

The Cement Industry

The Cement Industry in JAPAN



JAPAN CEMENT ASSOCIATION

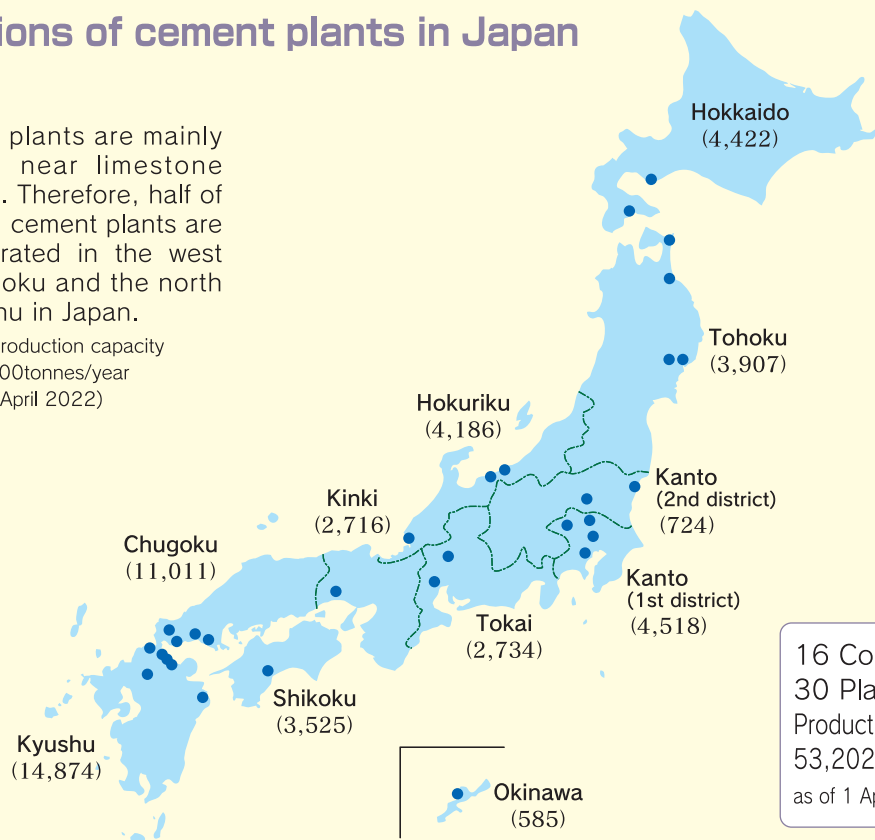
2022

Current state of the cement industry

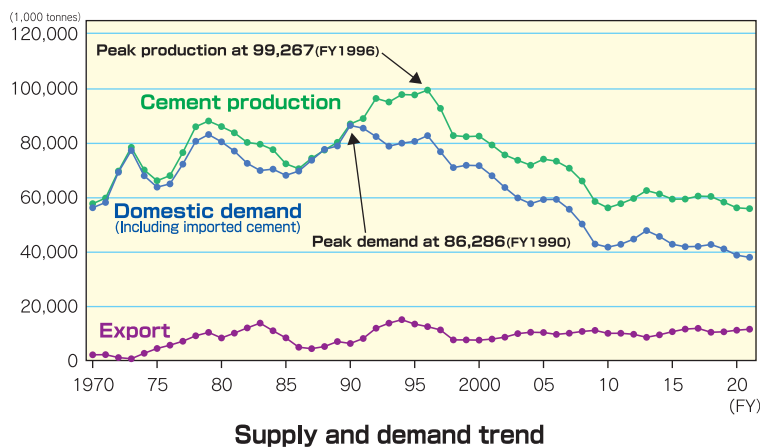
Locations of cement plants in Japan

Cement plants are mainly located near limestone quarries. Therefore, half of the total cement plants are concentrated in the west of Chugoku and the north of Kyushu in Japan.

※Clinker production capacity
Unit: 1,000tonnes/year
(as of 1 April 2022)

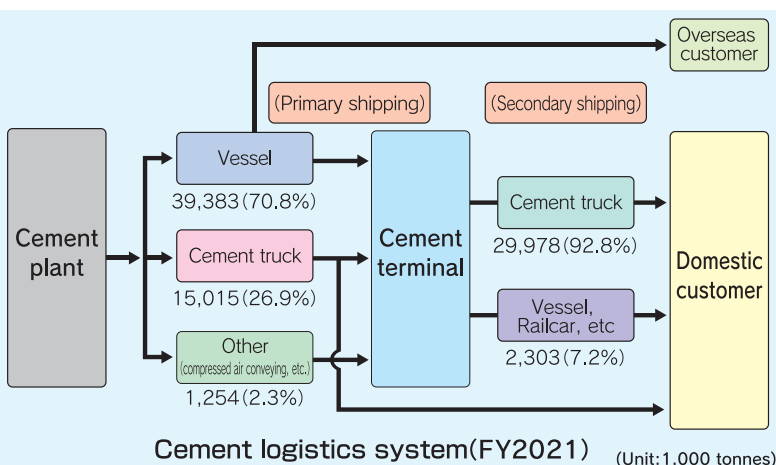


16 Companies
30 Plants
Production capacity :
53,202 thousand tonnes/year
as of 1 April, 2022



Distribution system to users in Japan

Most cement is used in “concrete” and 70% of cement is shipped to ready-mixed concrete plants. Because ready-mixed concrete needs to be delivered to a construction site within 90 minutes of mixing, ready-mixed concrete plants are spread all over the country. In order to deliver cement to these users in the most economical as well as effective manner, cement manufacturers have their own service stations (cement terminals).



Promoting efficiency in distribution costs and reducing environmental impact.

There are 333 service stations across the country, 81% of which are located in the coastal areas. Large vessels dedicated to cement shipping are widely used for mass transportation. They also transport blast furnace slag or coal ash on the way back, striving to reduce logistic costs. Furthermore, upsizing the capacity of trucks also contributes to streamlining the transportation system. Such rigorous efforts for rationalisation also lead to reducing pressure on the environment.

Using wastes and by-products for cement production

A lot of wastes, by-products and garbage generated from industries and households actually consist of the same constituents as those found in cement. Taking advantage of the fact that no secondary waste, and only a negligible amount of dioxin, is generated in the process of cement production, the cement industry is striving to recycle waste materials and by-products. Effective use of waste materials and by-products not only contributes to saving natural resources but also helps with extension of a remaining life of final disposal sites for waste materials which is currently a nationwide issue.

The amount of wastes and by-products used for cement production

(Unit: 1,000 tonnes)

Type	Used for	FY1990	FY2000	FY2010	FY2015	FY2019	FY2020	FY2021
Coal ash	Raw materials, Admixture	2,031	5,145	6,631	7,600	7,593	7,286	7,450
Blast furnace slag	Raw materials, Admixture	12,213	12,162	7,408	7,301	7,430	6,981	6,939
Sludge	Raw materials	341	1,906	2,627	2,933	3,091	2,950	2,904
By-product gypsum	Raw materials(Additive)	2,300	2,643	2,037	2,225	2,091	2,032	2,098
Incineration ash(excluding coal ash), Soot, Dust	Raw materials	468	734	1,307	1,442	1,554	1,482	1,471
Waste soil from construction	Raw materials	—	—	1,934	2,278	1,214	1,241	1,159
Waste plastic	Heat energy	0	102	445	576	746	746	774
Non-ferrous slag	Raw materials	1,559	1,500	682	722	740	725	708
Steel slag	Raw materials	779	795	400	395	441	364	439
Woodchips	Heat energy	7	2	574	705	450	437	400
Foundry sand	Raw materials	169	477	517	429	407	336	379
Waste oil	Heat energy	90	120	275	293	322	245	302
Waste white clay	Raw materials, Heat energy	40	106	238	311	260	260	267
Recycled oil	Heat energy	51	239	195	179	236	282	236
Cullet	Raw materials	0	151	111	129	165	154	151
Meat and Bone meal	Raw materials, Heat energy	0	0	68	57	63	71	71
Waste tire	Raw materials, Heat energy	101	323	89	57	65	69	68
RDF, RPF	Heat energy	0	27	48	37	46	46	34
Coal mining waste	Raw materials, Heat energy	1,600	675	0	0	0	0	0
Others	—	14	253	408	382	506	447	445
Total	—	21,763	27,359	25,995	28,053	27,422	26,155	26,294
Cement production		86,849	82,373	55,903	59,074	57,978	55,894	55,588
Consumption per ton of cement (kg/t)		251	332	465	475	473	468	473

Note 1) "Sludge" includes sewage sludge from waste water treatment plants.

Note 2) "Coal ash" includes not only coal ash from power plants, but also coal ash from other industries.

On the other hand, the cement industry supports the recovery and reconstruction of disaster areas by using disaster waste as a raw material and energy for cement production.

Disasters and their disaster wastes utilized for cement production since 2004

Date	Type of Disaster (Location)	Main Disaster Wastes
2004.Oct.	Earthquake (Niigata-Chuetsu)	Wood chips
2007 Mar.	Earthquake (Noto peninsula)	Wood chips
2007 Jul.	Earthquake (off the coast of Chuetsu)	Wood chips
2011 Mar.	Great East Japan Earthquake	Wood chips, Mixed disaster debris etc.
2014 Aug.	Sediment disaster due to heavy rain (Hiroshima)	Wood chips
2015 Sep.	Heavy rain and flood (Kanto/ Tohoku area)	Tatami mat
2015 Sep.	JICA joined in the D.Waste-Net (Disaster Waste Treatment Support Network) managed by the Ministry of the Environment	
2016 Apr.	Earthquake (Kumamoto)	Wood chips, Tiles, Mixed disaster debris
2016 Dec.	Large-scale fire (Itoigawa city)	Fire wastes
2017 Jul.	Heavy rain and flood (northern Kyushu)	Wood chips, Tiles, Mixed disaster debris,
2018 Jul.	Heavy rain and flood (western Japan)	Sediment, Sludge, Wood chips
2019 Apr.	Heavy rain and flood (northern Kyushu)	Sludge
2019 Oct.	Heavy rain and flood due to the Typhoon (Eastern Japan)	Sediment, Rice straw, Wood chips
2020 Jul.	Heavy rain and flood (Honsyu/Kyushu)	Tatami mat, Wood chips
Total amount of treatment (2004~2020)		1.63million tonnes



Examples of the disaster wastes

Left: Tatami mats wet with muddy water

Right: Rice straw mixed with sediment

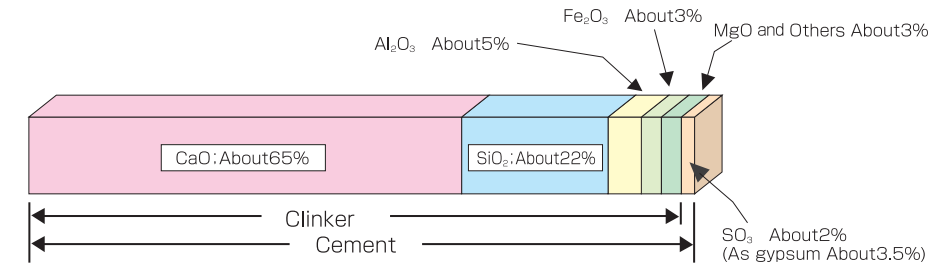
Manufacture of cement consists of the following three processes.

①Raw materials process ②Burning process ③Finishing process

Effective use of the thermal energy in manufacture of cement :

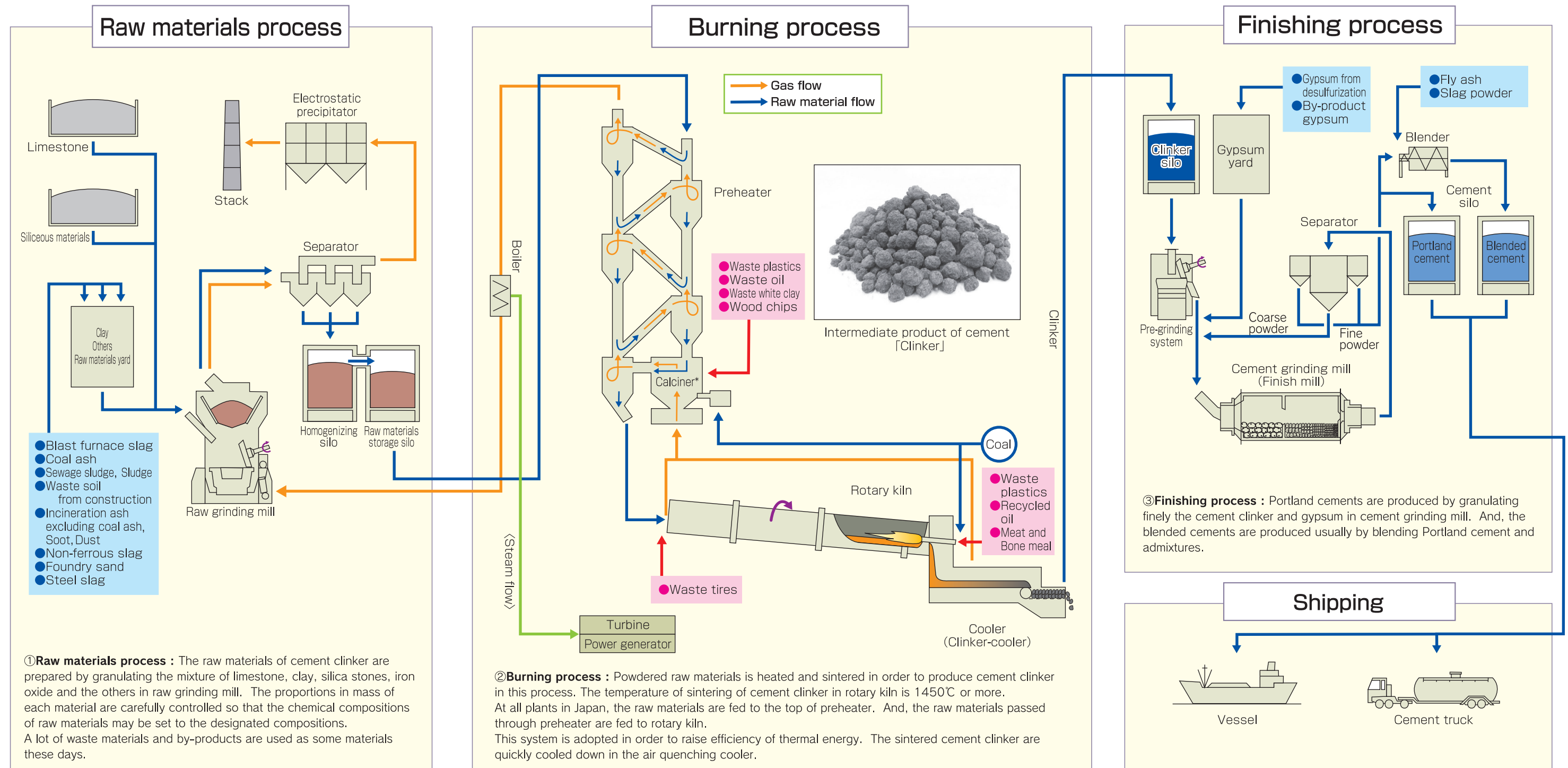
A lot of thermal energy is used in the cement plants. The orange line in the figure of burning process shows the flow of gas. The gases from rotary kiln and cooler are high temperature. When these gases are exhausted, the thermal energy of these gases is not used effectively. Then, the manufacturing processes of cement are designed to use the thermal energy of gases thoroughly. The gases from rotary kiln and cooler are led to the preheater. The thermal energy of these gases is used for the heating of raw materials including calcination of carbonate. And then, the gas from the preheater is led to the boiler (*) for generating steam of power generation. Finally, the gas from the boiler is led to the raw grinding mill at raw materials process, and the thermal energy of this gas is used for drying raw materials. Overall, the plant operates at over 80% thermal efficiency.

(*) The boiler may not be installed.



Various raw materials:

Primal constituents of cement clinker are CaO, SiO₂, Al₂O₃ and Fe₂O₃. The raw materials consist of limestone, clay, silica stones, iron oxide and the others. Since a lot of waste materials and by-products are composed of primal constituents of cement clinker, these are used effectively as some materials.



Long-term Vision for the Cement Industry toward Carbon Neutral

In March 2022, Japan Cement Association revised and announced the "Long-term Vision for the Cement Industry toward Carbon Neutral" taking into consideration the direction of the Japanese government's green growth strategy and others.

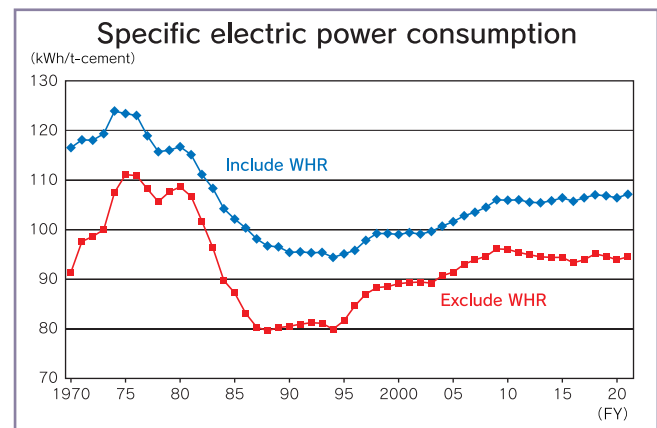
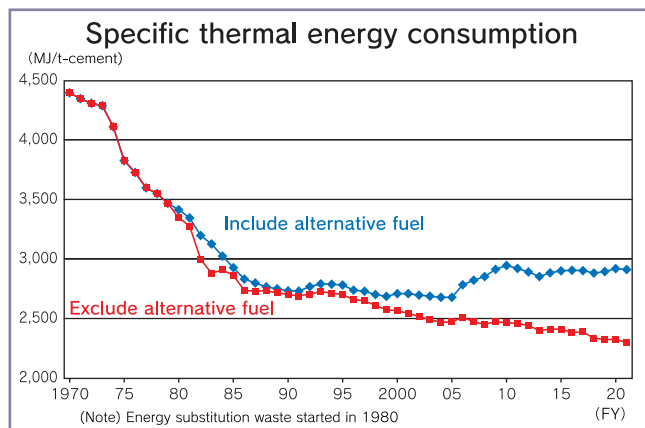
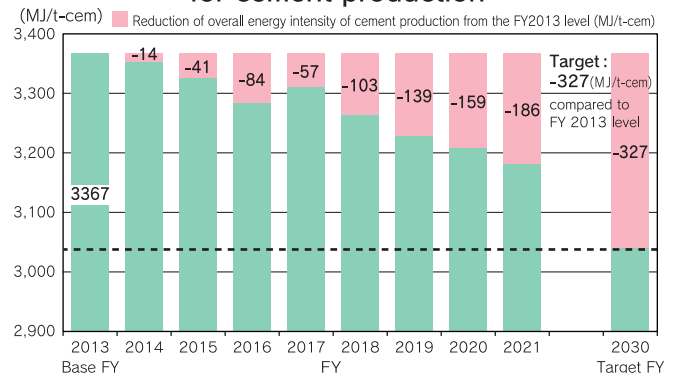
1. The vision shows a forecasted cement demand and our actions and challenges

1. Background and objective of the vision
2. Domestic demand of the wide sense: Estimation of the domestic demand in 2050
3. Roles of the cement industry: "Supply of basic material," "Contribution to an establishment of a recycling-based society," "Contribution to local community," "Cooperation in disaster debris treatments," etc.
4. Direction of measures and issues to be challenged: "Reducing clinker to cement ratio" "Switching to low carbon raw materials and thermal energy" "Improving thermal energy efficiency" "Development of low carbon binding materials and new cement" "Challenging to CCUS" "Taking up CO₂ by cement carbonation" etc.

2. Energy efficiency improvement

"Energy efficiency improvement" written in the conceivable measures for 2050 has been implemented by Japanese cement companies since 1996 when Japan Business Federation's voluntary action plan was started, in addition to increasing the use of waste as AFRs for producing clinker. Utilizing waste and energy conservation technologies are important to us, and are also necessary as the transition technology. Therefore we will continue to work on this issue.

The specific energy consumption for cement production



Outline of The Carbon Neutrality Action Plan

- 1) Pledge of Sector Target by 2030: Reduce a specific overall energy consumption of cement production (*1)(*2) 327 MJ/ton-cem. in FY 2030 from the FY 2013 level.

(*1) "Specific overall energy consumption of cement production" is calculated as the summation of "Specific thermal energy consumption of cement production", "Specific thermal energy consumption for on-site power generation" and "Specific electrical power purchased from the grid" divided by "Cement production volume", where alternative thermal energy from combustible wastes is excluded.

(*2) "Specific overall energy consumption of cement production measured for the fiscal assessment year" is slightly compensated by taking into account of fluctuations of "cement production volume" and "clinker/cement ratio" from the base year (FY2013) levels as "specific overall energy consumption of cement production".

- 2) Other Actions on Low-Carbon Products and Services

- ① Encouragement of diffusion of concrete pavement: CO₂ emitted from a heavy vehicle to drive on concrete pavement is reduced due to an improvement of mileage on a point of view of a life cycle assessment (LCA).
- ② Contributions to the establishment of the recycling-based society: Utilization of many types of combustible wastes and by-products from other industries for cement production results in extension of a remaining life capacity of existing landfill sites.

- 3) Contributions to the global mitigation: Statistical national information on energy consumption, diffusion rate of energy conservation technologies (equipment) and utilization of alternative fuels has been published to the public in order to contribute both to the reduction of an energy consumption to produce cement and the establishment of the recycled-based society globally.

- 4) Development of technologies (Plan after FY 2022) (*3)

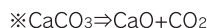
- ① Specific thermal energy consumption of cement production can be reduced by using mineralizer which decrease the burning temperature of clinker.
- ② Specific thermal energy consumption of cement production can be reduced by increasing the amount of C3A in the clinker and clinker substitutions in cement.

(*3) Under the right conditions of expected circumstances and technique such as availability of material containing fluorine, optimized clinker production conditions and quality control method for the aimed clinker, a feasible study for the clinker production would be carried out in an appropriate plant for the pilot test.

3.Challenges to CO₂ reduction and measures towards 2050

CO₂ emission from the cement industry is consisted of both decarbonation of limestone as main raw material (process-related CO₂ emission) and emission from energy used in cement manufacturing (energy-related CO₂ emission).

Process-related CO₂ emission
(Decarbonation of limestone)

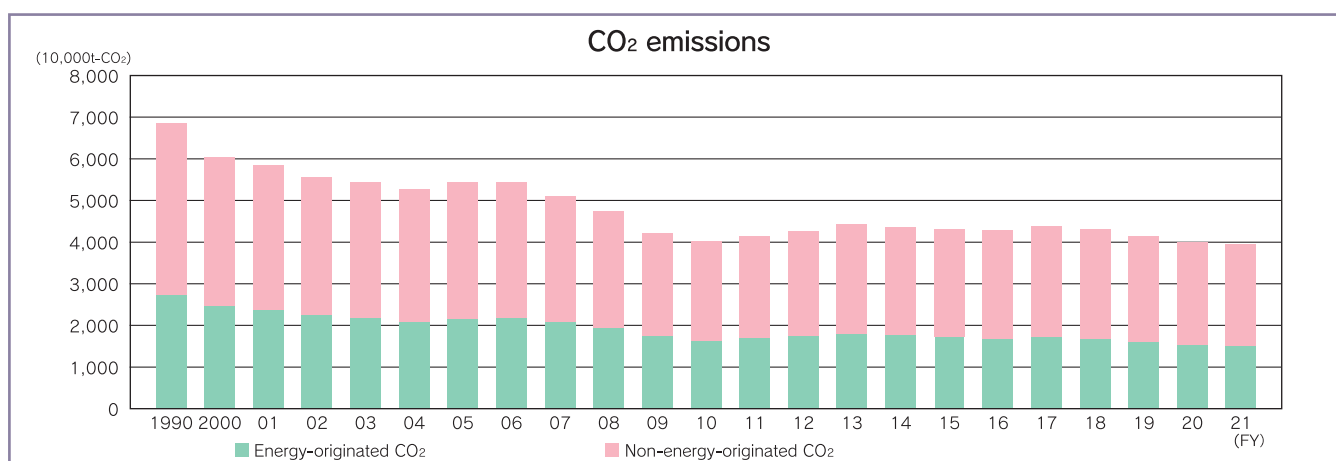


60%

CO₂ Emissions

40%

Energy-related CO₂ emission
(Thermal energy for burning and Electricity)



The cement industry has worked on reducing specific energy consumption of cement manufacturing by the voluntary action plan. In order to contribute to Japan's carbon neutrality in 2050, we continue to reducing both “process-related CO₂ emission” and “energy-related CO₂ emission” as possible.

Measures towards a Carbon Neutrality in 2050

(1) Process-related CO₂ Emissions

- Aiming at reducing a clinker to cement ratio from 0.85 to 0.825 by adding mainly minor additional constituent for the ordinary portland cement.
- Taking into consideration that substantial natural CO₂ uptake by cement carbonation has been reported. However, since no accounting methodology is internationally established, a range of estimated volume presents as a contribution to the carbon neutrality by the cement industry.

(2) Energy-related CO₂ Emissions

- Enhancing a reduction of energy consumption for cement production using energy conservation technologies, increasing alternative energies delivered from wastes and reducing the clinker to cement ratio.
- Aiming at replacing at least by 50% of zero-emission alternative energies from fossil energies for calcination using co-firing of hydrogen and ammonia and furthermore methanation, and co-processing with various wastes and biomass.
- Aiming at achieving net-zero emissions from the on-site power generation facility converting to alternative energies and biomass.

(3) Carbon Capture, Utilization and Storage (CCUS) for both CO₂ Emissions

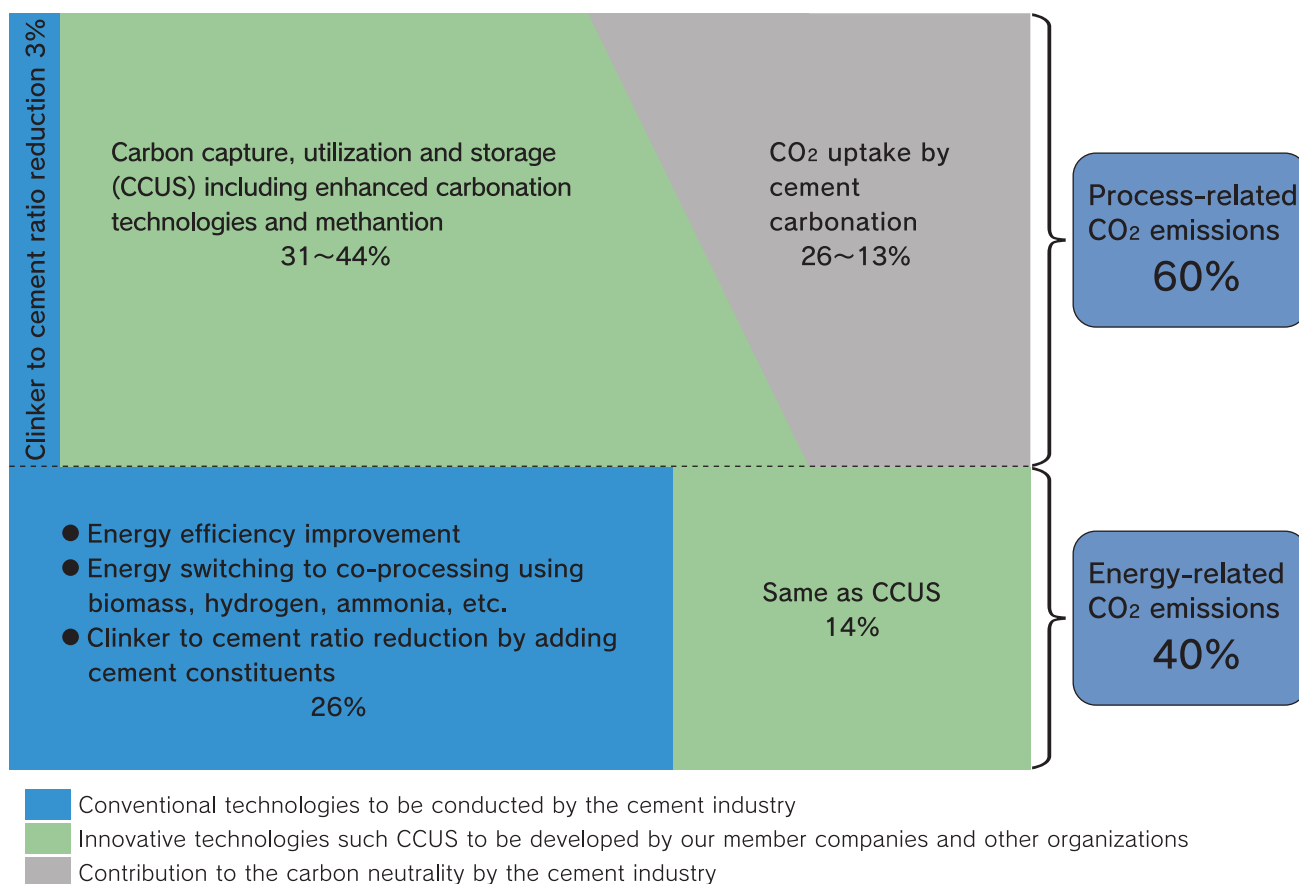
- Aiming at reducing CO₂ emissions through CCUS technologies while promoting technology developments in line with the national Green Growth Strategy through Achieving Carbon Neutrality in 2050, etc.

(4) Further Reduction in Future

- As an increase in users awareness of the need for zero carbon products, further innovative technologies are considered and also the clinker to cement ratio targeted at 0.825 in 2030 is expected to be 0.8 in 2050 by adding additional cement constituents.

4. Our Visions on a Carbon Neutrality of the Cement Industry in 2050

The schematic figure shows potential measures for the cement industry to achieve carbon neutrality in 2050. However, each implementation requires to ensure comprehensive understanding and supports by stakeholders including a construction sector, and a development of specific technology as well.



Note: A reduction ratio of process-related CO₂ emissions using CCUS is corresponded to an amount of CO₂ uptake by the cement carbonation using each estimation model.

JCA MEMBER COMPANIES

- | | | | |
|---|---|---|--|
| <p>● Aso Cement Co., Ltd.
Al Bldg., 2-4-27 Momochihama,
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https://www.aso-cement.jp</p> | <p>● Hitachi Cement Co., Ltd.
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TEL.(81-294)22-2111
http://www.hitachi-cement.co.jp</p> | <p>● Nippon Steel Blast Furnace Slag Cement Co., Ltd.
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Kokurakita-ku, Kitakyushu-shi,
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TEL.(81-93)563-5100
https://www.kourocement.co.jp</p> | <p>● Taiheiyo Cement Corporation
BUNKYO GARDEN GATE TOWER, 1-1-1,
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TEL.(81-3)5801-0333
https://www.taiheiyo-cement.co.jp</p> |
| <p>● DC Co., Ltd.
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Kawasaki-shi, Kanagawa-ken
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TEL.(81-44)223-4751
https://www.dccorp.jp</p> | <p>● Kanda Cement Co., Ltd.
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Fukuoka-ken
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TEL.(81-948)22-3604
https://www.aso-cement.jp/about/overview_kanda.html</p> | <p>● Nippon Steel Cement Co., Ltd.
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TEL.(81-3)5290-5055
https://www.denka.co.jp</p> | <p>● Mitsubishi UBE Cement Corporation
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TEL.(81-3)6275-0330
https://www.mu-cc.com</p> | <p>● Ryukyu Cement Co., Ltd.
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https://ryukyucement.co.jp</p> | <p>● Tosoh Corporation
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| <p>● Hachinohe Cement Co., Ltd.
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