For our Environment

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BAT in the Iron and Steel Industry

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Unit III 2.2 'Ressource Conservation, Material Cycles, Mineral and Metal Industries'
Outline:

1. BAT requirements for iron and steel production from the Protocols to the Geneva Convention
2. Development of the EU BREF for Iron and Steel Production
3. How to read the Iron and Steel BREF?
4. Examples for EU BAT conclusions
5. Implementation of the BAT conclusions in Germany
6. Conclusions
1. BAT requirements for iron and steel production from the Protocols to the Geneva Convention
## Limit values relevant for iron and steel production from the existing Protocols to the Geneva Convention

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</thead>
<tbody>
<tr>
<td><strong>SOx</strong></td>
<td>Combustion of coke oven gas</td>
<td></td>
<td>new: 400</td>
<td>400</td>
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<td></td>
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<td>existing: 800</td>
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<tr>
<td></td>
<td>Combustion of blast furnace gas</td>
<td></td>
<td>new: 200</td>
<td>200</td>
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<td></td>
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<td>existing: 800</td>
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<tr>
<td><strong>NOx</strong></td>
<td>Combustion of other gaseous fuels</td>
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<td>new: 200</td>
<td>new: 200</td>
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<td></td>
<td></td>
<td></td>
<td>existing: 350</td>
<td>existing: 300</td>
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<tr>
<td>Particulate</td>
<td>Sinter plant</td>
<td>50</td>
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<tr>
<td>Matter</td>
<td>Pelletization plant</td>
<td>25</td>
<td>40 g/t pellets</td>
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<td>20</td>
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<td></td>
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<td></td>
<td>Crushing, grinding and drying:</td>
<td>All other process steps:</td>
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<td></td>
<td>20</td>
<td>15</td>
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<tr>
<td></td>
<td>Blast furnace</td>
<td>50</td>
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<tr>
<td></td>
<td>Basic oxygen steelmaking</td>
<td>30</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Electric steelmaking</td>
<td>20</td>
<td></td>
<td>new: 5, existing: 15</td>
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<tr>
<td></td>
<td>Hot and cold rolling</td>
<td>20</td>
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<td>20,</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Bag filter not applicable:</td>
<td>50</td>
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<tr>
<td><strong>PCDD/F</strong></td>
<td>Sinter plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5 ng/m3</td>
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<tr>
<td></td>
<td>Electric arc furnace plant</td>
<td></td>
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<td>0.5 ng/m3</td>
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</tbody>
</table>
Changes in the revised Protocols from 2012

Amended Gothenburg Protocol from 2012
- stricter ELVs for Sulphur and NOx emissions from existing plants
- addition of ELVs for Particulate Matter
  → in line with the amended HM Protocol

Amended Heavy Metals Protocol from 2012
- new ELVs for PM emissions from additional sources

Amended POP Protocol from 2012
- ELVs for PCDD/F emissions from iron and steel plants
How to achieve / to implement these emission levels?

→ Description of Best available techniques (BAT) and associated emission levels (BAT-AELs) in the individual Guidance Documents
<table>
<thead>
<tr>
<th>Emission source</th>
<th>Control measure</th>
<th>BAT-associated emission level (mg/Nm3)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Dust</td>
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<tr>
<td></td>
<td></td>
<td>GP</td>
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<tr>
<td><strong>Sinter plant</strong></td>
<td>Primary emissions</td>
<td>Bag filters</td>
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<tr>
<td></td>
<td></td>
<td>Advanced ESP</td>
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<tr>
<td></td>
<td></td>
<td>wet waste gas desulphurization*</td>
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<tr>
<td></td>
<td>Secondary emissions</td>
<td>Bag Filters</td>
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<td></td>
<td></td>
<td>ESP</td>
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<tr>
<td><strong>Pellet plant</strong></td>
<td>Crushing, grinding, drying</td>
<td></td>
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<tr>
<td></td>
<td>Other process steps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>scrubbing or semi-dry desulphurization</td>
<td></td>
</tr>
<tr>
<td><strong>Blast Furnace</strong></td>
<td>BF Gas cleaning</td>
<td>Wet ESP / wet scrubber</td>
</tr>
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<td></td>
<td>Cowpers (hot stoves)</td>
<td></td>
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<tr>
<td></td>
<td>Cast house emissions</td>
<td>Bag filter / ESP</td>
</tr>
<tr>
<td><strong>Basic Oxygen Furnace plant</strong></td>
<td>Primary dedusting</td>
<td>Dry ESP / bag filter</td>
</tr>
<tr>
<td></td>
<td>Wet ESP (existing plants)</td>
<td></td>
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<tr>
<td><strong>Secondary dedusting</strong></td>
<td></td>
<td>Dry ESP</td>
</tr>
<tr>
<td><strong>Secondary steelmaking (EAF) plant</strong></td>
<td>Bag filter</td>
<td></td>
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<tr>
<td></td>
<td>Activated carbon + bag filter</td>
<td>Activated carbon + bag filter</td>
</tr>
<tr>
<td></td>
<td>ESP (existing plants)</td>
<td>ESP (existing plants)</td>
</tr>
</tbody>
</table>

*) not yet applied in the UNECE region or only applied under special local conditions due to high costs
Content of the UNECE Guidance Documents on BAT

- Very brief description of BATs
  - Information on applicability of individual techniques usually restricted to the question of new or existing plants

- More detailed BAT-AELs
  - Individual techniques are often associated with different BAT-AELs
  - BAT-AELs may differ from the ELVs in the Protocols

- Some BATs and BAT-AELs are not even consistent between the Guidance Documents for the different Protocols
  - depending on the date of issue of the individual Guidance Documents, and on the references used for its elaboration (e.g. EU BREF from 2001 or EU BAT Conclusions/revised BREF from 2012)

→ More comprehensive Information can be found in the EU BREF documents!
2. Development of the EU BREF for iron and steel production
What is the EU Iron and Steel BREF?

The Iron and Steel BREF is...

- the outcome of the information exchange on BAT for the sector under the EU Industrial Emissions Directive (2010/75/EU)
- a comprehensive document of more than 600 pages
- providing a lot of information on the sector, particularly on the techniques identified as BAT
Development of the Iron and Steel BREF

- First issue of the Iron and Steel BREF published in 2001
- Revision process started in 2006 according to the provisions of the former IPPC Directive
  - Technical Working Group carried out the revision until Mid 2010
  - Adoption was halted due to the upcoming enactment of the IED
- BAT conclusions from the BREF had to be converted into a stand-alone ‘BAT conclusion’ document according to the new Industrial Emissions Directive
  - Formal adoption by EU Commission + Member States in Nov. 2011
  - Publication as the first Commission Implementing Decision on BAT in Feb. 2012
Importance of the BAT Conclusions for industrial plants in the EU

- „BAT conclusions shall be the reference for setting the permit conditions.” (IED Article 14, para. 3)

- “The competent authority shall set emission limit values that ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques” (Art. 15-3)

- “Within 4 years of publication of decisions on BAT conclusions..., the competent authority shall ensure that:
  (a) all the permit conditions for the installation concerned are reconsidered and, if necessary, updated...
  (b) the installation complies with those permit conditions.” (Art. 21-3)

⇒ The reconsideration and updating of permits for all iron and steel plants in the EU, as well as their retrofitting, if necessary, had to be completed until March 2016!
3. Scope and content of the Iron and Steel BREF
Production routes for iron and steel → What is covered in the BREF?

**Blast furnace / basic oxygen furnace route** mainly based on sinter, pellets and coke

**Electric arc furnace route** almost 100% scrap-based

**DRI/EAF route** (gas-based)
Structure of the Iron and Steel BREF

1. General information
2. General processes and techniques
3. Sinter plants
4. Pelletisation plants
5. Coke oven plants
6. Blast furnaces
7. Basic oxygen steelmaking and casting
8. Electric arc furnace steelmaking and casting
9. BAT conclusions for iron and steel production
10. Alternative ironmaking techniques
11. Emerging techniques
12. Concluding remarks and recommendations for future work

3. Sinter plants
   3.1 Applied processes and techniques
   3.2 Current emission and consumption levels
   3.3 Techniques to consider in the determination of BAT

9.2 BAT conclusions for sinter plants
Subject of the BAT conclusions for iron an steel

<table>
<thead>
<tr>
<th>No. of BAT conclusions addressing...</th>
<th>19 general BAT conclusions regarding</th>
<th>76 process-specific BAT conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air emissions</td>
<td>Environmental management systems</td>
<td>thereof 30 include BAT-associated emission levels</td>
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<tr>
<td>Water use / waste water</td>
<td>Energy / Material management</td>
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<tr>
<td>Energy</td>
<td>Management of process residues</td>
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<tr>
<td>Production residues</td>
<td>Diffuse dust emissions</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Water and waste water management</td>
<td></td>
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<tr>
<td>General issues</td>
<td>Monitoring</td>
<td></td>
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<td></td>
<td>Decommissioning</td>
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<tr>
<td></td>
<td>Noise</td>
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</tbody>
</table>

19 general BAT conclusions

- Environmental management systems
- Energy / Material management
- Management of process residues
- Diffuse dust emissions
- Water and waste water management
- Monitoring
- Decommissioning
- Noise

76 process-specific BAT conclusions

- thereof 30 include BAT-associated emission levels
How to read the Iron and Steel BREF?

- If you look for general information on one of the processes (e.g. coking plant, blast furnace)
  → Start right from the beginning of the respective Chapter 3. – 8.

- If you look for technical solutions for a special issue
  → Check if the issue is addressed in Chapter 2 ‘General techniques’
  → Otherwise go to the respective Chapter 3. – 8. and look for sub-chapter x.3, where the ‘Techniques to consider’ are presented

- If you are interested in environmental standards in the EU
  → Start with the BAT conclusions (in the Commission Decision Document or Chapter 9.1 – 9.7 of the BREF)
  → for details on the techniques look into Chapter 2 or 3.3 – 8.3
4. Examples for EU BAT conclusions
Examples for BAT: Improvement of energy efficiency

2. BAT is to reduce thermal energy consumption by using a combination of the following techniques:

   I. improved and optimised systems to achieve smooth and stable processing, operating close to the process parameter set points by using
      i. process control optimisation including computer-based automatic control systems
      ii. modern, gravimetric solid fuel feed systems
      iii. preheating, to the greatest extent possible, considering the existing process configuration.

   II. recovering excess heat from processes, especially from their cooling zones

   III. an optimised steam and heat management

   IV. applying process integrated reuse of sensible heat as much as possible.

⇒ Practical measures for improving the energy efficiency of the plant and, as such, for reducing the operating costs
Examples for BAT: Material management

7. In order to achieve low emission levels for relevant pollutants, BAT is to select appropriate scrap qualities and other raw materials. Regarding scrap, BAT is to undertake an appropriate inspection for visible contaminants which might contain heavy metals, in particular mercury, or might lead to the formation of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB).

To improve the use of scrap, the following techniques can be used individually or in combination: e.g.

→ having adequate reception facilities and check deliveries
→ having procedures to exclude scrap that is not suitable for use
→ radioactivity control according to the UN-ECE recommendations

⇒ Simple organisational measures help to reduce emissions efficiently – and to reduce the risk of operation disturbances!
Examples for BAT: Monitoring

14. BAT is to measure the stack emissions of pollutants from the main emission sources ... whenever BAT-associated emission levels (BAT-AELs) are given, and in process gas-fired power plants in iron and steel works.

BAT is to use continuous measurements at least for:

→ primary emissions of dust, NO\textsubscript{X} and SO\textsubscript{2} from sinter strands
→ NO\textsubscript{X} and SO\textsubscript{2} emissions from induration strands of pelletisation plants
→ dust emissions from blast furnace cast houses
→ secondary emissions of dust from basic oxygen furnaces
→ emissions of NO\textsubscript{X} from power plants
→ dust emissions from large electric arc furnaces.

⇒ Emission limiting requirements should always be complemented with adequate emission monitoring
⇒ Relevant pollutants from main sources should be measured continuously (depending on their relevance and the mass flow)
⇒ Sampling and measurements should follow international standards, if available
Example for BAT: Sinter plants’ primary emissions

20. **BAT for primary emissions from sinter plants is to reduce dust emissions from the sinter strand waste gas by means of a bag filter.**

   BAT for primary emissions for existing plants is to reduce dust emissions from the sinter strand waste gas by using **advanced ESPs when bag filters are not applicable.**

   The BAT-associated emission level for dust is $<1 – 15 \text{ mg/Nm}^3$ for the bag filter and $<20 – 40 \text{ mg/Nm}^3$ for the advanced ESP, both determined as a daily mean value.

25. **BAT for primary emissions from sinter strands is to reduce Dioxin and PCB emissions by injection of adequate adsorption agents into the waste gas duct before dedusting with a bag filter or advanced ESP.**

   The BAT- associated emission level for Dioxins is $<0.05 – 0.2 \text{ ng I-TEQ/Nm}^3$ for the bag filter and $<0.2 – 0.4 \text{ ng-I-TEQ/Nm}^3$ for the advanced ESP, both determined for a 6 – 8 hour random sample under steady-state conditions.

→ The primary waste gas from the sinter plant still is a huge source for dust emissions and the dominating source for national dioxin emissions.

→ In combination with the injection of adsorption agents bag filters also efficiently reduce heavy metal and Dioxin emissions.

→ Please note: The Application of BAT also implies adequate maintenance procedures!
21 out of 96 BAT conclusions address diffuse emissions. Why?

- 48% of dust emissions are emitted from diffuse sources.
- At blast furnaces and steel plants the diffuse emissions account for 2/3 of the total emissions.
- The biggest amounts of diffuse dust emissions are emitted from BOF steel plants and from sinter plants.
Examples for BAT addressing diffuse emissions

46. BAT for coke plants is to reduce emissions through achieving continuous undisrupted coke production by using the following techniques:

   I. extensive maintenance of oven chambers, oven doors and frame seals, ascension pipes, charging holes and other equipment (a systematic programme should be carried out by specially-trained detection and maintenance personnel)

   IV. cleaning of doors, frame seals, charging holes, lids and ascension pipes after handling (applicable at new and, in some cases, existing plants)

   VI. adequate pressure regulation during coking…

47. BAT for the gas treatment plant is to minimise fugitive gaseous emissions by using the following techniques:

   I. minimising the number of flanges by welding piping connections wherever possible

   II. using appropriate sealings for flanges and valves

   III. using gas-tight pumps (e.g. magnetic pumps) …

→ Long lists of efficient measures that mostly do not require big investments!
5. Implementation of the BAT conclusions in Germany
Implementation of the BAT conclusions in Germany

- BAT is generally implemented in Germany by setting general binding rules, e.g.
  - the ‘Technical Instructions for Air Quality Control’ (TA Luft)
  - the ‘Waste Water Ordinance’

- Following the publication of new BAT conclusions the general binding rules are evaluated and updated, if required

- Then the competent authorities have to check and update the individual permits, if required

- The plants concerned have to comply with the new BAT requirements within 4 years after the publication date
  - i.e. Iron and Steel plants already have to do so since March 2016
6. Conclusions
Conclusions

- The Iron and Steel BREF is a comprehensive source of information on available techniques, their applicability and their associated emission levels.

- BAT is more than the application of specific technologies; good housekeeping, maintenance, input control and a proper monitoring system are often less costly than end-of-pipe techniques, but facilitate significant emission reductions.

- Application of BAT often also helps to reduce operating costs.

- Adaptation of installations to BAT may require some time and significant investments, but is a prerequisite for future competitiveness of the industry.
We encourage the EECCA countries to benefit from the information provided in the Iron and Steel BREF...

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