



NIPPON STEEL ENGINEERING

POWER GENERATION WITH COKE WASTE HEAT RECOVERY BY CDQ TO REDUCE CO2 EMISSIONS



Narumi Aoki

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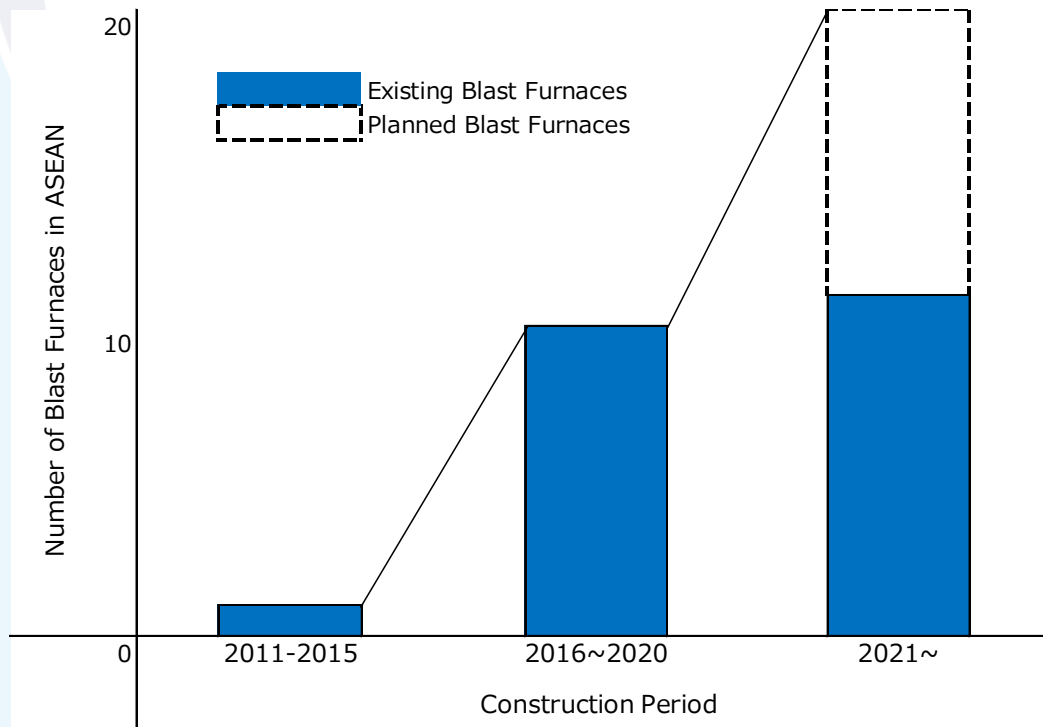
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Increase of Integrated Steel Mills in ASEAN Region

- Rapid increase of Integrated Steel Mills(Blast Furnace) in the ASEAN region.
- Introduction of Decarbonizing Technology shall be required.



Decarbonizing Technologies For Steel Industry

TRT
(Top pressure Recovery Turbine)

ESCAP™

Regenerative Burner

CDQ

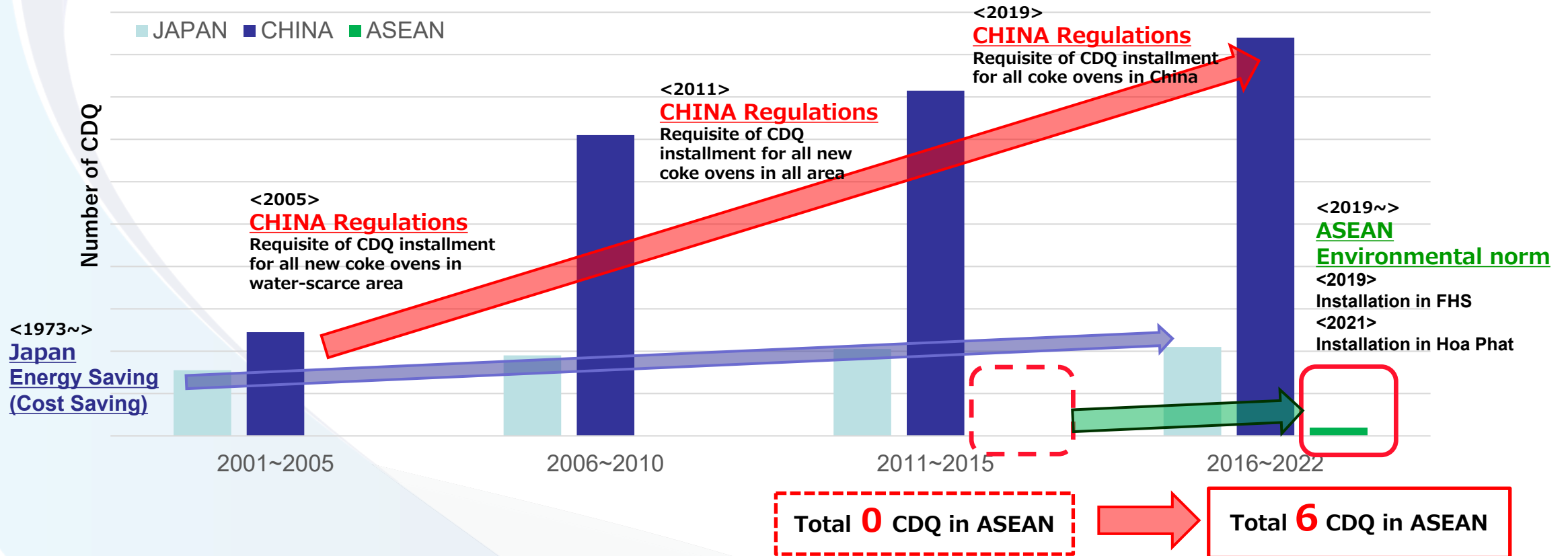
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Investment Factors of CDQ

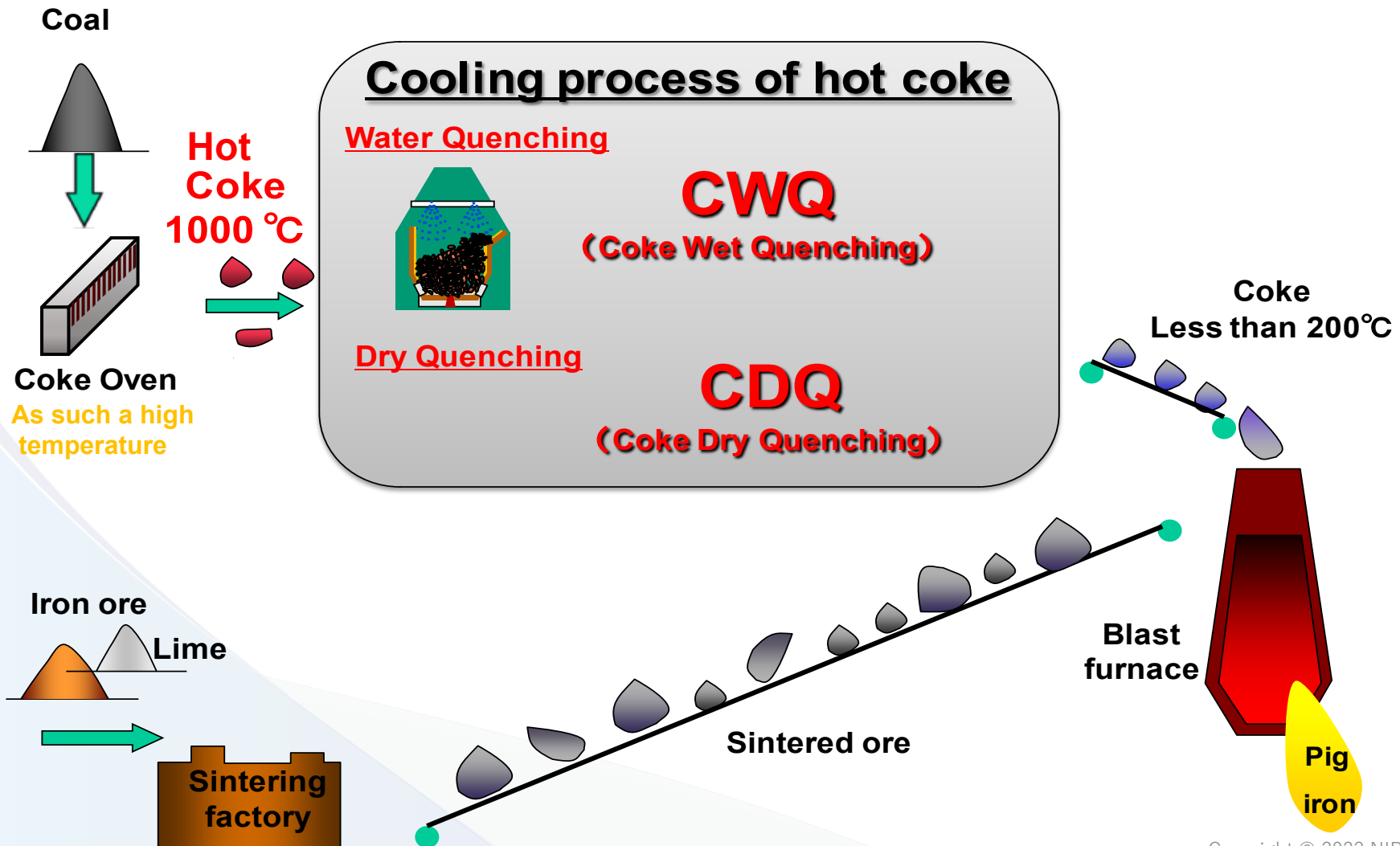
• Main factors and driving force of CDQ investment.

- ① Environmental Regulations
- ② Energy Saving(Cost Saving)



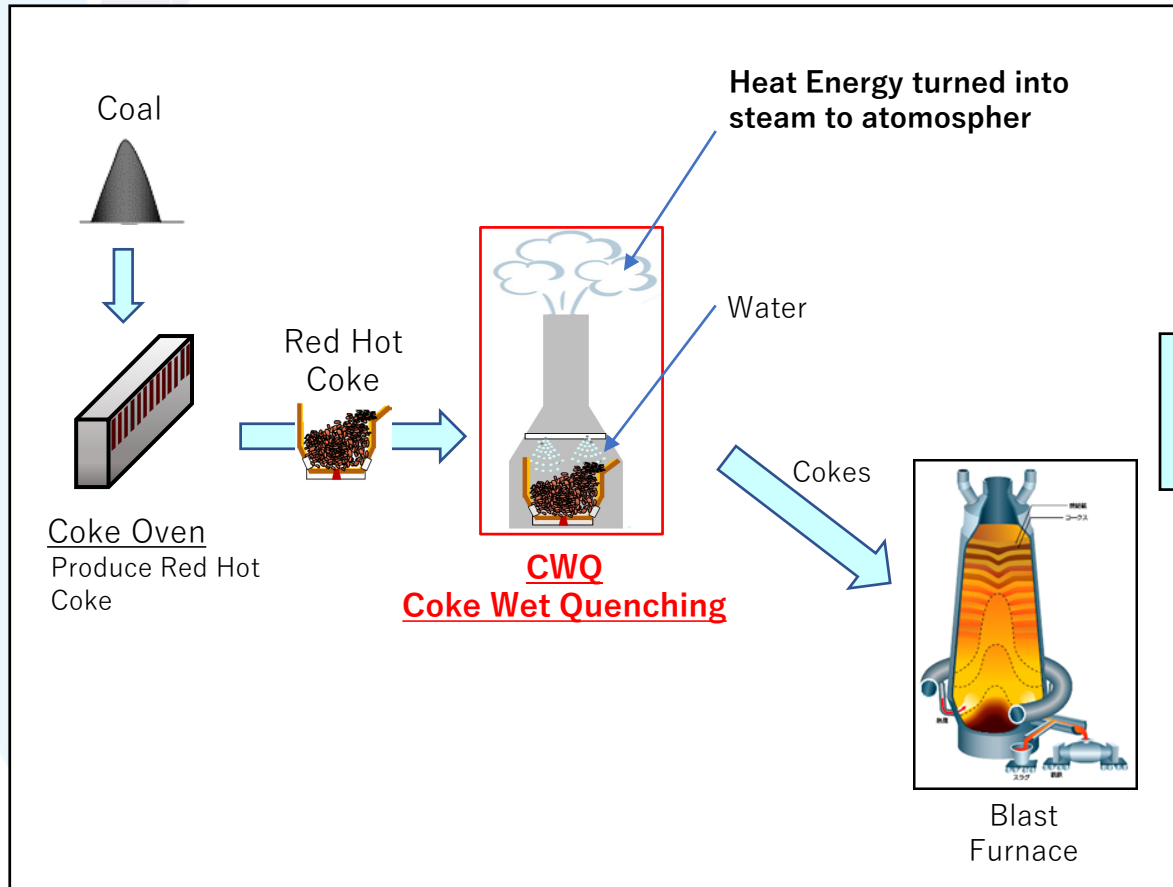
CWQ and CDQ

• Coke Production Process

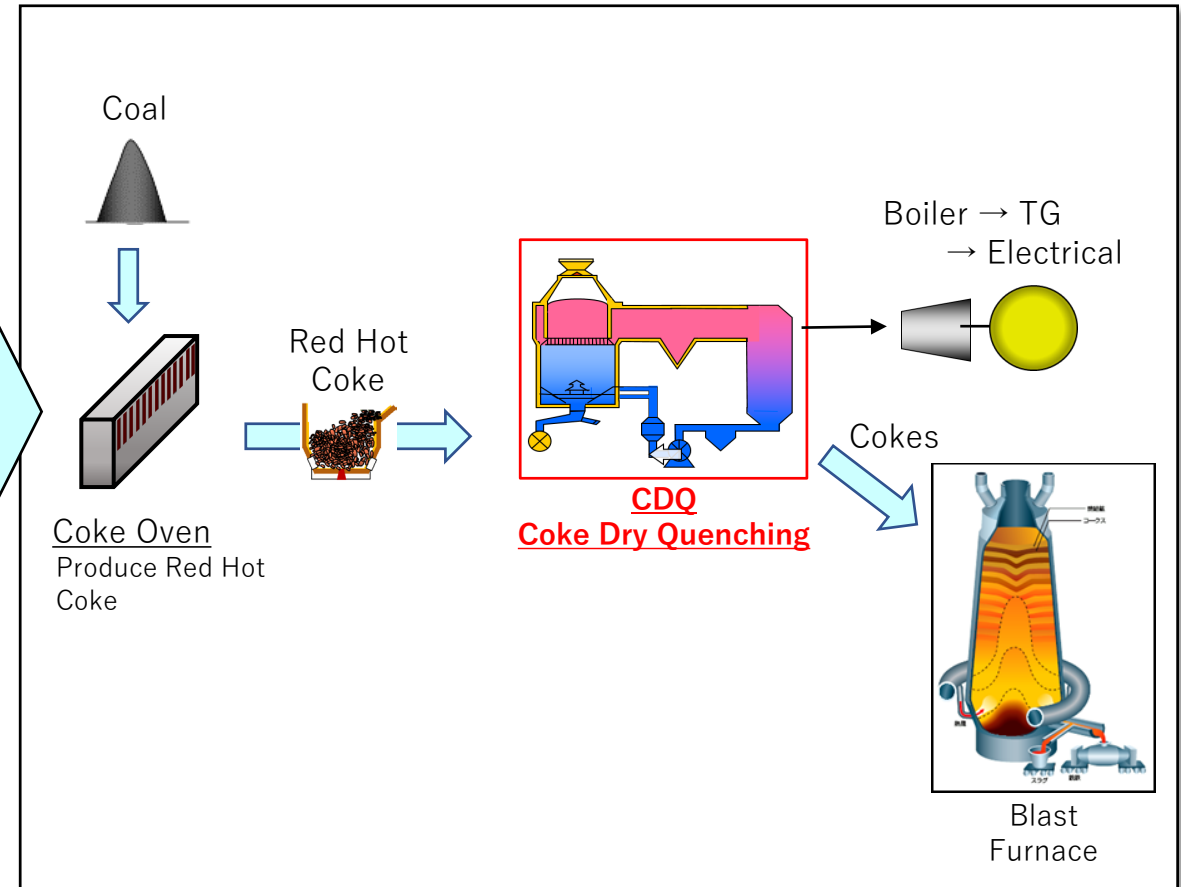


CWQ and CDQ

CWQ Coke **W**et **Q**uenching



CDQ Coke **D**ry **Q**uenching



Process Flow of CDQ

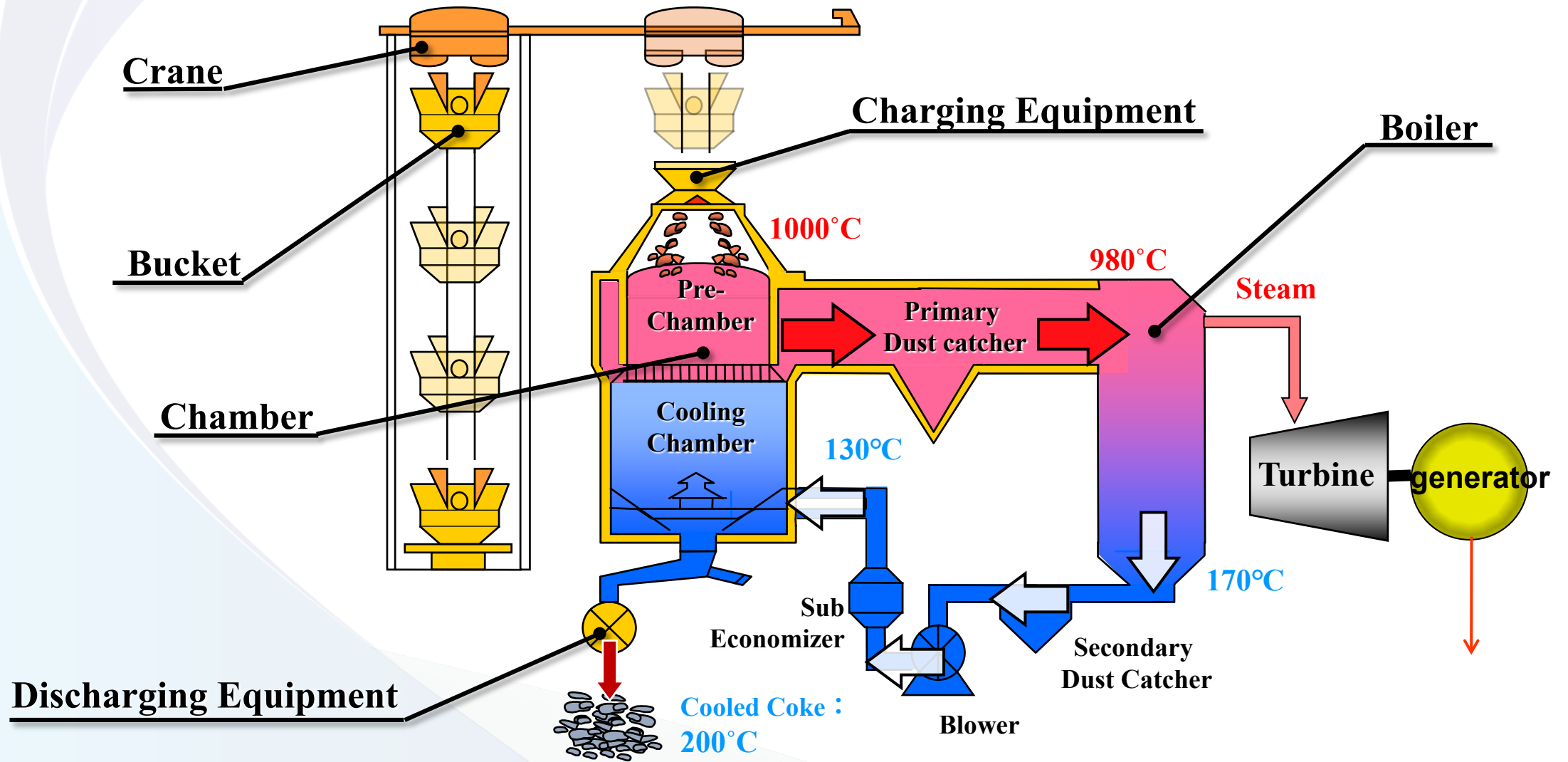
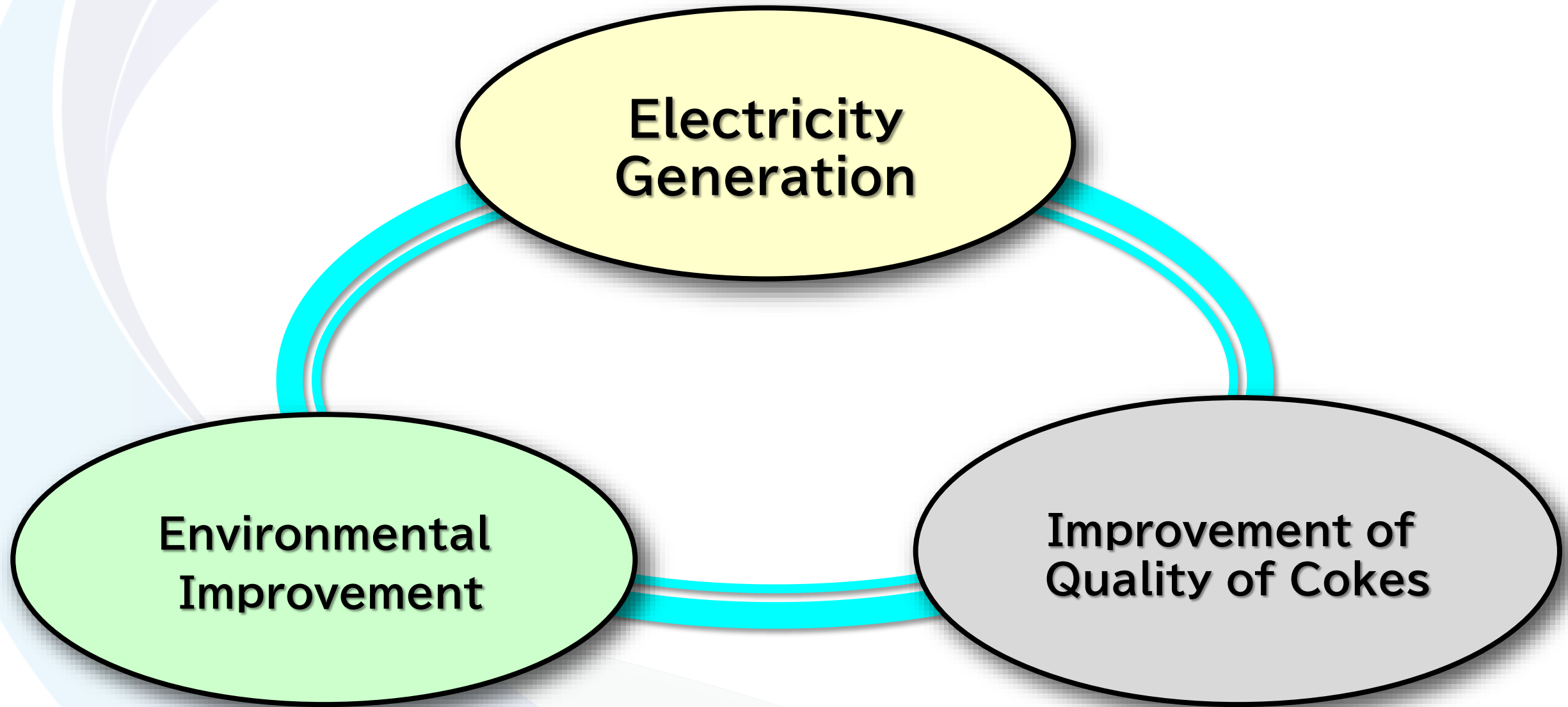


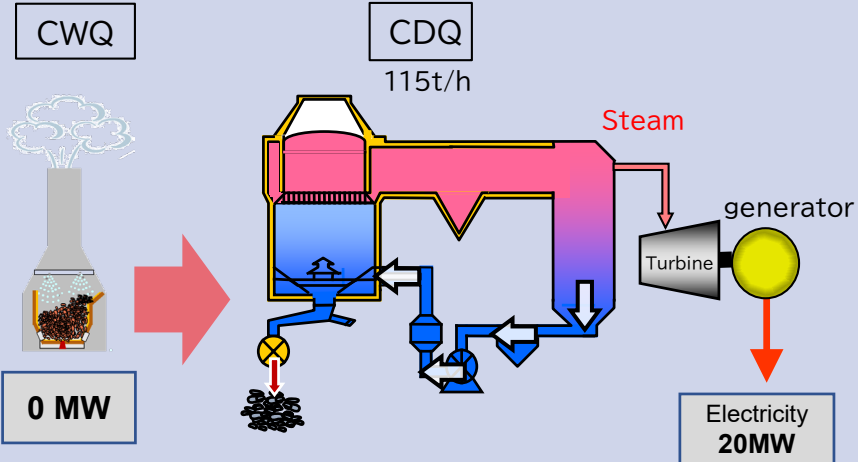
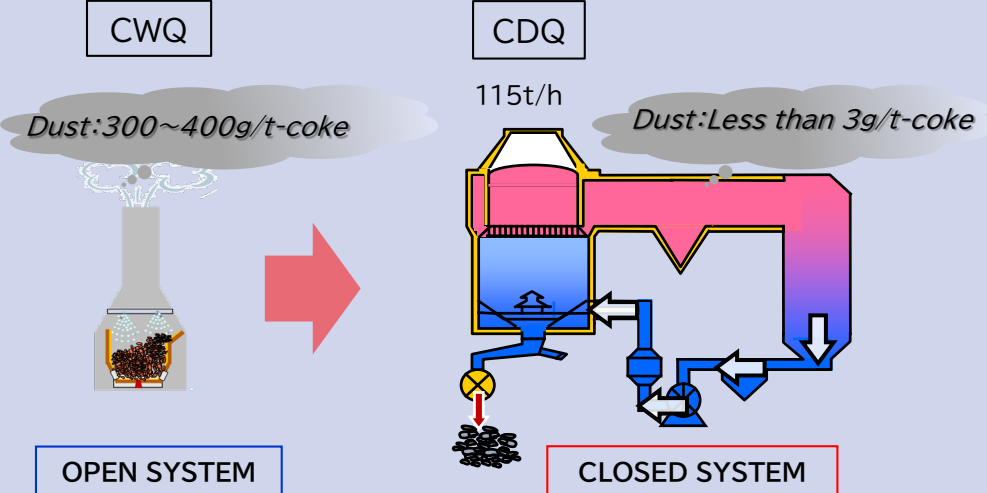
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Advantages of CDQ



Advantages of CDQ

Advantages	Electricity Generation	Environmental Improvement
CWQ	<ul style="list-style-type: none"> •Generate 0 MW electricity 	<ul style="list-style-type: none"> •Dust : 300~400 g/t-coke
CDQ	<ul style="list-style-type: none"> •Generate 20 MW electricity 	<ul style="list-style-type: none"> •Dust : Less than 3 g/t-coke
	 <p>The diagram illustrates the transition from CWQ to CDQ. On the left, CWQ (0 MW) is shown as a simple cooling unit. On the right, CDQ (115t/h) is shown as a cooling unit with a steam generator, turbine, and generator, producing 20MW of electricity. The CDQ system is labeled as a 'CLOSED SYSTEM'.</p>	 <p>The diagram compares the dust emissions of CWQ and CDQ. CWQ is labeled as an 'OPEN SYSTEM' with dust emissions of 300~400g/t-coke. CDQ is labeled as a 'CLOSED SYSTEM' with dust emissions of less than 3g/t-coke.</p>

Advantages of CDQ

Installation of CDQ

Quenching with inert gas

Waterless

Cooling gradually

Coke quality improvement

Moisture content of Coke
Nearly ZERO

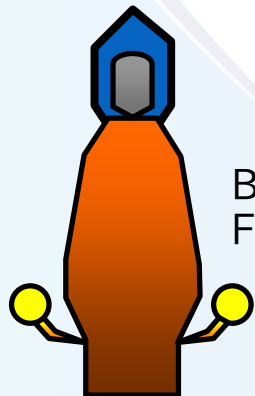
Coke strength after CO₂ reaction (CSR)
2.5% UP

Drum Index (DI)
1.5% UP

Reduction of coke ratio
6 kg/t-pig iron ↓

Iron productivity limit
8% ↑

Injection limit of pulverized non-coking coal
100 kg/t-pig iron ↑



Blast Furnace

※Actual result in NSC-group

Advantages of CDQ

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Waterless

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Coke quality improvement

Moisture content of Coke
Nearly ZERO

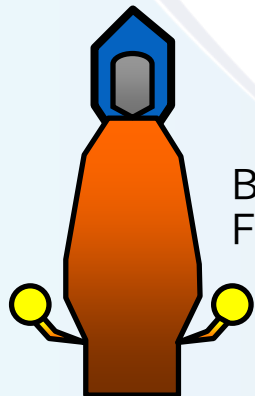
Coke strength after CO₂ reaction (CSR)
2.5% UP

Drum Index (DI)
1.5% UP

Keeping the coke strength

Reduction of coke ratio
6 kg/t-pig iron ↓

Increasing of bony coal (low quality coal) ratio of charging coal
↑



Blast Furnace

※Actual result in NSC-group

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Estimated potential CO2 reduction of CDQ in ASEAN

- Methodology of CO2 reduction calculation

1. Scope (Boundary) of calculation

Electricity generated from the Turbine Generator (TG) of CDQ to the Transmission System of National Power Grid.

2. Calculation of CO2 reduction

(Electricity Generated from CDQ – Electricity used for CDQ)

* IGES CO2 conversion rate

(Ref : IGES/Institute for Global Environmental Strategies)

Estimated potential CO2 reduction of CDQ in ASEAN Region

Country	A	B	C	D
	Coke Oven Capacity (Mt/year)	Number of CDQ (based on 115t/h CDQ)	Annual power generation (GWh/year)	Annual reduction (MtCO2/year)
Indonesia (Existing + Planned)	12.1	12	1,583	1.1
Vietnam (Existing + Planned)	7.9	8	1,033	0.7
Malaysia (Existing + Planned)	3.1	3	402	0.3
Philippines (Planned)	5.3	5	689	0.5
Cambodia (Planned)	1.3	1	172	0.1
Myanmar (Planned)	2.6	3	344	0.2
Total	32.2	32	4,223	2.9

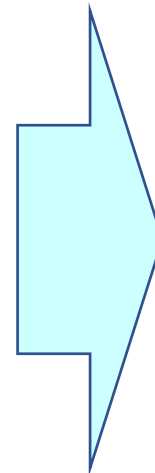
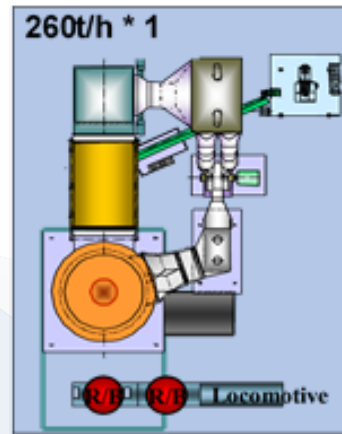
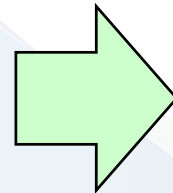
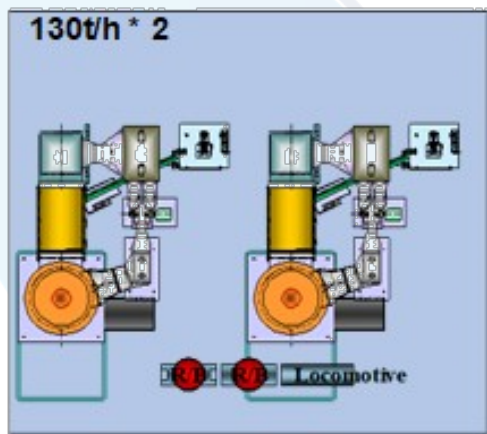
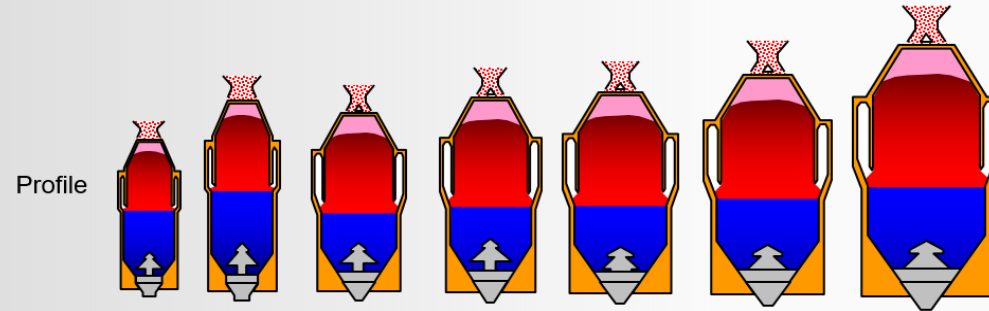
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Initial cost reduction by large scale CDQ

World largest scale CDQ developed by NSE

Operation Start	1974	→						1987	1988	2009
Capacity (t/h)	56	75	110	118	150	180	175	200	190	260

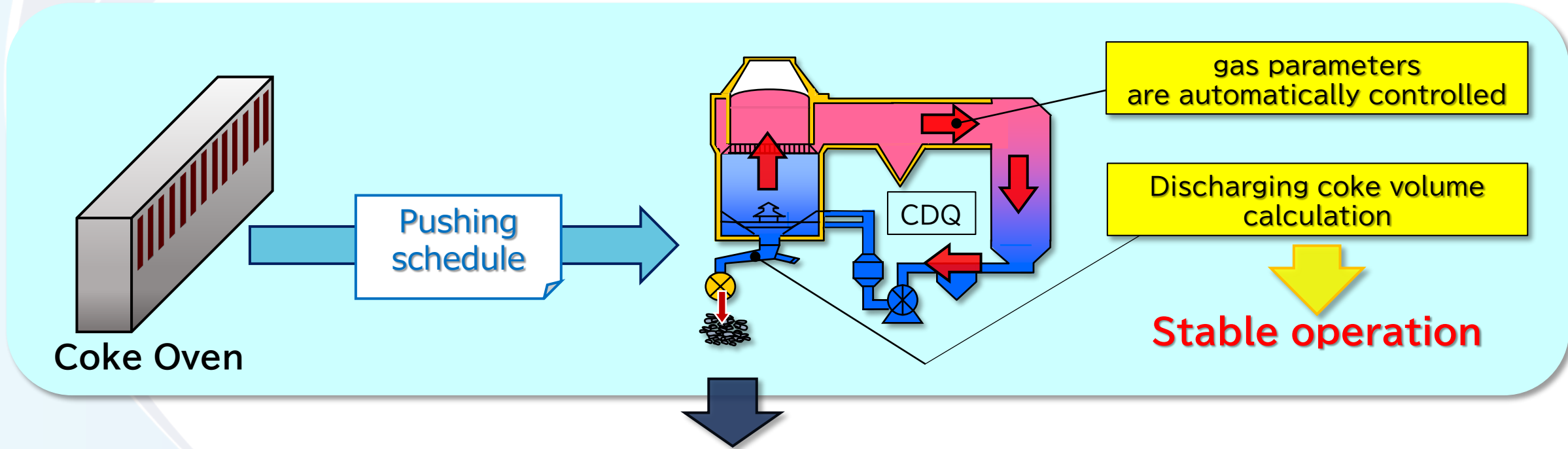


Benefits

- Total construction cost
- Running cost
- Installation space

**20-25%
Down !**

Fully Automated CDQ Operation



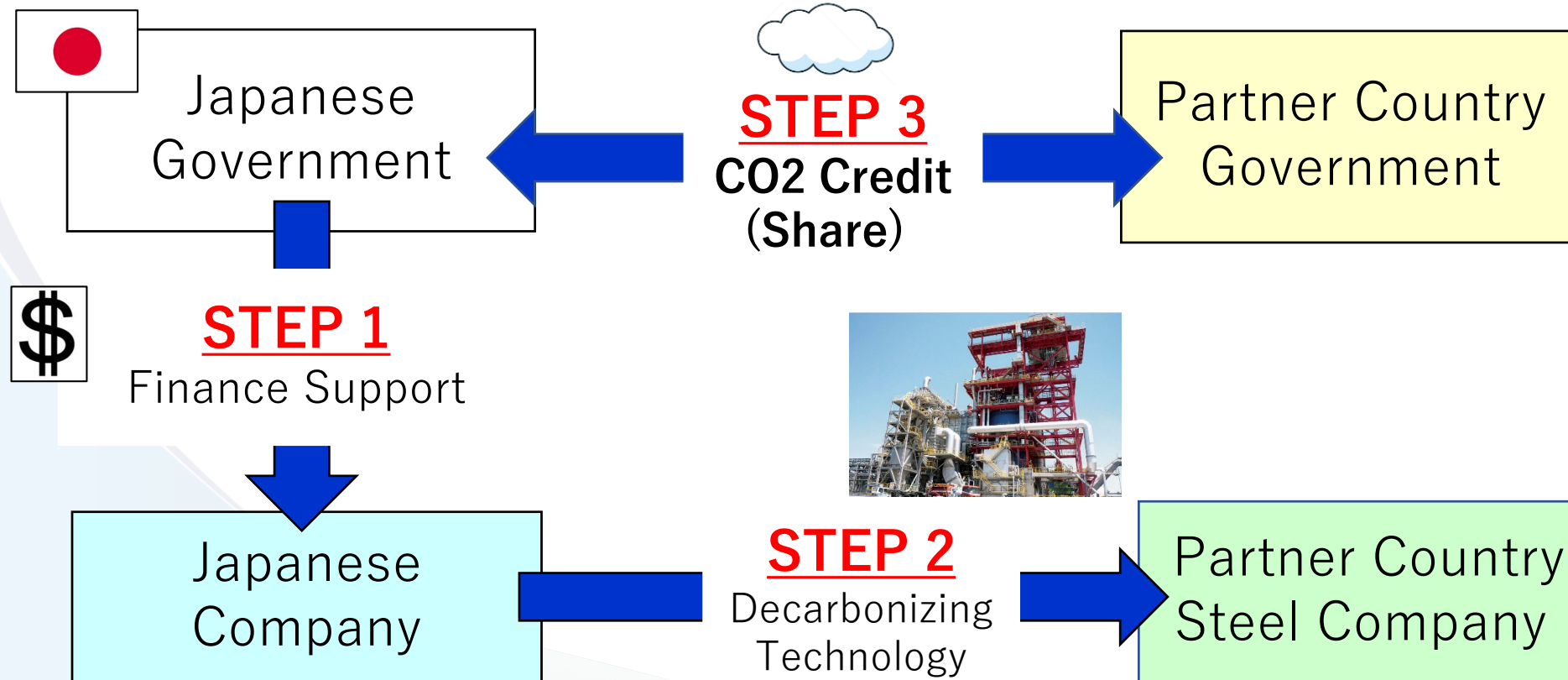
Easy to operate for inexperienced operator

Maximize recovery heat

Increase refractory life

JCM Financing Program

•Image of JCM Financing Program



JCM Financing Program



Vietnam



Indonesia



Cambodia



Myanmar



Thailand



Philippines



Lao PDR



Mongolia



Bangladesh



Ethiopia



Kenya



Maldives



Costa Rica



Palau



Mexico



Saudi Arabia



Chile



Senegal



Tunisia



Azerbaijan



Moldova



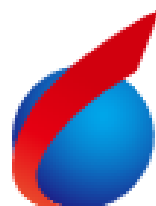
Georgia



Sri Lanka



Uzbekistan



NIPPON STEEL ENGINEERING

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