



Indicators and Benchmarking: Issues and Recent Developments

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Conceptual Framework

- **Indicators focus on the country and sector level**
- **Benchmarking goes down to the plant level**
- **Both are complementary**
- **For both, system boundaries and definitions matter**



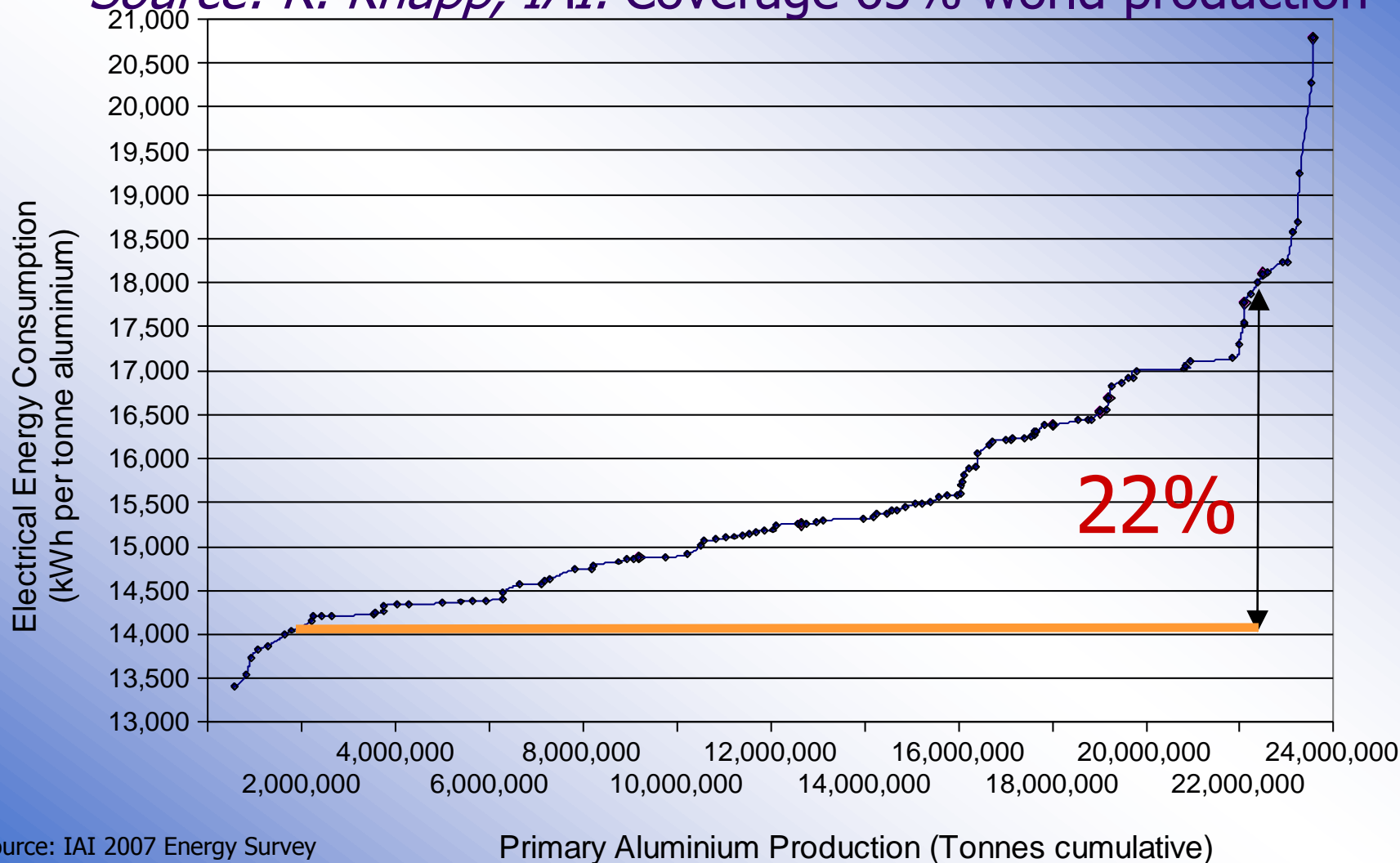
Benchmarking

- Done by consultants for the industry
- Practical, as simple as possible
- Plant level: comparable product
- Usually aggregate benchmarking curves are public, individual points are confidential
- On a voluntary basis
- ETS benchmarking agreement as part of EU-ETS phase II has boosted interest in Europe
- Data/methodologies exist for 50-60% of total energy use



Benchmarking Smelter Electrical Energy Consumption, 2007

Source: R. Knapp, IAI. Coverage 65% world production



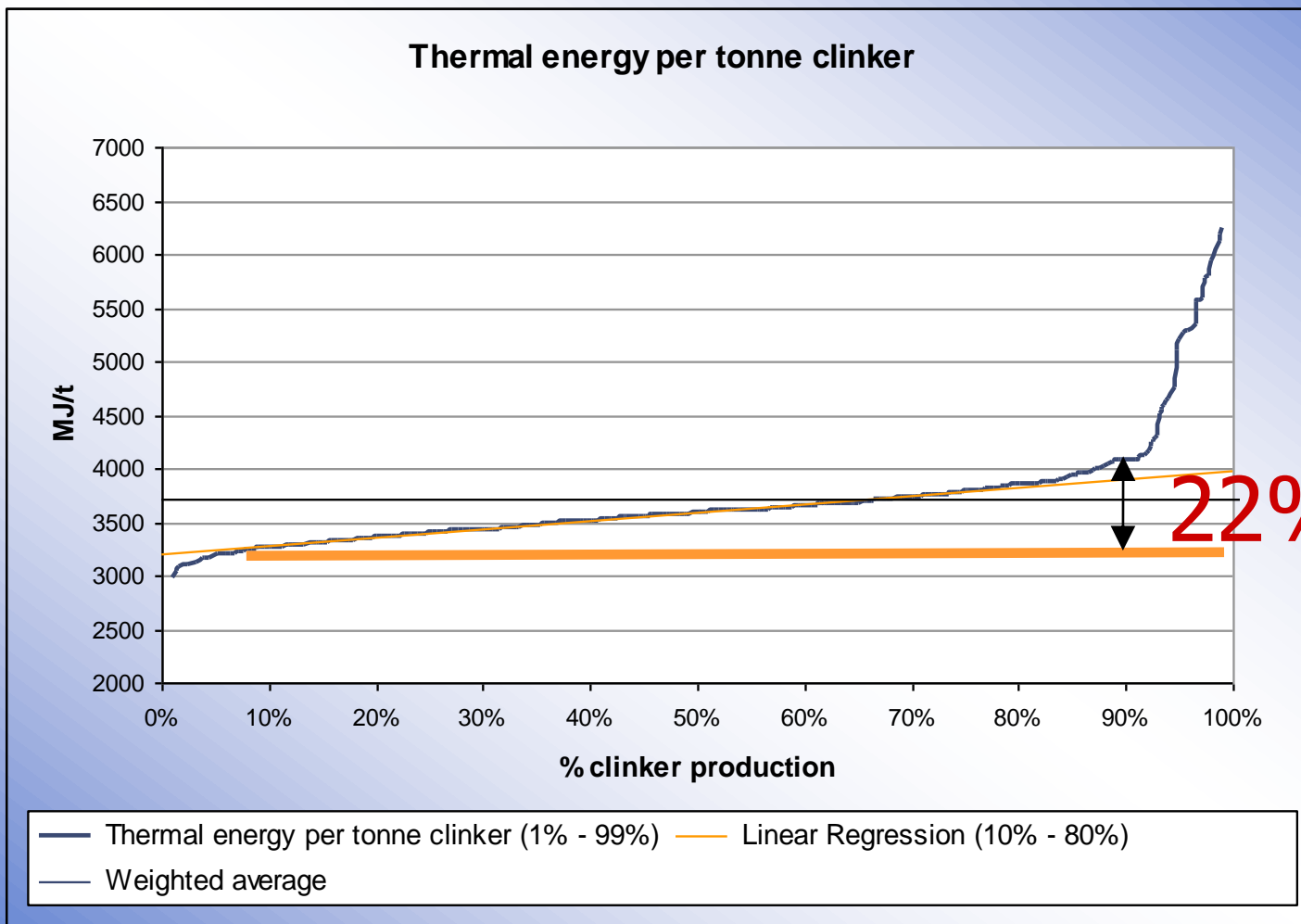
Source: IAI 2007 Energy Survey

Primary Aluminium Production (Tonnes cumulative)



Cement Plants in Europe (2006)

Source: Cement Sustainability Initiative: getting the numbers right

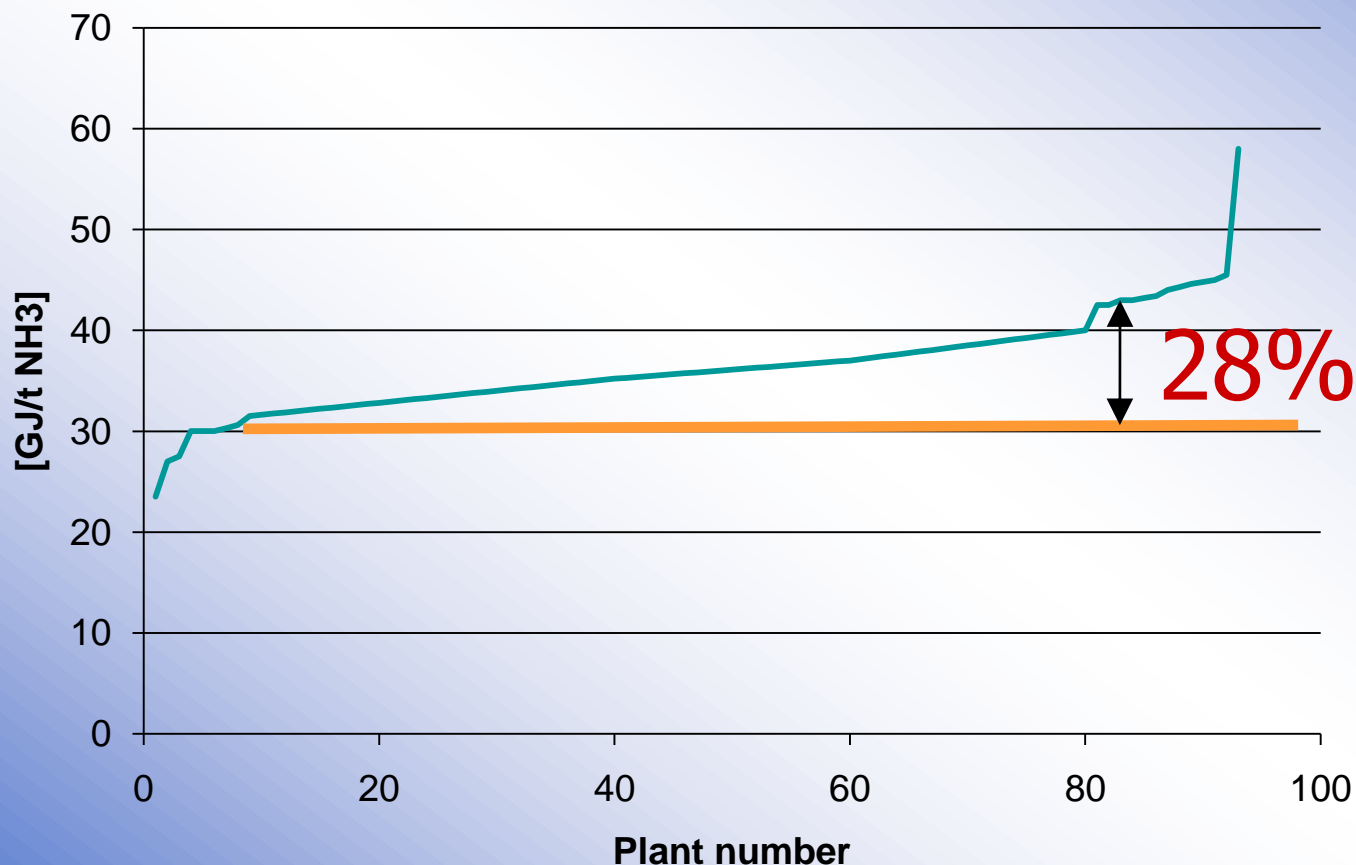


22%



Ammonia Production Benchmarking Survey for 2006/7, 93 plants, 30% world coverage

Source: International Fertilizer Industry Association





Industry Indicators for Complex Systems

- Current efficiencies & past trends on a country or region level, by sector (global coverage)
- Focus on energy and CO₂ emissions per unit of *physical* product (tons)
- Proposes multiple indicators: there exists no “true” country ranking
 - ◆ Separate energy and CO₂ indicators
- Based on indicators, assessment of realistic technical long term improvement potentials
- Enable country comparison – identification “hot spots”
- Focus on key energy/CO₂ intensive sectors

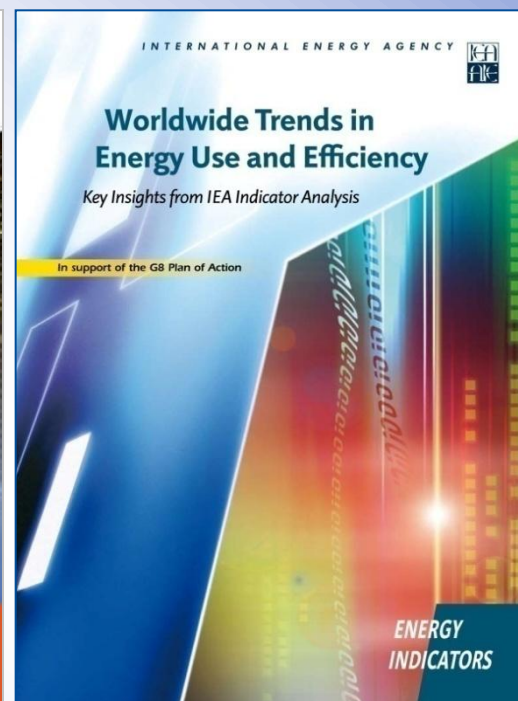
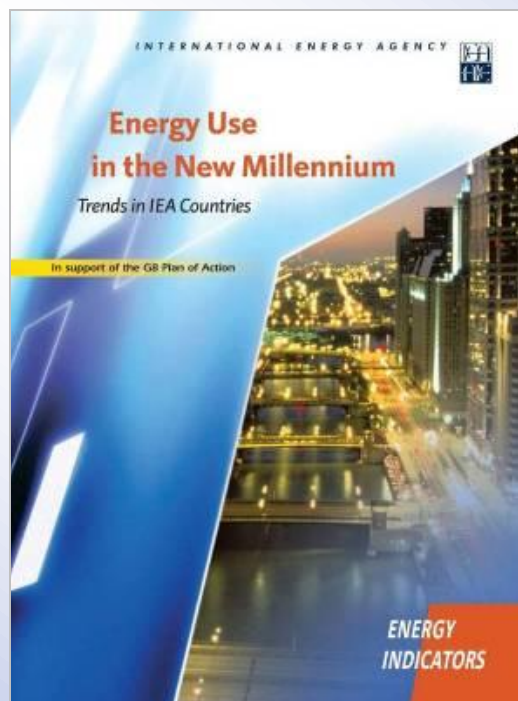
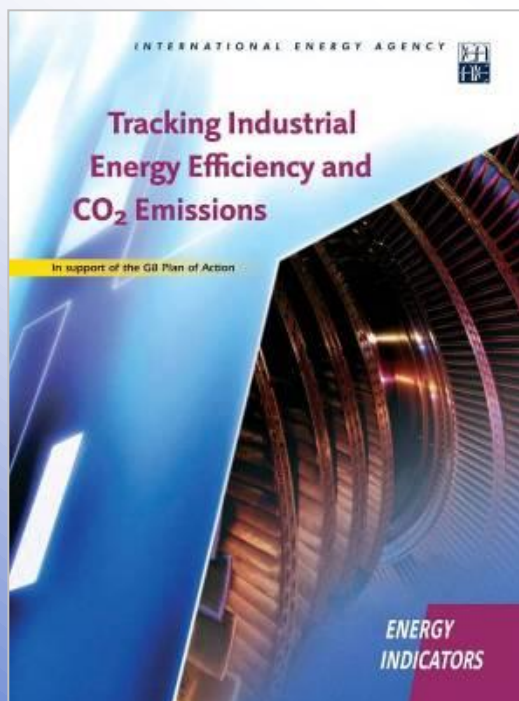


Energy Indicators

Ex-Post Analysis

2007

2008



In support of the G8 Plan of Action

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Indicators Scope

- Applied to key energy intensive sectors with discrete products
- Three sectors account for 70% of industrial energy use/CO₂ emissions
 - ◆ Iron and Steel
 - ◆ Cement
 - ◆ Chemicals and Petrochemicals
- Indicator results suggest that a lot of “other” energy use is not accounted for in benchmarking (especially electricity)



Chemicals and Petrochemicals Analysis Methodology

- Benchmarking data are more accurate but confidential (antitrust legislation, competition) and not comprehensive (exist for ethylene (Solomon), ammonia (IFA) etc.)
- The IEA data are the only comprehensive consistent energy data set for chemicals/petrochemicals in the world
- Data availability determines approach
 - ◆ $I = \Sigma P \times BPT / \text{Actual use (IEA stats)}$
- Physical production data from SRI
- BAT data from literature, IPPC documents & industry sources
 - ◆ Ideally based on Benchmarking data
- Energy (+non-energy use) data from IEA statistics includes ISIC 24:
 - ◆ 24.1 Basic chemicals (petrochemicals and fertilizers); 24.2 Other chemical products (pesticides, paints, pharmaceuticals, other); 24.3 Man-made fibres



Methodology (contd.)

- 49 products considered, 53 processes
- Cover the bulk of energy use
- Combine energy use and non-energy use data because reporting often inaccurate
- With and w/o electricity
 - ◆ Not based on BAT: across the board 20% improvement potential assumed
- So far only energy indicators – CO₂ indicators are challenging



DRAFT Indicators Results Chemicals & Petrochemicals

	Energy use (incl. Electricity)				Energy use (excl. Electricity)			
	Reported energy use (PJ/yr)	BAT Energy use (PJ/yr)	EEI	Improvement potentials	Reported energy use (PJ/yr)	BAT Energy use (PJ/yr)	EEI	Improvement potentials
USA	7,321	5,319	0.73	26.8%	6,412	4,592	0.72	28.4%
Japan	2,252	1,961	0.87	12.5%	2,053	1,802	0.88	12.2%
China	5,323	5,078	0.96	3.8%	4,301	4,260	0.99	1.0%
Saudi Arabia	1,369	1,081	0.79	21.0%	1,369	1,081	0.79	21.0%
Germany	1,241	1,127	0.91	8.6%	1,064	985	0.93	7.4%
Canada	843	755	0.90	10.1%	776	701	0.90	9.6%
France	714	593	0.84	16.4%	627	523	0.84	16.5%
Brazil	651	576	0.89	11.0%	572	513	0.90	10.3%
India	1,096	1,080	0.98	1.5%	1,096	1,080	0.98	1.5%
Taiwan	859	737	0.86	13.6%	736	639	0.87	13.2%
Italy	457	399	0.88	12.1%	389	344	0.89	11.5%
Benelux	1092	1134	1.04	-4.4%	1004	1066	1.06	-6.2%
Korea	1562	1650	1.06	-6.0%	1416	1533	1.08	-8.3%
Other	10,436	7,683	0.74	26.4%	9,713	7,074	0.73	27.2%
World	35,217	29,146	0.83	16.8%	31,529	26,195	0.83	16.9%

Source: IEA data, in preparation



Preliminary Indicator Insights

- Data suggest widely varying efficiencies/improvement potentials
- Unclear why potentials in the US, Saudi Arabia and “other” are so high (missing products ?)
- Indicator >100 for Benelux and Korea: physically impossible
- Globally 16.8% savings potential – less than other sectors



Methodological Issues

- No heat cascading/process integration correction
- No CHP credits
- No recycling/energy recovery correction
- Coverage for electricity needs improvement
- Energy use for petrochemical production in refineries is included in refineries
- Energy reporting for integrated refinery/petrochemical complexes unclear



BAT/BPT Issues

- Equipment manufacturers quote much lower numbers than petrochemical industry sources
- Product categorisation is an issue (gas-phase vs. other polymerisation processes etc.)
- Process rates (Chlorine current density etc.) affect BPT
- The feedstock type affects the energy use (coal vs gas based ammonia)
- No CHP efficiency correction (all credits for the power sector)



Iron and Steel

- At least four simultaneous data collection efforts
 - ◆ Asia-Pacific Partnership (seven countries)
 - ◆ Worldsteel (member companies)
 - ◆ Eurofer (Europe)
 - ◆ IEA (Global)
- China constitutes a key challenge (40% world production primary steel)
- So far only IEA data are public



Iron & Steel system boundary and definition issues

- Energy or CO₂ intensities
- Crude steel or finished steel
- Only BF-BOF or including scrap-EAF
- Residual BF gas – carbon content valuation
- Buying or own preparation feedstock



Iron and Steel – Latest IEA Indicator Approach

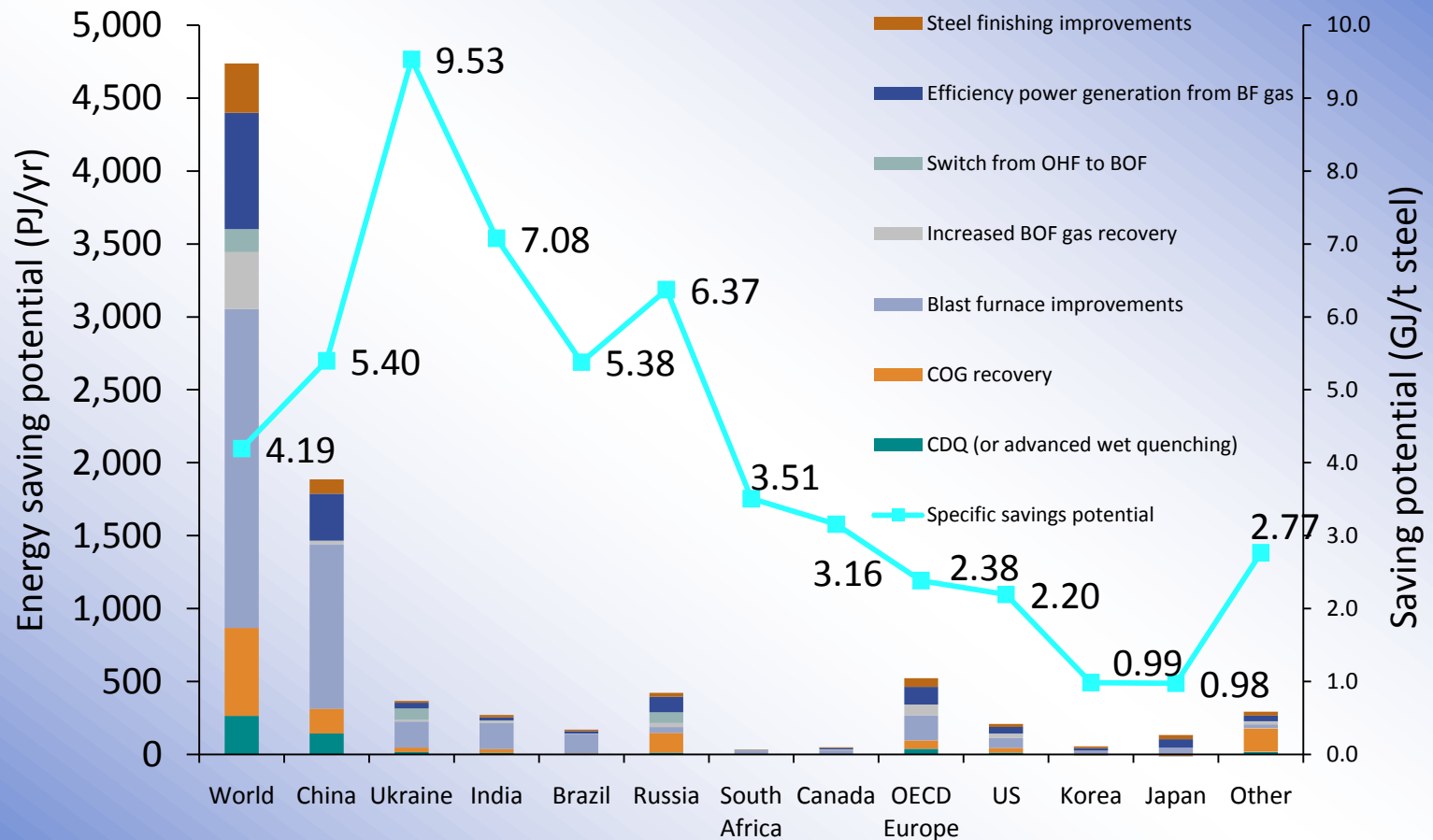
- Benchmarking data are more accurate but confidential (antitrust legislation, competition) and not comprehensive
- The IEA country level energy balance data are the only comprehensive consistent energy data set for iron and steel in the world
- Data availability determines approach
 - ◆ $I = \Sigma P \times BPT / \text{Actual use (IEA stats)}$
 - ◆ Eight separate processes/products
- Production data from Worldsteel
- BAT data from literature & industry sources

	Top-down (IEA stats) [GJ/t crude steel]	Bottom-up (technology diffusion) [GJ/t crude steel]
OECD	3.2	2
China	8.2	5.4
Brazil	6.0	5.4
India	12.6	7.1
<i>Russia</i>	<i>15.7</i>	<i>6.4</i>
<i>Ukraine</i>	<i>16.4</i>	<i>9.5</i>
<i>South Africa</i>	<i>17.9</i>	<i>3.5</i>

Countries with energy reporting issues → *Russia*, *Ukraine*, *South Africa*



Iron and Steel – Technology Diffusion Approach





Conclusions

- Every industry sector is a complex system, system boundaries and allocation issues will affect the outcome
- Many plants are integrated into complex sites
- There is no single “true” comparison method
- Electricity use/Motor systems and CHP require special attention
- Light industry poses a challenge – very diverse products, inadequate energy use datasets – 30% of manufacturing industry energy use
- “Good is good enough” – balance of data availability and methodological correctness needed