Progress of Flagship Projects
- Activities of SteelEcosol -

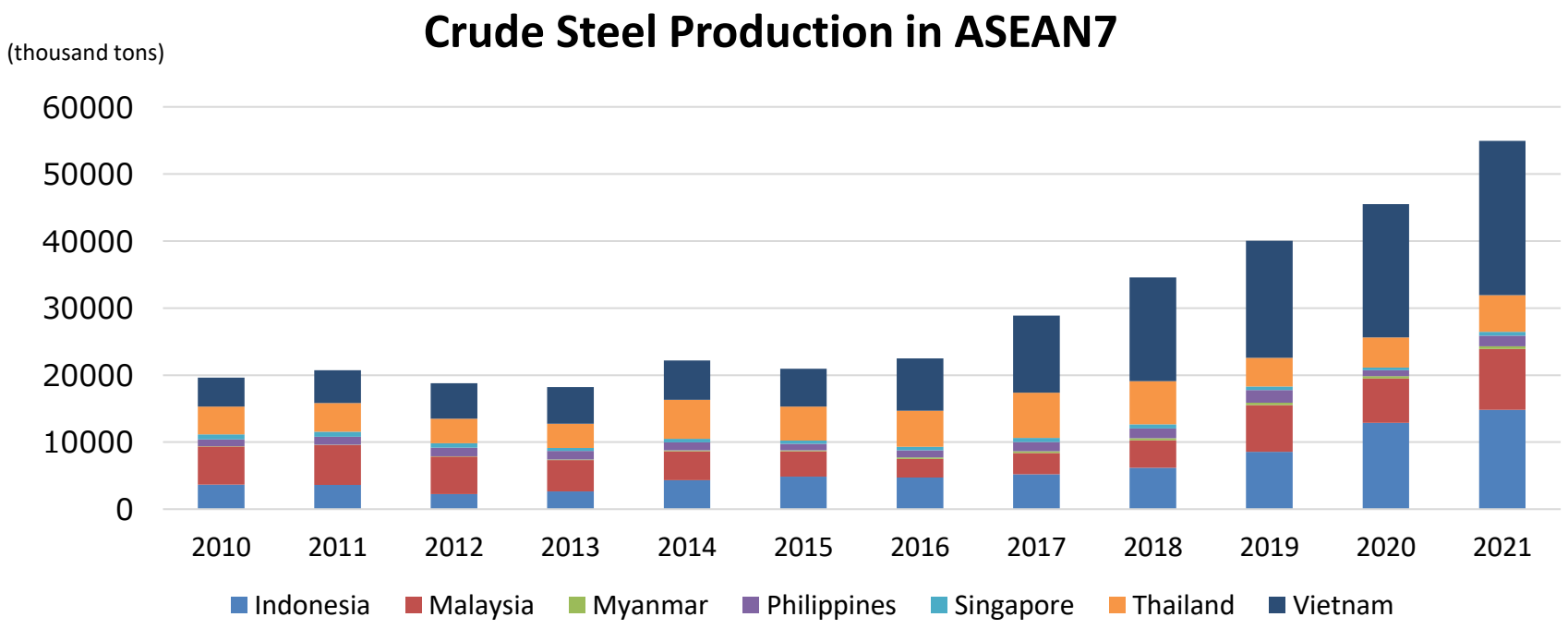
16th February 2023
The 4th Government-Private Forum
on the Cleaner Energy Future Initiative for ASEAN

Hitoshi Dohnomae, Dr.
The Chair for International Environmental Strategic Committee
The Japan Iron and Steel Federation

General Manager, Environment Planning Div.
Nippon Steel Corporation

SteelEcosol's Mission: Diffusion of BAT in ASEAN7 Steel Industry

- Steel sector is responsible for about **8% of global final energy demand** and **7% of energy sector CO_2 emissions***
- Innovative technologies (e.g., hydrogen steelmaking) are being developed to achieve carbon neutrality in the steel sector, but these technologies will not be available very soon
- Until such innovative technologies become available, **Best Available Technologies (BAT) will play an important role in ASEAN steel industry**, where steel making capacity is/will be increasing



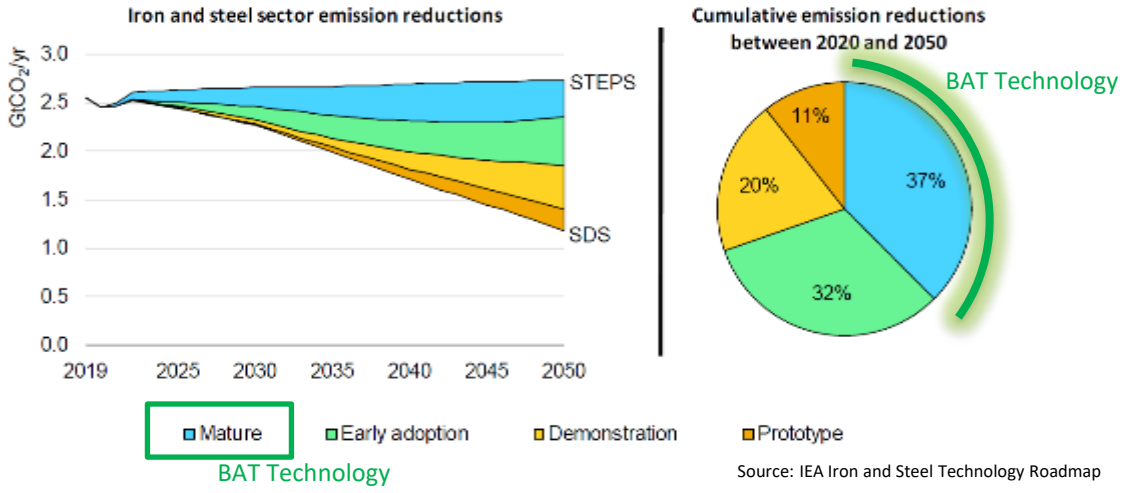
*Source: Iron and Steel Technology Roadmap, IEA (2020) https://www.iea.org/reports/iron-and-steel-technology-roadma

IEA recognizes importance of BAT in the steel industry

Iron and Steel Technology Roadmap

- Energy demand per steel ton can be reduced by improving manufacturing processes and upgrading equipments to BAT technologies*
- **Improved operating efficiency** in all BF-BOF production facilities and the **adoption of BAT** can reduce energy consumption by about 20% per ton of crude steel

Iron and steel sector direct CO_2 emission reductions in the Sustainable Development Scenario by current technology maturity category**



Source: IEA Iron and Steel Technology Roadmap

In the iron and steel sector, **BAT has the highest contribution in cumulative emission reduction** in 2020-2050

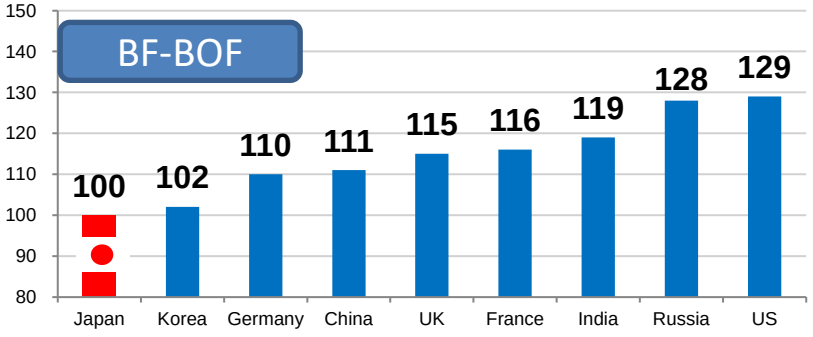
*BAT (Best Available Technologies): Refers to the effective utilization of byproduct gases generated from the steelmaking process and waste heat recovery technologies such as CDQ (Coke Dry Quenching) and TRT (Top Pressure Recovery Turbines).
**Sustainable Development Scenarios: A pathway to fully achieving the energy-related Sustainable Development Goals. An approach consistent with the Paris Agreement.

Source: Iron and Steel Technology Roadmap, IEA (2020) https://www.iea.org/reports/iron-and-steel-technology-roadma

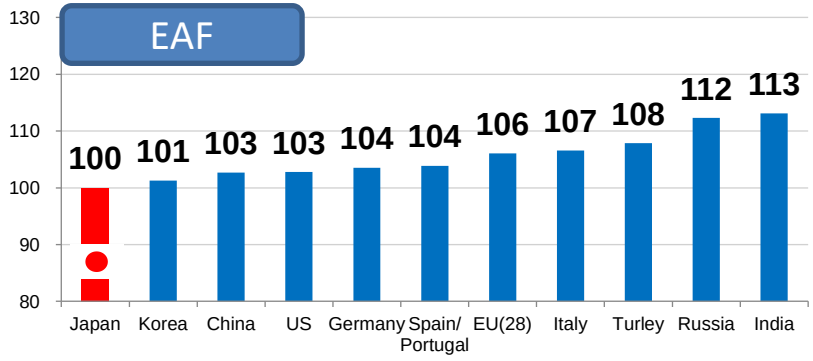
How cooperation with Japan benefits ASEAN Steel Industry

- **Japan's steelmaking process is the most energy-efficient** in the world by deployment of the Best Available energy-saving Technologies (BAT)

Energy efficiency by country/region (2019)
Indexed as Japan 100



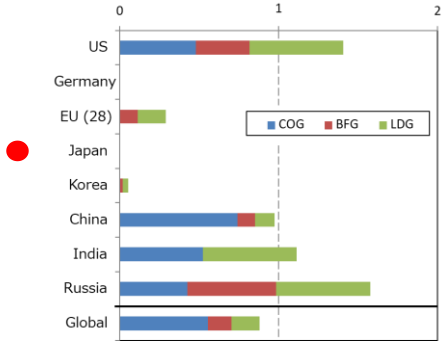
Source: RITE, "Estimation of Energy Intensity as of 2019 (Steel Sector – Blast Furnace – Basic Oxygen Steel).



Source: RITE, "Estimation of Energy Intensity as of 2019 (Steel Sector - Electric Furnace Steel).

Potential of Energy Saving Technologies(2019)

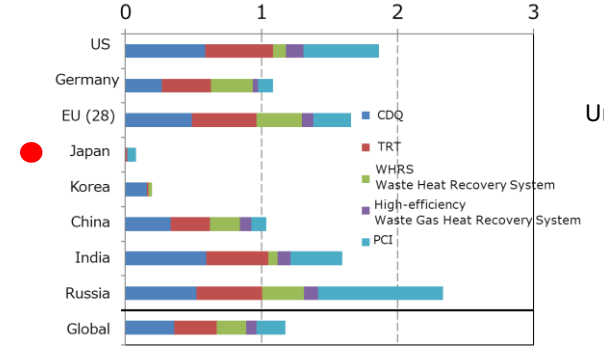
Potential for the recovery and efficient use of by-product gases



Unit: GJ/ton

Source: RITE estimates based on IEA Energy Balance Table (2021).

Potential for the major energy saving technologies



Unit: GJ/ton

Note :PCI is evaluated based on Steel Federation "Steel Statistics Handbook 2021" and German Steel Federation (2013).
The other four technologies are based on the 2015 penetration rate (based on Arens et al. (2017), Schulz et al. (2015), China Iron and Steel Industry Yearbook (2016), etc.) and the actual installations

ASEAN-Japan Steel Initiative

- **ASEAN-Japan Steel Initiative** started in 2014, contributes energy saving and environmental protection in ASEAN through mutual and collaborative platform

Purpose

- Exchange knowledge and experiences and thereby contribute to the energy saving and environmental protection in ASEAN
- Encouraging technology transfer from Japan to ASEAN steel industry

Participants

Public Sector
Ministries and governmental institutions related to steel industry and energy saving in ASEAN and Japan

Collaboration

Private sector
ASEAN Iron and Steel Council (AISC), national association in ASEAN, JISF and its member companies, Engineering Companies

Main Activities

1 **Public and Private Collaborative Seminar**

2 **Technologies Customized List**

3 **Steel Plant Diagnosis**

ASEAN-Japan Steel Initiative 2022-23

AJSI completed **AJSI webinar** and **online steel plant diagnosis** in collaboration with CEFIA

- The Japan Iron and Steel Federation leads the communication and information sharing with ASEAN national steel associations, member companies and the public sector through the CEFIA platform

AJSI webinar

Share Japan's BAT and climate change policies to a wide range of stakeholders

Webinar
14th February 2023

Steel plant diagnosis

Check energy consumption status and recommend implementing BAT at individual steel mills

Diagnosis at a steel plant in Thailand
Sep-Oct 2022

Explore the possibility of introducing BAT in ASEAN7 steel companies through synergies between the CEFIA platform and AJSI

ASEAN-JAPAN Steel Initiative Webinar 2023
"Pathways to Carbon Neutrality"

Date | 14th February 2023
Main Focus | Carbon Neutrality in terms of policy, technology and transition initiatives
Participants | Public and private steel-industry stakeholders in ASEAN7 and Japan

Main topics of AJSI webinar 2023

- **Policies and initiatives toward Carbon Neutrality** surrounding the steel industry in ASEAN and Japan
- **Tools to promote the transition to Carbon Neutrality** in the steel industry including;
  - Transition finance
  - International standards and EPD in the Japanese steel industry
  - JCM project finding activities in ASEAN
- **Results of Steel Plant Diagnosis**
- **Energy conservation and environmental protection technologies**

AJSI Webinar | Agenda

Malaysia Time	Agenda	Speaker	Duration
13:30-13:35	Welcome Remarks	Mr. Takatsune Ito, METI, GoJ	5 min
13:35-13:40	Opening Remarks	Mr. Yeoh Wee Jin, SEAISI	5 min
13:40-13:50	Overview of AJSI and CEFIA	Ms. Izumi Imai, JISF Mr. Kohei Mizuno, METI, GoJ	10 min
Session 1: Policies and Initiatives towards the Carbon Neutrality in the Steel Industry - How to close the gap between the status quo and the carbon neutrality? Chairperson – Mr. Hiroyuki Tezuka, JFE Steel Corporation			
13:50-14:05	Policy and Initiatives toward Carbon Neutrality in ASEAN	Mr. Yeoh Wee Jin, SEAISI	15 min
14:05-14:20	Policy and Initiatives toward Carbon Neutrality in Japan	Mr. Takatsune Ito METI, GoJ	15 min
14:20-14:35	Tools to promote the transition in the steel industry	Mr. Hiroyuki Tezuka, JFE Steel Corporation	15 min
14:35-14:50	Updates on international standards and EPD in the Japanese steel industry	Dr. Hitoshi Dohnomae, JISF	15 min
14:50-15:05	Steel Plant Diagnosis in ASEAN	Mr. Michio Nakayama, JFE Techno-Research Corporation	15 min
15:05-15:15	JCM Project Finding Activity in the ASEAN	Ms. Masako Nakajima, NSRI	10 min
15:15-15:35	Panel Discussion and QA	Moderator: Mr. Indirakumar Gunasekaran, SEAISI Panelist: Mr. Rio John Piter Silitonga, ASEAN Center for Energy Mr. Takatsune Ito, METI, GoJ Mr. Somsak Pikkanesuan, SEAISI Dr. Hitoshi Dohnomae, JISF	20 min
15:35-15:45	Coffee Break		10 min
Session 2: BAT (Best Available Technologies)/Transition Technologies - BAT as an initial step toward carbon neutrality Chairperson – Mr. Mochamad Ibnu Sina, Senior Technical Manager of SEAISI			
15:45-15:55	Overview of the Technologies Customized List	Dr. Shiro Watakabe, JFE Steel Corporation	10 min
15:55-16:10	Now and the future, technologies toward carbon neutrality and circular economy	Mr. Hajime Yoshida, JP Steel Plantech Co. Ms. Nguyen Thi Huong Van, Kobelco Eco-Solutions Co.,Ltd.	15 min
16:10-16:25	Combustion Technology for Hydrogen and Ammonia	Mr. Kazunari Nakai, Chugai Ro Co., Ltd	15 min
16:25-16:40	Overview of ESCAP®	Mr. Daisuke Hagiu, Nippon Steel Engineering	15 min
16:40-16:55	Overview of Coke Dry Quenching	Mr. Hikaru Suzuki, Nippon Steel Engineering	15 min
16:55-17:15	Panel Discussion and QA	Moderator: Ms. Hiromi Kawamata, JISF Panelist: Presenters of Session 2	20 min
17:15-17:20	Closing Remarks	Mr. Christopher G. Zamora, ASEAN Center for Energy	5 min
17:20-17:25	Closing Remarks	Dr. Hitoshi Dohnomae, JISF	5 min

Online Steel Plant Diagnosis

Outline of the diagnosis

- Scheme : Online diagnosis (using web conferences and questionnaires via emails)
- Target : Company A (EAF Steel plant) in Thailand

Results of the diagnosis (Summary)

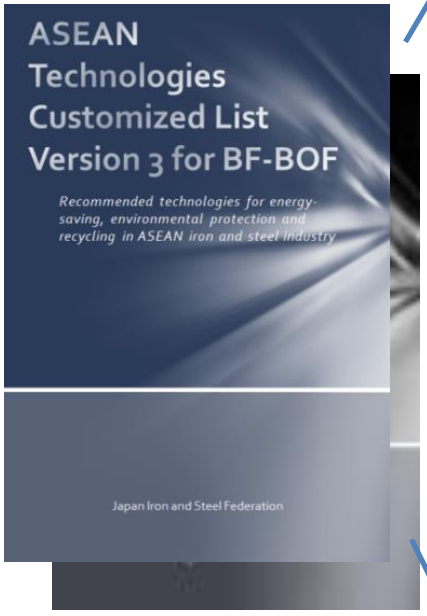
- Proposals were made on energy-saving measures that are easy to implement, focusing on operational improvements of the EAF (electric arc furnaces) and RHF (reheating furnaces).

	Target process	Type of measures	Proposed measures for energy-saving	CO2 reduction estimation (under an assumed condition)
(1)	EAF	Operational	Reducing heat-loss by shortening TTT (Tap to Tap Time)	Cannot quantify
(2)	EAF	Revamping	Scrap pre-treatment to reduce charging time ・Assumed investment cost: 3.09 million USD, ・Payback time: 2.8 years (assumed shear size; 1,250 t × 2)	5,600 t-CO2/year
(3)	EAF	Operational	Effective use of combustibles in scrap	5,600 t-CO2/year
(4)	EAF	Operational	Reducing air invasion and keeping molten slag layer	7,600 t-CO2/year
(5)	RHF	Operational	Air ratio control	3,800 t-CO2/year
(6)	RHF	Operational	Raising temperature of combustion air	3,000 t-CO2/year

- Comment by the target plant: “We welcome energy-saving idea sharing from the Japanese experts, as we are seeking for opportunities to obtain advise and neutral opinions from outsider’s perspectives apart from equipment suppliers.”

Technologies Customized List (TCL)

- **TCL is the list of recommended energy saving technologies** for ASEAN steel industry
- The effectiveness of the technologies in TCL has been proven by the operations of Japanese steelmakers
- **TCL is used for technical proposals for steel plant diagnosis in Sep-Oct 2022, and the technologies included in the TCL was introduced by the suppliers at the AJSI Workshop on 14th February, 2023.**



List of Technologies

Energy saving effect, co-benefit, supplier information etc.

- 42 techs for BF-BOF
- 34 techs for EAF

Technologies One-by-One Sheet

Includes supplier contact information

Last update in January 2022 | Available on JISF's website https://www.jisf.or.jp/en/activity/climate/Technologies/index.html

Proposal and Future activities

Goal: Transfer BAT on energy saving from Japan to ASEAN steel industry

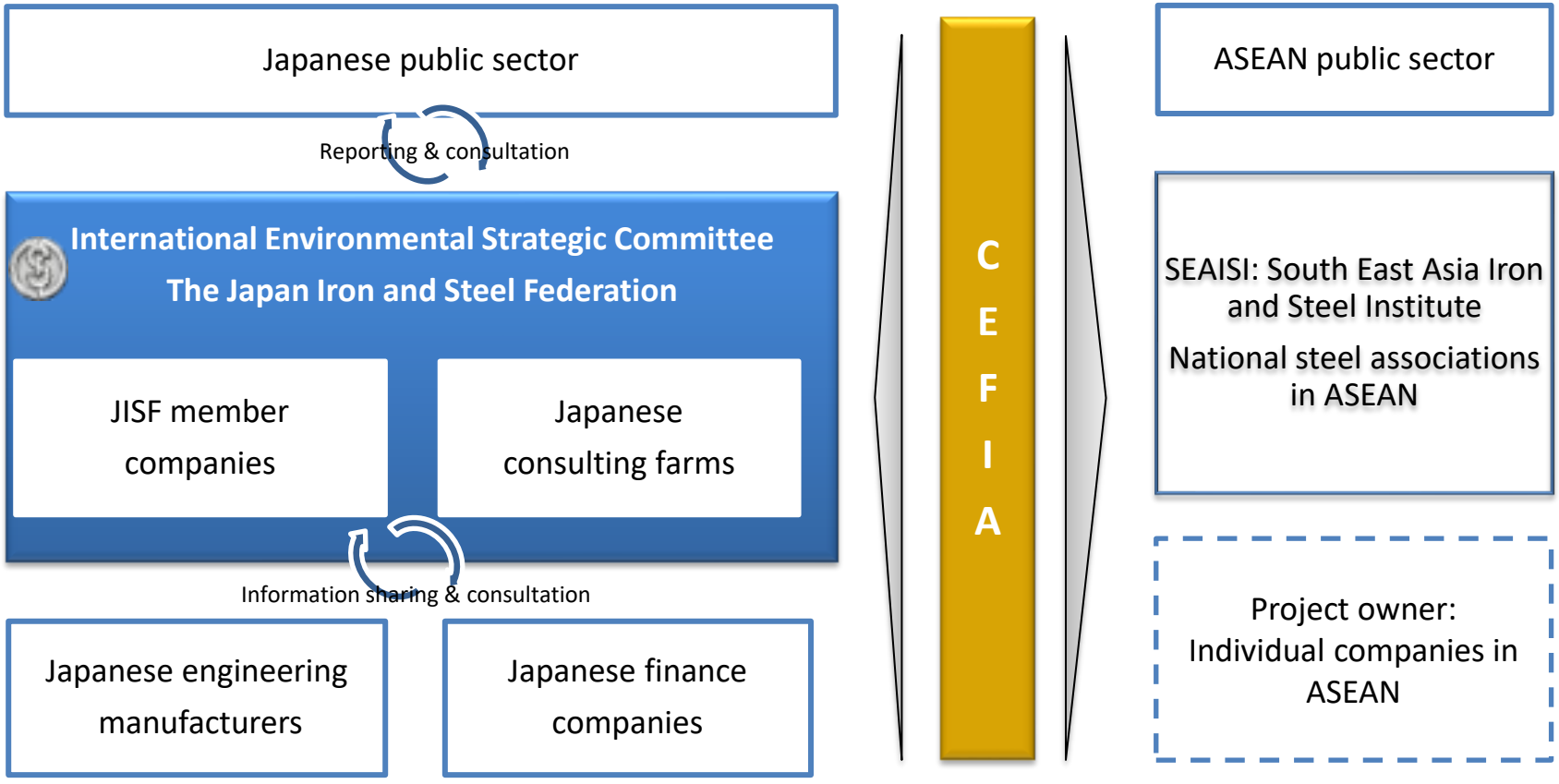
- Conduct **AJSI workshop** and **steel plant diagnosis** at least once a year
  - **BAT adoption is a shortcut to carbon neutrality** while there is growing interest in carbon neutral policies and innovative technologies
- Maintenance and disseminate **Technologies Customized List** or BAT list for ASEAN Steel Industry to include up-to-date information

	FY 2022	FY 2023	FY 2024
0. Establish basic tools	Maintenance and dissemination of BAT list →		
1. Public-private dialogue	Information sharing →	Information sharing/ →	Approach to key person →
2. Steel plant diagnosis	Recruiting target plant → Diagnosis →	Recruiting target plant → Diagnosis →	Recruiting target plant → Diagnosis →

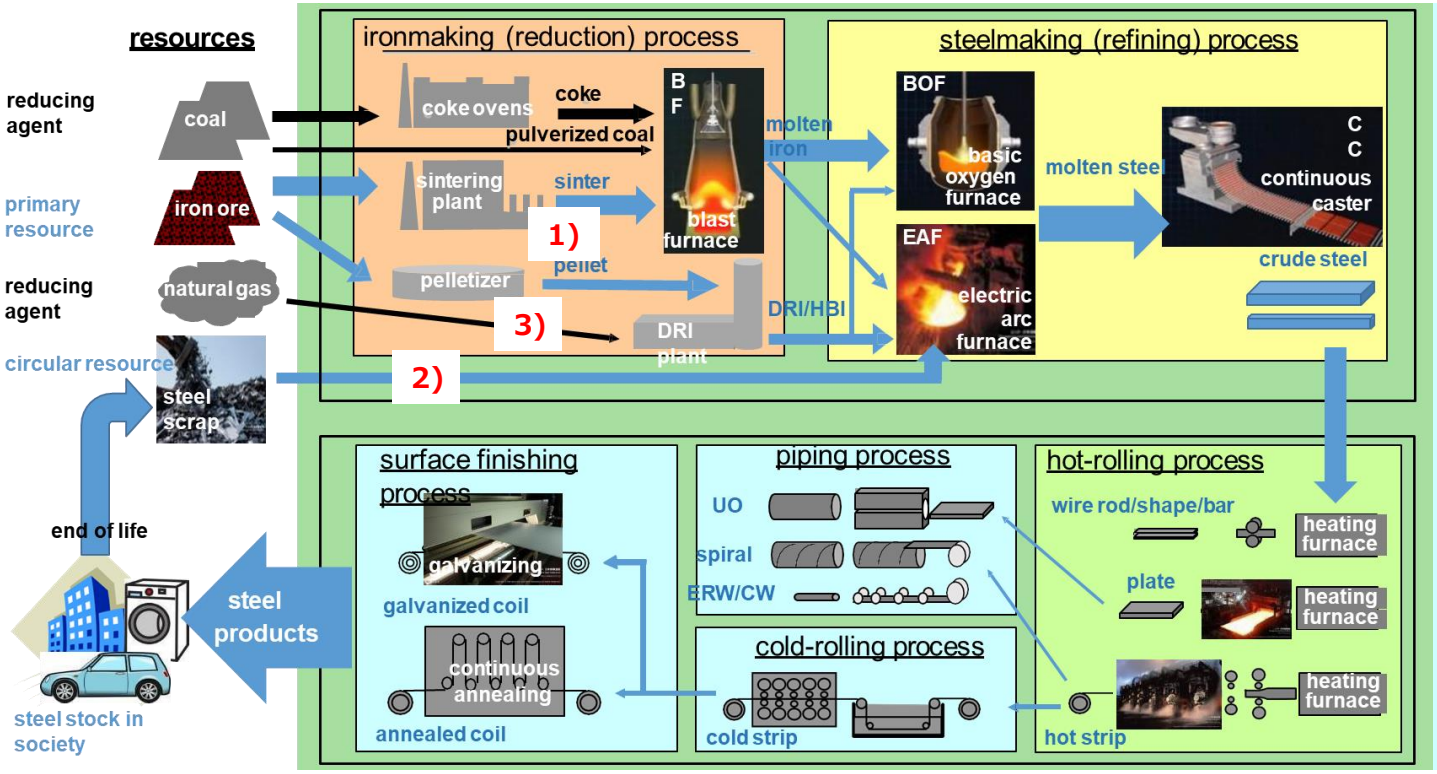
Appendix

Collaboration between CEFIA and JISF

The JISF International Environmental Strategic Committee will **lead the communication and information sharing** with ASEAN national steel associations, member companies and the public sector through the CEFIA platform.



How to make steel



1) Blast furnace method : a method of producing steel from iron ore and coal (coke) by reducing them in a blast furnace and then removing impurities in a basic oxygen furnace.

2)The "electric furnace method" : a method of producing steel from scrap by melting it in an electric furnace.

3) "Direct reduction method": Iron ore is directly reduced with natural gas and then melted in an electric furnace.

Source: Nippon Steel Research Institute, Inc.

Online Steel Plant Diagnosis

14 on-site steel plant diagnosis was conducted in ASEAN countries from 2014 to 2018, through JISF's Eco-solution activities.
→ Due to COVID-19, online steel plant diagnosis using email based questionnaire and web conferences has started since 2021.

Outline of the diagnosis

- Scheme : Online diagnosis
- Target : Company A (EAF Steel plant) in Thailand
- Timeline :

~2022.8 Selecting the target plant

2022.9.6 **Kick-Off Web Meeting**
- Explanation of diagnosis procedure and request to fill in the questionnaire

The target plant submits the questionnaire
- facility specification, operational status, energy consumption data

2022.10.4 **Mid-term Web Meeting**
- Confirmation of questionnaire responses. Explanation and discussions on the direction of the final proposal.

Detailed analysis by experts
Preparation of the final report

2022.10.19 **Final Web Meeting**
- Reporting the diagnosis result. Discussions on the possibility of implementing the proposed measures

Results of the diagnosis (Summary)

- Proposals were made on energy-saving measures that are easy to implement, focusing on operational improvements of the EAF (electric arc furnaces) and RHF (reheating furnaces), which account for a large proportion of energy use in the steel plant.

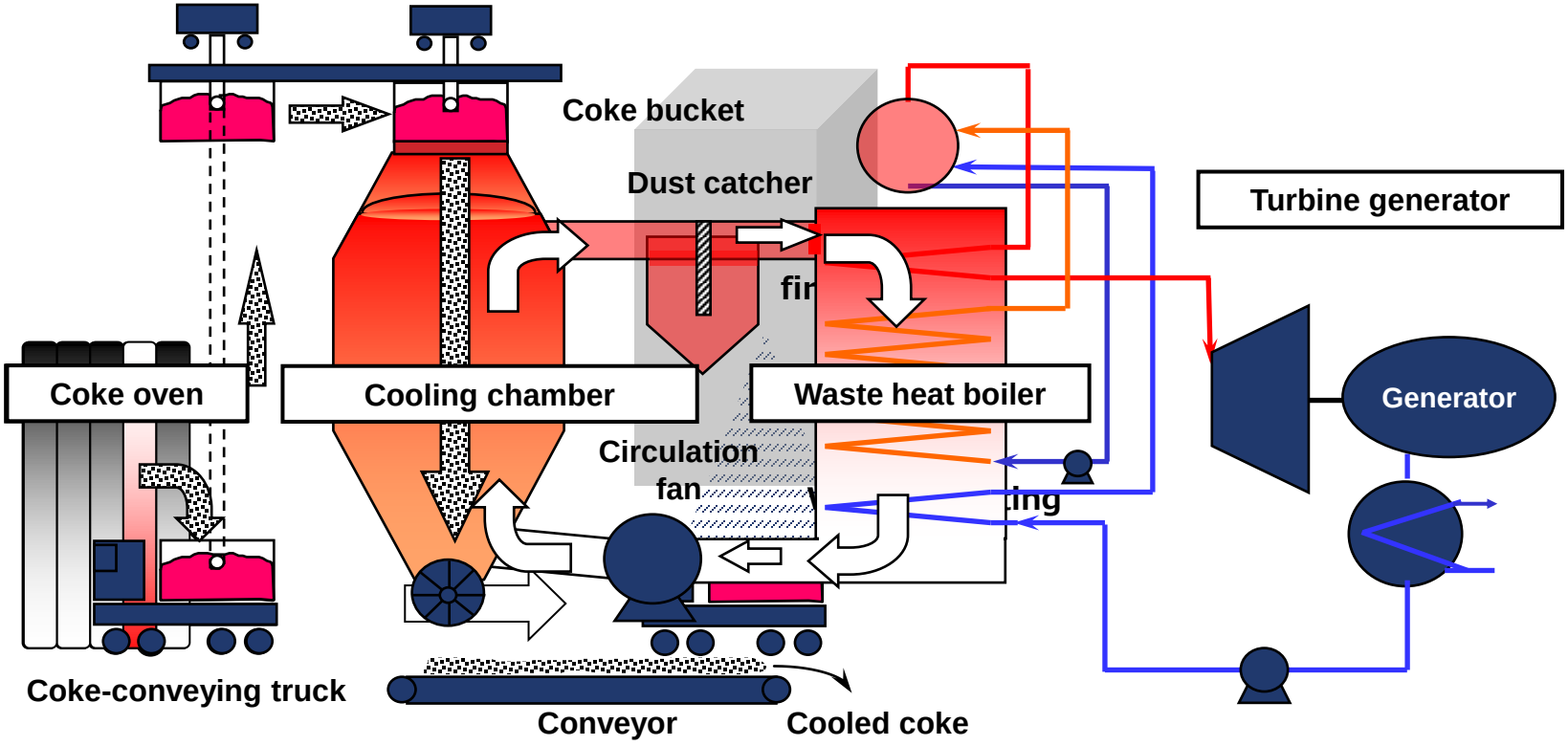
  →Number of proposed measures: 4 for EAF, 3 for RHF
- At the end of the diagnosis, experts requested to the target plant to study the implementation of the proposed measures based on the actual conditions of the plant.

Examples of BAT for Blast Furnace-Basic Oxygen Furnace

Coke Dry Quenching (CDQ)

- CDQ is an eco-friendly technology for steel industry. Since CDQ uses the recovered heat to generate steam and electricity in the steel plant, it can reduce the overall energy use and CO_2.
- In ASEAN, Some Vietnam steel works introduced CDQ for its ironmaking process.

Ref: Appendix of this document_P20 How to make steel



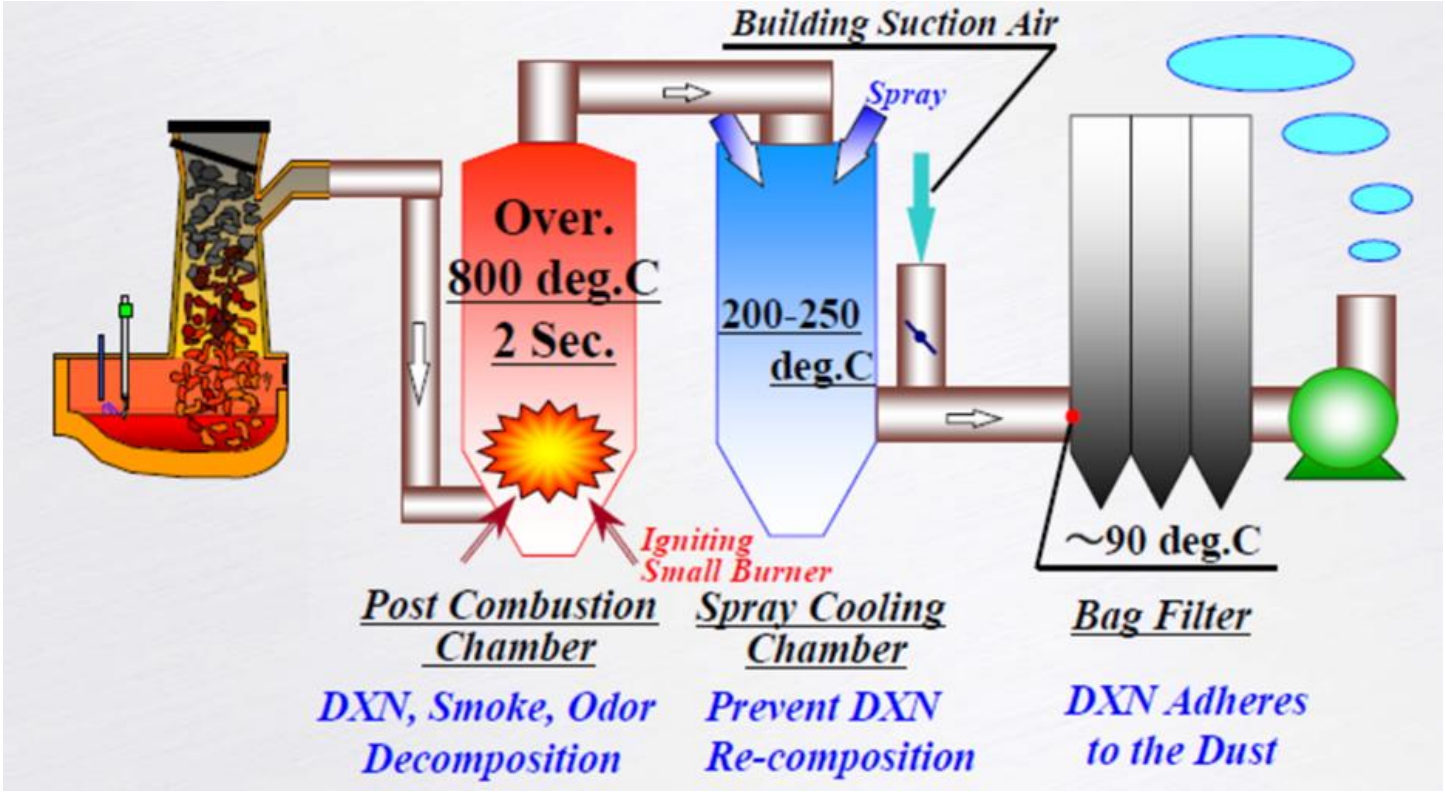
Source: Nippon Steel Engineering

Examples of BAT for Electric Arc Furnace

High temperature continuous scrap preheating EAF*

- High temperature continuous scrap preheating EAF is an environmentally friendly technology for steel industry. This technology enables high-temperature preheating of the scraps, resulting in a reduction of power consumption.

Ref: Appendix of this document_P20 How to make steel



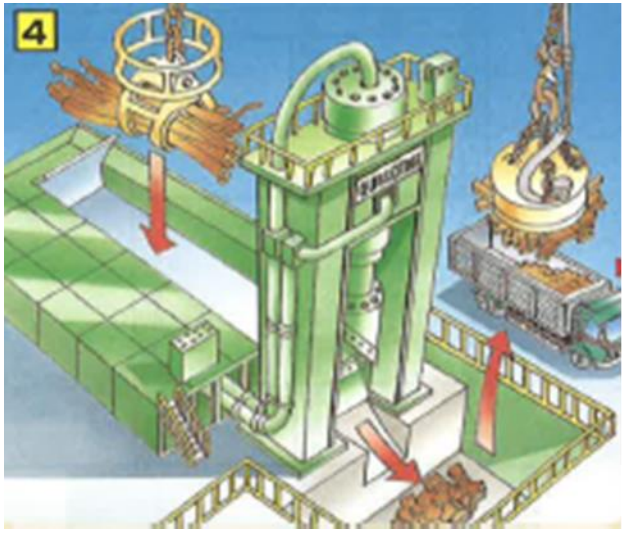
*Electric Arc Furnace

Source: "The Japan Iron and Steel Federation"
Technologies Customized List for ASEAN version3-2

Proposed energy-saving measures on EAF (Steel Plant Diagnosis 2022)

Scrap pre-treatment to reduce charging time

- When charging frequency is reduced by once (for example 4 to 3), expected energy saving is 20 kWh/ton. Bulk density of scrap is increased from 0.3 ton/m3 to 0.6 by the scrap shear with pressing facility.

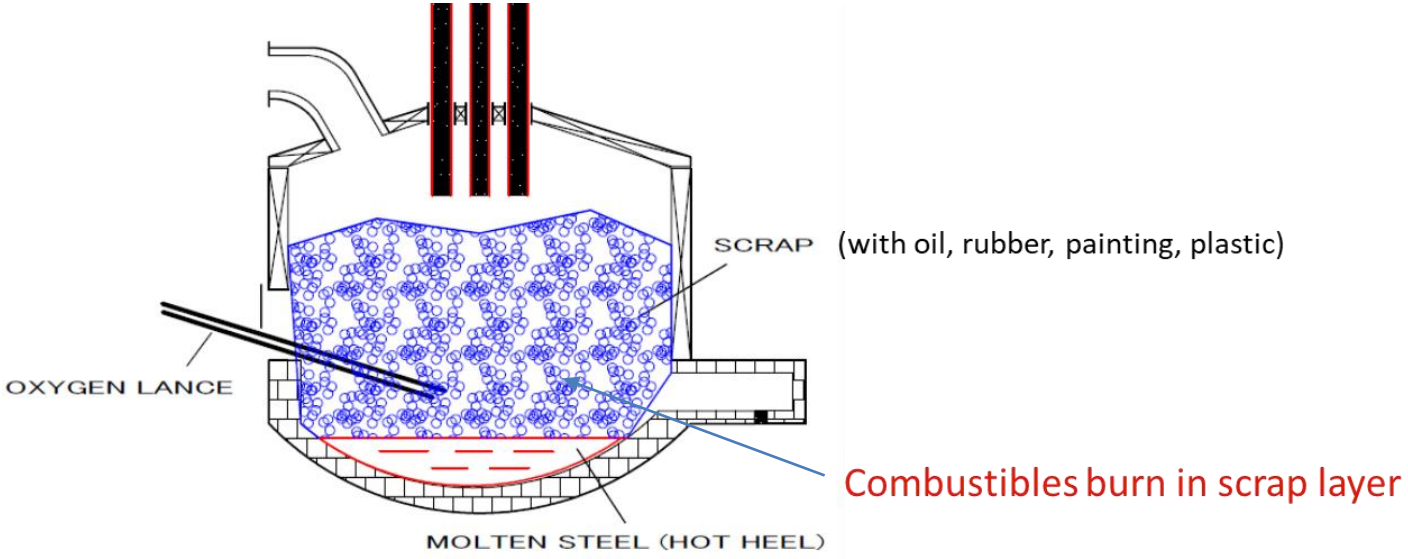


Source: Fuji Car Manufacturing Co., Ltd.

Proposed energy-saving measures on EAF (Steel Plant Diagnosis 2022)

Effective use of combustibles in scrap

- Scrap is a kind of industrial wastes which contain combustibles, such as oil, rubber, painting, and plastics.
- When properly used, these materials can be a good energy source.

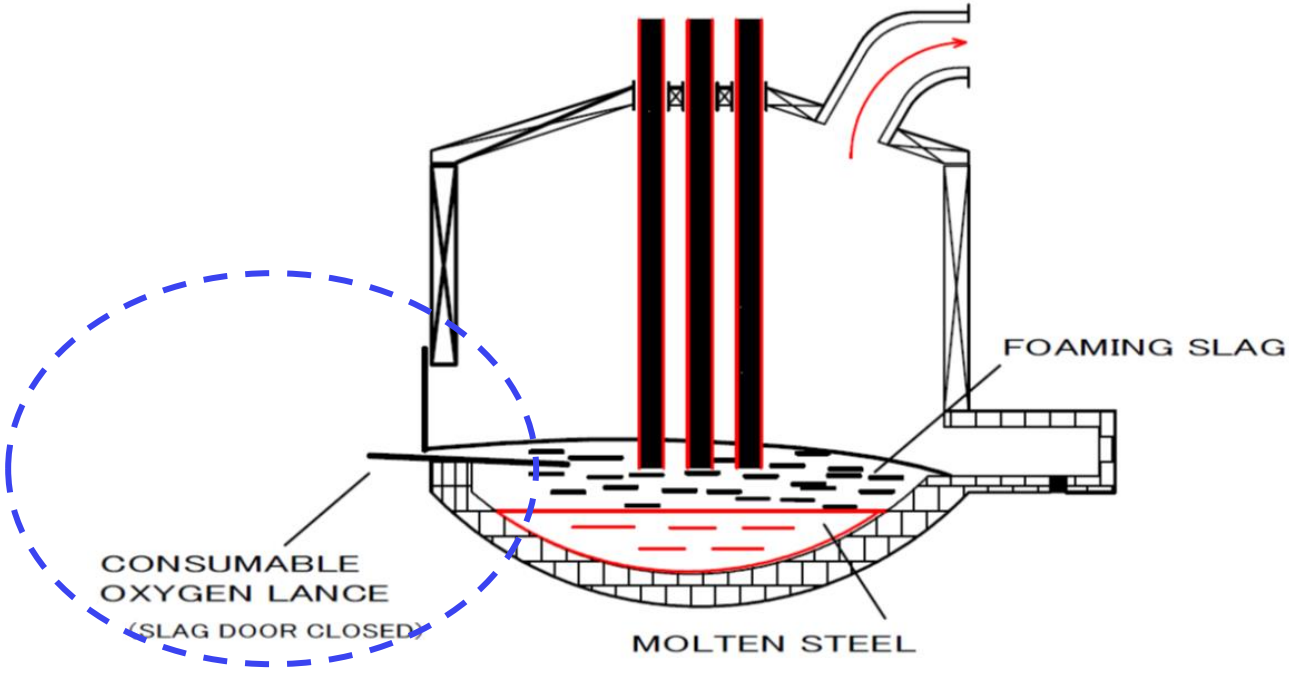


- One idea to utilize combustibles in scrap is, when there is some time allowance, to supply oxygen into the scrap bottom for 5-10 minutes before arc-power on.
- Preheated scrap helps energy saving and smooth melting.
- Expected energy saving may be 20 kWh/ton.

Proposed energy-saving measures on EAF (Steel Plant Diagnosis 2022)

Reducing air invasion and keeping molten slag layer

- One of the good performance EAFs seen in Japan operates to make the slag door closed until tapping.
- From the viewpoint of energy saving, consumable lance is better than water-cooled one. Water-cooled lance requires full-open of slag door.
- Effect of slag door closing is said to be 27-28 kWh/ton (PROCESS CORPORATION, Sixteens Annual Symposium, 1994)

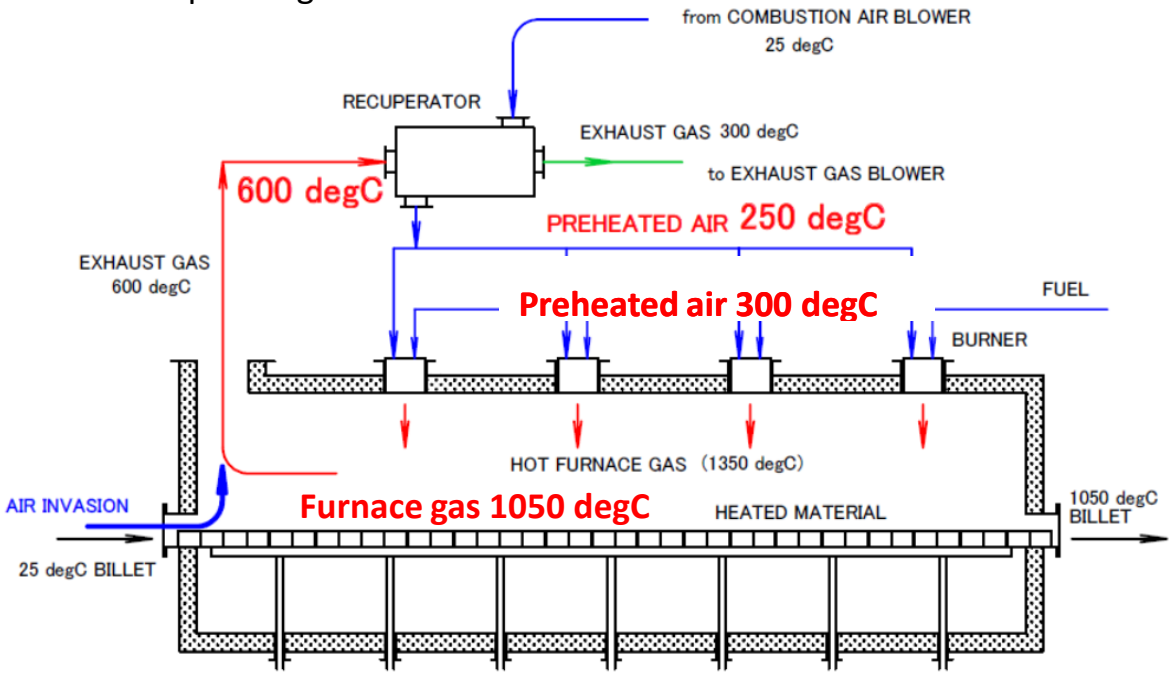


Proposed energy-saving measures on RHF (Steel Plant Diagnosis 2022)

Raising temperature of combustion air

- Average preheated air is higher than 450 degC in many cases. But at the diagnosed plant, hot gas at recuperator inlet was 600 degC and air temperature was only 300 degC. This is because of invasion of cold air from outside furnace.
- To avoid hot gas flow-out and cold air invasion, furnace pressure shall be controlled as 1 mmWG in general. Pressure gauge shall be installed at the right position in order to know the right pressure inside the furnace.

Actual operating condition of RHF



Contribution to the introduction of energy-saving technologies in the Indian steel industry

At nine steelworks where steel plant diagnoses were implemented between 2007 and 2018, Japanese experts recommended the introduction of energy conservation technologies in **42 cases** on the basis of the Technologies Customized List. **About 70%** of the recommended technologies have been introduced or are planned to be introduced (as of January 2021).

Technologies recommended for steelworks where energy conservation diagnoses have been implemented and technologies that have been introduced

	Number of cases
Number of technologies recommended	**42**
Number of technologies introduced*	15 (36%)
Number of technologies planned to be introduced	14 (33%)

*Many of them are large-scale, cost-effective technologies, including coke dry quenching (CDQ) and top-pressure recovery turbines (TRT).