Steelmaking Electric Arc Furnaces (EAFs): Canadian Experience in Measurement, Standards Development and Reduction of Emissions

Case Study - Gerdau Ameristeel, Cambridge, Ontario, Canada

Presented by
Patrick Finlay, Environment Canada
at
Workshop on Emissions Reductions
North American Commission for Environmental Cooperation (NACEC)
Monterrey, Mexico
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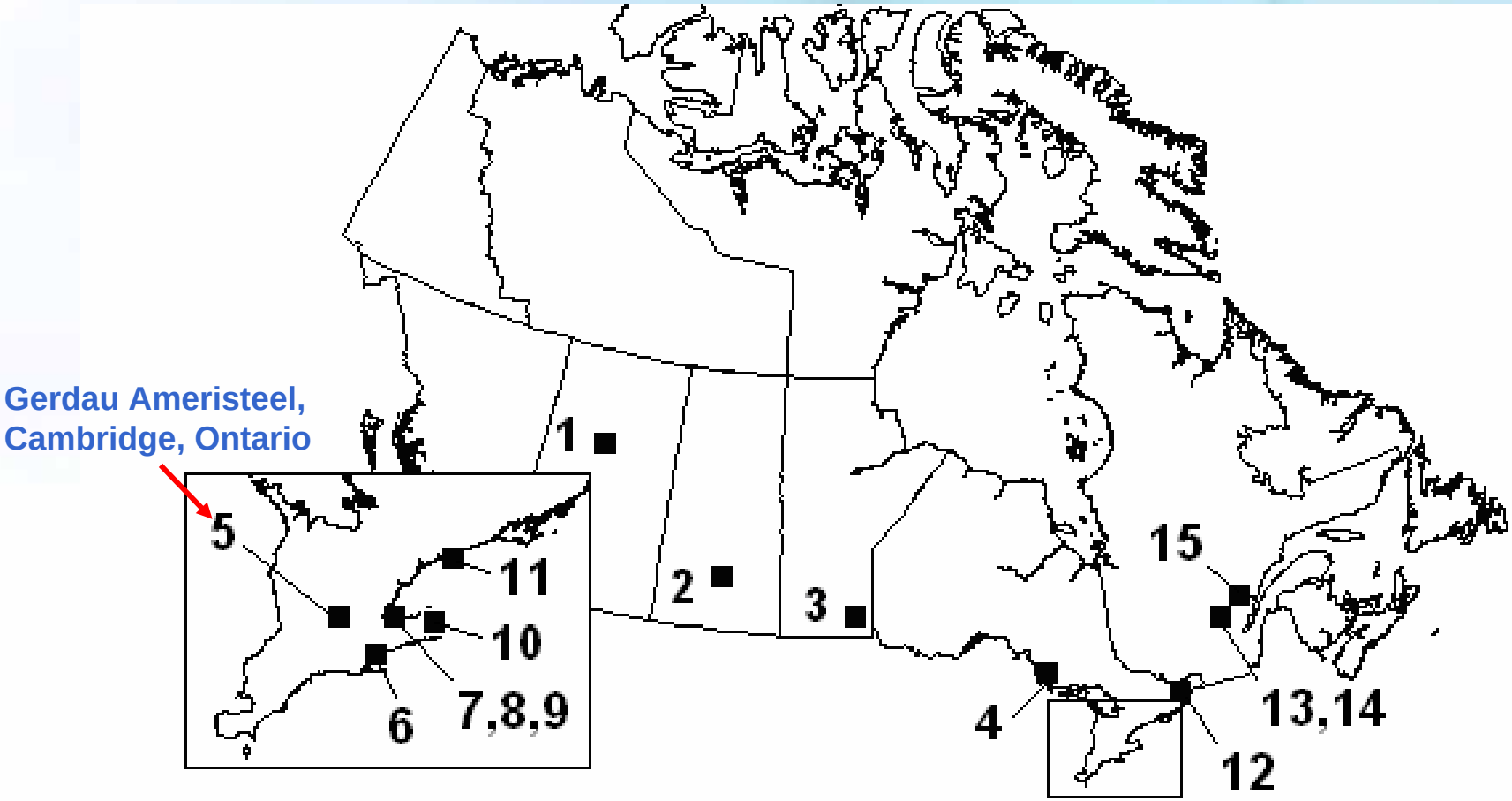
Contexts

- *Canadian Environmental Protection Act (CEPA 1999)* – Virtual Elimination of Persistent Bioaccumulative Toxics (PBTs)
- Canadian Council of Ministers of Environment (CCME), Canada-wide Standards (CWS) for Dioxins and Furans Emissions from Steel Manufacturing Electric Arc Furnaces (EAFs)
- United Nations Environment Programme (UNEP) Stockholm Convention and Unintentionally produced Persistent Organic Pollutants (UPOPs) National Action Plan (NAP) requirements

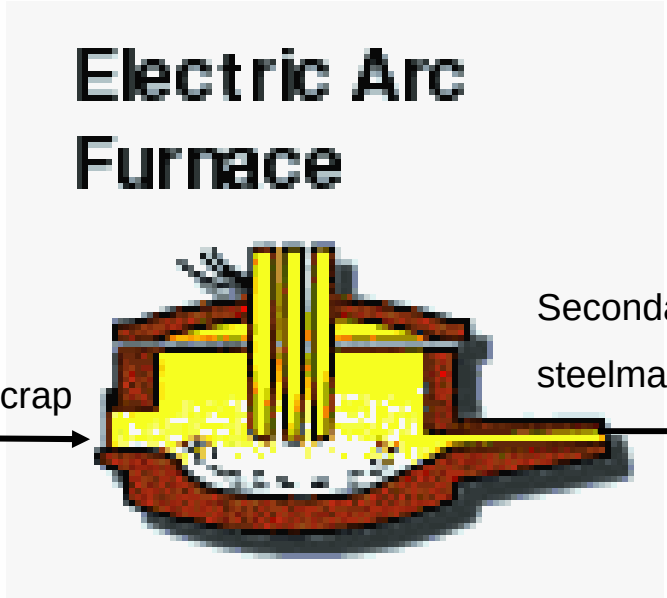
Canadian Iron and Steel Facilities

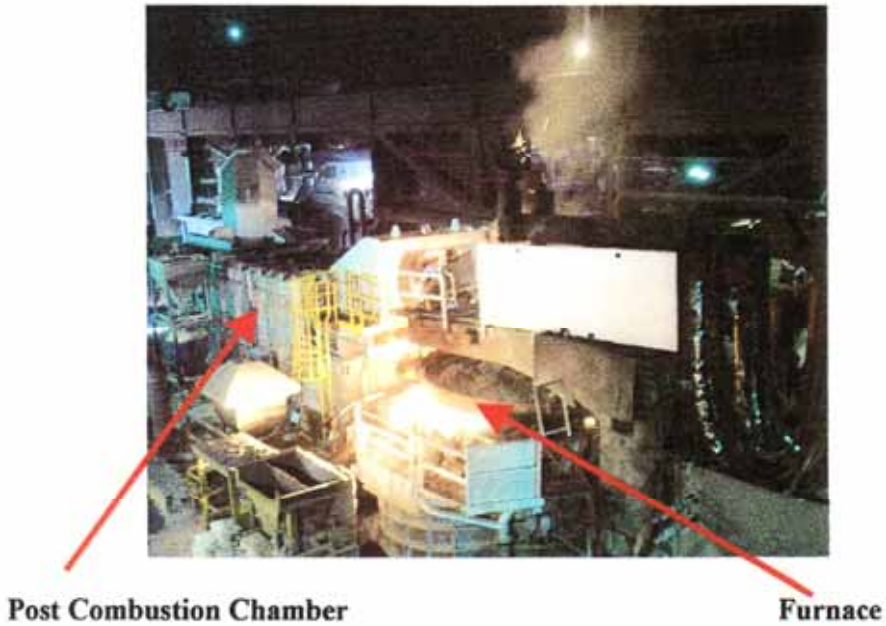


Company Profile

- Gerdau Ameristeel, Cambridge, Ontario (The Gerdau Group (Brazil) is the majority shareholder)
- Electric Arc Furnace, 43 ton capacity
- Recycles post-consumer and industrial metal to produce steel squares, rounds, angles, unequal angles, flats, channels, rebar
- Operates on a seven day, 24 hour basis employing approximately 280 hourly and salaried staff

Electric Arc Furnace (EAF)

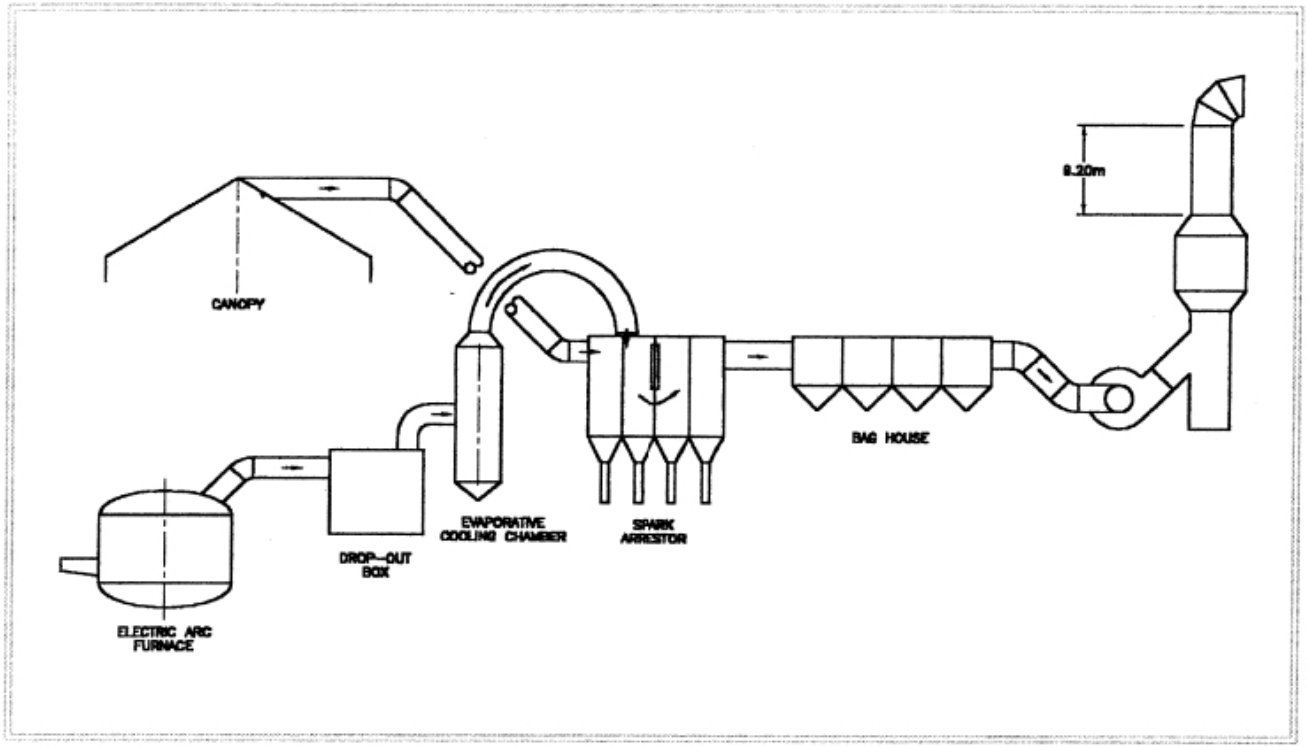




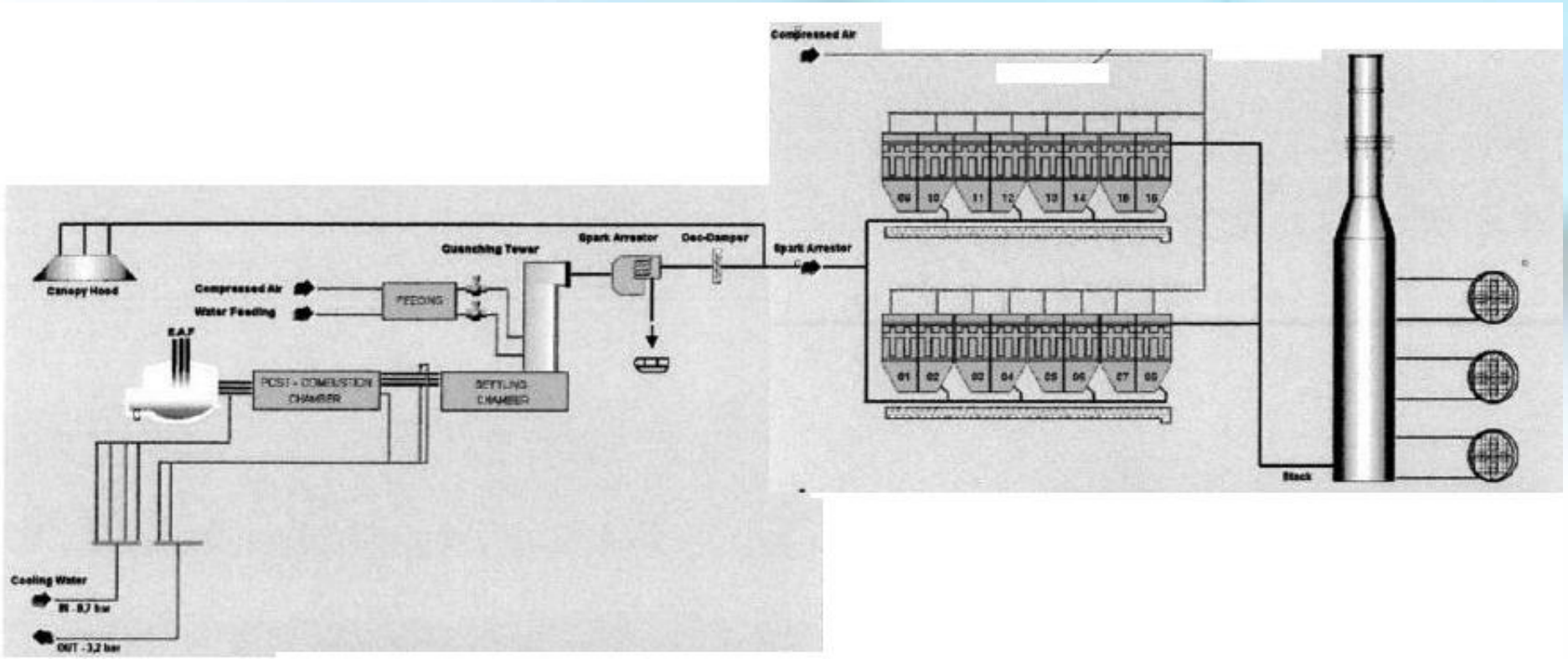
Air emissions: **Particulate Matter (PM)**,
Nitrogen Oxides (NOx), Volatile Organic Compounds (VOCs),
Carbon Monoxide (CO), Carbon Dioxide (CO_2),
Dioxins/Furans (PCDDs/PCDFs)

Previous Emissions Management System

Figure 1: Schematic of EAF Emission Control System



New Emissions Management System



Overview of the New Emissions Management System (1)

Overview of the New Emissions Management System (2)

View of EAF Fume Control System from the Top of the Stack

EAF: Electric Arc Furnace

Sampling and Analyses

- Test program teams (2005)
  - Plant Environmental Manager (1)
  - Local Ontario Ministry of the Environment (MOE) Abatement Officer (1)
  - MOE Source Assessment Officer (1)
  - Sampling company staff (LEHDER Environmental Services Ltd.) (5)
  - Analytical laboratory (1)
- Reference methods
  - Sampling: Environment Canada (EC) report EPS 1/RM/2, June 1989
  - Analysis: EC report EPS 1/RM/3, May 1990
  - Quality Assurance: EC report EPS 1/RM/23, October 1992
  - Test Protocols: Ortech Environmental Report #30121
- Procedures

  Develop test protocol → Determine concentration and mass rate → Analysis → Report

EAF Baghouse and Exhaust Stack

Source: LEHDER Environmental Services Ltd.

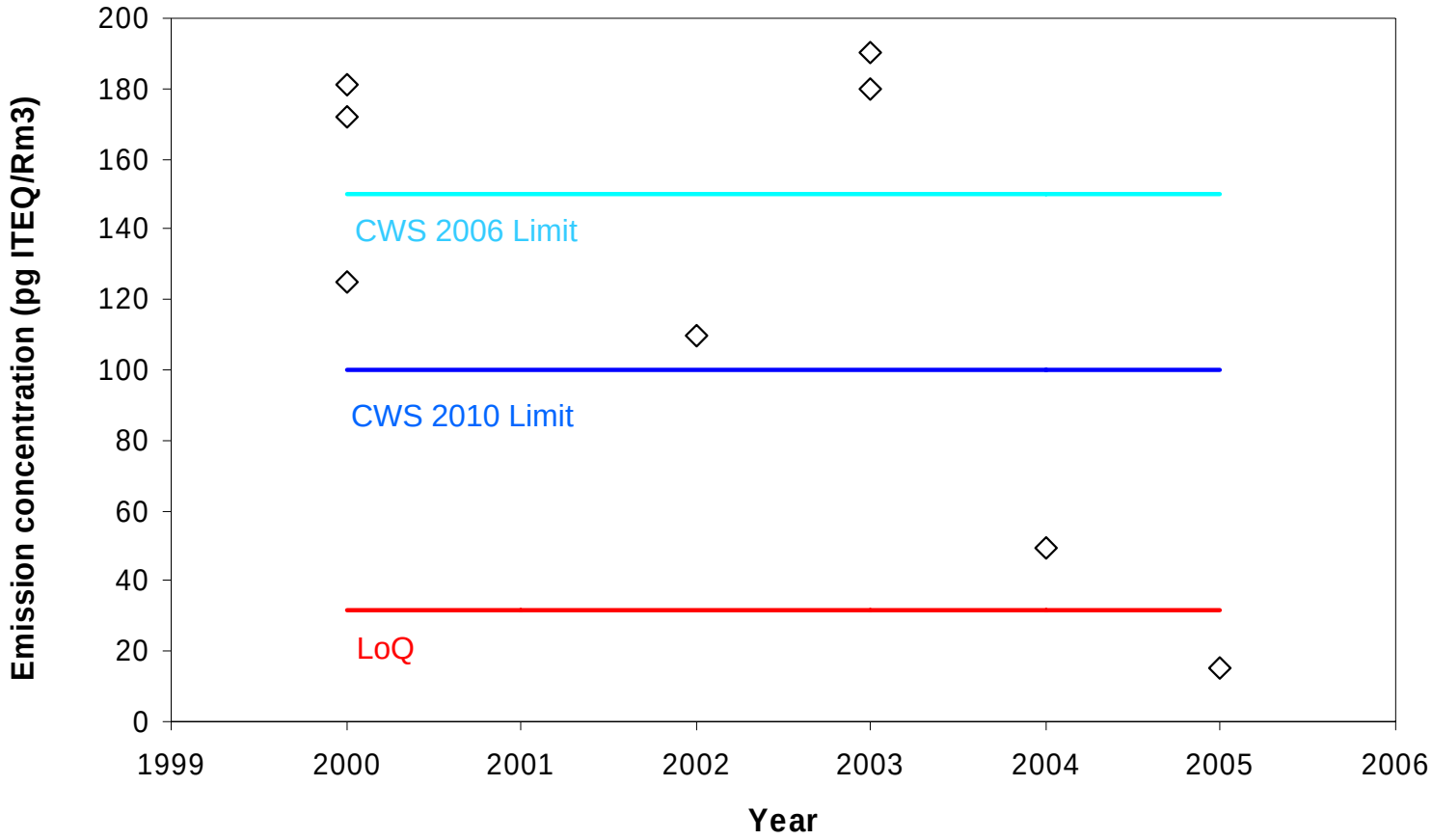
Tests Conducted in Recent Years

- Sampling company

  LEHDER Environmental Services Ltd.
- Test dates
  - November 2005 (new baghouse)
  - April 2004 (new baghosue, after system adjustment)
  - December 2003 (new baghosue, performance test #2)
  - September 2003 (new baghosue, performance test #1)
  - May 2002 (old baghouse)
  - August 2000 (two tests, old baghouse)
  - April 2000 (old baghouse)
- Data assistance

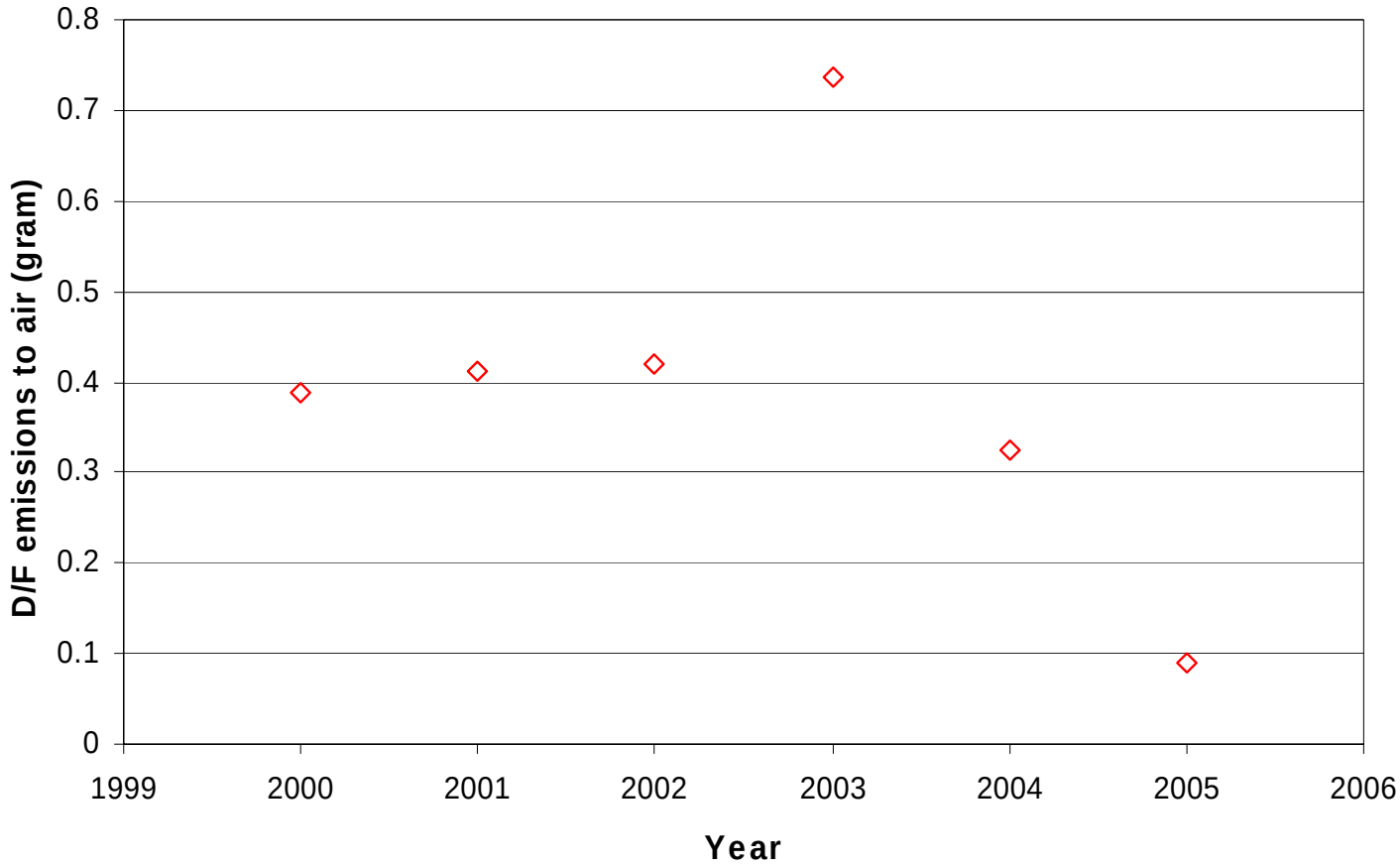
  Emissions Research and Measurement Division (ERMD), Environmental Technology Center (ETC), Environment Canada

Emissions Performance Data: Dioxins/Furans Concentrations (2000-2005)



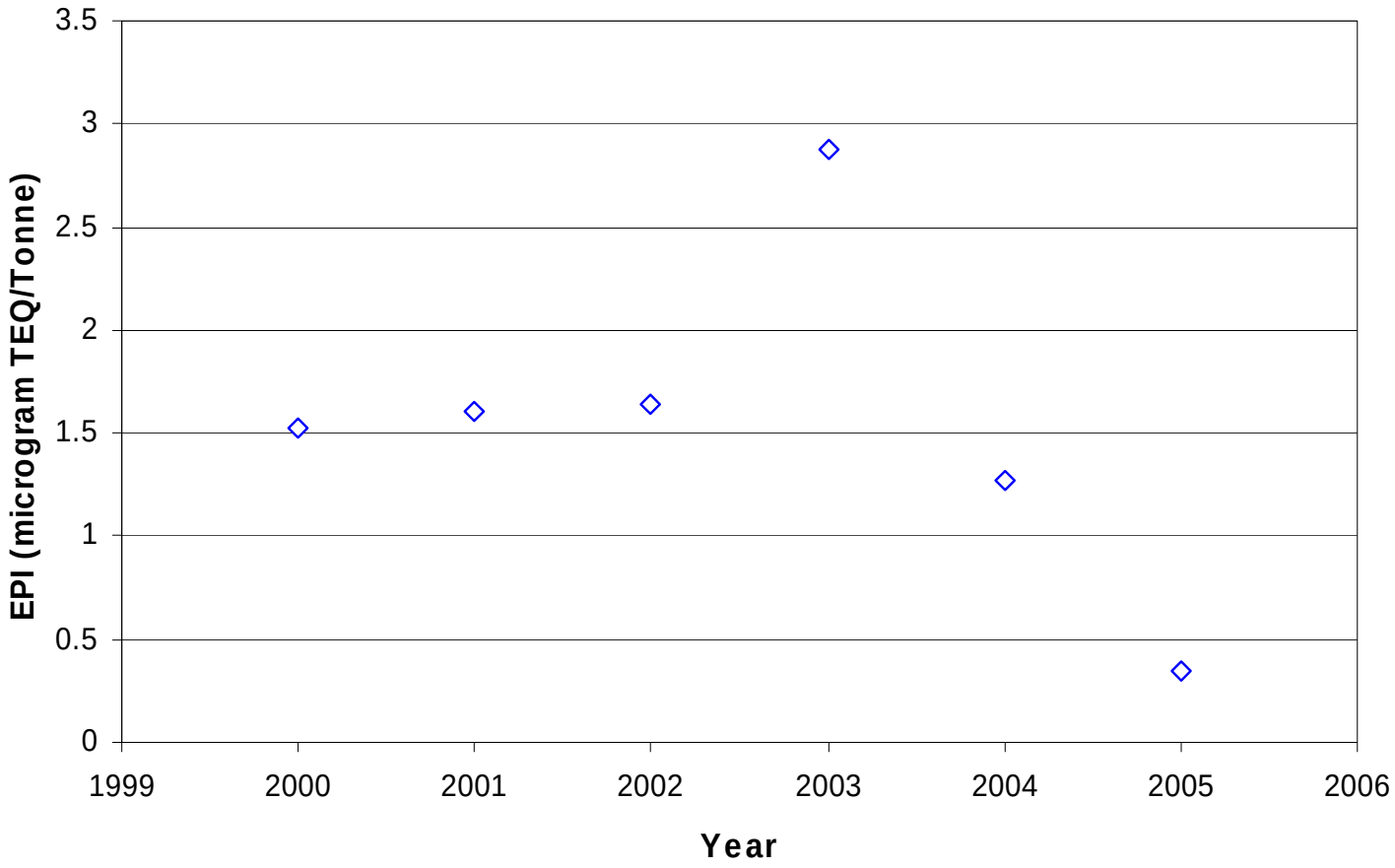
CWS: Canada-wide Standards
LoQ: Level of Quantification

Emissions Performance Data: Dioxins / Furans Emissions to Air (2000-2005)



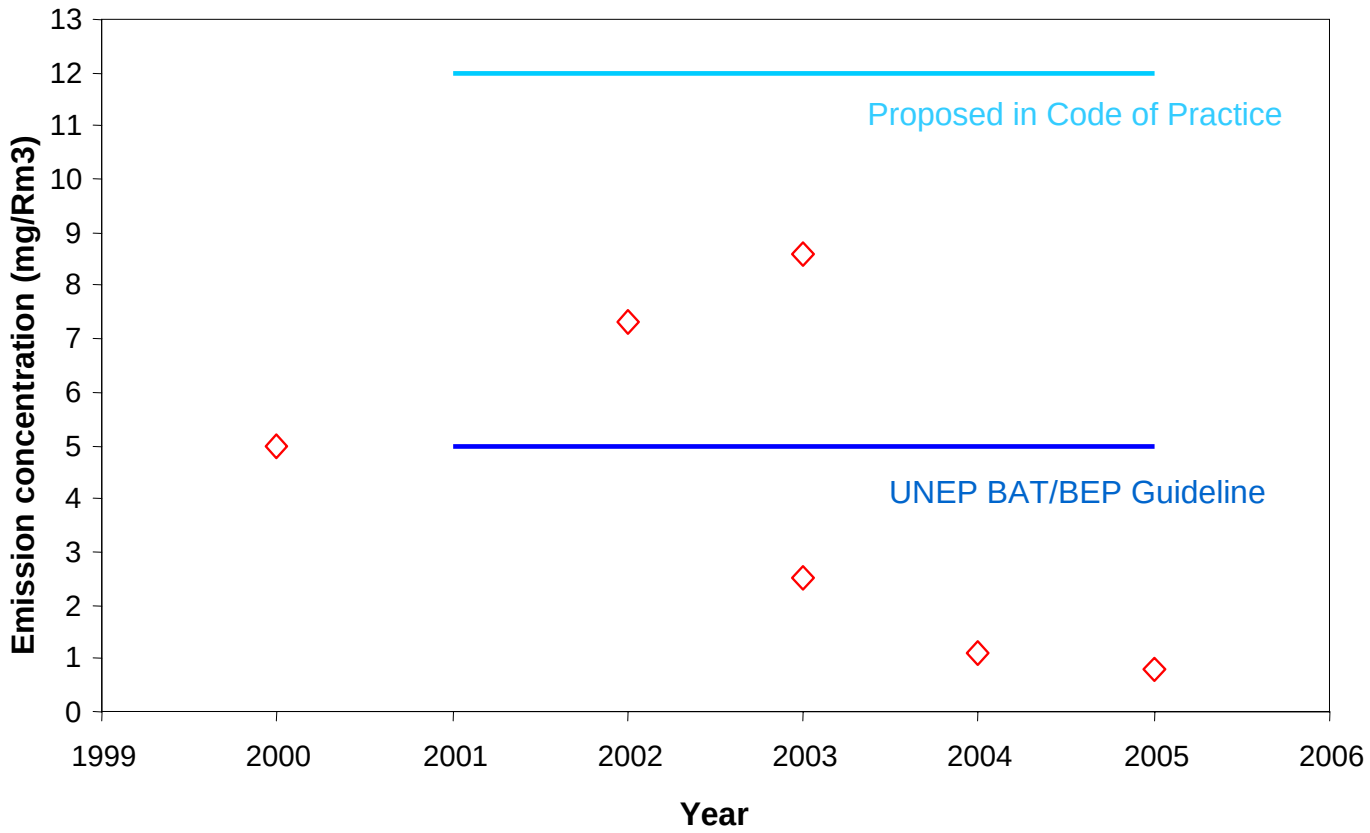
Data source: Environment Canada, National Pollutant Release Inventory (NPRI), http://www.ec.gc.ca/pdb/npri/npri_home_e.cfm

Emissions Performance Data: Dioxins/Furans Environmental Performance Indicators (EPI)(2000-2005)



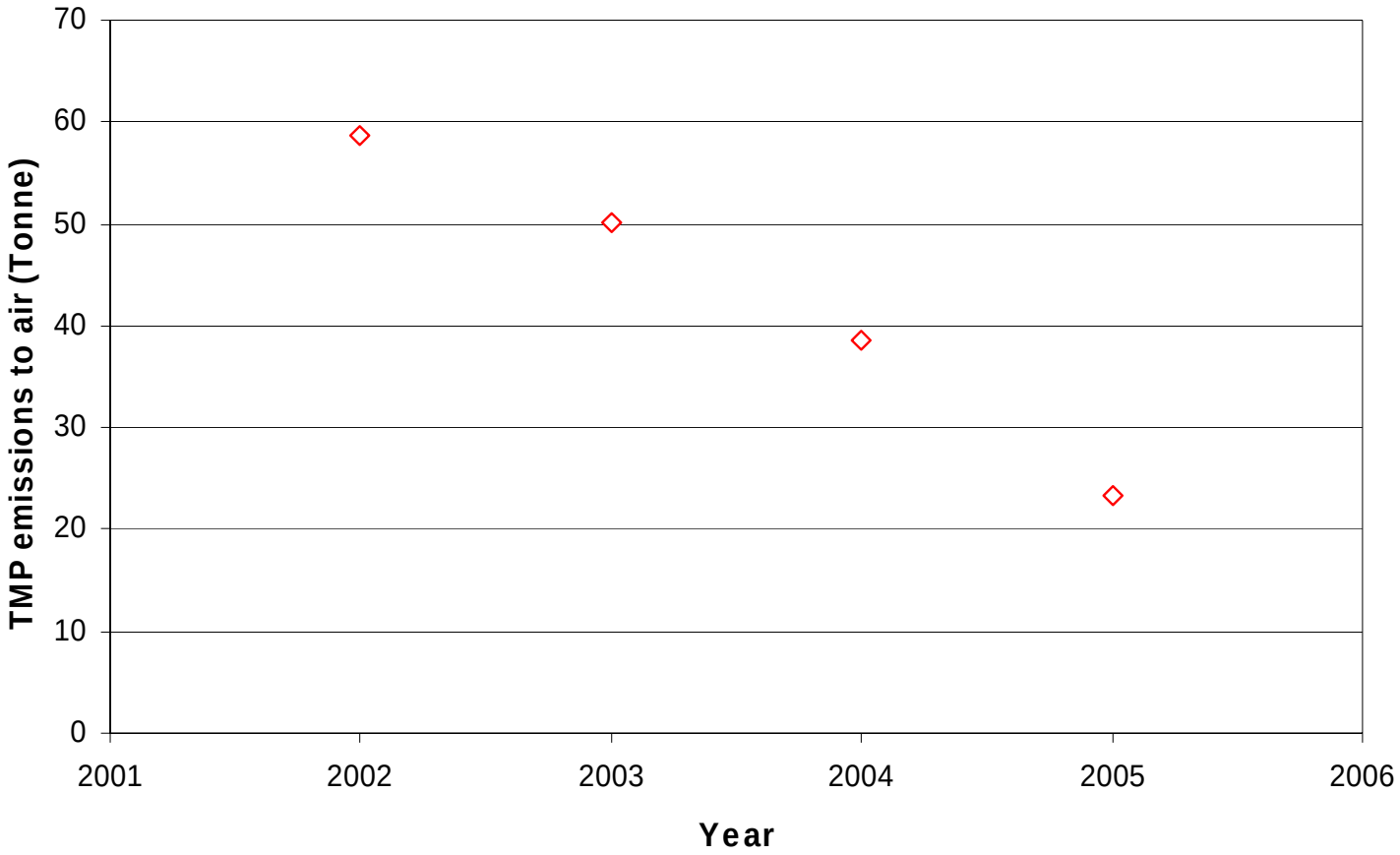
Data source: Environment Canada, National Pollutant Release Inventory (NPRI), http://www.ec.gc.ca/pdb/npri/npri_home_e.cfm

Emissions Performance Data: Total Particulate Matter (TPM) Concentrations (2000-2005)



UNEP: United Nations Environment Programme
BAT: Best Available Techniques
BEP: Best Environmental Practices

Emissions Performance Data: Total Particulate Matter (TPM) Emissions to Air (2002-2005)



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Emissions Performance Data: Total Particulate Matter (TPM)

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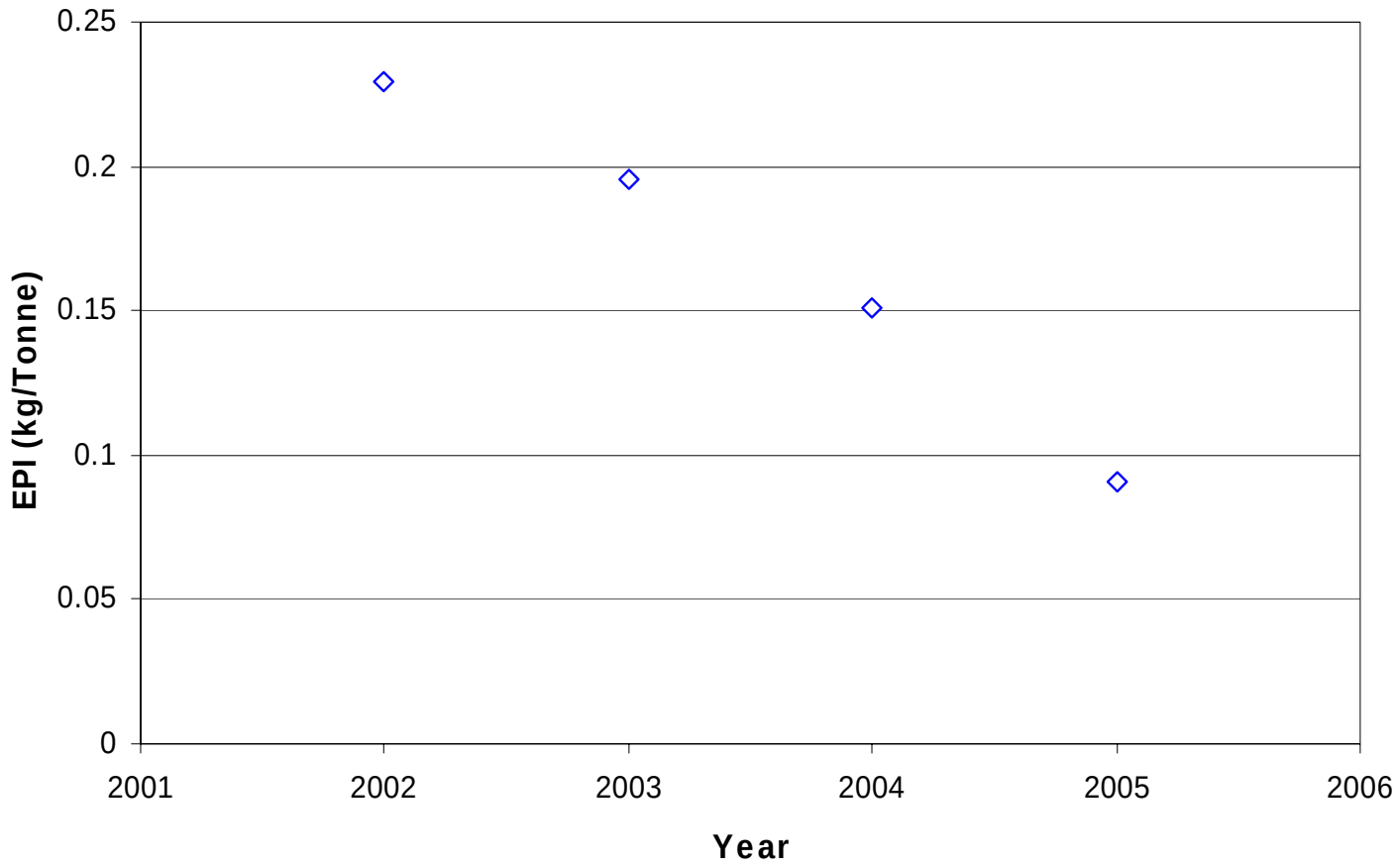

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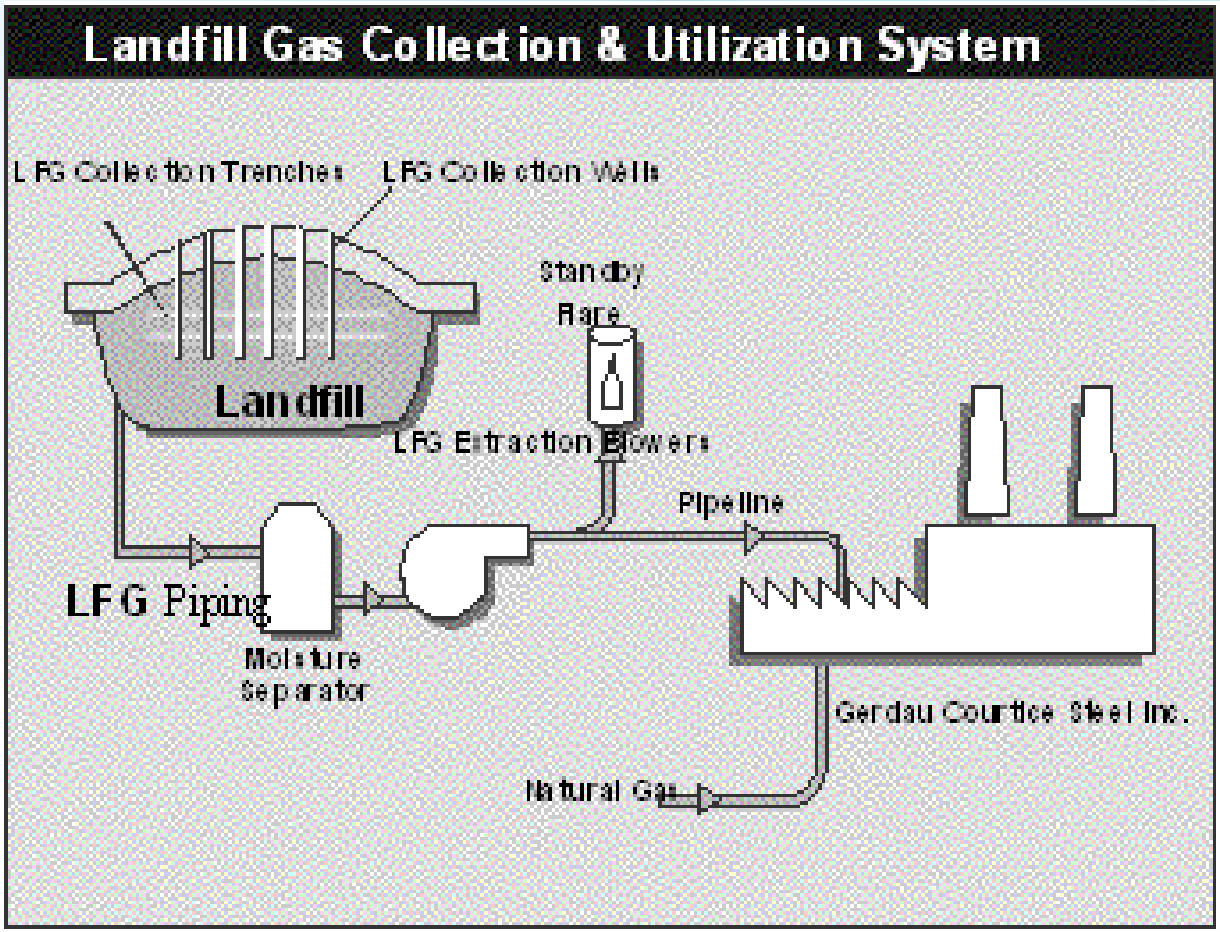
Landfill Gas Fuel Use



Source: Environment Canada, http://www.environment-canada.ca/nopp/lfg/en/issue9.cfm

Landfill Gas Fuel Use

A view of the landfill gas collection facility and the flare at the Cambridge landfill. The flare is not actually burning the gas, but it is required as a backup.

This photograph shows the Cambridge landfill gas collection building in the foreground and the Gerdau Ameristeel plant in the background behind the trees.

- LGF provided about **32%** of the reheat furnace energy use in 2000
- Reduced GHG emissions by **118,000** tonnes of eCO_2 per year,
  - equivalent of taking **17,000** cars off the road per year

Source: Natural Resources Canada, http://www.canren.gc.ca/renew_ene/index.asp?CaID=47&PgID=1136

Lessons Learned (1)

- Design specifications (performance guarantees)
  - Dioxins/Furans: < 100 pg/Rm^3 (I-TEQ*)
  - Total Particulate Matter: < 5 mg/Rm^3
- Awarded contract to DECOS (Italy), Division of Voest Alpine (Austria)
- Design included
  - Improved EAF hood capture (doubled fan capacity)
  - Post combustion chamber
  - Cooling tower rapid quench
  - Induced draft fans (Three - 50% capacity)
  - High efficiency filter fabric bag houses (16 units)
  - Broken bag detectors
  - Stack sampling deck and jib
  - 35 m stack

* I-TEQ: International Toxic Equivalent

Lessons Learned (2)

- Commissioning was challenging
  - Baghouse temperature now controlled to 80 Degrees C (was higher and DF vaporized)
  - Increased cakes on fabric filters
- EAF dust sent to secure hazardous waste disposal site (Trials to pelletize and reuse in EAF)
- Costs
  - Air Pollution Control System - $10 million
  - Dioxins and Furans Stack Tests - $25 k
  - Dioxins and Furans Dust test - $900

Other Best Environmental Practices

- Paved yard for feed and waste storage with drains, and oily water separators
- Covered building for slag cooling to control fugitive dusts
- Dispersion modeling for all sources for Ontario Point of Impingement predictions
- Acoustic Enclosure buildings, Silencers etc for noise sources - good neighbours
- Ultra clean baghouse building!

Baghouse (Cleanest place in plant!)

16 units in total

Dust conveyor

Conclusions

- Co-benefits of Canada wide Standards (CWS) implementation
  - Surpassing CWS requirements
  - Reduced process fugitives and worker exposure in EAF melt shop
  - Improving understanding of D/F formation, prevention and control
- Factors to consider
  - Feed quality
  - Temperatures
  - Residence times
  - Filter fabric performance
  - System design, operation and maintenance
- Achievable Performance Levels (APL)
  - 100 pg/Rm^3 I-TEQ* achievable
  - 32 pg/Rm^3 I-TEQ Level of Quantification achieved

* I-TEQ: International Toxic Equivalent

Acknowledgements

- Gerdau Ameristeel
- Bob Downie

  Corporate Environmental Manager

  Hopkins Street South

  Whitby, Ontario

  L1N 5T1

  bdownie@gerdauameristeel.com

Further Information

- Hui Peng, Program Engineer, Metals, Cement and By-product Organics Section, Pollution Prevention Directorate, Environment Canada

  - hui.peng@ec.gc.ca
- Patrick G. Finlay, P.Eng., Senior Advisor, Industrial Sectors Environmental Performance, Environment Canada

  - patrick.finlay@ec.gc.ca

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Thank you!