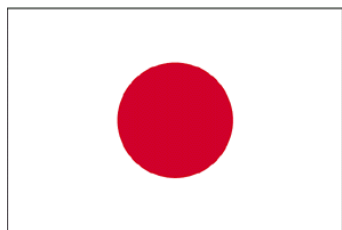


Japan – Brazil Cooperation on Energy Conservation Remote Open Seminar

(Program-2) Methodology of “Benchmark Approach” to Promote EE&C in Energy Intensive Industry



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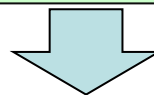
Main Contents

1. **“Benchmark Approach” : Target and Benefits**
2. **Program-2 : Formation and Key Organizations**
3. **“Benchmark Approach” : Implementation**

1. “Benchmark Approach” : Target and Benefits

1. “Benchmark Approach” : Targeted Outcome

- (1) Establish and Operate the **National Data and Information System for the “Benchmark Approach”** for the Individual Sub-Industries to Share Common EE Targets and Effective Measures (Technology and Equipment)
- (2) Establish and Disseminate the **Standardized Methodology of “Benchmark Approach for Practice”** by Companies
 - The “Benchmark Approach” is incorporated with the Energy Management System (EnMS)
 - The national level of data and information can be utilized through the “National Data and Information System”
- (3) Propose **Support System** to Accelerate Dissemination of The Identified Effective Technologies



Improve E.E. in the Energy Intensive Industry by 5% to 10%



1. “Benchmark Approach” : Benefits

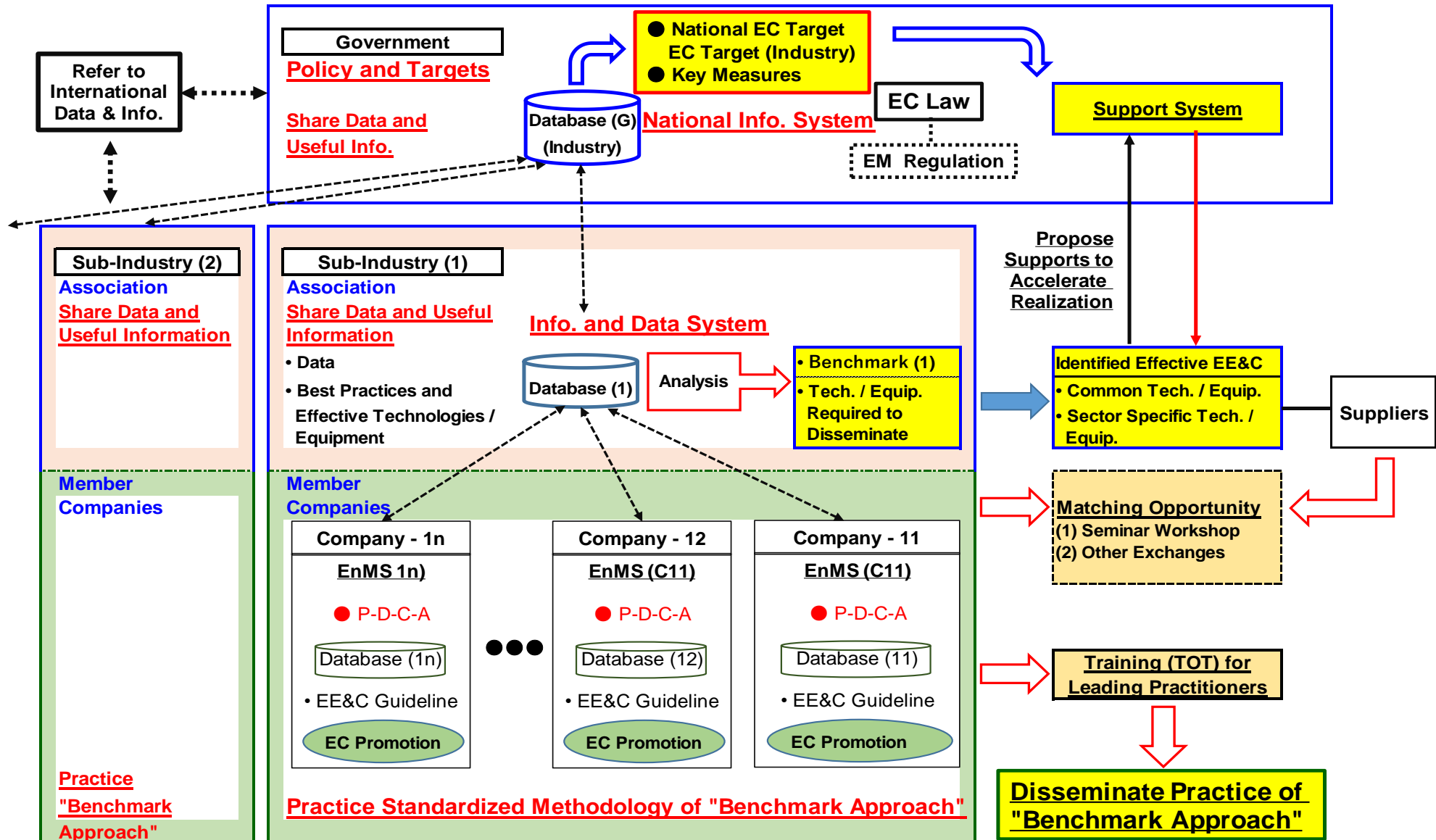
Direct Merits through Enhanced EC Promotion

- (1) Reduction in Cost and Improvements in Competitiveness
- (2) Contribution to Mitigating the Global Warming & Pollution
- (3) Improved Reputation of Each Company by Realizing CSR (Corporate Social Responsibility)
- (4) Expected Expansion of Business

Sustainability

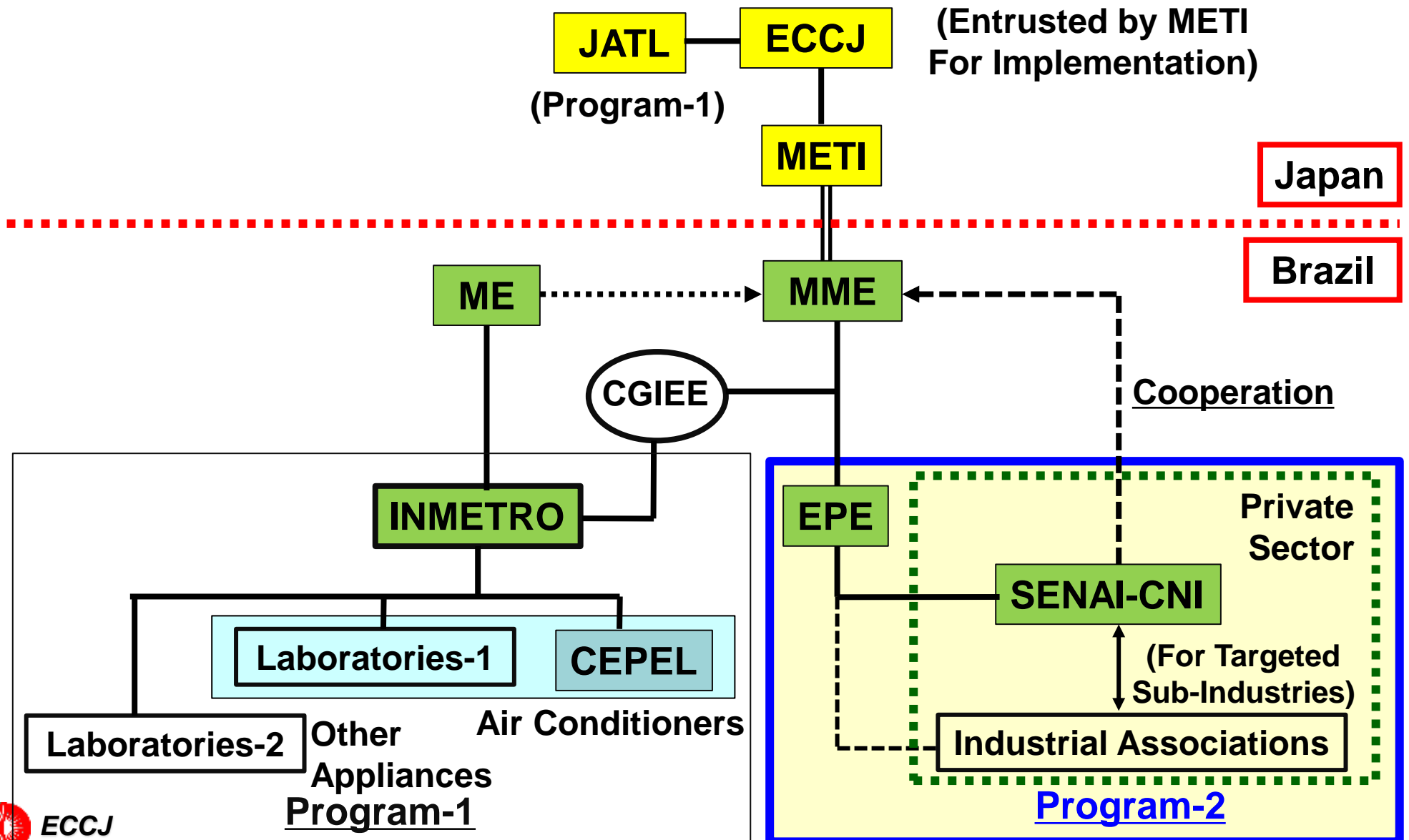
- Established Effective and Functional EnMS with Useful Tools for Systematic Improvement
- Total System for A Specific Sub-Industry Linked with the Company Based System with Better Access to Useful Data and Information
- Support System to Lower / Eliminate Various Barriers against Realization of Improvements

1. "Benchmark Approach" : Overview of System



2. Program – 2 : Formation and Key Organizations

2. Program-2 : Key Organizations and Formation



2. Program-2 : Expected Roles of Key Organizations (1)

EPE

(1) Collaborate with ECCJ to Jointly Conduct Survey

- In Advising to Select the Targeted Sub-Industries
- In Sharing the Data and Information Owned by EPE for ECCJ' Study (Including Information Owned by EPE on Contacts at Associations of the Targeted Sub-industries)
- In Advising for ECCJ to Prepare the Questionnaires
- In Assisting ECCJ to Distribute and Collect Filled Questionnaires (ECCJ will distribute and collect the Questionnaires by emails etc.)
- In Assisting ECCJ in Communication with Associations etc.

(2) Collaborate with ECCJ to Jointly Implement Activities

- In Analyzing Data Collected through Questionnaires
- In Discussing and Advising for ECCJ to Identify Baseline and to Develop EE Targets (Benchmarks)
- In Providing Data / Information to Develop Database and EC Guideline
- In Advising for ECCJ to Develop and Disseminate the National System and Methodology of the “Benchmark Approach” for Practice

2. Program-2 : Expected Roles of Key Organizations (2)

SENAI - CNI

(1) Collaborate for ECCJ-EPE to Conduct Survey

- In Advising for ECCJ-EPE to Select Targeted (Showcase) Sub-Industries
- In Sharing the Data and Information Owned by SENAI - CNI
- In Introducing Contacts at Associations of the Targeted Sub-Industries for ECCJ to Send the Questionnaires and Request to Fill Them (ECCJ will Distribute and collect the Questionnaires by emails etc.)

(2) Collaborate for ECCJ-EPE to Implement Activities

- In Arranging Meeting etc. with Associations etc.
- In Reviewing Tools Especially the EC Guideline by Providing Information of Technologies and Equipment Existed in Brazil
- In Disseminating Methodology of “Benchmark Approach” for Practice and Tools (Database and the EC Guideline)
- In Assist ECCJ-EPE in Inviting Participants to the Seminar-Workshops both to Disseminate the “Benchmark Approach” and to Match Suppliers and Customers for Identified EE&C Technologies and Equipment

2. Program-2 : Expected Roles of Key Organizations (3)

Industrial Associations (For the Targeted Sub-Industries)

(1) Collaborate for ECCJ-EPE / SENAI-CNI to Conduct Survey

- In Filling the Questionnaire
- In Sharing the Data and Information Owned by Associations

(2) Collaborate for ECCJ-EPE / SENAI-CNI to Implement Activities

- In Providing Information for ECCJ to Prepare the EC Guideline (Technology Guideline)
- In Discussing / Reviewing the Tools (Database and EC Guideline) Developed by ECCJ
- In Disseminating Methodology of the “Benchmark Approach” for Practice and the Tools in the Concerned Sub-industries
- In Inviting the Member Companies to the Seminar-Workshops to Disseminate the “Benchmark Approach” and to Match between Suppliers and Customers on the Identified Technologies and Equipment Effective for EE&C Promotion in Industry
- In Introducing Contacts at Member Companies When Required

3. Program – 2 : Implementation

3. “Benchmark Approach” : Implementation – Kick-off

Kick-off the “Program-2” and Prepare to Implement as Follows.

(1) Decide the 2 or 3 Targeted Sub-Industries to Be the Showcases

The Following Steps Are Proposed by ECCJ

1st Start : Iron and Steel Industry

2nd Start : Pulp and Paper Industry or Sugar Industry

3rd Start : The Remaining of the 2nd or Cement Industry

- ▶ **Hold (Remote) Open Seminar for the Candidate Sub-Industries and the Related Organizations**
 - ▶ **Discuss and Decide the Targeted (Showcased) Industries**

(2) Decide the Organizations to Involve and Organize “Working Group” with Members from These Organizations and Assign Responsible Person (Core : EPE and CNI-SENAI)



Targeted Sub-Industries (Showcases) – Proposed Candidates

The Following 3 Sub-Industries

(1) Iron and Steel / (2) Sugar or Paper and Pulp / (3) Cement
 (Based on the Analysis of Energy Situations in Brazilian Industry)

- In terms of Magnitude of Energy Consumption

(1) Iron and Steel / (2) Sugar / (3) Cement

- (or) • In terms of Availability of Data and Information

(1) Iron and Steel / (2) Paper and Pulp / (3) Cement

Sub-Industry	Basic Data (*1)		Country Benchmark for International Comparison (*1)			Process	Base Tools Owned by ECCJ	
	Share (%) of Final Energy Consumption	Energy Intensity (toe/t-product)	Data for Benchmarking	Conditions	Data Limitation	Feature	Database Template	Info. & Data for Guidelne
1. Iron & Steel	21	0.481	Yes	BF - BOF : 80%			Yes	Yes
2. Sugar	17	0.470	Not clear			To include ethanol ?	No	Partially Yes
3. Paper & Pulp	17	0.424	Yes	High ratio of pulp for export	Lack : Separate Sub-processes		Yes	Yes
4. Chemical	9					Diverse / Complex	Yes (For 3 Industries)	Yes (For 2 Industries)
5. Other Food	7					Diverse	Yes (For 4 Industries)	Partially Yes
6. Other Metallurgy	6		Yes	Aluminum & Alumina	Not published	Diverse / Complex	Yes (For 2 Industries)	Partially Yes
7. Ceramics	5					Diverse		
8. Cement	5	0.072	Yes	Dry Process	Lack : Separate Sub-processes		Yes	Yes
9. Mining	3							
10. Ferro Alloys	2					Diverse / Complex		
11. Textile	1						Yes	Partially Yes
12. Others	7							

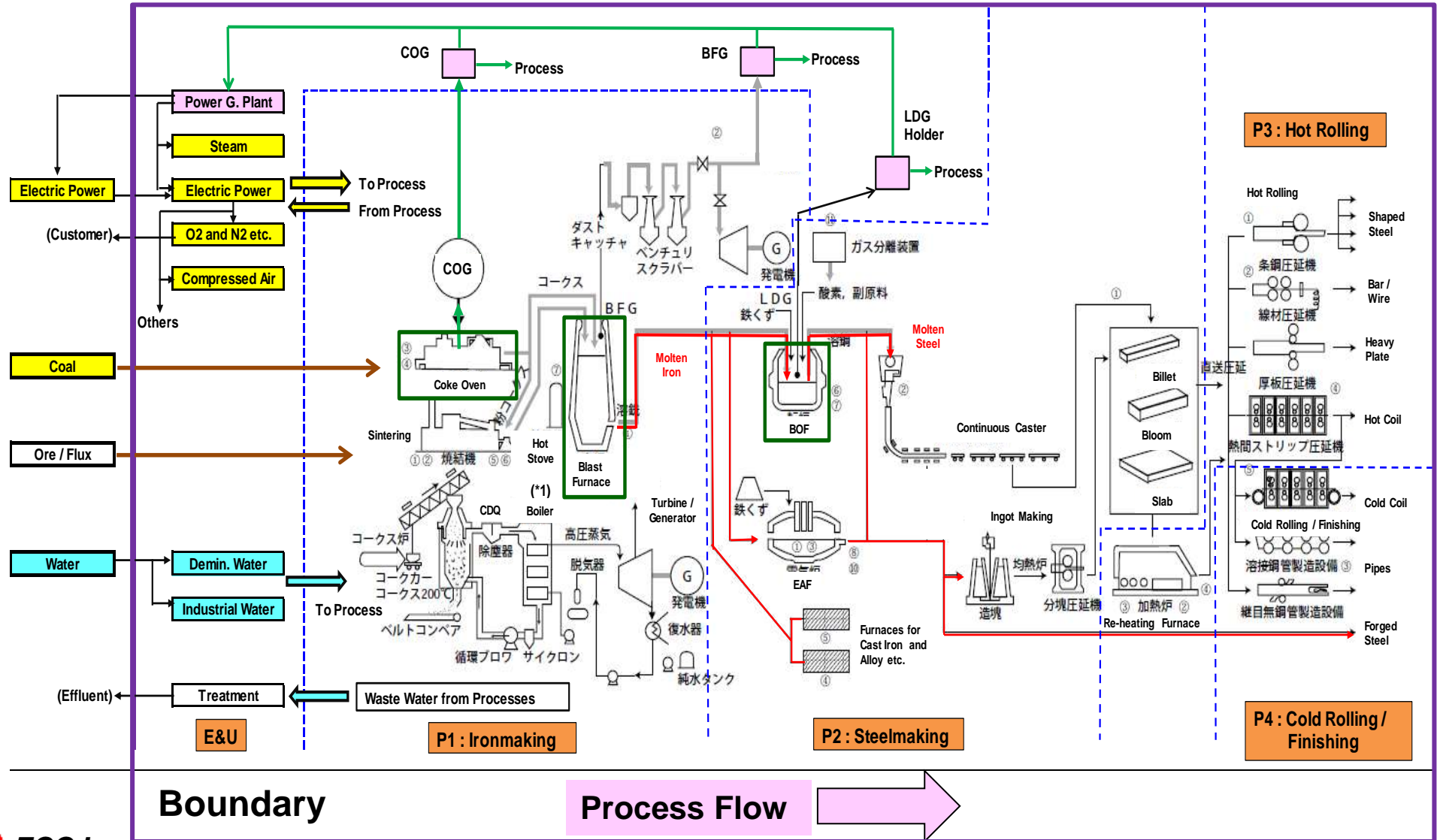
(*1) Reference : Atlas da Eficiência Energética do Brasil (Brasil 2019)

3. “Benchmark Approach” : Implementation – Survey

ECCJ and The “Working Group” Will Conduct the Survey for the Targeted Industries as Follows.

- (3) Prepare the Survey Sheet (Questionnaire) for Each Industry**
 - 3-1) Define the Scope and Boundary of Each Sub-Industry Based on the Process Flow Diagram
(This is the base definition by which each company can also decide their own scope and boundary for EnMS.)**
 - 3-2) Prepare for Survey Sheet (Questionnaire)**
 - 3-3) Modify or Develop the Database to Compile the Data and Information Collected by the Questionnaire**
- (4) Distribute the Questionnaire to the Industrial Association(s) Related to Each Targeted Industry**
- (5) Collect the Questionnaire Filled by Associations etc.**

Definition of Scope and Boundary for Survey (Basis of EnMS) - Process Flow Diagram (Iron & Steel) → Basis of Database etc. -



Survey : Questionnaire – Main Contents (1)

Introduction

(1) Background

- Outline of the “Project”
- Purpose of Survey

(2) Requirement for Cooperation and Guidance to Fill the Questionnaire

General Information

(1) Production Capacity and The Actual Results of the Sub-Industry with

- Number of Companies and Plants
- Amount of Total Production and Breakdown of Each Main Product
- Manufacturing Process

Major Processes – Number of Plants

Specific Information and Data Required

(2) Energy Efficiency Indicators and Numbers Published by Associations Related to the Targeted Industries (If any)

(With the Actual Results of the Whole Each Sub-Industry)

Survey : Questionnaire – Main Contents (2)

Specific Information and Data Required

(3) Status to Promote Introduction of Energy Management System

- Issues to Promote Energy Conservation
- Sharing Key Data and Information among Member Companies etc.

(4) Issues to Promote Energy Conservation

(5) Status and Conditions to Affect Energy Efficiency

- Introduction of Technologies and Equipment Effective for EC
- Various Conditions
- Future Plan to Promote EC

ANNEX

Data to Evaluate Energy Efficiency Indicators Including Benchmark

- Definition of Scope of Data
- Key Data (Raw Materials / Annual Energy / Utility Consumption)

“Benchmark Approach” : Implementation – Analysis

- (6) Analyze the Actual Data and Status Collected by Survey
(Including Process, Conditions and Technology etc.)**
- (7) Assess Baseline and E.E. Targets (Benchmarks)**
- (8) Identify Possible EC Measures, Technologies and
Equipment to Achieve the EE Targets**
- (9) Clarify EC Potentiality by Analyzing Gap between the
Targets and the Baseline
Identify Recommended EC Measures, Technologies and
Equipment to Achieve Target**

“Benchmark Approach” : Implementation–Study Output

- (10) Review the Targets, the Recommended EE&C Measures Including Effective Technologies and Equipment by the Related Industrial Associations**
- (11) Propose Benchmarks and Identified Recommended Measures, Equipment and Technologies to Achieve the Targets (Benchmarks) for the Individual Sub-Industries**

Benchmark Approach : Basic Flow of Survey and Analysis

Survey : Collect Data and Information by Questionnaire

Analysis of Survey Results

Analysis 1 Baseline

- The EnPIs (The Actual Results of Energy Consumption, Production and Product Mix etc. for 2-3 years)
- The Existing Factors to Affect EE (Operation & Maint. Conditions, Qualities of Raw Materials & Products, Technologies and Equipment)

Analysis 2 Targets

- Identification of Possible Improvements in Factors to Affect EE
- Sensitivity Analysis / Simulation Using the "Database" by Adding the Affecting Factors or Changing Conditions of the Factors
- Assess the Results and Propose the Targets of EnPIs and Measures

Output Report

- Actual Baseline : EnPIs and The Existing Main Factors to Affect EE
- Recommended Targeted EnPIs (Benchmarks) and Measures to Achieve the Targets (Improvements in the Affecting Factors)
- The Expected EE Potential and Effects

Guideline for EC

• Database
• Analysis Tools

Study Report : Proposed Targets (Benchmark) and Measures

“Benchmark Approach” : Implementation – Tools

(12) Develop the Following Tools. (Useful for Various Activities to Implement “Benchmark Approach”)

- Database (To Compile Important Data and Information)**
- Check Sheet of EE Affecting Factors**
- Guideline for EE&C**

(13) Review the Developed Tools by the Related Industrial Association

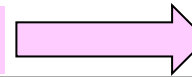
(14) Improve Tools Reflecting the Results / Recommendations by the Related Industrial Associations

Tool – 1 : Database (Basis to Share Data) Integrated Key Data – Balance of Energy & Utility and Materials

Sheet to Input Data

2019-02-05

Process Flow



Data Input Table for Energy Balance

Items	Primary (Purchase) or (Output)	Total (Buy) or (Output)		Coke Oven		P-1 (Blast Furnace)		P-2 (Steelmaking & CC)		P-3 (Hot Rolling)		P-4 (Cold Rolling)		P-5 (Energy & Utility)		P-6 (Energy & Utility)		P-7 (Energy & Utility)		P-8 (Energy & Utility)		P-9 (Energy & Utility)		P-10 (Energy & Utility)		P-11 (Energy & Utility)		P-12 (Energy & Utility)		P-13 (Energy & Utility)		P-14 (Energy & Utility)		P-15 (Energy & Utility)		P-16 (Energy & Utility)		P-17 (Energy & Utility)		P-18 (Energy & Utility)		P-19 (Energy & Utility)		P-20 (Energy & Utility)	
		amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y	amount	TJ/y
Energy																																													
Energy & Utility																																													
Material																																													

In

Out

Energy

Material

Process Flow

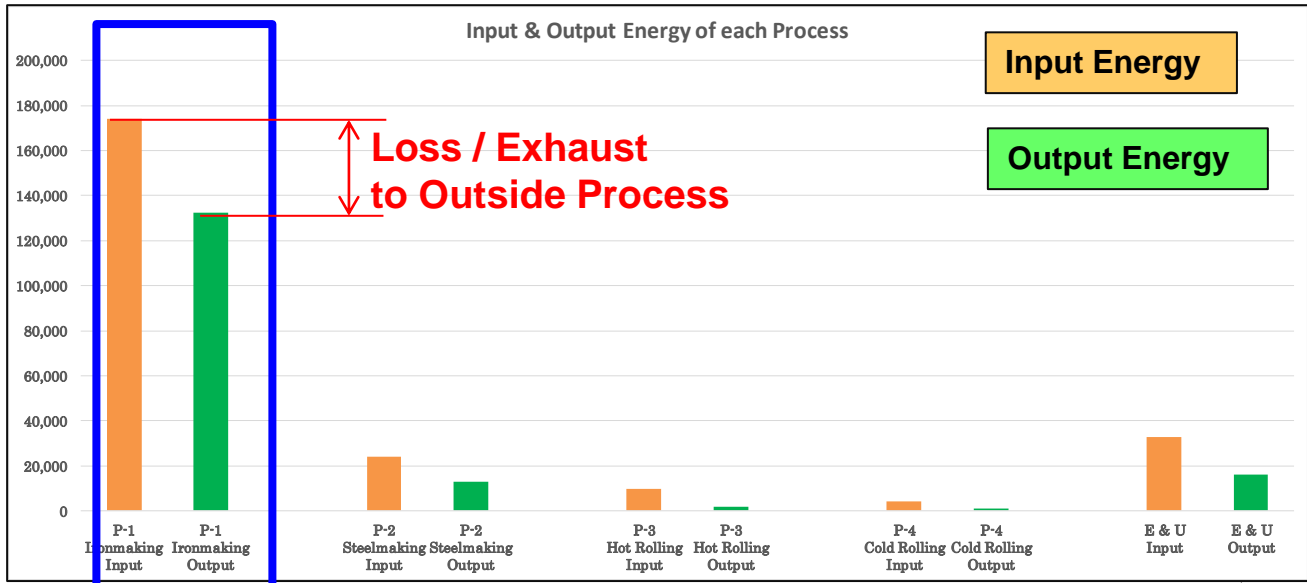
- Target and Difference
- Target for Energy Efficiency (Unit Energy Consumption : GJ/t-crude steel)
 - Target Comparison (Benchmark) : National Benchmark, Other Benchmark, Actual Status
 - Difference between 'Actual' and 'Target' (Unit: GJ/t-crude steel)

- EnPI – Target (Benchmark)
- Compare (Target – Actual)

Monitoring and Evaluation Simulation to Estimate



Tool – 1 : Database → Visualize Data / “SEU” Identified



SE U :
Significant Energy Use

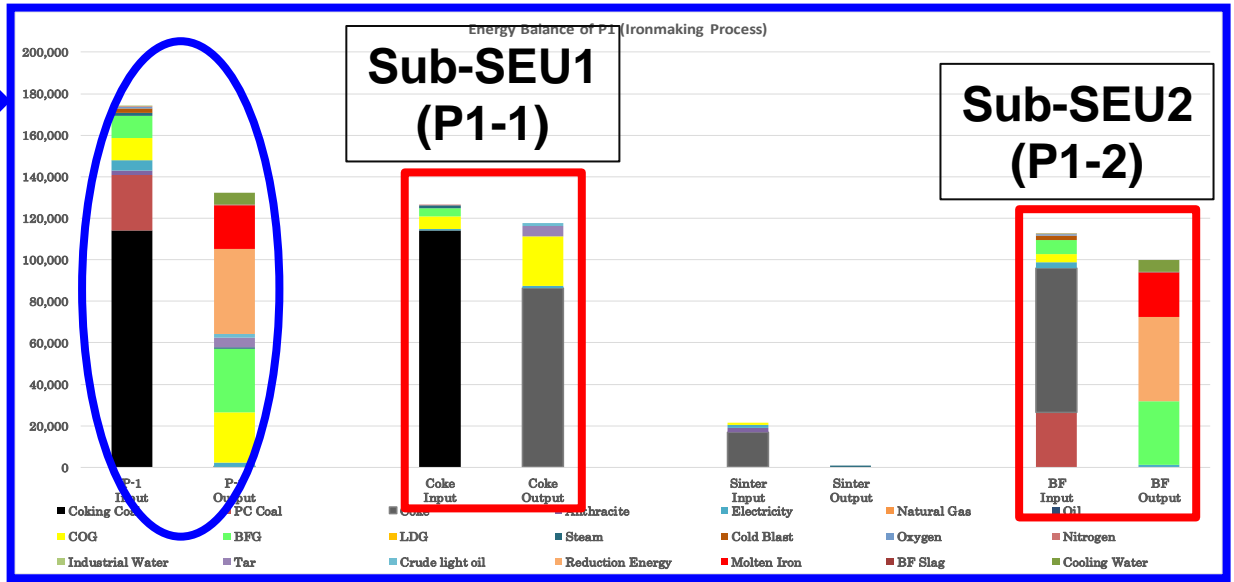
Detailed Analyses
Loss, Chemical Reactions, Each Equipment etc.

SEU (P1)

Process Flow

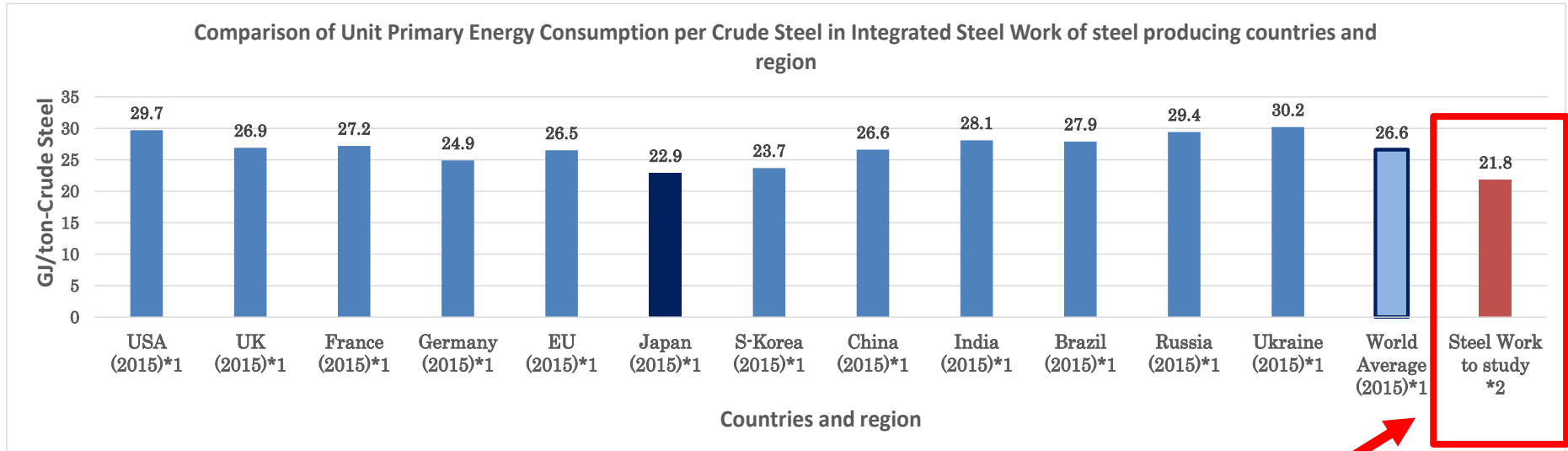
Breakdown Analysis

- Subprocess of P1
- Evaluation on Each Energy Resources etc.



Tool – 1 : Database

- Comparison of Output - Gap Analysis with Others -



Sample

Our Company or Country

Important Requirements and Functions for Database

- (1) Precise Data to Evaluate Energy and Material Balance
- (2) Availability and High Reliability of Data and Information to Compare
- (3) Simulation Possible to Equalize Information and Data for Evaluation by the Following to Affect EnPI
(Process / Operation / Technologies / Conditions of Materials and Products, etc.)

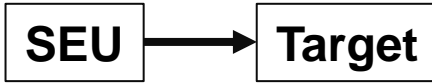


Tool – 2 : Sheet to Check Factors / Conditions to Affect EnPI

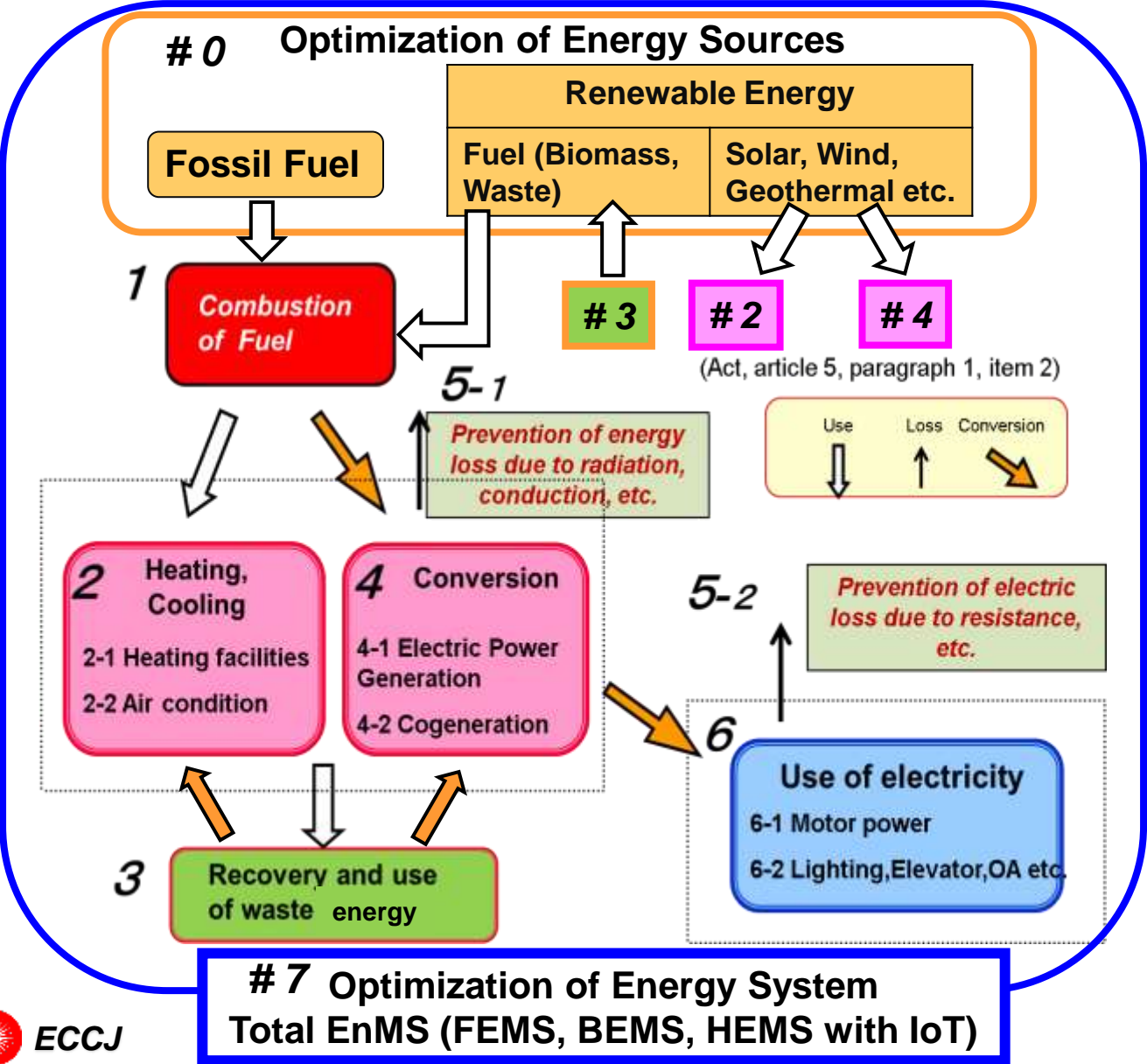
Conditions
(Material etc.)

Technology
Measures

	Process	Energy & Utility	P1 : Ironmaking		P2 : Steelmaking			P3 : Hot Rolling	P4 : Cold Rolling / Finishing
			Raw Material Pre-treatment	Blast Furnace (BF)	Hot Metal Pre-treatment	Converter (BOF / LD) Electric Arc Furnace	Casting / Ingot Making	Hot Strip Mill (HSM) Heavy Plate Mill etc.	Cold Strip Mill (CSM) Finishing
Factors to Affect EnPI	Conditions of Raw Materials	Iron Ore - Total Fe - SiO ₂ /Al ₂ O ₃ , etc.	Sizing / Blending Sintering / Pelletizing - Basicity Control, etc.	Ore Mixing Conditions Low Quality Ore Usage Scrap Charging	Hot Metal Conditions ([S], [Si], [P])	Hot Metal Ratio Scrap / DRI Conditions Ferro Alloys	Molten Steel Temp.	Slab / Bloom / Billet - Temp.	Rolled Steel Coil - Pretreatment
		Limestone - CaO Content Other Fluxes	Sizing / Blending Calcining (Quicklime)	Flux Conditions (Slag Basicity etc.)	Flux Conditions	Basicity Control (CaO Content in Slag)	Flux		
		Coal - Total C / Ash Content, etc.	Sizing / Blending Coke Making	Fuel Conditions Coke / Pulverized Coal / Natural Gas, etc.		Carbon			
Energy & Utilities	Fuel / Electricity / Gas / Water etc.	Electricity / Fuel for Combustion / Heating Media / N ₂ , etc.	Cold Blast / O ₂ Enrichment / Moisture / Fuel for Hot Stove / Electricity / Water / N ₂ etc.	blowing Gas	O ₂ & Ar for Refining & Degassing / Electricity / Water etc.	Electricity / Fuel for Heating / Water, etc.	Electricity / Fuel for Heating / Water, etc.	Electricity / Fuel for Heating / Water, etc.	
Conditions of Products			Hot Metal (Temp. [Si], [S], [P]) * Foundry Iron (Qualities)	[Si], [P] Content Temp. of Hot Metal	Crude Steel (Temp. and Quality) Stainless Steel, Alloyed Steel etc.	Slab / Billet / Bloom (Qualities, Yield)	Kinds / Qualities / Lot Size etc. (Coil, Plate, Wire, Rod, Pipe etc.)	Kinds / Qualities / Lot Size etc. (Coil, Plate, etc. / Galvanizing, Plating etc.)	
Typical Technologies (Refer to "Technical Guideline for EE&C")	For Process	Energy Control Center (Monitoring / Guidance to Optimize Process Ope.)	Sintering - Mixture / Segregation Control - Ignition Furnace, etc. - Dust etc. Recycling Coke Making - Automatic Combustion Control - Coal Moisture Control - End-flue Burner - Recycle waste Plastic	- Hot Blast Control (O ₂ Enrichment, etc.) - Burden / Gas Distribution Control, Small Coke Usage - Hot Metal Si Control - Flexible Management of Fuels (All Coke, Fuel Injection etc.) - Fuel Injection : PCI, Waste Plastic, NG, Waste Gas etc.	Optimization with BOF Flux Injection Synchronization of BF-BOF Operation Torpede Ope. Control System	BOF - Bottom / Top Blowing - Refining Control - Ladle Furnace Treat. - Degasser EAF - Oxygen Blowing	- Continuous Casting (CC) - Synchronizing Control with Hot Rolling - Low Frequency Stirring	- Rolling Control - Continuous Rolling - Synchronizing Control with CC (Hot Slab Direct Charge - HDR, DHCR etc.) - Descaling	- Continuous Annealing (Temp. / Atmosphere Control) - Synchronization with HSM - Galvanizing / Plating / Coating
	Common EE&C Tech.	-Co-generation Combined Cycle - Air Preheater - VVVF (Blowers, Pumps, etc.) - High Effi. Motors - Pressure Swing Adsorption Separation (PSA)	Sintering - Cooler Heat Recovery Coke Making - C.O. Gas Recovery - CDQ	- BF Gas Recovery (Inc. BGR) - TP Recovery Turbine with Dry Gas Cleaning - Hot Stove Waste Heat Recovery - VVVF for Dust Collectors		BOF - BOF Heat Recovery - LD Gas Recovery (OG) EAF - DC Type Furnace - Scrap Pre-heating	- Regenerative Burner	Re-heating Furnace - Combustion Control - Regenerative Type	Annealing Furnace - Temperature Control
Unit Energy Consumptions	GJ / t - Steel	GJ / t - Sintered Ore GJ / t - Coke	GJ / t - Hot Metal (Pig Iron)			GJ / t - Crude Steel (Slab, Billet, Ingot)	GJ / t - Hot Coil etc.	GJ / t - Finished Steel	



Tool – 3 : Basic Guideline for EC Based on Energy Flow



Guideline Based on

- The Structure of The Energy System
- Energy Flow

↓

Effective Tool for Sustainable EE&C Promotion

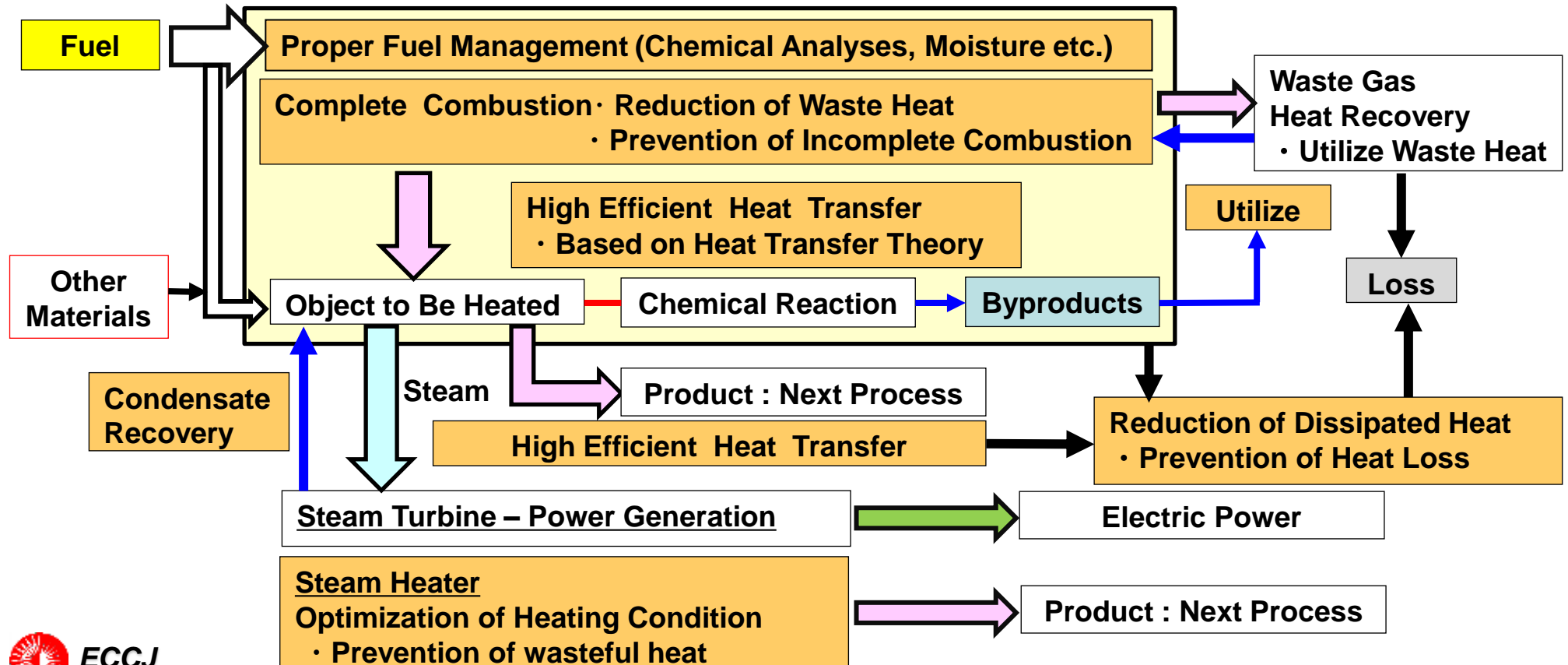
- Rationalization of**
1. Fuel and Combustion
 2. Heating, Cooling and Heat Transfer
 4. Conversion of Heat to Driving
 6. Conversion of Electric Power to Driving Force and Heat, etc.
- Recovery and Utilization of**
3. Waste Energy (Heat etc.)
- Prevention of Energy Loss by**
5. Radiation, Conduction and Resistance etc.

(Reference)
EC Guideline (Japanese EC Act)

Tool – 3 : Basic EC Guideline - Rational Use of Thermal Energy

Points

- (1) Understand Actual Total Heat Balance / Consuming Situation of Each Equipment
→ Visualization of data is effective (Statistical Processing Using Graphs etc.)
- (2) Evaluate whether Heating / Cooling Condition (Optimum or not)
→ Check Heating Temperature, Specifications of Steam and Furnace etc.)
- (3) Decide Possible EC Measures and Potentiality to Improve / Prioritize EC Measures



Tool – 3 : Basic EC Guideline - Rational Use of Electrical Energy

Power Plant (High Efficiency Generator)

Reduction & Prevention of Loss and Wasteful Use

Substations
 • High Efficiency Transformer

Pressure Drop
 Leakage

Loss

Loss

Loss

Loss

Transmission Line
 • Prevention of Loss

Required Motor Power
 - Air Pressure
 - Flow Rate (Ave. & Max.)

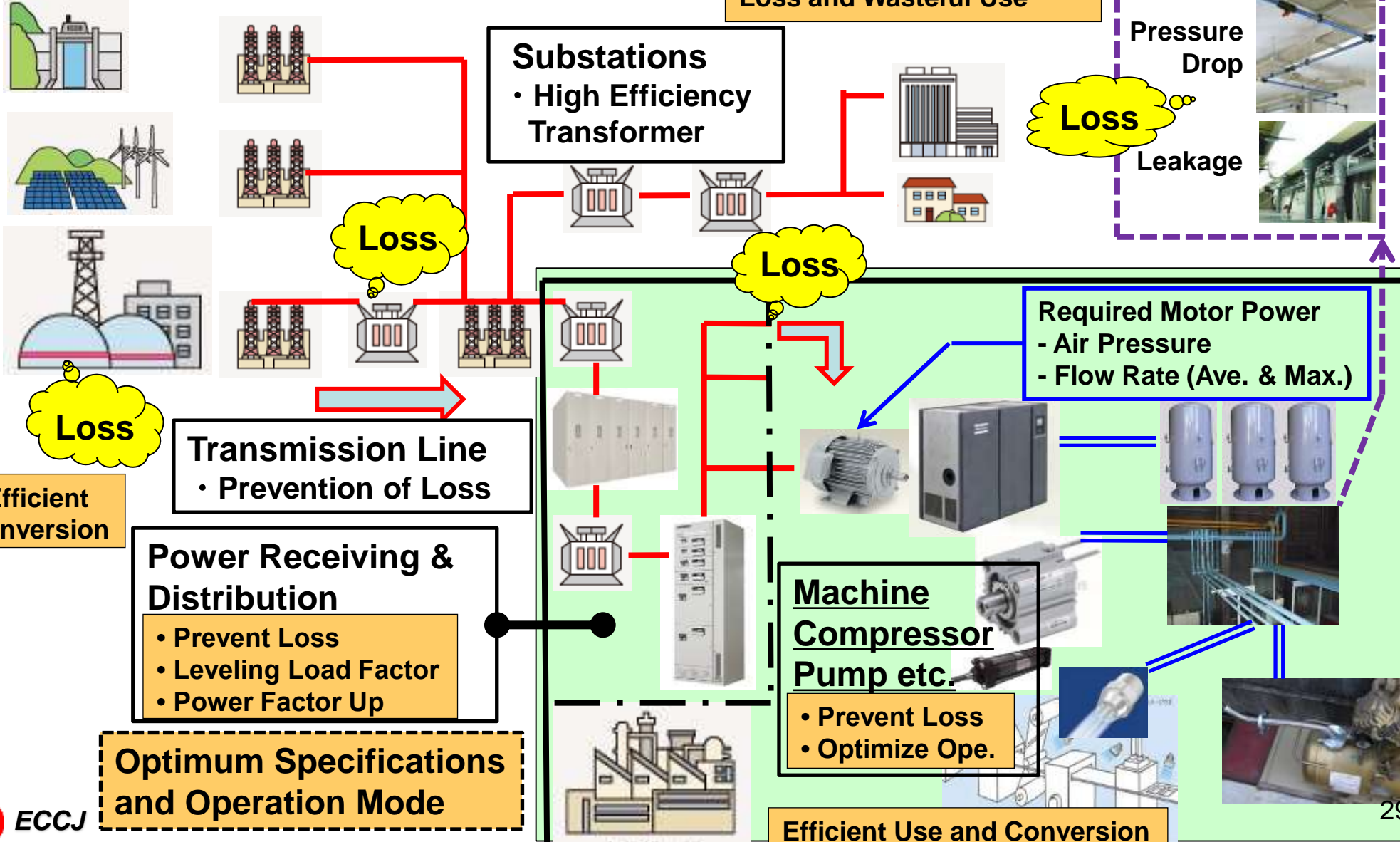
Efficient Conversion

Power Receiving & Distribution
 • Prevent Loss
 • Leveling Load Factor
 • Power Factor Up

Machine Compressor Pump etc.
 • Prevent Loss
 • Optimize Ope.

Optimum Specifications and Operation Mode

Efficient Use and Conversion



Tool – 3 : Guideline for EE&C Technologies and Equipment (Common) Linked with EE&C Basic Guideline

Items of Technology / Equipment		Guideline No.		(*)		A. Inter-Sector (Common to Many Industries and Buildings)	
Field / Industrial Sectors		Basic EC Guideline No.	GL No.		JASE-W Tech. Directory (Ref. No.)		
Technology / Equipment							
#0	Optimization of Energy Resources	0					
4-4	Friction welding	0	0		F-26		
5-6	Power Generation by Renewable Energy	6 #0	0		E-14, E-47, E-04, E-19, E-08, E-20, E-45, E-23		✓
6-2	6-2-4 Heaters Using Various Sources (Sun, Underground)	0, #6-1, #3	0	3			✓
7-3	Utilization of Natural Light (Mirror Duct etc.)	0, #5-2	0		O-21		✓
10	Utilization of unutilized energy	0, #3	0	3			
10-1	Conversion of Waste to Fuels	0, #3, #1, #5-1	0	3	1 51	E-08, E-20	
10-2	Power Generation and Heat Utilization by Waste Fuels	0, #3, #4, #5-1	0	3	4 51	O-24	
10-3	Utilization System of Methane Gas of Anaerobic Treatment for Waste Water	0, #3, #2, #3	0	3	2		
10-4	Utilization of Energy with Temperature Difference	0, #5-1, #3	0	3	51		✓
10-5	Power Generation by Utilizing Remaining Pressure	0, #3, #4	0	3	4		✓
10-6	Utilization of Other Energy Resources (Municipal Solid Waste, Underground Heat and Urban Waste Heat etc.)	0, #3, #5-1, New G/L	0	3	51	F-75, O-16, O-24, O-22	
		0, #1 New G/L	0			F-75, O-16, E-41, E-02, E-14, E-42, E-44, E-23, E-28, O-20, O23	✓
12-1	Utilization of Renewable Energy						
12-2	Optimization of Energy Sources	0, #3, New G/L	0	3		C-01	
12-4	Passive Design	0 New G/L	0			O-20	
0-1	Fuel Cell	0	0			F-02, F-03	
0-2	Hydro Power	0, #3	0	3		E-26, E-27, E-34	
0-3	Storage of Power	0	0			E-05, E-13, E-18, E-33	
#1	Rationalization of Fuel and Combustion		1				
1-1	Air Ratio Improvement	1	1				✓
1-1-1	Gas Analyzers	1	1				✓
1-1-2	Fuel - Air Flow Rate Measurement & Controllers	1	1				✓
1-1-3	Air Ratio Controllers	1	1				✓
1-1-4	Automatic Combustion Control (?)	1	1				✓
1-2	Thermal Efficiency Improvement	1, #2, #3, #5-1	1	2	3 51		✓
1-2-1	Atomizers (by Steam and Gas)	1	1				✓
1-2-2	Oxygen (Enriched) Burners	1	1				✓
1-2-3	Catalyst Combustion Burners	1	1				✓
1-2-4	Efficient Combustion Air Blower	1	1				✓
1-2-5	Fluidized Combustion Equipment	1	1				✓
1-3	Air Blower / Ventilation	1	1				✓
1-3-1	Automatic Draft Controller	1	1				✓
1-4	Combustion Control	1	1				✓
1-4-1	Measuring Sensors of Fuel Flow Rate	1	1				✓
1-4-2	Controllers for Fuel Feeding	1	1				✓
1-4-3	Controllers for Combustion Air Volume	1	1				✓
1-4-4	Automatic Combustion Controllers	1	1				✓

Main Basic EC Guideline

Common Technology and Equipment

Commonness to Many Sectors

(*) Item No. of "Japanese Smart Energy Products & Technologies"

Tool – 3 : Guideline for EE&C Technologies & Equipment (Common – Sector Specific) Linked with EC Basic Guideline

EC Guidelineに基づく分類のベース (2019年7月6日)				Iron and Steel		Cement	
Field / Industrial Sectors	Basic EC Guideline No.	GL No.	JASE-W Tech. Directory (Ref. No.)	A. Inter-Sector (Common to Many Industries and Buildings)	Additional Basic EC Guideline No.	Additional Basic EC Guideline No.	Additional Basic EC Guideline No.
0 Optimization of Energy Resources							
*1 5-6 Power Generation by Renewable Energy	#6	0	E-14, E-47, E-04, E-19, E-08, E-20, E-45, E-23				
*1 6-2 Heaters Using Various Sources (Sun, Underground)	#6-1, #3	0 3					
*1 7-3 Utilization of Natural Light (Mirror Duct etc.)	#5-2	0	O-21				
*1 10 Utilization of unutilized energy	#3	0					
*1 10-1 Conversion of Waste to Fuels	#3, #5-1	0 51	E-08, E-20		Recovery of COG, BFG and LDG - Power Generating Plants, BGR, TRT		
*1 10-2 Power Generation and Heat Utilization by Waste Fuels	#3, #4, #5-1	0 4 51	O-24		Utilization of Fine Coke and Coal (Including Dust and Sludge), Waste Oil	Utilization of Waste Tire and Biomass	Process
*1 10-3 Utilization System of Methane Gas of Anaerobic Treatment for Waste Water	#3, #2, #3	0 2 3			Utilization of Waste Plastic (for CO and BF)		
*1 10-4 Utilization of Energy with Temperature Difference	#5-1, #3	0 3					
*1 10-5 Power Generation by Utilizing Remaining Pressure	#4	0					
10-6 Utilization of Other Energy Resources (Municipal Solid Waste, Underground Heat and Urban Waste Heat etc.)	#5-1, New GL	0	F-75, O-16, O-24, O-22		TRT		
12-1 Utilization of Renewable Energy	New GL	0	F-75, O-16, E-41, E-02, E-14, E-42, E-44, E-23, E-28, O-20, O23				
12-2 Optimization of Energy Sources	#3, New GL	0	C-01				
12-4 Passive Design	New GL	0	O-20				
*1 x x Fuel Cell		0	F-02, F-03				
*1 x x Hydro Power		0	E-26, E-27, E-34				
1 Rationalization of Combustion of Fuel							
1-1 Air Ratio Improvement	#1	1		✓	Coke Oven, Hot Stove, Re-heating Furnaces etc.	Kiln Burner, Calciner	Process
1-1 Gas Analyzers	#1	1		✓			
1-1 Fuel - Air Flow Rate Measurement & Controllers	#1	1		✓			
1-1 Air Ratio Controllers	#1	1		✓			
1-1 Automatic Combustion Control (?)	#1	1		✓			
1-2 Atomizers (by Steam and Gas)	#1	1		✓	Oil Injection, Pulverized Coal Injection (PCI) to BF	BF, EAF	Process Guidelines
1-2 Oxygen (Enriched) Burners	#1	1		✓			
1-2 Catalyst Combustion Burners	#1	1		✓			
1-2 Efficient Combustion Air Blower	#1	1		✓	Combustion Air Fans for Various Furnaces		
1-2 Fluidized Combustion Equipment	#1	1		✓			
1-3 Air Blower / Ventilation	#1	1		✓	Hot Stove	Blowers for De-dusting System and Pneumatic Transportation, Various Mills	
1-3 Automatic Draft Controller	#1	1		✓			
1-4 Combustion Control	#1	1		✓	Coke Oven, Hot Stove, BF, Re-heating Furnace etc.	Kiln, Calciner (New Suspension Pre-heater (NSP))	Process
1-4 Measuring Sensors of Fuel Flow Rate	#1	1		✓			
1-4 Controllers for Fuel Feeding	#1	1		✓			
1-4 Controllers for Combustion Air Volume	#1	1		✓			
1-4 Automatic Combustion Controllers	#1	1		✓			
1-5 Latent Heat Recovery Type Boilers	#1, #3	1 3		✓			
1-5 Others (Boilers etc.)	#1, #3, #5-1	1 3 51		✓	Boilers for Power Generating Plant, Various Waste Heat Recovery Boilers	Waste Heat Recovery Power Generation System	
2 Rationalization of Heating Cooling and Heat Transfer							
*1 1-2 Thermal Efficiency Improvement	#1, #2, #3	2 1 3		✓	Coke Oven, Hot Stove (S-18), Re-heating Furnace etc.	Pre-Heaters and Calciner (New Suspension Pre-heater (NSP)), Kiln,	Process
*2 1-2 Merged Burner for Heating Liquid Materials	#1, #2	2 1		✓			
1-3 Dehydration Blowers (Re-heater for Dehydrated Air)	#2	2		✓			
*2 1-3 Blowers of soot	#2	2		✓			
*1 1-5 Ceramic Radiant Tube	#1 & #2	2 1		✓			
2-1 High Efficiency of Heating Elements	#2, #3	2 3		✓			
2-3 Improvement in Emissivity of Furnace Wall	#2	2		✓	Annealing Furnace		
2-3 Far Infrared Paint Dryer, High Performance Far Infrared Dryer	#2	2		✓			
2-3 High Efficiency Radiant Heating and Drying Equipment	#2	2		✓			
2-3 High Emissivity of Paint to Coat Furnace Inner Surface	#2	2		✓			
2-4 High Emissivity Heaters (Radiant Heater, etc.)	#2	2	F-17, F-18	✓			
2-4 Hybrid Heating Equipment	#2	2		✓			
2-4 High Efficiency Radiant Tube Burners	#2	2		✓			
2-4 High Efficiency Heating Tube	#2	2		✓			
2-4 Heat Transfer Improvement	#2, #5-1	2 51		✓	Coke Oven, Sintering Machine, BF, Ladle Heaters, Re-heating Furnace, Annealing	Pre - Heaters, High Efficiency Clinker Cooler (Air Beam Type etc.)	Process
2-4 Stirrers of Gas inside Furnaces	#2, #5-1	2 51		✓	Induction Stirrer		
2-4 Direct Heating Including Special Burners	#2, #5-1	2 51		✓		Kiln (Clinker Production)	Process
2-4 Heating Control	#2, #5-1	2 51		✓			
*1 2-4 High Efficiency Industrial Furnaces	#5-1	2		✓			
2-6 Direct Heating Facility	#2, #1	2 1		✓			
2-6 Merged Burner for Heating Liquid Materials	#2, #1	2 1		✓			
2-6 Direct Firing Type of Dryer for Textile	#2, #1	2 1		✓			
2-6 Direct Firing Type of Dryers	#2	2		✓			
2-7 Multiple Stage Effect Heating	#2, #3	2 3		✓	Hot Air Generator for PCI		
2-8 High Efficiency Distillation Tower	#2, #5-1	2 51		✓			
*2 2-9 Complex Thermal Utilization for Heating Equipment	#2, #3	2 3		✓			
2-10 Heating Control Improvement	#2	2		✓	Coke Oven, Sintering Machine, Hot Stove, Re-heating Furnace	Pre - Heaters, Calciners, Coal Mill, Raw Mill	
2-10 Automatic Heating Controllers	#2	2		✓			
2-10 Controllers of Heat Pattern	#2	2		✓			
2-11 Process to Shorten / Eliminate	#2, #5-1	2 3		✓	PCI, CC, DHC, DHCR, Continuous Hot Rolling	Kiln	
2-16 Hybrid Heating System	#2	2		✓			
2-16 Vacuum Steam Heating (Including Steam Ejector)	#2	2		✓			
2-19 Others (Heat Pump, Boosting Steam Heating, etc.)	#2, #3	2 3	F-08, F-67, O-24	✓			
*1 6-1 Far Infra-red Heater	#6-1	2	F-16, O-12, R-06	✓			
*1 6-1 Sprayed Water Cooling of Outside Heat Exchanger	#6-1	2		✓			

Tool – 3 : Guideline for EE&C Technologies & Equipment (Common – Sector Specific) Linked with EC Basic Guideline



Iron and Steel

Cement

6 Rationalization of Electric Power to driving Force and Heat		#6-1, #5-2, Other	6	52			Major Electrical Equipment (Power Plant, Rolling Machine, Big Blowers etc.) Various Machine Driving		Various Machine Drive		
5-1	High Efficiency Motor	#6-1	6								
5-5	Electrical Heating	#6-1	6				EAF (DC), Submerged Arc Furnaces, Various Induction Furnaces and Heating				
5-5	High Efficiency Electric Furnace (Arc, Joule Heating)	#6-1	6								
5-5	High Efficiency High / Low Frequency Heating Furnace, etc.	#6-1	6								
5-5	Other Electrical Heating (Microwave Heater etc.)	#6-1	6								
5-6	Stabilizer for Loaded Voltage	#6-1	6								
5-6	High Efficiency Electrolysis	#6-1	6				Zn and Sn Plating				
5-6	High Efficiency Hydraulic Pressure Unit, etc.	#6-1, #5-2	6	52			F-85, C-02, C-04				
*2	6-1 High Efficiency Turbo Chillers	#6-1	6				F-16, O-12, R-06				
*2	6-1 Far Infra-red Heater	#6-1	6								
7-1	High Efficiency Lighting	#6-2	6				O-29, O-32				
7-1	High Frequency Light (LED, High Pressure Na, etc.)	#6-2	6								
7-1	High Frequency Lighting	#6-2	6								
7-1	Reflector with High Reflection	#6-2	6								
*1 x x	Storage of Power						E-05,E-13,E-18, E-33				
7 Optimization of Energy System			7								
*1	2-17 Accumulators of Thermal Energy	#2	7					Hot Stove, Regenerators, Steam System	Process Guidelines		
*1	2-17 Heat Accumulating Heaters / Coolers of water	#2	7								
*1	2-17 Steam Accumulator	#2	7								
*1	4-3 Steam Control System (Temp. and Pressure, etc.)	#3, #4, #5-1	7	4	51						
*1	5-4 Instrumentation and Control Equipment (Including PLC-DCS)	#5-2, #6-1, #6-2	7	6			F63, F-65, E-36, F-64, F-85, F-55, F-56, F-57, F-58, O-33, O-19, E-44	All Processes and Facilities	Process Guidelines	All Processes and Facilities Process Guidelines	
*1	5-4 Demand Controller	#6-1, #6-2, Other	7								
*1	5-4 System to Improve Load Factor with Transformer Ope.	#6-1	7								
*1	5-4 Operational Control for Pumps, Compressors etc.	#6-1	7								
5-4	On-line Measurement with Sensors	G	7				E-38				
*1	6-1 Demand Controlled Air Conditioning etc.	#5-2, Other	7	52			O-04, O-37				
8-1	Function to Manage Unit Energy Consumption		7								
8-2	Total Energy management System		7								
8-2	FEMS (Including Packaged Control System)	#1,#6	7				F-62, F-64, F-85, F-58, F-60, E-15,E49	All Processes Including "Energy Center"	Process Guidelines	All Processes	
8-2	BEMS (Including Packaged Control System)		7				O-19, E-15				
8-2	CEMS (Including Packaged Control System)		7				O-35				
11	Utilization of Information Technology (IoT)	#1 - #6	7				F-62, F-60, E-49	Energy Center			
11-1	Network System		7								
11-2	Simulation Technology		7					Simulators with Guidance of Operation for Main Processes	process Guidelines		
8 Technology / Equipment for Specific Industrial Process											
GL No. / Application		#1-#6						1. Coke Making : Automatic Combustion / CDQ-CMC (S-10, S-11, F-23) / End Flue Burner / SCOPE 21 (High Efficiency and High Productivity) Coke Making Process) 2. Ore Pre-treatment (Sintering): Segregated Charging / Direct Ignition Burner / Heat Recovery of Strand Cooling - Cooler / Hybrid Sintering (Blast Furnace) Fuel Injection such as PCI / Burden Distribution Control / TRT (S-13, S-08) / BGR / Low [Si] Control of Hot Metal 4. Steel Making : Hot Metal Pre-Treatment System / LD-OG / DC EAF / Continuous Caster (CC) / ECO EAF 5. Rolling HCR - DHCR / Regenerative Re-heating Process / Continuous Hot Rolling / Plunger Pumps / Continuous Annealing 6. Others : Rotary Hearth Furnace (S-09), DRI Fabrication System (S-16) Smelting Furnace - Shaking Ladle for Fe-Mn Manufacturing	Process Guidelines For EE&C and For Improvement in Productivity / Quality	1. Raw Material Preparation Vertical Type of Raw & Coal Mills with Automatic Classifier / Optimization of Grain Size 2. Pyro Process SP / NSP / Alternative Fuel Usage for Calciner (Waste Fuel and Biomass etc.) Efficient Kiln Burner 3. Cement Finishing Utilization of Recycled Materials (BF Slag etc.) Gas Recirculation System for Cement Mill	Process Guidelines For EE&C and For Improvement in Productivity

Process Technology for Specific Sector

Tool – 3 : Guideline : EE&C Technologies & Equipment Useful Information of Effective Tech. and Equip. (Effects etc.)

	Technology for EE&C	Outline of Technology	EC Effect (Unit Energy Consumption)		Payback Year (*)
			Unit-1 by EnPI	Single Unit (MJ)	
1	CO : Automatic Combustion Control	Programmed combustion control is applied to the individual combustion chambers for optimized heating to produce coke.	40 Mcal/t-coal		A
2	CO : Coke Dry Quenching Facility (CDQ)	Hot coke is cooled by inert gas of which sensible heat generates steam at a boiler. The steam is used for power generation and for heating materials such as CMC etc. The coolant gas is recycled in the system.	170-180 kWh/t-coke (0.5 t-steam/t-coke)		A
3	CO : Coal Moisture Control Facility (CMC)	Before charging coal to coke ovens, moisture of coal is reduced by heating with use of steam, which results in reducing fuel consumption at the coke oven. It is effective to combine with the CDQ System.	49 - 90 Mcal/t-coal		B
4	SP : Segregated Charging of Raw Mix	The size of raw mix and distribution of material are controlled when charging, which results in improving in gas permeability of raw mix hence improving yield and quality of sintered ore.	2.8 kg-coke/t-sinter		A
5	SP : Waste Heat Recovery System for Exhaust Gas Main	Sensible heat of exhaust gas main is recovered to generate steam to be used in the steel works including to preheat fuel gas / combustion air for the ignition burner etc.	30 Mcal/t-sinter		A
6	SP: Heat Recovery System for Cooling Air at Cooler	Sensible heat of cooling air of sintered ore is recovered to generate steam used for power generation and/or for combustion air and/or to preheat fuel gas at the ignition furnace etc. The cooled air is recycled.	95 Mcal/t-sinter or 26 kWh/t-sinter		B
7	SP : Direct Ignition Burner	The raw mix is directly ignited by a special burner. This is more efficient compared with the radiation type of ignition furnace.	6 - 7 Mcal/t-sinter		A
8	BF : Waste Heat Recovery System for Hot Stove	Sensible heat of combustion waste gas at hot stoves is recovered to pre-heat combustion air and/or fuel gas.	30-40 Mcal/t-iron		A
9	BF : Pulverized Coal Injection to BF (PCI)	Pulverized coal (PC) is directly injected into a blast furnace. PC is replaced with coke. This results in reducing energy consumption at the coke oven.	300 - 350 Mcal/t-iron		A



“Benchmark Approach” : Implementation – Output (1)

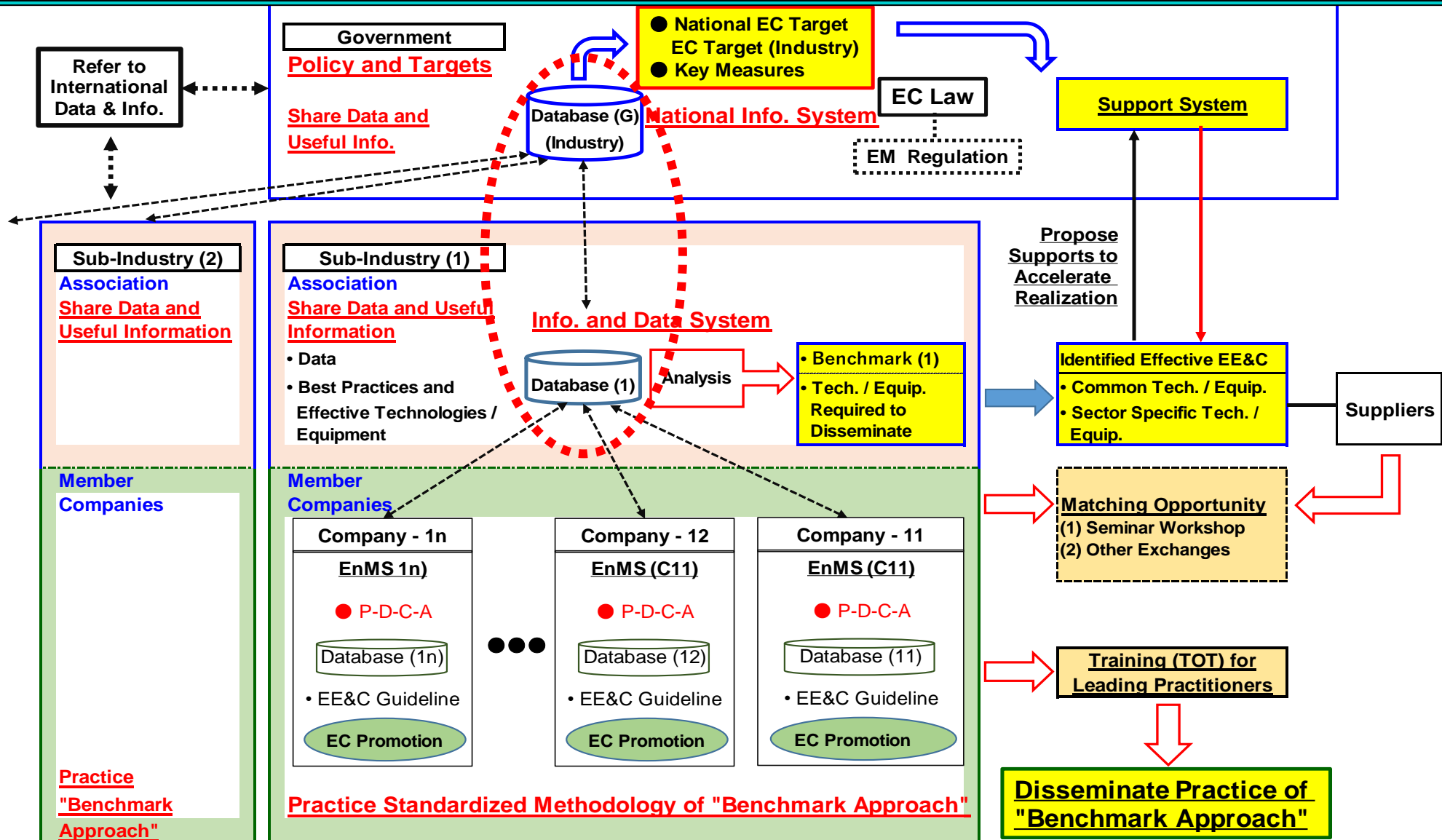
(15) Establish the “National System” to Share the Following Useful Data and Information for Each Sub-Industry

Useful Tools

→ The “National System” for Companies to Access Easily

- The “National System” will be consisted of the system established by the industrial association(s) for each sub-industry and the system operated by the Brazilian government (MME).**
- The “National System” is useful for companies both to refer to the targets (benchmarks) and to get information and tools in practice for EE&C promotion.**

“Benchmark Approach” : Implementation – Output (1)



“Benchmark Approach” : Implementation – Practice

It is important for companies to realize various measures to promote EE&C under EnMS. **“Benchmark Approach” is the Key Component of EnMS.** For the purpose of practicing “Benchmark Approach”, the following will be implemented.

- (16) Study and Develop the Standardized Procedure and System for the “Benchmark Approach” for Companies to Practice with Utilizing the Tools
- 1) Identify Baseline / Study and Establish EE Targets (Benchmarks) and Measures with Referring to the National EE Targets (Benchmarks) for Each Sub-Industry
 - “National System” ; To Get Data, Information and Tools
 - “Database” ; To Use for Collecting Data, Simulation and Sensitivity Analysis etc.

“Benchmark Approach” : Implementation – Practice

(16) (Continued)

2) Identify and Systematize Effective EE&C Measures to Achieve the Targets (Benchmarks) with Referring to the Recommended EE&C Measures of Each Sub-Industry

→ Basic EC Guideline

Guideline for Effective Technology and Equipment

3) Develop Action Plan (Energy Planning)

4) Systematic Implementation of the Action Plan

5) Analyze / Evaluate Results and Recommend the Next Actions

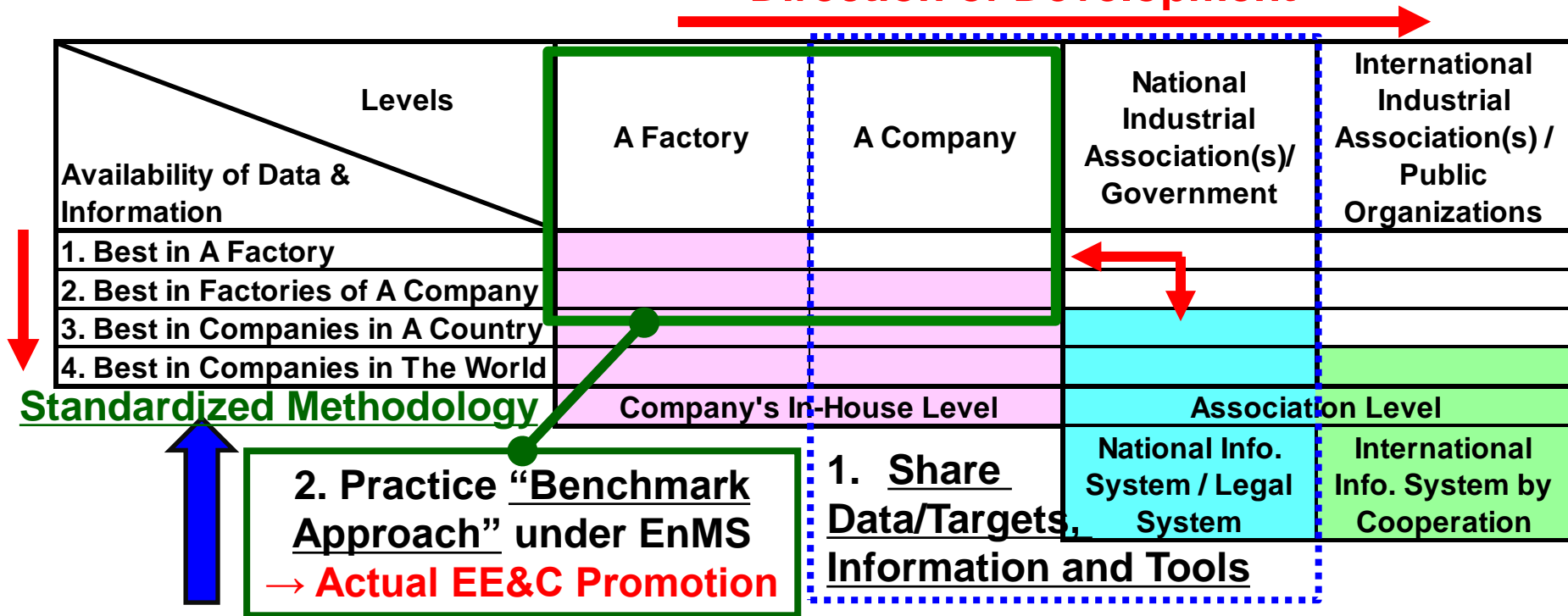
(17) Draft the Standardized System and Procedure of the

“Benchmark Approach” for Practice

Review It by the Industrial Associations

“Benchmark Approach” : Implementation – Practice

Direction of Development →



Key Points for Evaluation / Comparison → Assess Affecting Factors

(1) Technologies

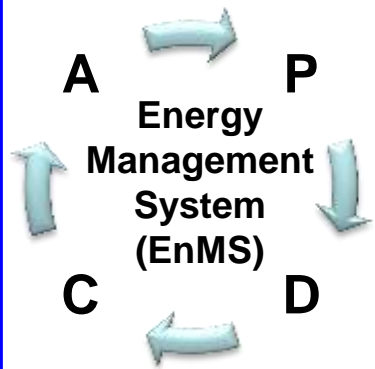
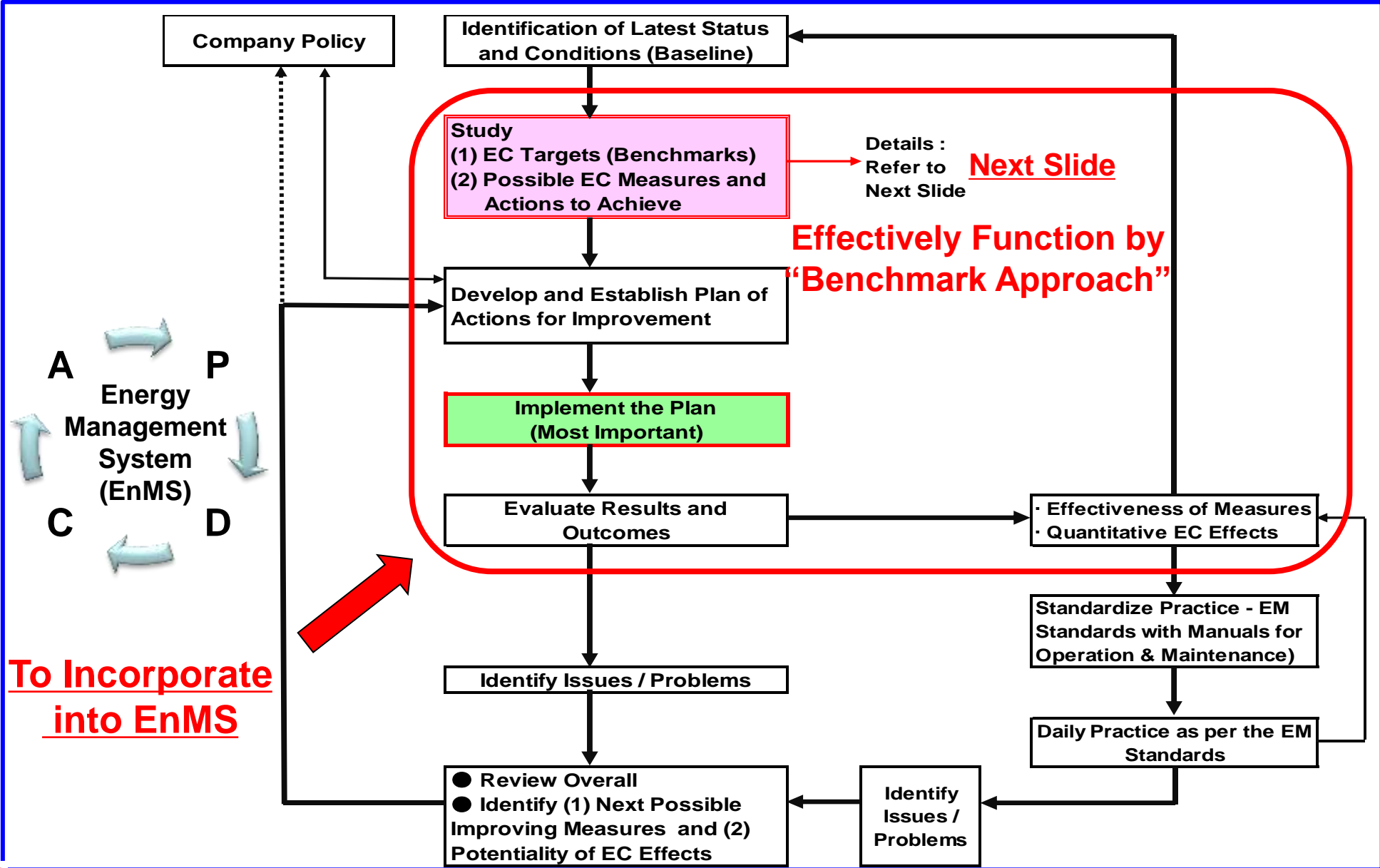
- Process
- EE&C Technology & Equipment

(2) Operating Conditions

- Plant Availability - Productivity
- Quality of Raw Materials / Products
- Product Mixture
- Available Energy and Utility, etc.

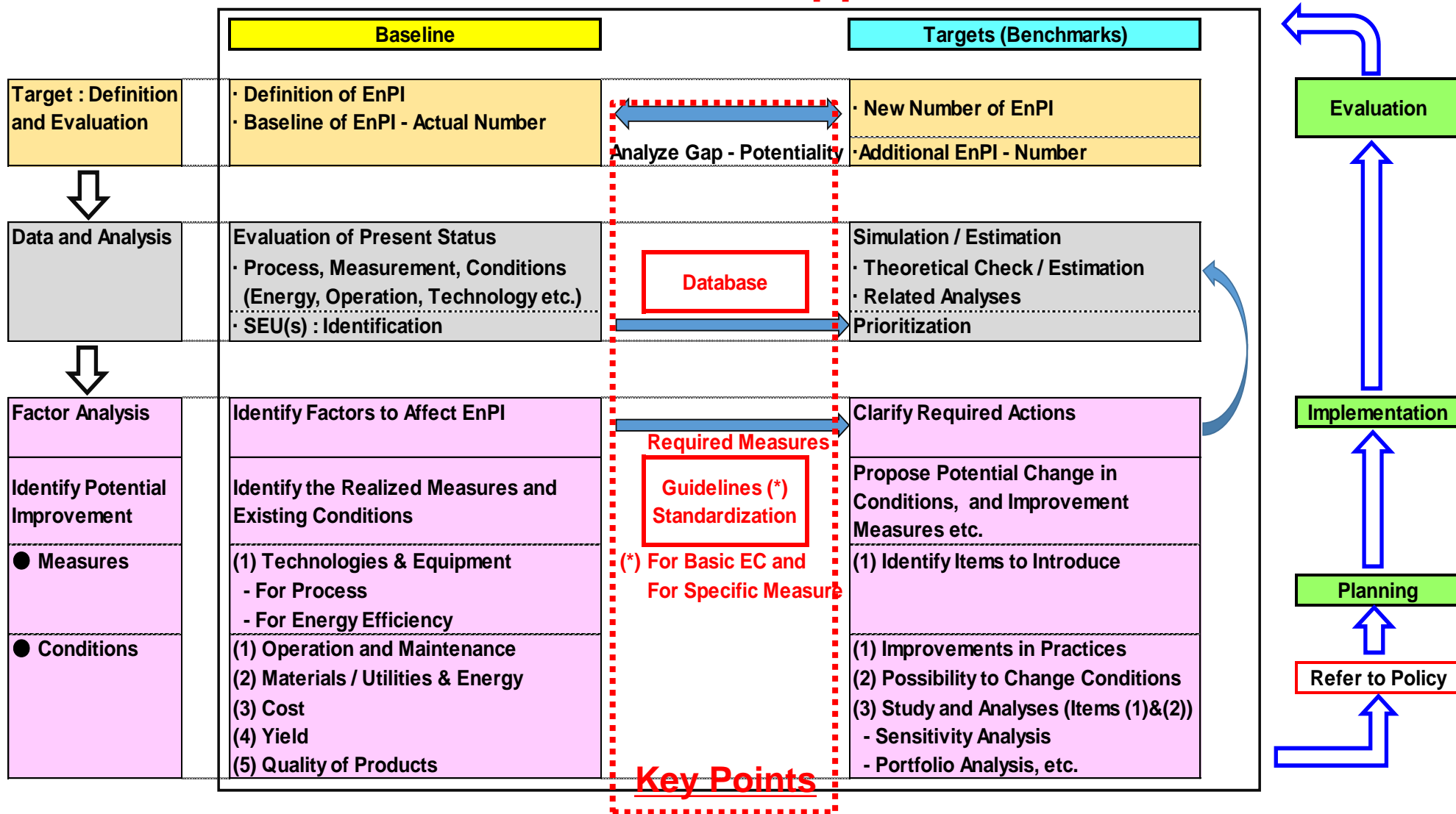


“Benchmark Approach : Points of Practice under EnMS



“Benchmark Approach : Basic Process in Practice under EnMS

Basic Process of the “Benchmark Approach”



“Benchmark Approach : Flow to Assess Benchmark / Measures

Survey / Energy Audit to Collect Data and Information – Online Collection

Analysis of Survey Results

Analysis 1 Baseline

- The EnPIs (The Actual Results of Energy Consumption, Production and Product Mix etc. for 2-3 years)
- The Existing Factors to Affect EE (Operation & Maint. Conditions, Qualities of Raw Materials & Products, Technologies and Equipment)

Analysis 2 Targets

- Identification of Possible Improvements in Factors to Affect EE
- Sensitivity Analysis / Simulation Using the “Database” by Adding the Affecting Factors or Changing Conditions of the Factors
- Assess the Results and Propose the Targets of EnPIs and Measures

Output Report

- Actual Baseline : EnPIs and The Existing Main Factors to Affect EE
- Recommended Targeted EnPIs (Benchmarks) and Measures to Achieve the Targets (Improvements in the Affecting Factors)
- The Expected EE Potential and Effects

Guideline for EC

• Database
• Analysis Tools

Planning and Implementation of Recommended Measures



Basic Flow for Energy Planning

(1) Collect Energy Data

(2) Analyze Energy Data (Past / Present / Future)

(3) Specify Process / Equipment of "SEU"

(4) Identify Parameters Affecting "SEU"
(Production / Climatic Conditions etc.)

**SEU : Significant
Energy Use
Concentrate
Resources on "SEU"**

(6) Study Effectiveness of Operation,
Maintenance, Design / Measurement /
Competence of Staffs

(7) Conduct Energy Audit

(5) Define Baseline / Energy Performance
Indicators (by Corelation Analyses etc.)

(Gap Analysis)

**Target
Benchmark**

**Develop Action Plan by Specifying Measures to Improve
Energy Performance with Estimated EC Potential**

“Benchmark Approach” : Implementation – Output (2)

- (18) Finalize the Standardized System and Procedure of the “Benchmark Approach” for Practice by Reflecting the Review Results**
- (19) Train Key Policy Makers and Leading Practitioners to Disseminate the “Benchmark Approach” for Practice with Database and the Guideline (Basic EC Guideline and Guideline of Effective EE&C Technology / Equipment (Training – Workshop in Japan)**
 - Development of Dissemination Plan**
 - Actual Usage in Practices in Companies**
- (20) Disseminate Standardized System and Procedure of the “Benchmark Approach” for Practice Including Database and Guideline of Effective EE&C Technology / Equipment**

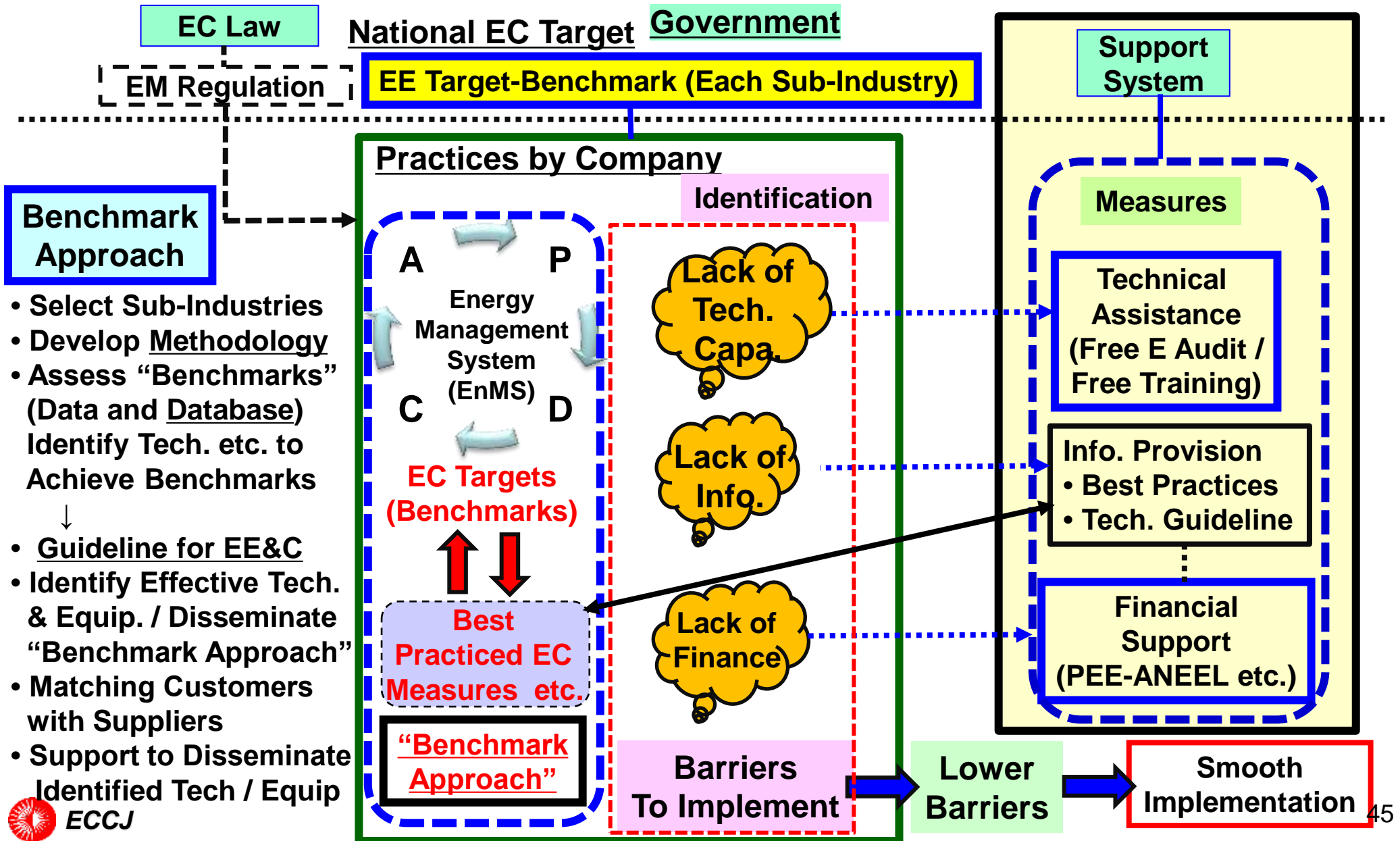
“Benchmark Approach” : Implementation - Support

In order to enhance realization of effective measures including technologies and equipment by companies, preparation of the appropriate “Support System” by Government will be effective.

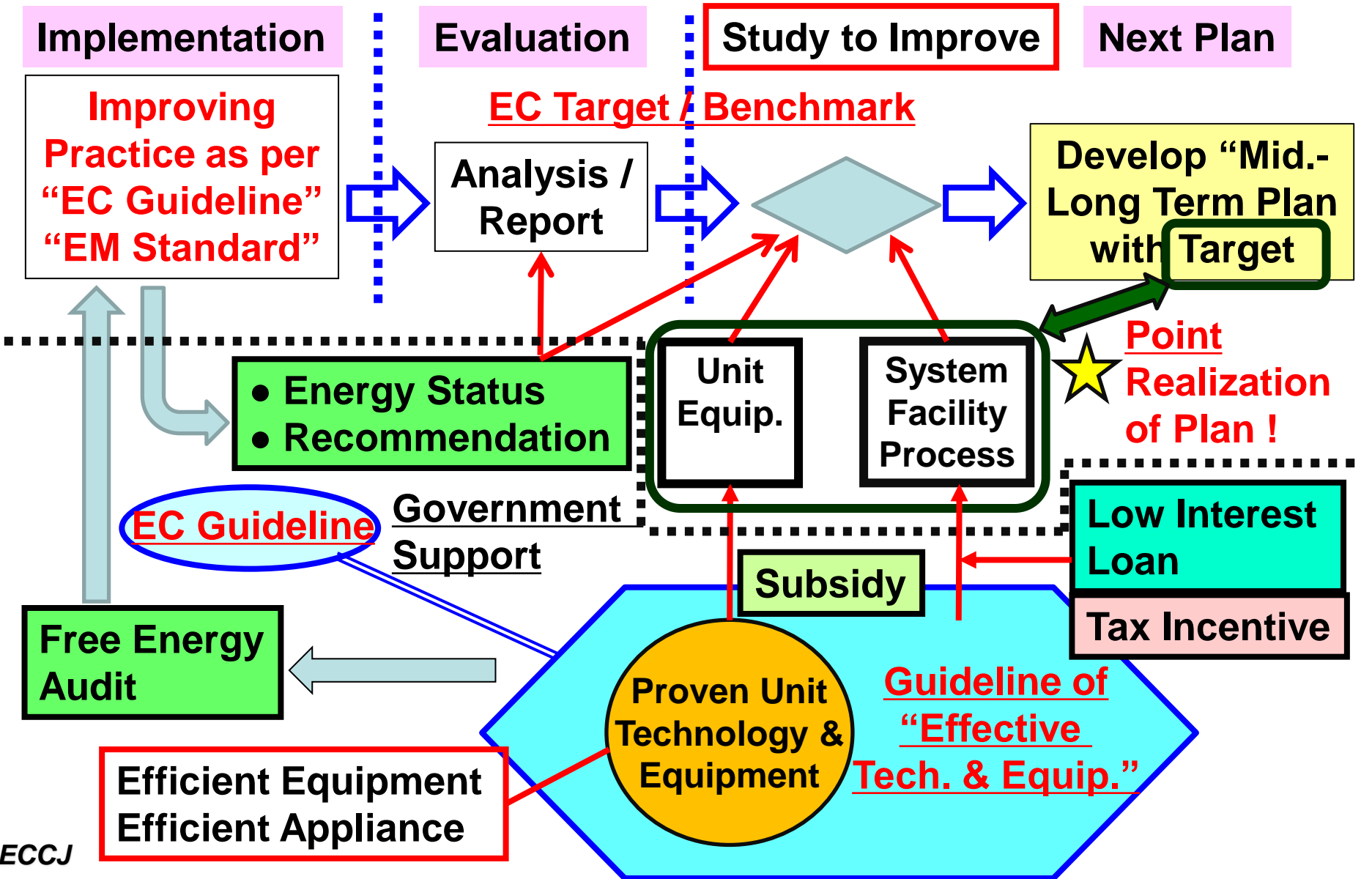
(21) Study and Propose Supporting Measures for Companies to Ease Introduction of Effective EC Technologies / Equipment Identified to promote EE&C

- The Proposed “Support System” Is Consisted of Financial and Technical Support Especially for Companies to Introduce Effective Technologies and Equipment Identified through the Activities.**
- The Addition of the Regulation on Energy Management System under The Existing EC Law Proposed in the Phase-1 Project also Will Be Discussed.**

Support System to Accelerate EE&C Promotion



Function of Support System in Various Phases of Energy Management to Accelerate EE&C Promotion



“Benchmark Approach” : Dissemination of Outputs

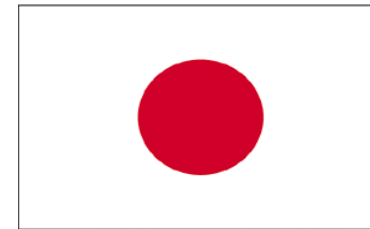
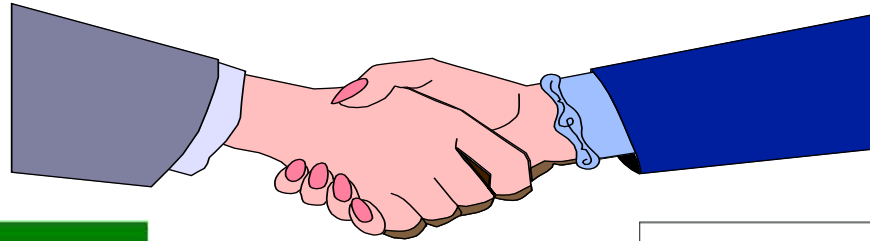
It is essential to establish the system and procedure for dissemination of the “Outputs” of the “Project”.

(22) Conduct Seminar Workshop to Disseminate the “Outputs” of the “Project”

Setup Opportunity (Seminar etc.) to Match between Customers and Suppliers of the Identified Effective EE&C Technologies / Equipment

(23) Develop Roadmap to Establish the Dissemination System and to Expand the “Benchmark Approach” to the Other Sub-Industries

Thank you very much



For More Information

[The Energy Conservation Center, Japan \(ECCJ\)](https://www.eccj.or.jp)

<https://www.eccj.or.jp>

[Asia Energy Efficiency and Conservation Collaboration Center \(AEEC\)](https://www.asiaeec-col.eccj.or.jp/index.html)

<https://www.asiaeec-col.eccj.or.jp/index.html>

[Japanese Business Alliance for Smart Energy Worldwide](https://www.jase-w.org/english/top/)

<https://www.jase-w.org/english/top/>