

## 1. Transition of Recycling Rates According to the Food Recycling Law

### 1) Progress of Recycling Rates

<Refer "Reducing and Recycling Waste and Byproducts," Corporate Citizenship Report 2010, website>

The Kikkoman Group adapts the priority order for recycling and recycling rates set forth in the Food Recycling Law as the criteria to determine the enhancement of recycling wastes and byproducts.

#### <Priority Order for Recycling>

- Suppress the generation of food waste and byproducts at each manufacturing, distribution and consumption stage.
- Reuse waste and byproducts which can be used as resources for feed and fertilizer.
- Put waste to heat recovery (burning waste and using the heat) only when they are not recyclable.
- Dehydrate and dry waste in case either reuse or heat recovery is not possible, in order to reduce the volume for proper processing.

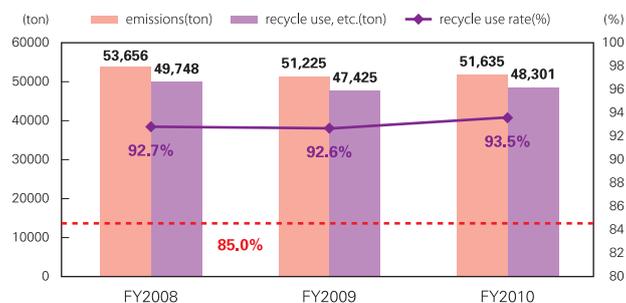
The Kikkoman Group makes effective use of food-related waste and byproducts (soy sauce cake, soy sauce oil, *okara* (soy pulp), *mirin* cake, apple residue, grape residue, seaweed extraction residue and bonito and kelp soup stock extraction residues), in particular, it is strengthening the use of wastes as feed which is given a high priority. As a result, soy sauce cake is reused almost 100% as feed, and overseas manufacturing group companies also attained 95.5% reuse of byproducts as feed.

#### <Recycling Rates>

A recycling rate is obtained by dividing the total volume of "controlled generation of waste and byproducts," "reuse," "heat recovery x 0.95" and "reduced waste volume" in the fiscal year by the total of "controlled generation of waste and byproducts" and "actual generation of waste and byproducts" of the fiscal year.

The recycling rates of nine manufacturing companies, Kikkoman Food Products Co., Hokkaido Kikkoman Co., Nagareyama Kikkoman Co., Ltd., Heisei Foods Co., Edogawa Foods Co., Nippon Del Monte Corp., Manns Wine Co., Ltd., Foodchemifa Co., Ltd., and Takara Shoyu Co., Ltd. are shown in the chart below. The rates are well over the target of 85% as designated for the food manufacturing industry in the Food Recycling Law.

### ● Transition of recycling rates according to the Food Recycling Law



## 2) Recycling Rates by Major Domestic and Overseas Manufacturing Companies

### 【FY2011】

<Refer "Reducing and Recycling Waste and Byproducts" in Corporate Citizenship Report 2012, website>

The Kikkoman Group added a new goal for the reuse and recycle of waste and byproducts in the Medium- and Long-term Environmental Preservation Goals set forth in FY2011. The goal is "to increase the recycling rate at manufacturing companies in Japan and major overseas manufacturing companies by at least 99% by FY2015."

The target companies: 10 domestic manufacturing companies (Kikkoman Food Products Co., Hokkaido Kikkoman Co., Nagareyama Kikkoman Co., Ltd., Heisei Foods Co., Edogawa Foods Co., Nippon Del Monte Corp., Tohoku Del Monte Corp., Manns Wine Co., Ltd., Foodchemifa Co., Ltd., and Takara Shoyu Co., Ltd.) and 3 major overseas manufacturing companies (KFI, KSP, KFE).

The recycling rate in FY2011 was 95.6%.



## Reducing and Recycling Waste and Byproducts

### **【FY2012】**

<Refer “Reducing and Recycling Waste and Byproducts” in Corporate Citizenship Report 2012, website>

In FY2012, the recycling rate of domestic and major overseas manufacturing companies reached 97.9%.

\*In FY2012, the Fukushima Factory of Nippon Del Monte Corp. and Tohoku Del Monte Corp. consolidated their business, therefore, these two companies were excluded from the target companies. Foodchemifa Co., Ltd. was separated into Kikkoman Biochemifa and Kikkoman Soyfoods. As a result, the number of target companies remained 13.

The target companies: 10 domestic manufacturing companies (Kikkoman Food Products Co., Hokkaido Kikkoman Co., Nagareyama Kikkoman Co., Ltd., Heisei Foods Co., Edogawa Foods Co., Nippon Del Monte Corp. (except for Fukushima Factory), Manns Wine Co., Ltd., Kikkoman Biochemifa Co., Kikkoman Soyfoods Co. and Takara Shoyu Co., Ltd.) and 3 major overseas manufacturing companies (KFI, KSP, KFE).

In the Kikkoman Group, effective use of food-related waste, sludge, post-cleaning residue, waste plastics and other waste and byproducts is sought. In FY2012 high priority was placed on the recycle/reuse of food-related waste and byproducts (soy sauce cake, soy sauce oil, *okara* (soy pulp), *mirin* cake, apple residue, grape residue, seaweed extraction residue, and bonito and kelp soup stock extraction residues). These were effectively used to manufacture animal feed. The quality of recycling was enhanced in accordance to the Food Recycling Law.

### **【FY2013】**

<Refer “Reducing and Recycling Waste and Byproducts” in Corporate Citizenship Report 2013, website>

In FY2013, the recycling rate of domestic and major overseas manufacturing companies reached 98.9%, which was enhanced by an increase of 1.0% from 97.9% of the previous year. A significant contribution for this improvement was made by the recycling of sludge at the Kamogawa Plant of Kikkoman Biochemifa Co. In order to achieve the goal of 99% in FY2015, we will make further efforts to increase recycling of waste and byproducts.

\*Saitama Kikkoman Co., which began full operation in FY2013, was added as a target company.

The target companies: 11 domestic manufacturing companies (Kikkoman Food Products Co., Hokkaido Kikkoman Co., Nagareyama Kikkoman Co., Ltd., Heisei Foods Co., Edogawa Foods Co., Saitama Kikkoman Co., Nippon Del Monte Corp. (except for Fukushima Factory), Manns Wine Co., Ltd., Kikkoman Biochemifa Co., Kikkoman Soyfoods Co. and Takara Shoyu Co., Ltd.) and 3 major overseas manufacturing companies (KFI, KSP and KFE).

### **【FY2014】**

<Refer “Improve the recycling rate,” and “Improve methods of recycling waste and byproducts,” Corporate Citizenship Report 2014, detailed edition (web edition)>

In FY2014, the overall recycling rate by manufacturing companies in Japan and major overseas manufacturing companies was 99.3%, an increase by 0.4% over that of FY2013 at 98.9%. The goal “to recycle more than 99% by FY2015,” set in the “Medium- and Long-term Environmental Preservation Goals,” was achieved. In FY2014, efforts to make effective use of food-related wastes (soy sauce cake, soy sauce oil, *okara*, *mirin* cake, apple residue, grape residue and bonito and kelp soup stock extraction residues) continued.

### **【FY2015】**

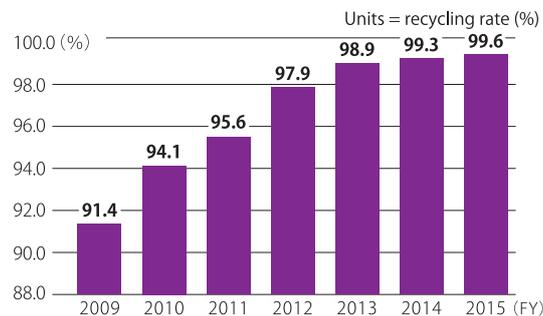
<Refer “Improve the recycling rate,” and “Improve methods of recycling waste and byproducts,” Corporate Citizenship Report 2015, detailed edition (web edition)>

In FY2015, the overall recycling rate by manufacturing companies in Japan and major overseas manufacturing companies was 99.6%, an increase by 0.3% over that of the previous fiscal year with 99.3%. The goal “to recycle more than 99% by FY2015,” set in the “Medium- and Long-term Environmental Preservation Goals,” was achieved. In FY2015, continuous efforts to make effective use of food-related wastes (soy sauce cake, soy sauce oil, *okara*, *mirin* cake, apple residue, grape residue and bonito and kelp soup stock extraction residues) were made.



## Reducing and Recycling Waste and Byproducts

### ● Transition of recycling rate of waste and byproducts (Manufacturing companies in Japan and major overseas manufacturing companies)



(note) Recycling rates for FY2009-2010 are recalculated based on the calculation formula and the data by the target companies (domestic and major overseas manufacturing companies) used to evaluate the level of achieving the goal as set in the Medium- and Long-term Environmental Preservation Goals designated in FY2011.

## 2. Transition of the Waste Generation per Unit of Production

### [FY2016]

<Reported in FY2017>

The Kikkoman Group set forth a objective "Increase the recycling rate at domestic and major overseas manufacturing companies by at least 99% by FY2015" in line with the reuse and recycle of waste and byproducts in the Medium- and Long-term Environmental Preservation Goals FY2013-2015.

In FY2015, the recycling rate by domestic and major overseas manufacturing companies reached 99.6%, and the goal was achieved. Upon its success, the Kikkoman Group decided upon a new objective regarding the reduction of waste generation per unit of production in its Medium-term Environmental Preservation Goals FY2016-2018, and efforts to achieve the objective were started.

### [Objectives in the Medium-term Environmental Preservation Goals FY2016-2018]

(1) To keep the waste generation per unit of production at the domestic and major overseas manufacturing divisions comparing with the level of the previous fiscal year or below.

The target divisions: 19 plants of domestic manufacturing companies (Kikkoman Food Products Co., (Noda Factory, Takasago Factory), Hokkaido Kikkoman Co., Nagareyama Kikkoman Co., Ltd., Heisei Foods Co. (Main Plant, Nakanodai Plant and Nishinippon Plant), Edogawa Foods Co., Saitama Kikkoman Co., Nippon Del Monte Corp. (Gunma Plant and Nagano Plant), Manns Wine Co., Ltd. (Katsunuma Winery and Komoro Winery), Kikkoman Biochemifa Co. (Edogawa Plant and Kamogawa Plant), Kikkoman Soyfoods Co. (Saitama Plant, Gifu Plant and Ibaraki Plant) and Takara Shoyu Co., Ltd. (Choshi Plant)) and 4 plants of major overseas manufacturing companies (Wisconsin and California Plants of Kikkoman Foods, Inc. (KFI), Plant of Kikkoman (S) Pte. Ltd. (KSP) and Plant of Kikkoman Foods Europe B.V. (KFE))

(2) To keep the waste generation at the domestic sales and back-office division comparing with the level of the previous fiscal year or below.

The target divisions: Domestic sales and back-office divisions: Kikkoman Corp., Kikkoman Food Products Co., Kikkoman Beverage Co., Kikkoman Business Service Co., Nippon Del Monte Agri Co. and Kikkoman Daily Co.

\*Definition of waste: Waste and byproducts which are collected, transported and disposed of by outside companies for compensation. The following items are not included in waste;

- 1) Processed as a product within the Group (ex. soy sauce cake for feed)
- 2) Consumed within the Group (ex. soy sauce oil as fuel)
- 3) Sold to treatment companies outside the Group (ex. scrap metal)
- 4) Collected for free of charge (ex. waste paper)



## Reducing and Recycling Waste and Byproducts

\*Calculation of waste generation per unit of production: In order to accurately understand the relations between manufacturing activities and waste generation, and to promote waste reduction, the weights of containers and packaging are excluded when calculating waste per unit of production.

The waste generation per unit of production at Kikkoman Group domestic and major overseas manufacturing divisions in FY2016 was 0.0335t/t, which was increased by 4.4% as compared with FY2015 (0.0321t/t). We could not achieve the objective.

The waste generation at Kikkoman Group domestic sales and back-office divisions in FY2016 were 330 tons, which was increased by 3.1% as compared with FY2015 (320 tons). We could not achieve the objective.

### **【FY2017】**

<Reported in FY2019>

The waste generation per unit of production at Kikkoman Group domestic and major overseas manufacturing divisions in FY2017 was 0.0366t/t, which was increased by 9.3% as compared with FY2016 (0.0335t/t). We could not achieve the objective.

The waste generation at Kikkoman Group domestic sales and back-office divisions in FY2017 were 350 tons, which was increased by 6.1% as compared with FY2016 (330 tons). We could not achieve the objective.

\*Kikkoman Beverage Co. merged Kikkoman Daily Co. on April 1, 2016.

The target divisions: Domestic sales and back-office divisions: Kikkoman Corp., Kikkoman Food Products Co., Kikkoman Beverage Co., Kikkoman Business Service Co. and Nippon Del Monte Agri Co.

### **【FY2018】**

<Reported in FY2019>

The waste generation per unit of production at Kikkoman Group domestic and major overseas manufacturing divisions in FY2018 was 0.0375t/t, which was increased by 2.5% as compared with FY2017 (0.0366t/t). We could not achieve the objective.

\*Heisei Foods Co. merged Edogawa Foods Co. and changed its name to Kikkoman Foodtech Co. on April 1, 2017.

The target divisions: 19 plants of domestic manufacturing companies (Kikkoman Food Products Co. (Noda Factory and Takasago Factory), Hokkaido Kikkoman Co., Nagareyama Kikkoman Co., Ltd., Kikkoman Foodtech Co. (Main Plant, Nakanodai Plant, Edogawa Plant and Nishinippon Plant), Saitama Kikkoman Co., Nippon Del Monte Corp. (Gunma Plant and Nagano Plant), Manns Wine Co., Ltd. (Katsunuma Winery and Komoro Winery), Kikkoman Biochemifa Co. (Edogawa Plant and Kamogawa Plant), Kikkoman Soyfoods Co. (Saitama Plant, Gifu Plant and Ibaraki Plant) and Takara Shoyu Co., Ltd. (Choshi Plant)) and 4 plants of major overseas manufacturing companies (Wisconsin and California Plants of Kikkoman Foods, Inc. (KFI), Plant of Kikkoman (S) Pte. Ltd. (KSP) and Plant of Kikkoman Foods Europe B.V. (KFE))

The waste generation at Kikkoman Group domestic sales and back-office divisions in FY2018 were 330 tons, which was decreased by 5.7% as compared with FY2017 (350 tons). The objective was achieved in these divisions.

## 3. Use of Soy Sauce Cake

<Reported in FY2017>

“Soy sauce cake” is the byproduct remaining after pressing out raw soy sauce from *moromi*.

Soy sauce cake has been used as fuel, fertilizer, and animal feed. At Kikkoman Corp., Soy sauce cake was used as fuel for boilers at the factory. However, beginning in 2004, research on its usefulness as feed began and the dryer for Soy sauce cake was installed in the factory in 2006 followed by the introduction of packaging equipment in 2007. In the meanwhile, the sales channels for animal feed were explored and expanded. Soy sauce cake contains fat from soybeans, Vitamin E, Vitamin K1, isoflavones (genistein, daidzein, glycitein) and other functional ingredients which are good to feed cattle, pigs and poultry. Kikkoman Food Products Co. offers almost all of soy sauce cake produced from the soy sauce manufacturing process to livestock farmers through feed manufacturing companies.

- “Kikkoman Fresh Meal” livestock feed made of soy sauce cake



- Cows eating feed made of soy sauce cake



In 2000, Kikkoman collaborated with a paper manufacturing company to develop technology to mix Soy sauce cake with non-wood paper pulp to produce paper products (writing paper, business cards, letter pads, envelopes, etc.). Now, these paper products are used as office supplies.

- Paper mixed with soy sauce cake (writing pad, envelopes, etc.)



### 4. Use of Soy Sauce Oil

<Reported in FY2017>

A great amount of oil from soybeans (soy sauce oil) is contained in raw soy sauce immediately after pressing. When it is stored in a clean tank, the oil comes floating to the upper part of the soy sauce tank forming an oil layer. This soy sauce oil had been used as fuel (lamp oil in the Edo era), a material for soap, and machine oil.

#### ● Boiler driven specifically by soy sauce oil



Kikkoman Food Products Co. has reduced its consumption of fossil fuel since 1994 by using most of the soy sauce oil generated in the soy sauce manufacturing process as carbon-neutral fuel, leading to the reduction of fossil fuel consumption.

### 5. Use of Okara

<Reported in FY2017>

Kikkoman Soyfoods Co. manufactures and sells soymilk products such as "Chosei Tonyu" and "Oishii Muchosei Tonyu." Soymilk is produced by steaming, crushing and pressing soybeans. The residue that remains after pressing is "Okara."

#### ● Raw food material "Okara Powder"



Kikkoman Soyfoods Co., dries the byproduct of *okara* to make "Okara Powder", and sells the product as raw materials for processed food, feed and fertilizer.

## III Reducing and Recycling Waste and Byproducts

### 6. Use of Seaweed Residue

<Reported in FY2015>

The Kamogawa Plant of Kikkoman Biochemifa Co. manufactures alginic acid from seaweed. Seaweed extractive residue is a byproduct from the manufacturing process of alginic acid and contains a filter aid (diatomaceous earth) which is used in the process.

● Extracted seaweed residue being fermented



● Organic fertilizer and soil improvement agents made from extracted seaweed residue



Making use of its properties, rice bran, soybean dregs and wood ash are mixed with the extracted seaweed residue and then the mix is fermented to merchandise as organic fertilizer and a soil improvement agent.

### 7. Use of Wastewater Sludge Residue

<Reported in FY2017>

The Kikkoman Group pays full attention to the prevention of the pollution of rivers by purifying and processing wastewater discharged from factories in the wastewater treatment facilities within the factories before the wastewater is released into them. A muddy sediment and supernatant generated in the wastewater processing facilities are "sludge."

● Fermented fertilizer made from sludge.



Noda Factory of Kikkoman Food Products Co., and Nagareyama Kikkoman Co., Ltd. put all the sludge (100%) from their wastewater treatment facilities into the hands of treatment contractors to process it as fermented fertilizer. The fertilizer is offered to farmers growing Japanese mustard spinach and strawberries.

## III Reducing and Recycling Waste and Byproducts

- Japanese mustard spinach (left) and strawberries (right) grown with fertilizer from fermented sludge (2015, Ibaraki prefecture).



Fertilizer made from fermented sludge and other ingredients contains great amounts of nitrogen and phosphorus which are helpful in growing these produce.

Some part of wastewater sludge from the Kamogawa Plant of Kikkoman Biochemifa Co. is heat-compressed into slag to be processed for a base course material and other road maintenance agents.

### 8. Research & Development to Make Use of High-Quality Byproducts

<Reported in FY2017>

The Kikkoman Group considers it important to upgrade the quality of reusing byproducts, and conducts R&D activities to that end. One example is an R&D study on the use of soy sauce oil as fish feed. The Kikkoman R&D Division discovered the effectiveness of Soy sauce oil consisting of fatty acid ethyl ester (appx. 59%) with linoleic acid and oleic acid from soybeans and free fatty acids (15%) as a substitute for conventional fish feed made of sardine oil. The R&D Division also found other functions such as antioxidant activity and antibacterial activity against fish disease bacteria. This study on the development of new uses of the byproducts was evaluated by specialists, and the Kikkoman R&D Division received the Award by the Director of the Industrial Science and Technology and Environment Bureau, the Ministry of Economy, Trade and Industry for FY2004.

- Use of feed at a fish pond

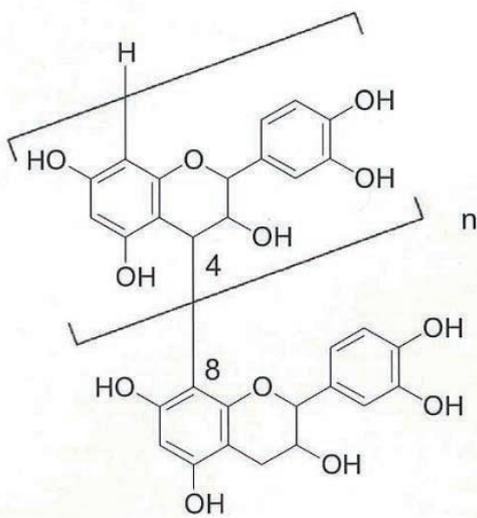


## Reducing and Recycling Waste and Byproducts

Grape seeds discharged from the winery at Manns Wine Co., Ltd. had been used as fertilizer. But the joint research group of Kikkoman and Manns Wine found that the polyphenols (proanthocyanidins) contained in grape seeds had strong antioxidant action, and developed a unique method to efficiently extract this ingredient. The result was highly evaluated among specialists, and was given the Award for Achievement in Technological Research by the Japan Society for Bioscience, Biotechnology and Agrochemistry in FY2000.

Tomato peel removed in the process of making tomato juice at the Nagano Plant of Nippon Del Monte Corp. had been reused by treatment contractors as animal feed. Kikkoman found through an R&D study with the Mibyo Medical Research Center that the tomato peel containing polyphenol (naringenin chalcone) had a strong anti-allergy action helpful to mitigate the symptoms of pollen allergy.

### ● proanthocyanidins (grape seed polyphenols)



### ● naringenin chalcone (tomato peel polyphenol)

