APEC Symposium on Promoting Energy Efficiency and Energy Management System

Improving Energy Efficiency in Industry in Japan

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Energy efficiency trend

and the situations in industry

Situations of industry for energy efficiency and low carbon

Measures in industry, as in other sectors, continue to be important to achieve low carbon. While electrification and the expansion of renewable electricity are important directions for transport, household and business sectors, industry further needs multilateral approaches such as process efficiency, efficient use of heat and electricity, and non-fossil energy sources.

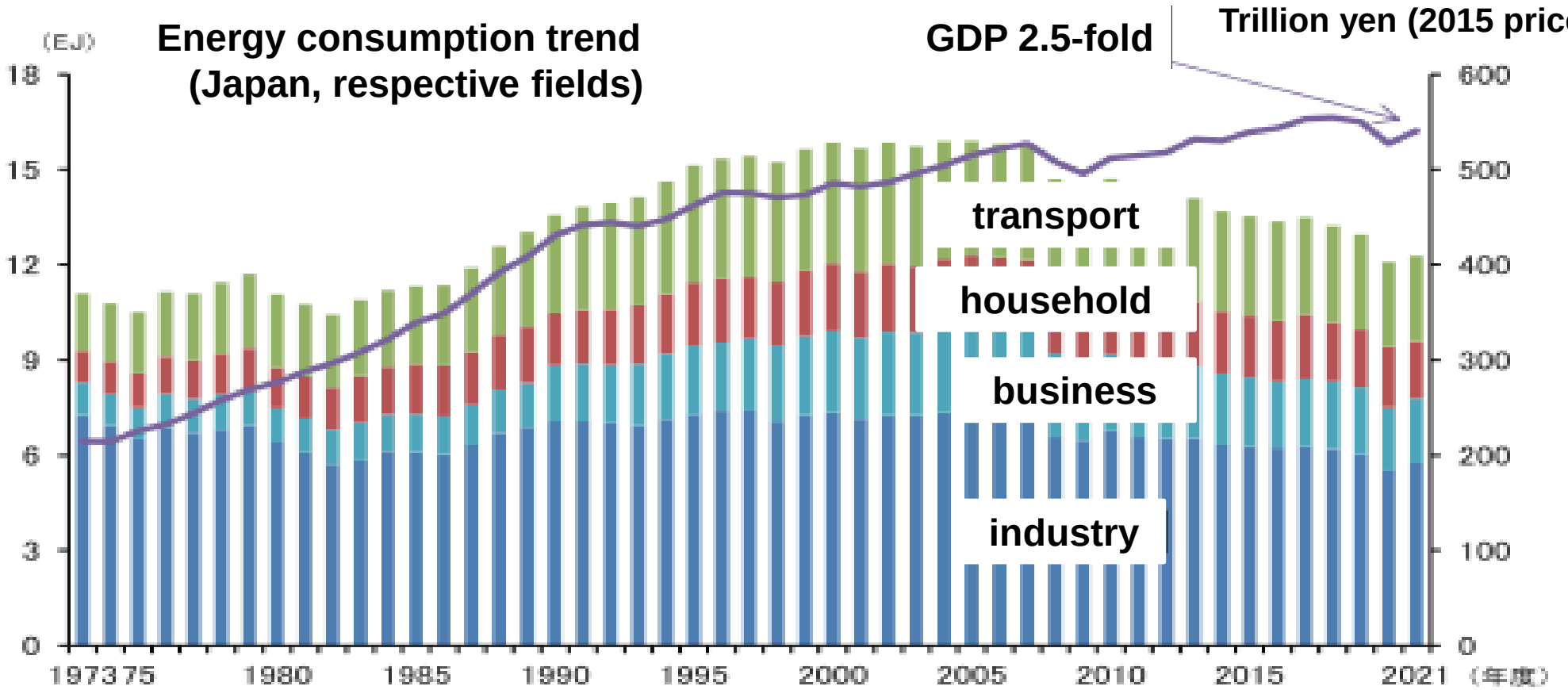
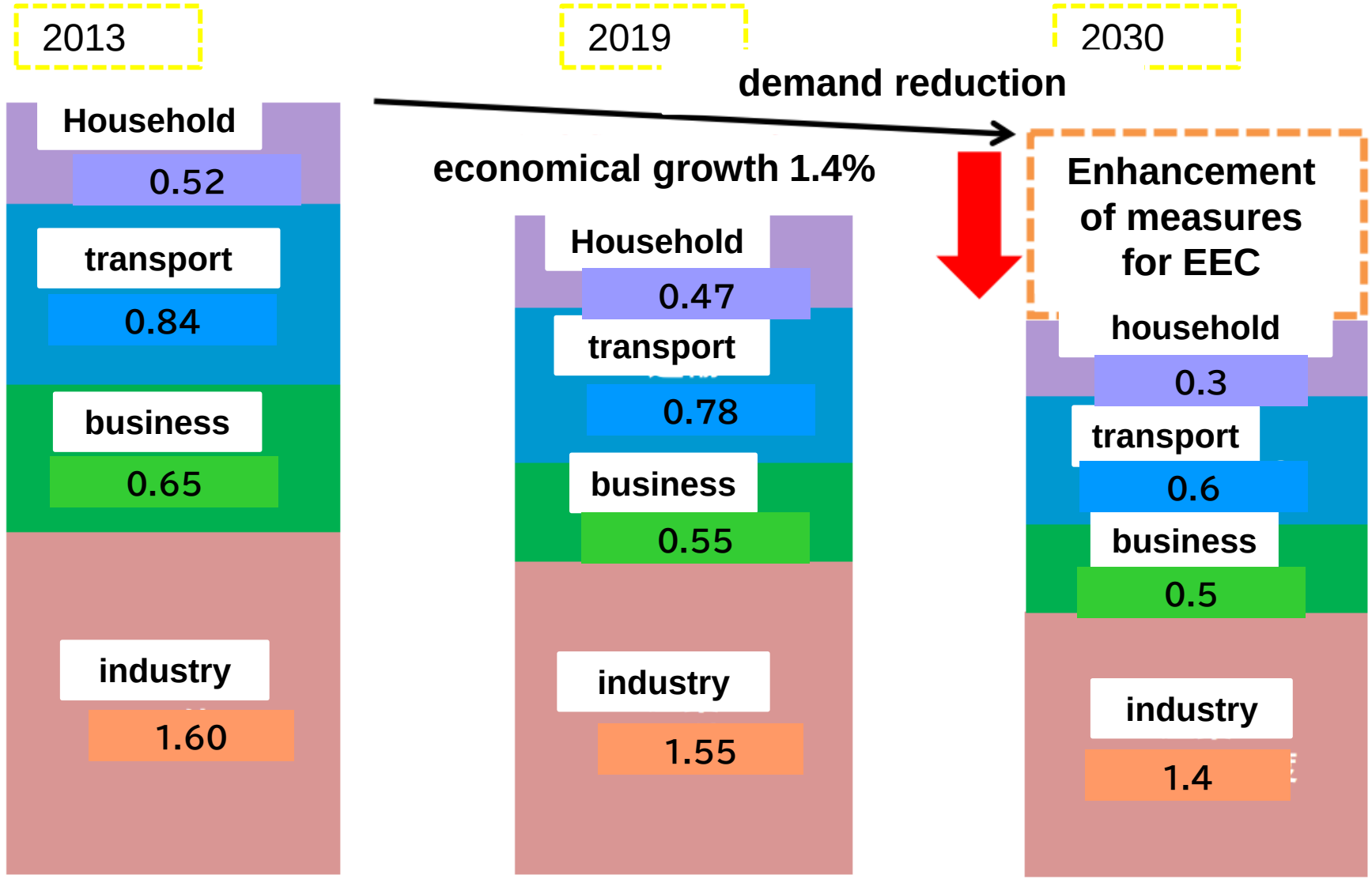


fig: Annual report on energy 2023 (Gov)

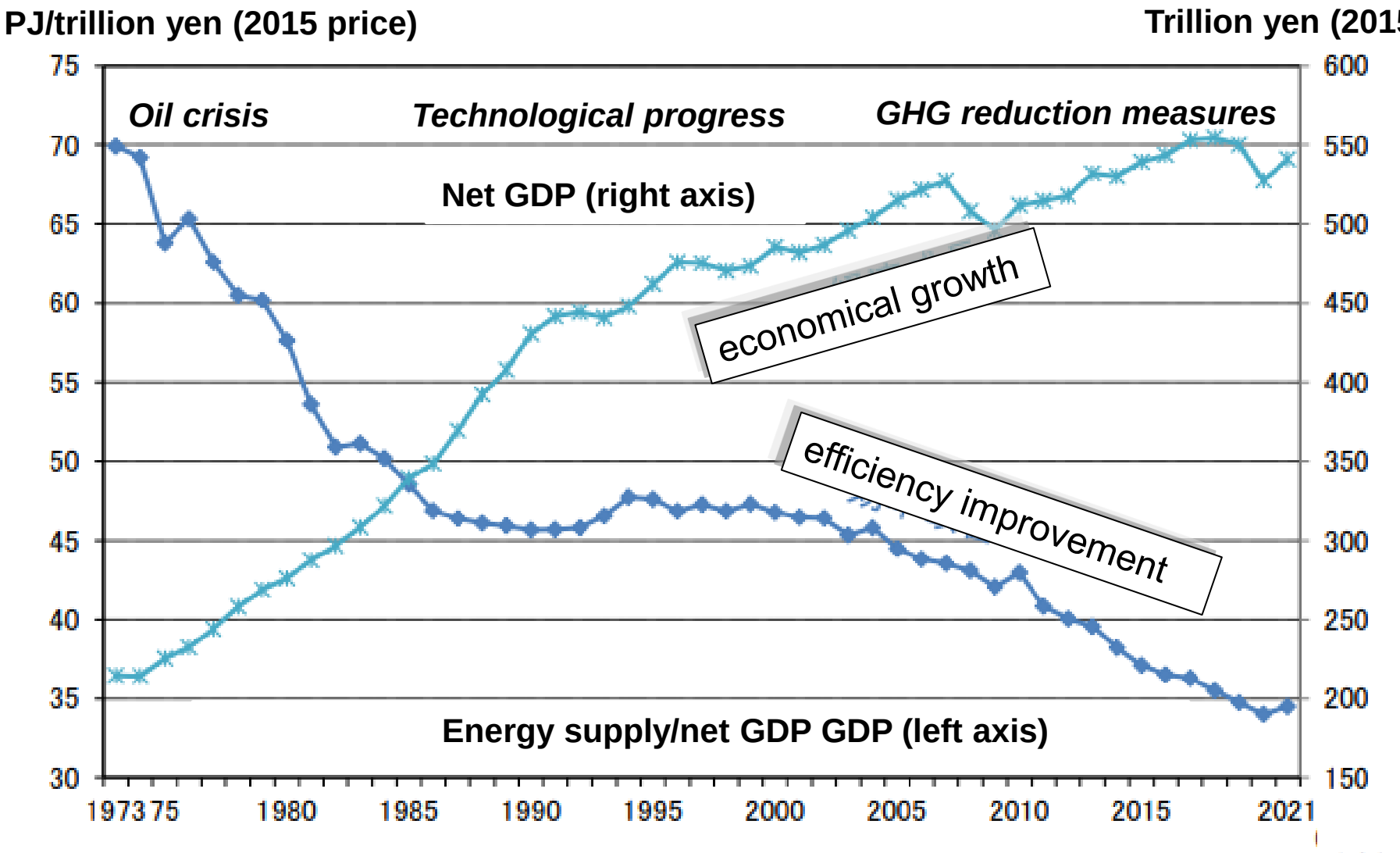
Medium period energy efficiency plan (Japan)



unit 100million-kL
(crude oil equiv.)

Source: 6th Strategic energy plan

Trends of energy efficiency



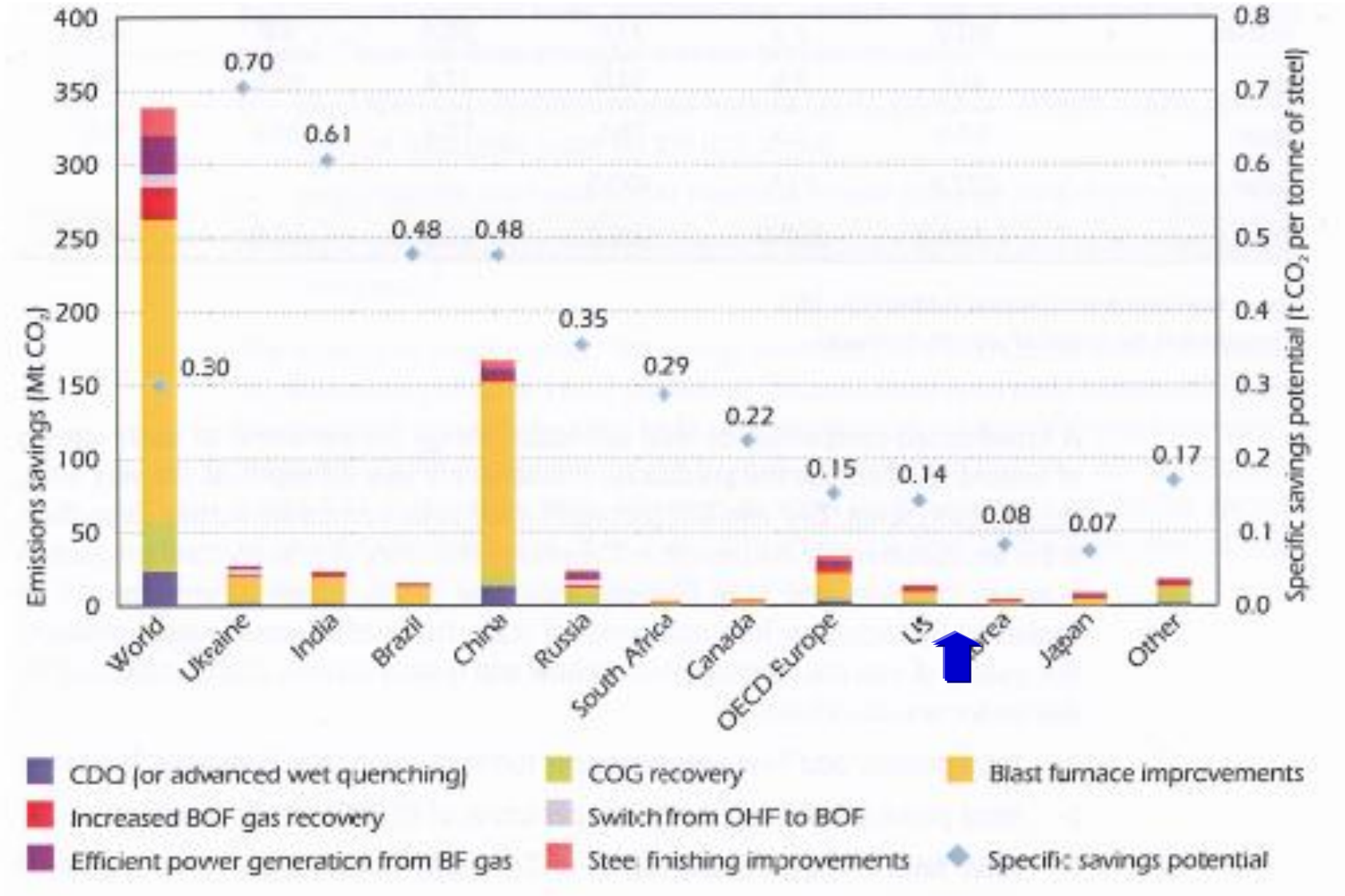
Energy efficiency is improving in a long trend. It should be enhanced further.

The horizontal trend seen is 1990s might be influenced by the addition of equipment and process for environment and quality.

fig: Annual report on energy 2023 (Gov)

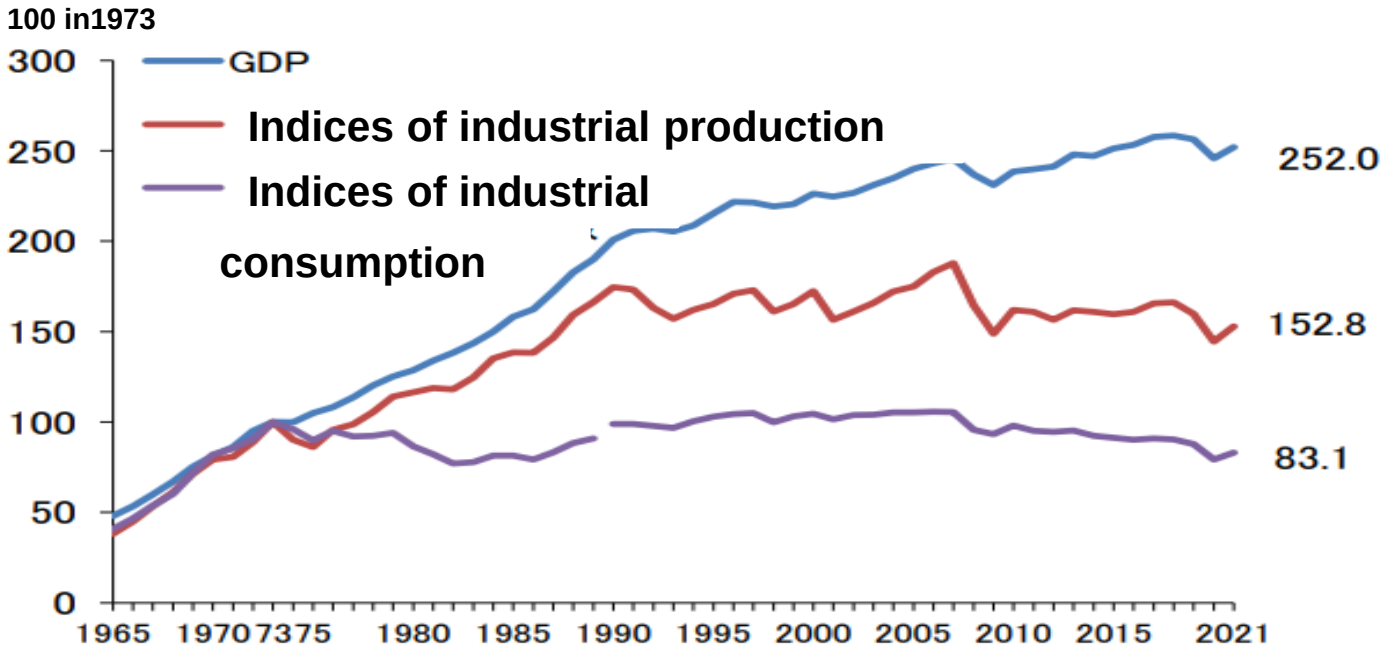
CO_2 reduction potential reference (iron and steel)

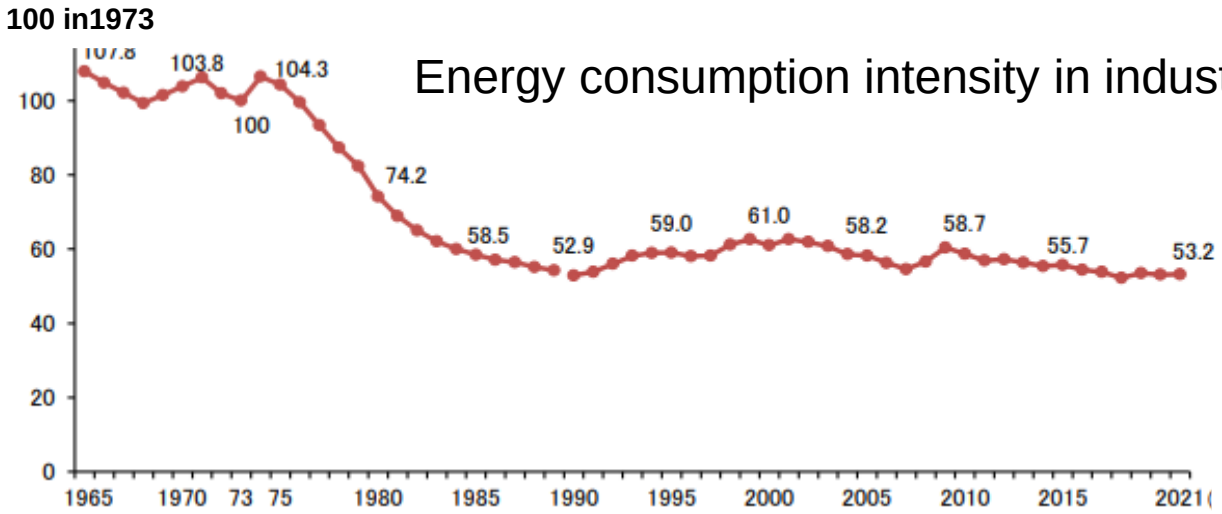
Best available technologies are adopted in a high level in Japan, implicating low reduction potential. (A view from IEA data in the past.)



Worldwide Trends in Energy Use and Efficiency（IEA, 2008) p32
CO_2 reduction potential in iron and steel in 2005 based on best available technology.

Trends of energy efficiency (industry)





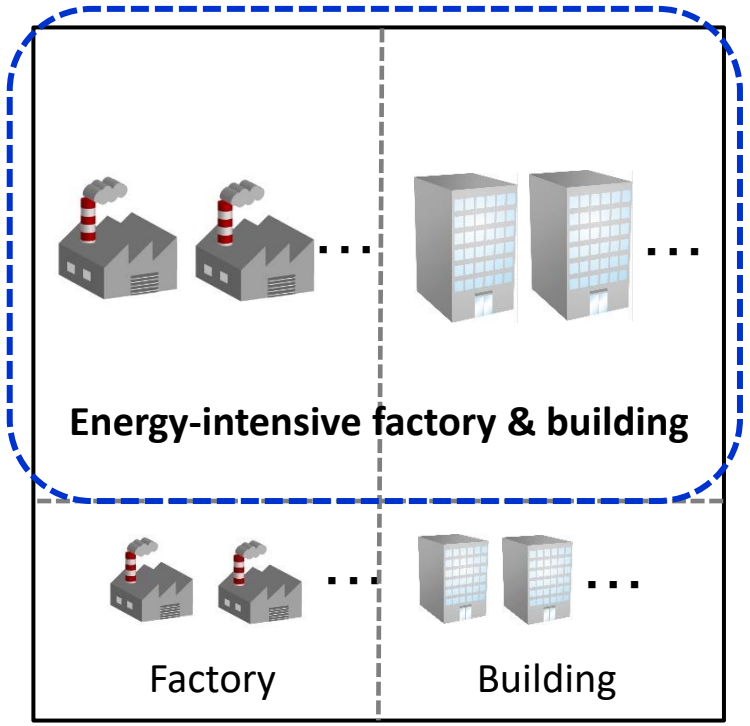
The trend in industry is similar as the whole field trend, but recent progress ratio is not so large, which seem to be under the influence of low reduction potential.

Multilateral measures are needed.

fig: Annual report on energy 2023 (Gov)

Methodologies to promote energy efficiency in industry

Total EM System as a fundamental methodology



Designation system to energy-intensive factory and building

Threshold of the designation

Obligations

Periodical Report System

Items to be reported (Format)

Procedure (Submission date, method, etc.)

Energy Manager System

Duties

Qualification system

Energy Audit & Auditor System

Follow-up system

Checking items

Standard for follow-up

Follow-up contents

System and motivation

Target and evaluation

EC Guideline

Contents

Guidance and instruction

Transition to non-fossil energy in EC Act

expansion of target of policies in EC Act toward carbon neutrality
(amendment in 2022) red letters: newly introduced concept in EC Act

Rational use of energy
(energy efficiency and conservation)

Transition to non-fossil energy

Optimization of the demand for electricity
(demand response in both of increasing and decreasing)

(definition)
Expansion of kind of energies regulated in EC Act
to non-fossil fuel
non-fossil electricity
non-fossil heat

Approaches for higher energy efficiency and low carbon (in industry)

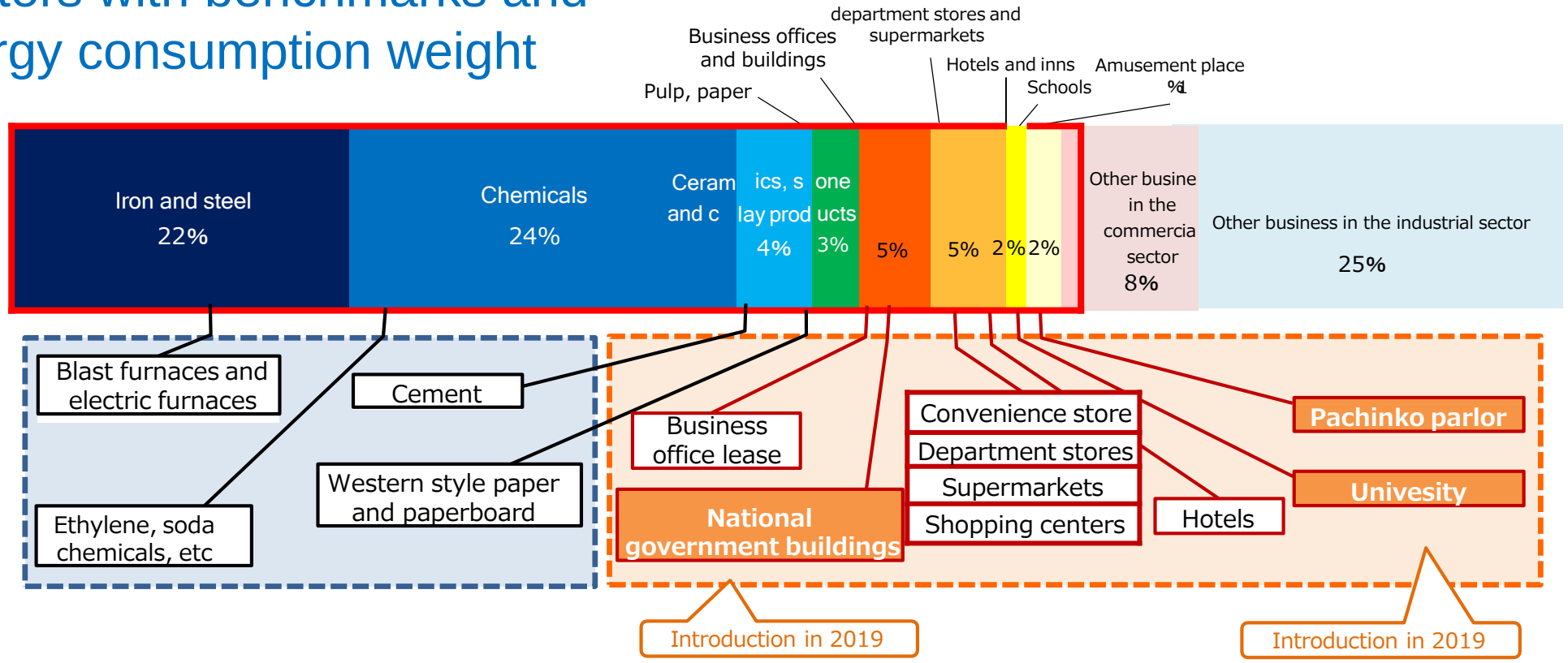
Subsets	Policy and management
Energy intensive (material) subsectors	Benchmark on energy efficiency Non-fossil ratio target Cooperation between factories
Large scale businesses	Carbon target management
Small and medium businesses	Energy audit and implementation (government support)
Electricity system	Use of renewable energy Use of non fossil fuels Optimization of electricity use Non-fossil certificate

Technology and system background
Production technologies
Heat process technologies
Heat pumps and efficient thermal utility
Cogeneration technologies
EMS and production control system
Established energy efficient devices
Electricity use optimization (demand-side measures to electrification)
Non-fossil fuel technologies
On site renewable energy

Subsector approach (benchmark in EC Act)

The benchmark system in EC Act has been established for energy intensive and material subsectors in industry and focused subsectors in buildings and non-industry business.

subsectors with benchmarks and the energy consumption weight

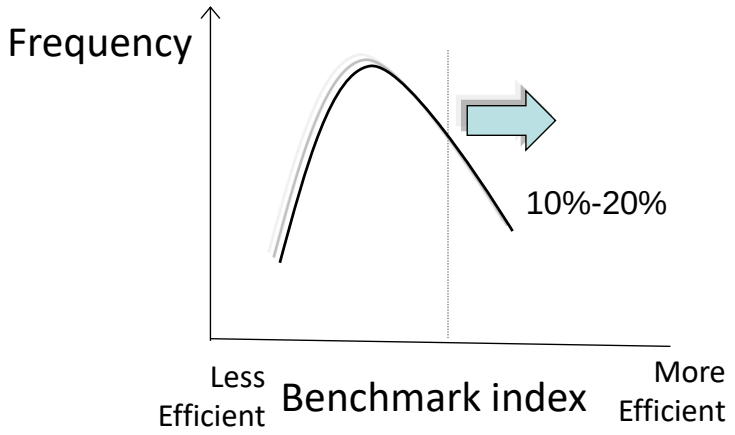


advantages and setting of the value

Advantages of the benchmark target;

- raising motivation to pursue a realizable target
- useful in the evaluation process as a fair target.

Benchmark value is set as the top 10%-20% business operators to satisfy, which is a kind of top runner.



examples of industry benchmark indices and value

Source: EC Guideline (METI)

Business operation	Benchmark indices	Aimed level
Steel manufacturer using blast furnaces	Energy consumption per basic unit quantity of crude steel.	≦0.531kl/t
Ordinary steel manufacturer using electric furnace	Sum of unit consumption (energy consumption per unit quantity of crude steel) of upper processes and unit consumption (energy consumption per unit rolled metal quantity) of lower processes. Modification by out-of-fire refining is applied to upper processes, and modification by kind of product is applied to lower processes.	≦0.150kl/t
Cement manufacturer	Sum of energy consumption of the following processes; raw material, calcination, finishing, and also shipping and other, divided by the production amounts or shipping amount of the respective processes.	≦3,739MJ/t
Paperboard manufacturer	Energy consumption in paperboard manufacturing processes per paperboard production amount. Modification by production of specific products is applied.	≦4,944MJ/t
Petrochemical basic product manufacturer	Energy consumption in the production of ethylene and the like products divided by the production volume of ethylene and ethylene related components of the like products.	≦11.9GJ/t
Soda chemical manufacturer	Sum of energy consumption in electrolysis processes divided by the weight of caustic soda derived from electrolytic tanks, and the steam heat consumption in condensation processes divided by the weight of liquid caustic soda.	≦3.22GJ/t

Non-fossil target system

Indices

Non-fossil electricity ratio
(non fossil electricity account to total electricity account)

Non-fossil energy index
indices separately defined for several subsectors with expected value levels

Indices related to non-fossil energy adopted by business operators (not mandatory)

recommendation of actions

Business operators

Target setting

Planning

Action

Report

Energy audit in Japan

Supports for small and medium businesses

Energy Audit by METI project

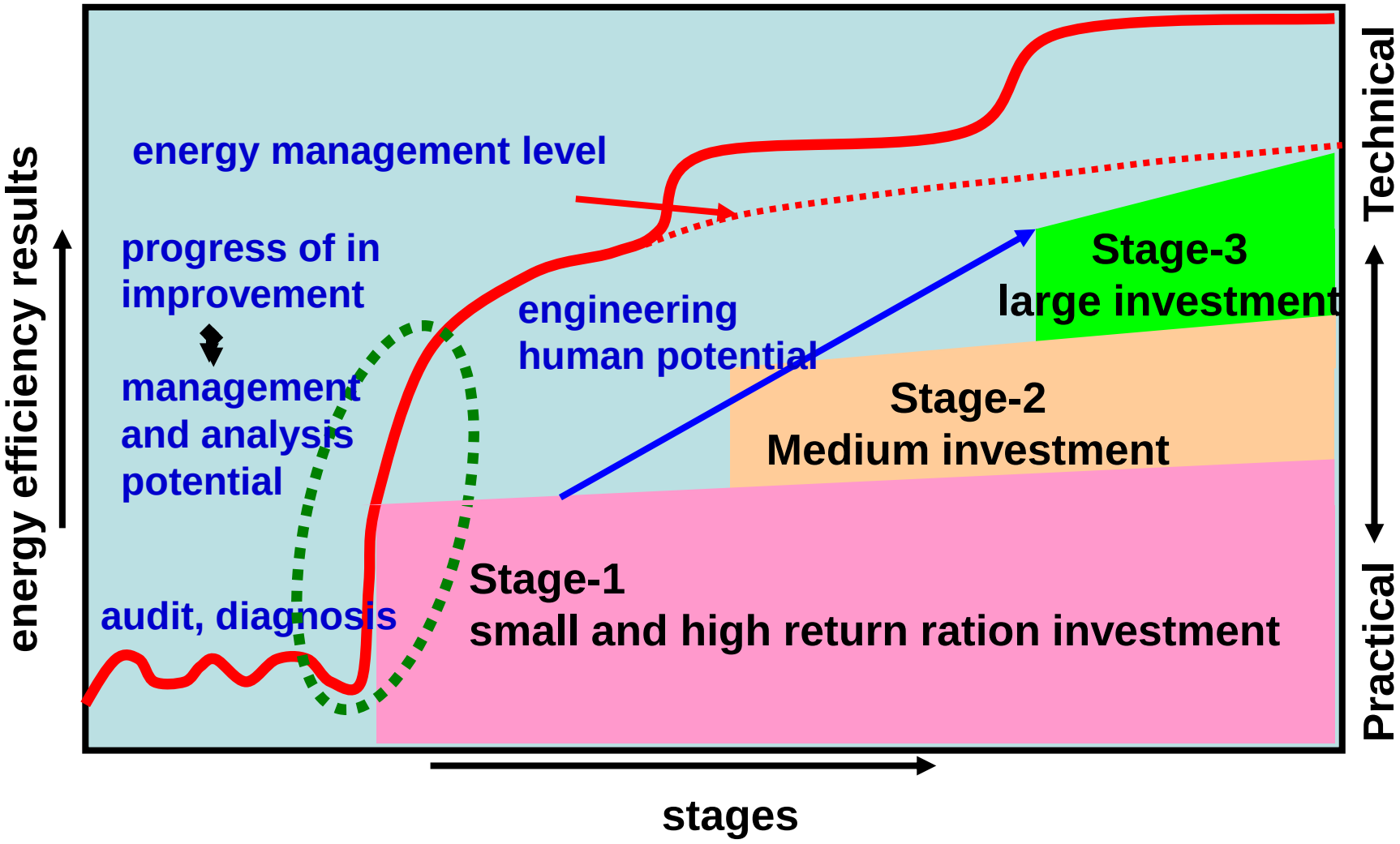
ECCJ has conducted more than 15,000 free energy audits since 1978. Recently, the main target is small & medium factory/building.

Further support by local platforms

Classified information search

ECCJ Web information on site audit reports

site-oriented improvement promotion scheme



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A case study

Management in a large business

Corresponding SDGs

Basic Philosophy	**Reducing environmental footprint** **as a high priority environmental strategy together with** **developing sustainable products, and** **sustainable and responsible procurement**
Current activity (problems and measures)	**Promotion of field/site based energy conservation** **Measurement and visualization** **→ To review efficiency of the production method and line** **Power consumption prediction system** **Input: production plan, actual power consumptions, meteorological data** **Output: prediction of power consumption and solar generation** **→ To establish standard production plan based on the weather conditions** **Enhancement of motivation** **Reporting on EE actions directly to higher managements** **System to allow energy data to any member anytime** **(results) 10% reduction of energy consumption/CO2 emission**

Technical trends and development

The case of iron and steel industry

Technological Development

process innovation (CC, CAPL, PCI, CMC, expansion use of EF) → ferro cokes COURCE50

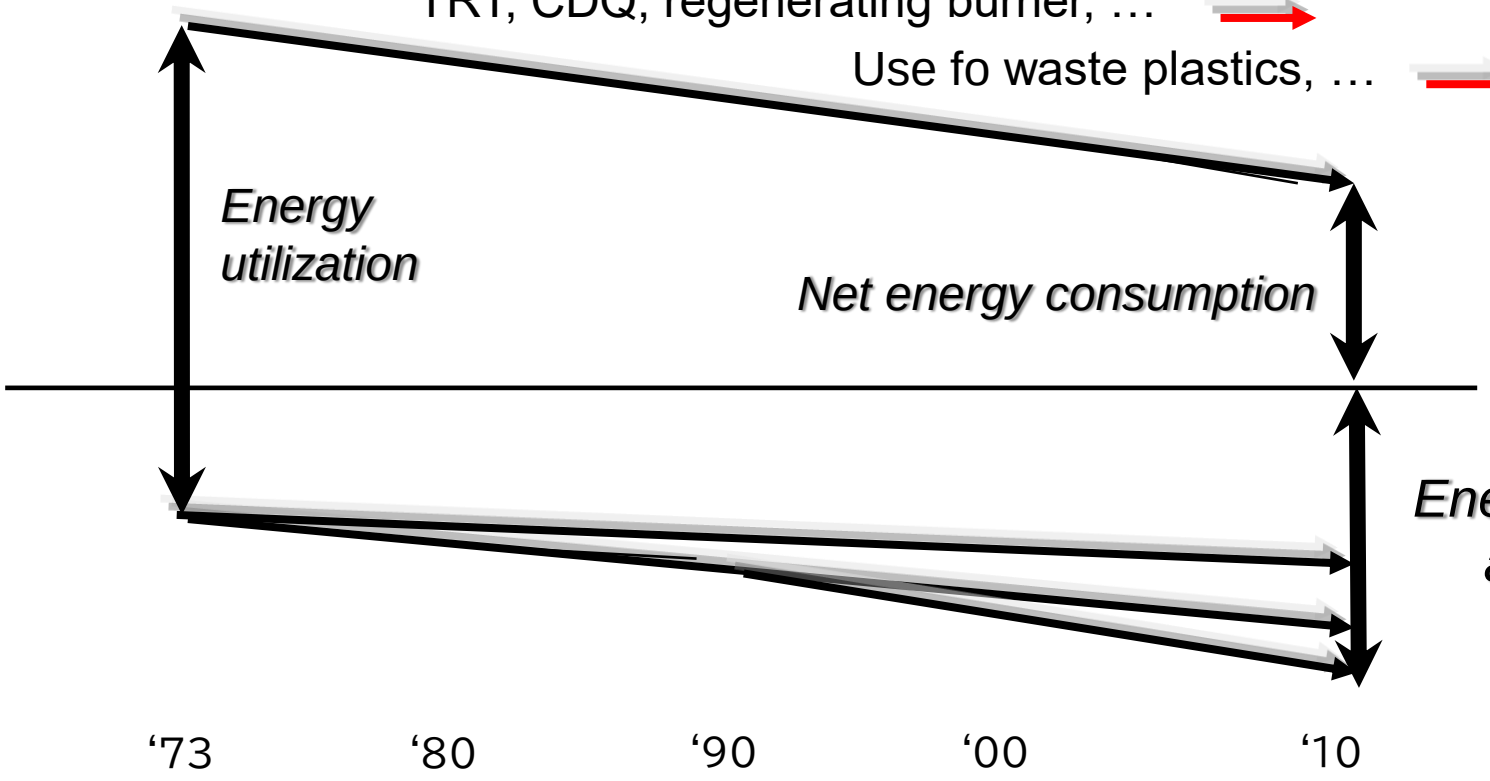
process improvement (hot charge, thermal control, …) →

efficient use of byproduct gas, combined cycle, … →

TRT, CDQ, regenerating burner, … →

Use fo waste plastics, … →

Development for future: innovative reduction performance



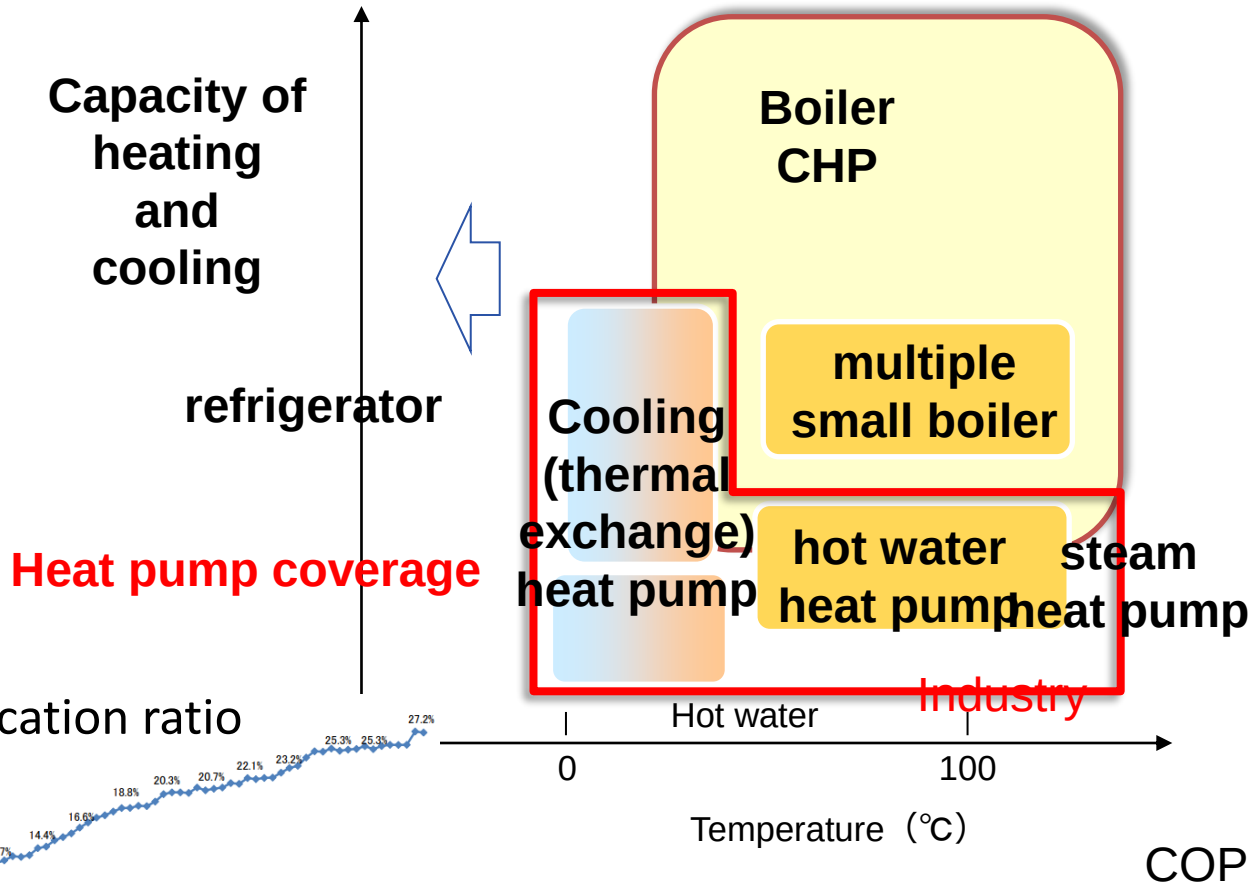
The commitment for a low-carbon society

- Eco Process
- Eco Solution
- Eco Producs

Made using information by Japan Iron and Steel Federation

Review on Technologies

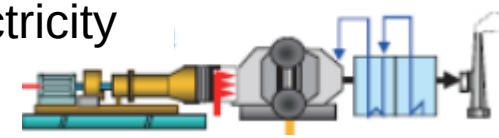
Heating facility and heat pump



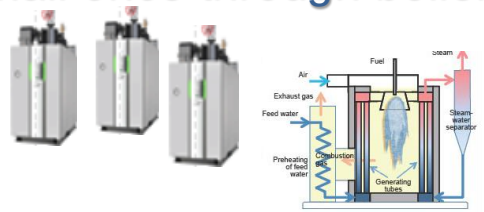
CHP (cogeneration)

steam

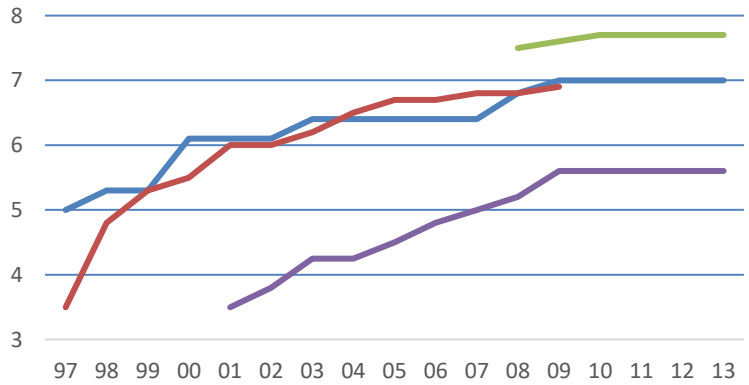
electricity



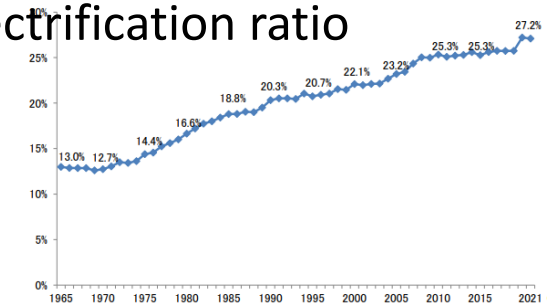
multiple high efficiency small once through boiler



Heat Pump : COP increases.



Electrification ratio



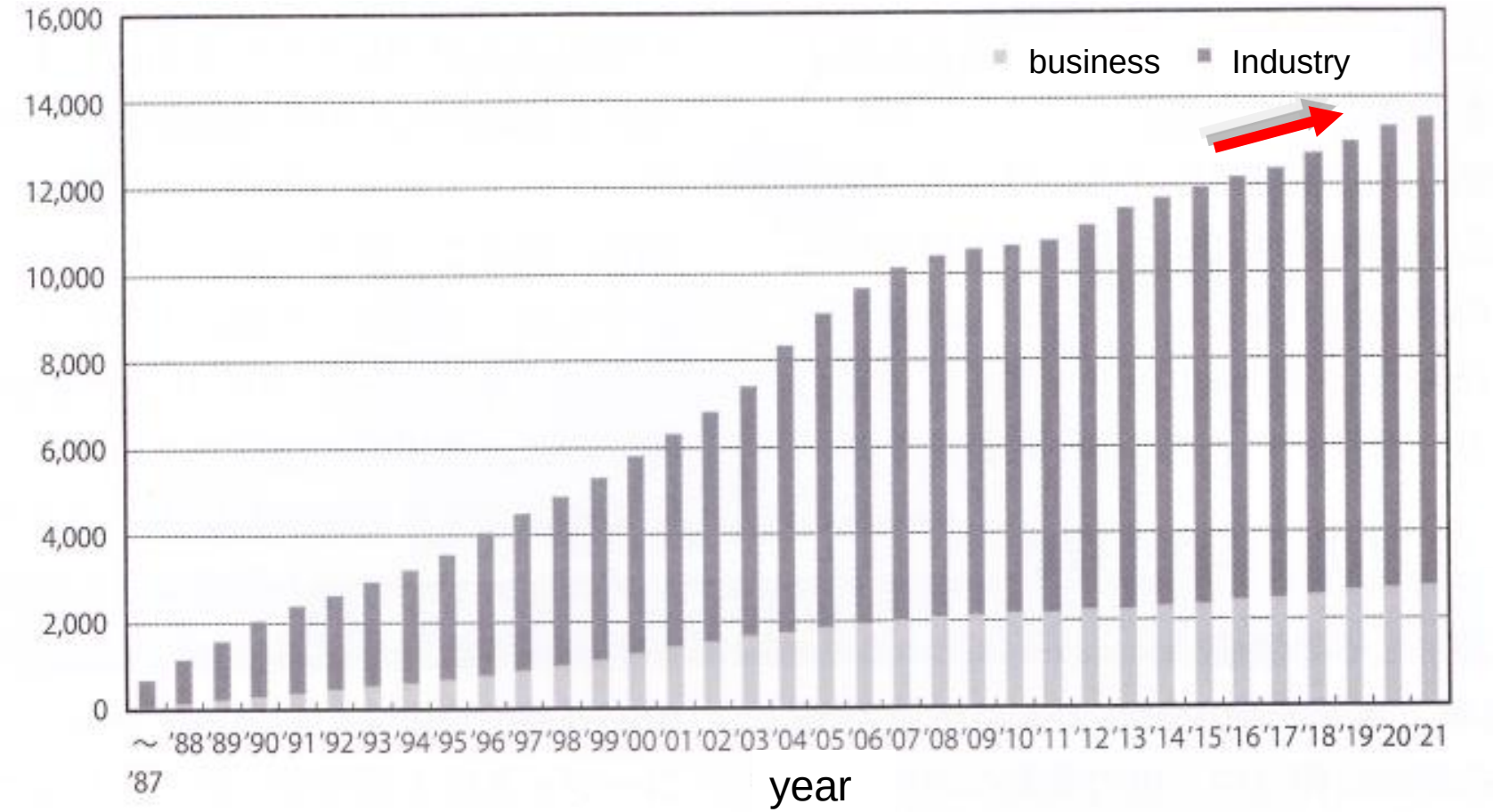
coefficient of performance (COP)= output energy (heat transfer) / input energy

Cogeneration

Source: “Energy Conservation” (ECCJ) Mar 2022 and Dec 2022

Accumulated implementation volume of cogeneration in Japan (industry and business)

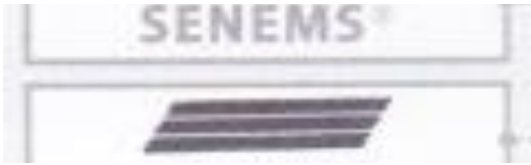
Generation capacity



A case of application (Kiyohara industry area, Tochigi pref., Japan)

Energy center

Energy management system



Solar power generation

Gas

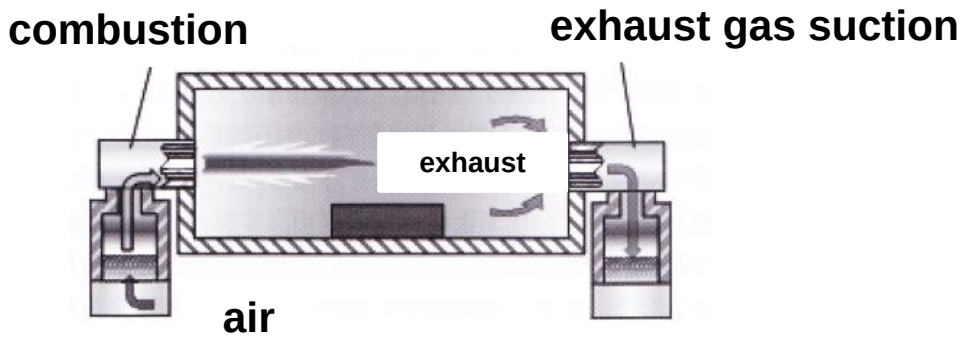
Gas cogeneration system

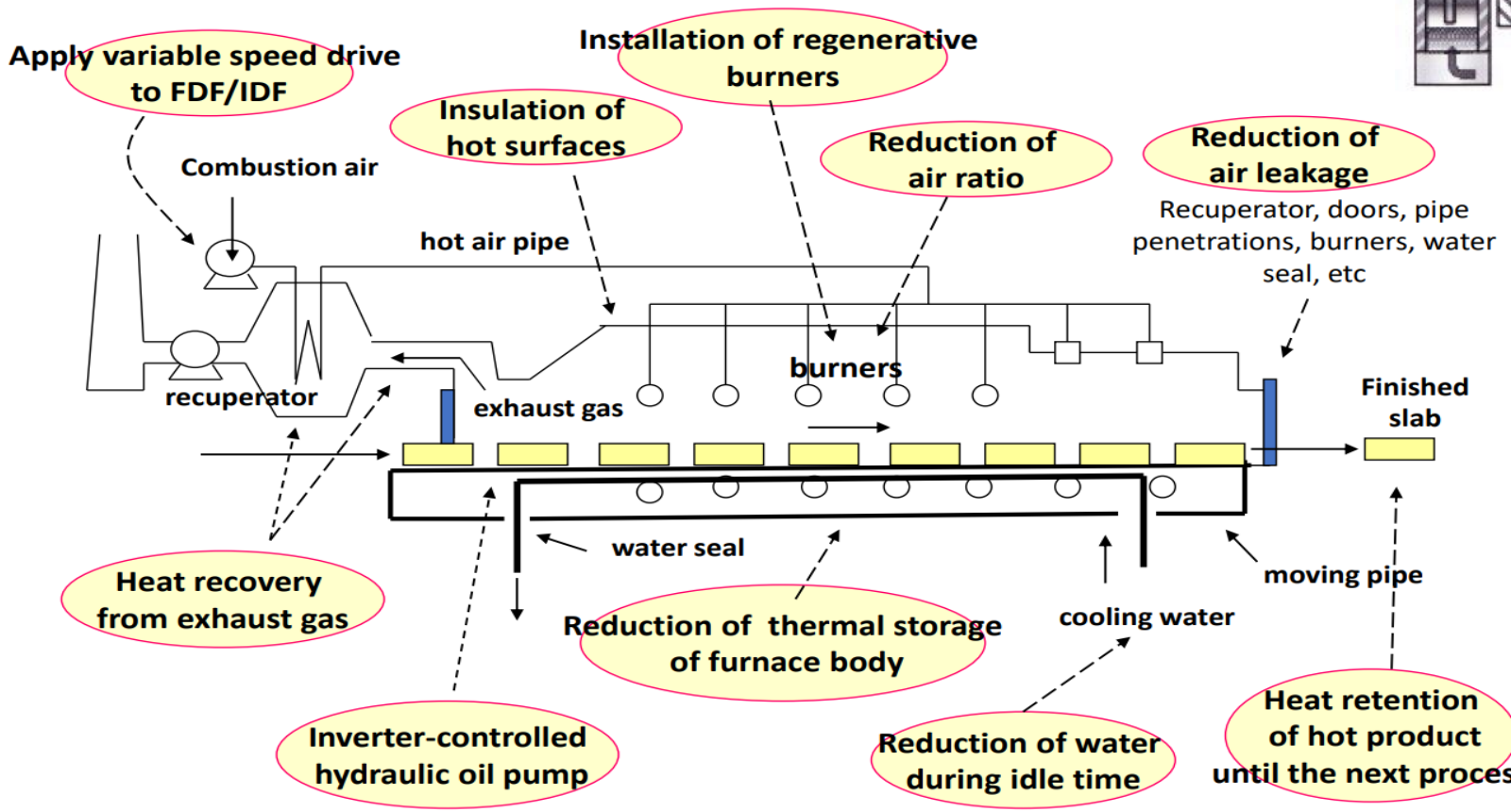
Multiple once-through boilers

Industrial furnace

Application of recent technologies for higher efficiency including regenerative burner systems

Regenerative burner

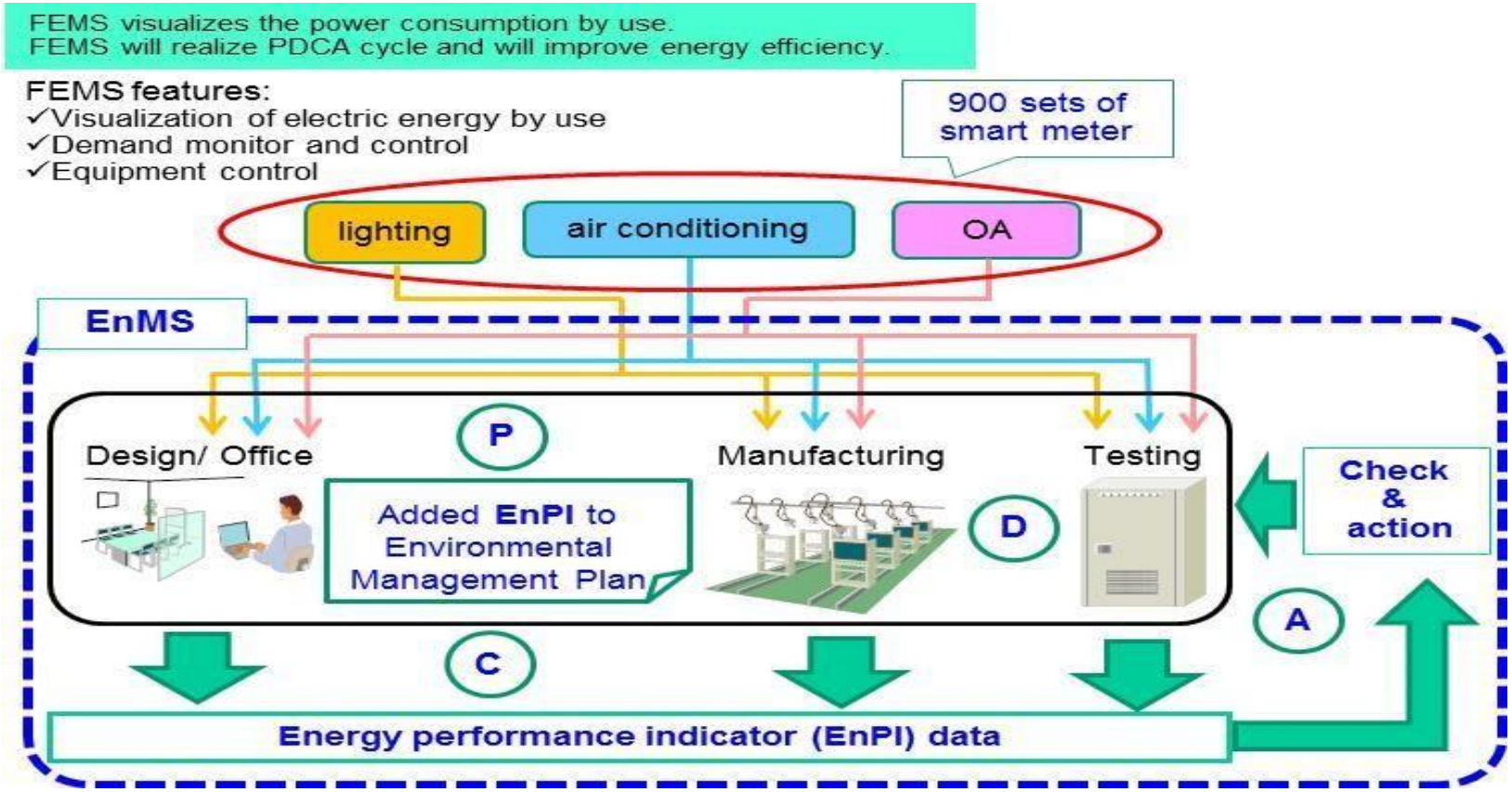




Technological study for future possibility of use of non-fossil energy resource

FEMS and optimization

FEMS: management and visualization



Optimization of production energy

- Measurement and energy visualization
- Flexible fabrication by compact equipment and arrangement
- Minimum consumption control according to production demand
- Renkei (cooperative) control

Source: ”Energy Conservation” (ECCJ) Dec. 2023

Source of figure: Hitachi, Omika Works
“EMWG leadership awards document in public”

conclusion

(1) The energy efficiency of Japan's Industry has been improved by technologies such as heat recovery. Currently, it is also improving but not rapidly. It is necessary to promote multilateral measures of policy and technology.
(2) EC Act (amendment) will promote energy conservation, conversion to non-fossil energy, and optimal use of electricity.
(3) Measures appropriate to respective fields or businesses, should be taken; such as energy audits for small and medium-sized businesses, carbon emission reduction targets for large businesses, energy efficiency benchmark target values for subsectors, etc.
(4) The efficiency of thermal systems should be raised by expanding heat pumps, cogenerations, high-efficiency boilers and combustion systems. Also, technologies for the use of non-fossil energy is important.
(5) It is expected that FEMS including visualization, effective production planning, and control for the entire production process, will be useful.