We "Act" to touch the heart and make society better

Third Quarter, 2019 Financial Results

- Consolidated -

SHOWA DENKO K.K.

November 6, 2019

Motohiro Takeuchi, CFO
Director & Corporate Officer

Performance forecast and other statements pertaining to the future as contained in this presentation are based on the information available as of today and assumptions as of today regarding risk factors that could affect our future performance. Actual results may differ materially from the forecast due to a variety of risk factors, including, but not limited to, the economic conditions, costs of naphtha and other raw materials, demand for our products such as graphite electrodes and other commodities, market conditions, and foreign exchange rates. We undertake no obligation to update the forward-looking statements unless required by law.

Consolidated Companies

- Consolidated subsidiaries: 63 〔Compared with the end of 2018: +5 (newly consolidated 9, excluded 4),
  Compared with the end of June: +7* (newly consolidated 8, excluded 1)〕

【Newly consolidated】
(Electronics) SHOKO Electronics K.K.
(Chemicals)
GMM: GMM Development Holdings Limited*, GMM Coatings Private Limited*, Zhuhai Sunbright New Materials Co., Ltd.*
ILAG: HC Holding Beta AG*, Industrielack Holding AG*, Industrielack AG*, Ilag High Performance Coatings (Shanghai) Co., Ltd.*, ILAG RUI ZHONG NEW MATERIAL (SHANGHAI) CO., LTD.*

【Excluded】
PT. Showa Esterindo Indonesia (Petrochemicals, liquidation)
SHOWA DENKO CARBON Shanghai Co., Ltd. (Inorganics, liquidation)
SHOTIC (Singapore) Pte Ltd. (Aluminum, liquidation)
Showa Aluminum Corporation of America* (Aluminum, merger)

- Equity method applied: 11
  Remains same as those at the ends of 2018 and June 2019

Selected Data

(Average)

	2018		2019		Increase/decrease	
	Jan.-Sept.	Jul.-Sept.	Jan.-Sept.	Jul.-Sept.	Jan.-Sept.	Jul.-Sept.
■Exchange rate:						
¥/US$	109.6	111.5	109.2	107.4	-0.5	-4.1
¥/€	131.0	129.6	122.7	119.3	-8.3	-10.3
■Domestic naphtha price: ¥/KL	50,050	53,500	42,250	40,200	-7,800	-13,300
■Aluminum						
LME price: US$/T	2,163	2,067	1,829	1,788	-334	-279
Domestic market*: K¥/T	296	289	251	244	-45	-45

Exchange rate at December 31, 2018 ¥111.0/US$, at September 30, 2019 ¥107.9/US$
⇒Yen appreciated by ¥3.1/US$

*Domestic market: data from Nikkei

Summary

Jan. 1 – Sept. 30, 2018 vs. Jan. 1 – Sept. 30, 2019

(Unit: Billions of Yen)

	Jan.-Sept. 2018	Jan.-Sept. 2019	Increase/ decrease
Net sales	724.9	695.6	-29.4
Operating income	134.5	109.3	-25.2
Non-operating income and expenses, net	-0.3	-1.7	-1.4
Interest/Dividends income and expenses	-0.7	0.1	0.8
Equity in earnings of affiliates	1.0	0.2	-0.7
Foreign exchange gains or losses	0.2	-0.2	-0.4
Other	-0.8	-1.9	-1.1
Ordinary income	134.2	107.6	-26.6
Extraordinary profit	0.5	2.2	1.6
Extraordinary loss	-3.1	-4.3	-1.2
Income before income taxes	131.7	105.5	-26.2
Income taxes	-27.9	-22.2	5.7
Profit	103.7	83.3	-20.5
Net income attributable to non-controlling interests	-4.5	-2.3	2.1
Net income attributable to owners of the parent	99.3	81.0	-18.3

Extraordinary Profit/Loss

(Unit: Billions of Yen)

	Jan.-Sept. 2018	Jan.-Sept. 2019	Increase/ decrease
■Extraordinary Profit	0.5	2.2	1.6
●Gain on sales of non-current assets	0.1	0.7	0.6
●Gain on sales of investment securities, net	0.3	1.3	1.1
●Gain on liquidation of subsidiaries	0.2	—	-0.2
●Other	0	0.2	0.1
■Extraordinary Loss	-3.1	-4.3	-1.2
●Loss on sales and retirement of non-current assets	-2.4	-1.9	0.5
●Impairment loss	-0.1	-1.3	-1.2
●Other	-0.6	-1.1	-0.5
■Extraordinary Profit/Loss, Net	-2.5	-2.1	0.4

Consolidated Sales by Segment

(Unit: Billions of Yen)

	Jan.-Sept. 2018	Jan.-Sept. 2019	Increase/ decrease	
Petrochemicals	191.6	189.6	-2.0	【Olefins】sales decreased (shipment volumes up after the 2018 large-scale shutdown maintenance, market prices down) 【Organic chemicals】sales decreased (vinyl acetate, ethyl acetate: market prices down) 【SunAllomer】sales slightly increased
Chemicals	115.1	115.6	0.5	【Basic chemicals】sales slightly decreased (AN: market prices down, ammonia, chloroprene rubber: sales maintained at the year-earlier level) 【Electronic chemicals】sales decreased (shipment volumes down) 【Industrial gases】【Functional chemicals】sales slightly increased 【Coating materials】newly consolidated
Electronics	85.3	70.0	-15.3	【HDs】sales decreased (shipment volumes down mainly in 1H) 【Rare earths】sales decreased (structural reform), 【Compound semiconductors】sales decreased (shipment volumes down) 【LIB materials】sales decreased (shipment volumes down) 【SiC epitaxial wafers】sales increased (shipment volumes up)
Inorganics	192.2	190.1	-2.0	【Ceramics】sales decreased (shipment volumes of alumina down) 【Graphite electrodes】sales increased (though shipment volumes down due to reduced production, international market prices up)
Aluminum	81.1	73.7	-7.4	【High-purity foil for capacitors】sales decreased (shipment volumes down) 【Aluminum specialty components】sales decreased (shipment volumes of automotive parts and industrial equipment down) 【Aluminum cans】sales maintained at the year-earlier level
Others	101.7	95.8	-5.9	【SHOKO】sales decreased
Adjustments	-42.0	-39.2	2.7	
Total	724.9	695.6	-29.4	

(note) From 2019 SDK changed the segmentation (SiC epitaxial wafers business was transferred from “Others” to “Electronics”) . Figures of 2018 are based on the new segmentation.

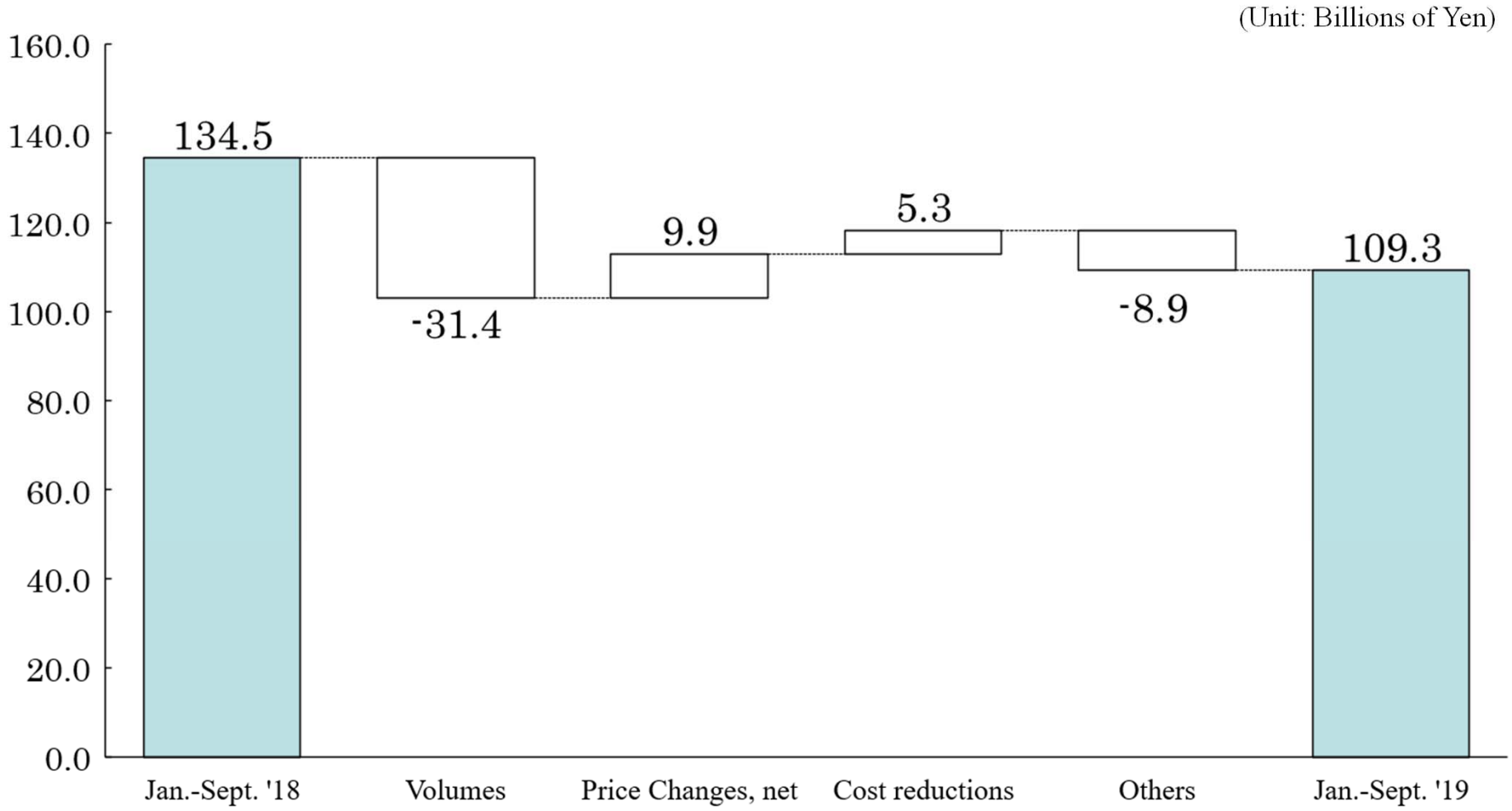
Consolidated Operating Income by Segment

(Unit: Billions of Yen)

	Jan.-Sept. 2018	Jan.-Sept. 2019	Increase/ decrease	
Petrochemicals	15.5	13.3	-2.2	【Olefins】profit decreased (profit up after the 2018 shutdown maintenance, depreciation of naphtha inventory due to a fall in market price, spread squeezed due to softening supply-demand situation in Asia) 【Organic chemicals】profit increased (vinyl acetate: shipment volumes up) 【SunAllomer 】profit increased (shipment volumes up)
Chemicals	12.6	9.5	-3.1	【Basic chemicals】profit slightly increased 【Electronic chemicals】profit decreased (shipment volumes down) 【Industrial gases】profit decreased (shipment volumes down, shipping cost up due to tight supply in Western Japan) 【Functional chemicals】profit maintained at the year-earlier level
Electronics	10.8	3.0	-7.8	【HDs】profit decreased (shipment volumes down) 【Rare earths】profit maintained at the year-earlier level, 【Compound semiconductors】profit decreased (shipment volumes down) 【LIB materials】profit decreased (shipment volumes down) 【SiC epitaxial wafers】profit decreased (R&D cost up)
Inorganics	97.9	84.9	-13.0	【Ceramics】profit decreased (shipment volumes down) 【Graphite electrodes】profit decreased (shipment volumes down due to reduced production)
Aluminum	4.0	1.4	-2.6	【High-purity foil for capacitors】profit decreased (shipment volumes down) 【Aluminum specialty components】profit decreased (shipment volumes of automotive parts and industrial equipment down) 【Aluminum cans】profit increased
Others	1.4	0.9	-0.4	【SHOKO】profit increased
Adjustments	-7.7	-3.7	4.0	
Total	134.5	109.3	-25.2	

(note) From 2019 SDK changed the segmentation (SiC epitaxial wafers business was transferred from “Others” to “Electronics”) . Figures of 2018 are based on the new segmentation.

Operating Income Breakdown by Factor



Summary

CQ3 (Jul.1 – Sept.30), 2018 vs. CQ3 (Jul.1 – Sept.30), 2019

(Unit: Billions of Yen)

	CQ3, 2018	CQ3, 2019	Increase/ decrease
Net sales	269.1	220.1	-49.0
Operating income	56.6	23.8	-32.8
Non-operating income and expenses, net	-0	-1.1	-1.1
Interest/Dividends income and expenses	-0.3	-0.1	0.1
Equity in earnings of affiliates	0.4	-0.3	-0.7
Foreign exchange gains or losses	0.7	-0.2	-0.9
Other	-0.8	-0.4	0.4
Ordinary income	56.6	22.8	-33.9
Extraordinary profit	0	0.3	0.3
Extraordinary loss	-1.1	-1.3	-0.2
Income before income taxes	55.6	21.8	-33.8
Income taxes	-12.7	-6.0	6.7
Profit	42.9	15.8	-27.1
Net income attributable to non-controlling interests	-1.6	-0.7	0.9
Net income attributable to owners of the parent	41.3	15.1	-26.2

Consolidated Sales by Segment

CQ3 (Jul.1 – Sept.30), 2018 v s. CQ3 (Jul.1 – Sept.30), 2019

(Unit: Billions of Yen)

	CQ3, 2018	CQ3, 2019	Increase/ decrease	
Petrochemicals	76.2	62.1	-14.1	【Olefins】sales decreased (market prices down) 【Organic chemicals】sales decreased (vinyl acetate, ethyl acetate: market prices down) 【SunAllomer】sales decreased (market prices down)
Chemicals	40.5	42.1	1.6	【Basic chemicals】【Industrial gases】【Functional chemicals】sales maintained at the year-earlier level 【Electronic chemicals】sales decreased (shipment volumes down) 【Coating materials】newly consolidated
Electronics	28.6	25.4	-3.2	【HDs】sales decreased (shipment volumes slightly down) 【Rare earths】sales decreased (structural reform), 【Compound semiconductors】sales decreased (shipment volumes down) 【LIB materials】sales decreased (shipment volumes down) 【SiC epitaxial wafers】sales decreased (shipment volumes for export down)
Inorganics	75.7	47.4	-28.3	【Ceramics】sales decreased (shipment volumes of alumina, abrasives, and fine ceramics down) 【Graphite electrodes】sales decreased (shipment volumes down due to reduced production)
Aluminum	27.8	24.7	-3.1	【High-purity foil for capacitors】【Aluminum specialty components】sales decreased (shipment volumes down) 【Aluminum cans】sales maintained at the year-earlier level
Others	34.4	31.5	-2.9	【SHOKO】sales decreased
Adjustments	-14.1	-13.1	1.0	
Total	269.1	220.1	-49.0	

(note) From 2019 SDK changed the segmentation (SiC epitaxial wafers business was transferred from “Others” to “Electronics”) . Figures of 2018 are based on the new segmentation.

Consolidated Operating Income by Segment

CQ3 (Jul.1 – Sept.30), 2018 v s. CQ3 (Jul.1 – Sept.30), 2019

(Unit: Billions of Yen)

	CQ3, 2018	CQ3, 2019	Increase/ decrease	
Petrochemicals	8.1	4.8	-3.3	【Olefins】profit decreased (market prices down) 【Organic chemicals】profit decreased (vinyl acetate, ethyl acetate: market prices down) 【SunAllomer】profit increased (time lag between the drop in raw material prices and that in sales prices)
Chemicals	4.9	4.0	-0.9	【Basic chemicals】profit increased (power generating business: volumes up) 【Electronic chemicals】profit decreased (shipment volumes down) 【Industrial gases】profit slightly decreased 【Functional chemicals】profit maintained at the year-earlier level
Electronics	4.8	2.0	-2.8	【HDs】profit decreased (inventory prices up due to decreased shipment volumes in 1H) 【Rare earths】【Compound semiconductors】profit decreased (shipment volumes down) 【LIB materials】profit decreased (shipment volumes down) 【SiC epitaxial wafers】profit decreased (R&D costs up)
Inorganics	39.8	13.1	-26.7	【Ceramics】profit decreased (shipment volumes of abrasives, and fine ceramics down) 【Graphite electrodes】profit decreased (shipment volumes down due to reduced production, raw material inventory prices up due to difference in the timing of procurement)
Aluminum	1.4	0.9	-0.4	【High-purity foil for capacitors】【Aluminum specialty components】profit decreased (shipment volumes down) 【Aluminum cans】profit increased (cost reduction)
Others	0.4	0.3	-0.1	
Adjustments	-2.7	-1.3	1.4	
Total	56.6	23.8	-32.8	

(note) From 2019 SDK changed the segmentation (SiC epitaxial wafers business was transferred from “Others” to “Electronics”) . Figures of 2018 are based on the new segmentation.

Consolidated Balance Sheet

(Unit: Billions of Yen)

Assets	Dec. 31, 2018	Sept. 30, 2019	Increase/ decrease	Liabilities and net assets	Dec. 31, 2018	Sept. 30, 2019	Increase/ decrease
Cash and deposits	113.2	119.7	6.5	Notes and accounts payable	139.4	107.6	-31.9
Notes and accounts receivable	203.7	162.3	-41.4	Interest-bearing debt	288.0	304.6	16.6
Inventories	152.8	174.4	21.6	Net defined benefit liability	22.0	12.1	-9.9
Other current assets	26.8	26.9	0.1	Other liabilities	160.2	126.6	-33.6
Total current assets	496.5	483.3	-13.3	Total liabilities	609.6	550.9	-58.8
Buildings and structures	78.8	80.2	1.4	Capital stock	140.6	140.6	0
Machinery and equipment	146.8	139.5	-7.2	Capital surplus	78.9	78.9	0
Land	235.0	236.8	1.8	Retained earnings	197.7	257.1	59.4
Other tangible fixed assets	17.9	25.9	8.1	Treasury stock	-11.7	-11.7	-0
Total tangible fixed assets	478.4	482.4	4.0	Total shareholders' equity	405.5	464.9	59.4
Intangible fixed assets	15.0	22.1	7.2	Valuation difference on available-for-sale securities	7.5	9.1	1.6
Investments and other assets	85.1	81.4	-3.7	Deferred gains or losses on hedges	0.8	-0.1	-0.9
incl. investment securities	71.9	70.4	-1.5	Revaluation reserve for land	33.3	33.0	-0.3
				Foreign currency translation adjustment	7.1	-2.0	-9.1
				Remeasurements of defined benefit plans	-8.2	-6.8	1.4
				Total accumulated other comprehensive income	40.4	33.2	-7.3
				Non-controlling interests	19.4	20.2	0.8
Total fixed assets	578.5	585.9	7.5	Total net assets	465.3	518.3	53.0
Total assets	**1,075.0**	**1,069.2**	**-5.8**	**Total liabilities and net assets**	**1,075.0**	**1,069.2**	**-5.8**

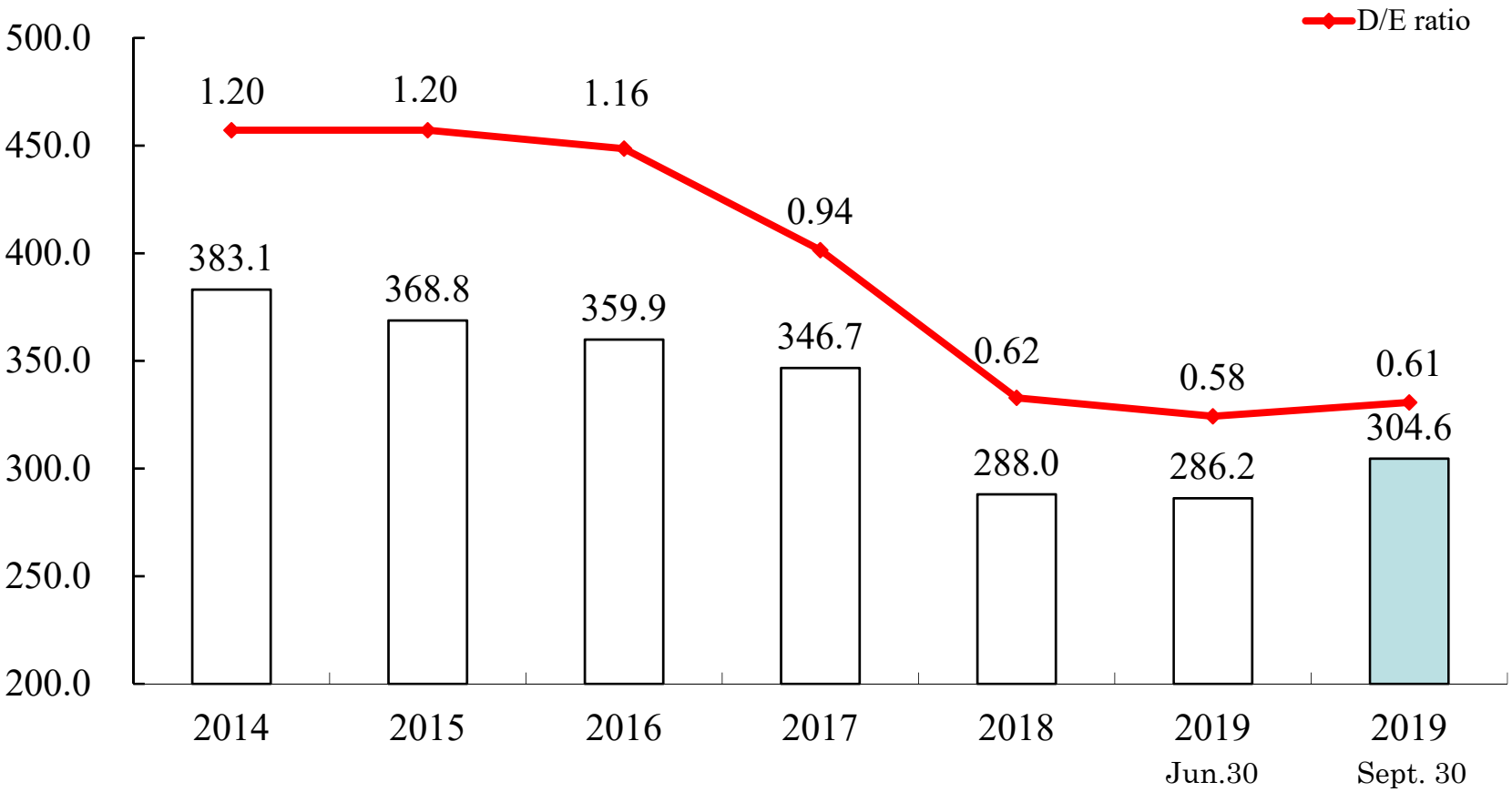
Total Assets
Interest-bearing Debt and D/E ratio

(Unit: Billions of Yen)

	Dec. 31, 2018	Sept. 30, 2019	Increase/ decrease
● Total assets	1,075.0	1,069.2	-5.8
● Interest-bearing debt	288.0	304.6	16.6
● Debt/Equity ratio	0.62 times	0.61 times	-0.01p
● Stockholders' Equity ratio	41.5%	46.6%	5.1p

Interest-bearing Debt

(Unit: Billions of Yen)



Equity ratio	29.7%	31.5%	31.8%	34.3%	41.5%	45.6%	46.6%

(Reference) Summary

CQ2 (Apr.1 – Jun.30), 2019 vs. CQ3 (Jul.1 – Sept.30), 2019

(Unit: Billions of Yen)

	CQ2, 2019	CQ3, 2019	Increase/ decrease
Net sales	240.8	220.1	-20.7
Operating income	40.1	23.8	-16.3
Non-operating income and expenses, net	0.6	-1.1	-1.6
Interest/Dividends income and expenses	0.1	-0.1	-0.3
Equity in earnings of affiliates	1.0	-0.3	-1.3
Foreign exchange gains or losses	-0.1	-0.2	-0.1
Other	-0.5	-0.4	0.1
Ordinary income	40.6	22.8	-17.9
Extraordinary profit	1.5	0.3	-1.2
Extraordinary loss	-2.3	-1.3	1.0
Income before income taxes	39.9	21.8	-18.0
Income taxes	-6.7	-6.0	0.7
Profit	33.2	15.8	-17.4
Net income attributable to non-controlling interests	-0.5	-0.7	-0.2
Net income attributable to owners of the parent	32.7	15.1	-17.6

(Reference) Consolidated Sales by Segment

CQ2 (Apr.1 – Jun.30), 2019 vs. CQ3 (Jul.1 – Sept.30), 2019

(Unit: Billions of Yen)

	CQ2, 2019	CQ3, 2019	Increase/ decrease	
Petrochemicals	64.8	62.1	-2.7	【Olefins】sales decreased (market prices down) 【Organic chemicals】sales decreased (vinyl acetate, ethyl acetate: market prices down) 【SunAllomer】sales decreased
Chemicals	37.5	42.1	4.6	【Basic chemicals】sales increased (power generating business: volumes up, ammonia: shipment volumes up) 【Electronic chemicals】sales increased (shipment volumes up) 【Industrial gases】sales increased (shipment volumes up: seasonal) 【Functional chemicals】sales maintained at the CQ2 level 【Coating materials】newly consolidated
Electronics	24.0	25.4	1.4	【HDs】sales increased (shipment volumes up) 【Rare earths】【Compound semiconductors】sales slightly decreased 【LIB materials】sales decreased (shipment volumes down) 【SiC epitaxial wafers】sales decreased (shipment volumes down)
Inorganics	70.3	47.4	-22.9	【Ceramics】sales decreased (shipment volumes of abrasives down) 【Graphite electrodes】sales decreased (shipment volumes down due to reduced production)
Aluminum	25.3	24.7	-0.6	【High-purity foil for capacitors】sales maintained at the CQ2 level 【Aluminum specialty components】sales slightly decreased 【Aluminum cans】sales slightly decreased
Others	31.9	31.5	-0.3	【SHOKO】sales slightly decreased
Adjustments	-13.0	-13.1	-0.1	
Total	240.8	220.1	-20.7	

(Reference) Consolidated Operating Income by Segment

CQ2 (Apr.1 – Jun.30), 2019 vs. CQ3 (Jul.1 – Sept.30), 2019

(Unit: Billions of Yen)

	CQ2, 2019	CQ3, 2019	Increase/ decrease	
Petrochemicals	4.5	4.8	0.3	【Olefins】profit decreased (spread squeezed) 【Organic chemicals】profit decreased (vinyl acetate, ethyl acetate: market prices down) 【SunAllomer】profit increased
Chemicals	3.1	4.0	0.9	【Basic chemicals】profit maintained at the CQ2 level 【Electronic chemicals】profit increased (shipment volumes up) 【Industrial gases】profit increased (shipment volumes up: seasonal) 【Functional chemicals】profit slightly increased
Electronics	1.2	2.0	0.8	【HDs】profit increased (shipment volumes up) 【Rare earths】【Compound semiconductors】profit slightly decreased 【LIB materials】profit slightly decreased 【SiC epitaxial wafers】profit slightly decreased
Inorganics	32.3	13.1	-19.3	【Ceramics】profit maintained at the CQ2 level 【Graphite electrodes】profit decreased (shipment volumes down due reduced production)
Aluminum	0.2	0.9	0.7	【High-purity foil for capacitors】profit slightly increased 【Aluminum specialty components】profit maintained at the CQ2 level 【Aluminum cans】profit increased
Others	0.3	0.3	0	
Adjustments	-1.6	-1.3	0.2	
Total	40.1	23.8	-16.3	

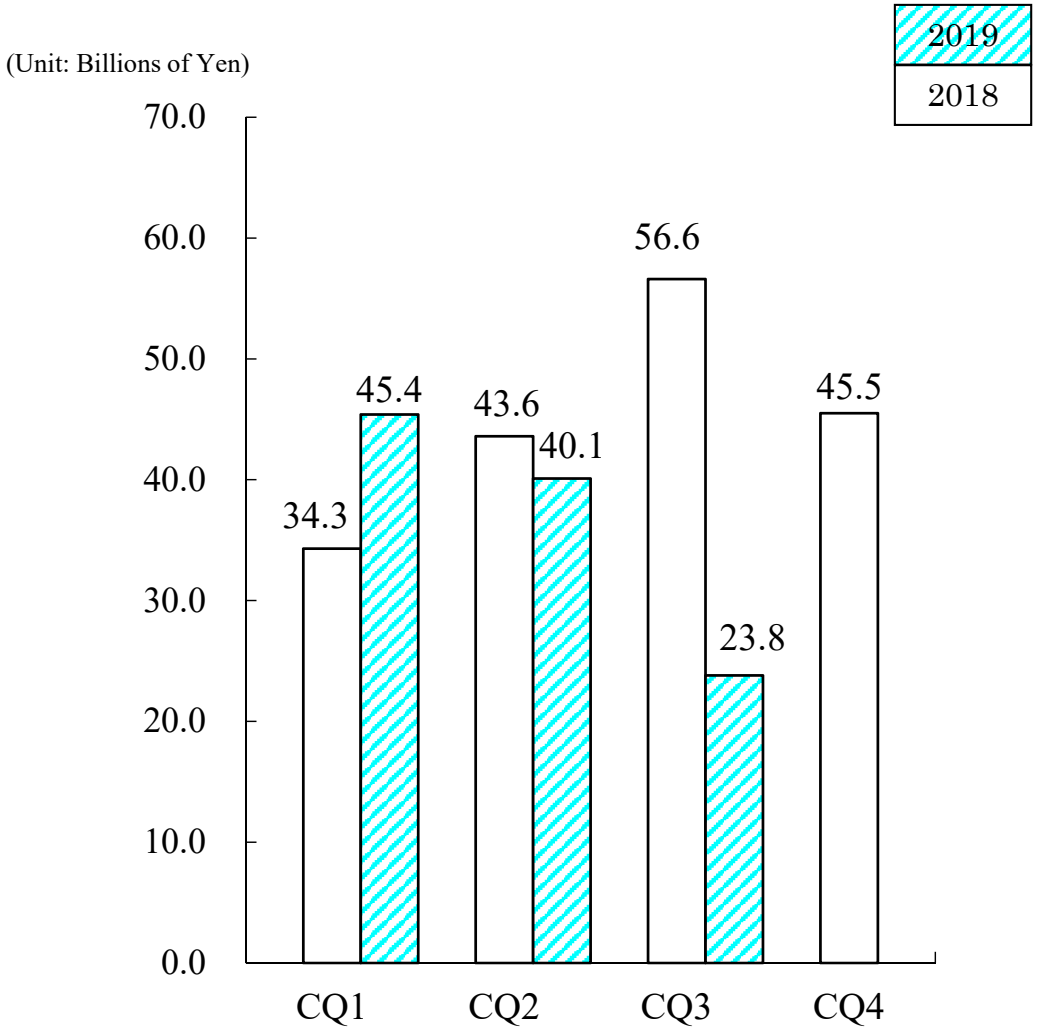
(Reference) Quarterly Summary 2019

(Unit: Billions of Yen)

	CQ1, 2019	CQ2, 2019	CQ3, 2019	Jan.－Sept. 2019	2019 Forecast*
Net sales	234.7	240.8	220.1	695.6	980.0
Operating income	45.4	40.1	23.8	109.3	145.0
Net income attributable to owners of the parent	33.1	32.7	15.1	81.0	90.0

*Forecast was revised on August 7, 2019.

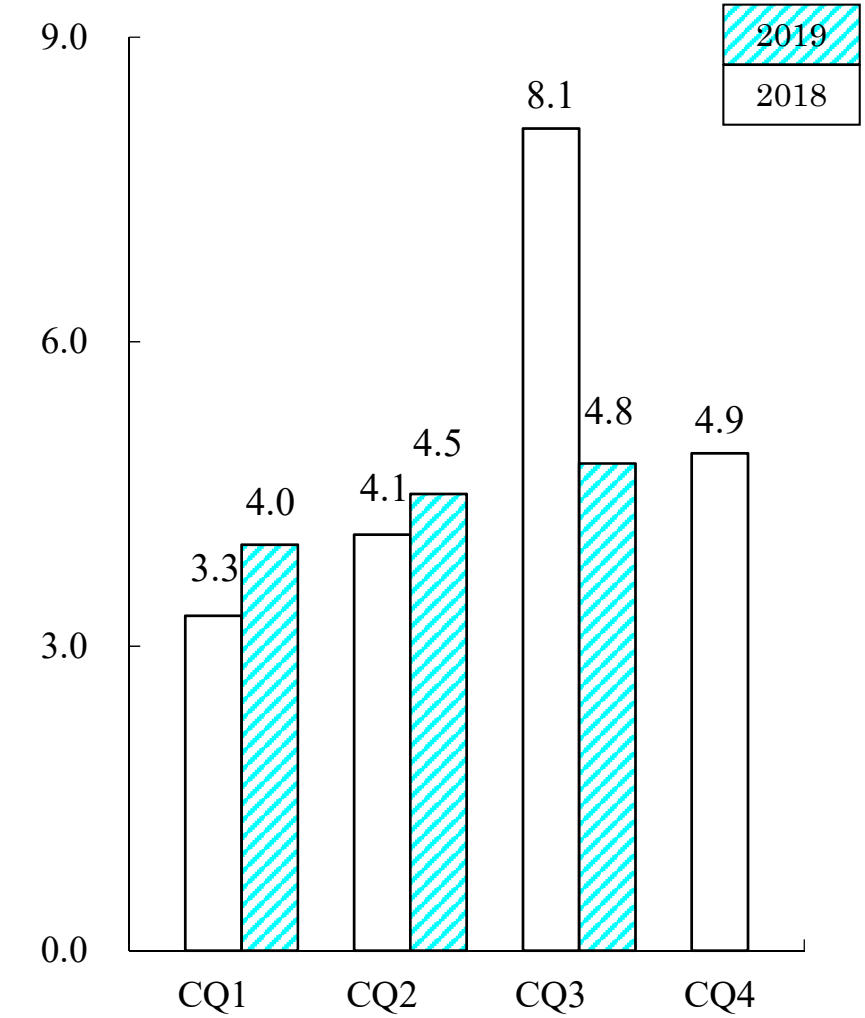
(Reference) Quarterly Operating Income



(Reference) Quarterly Operating Income by Segment

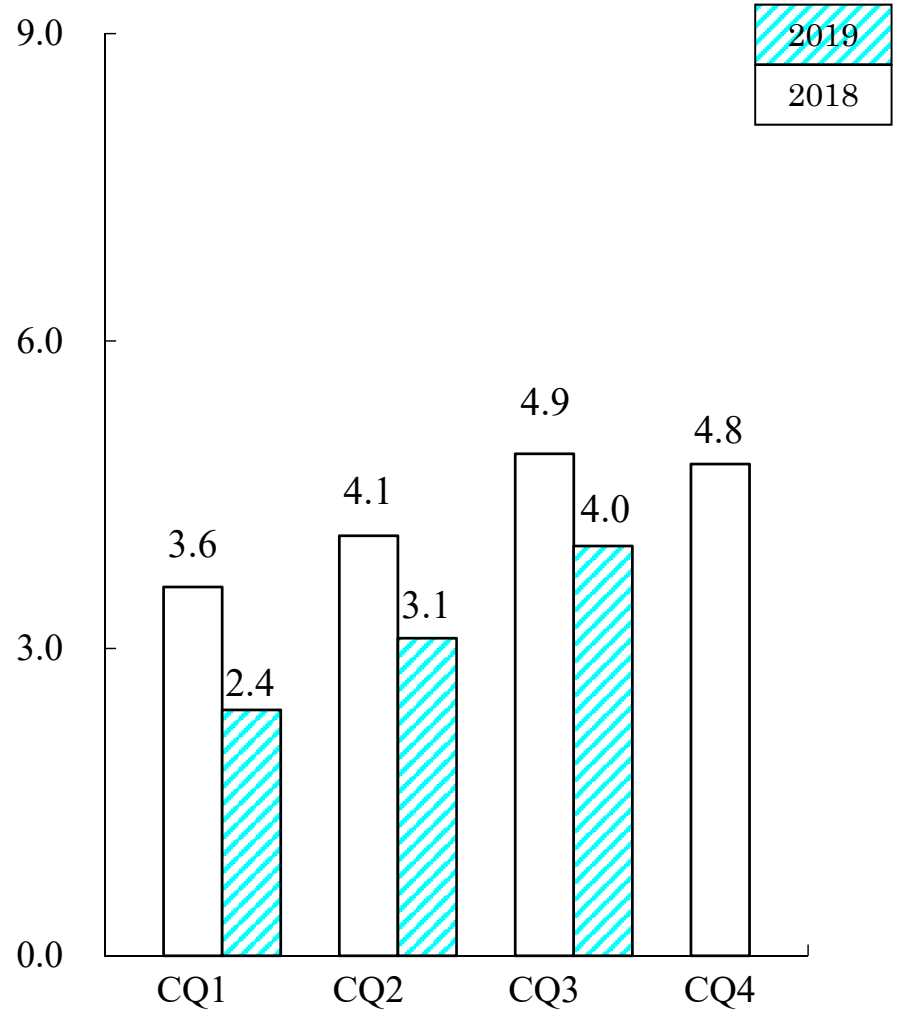
《Petrochemicals》

(Unit: Billions of Yen)



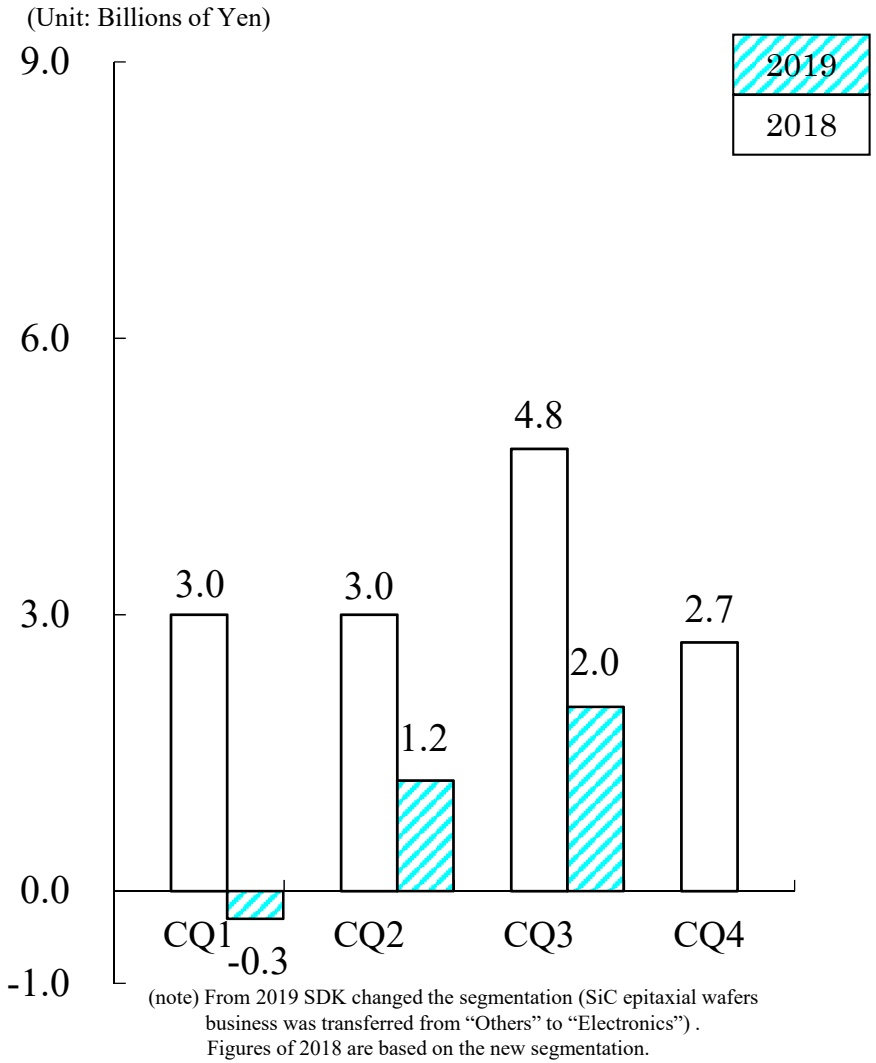
《Chemicals》

(Unit: Billions of Yen)



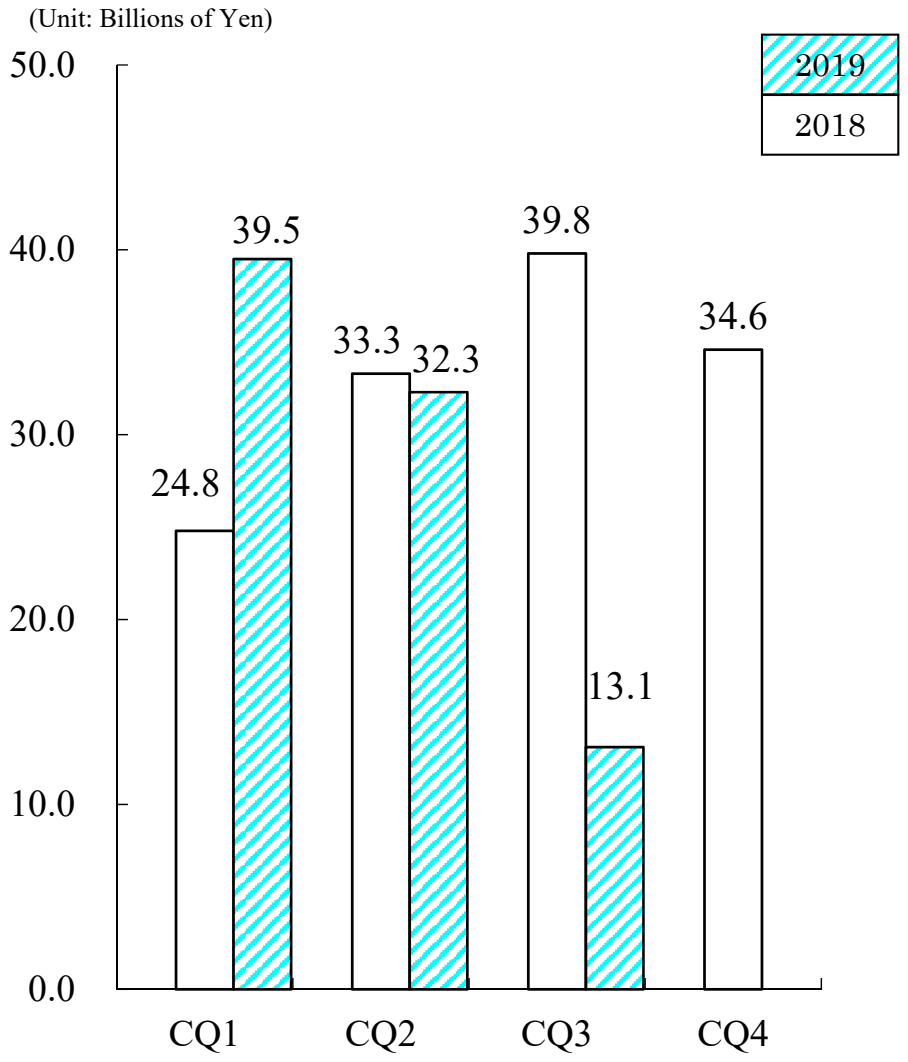
(Reference) Quarterly Operating Income by Segment

《Electronics》



(note) From 2019 SDK changed the segmentation (SiC epitaxial wafers business was transferred from "Others" to "Electronics") .
Figures of 2018 are based on the new segmentation.

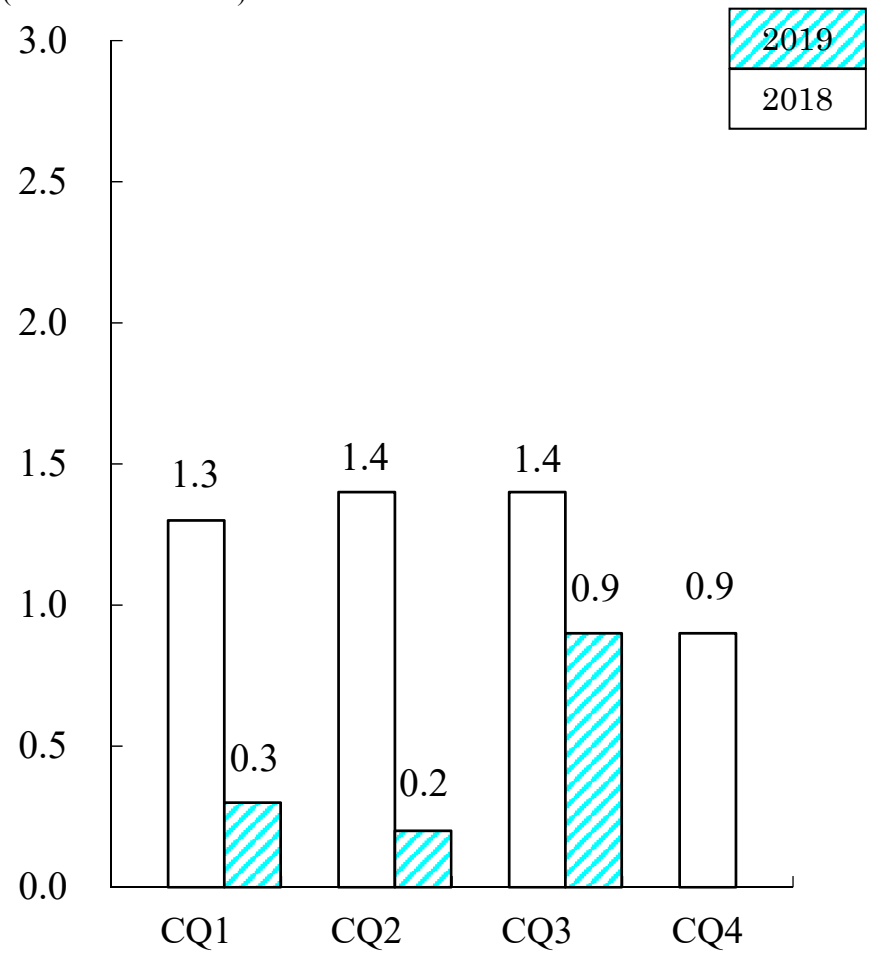
《Inorganics》



(Reference) Quarterly Operating Income by Segment

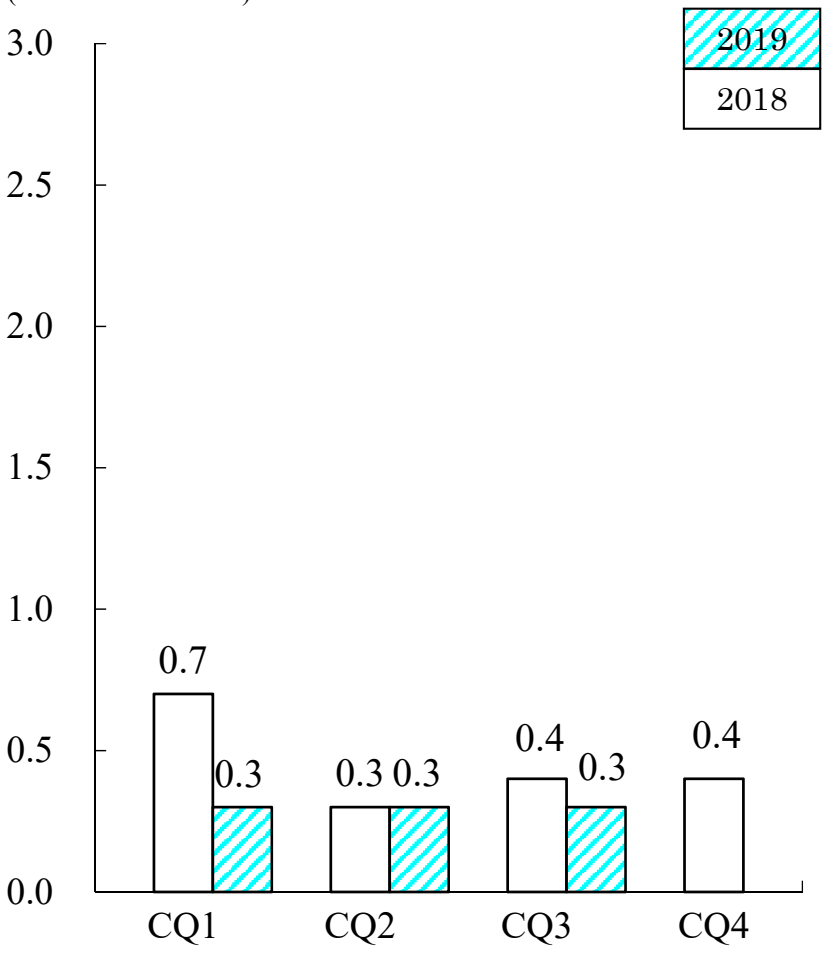
《Aluminum》

(Unit: Billions of Yen)



《Others》

(Unit: Billions of Yen)



(note) From 2019 SDK changed the segmentation (SiC epitaxial wafers business was transferred from "Others" to "Electronics") .
Figures of 2018 are based on the new segmentation.

Topics

[General]

- Set 2030 GHG reduction target conforming to global standard

In July 2019, SDK set a medium-term target figure to reduce emissions of greenhouse gases (GHGs) by 2030. In addition, recognizing importance of information disclosure to the global community, SDK has decided to announce the amount of the Showa Denko Group's GHG emissions in conformity with "GHG Protocol," which is the global standard, starting from the data for FY 2018 (April 2018 - March 2019). Based on these policies, the Showa Denko Group set a goal of 11% reduction of GHG emissions from its domestic bases for FY 2030 compared with that for FY 2013. In addition, with the announcement of data for FY2018 as its beginning, the Showa Denko Group has started to disclose the total amount of GHG emissions from bases at home and abroad in accordance with GHG Protocol, namely, the amount of direct GHG emissions from the Group's own facilities (Scope 1), the amount of indirect GHG emissions from purchased or acquired electricity, steam and heat (Scope 2), and the amount of indirect GHG emissions from the corporate value chain (Scope 3). The Group will announce these data through its integrated report (Showa Denko Report), its Website explaining the Group's CSR activities, and other media. Moreover, aiming to set the Group's global warming mitigation measures as a part of its business strategy, the Group will introduce Internal Carbon Pricing* mechanism and incorporate reduction of GHG emissions into the decision-making process for investment as a factor to be considered. The Showa Denko Group will continue introducing environment-conscious production equipment and technologies, promoting environment protection measures, and providing products that support recycling-oriented society, thereby contributing to creation of society where affluence and sustainability are harmonized.

*Internal Carbon Pricing: This mechanism assumes a situation in which emission of CO_2 is taxed, makes target organizations recognize the value of low-carbon operation, and motivates them to choose investment programs with less CO_2 emission.

Topics

[General]

- **Acquired ILAG Group, global non-stick coatings manufacturer**

  In July 2019, SDK acquired all shares in ILAG Industrielack AG, which leads the ILAG Group (ILAG), a specialty non-stick coating materials manufacturing company. Non-stick coating materials (NSCs) are used on consumer goods such as cookware, bakeware, and home electrical appliances, and also on industrial goods including automotive parts and other industrial equipment, for the purposes of preventing sticking of substances on their surfaces and supporting low friction and release during use. The global market for NSCs is put about ¥130 billion (about $1.2 billion) a year (SDK's estimate as of May 2019). ILAG has the fourth largest share in the consumer-goods NSC market of worldwide operating companies. ILAG exports its products to more than 50 countries. On the other hand, SDK already acquired GMM Group, another large manufacturer of NSCs for consumer goods, in November 2016. Therefore, SDK Group can pursue a synergy effect of integrated operation and marketing between ILAG and GMM groups because they have competitive market shares in different geographic areas in the world. In addition, after the acquisition of ILAG, annual sales figure of SDK's NSC business leaped up to about $60 million, and now has strong presence and competitiveness in global market, especially in the field of consumer goods. SDK's functional polymer/monomer business sector manufactures and sells materials for coatings for various purposes, and have rich expertise in prescription and manufacturing of raw materials for high-performance coatings and evaluation of performance of those coatings. NSCs can be classified into three categories in terms of raw materials, namely, fluorinated-resin based, silicon based, and Sol-Gel based coatings. Therefore, SDK can offer optimum solutions to its own NSC business by taking advantage of its wide-ranging businesses, products and technologies as an integrated chemical company.

Topics

[General]

- **Established a technology to joint aluminum alloy and polycarbonate directly**

  SDK developed a technology to joint aluminum alloy and polycarbonate resin directly. Mechanical joining with bolts and nuts and gluing is widely used to joint metal and plastics. Technologies to joint metal and resins directly when resin materials are injected for molding are now attracting manufacturers' attention because such technologies enable manufacturers to simplify manufacturing processes, improve productivity, and process parts with complicated shapes. It has been believed difficult to joint aluminum alloy with amorphous engineering plastics including polycarbonate resin by utilizing joining technologies depending on mechanical cohesiveness including anchoring. However, SDK has successfully developed a technology to joint aluminum alloy and polycarbonate resin directly by utilizing our special surface-treatment technology and expertise in primers. This new technology is characterized with joining mechanism utilizing not only anchoring effect but also chemical cohesiveness. In addition, in experiments, this technology successfully achieved cohesiveness of more than 25Mpa between aluminum alloy and polycarbonate under normal molding condition for polycarbonate resin. Since this technology realizes direct joining between polycarbonate resin, which has wide multiplicity of use, and light aluminum alloy, it is applicable to molding of composite housings for smartphones and other equipment. For the future, we will aim to strengthen cohesiveness and durability of this joining, apply this technology to heat-resistant super-engineering plastics, and put automotive parts made with this technology to practical use.

Topics

[General]

- **Gained government approval for the Company's plan for innovative use of data**

In July this year, SDK's plan for establishing a new information platform was approved by the government as one of the "Plans for Innovative Use of Data for Industrial Activities." In accordance with the Article 22 of the Act on Special Measures for Productivity Improvement, Minister for Internal Affairs and Communications as well as Minister of Economy, Trade and Industry approve capital investment plans for productivity improvement (in terms of labor productivity and return on investment) through coordination and utilization of data with prescribed cybersecurity measures. In cases of capital investments based on such approved plans, companies can receive government support in the form of tax credit and special depreciation. SDK has decided to introduce "SAP S/4HANA," an enterprise resource planning (ERP) system developed by SAP SE. Based on the system, SDK will establish a platform for unified management of information on sales, accounting and procurement pertaining to various sites it operates globally. The unified data under "SAP/S4HANA" will be supplied to new systems of sales target and profit/loss simulation, and analyzes. Thus SDK will achieve a proactive management style, and its plan for establishing the new information platform has been approved as a Plan for innovative Use of Data for Industrial Activities. Under its medium-term business plan "The TOP 2021," SDK aims to maximize CUSTOMER Experience through utilization of artificial intelligence (AI) and internet of things (IoT). By establishing the new information platform, SDK will continue increasing management efficiency and creating best solutions through integration of various products and services.

Topics

[Petrochemicals segment]

- **Decided to commercialize 1,3-BG**

In October this year, SDK decided to commercialize 1,3-butylene glycol (1,3-BG), which is mainly used as raw material for cosmetics. SDK will finish installation of facilities to produce 1,3-BG in its Oita Complex by the end of 2019, and plans to start sale of the product in April 2020. 1,3-BG is mixed into many kinds of cosmetics as moisturizing component. Due to rapid growth in Asian demand for cosmetics, the demand for 1,3-BG is expected to increase 10% every year*. SDK will support the growth of cosmetics market centering on Asia from supply side of raw materials including 1,3-BG. In addition, SDK will realize production of 1,3-BG with quality good enough to be used as an ingredient of cosmetics by utilizing its original technology. In Oita Complex, SDK will practice integrated production of 1,3-BG from ethylene. SDK will continue striving to make its petrochemicals business the most competitive one in East Asia by enhancing its profitability through commercialization of new derivatives and improvement in mutual cooperation among members of the regional complex, including strengthening of its acetyl chain.

*SDK's estimate

[Chemicals segment]

- **Started shipments of BMC for TOYOTA's hybrid vehicles in China**

SDK started supplying bulk molding compound (BMC) to Toyota Motor Corporation (TOYOTA) as sealing material for generator motors used in COROLLA HYBRID and LEVIN HYBRID recently launched in China. SDK's BMC has such characteristics as high heat conductivity, insulation properties, heat resistance, fluidity, dimensional stability and chemical resistance. The material has been used as sealing material for generator motors for hybrid vehicles (HVs), such as TOYOTA's PRIUS. This time, TOYOTA decided to develop and produce electric-vehicle power trains in China on the occasion of the introduction of two new HV models for the Chinese market. In response to this new policy, Shanghai Showa Highpolymer started producing BMC for HVs for the first time since its foundation in 2010, and supplying the material to Toyota Motor (Changshu) Auto Parts. The Chinese government introduced this year a new environmental regulation, obliging car makers to produce a certain number of new energy vehicles (NEVs). There is a move to spread the use of HVs as fuel-efficient cars for environmental protection. Thus, the HV market in China is expected to grow further.

Topics

[Electronics segment]

- **Developed second generation of high-grade SiC epitaxial wafers**

SDK has developed a second generation of high-grade silicon carbide (SiC) epitaxial wafers (HGE-2G) for power semiconductors. SDK has been mass-producing the first generation of high-grade epitaxial wafers under the trade name of "High-Grade Epi" (HGE). HGE-2G achieved further improvement in quality. When compared with the currently mainstream silicon-based semiconductors, SiC-based power semiconductors can operate under high-temperature, high-voltage, and high-current conditions while substantially reducing energy loss. These features enable device manufacturers to produce smaller, lighter and more energy-efficient power control modules, and the products' market is rapidly expanding. SiC power semiconductors are already used in power modules for servers in data centers, on-board battery chargers and rapid charging stands for EVs. In addition, SiC power semiconductors are expected to be used in power control units (PCU) for EVs in the first half of 2020s. Thus the demand for SiC-based semiconductors is expected to grow further. In recent years, improvement in quality of SiC epitaxial wafers and advances in device manufacturing process enabled manufacturers to put SiC-MOSFET into practical use, and full-SiC-based inverters with higher energy efficiency has begun to spread. For applications to inverter modules to drive motors for EVs and railcars, meanwhile, large chips measuring around 10mm square are made out of epitaxial wafers. This is because one device needs to handle a current as high as 100A. To prevent deterioration in the production yield of such large chips, the defect density on the surface of epitaxial wafers should be controlled to be less than $0.1/cm^2$. In the new product "HGE-2G," SDK has succeeded in controlling the density of surface defect (SD), which affects production yield of power semiconductors, to be half of the current HGE by improving epitaxial SiC growth process. In addition, SDK has succeeded in enhancing reliability of power semiconductors through improving the basal plane dislocation (BPD) conversion rate by more than ten times compared with that of HGE. The global demand for SiC epitaxial wafers is expected to increase to be about ¥150 billion by 2025. As the largest independent manufacturer of SiC epitaxial wafers, and under a motto of "Best in Class," SDK will continue coping with rapid expansion of the market for SiC epitaxial wafers, developing reliable products, and investing positively to expand its production capacity, thereby making its SiC epitaxial wafer business a *Koseiha* business.