The Application of BAT/BEP in THAILAND's Scrap Metal Value Chain

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Thailand Metal Industry (upstream) Overview

Metal	Capacity (Tons/Year)	Number of plants
Iron and Steel	12,000,000	30
Aluminium	200,000	11
Lead	120,000	8
Copper	50,000	3
Silicon	30,000	1 *
Tin	30,000	1 *
Antimony	3,000	2 *
Tantalum	650	1
Gold	5	1 *

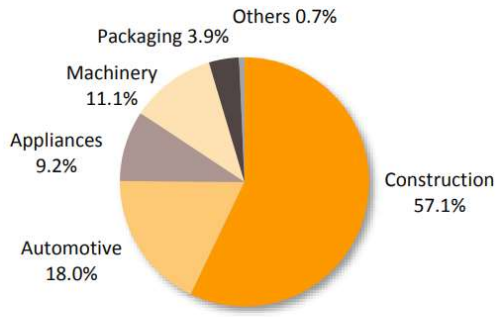
* Uses primary raw materials

***Source**: Department of Primary and Industries, 2019*

Thailand Steel Industry

Steel Production at **6.86** MT **-13.72%**
Capacity Utilization ratio
~ 30-40 percent

Domestic Demand Breakdown by Steel Consuming Sector (in 2017)

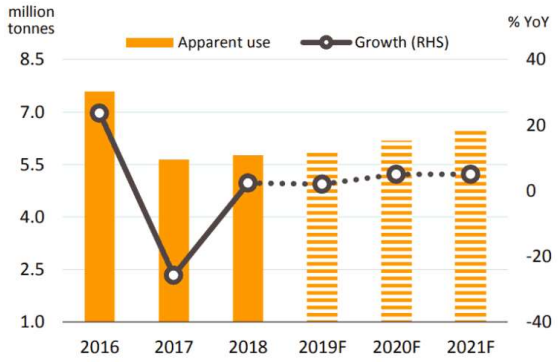


Source: Iron and Steel Institute of Thailand (ISIT)

10 Largest Steel Producers

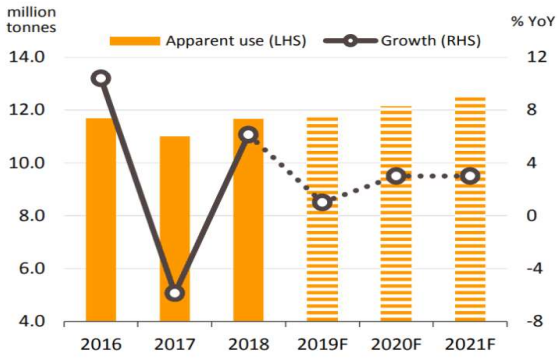
Rank	Company	Share (%)	Products
1	Millcon Steel	5.4	Steel bar & structure
2	MC Metal Service ASIA	4.8	Steel sheets, coils
3	Sahaviriya (SSI)	4.6	Slab, HRC and steel products
4	Tata Steel (Tata)	4.5	Steel bars and wire rod
5	NS Bluescope (Thailand)	3.2	Coated steel sheets
6	TMT-Thai Metal Trade	2.9	Structure steels
7	UNITED COIL CENTER	2.8	Vehicle steels
8	G J Steel	2.7	Structural, pipes and automotive
9	G Steel	2.4	HRC
10	Danieli Thailand	2.1	Steel products (flat and long)

Long Steel Apparent Use Trend



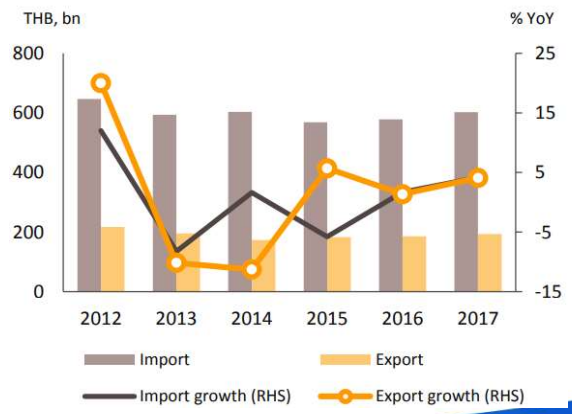
Source: ISIT, forecast by Krungsri Research.

Flat Steel Apparent Use



Source: ISIT, forecast by Krungsri Research

Thailand Steel Import and Export



Thailand Metal Industry

Advantages

- Potential of metal demand growth from new investment in construction and manufacturing sectors
- The largest metal market in region due to rising demand in Cambodia, Laos, Myanmar and Vietnam which nearby Thailand
- Capable of producing various metal products
- Potential to increase the value of products due to their broad supply chain

Disadvantages

- Lack of natural resources
- Poor management of replacement resources such as metal scrap, industrial waste and household waste
- High production cost especially the cost of energy such as electricity, fuel and coal etc.
- Lack of local research and development on new technologies and innovations
- Lack of efficiency linkage in the supply chain
- Using old technology/facilities in SME causes the environmental impacts





Potential releases of POPs (PCDD/Fs)

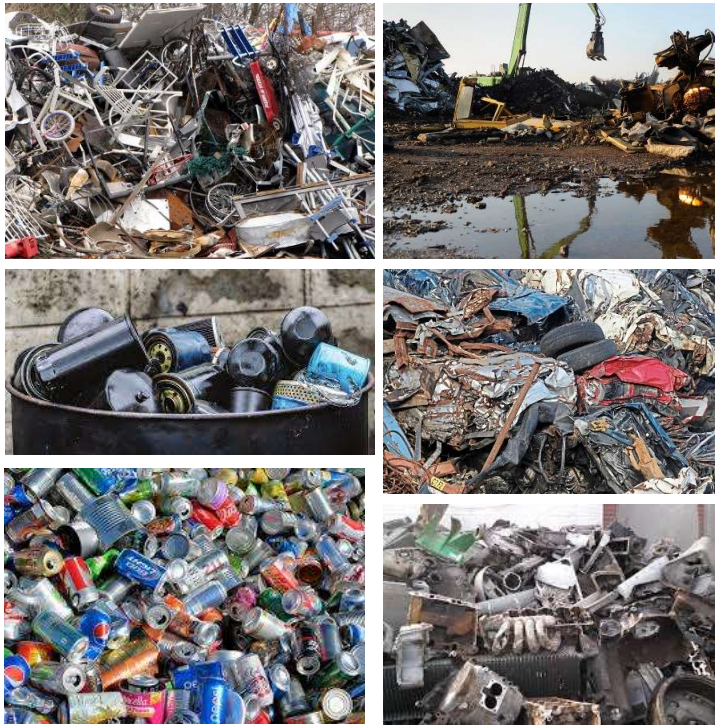
The National Implementation Plan (NIP) reported establishment of POPs Inventories since June 2005. Potential national releases of PCDD/Fs emission to air, water land, product and residue were estimated at **1075.88 g TEQ/year**. The total release from secondary metal production was estimated at 119.675 g TEQ/year (**11.14%** of total National releases)

Annual releases of PCDD/Fs in Thailand from source category 2: Ferrous and Non-ferrous metal production (Base year 2004)

Scrap metal recycling facilities	Releases of PCDD/Fs (g TEQ/year)		
	Air	Residues	Total
Iron and steel production	19.776	98.78	118.553
Secondary aluminium production	0.009	0.103	0.112
Secondary copper/bronze production	0.061	0.756	0.817
Secondary lead production	0.193	ND	0.193
Total for source category 2	**20.04**	**99.66**	**119.675**

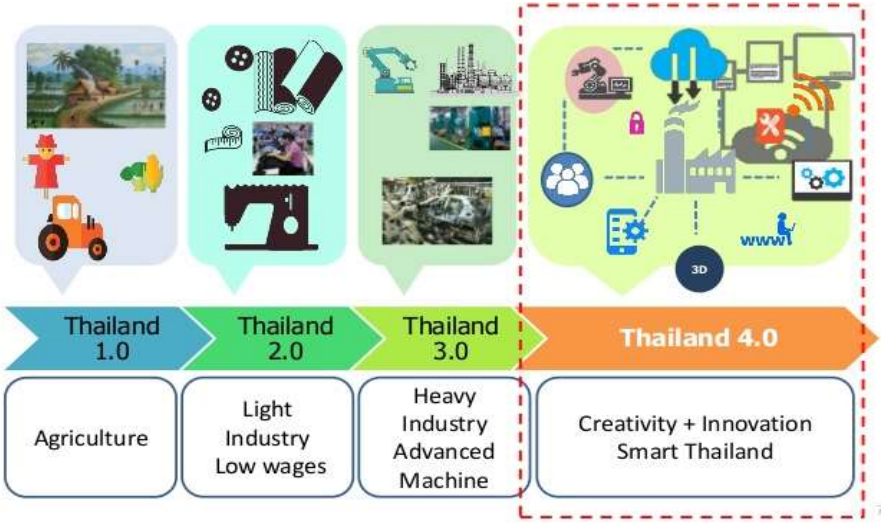
Source: NIP/POPs Coordination Office, 2005

Government Initiatives



- **Guideline for metal scrap classification**

Thailand 4.0 policy



- New S-Curve Industries
- AI / Robotic
- IOT
- Big Data

- ITC
- Start up
- Community Enterprise
- Creative Industry Village

- Circular Economy
- Recycling Technology R&D Center
- Green Industry
- CSR

Thai Government and UNIDO Cooperation Project: Green Scrap Metal Thailand

"Greening the Scrap Metal Value Chain through Promotion of BAT/BEP to Reduce U-POPs Releases from Recycling Facilities"

Overall Objectives:

- The project aims to promote and introduce BAT/BEP measures in scrap recycling facilities in order to reduce or eliminate unintentional POPs releases.

Duration: 5 years (2018 - 2022)

Target:

- Reduction of about 20% of PCDD/Fs released from demonstration facilities

Best Available Techniques (BAT)

- **Best**: most effective in achieving a high general level of protection of the environment as a whole.
- **Techniques** : the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned
- **Available** techniques : developed on a scale which allows
  - implementation in the specific industrial sector,
  - under economically and technically viable conditions,
  - taking into consideration the costs and advantages,
  - reasonably accessible to the operator,

Best Environmental Practices (BEP)

- environmental management system in the plants
- the way of the management of a plant, maintenance and repair of facilities to reduce emissions
- the training of managing staff of the enterprise to options for the efficient use of energy and influence on the prevention of environmental damage
- the involvement of all employees of the company in creating an environmentally friendly production
- the information of the public about it Environmental effects of the plant

Persistent Organic Pollutants (POPs)

Why should we worry about ?

- Toxicity
- Persistence
- Long-range transport
- Bio-magnification

A global issue → a global response

In 2004, the Stockholm Convention on Persistent Organic Pollutants was ratified by governments to decrease environmental and human exposure to these substances

Major factors influencing dioxin formation

- The process feed (raw materials);
- The process operating conditions (combustion quality);
- The off-gas cooling conditions (residence time, critical temperature for de novosynthesis);
- Memory effects (i.e. dust cumulated inside the ducts).

Stockholm Convention on Persistent Organic Pollutants

<u>Annex C</u>, Part II

(a) Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge;

(b) Cement kilns firing hazardous waste;

(c) Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching;

(d) The following thermal processes in the metallurgical industry:

(i) Secondary copper production;

(ii) Sinter plants in the iron and steel industry;

(iii) Secondary aluminum production;

(iv) Secondary zinc production.

Annex C, Part III

(a) Open burning of waste, including burning of landfill sites;

(b) Thermal processes in the metallurgical industry not mentioned in Part II;

(i)Secondary lead production;

(ii)Primary aluminum production;

(iii)Magnesium production;

(iv)Secondary steel production;

(v)Primary base metals smelting.

(c) Residential combustion sources;

(d) Fossil fuel-fired utility and industrial boilers;

(e) Firing installations for wood and other biomass fuels;

…

(k) Shredder plants for the treatment of end of life vehicles;

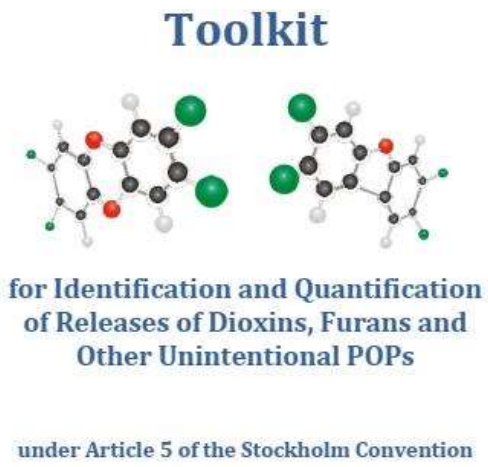
(l) Smoldering of copper cables;

(m) Waste oil refineries.

Guidelines/Guidance on Best Available Techniques and (BAT) Best Environmental Practices (BEP)

http://chm.pops.int/Implementation/BATandBEP/BATBEPGuidelinesArticle5/tabid/187/Default.aspx

The UNEP Toolkit for estimating emission inventories of PCDDs/PCDFs and other U-POPs



Primary and secondary measures

Measures to control and abate emissions to the environment generally fall into two categories:

- primary or process-integrated measures that attempt to prevent or minimize the pollutant being formed and emitted from the main process;
- secondary or end-of pipe measures that attempt to destroy or recapture emissions after they have been formed and emitted from the main process.

From a general point of view, it is better to avoid PCDD/Fs formation rather than abate them after their formation.

Generic primary measures

Primary measures identified to prevent or minimize the formation of PCDDs/Fs:

- feed material selection;
- feed material preparation (i.e. de-coating and de-oiling processes, stripping cable insulation);
- effective process control to establish and maintain optimum operating conditions that minimize PCDD/Fs generation;
- continuous parameter monitoring.

BAT for scrap metal handling

- ✓ Apply roads with hard surfaces;
- ✓ Clean roads with hard surfaces with sweeper and moisten roads with non-hard surfaces with fixed or mobile sprinkler system;
- ✓ avoid emission of dust from traffic;
- ✓ store the scrap according to different criteria (e.g. size, alloys, degree of cleanliness);
- ✓ provide scrap storage under cover and/or on impermeable surfaces (i.e. concrete floors) with a drainage and collection system;
- ✓ avoid emission of dust when storing metal scrap outside (e.g. install wind reduction screens) and when transporting, loading and unloading materials.

Sorting of scrap

The sorting of scrap implies the selection of separate fractions in quality or grade. Separation methods can include:

- Hand sorting;
- Drum magnet;
- Media separation;
- Eddy current separator;
- Color sensor.

Sorting of feed material should be conducted prior to smelting. The selection of the scrap is effective to reduce the entry of contaminants in the melting furnace, including contaminants that can lead to the formation of dioxins.

Scrap pre-cleaning

Scrap pre-cleaning (de-coating, de-laquering) is a key determinant in secondary aluminum production.

Part of the aluminum scrap is often wet, oily, chemically surface treated, coated, plastic laminated or adhesively bonded.

Dedicated cleaning is favorable as contaminants may cause oxidation on melting, produce dross, contaminate the melt and decreases metal recoveries. De-coating also improves safety, has lower emissions and improves energy efficiency.

Most common technology is thermal de-coating of scrap in a rotary kiln at a temperature of approx. 500◦C. The kiln must be equipped with a post-combustion chamber and activated carbon injection for an effective dioxin control.

BAT for improving the use of scrap

- ✓ specification of acceptance criteria suited to the production profile in purchase orders of scrap;
- ✓ having procedures to exclude scrap that is not suitable for use in the installation;
- ✓ having a good knowledge of scrap composition by closely monitoring the origin of the scrap;
- ✓ check, as far as practicable, for contaminants and evaluate small quantities of plastic (e.g. as plastic coated components);
- ✓ scrap sorting to minimize the risk of including contaminants, particularly PCBs and oil or grease;
- ✓ fixing the absence of mercury in scrap purchase contracts;
- ✓ refusal of scrap which contains visible electronic components and assemblies;
- ✓ adequate reception facilities and check deliveries.

Generic secondary measures

Secondary measures capable to reduce PCDD/PCDF releases into the environment from metallurgical plants:

- efficient fume and gas collection;
- high efficiency dust removal equipment;
- continuous monitoring of APCS;
- Post-combustion of the waste gas at a temperature above 850◦C followed by a rapid quenching of the hot gases to temperatures below 250 ^{o}C to avoid de novo synthesis;
- Adsorption/absorption onto materials such as activated carbon in a fixed bed or moving bed reactor or by injection into the gas stream, and subsequent removal as filter dust.

Application of BAT/BEP in Secondary Metal Production

Electric arc furnace steel-making process

Scrap processed in secondary steel facilities comes mainly from construction and demolition, automobiles, other vehicles, machinery and appliances. The process combusts impurities in scrap and can results in dioxin emission, especially when scrap is contaminated with paints, plastics, lubricants, and other organics including phenols, chlorinated plastics such as PVC and PCBs (e.g. from small capacitors in old appliances).

Dioxin UNEP Toolkit
Emission factors for EAF steel-making
µg TEQ/t of liquid steel

Classification	Air	Water	Land	Product	Residue
Dirty scrap (cutting oils, general contamination), scrap preheating, limited controls	10	ND	NA	NA	15
Clean scrap/virgin iron, afterburner and fabric filter	3	ND	NA	NA	15
Clean scrap/virgin iron, EAF designed for low PCDD/PCDF emission	0.1	ND	NA	NA	0.1

Primary measures in the electric arc furnace steel-making process

Pollution prevention practices to prevent the entry of contaminants into EAFs include changes in material specifications and types of raw materials accepted (such as avoidance of oily scrap).

It could be required that metal shredders remove any small capacitors (that may contain PCBs) from electrical and electronic equipment prior to shredding, thereby preventing PCB releases as well as reducing dioxin emissions.

Certain measures that improve operational and energy efficiency appear also to reduce dioxin emissions, such as minimizing the time the roof is open to receive the metal charge, reducing air infiltration into the furnace, avoiding operational delays, monitoring off-gas entry temperature at the bag-house, preventive maintenance and improving fabric filter design and material, as well as baghouse operation.

A specific primary measures identified to prevent or minimise the formation of PCDDs/PCDFs from the electric arc furnace steel-making process:

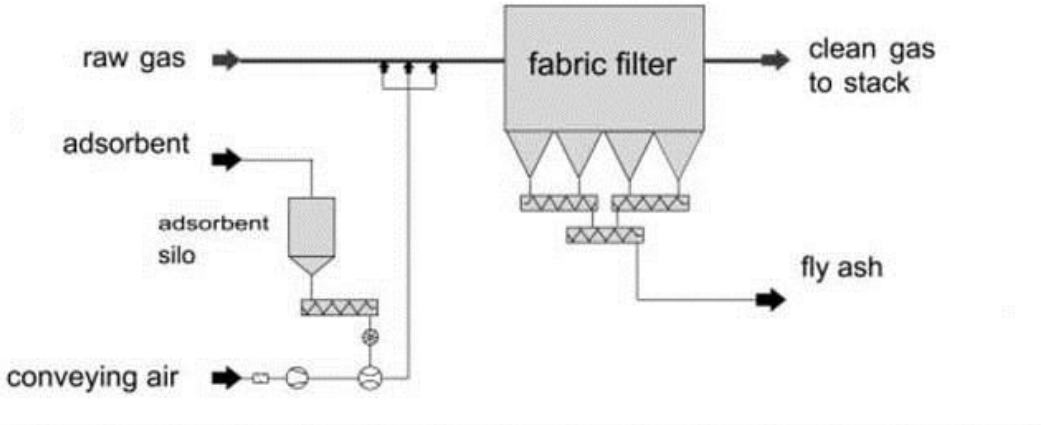
- Avoid scrap pre-heating if post-combustion is not performed.
- Control of PCDD/F emissions through activated carbon injection in combination with fabric filters

Effect of carbon injection on PCDD/F concentrations in the waste gas of a sinter plant in Germany

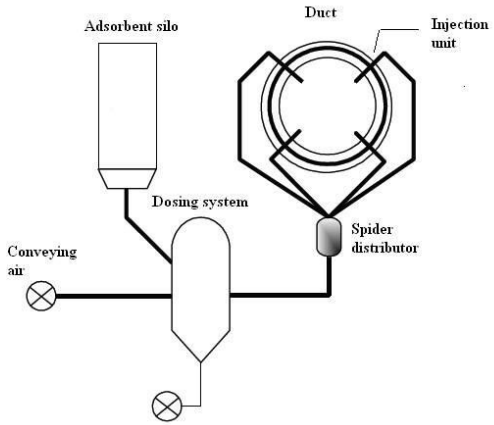
Adsorbent mg/m3	Concentration ng TEQ/m3	Emission Factor mg TEQ/t sinter
0	9.83	26.6
50	1.86	3.78
75	0.94	1.99
100	0.09	0.19
145	0.02	0.045

Sized lignite coke injection technology is largely used in a number of European EAF steel-making plants to supplement the fabric filter technology. Reported emission tests indicate that this technique achieves PCDD/PCDF emission concentrations of less than 0.1 ng TEQ/Nm3 consistently.

Control of PCDD/F emissions through activated carbon injection in combination with fabric filters



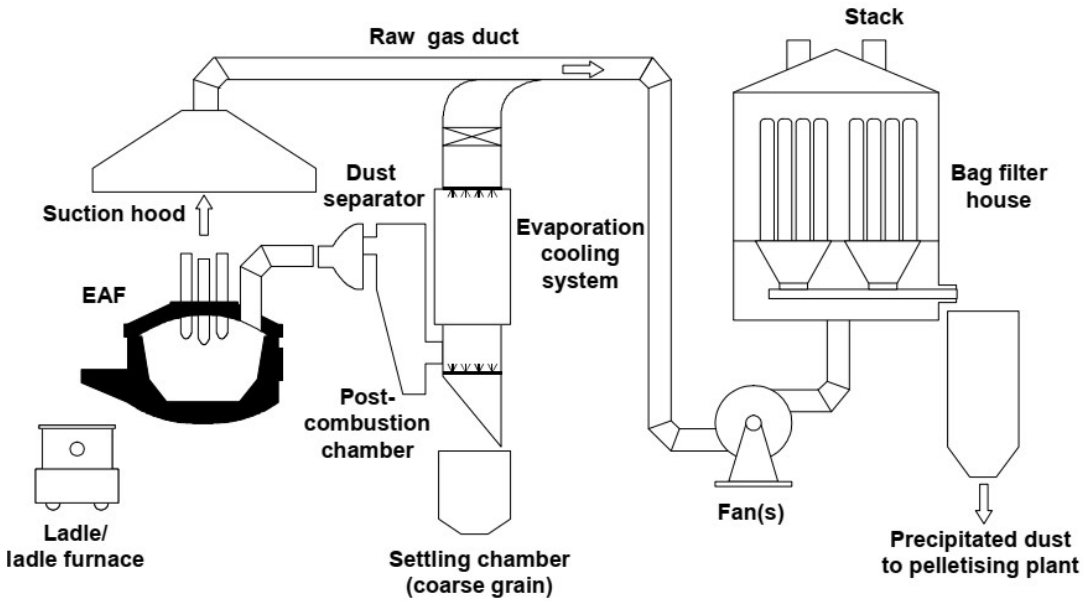
Schematic of an air pollution control system based on fabric filter with activated carbon injection



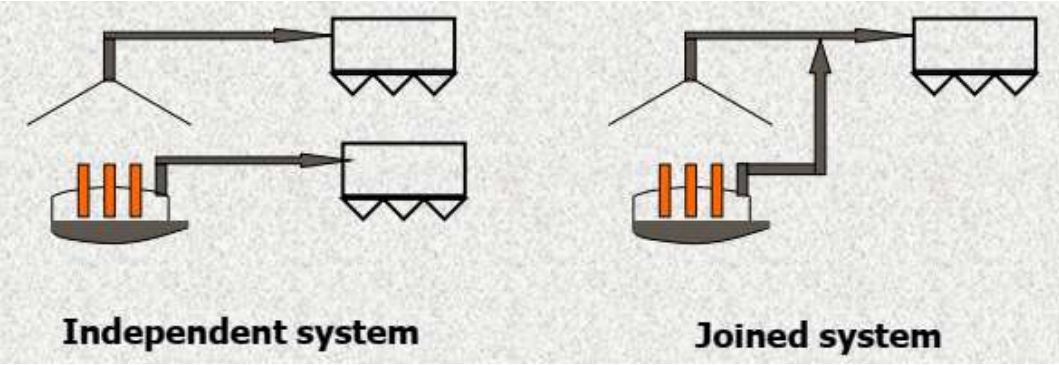
Schematic of an adsorbent injection system

- Reduction of PCDD/F by means of post-combustion and quenching

  Post-combustion in a combustion chamber reduces the emission of compounds such as PCDD/F. To prevent the de novo synthesis of PCDD/F, it is essential to have a rapid cooling (quenching) of the fumes as soon as possible after post-combustion to a temperature of below 250 ◦C.



- Change from an independent to a joined ducting and cleaning system



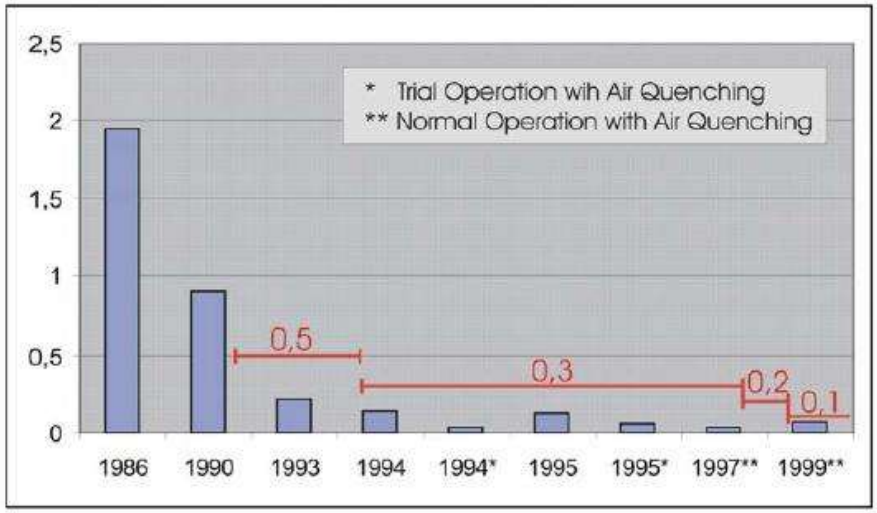
According to Japanese data, emission concentrations in four different plants decreased from an average of 3.93 ng I-TEQ/Nm3 to an average of 0.79 ng I-TEQ/Nm3, with an 80 % emission reduction.

Badische Stahlwerke (BSW) in Germany

Two electric arc furnaces, 1.8 million tons of steel per year

Limiting values for permits
1991: 0.5 ng TEQ/Nm3
1994: 0.3 ng TEQ/Nm3
1998: 0.2 ng TEQ/Nm3
1999: 0.1 ng TEQ/Nm3

Yearly average emission concentrations
1986 ~ 2 ng TEQ/Nm3
1999 < 0.1 ng TEQ/Nm3



These performance were obtained with:

- stopping scrap preheating;
- doing extensive development works on de-dusting system

(succeeding to comply with a value of 1 mg/Nm3 at 1.8 million Nm3/h);

- installing a quenching system

Two examples of application of BAT/BEP in the electric arc furnace steel-making process

A) By improving and optimizing post-combustion and quenching and by injecting activated carbon in the flue gases of an EAF in Italy, PCDD/F emissions decreased from 1.7 ng I-TEQ/Nm3 to < 0.1 ng I-TEQ/Nm3.

B) Improvement of scrap quality in an EAF in China led to a reduction of PCDD/PCDF concentrations in the flue gases emitted into the atmosphere and in filter dust .

	Emission rate (g TEQ/a)		
	Air	Filter dust	Total
Baseline scenario	0.33	5.06	5.39
Modified scenario	0.19	2.86	3.05

Application of BAT/BEP in Secondary Metal Production

Secondary Aluminum Production

Secondary aluminum plants recover aluminum from scrap such as used beverage cans, foundry returns, other aluminum scrap, and dross.

Unintentionally produced POPs are released from pre-processing operations (such as scrap drying/de-coating/de-lacquering) and furnace operations (i.e., melting, holding, refining, fluxing, or alloying).

Dioxin UNEP Toolkit.

Emission factors for secondary aluminum production

µg TEQ/t of aluminum

Classification	Air	Water	Land	Product	Residue
Minimal treatment of inputs and simple dust removal	100	ND	NA	NA	200
Scrap pre-treatment, good controls, fabric filters with lime injection	3.5	ND	NA	NA	400
Optimized for PCDD/PCDF control afterburners, lime injection, fabric filters and active carbon	0.5	ND	NA	NA	100
Shavings/turning drying (simple plants)	5.0	NA	NA	NA	NA
Thermal de-oiling of turnings, rotary furnaces, afterburners, and fabric filters	0.3	NA	NA	NA	NA

Scrap Dryers/De-lacquering kilns/De-coating kilns

- Remove coatings and other contaminants that may be present in scrap prior to melting (e.g., oil, grease, lubricants, lacquers, rubber, and plastic laminates);
- In general, the scrap is combusted in furnaces before being smelted;
- Emissions: inorganics including particulate metals and organics including dioxins and furans;
- Without corresponding exhaust gas cleaning, pre-treatment simply leads to a shift of the emissions in the preceding process steps.

Primary measures in secondary aluminum production

Specific primary measures identified to prevent or minimize the formation of PCDDs/Fs:

- Avoid hexachloroethane for demagging (removal of magnesium): hexachloroethane produces HCB.
- Use of argon or nitrogen bubbling as degassing agents (removal of hydrogen gas from the melt) instead that chlorine is capable to attain similar or even superior technical efficiency and performance.

Secondary measures in secondary aluminum production

- Control of PCDD/F emissions through activated carbon injection in combination with fabric filters

Activated carbon injection in a secondary aluminum plant.

Application of BAT/BEP in Secondary Metal Production

Secondary copper production

A wide range of secondary raw materials are used (Cu content)

- Mixed copper sludge (2-25 %)
- Computer scrap (15-20 %)
- Copper sludge (2-40 %)
- Copper-iron material (10-20 %)
- Brass dross, copper-containing ashes and slag (10-40 %)
- Shredded material (30-80 %)
- Copper-brass radiators (60-65 %)
- Mixed red brass scrap (70-85 %)
- Light copper scrap (88-92 %)
- Heavy copper scrap (90-98 %)
- Mixed copper scrap (90-95 %)
- Copper granules (90-98 %)
- Pure scrap (99 %)

Dioxin UNEP Toolkit

Emission factors for secondary copper

µg TEQ/t of copper

Classification	Air	Water	Land	Product	Residue
Sec. Cu – Basic technology	800	0.5	NA	NA	630
Sec Cu – Well controlled	50	0.5	NA	NA	630
Sec. Cu – Optimized for PCDD/PCDF control	5.0	0.5	NA	NA	300

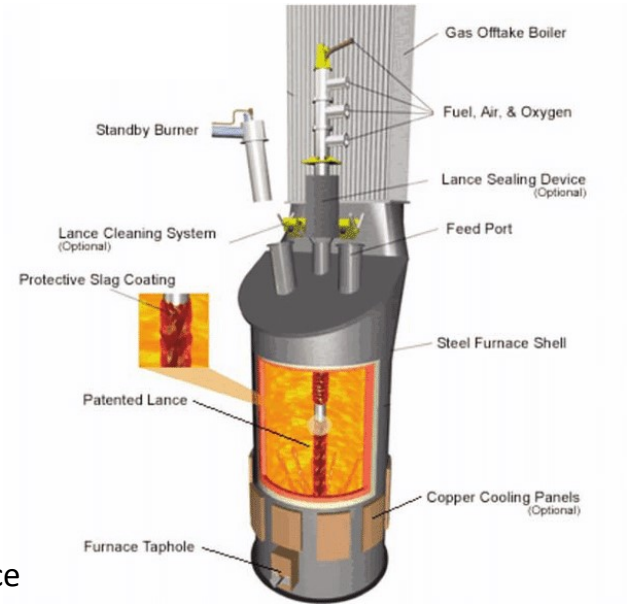
Shaft furnace for secondary copper production in Austria (1995-1998).

Flue gas flow: 27,000 m3/h

Required emission limit: 0.4 ng I-TEQ/Nm3

Changed conventional acrylic felts filter media used before with Gore-tex membrane filter bags.

The plant met the required emission limits without injecting activated carbon.



Ref. : Ausmelt TSL Furnace

Application of BAT/BEP in Secondary Metal Production

Secondary lead production

Considerable quantities of lead are recovered from scrap, in particular vehicle batteries. PCDD/PCDF emissions may be linked to the use of PVC separators in vehicle batteries.

Replacing PVC separators with non-chlorinated materials could aid in the reduction of dioxin emissions from secondary lead production, given that PVC is one of the main sources of chlorine in scrap.

Dioxin UNEP Toolkit.

Emission factors for secondary lead production

µg TEQ/t of lead

Classification	Air	Water	Land	Product	Residue
Lead production from scrap containing PVC	80	ND	NA	NA	ND
Lead production from PVC/Cl2 free scrap, some APCS	8	ND	NA	NA	50
Lead production from PVC/Cl2 free scrap in highly efficient furnaces, with APC including scrubbers	0.05	NA	NA	NA	ND

Application of BAT/BEP in Thailand Scrap Metal Value Chain

Project : "Greening the Scrap Metal Value Chain through Promotion of BAT/BEP to Reduce U-POPs Releases from Recycling Facilities" (GEF Project ID: 9222)

Overall Objectives:

- The project aims to promote and introduce BAT/BEP measures in Thailand scrap recycling facilities in order to reduce or eliminate unintentional POPs releases.

Budget and Funding Sources:

- US $4,500,000 GEF grant
- Co-financing (investment and in-kind) of Approx. US $38,950,000

Duration: 5 years (2018 - 2022)

Global Environment Benefits:

- Reduction of about 20% of PCDD/Fs released from demonstration facilities

Project framework:

Green Scrap Metal Thailand

Component 1

Policy and regulatory about U-POPs released from metal recycling facilities

Expected Outcomes

Policy and regulatory framework strengthened and enhanced for the implementation of a sound management of metal recycling in compliance with the Stockholm Convention requirements.

Expected Outputs

1. Scrap metal value chain assessed and interventions identified.
2. Database capturing various aspects of the metal recycling chain, as a new tool for policy makers, compiled.
3. Specific guidelines on environment, health and safety measures in the metal recycling chain value developed.
4. Improved and harmonized national policies and regulations for environmental and health protection from metal recovery activities

Component 2

Information dissemination and capacity building

Expected Outcomes

1. Increased awareness on U-POPs and BAT/BEP concepts by relevant stakeholders
2. Improved national capacity in the sound management of the recycling chain of scrap metal.

Expected Outputs

1. Awareness raising materials and workshop developed and implemented.
2. Technicians and operators of the scrap metal sector are trained on BAT/BEP.

Component 3

Pilot project for the demonstration of BAT/BEP in selected metal recycling facilities

Expected Outcomes

State-of-the-art primary and secondary measures for U-POPs release reduction in selected facilities identified and deployed.

Expected Outputs

1. BAT/BEP measures identified and implemented for scrap collectors and scrap consumers
2. Training of technical staff and other potentially interested local stakeholders in the management of BAT/BEP undertaken
3. Results of the implemented demonstration projects published and disseminated for replication through collaboration with existing financial institutions in the country

Thailand Scrap Metal Value Chain Database

Stakeholder > 2,000

Scrap collector 610

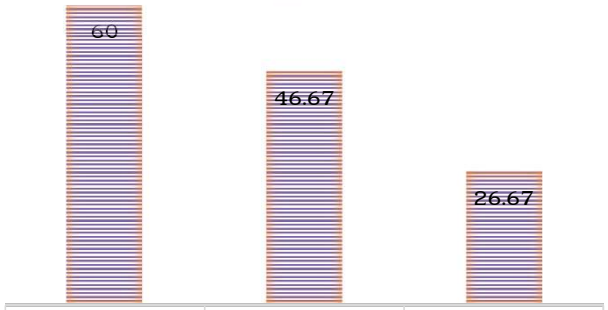
Government/Local agencies 91

Metal trader 424

Metal Recycling Facilities 297

Downstream Industry 467

Air pollution treatment system



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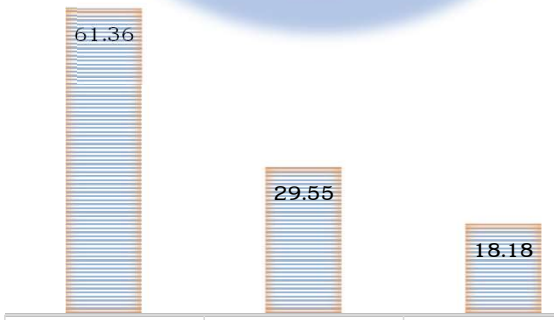
60	46.67	26.67

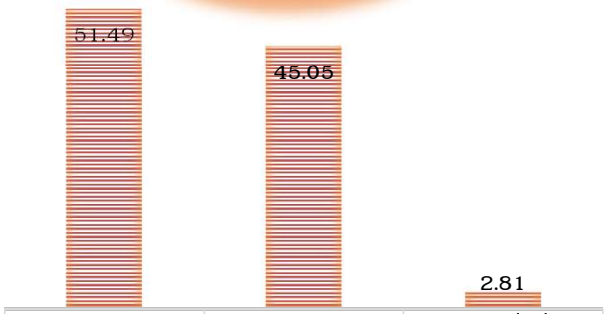
Raw materials preparation



คัดแยกขนาด/ประเภท	อัด/บดย่อย/แปรรูป	อุ่นโลหะ
61.36	29.55	18.18

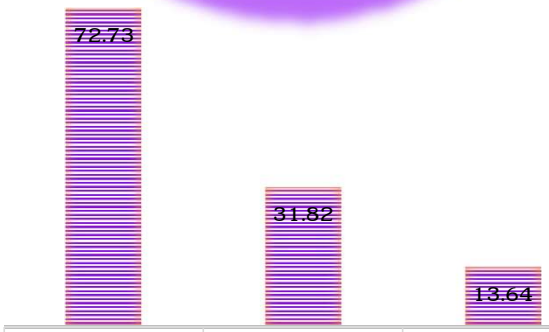
Environmental Management

Metal scrap management



ขายต่อทันที	คัดแยกขนาด/ประเภท	แยกวัสดุอื่นที่ติดมาด้วย
51.49	45.05	2.81

Waste management



ใช้ผู้รับบริการกำจัดกากของเสีย	คัดแยกขนาด/ประเภท	อัดก้อน
72.73	31.82	13.64

Survey results

11.11 %

Knowledge about Stockholm Convention

79.84 %

9.05 %

8.98 %

U-POPs released from scrap metal recycling industry

88.57 %

2.45 %

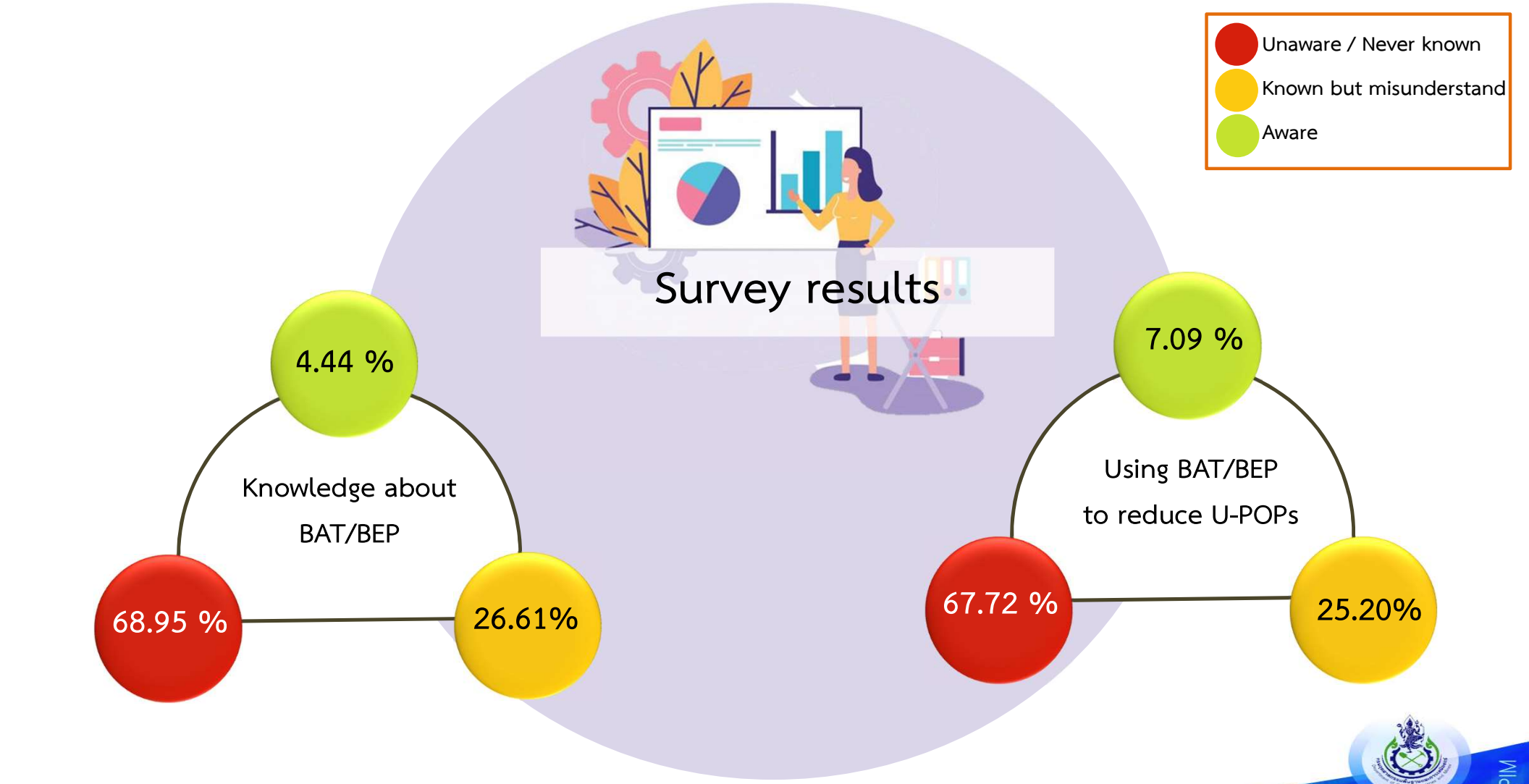
8.98 %

Industry sector must comply with the Stockholm Convention.

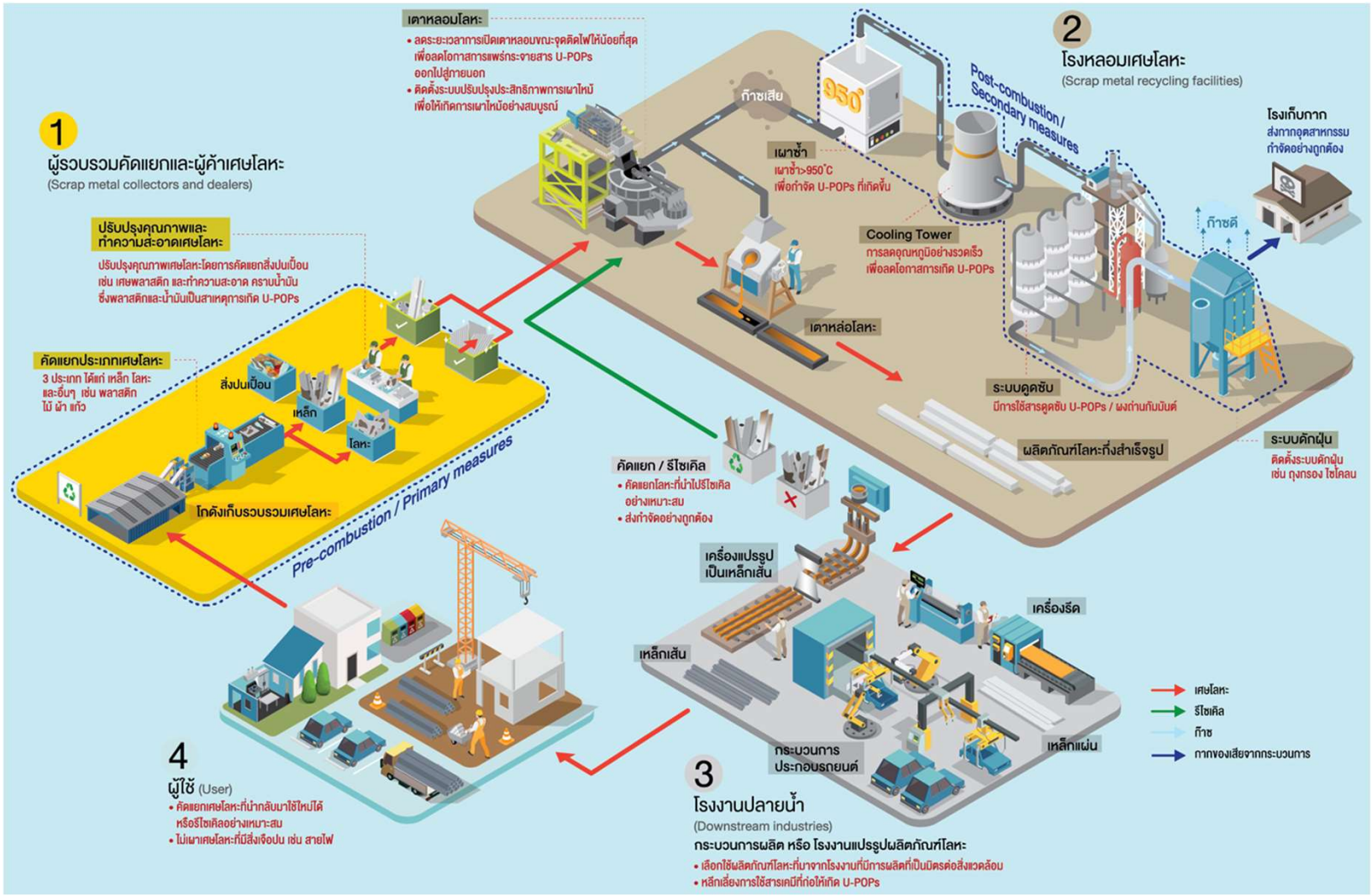
84.08 %

6.94 %

- Unaware / Never known
- Known but misunderstand
- Aware


Unaware / Never known
Known but misunderstand
Aware
Survey results
4.44 %
Knowledge about
BAT/BEP
68.95 %
26.61%
7.09 %
Using BAT/BEP
to reduce U-POPs
67.72 %
25.20%

Application of BAT/BEP in Metal Scrap Value Chain



Pilot project for the demonstration of BAT/BEP in metal recycling facilities

Demonstration Factory

- Bangkok Iron & Steel Works Co.,Ltd.
- Tata Steel Manufacturing (Thailand) PLC.
- Thai Metal Aluminium Co.,Ltd.
- Daiki Alminium Industry (Thailand) Co.,Ltd.
- Panyaraksa Co.,Ltd.

Co-financed Investment Projects consist of 4 main types which are:

1. Scrap processing system
2. Improvement of combustion efficiency
3. Post-combustion chamber installation
4. Air emission control system

Proposed Co-financed investment from 5 companies

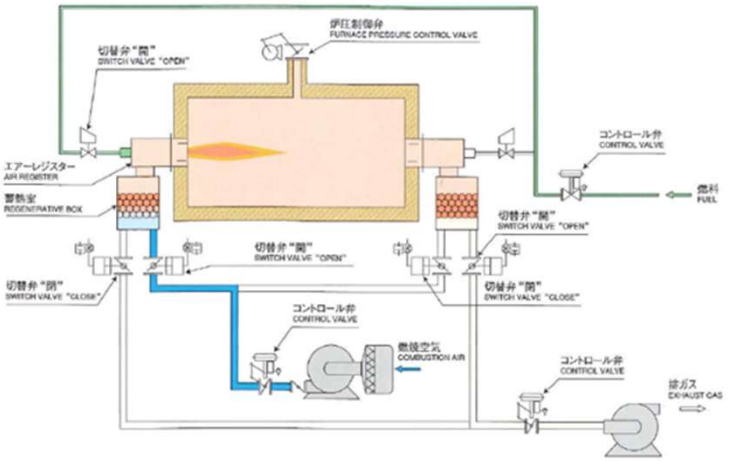
~ 7 million USD

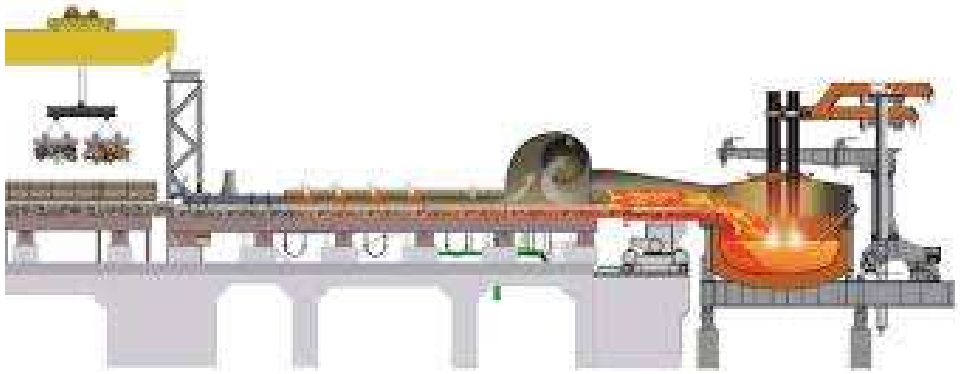
Scrap processing system

- Sorting
- Screening
- Shearing
- Cleaning
- Magnetic / Eddy current separating

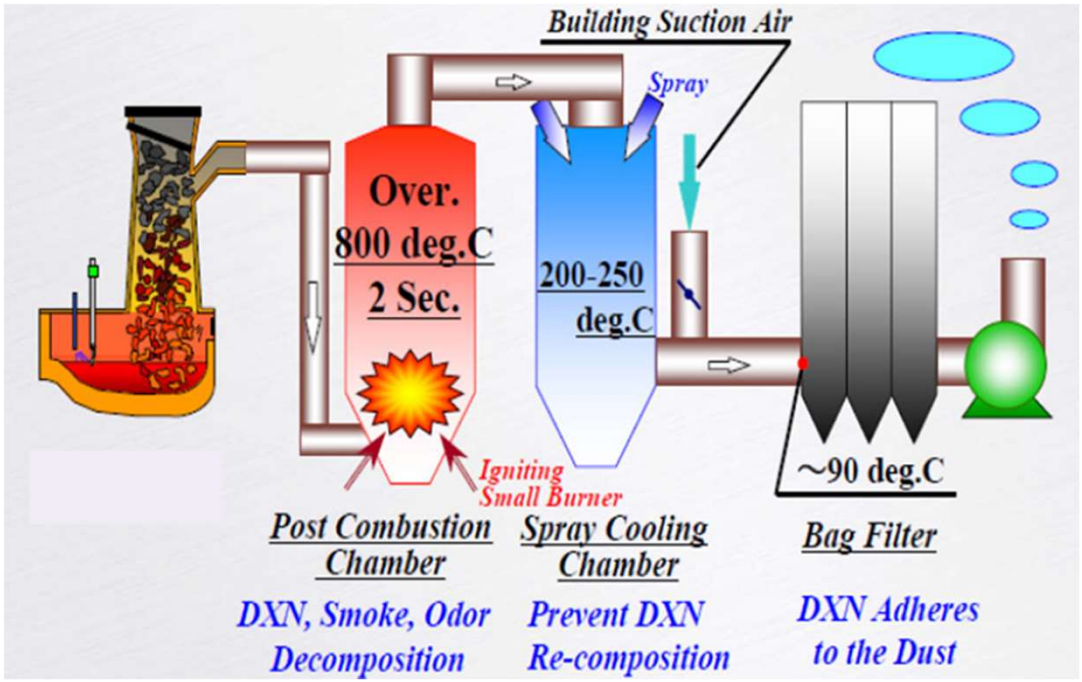
Improvement of combustion efficiency

- Oxy-burner
- Regenerative burner
- Heat waste recovery for scrap/billet heater





Post-combustion chamber installation



Air emission control system


Induction furnace:
waste gas collection system according to BAT


Induction furnace:
hood opened to demonstrate
waste gas collection efficieny
(usually closed)


Induction furnace:
closed hood melting phase

Estimated potential of reduction of PCDD/Fs releases from proposed projects of demonstration facilities (according to the UNEP Toolkit 2013)

Scrap metal recycling facilities	Source category	Plant Capacity	Actual level (class 1)		BAT/BEP based plant (class 3)		Potential PCDD/Fs reduction (g TEQ/y)
			Emission (g TEQ/y)		Emission (g TEQ/y)		
			Air	Residues	Air	Residues	
1 & 2	Secondary Steel	900,000	9.0	13.5	0.09	0.09	22.32
3 & 4	Secondary Aluminium	122,000	12.2	24.4	0.061	12.2	24.37
5	Secondary lead	15,000	1.2	ND	0.001	ND	1.199
Total potential PCDD/Fs reduction from 5 demonstration facilities							**47.89**

Conclusion

- ✓ Recycling is important in a circular economy because it conserves valuable resources and prevents useful materials going to landfill sites as waste.
- ✓ Because of the high value of metal scrap, there are also economic incentives that help to maintain high recycling levels.
- ✓ A key aspect of environmental protection is to minimize releases of pollutants, including U-POPs. Process improvements using BAT/BEP can be identified and implemented with the goal of reducing emissions. Moreover BAT/BEP also help for increasing production efficiency, increasing energy saving and production cost reduction.
- ✓ BAT/BEP is crucial in determining and influencing the three sustainability pillars (economic, environmental and social), minimizing strong conflict between each dimension. Of course, these help industry moving forward for a sustainable development.

For more information:

www.GreenScrapMetalThailand.com

Thank You