and practice transfer
- CO_2 Breakthrough Technologies programmes
- Potential storage required for iron and steel industry by 2050 – 2075
- Technical challenges in the Capture, Transport and Storage
- Need for Political and Public sponsorship for CCS

Global crude steel volumes1980–2010, potential scenario for 2015–2075*



- ***Source - 1980 – 2010 data worldsteel, 2015 – 2075 Example based on 9.9 Billion people in 2075 @ 255kg /capita, updated with worldsteel megatrend details 2018 – 2025 in October 2013.***

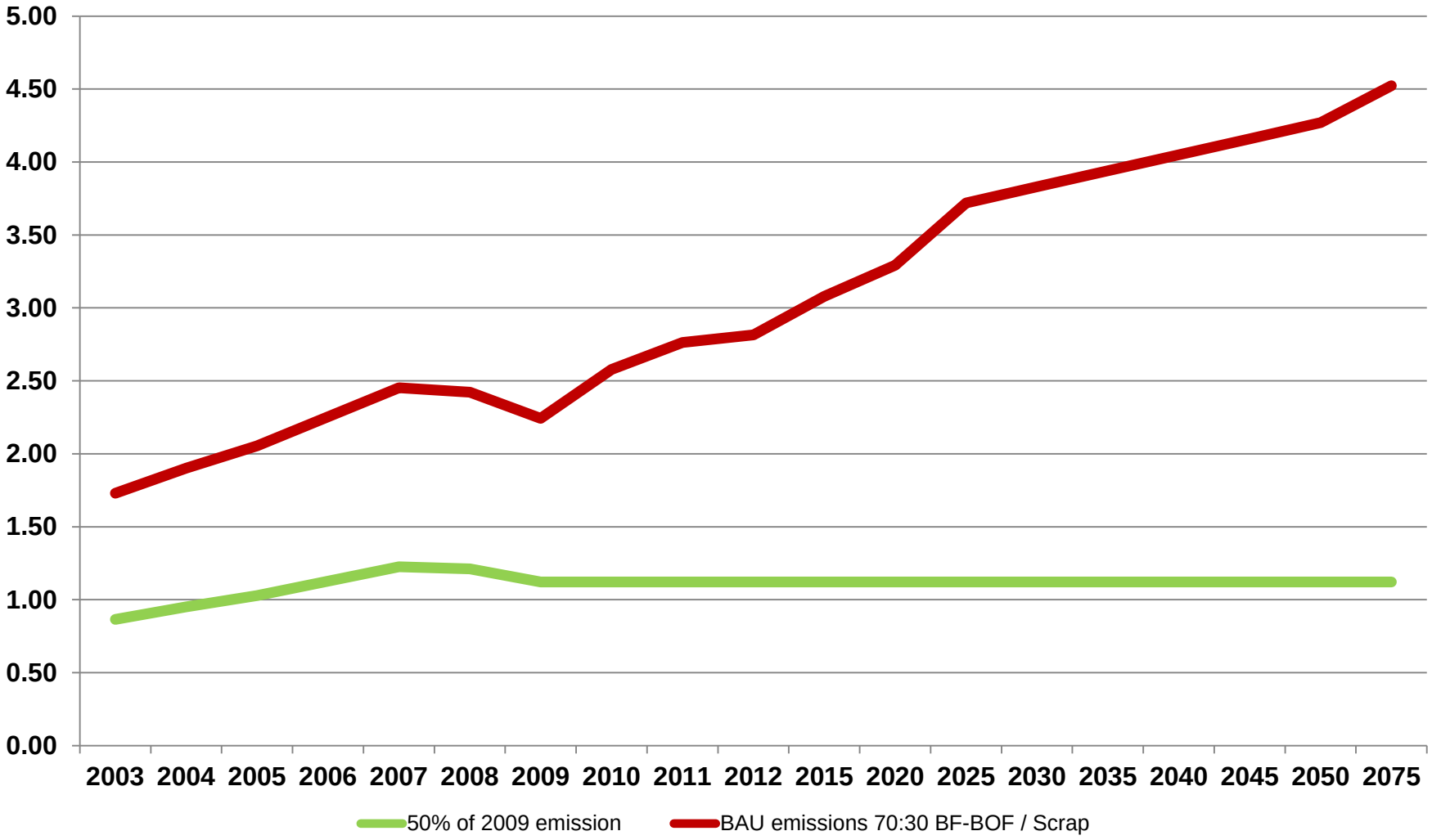
Iron and steel industry impact on emissions

Year	Global CO2 emissions Bt.	Global GHG emissions in CO2 equivalent Bt	I&S CO2 emissions Bt	Percentage of I&S / Global CO2 emissions	Percentage of I&S / Global GHG & I&S CO2 equivalent
1990	27.45	37.50	1.6365	5.96%	4.74%
1995	28.17	38.15	1.4568	5.17%	4.15%
2000	29.34	39.28	1.6071	5.48%	4.45%
2005	34.25	45.30	2.1349	6.23%	5.12%
2009	38.11	50.55	2.2443	5.89%	4.83%
2010	38.68	51.50	2.5975	6.72%	5.48%
2011	39.26	52.14	2.6860	6.84%	5.60%
2012	39.85	52.88	2.6831	6.73%	5.51%

Calculated percentage on Global CO_2 emissions and GHG at CO2 equivalent GWP 100.

Source IEA (2010) CO_2 emissions from Fuel Combustion, worldsteel data sources.

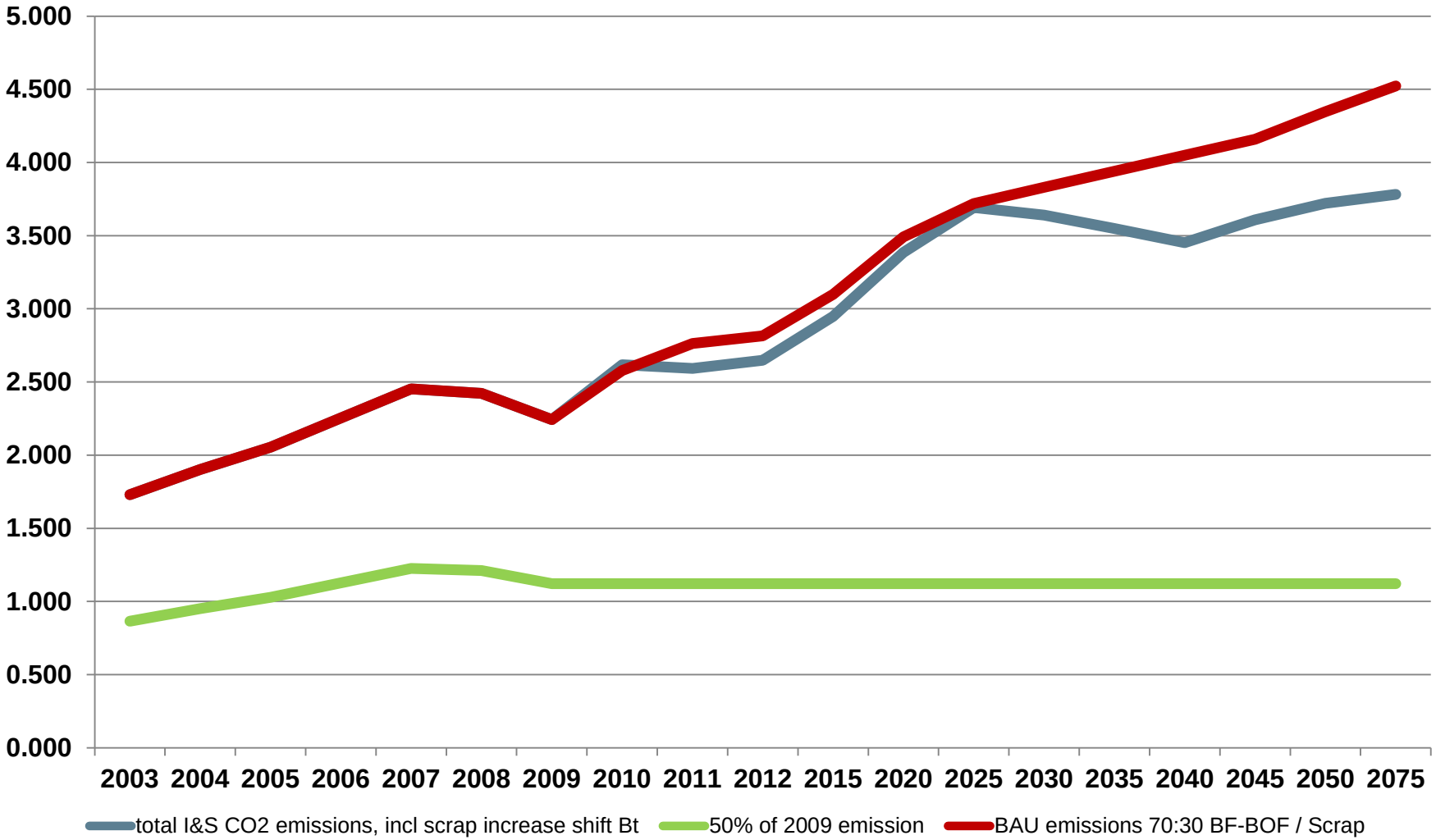
Likely emissions with BAU, 2DS level with 50% of 2009



Three key influencers on emissions

- 1 Raw Materials – demand high Fe ore and low ash Coal
  - Iron-ore beneficiate economically to high Fe rates (63-68%) saves on transport, reduces slag rates, reduces energy intensity (reductants) and improves efficiency of Blast furnaces (throughput rate)
- 2 Scrap usage – increase scrap volume to the maximum available and economically equivalent to iron-ore.
  - Increase scrap usage in BOF 8-12 % to over 25%
  - Shift to Scrap instead of DRI for EAF (emits more overall than BF-BOF)
  - Shift balance of BF-BOF to EAF operation if economically viable
  - New build EAF instead of BF-BOF or reline BF
- 3 Improve industry wide operation to level of best practice
  - Only make what you have an order for
  - Key Technologies available on most sites but not effectively used globally
  - Shift industry to lowest energy intensity
  - Increase asset reliability levels

Likely emissions with BAU, Scrap shift from 30 – 45%, and 2DS level with 50% of 2009 allowance

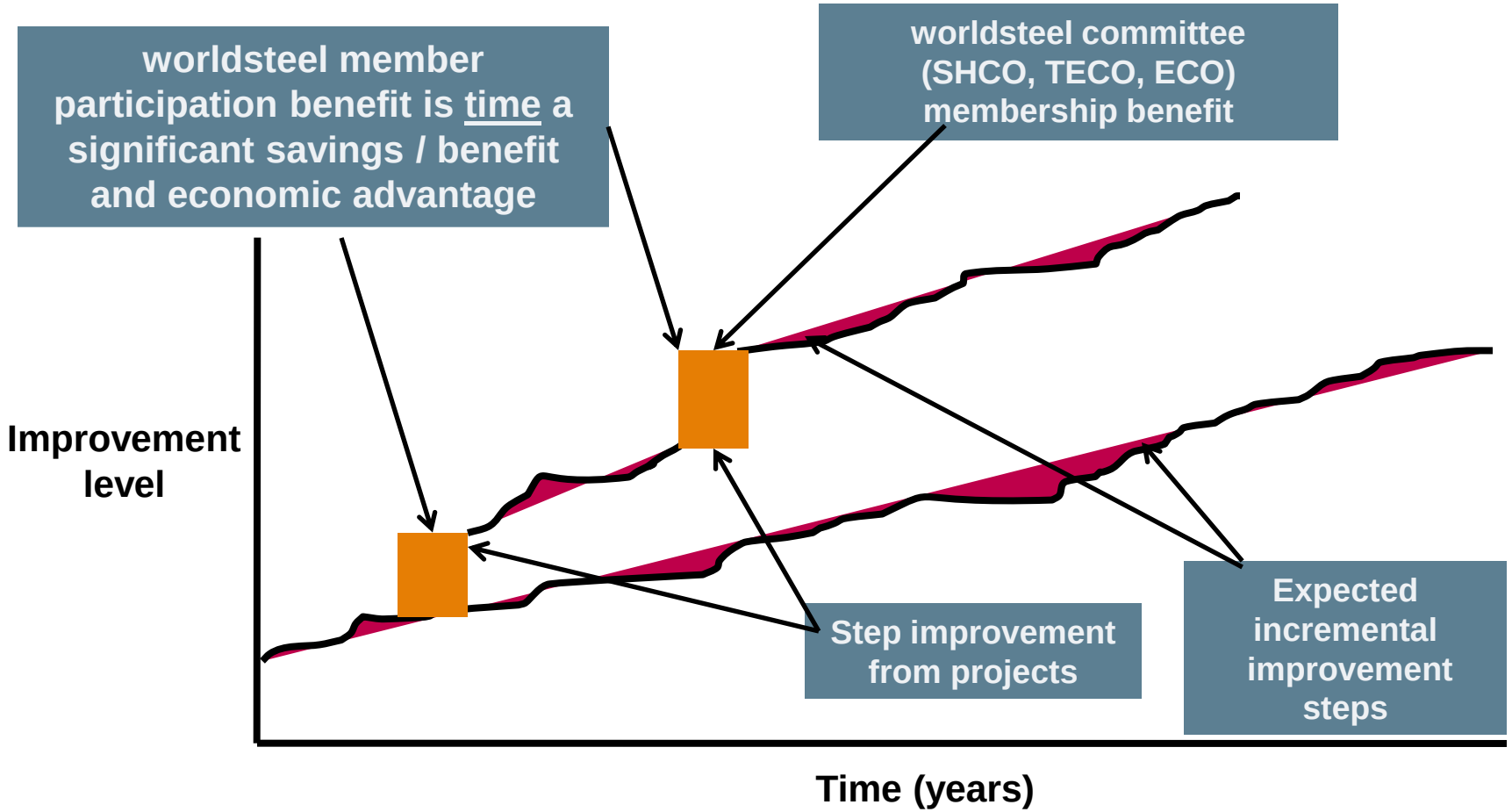


The challenge starts: Practice transfer

Efficiency improvement by participating in worldsteel projects:

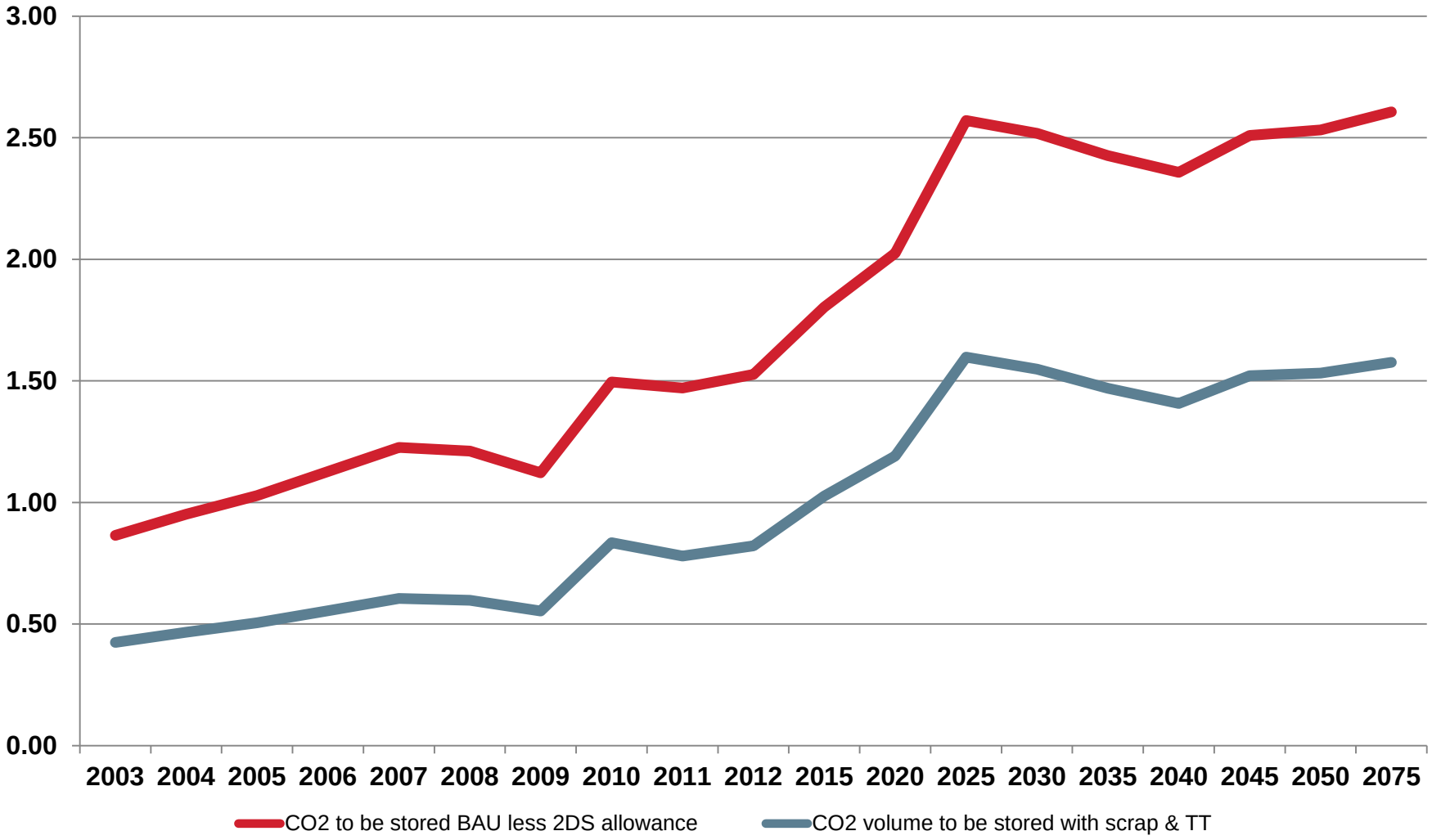
- Active projects or ongoing metrics:
  - Safety improvement to zero injuries
  - Air Quality (Dust PM10/2.5, Mercury, Nox)
  - Energy use in the steel industry
  - Maintenance / Reliability
  - Water management
  - CO_2 Data reporting and analysis
  - CO_2 Breakthrough expert group
- Completed projects:
  - Yield
  - By Products
  - Water management
  - Raw Materials beneficiation

worldsteel projects participation benefit



Project types: Technical & Best Practice Transfer, R&D (domestic & imported), Fellowships, University research, Global partnerships, Innovation, Task Forces, Coordination of Expert Group activities, steeluniversity.

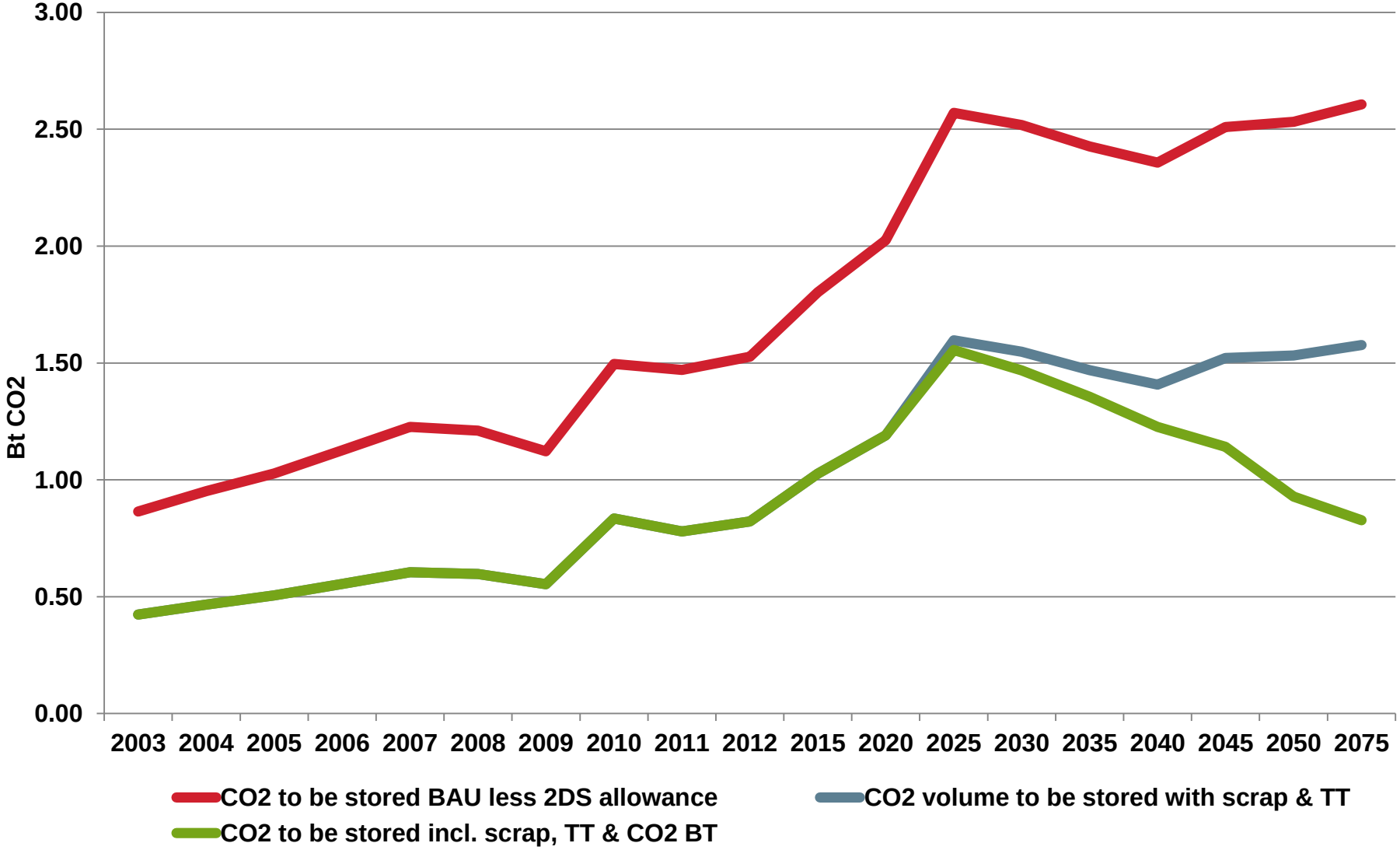
Reduction in storage need from scrap, practice transfer



The next challenge:
CO_2 Breakthrough 7 programmes

- AISI - Paired Hearth Furnaces, Molten Oxide Electrolysis, Flash Smelting
- Australian Programme – Charcoal use waste heat recovery
- Baosteel - Ethanol production from BOF off gas, Solar
- China Steel Corporation (CSC) - Oxy fuel burners, Storage
- “Course 50” Programme, reduce CO2 intensity, re-use, store
- ULCOS – Hisarna, Top Gas recycling
- POSCO CO_2 - Finex to minimise intensity using H2 reduction, Capture technology.

CO2 to be stored per year for all improvements, 50% of 09, scrap T&P transfer and CO2 BT.

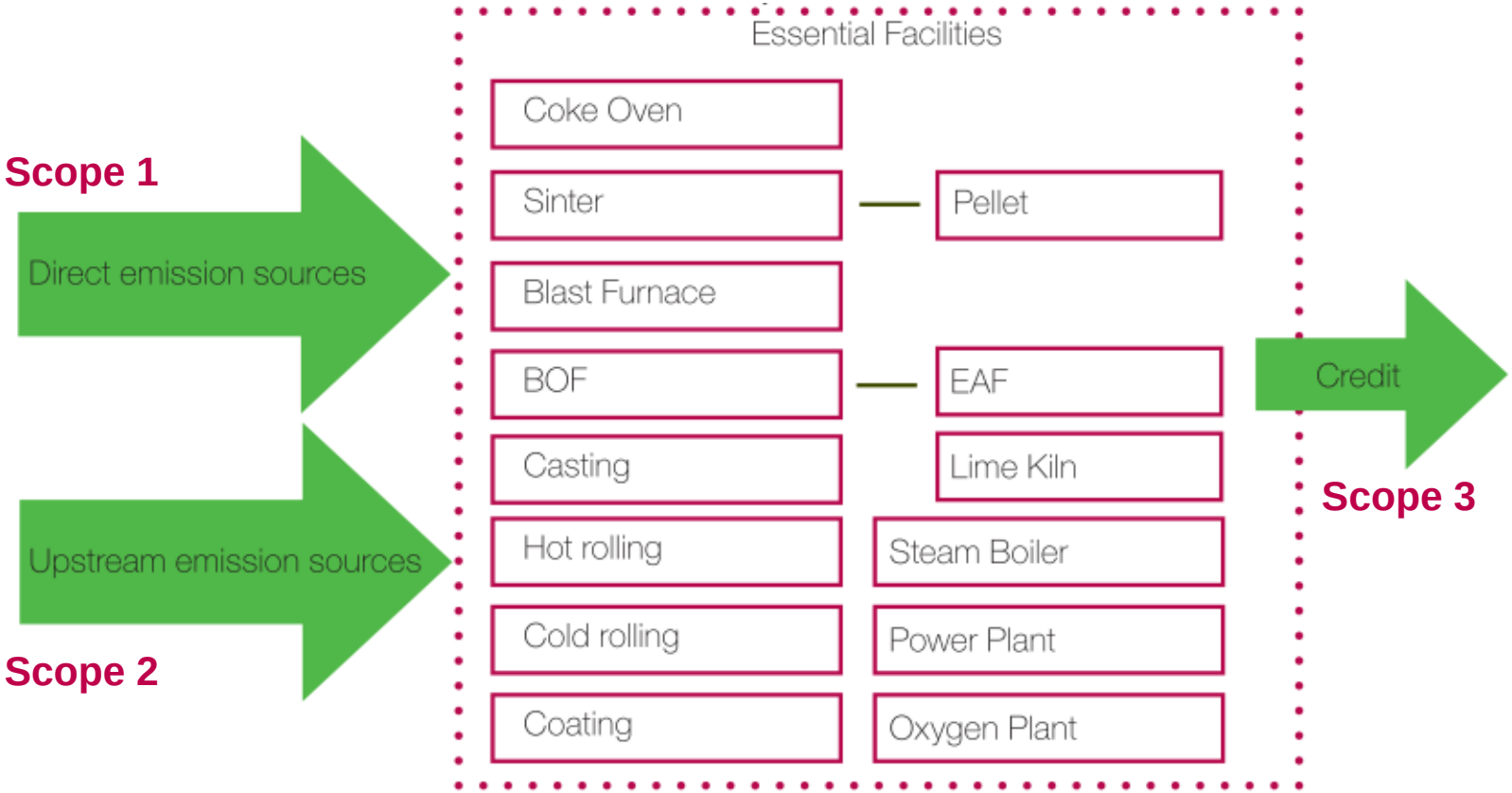


Common methodologies for measurement

- Standardised method of measurement or management
  - Safety metrics methodology and leading indicators
  - Life Cycle Assessment process and standard
  - CO_2 intensity t of CO_2 / t of Crude steel cast
  - Energy intensity on a process by process bases
  - Maintenance & Reliability methodology developed

CO_2 emission measurement methodology

System boundaries



CO_2 emissions = Direct + Indirect – Credit

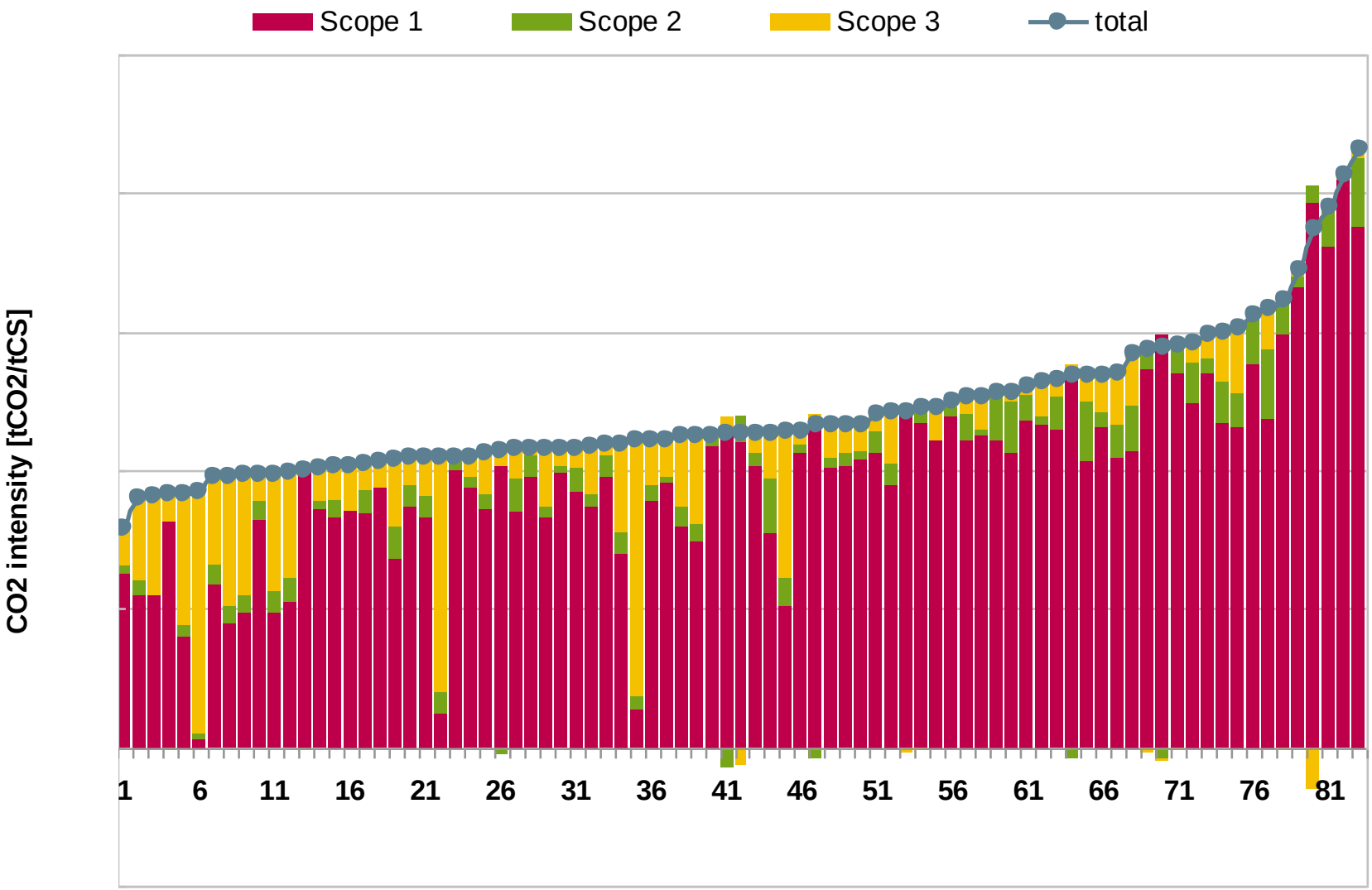
CO_2 intensity = CO_2 emissions(tonne)/crude steel(tonne)

Data coverage based on crude steel production

Region	Number of companies						Number of sites					
	2007	2008	2009	2010	2011	**2012**	2007	2008	2009	2010	2011	**2012**
Global	38	49	45	51	52	**49**	188	207	208	212	212	**212**
EU-27	13	16	13	17	19	**17**	69	69	66	67	71	**69**
Other Europe	0	3	4	2	2	**1**	3	6	7	5	4	**4**
C.I.S.	2	2	2	1	2	**1**	5	7	5	4	5	**4**
North America	5	6	6	7	7	**7**	61	61	63	65	65	**65**
South America	2	4	4	5	4	**5**	11	14	22	19	18	**20**
Africa	0	0	0	0	0	**0**	6	6	6	6	6	**6**
Middle East	1	2	3	2	2	**3**	1	2	3	3	3	**3**
Developed Asia	8	10	8	11	12	**11**	20	36	31	32	36	**37**
Other Asia (excl. China & India)	0	1	1	1	1	**1**	0	1	1	1	1	**1**
China	0	0	0	0	0	**0**	0	0	0	0	0	**0**
India	7	5	4	5	3	**3**	12	5	4	10	3	**3**

2012 CO_2 data collection (Submitted & Approved, Oct.2, 2013)

CO_2 intensity (tCO_2/tCS) Pareto for Steel making route



CO_2 Methodology adopted as ISO standard

- New Work Item proposal accepted in September 09 by Technical Committee ISO/TC 17, steel
  - Title: Calculation Method for CO_2 emission Intensity at steel production sites
- A new working group (WG21) set up, Japan provides the secretariat
- Standard published by ISO in March 2013 ISO 14404 part 1 for BF/BOF and ISO 14404 part 2 for EAF process only (latter excludes DRI).
- Worldsteel expert group is being re-convened in 2014 along the ECO meeting to establish other options to capture the DRI component for EAF producers.

Climate Action recognition

- Scheme recognizes that a steel producer has fulfilled its commitment of the worldsteel CO_2 data collection programme
- Recognition can be obtained at a corporate level or at a site level if data has been received for more than 90% of total crude steel production
- Data must be complete, verifiable and approved each year
  - 2007 38 companies covering 188 sites were eligible
  - 2008 49 companies covering 207 sites were eligible
  - 2009 43 companies covering 206 sites were eligible
  - 2010 44 companies covering 209 sites are eligible
  - 2011 52 companies covering 212 sites are eligible
  - 2012 49 companies covering 212 sites are eligible

  2012 report will be available to participating companies in December 2013

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Challenge continued:
Products – develop and application of new steels

- Examples:
  - Only make what you have an order for.
  - Turn off assets when there is no demand
  - Design for yield within the I&S processes, test logistics
  - Design for yield with customers products and processes
  - Increase share of High strength steel for car bodies (BIW)
  - High strength steel for Commercial and Residential buildings
  - High Strength steel for construction, machines and tools
  - HSS for Railway networks
  - HSS for Rail Rolling stock, Bridges, Power transmission grids
  - Gas transportation networks, CCS technology
  - Power station boiler materials and equipment
  - Oil and Gas product used outside the industry

Carbon Capture and Storage

- CO_2 capture technologies have long been used in gas streams treatment (ammonia and hydrogen production, natural gas processing) – 15-30 Mt/yr – all chemical absorption based
- For the steel industry trials have been held successfully using a experimental blast furnace
- Full scale commercial site needs to be established to prove up-scaling is practical (was planned as part of the the ULCOS programme in EU).
- Transportation is not a problem provided the sulphur content can be managed
- Storage pressures are high at 200 – 250 Bar requiring significant energy for the large volumes produced on sites.

Political and Public support to change

- Funding is the key issue for both technologies
  - CO_2 Breakthrough technologies
  - CCS Implementation technologies
    - Capture technology is available on small scale
    - Transport infrastructure from major industrial centres to storage sites needs to be established
    - Storage opportunities / understanding of impact needs to be tested urgently.
  - Governments support for public / private development
  - Government need to be involved in the transport infrastructure and storage sites (state ownership)
- Timing
  - Any delay in projects will impact the results for both CO_2 BT
  - Any delay will impact on the outcome for CCS and volumes required to store
  - Public and political awareness needs to be increased by setting up forums such as these and through publications

Thank you for your time and interest

Please feel free to contact me anytime

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