Second Batch of Domestic TOP TENs List

Japan Buiding BAT List

BAT1: Split–type Air Conditioner 'Kirigamine FZ Series'

1.Category of industry

Electrical equipment

2.Category of technology

Air conditioner

3.Source of energy

Electrical equipment

4.Practical application

November 1,2015

5.Summary

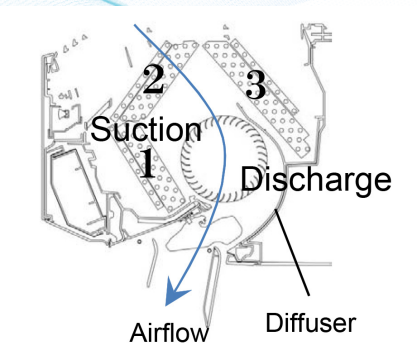
This product is the split-type air conditioner in which the internal configuration of the indoor unit has been radically reviewed. In recent years,improvements have been made to the energy conservation efficiency of air conditioners by increasing the heat exchanger equipping capacity of the air conditioner indoor units through enlarging the depth dimension,but currently there is little room to further increase the depth of the housing. Therefore,in these products the ventilating efficiency has been greatly improved while realizing an increase in the equipping capacity of the heat exchangers by changing the blowers of the indoor unit from cross flow fans to high efficiency propeller fans,and changing the layout of the heat exchangers from a shape to a W shape. As a result,the models with cooling capacities between 4.0 kW and 9.0 kW have achieved the industry's leading APF (Annual Performance Factor) energy conservation efficiency. In addition,these

products realize twin temperature air conditioning by driving the two propellers independently and incorporate the newly developed software technology for energy conservation that reference differences in the perceived temperature of the persons in the room,indicating the new concept of air conditioners going forward.

6.Principle and operation

In order to improve the energy conservation (APF: Annual Performance Factor) of the air conditioner hardware,it will be important to reduce the input of the blower,which consumes the second largest electric power after the compressor. The blower consists of an electronic circuit board,a motor,and a cross flow fan. From measurements of the efficiency (loss analyses) of each component it was confirmed that the greatest losses are caused by the fan. Here it would be possible to drastically reduce the electric power consumption if the cross flow fan,which has a poor blowing efficiency,could be changed for a highly efficient propeller fan. However,propeller fans generally have the characteristic of being vulnerable to the pressure rise,so it was previously difficult to incorporate them particularly in indoor units which incorporate many heat exchangers. In addition,there were no small-sized high-efficiency motors,which meant that the reduction of the indoor unit electric power consumption could not be realized.

In the new products this time,the basic shape of the blower was radically improved by improving the pressure-raising characteristics of the propeller fans as well as by newly developing high efficiency small-sized motors that can be built in to the small boss unit of the propeller fan. Further,because the heat exchanger incorporating space could be enlarged due to discontinuing the use of the cross flow fans,it was possible to



achieve a large improvement in the energy conservation efficiency. By additionally replacing the cross flow fan with two propeller units,it became possible to drive the rotation of the right and left fans independently to control the strength of the discharged airflow. This has led to the development of an energy conservation software technology that enables the creation of two temperature zones in a single room.

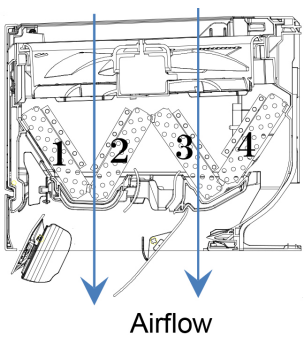
7.Description of improvement

Before improvement

(1) Arrangement in which the heat exchanger is arranged enclosing the suction side.

(2) In order to output the breeze,a slide plate (diffuser) will be essential.

After improvement



(1) The restrictions on the arrangements are eliminated,making it possible to have a W-shaped heat exchanger.

(2)Due to the increase in the surface area,ventilation resistance is reduced.

8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio)

-The blower was changed from a cross flow fan to propeller fans,reducing the electric power consumption during ventilation by 31%. (Comparison at an airflow of 18 m3/min)

-In the large capacity class,the highest rank in energy conservation labeling of '★★★★★' was achieved by the models between 4.0 kW and 8.0 kW.

-The shape of the heat exchanger was changed from a shape to a W shape,increasing the equipping capacity for the same profile by 15%. (27% increase in the actual equipping capacity).

-In the 5.6 kW,6.3 kW,and 8.0 kW classes,the industry's leading energy conservation performance was achieved. (As of February 19,2016).

-A five-year portion of the cross flow fan energy conservation improvement rate (13.2%) was achieved in one year. (Improvement rate: 13.3%).

-By increasing the resolution of the thermopile sensor from the previous fiscal year's 4052 pixels to 18392 pixels,a technology that detects the perceived temperature of the persons in the room was developed.

-By individually driving two propeller fans to realize twin temperature air conditioning,the comfort of users was improved while reducing the electric power consumption by 7% (in the MSZ-FZ6316S model).

9.Economic efficiency and its trend

(1)Not disclosed

(2)Unknown

(3)Reduction of 11.7% in the annual electricity charge (Model MSZ-FZ5616S,compared to the previous fiscal year's model MSZ-ZW565S)

(4)Payback period: Approximately three years

(5)Not disclosed

10.Trend in market

(1)Number of units to be produced in 2016 (Planned): 10,000 units/year.

(2)Number of units to be produced in 2017 (Predicted): 20,000 units/year.

11.Reference information

(1)CO_2 reduction amount: 11.7% (Model: MSZ-FZ5616S; comparison with the previous fiscal year's model MSZ-ZW565S)

Due to the right and left independent air flow control,twin temperature air conditioning is realized,and the electric power consumption is reduced by 7% (in model MSZ-FZ5616S).

(2)By realizing twin temperature air conditioning while observing the perceived temperature (comfort) of two persons in the room,the ideal for new air conditioners going forward is indicated.

12.Implementation sites

Mitsubishi Electric Shizuoka Laboratory.

13.Cited documents

-FY2015 Energy Conservation Grand Prize for excellent energy conservation equipment.

Award-winning Entry Abstracts [Products and Business Models Category],The Energy Conservation Center,Japan

-Mitsubishi Denki Giho January 2016,Mitsubishi Electric

Corporation.

-'Energy Conservation',February 2016 edition,The Energy Conservation Center,Japan.

-Next Generation Split-type Air Conditioner 'Kirigamine FZ Series' Journal of the Japan Institute of Energy,95,318-326,2016.

-The Energy Conservation Technology and Airflow Control of Split-type Air Conditioner with Twin-Propeller Fans. Japan Society of Refrigerating and Air Conditioning Engineers,Annual Conference 2016.

14.Contact information

Mitsubishi Electric Corporation,Shizuoka Works,Room Air Conditioner Department,Engineering Section A.

BAT2: Carbon Dioxide (CO_2) Heat Pump Water Heaters for Home Use EcoCute 'ESTIA Premium Model'

1.Category of industry

CO_2 Refrigerant High Efficiency Heat Pump Water Heating System.

2.Category of technology

EcoCute System for Home Use

3.Source of energy

Electrical equipment

4.Practical application

Jun 2016

5.Summary

These products are heat pump hot water heaters for home use (EcoCute*) that use carbon dioxide (CO_2) as a natural refrigerant to realize a high efficiency energy-saving water heater. They realize a value of 3.6 in the energy conservation Top Runner standards (2017 targets),which is an achievement rate of 109%. In addition to the characteristics of EcoCute which contribute to peak shifting of electric power demand by heating water mainly during the nighttime band,the system is newly provided with a power-saving additional boiling mode which enables the reduction of electric power consumption in the daytime additional boiling mode by 25% to limit the daytime peak electric power demand. Further,by connecting with HEMS,it is possible to select an operation control that makes practical use of photovoltaic power generation in response to weather forecasts. Control has also been provided that enables operation of the water heater in response to notifications of electric power restrictions.

* EcoCute: Registered trade mark of the Kansai Electric Power Company.

6.Principle and operation

EcoCute is a hot water storage type water heater that produces hot water by transferring heat from the air to water using heat pump technology utilizing carbon dioxide (CO_2) which is a natural refrigerant. The annual water heating and heat retention efficiency (JIS) is an index stipulated according

to Japan Industrial Standard (JIS C 9220:2011) showing the hot water supply system efficiency that is assumed for the actual use of residential heat pump water heaters,including the thermal insulation performance of the hot water storage unit and the heat retention of the bath. The full auto type is a type that has functions in which a bath is prepared by adding a set temperature and amount of hot water to the bathtub,and it additionally has a function (temperature maintaining function) for maintaining the temperature of the hot bath water for a set time.

In these products,reviews were implemented of the heating stage where the cold water is heated to make hot water (efficiency of the heat pump unit),and of the temperature-maintaining and usage stage including the hot water storage and supply (hot water storage unit radiation loss reduction). This resulted in improving the equipment efficiency and increasing the annual water heating and heat retention efficiency. Additionally,by connecting to an HEMS,it was intended to realize energy conservation also as a system for the portion that is not reflected in the annual water heating and heat retention efficiency.

7.Description of improvement

Before improvement

See Figure below.

After improvement

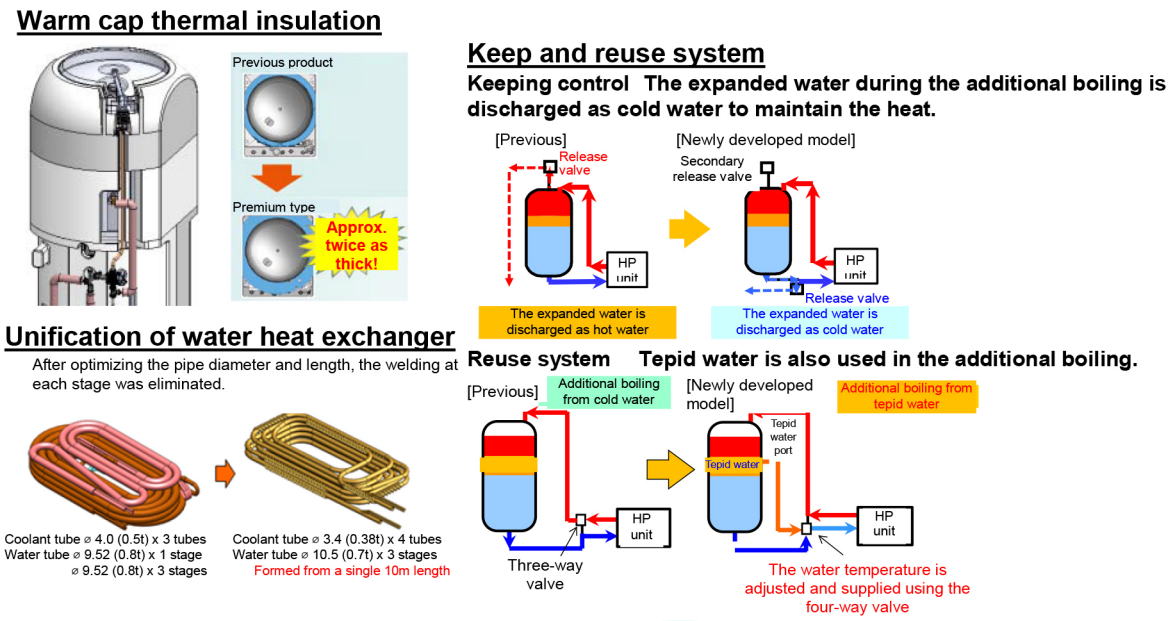
Compared to the previous models,energy conservation was realized by making the following improvements.

(1)Improvement of the heating efficiency (Heat pump unit performance improvement).

1)New CO_2 rotary compressor: Improvement of the motor efficiency such as by increasing the coil winding and motor electromagnetic steel sheet lamination thickness.

2) New inverter: Implementation of electric current control and optimum motor tuning.

3)New water heat exchanger: Change of refrigerant piping to a thinner diameter and multi-pathing,change of water pipes to a large diameter,and unification of the water heat exchanger.



4)New air heat exchanger: Utilization and duplication of new heat transferring pipe shape for carbon dioxide.

(2)Improvement of heat usage efficiency (Reduction of heat loss of the hot water storage unit).

1)Improvement of tank can body thermal insulation performance using warm cap thermal insulation.

2)Reduction of heat loss due to the keep and reuse system.

3)Power-saving additional boiling operation.

(3)Promotion of energy conservation such as by connecting with HEMS,etc.

1)Demand control by using HEMS connection (Effective application of photovoltaic power generation in response to weather forecasts,etc.).

2)Light touch remote control (Improvement of user interface,and enhancement of visualization).

3)Reducing the heat loss during bathtub heat retention in 'Assisted heat retention'.

8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio)

EcoCute systems for home use have become energy conservation Top Runner subject appliances,and target values have been determined for FY2017. For these products,with regard to the target value of 3.3 for full auto model types (classification 17),both the 370L and 460L model types have achieved an annual water heating and heat retention efficiency of 3.6 (an achievement rate of 109%). The CO_2 emissions amount can be reduced by approximately 15% compared to previous model types when converted from the annual water heating and heat retention efficiency. By additionally connecting with HEMS,there will be an approximately 5% CO_2 reduction effect,and if the items are added that promote energy-saving behavior by users there will be an approximately 10% CO_2 reduction effect in the portion that is not reflected in the annual water heating and heat retention efficiency. Therefore,a total CO_2 reduction effect that is approximately 30% better than previous model types can be provided.

9.Economic efficiency and its trend

In these products,the achievement rates with regard to the FY2017 energy conservation standards have been improved to 109% both for the 460L class models for 4 to 7-person families and the 370L class models for 2 to 5-person families. As a result,compared to this company's previous models,a reduction of approximately 3,200 yen,corresponding to approximately 12%,can be made to a family's annual lighting and heating expenditures. In addition,compared with electric water heaters,an annual difference of 40,000 yen or more can be achieved (approximately 68,000 yen as the value calculated using the 370L fully automatic type),showing the large merits that can be realized by using these products.

10.Trend in market

In the overall market for heat pump water heaters for home use (EcoCute),there are the following conditions.

(1)The accumulated total number of unit shipments since 2001 have been approximately 5,000,000 units (predicted at March 2016). This corresponds to a diffusion rate of approximately 9.1% (52,000,000 households,residual rate of 95%).

(2) With shipments of 450,000 units/year,in 2017 the accumulated total unit shipments will reach 5,900,000 units and the diffusion rate will reach 10.8% (52,000,000

households,residual rate of 95%).

11.Reference information

N/A

12.Implementation sites

N/A

13.Cited documents

-Statistics Bureau,Ministry of Internal Affairs and Communications 'Statistical Handbook of Japan' (Number of households).

-The Japan Refrigeration and Air Conditioning Industry Association 'Actual shipments of residential heat pump water heaters'.

14.Contact information

Toshiba Carrier Corporation.

Technical Planning Department,Technical Planning Manager Mr. Yasunari Daijogo.

yasunari.daijogo@toshiba.co.jp Phone: +81-44-331-7482.

BAT3: Carbon Dioxide (CO_2) Refrigerant Heat Pump Water Heater Using a New Thermal Insulation Structure

1.Category of industry

Water Heaters

2.Category of technology

High Efficiency Water Heaters

3.Source of energy

Electricity

4.Practical application

2014

5.Summary

In response to global warming countermeasures and the increasing energy consumption in the household sector,the promotion of energy conservation in housing and related equipment occupies an important position in Japan's energy policy. In addition,for the hot water supply application that takes up 30% when considering the energy consumption of each application in households,a CO_2 emissions reduction effect is anticipated due to the popularization of high efficiency water heaters. Hitachi Appliance concentrated on the development of CO_2 refrigerant heat pump water heaters that have industry-leading high energy conservation efficiencies. In FY2013,new technologies were developed relating to compressors,evaporators,and water refrigerant heat converters which are the components of heat pump units,and the all-new products attained the Top Runner standards (FY2017 target fiscal year) under the Act on the Rational Use of Energy. In the following FY2014,the industry's first hot water storage unit with a urethane foam-filled heat insulation structure was developed,and the high efficiency type 370L model realized the industry's top annual water heating and heat retention efficiency (JIS) value of 3.9.

6.Principle and operation

CO_2 refrigerant heat pump water heaters consist of a heat pump unit that heats cold water to generate hot water and a hot water storage unit that thermally stores the heated water. During the heating of the cold water to make hot water,stored

water is sent from the lower part of the storage tank to the water refrigerant heat exchanger where the water receives the heat from the refrigerant. After heating to a temperature between 65°C and 90°C according to the settings,the water is returned to the upper part of the storage tank. When using the thermally stored hot water,hot water taken from the top part of the hot water storage tank is used to adjust tap water to the temperature set using the hot water supply heat exchanger and the tap water is supplied from the hot water supply faucet (in the case of the 'tap water direct pressure hot water supply' system). The heat pump cycle is a mechanism in which a flow path mainly consisting of a compressor,evaporator,water refrigerant heat exchanger and an expansion valve is filled with the carbon dioxide refrigerant. The heat obtained from the outside air using the evaporator is changed to a high temperature by the compressor,and passes through the water refrigerant heat exchanger where the heat is transferred to the water. The efficiency of CO_2 refrigerant heat pump water heaters mainly depends on the heat retaining performance of the hot water storage unit and the efficiency of the heat pump unit (compression efficiency of the compressor,efficiency of absorbing heat from the outside air by the evaporator,and efficiency of heating the water in the water refrigerant heat exchanger). Therefore,in order to increase the annual water heating and heat retention efficiency (JIS),it will be important to improve the hot water storage tank heat retaining efficiency,compressor efficiency,evaporator heat-absorbing efficiency,and the water refrigerant heat exchanger heating efficiency. Hitachi Appliances therefore promoted development which focused on these topics. In FY2013,improvements were made to the compressor,evaporator,and water refrigerant heat exchanger of the heat pump unit,and in FY2014 the hot water storage tank was completely covered with urethane foam in a new thermal insulating structure used in the industry for the first time. The details of the improvements shown below relate to the new thermal insulation structure implemented in FY2014.

7.Description of improvement

Before improvement

Previously,thermal insulation was provided by incorporating and mounting separate piecesof expanded bead polystyrene (known below as EPS) surrounding the hot water storage tank which stores the hot water. In addition,metal plates were incorporated surrounding the expanded polystyrene to form an enclosure.

See Figure 1.

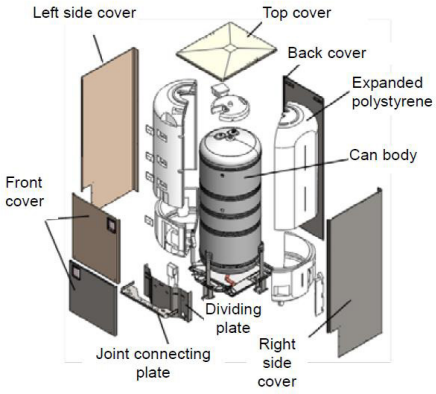


Figure 1

After improvement

In the new thermal insulating configuration,urethane is injected into the outer panel which encloses the hot water storage tank. The urethane is foamed inside the outer panel in a configuration that completely fills the surroundings of the hot water storage tank with heat insulating material. Due to this,hardened urethane foam with an outstanding thermal insulation performance will surround the hot water storage tank,and will also be bonded to the outer panel,enabling the formation of a solid and integrated structure.

See Figure 2.

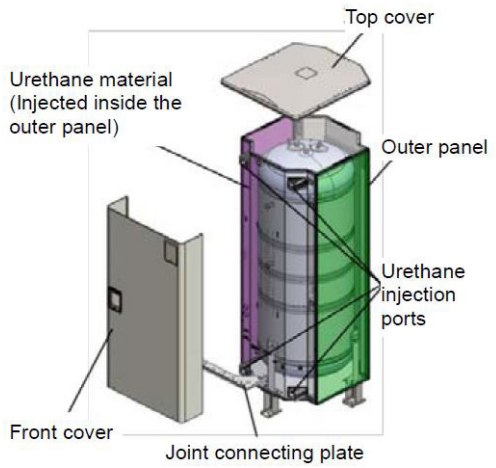


Figure 2

8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio)

Calculation of the primary energy consumption was made using the Building Research Institute's primary energy calculation program (Housing and Building Energy Conservation Performance Evaluation Program Ver. 1.12) disclosed under the revised energy conservation standards (Standards of Judgment for Construction Clients,etc. and Owners of Specified Buildings Relating to the Rational Use of Energy). The primary energy consumption are shown in the figure below. The annual water heating and heat retention efficiency (JIS) of the FY2014 'tap water direct pressure hot water supply system' high efficiency type (370L) was 3.9,and the primary energy consumption was 14.95GJ/year. This product realized a primary energy efficiency which was better than the hybrid type water heater (100L type FY2013 model) with small primary energy consumption.

See Figure 3.

9. Economic efficiency and its trend

(1) Marketability

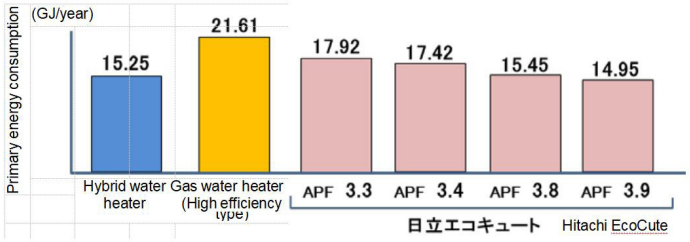


Figure 3

*The APF values in the figure show the annual water heating and heat retention efficiency (JIS)

Improvements in efficiency obtained by the high efficiency type utilizing the new thermal insulation structure:

• High efficiency type 370L

FY2013 APF 3.6 FY2014 APF 3.9

• High efficiency type 460L

FY2013 APF 3.5 FY2014 APF 3.8

[Test conditions] As of July 2014,investigated by Hitachi.

(1)The primary energy consumption of the CO_2 refrigerant heat pump water heater was calculated using the next-generation energy conservation standards in six regions (Region IVb).

(2)The gas water heater (high efficiency type) thermal efficiency was calculated as 92.5% using the mode efficiency based on JIS S 2075.

All new products of Hitachi Appliance's FY2014 CO_2 refrigerant heat pump water

heaters achieved 100% or more in the Top Runner standards taking FY2017 as thetarget fiscal year. Due to the spread of the energy conservation labeling system(according to JIS C9901) and the implementation of corporate public relations activities,it can be expected that awareness of the products will increase, improving themarketability.

(2) Economic efficiency

The results of calculating the running costs of hybrid water heaters, high efficiency typegas water heaters, and CO_2 refrigerant heat pump water heaters are shown in thefigure

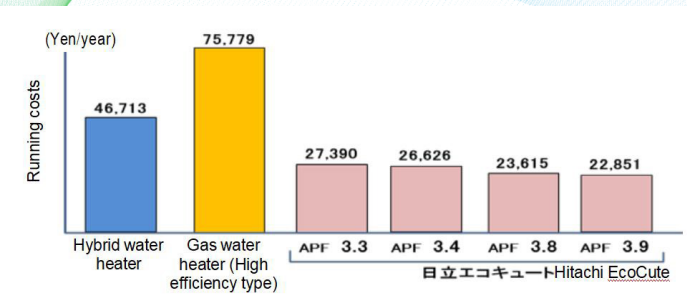


Figure 4

*The APF values in the figure show the annual water supply thermal insulation efficiency (JIS).

[Test conditions] As of July 2014,investigated by Hitachi.

(1)Calculation from the primary energy consumption calculated using the program in section (1) of Fig. 9.

(2)Calculation was made taking the proportion of gas and electricity in the hybrid water heater as 40% gas to 60% electricity.

(3)Calculation conditions: Calorific value of city gas: 45MJ/m^3 (Tokyo Gas city gas,Tokyo region calorific value).

(4)The electricity receiving end efficiency was calculated at 36.9% (From the Energy Conservation Center,Japan online glossary entry 'Primary Energy [Electric Power]').

(5)Calculation was made taking the nighttime electricity consumption ratio for CO_2 refrigerant heat pump water heaters of 80%.

(6)City gas charge: 157.8 yen/m^3 (Tokyo Gas July 2014 charge when the amount is between 20-80m^3 [Not including the basic charge]).

(7)Electricity charge: Hybrid water heater: 27 yen/kWh (Home Electric Appliances Fair Trade Conference standard rate) [April 28,2014].

(8)Electricity charge: CO_2 refrigerant heat pump water heater: Morning and evening 25.92 yen/kWh,nighttime 12.16 yen/kWh (Morning and evening rates and nighttime rates of Tokyo Electric Power Company's 'Denka Jozu' season-and-time-specific lighting plan).

below. CO_2 refrigerant heat pump water heaters, which make effective use of reduced-rate nighttime electricity, can be expected to achieve a greater reduction in hot water supply, lighting and heating costs than hybrid water heaters and high efficiency type gas water heaters.

See Figure 4.

10.Trend in market

[CO_2 refrigerant heat pump water heater for home use].

(1)Current diffusion rate: Approximately 10%.

(2) Prediction for 2017 (or 2020): Unknown.

11.Reference information

(1)Industrial property rights including patents

Patents relating to electric water heaters,hot water storage units,and heat pump units Registered: Japanese Patent No. 5753961,Japanese Patent No. 5760052

Under application: 22 patent applications.

(2)Awards

FY2014 Energy Conservation Grand Prize for excellent energy conservation equipment,Chairman Prize of ECCJ

FY2015 Japan Society of Refrigerating and Air Conditioning Engineers,Technology Award.

12.Implementation sites

Throughout Japan.

13.Cited documents

N/A

14.Contact information

Hitachi Appliances,Inc. ■

BAT4: Technology for Virtually Operating Multiple Storage Batteries as One Large Storage Battery, and Using for Adjusting the Electric Power Receiving Balance

1.Category of industry

Energy storage

2.Category of technology

Promotion of renewable energy introduction

3.Source of energy

N/A

4.Practical application

Around 2020 (Anticipated)

5.Summary

System instability phenomena create problems and require countermeasures when there is an increase in the introduction amounts of renewable energies such as photovoltaic power generation. Among the countermeasures,the utilization of storage batteries is effective. While it is believed that these will be introduced going forward,issues will occur in the future regarding how to implement control of such large numbers of batteries. The battery SCADA virtually aggregates multiple storage batteries and implements control of individual batteries so that they behave as though they are one storage battery. This supports the system operation on the upper system,and also enables the introduction of seamless storage batteries regardless of the scope and the introduction location.

6.Principle and operation

The storage battery SCADA is positioned below the upper EMS (Energy Management System),for example the automatic load dispatching system of the power system control center of an electric power business operator. It receives the commands corresponding to the functions for moderate Demand Response (DR) and Spinning Reserve (SR),such as Load Frequency Control (LFC) and peak cut,and based on these commands it virtually aggregates many storage batteries and handles them as if they were a single large-scale storage battery (virtual battery).

The storage battery SCADA comprehends the specifications

and statuses of individual storage batteries,appropriately allocates each of the storage batteries according to the functions,and gives the battery charging and discharging instructions. For example,in order to make use of the portion of consumer side storage batteries that are not being used,the battery charging and discharging schedules of the consumer side storage batteries are collected. Then,if there is available capacity and spare time in the storage batteries of each consumer,the peak cut and peak shifting of the electricity demand is realized through coordinating the charging and discharging of these battery portions.

See Figure 1.

7.Description of improvement

This system is not an improvement,but a proposal of a system based on a new concept. Functionally,the system will become a substitute for pumped storage power plants. However,because there are already no locations in Japan where large capacity pumped storage power plants can be constructed,this type of software will become necessary. As the merit of utilizing this system,because it is possible to introduce only the necessary amount at the required timing,the threshold of facility investment plans can be lowered with regard to the introduction compared to large facilities such as pumped storage power plants.

8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio)

There is no energy conservation effect in the batteries or in the battery SCADA itself. However,because it will become possible to increase the use of renewable energies by introducing these systems,this will consequently lead to reductions in CO2 emissions.

9.Economic efficiency and its trend

Although these are not actual result values,calculation is carried out of a model using consumer side storage batteries (with a capacity around 2 GWh) as described below as a substitute for a 200,000 kW thermal power generator that is being actively used as a peak power source. Although 200,000 kW was assumed as the target value,it is believed that the scale of the introduction can be adjusted. This trial calculation created a realistic plan that enabled investment payback in 10 years,and it is thought that depending on the operation method it may be possible to keep the expenses even lower than this.

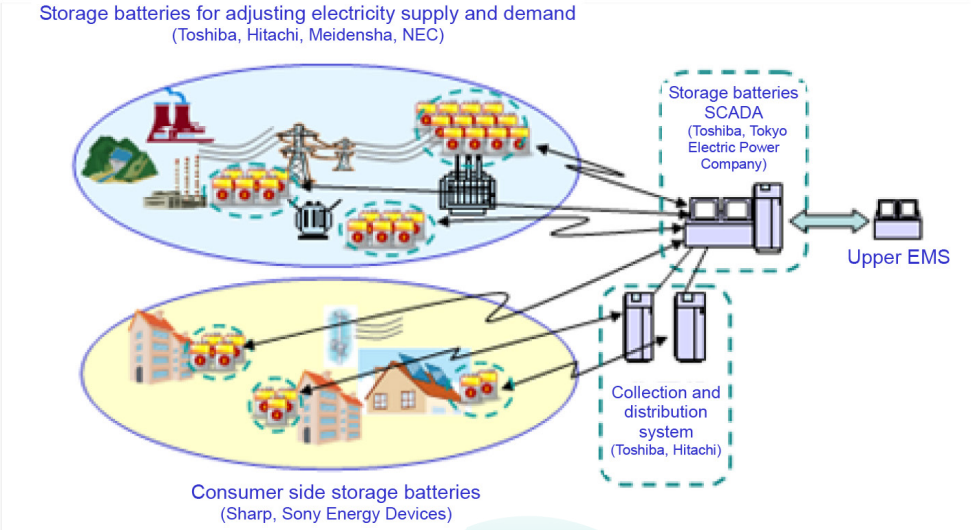


Figure 1

(1)Equipment investment costs: 1.4 billion yen (Not including the expenses of the consumer side storage batteries)

(2)Remodeling costs: Included in the above description

(3)Running costs: 1.4 billion yen/year 1.4 billion yen/year

(4)Payback period: 10 years

10.Trend in market

(1) Current diffusion rate None

(2) Prediction for 2020 Unclear

11.Reference information

(1) CO_2 emissions reduction amount Unclear

(2) Social impact,other

1)Patents and utility models

-Operation method,operation apparatus of power system,and storage battery management device

(Japanese patent No. P6088737,registration date: February 10,2017)

-Rechargeable battery surplus capability borrowing method,power system operation method,power operation system,consumer side controller,program used for consumer side controller,system side controller and program used for system side controller

(Japanese patent application No. P2012-039203,application date: February 24,2012) Other

2)Awards

None in particular

3)Documents,etc.

-Isono,E. 2013 Development of battery aggregation technology for smart grid. PowerTech (POWERTECH),2013 IEEE Grenoble pp.1-6

-Ebata et al,2014 'Creation of a virtually aggregated storage battery using the storage battery SCADA,and LFC verification testing',Proceedings of the 2014 Annual Conference of Power and Energy Society,IEEJ,September 2014

-Ebata et al,2015 'Demonstration and Business Method of Peak Shifting using Battery Aggregation Technology by Demand Response without Restriction of Customer's Electricity Usage',IEEJ Transactions on Power and Energy Vol. 135 No. 1 (2015),Special Issue of 2014 Annual Conference of Power and Energy Society,IEEJ pp.78-84.

12.Implementation sites

The storage battery SCADA,collection and distribution system,and stationary batteries for large-scale supply and demand adjustment have been installed in a verification center located in Kohoku Ward,Yokohama City,while storage batteries for consumers have been installed in offices and consumers' houses in Yokohama City,and verification testing is conducted. (Currently implemented under the framework of the Yokohama Smart City Project (YSCP))

13.Cited documents

Advisory Committee for Natural Resources and Energy,Agency of Natural Resources and Energy,8th Basic Problem Committee 'Report of Verification Committee for Costs,etc.' http://www.enecho.meti.go.jp/committee/council/basic_problem_committee/008/pdf/8-3. pdf

14.Contact information

Toshiba Corporation

Tokyo Electric Power Company

BAT5: Ultrafine Fiber High Heat Insulating Glass Wool 'Aclear α' series

1.Category of industry

Ceramic engineering

2.Category of technology

Glass wool heat insulating material

3.Source of energy

N/A

4.Practical application

July 2014

5.Summary

'Aclear α' is mat type glass wool heat insulating material with the world's first approx. 3μm fiber diameter. In the case of mat type glass wool manufactured by the centrifugal spinning method,4μm was considered as the limit value of the fiber diameter; however,development of fiberizing and forming technologies has enabled continuous production of the 3μm fiber diameter glass wool.

'Aclear α' high density 36 kg/m3 model attains thermal conductivity (λ value) of 0.032 W/mK,which is at the world's lowest level for the general glass wool heat insulating material for houses. The product is the only glass wool heat insulating material which establishes thermal resistance value (R value) of 3.3 m^2K/W requested for the 2013 energy conservation standards for walls of wooden houses in cold areas such as Hokkaido,by only filling in walls of the wooden houses with normal 105 mm thickness wooden pillars.

'Aclear α' low density 20 kg/m^3 model facilitates the application to the houses requiring higher heat insulating performance such as the certified low carbon houses and the Zero Energy Houses (ZEH) in Honshu and southward,and drives the construction of the houses with higher heat insulating performance than the highest grade houses certified in energy conservation standards.

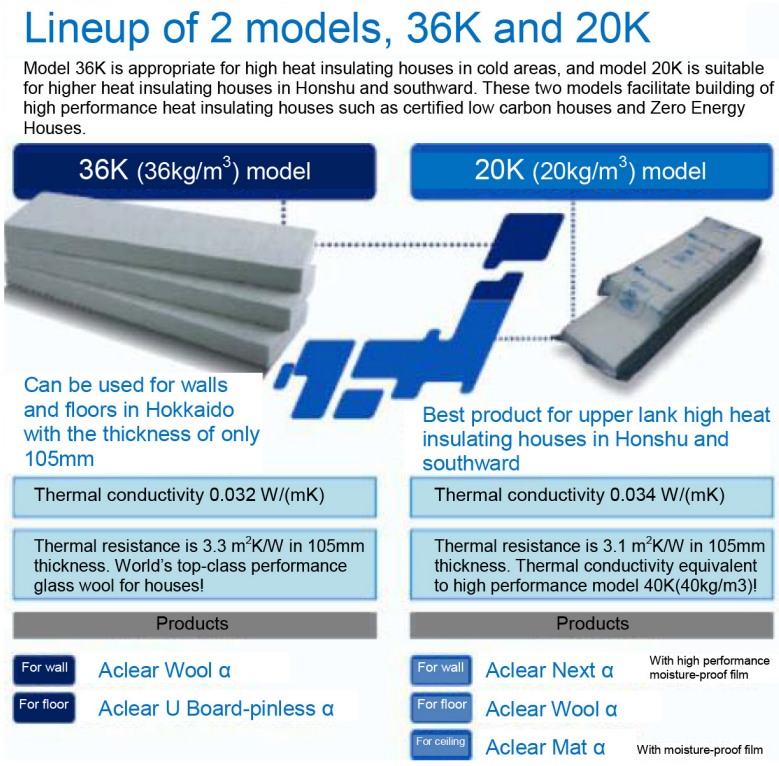


Figure 1

'Aclear α' contains no formaldehyde to keep health and environment,has good workability for easy cutting,and ultrafine fiber prevents glass wool's unique itchy touch. These features are supported by carpenters and construction workers and are expected to facilitate the spread of the product in the future.

See Figure 1.

6.Principle and operation

N/A

7.Description of improvement

[Technological features]

Progressiveness and originality

'Aclear α' was developed using the following two progressive and original technologies.

(1) Fiberizing technology for 3μm fibers.

Glass wools are manufactured by 'the centrifugal spinning method'. In the case of the batt type glass wool that can be manufactured using this method,4μm was considered as the limit value of the fiber diameter. Development of the newly designed device assemblies and the manufacturing conditions has enabled the production of glass wool of 3μm fiber diameter having a sufficient length for the mat type.

(2) Forming technology for high density board using ultrafine glass wool of 3μm diameter.

Collection of fiberized fiber by suction is required in order to form glass fiber into mat. However,in the case of forming ultrafine fiber (equal to or less than 3μm in diameter) into thick glass wool mat,large suction load in the fiber collecting zone prevents the manufacturing of the intended thickness of the

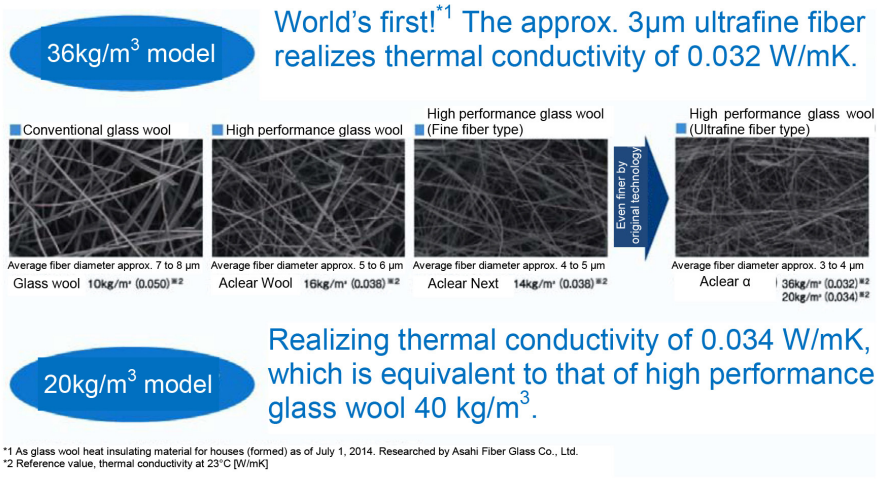


Figure 2

product.

In order to solve this problem,a new manufacturing method,which forms thin blanket at first and laminates them to create a thick batt,instead of directly forming a thick batt,was developed and newly designed manufacturing device was put into practical use.

See Figure 2.

8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio)

[Energy conservation]

• Annual energy cost reduction per house

<Comparison between a Grade 3 house certified in energy conservation standards and an Aclear α-installed house with thermal resistance value of 3.3 m^2K/W>

Area 1: about 25,000 yen　Area 3 to 5: about 145,000 yen

Area 6 and southward: about 57,000 yen

(Area1: Northernmost region,e.g. Hokkaido,Area3,4: Northern Honsyu region,Area 6: Southern Honsyu region)

See Table 1.

•Reduction effect of primary energy consumption

< Calculation results for model houses of Autonomous Circulating House Development Project using Aclear α (Annual)>

See Table 2.

Table 1

	Area 1		Area 3		Area 4		Area 6	
	KWH	MJ	KWH	MJ	KWH	MJ	KWH	MJ
Primary energy	1,016	3,656.0	5,899	21,220	5,663	20,371	2,317	8,334
Converted into money	¥25,409		¥147,479		¥141,578		¥57,921	

(1MJ = 0.278 kWh, Electricity charge: 25 yen/kWh)

Reduction of electricity charge by up to 147,000 yen per house

Table 2

Heat insulating specifications	Area 1		Area 3		Area 4		Area 6	
	Average outer surface thermal transmittance UA value	Primary energy consumption	Average outer surface thermal transmittance UA value	Primary energy consumption	Average outer surface thermal transmittance UA value	Primary energy consumption	Average outer surface thermal transmittance UA value	Primary energy consumption
Grade 3	0.54	156,180MJ	1.04	114,237MJ	1.25	112,947MJ	1.54	86,724MJ
Aclear α: R3.3	0.52	152,524MJ	0.50	92,733MJ	0.66	92,359MJ	0.77	78,298MJ
Aclear α: R3.1	—	—	0.50	93,017MJ	0.66	92,576MJ	0.78	78,390MJ

(1MJ = 0.278 kWh, Electricity charge: 25 yen/kWh)

Reduction of primary energy consumption per house by up to approx. 19%

9.Economic efficiency and its trend

[Economic efficiency and marketability]

(1) On account of the imposition of New Energy Conservation Standards for 2020,ratio of the high grade energy-saving houses (provisional title: super next-generation houses),i.e. ZEH(Zero Energy House),LCCM(Life Cycle Carbon Minus House),etc.,is estimated to reach approx. 10% of detached residences.

(2) Popularization of super next-generation houses is expected to reduce annual primary energy consumption of houses in 2020 by 176,000 GJ,which is about 4,600 kl as crude oil equivalent.

Reduction of primary energy consumption by introducing super next-generation houses

< Comparison with Grade 3 houses > * Estimated by Asahi Fiber Glass Co.,Ltd.

See Table 3.

10.Reference information

(1)Awards

-Energy Conservation Grand Prize 2014,Products and Business Models Department,Director General Prize of Agency of Natural Resources and Energy

Sponsor: The Energy Conservation Center,Japan,

The Annual Grand Prize of the ECHO CITY Product 2014

Sponsor: NIKKEI Architecture,NIKKEI Homebuilder

(2)Documents,etc.

The Energy Conservation (April 2015),P.56

"Ultrafine fiber high heat insulating glass wool 'Aclear α' series"

11.Implementation sites

N/A

12.Cited documents

Application documents and presentation documents for the Energy Conservation Grand Prize 2014

Asahi Fiber Glass Products Catalogue

13.Contact information

Asahi Fiber Glass Co.,Ltd.

Table 3：Reduction of primary energy consumption by introducing super next-generation houses

< Comparison with Grade 3 houses > * Estimated by Asahi Fiber Glass Co.,Ltd.

	2014	2015	2016	2017	2018	2019	2020
Total reduction of primary energy consumption by super next-generation houses (GJ)	223	5,533	15,130	33,051	59,491	107,084	176,803
Area 3 to 5 (GJ)	74	1,842	5,037	11,003	19,805	35,649	58,458
Area 6 and southward (GJ)	149	3,691	10,093	22,048	39,686	71,434	118,345
Converted to crude oil (kl) (by 0.0258 kl/GJ)	6	143	390	853	1,535	2,763	4,562

BAT6: High-performance Triple-glazed Vinyl Windows APW430

1.Category of industry

Nonferrous metals and metal products

2.Category of technology

High-performance thermal insulation materials (for construction use)

3.Source of energy

N/A

4.Practical application

2014

5.Summary

APW430 windows comprise YKK AP original low-E triple-glazing (three layers of glass) having a total thickness of 41mm and a high thermal insulation vinyl frame. They realize a world top-class thermal insulation performance with a heat-transfer coefficient of 0.90W/m^{2}K. (This corresponds to an approximately 75% smaller value than the heat-transfer coefficient values of the windows currently most popular in Japan consisting of aluminum frames and multilayer glass.) They greatly limit the inflow and outflow of heat from building openings,enabling a large reduction in the cooling and heating energy consumption. Additionally,the product lineup also includes the high-end APW430Kr model with a heat-transfer coefficient of 0.78W/m^{2}K.

Further,the lineup of products also contains glass that is designed to enhance the acquisition of solar radiation in wintertime,and "wind-catching multiple windows"which are suitable for generating breezes and providing ventilation in summertime and in the evenings,as optimum windows for realizing lifestyles that avoid using energy as far as possible.

6.Principle and operation

(1)New frame and glass designs for realizing U-values which are less than 1.0W/m^{2}K Low-E triple-glazing (three-layer glass) is utilized,and the optimum air layers are set to obtain the highest thermal insulation performance. Argon gas and krypton gas are used as the gases contained inside the air

layers,which maintain a high thermal insulation effect.

It was also intended to improve the thermal insulation performance of the frame itself by giving the frame a large depth dimension and by adopting an exclusive design (multi-chamber structure) in which the number of chambers (number of hollow gaps (partitions) which prevent the transfer of heat between the inside and outside of the room) have been increased. Compared to standard double-glazed vinyl window frames,the heat-transfer coefficient has been reduced by 13%. (Refer to Fig. 1)

(2)Development of glass types that enhance the solar radiation heat acquisition rates (Best balance of heat-transfer coefficient and solar radiation heat acquisition rate)

The heat-transfer coefficient and solar radiation heat acquisition rate have a reciprocal relationship. That is,although the heat-transfer coefficient will be enhanced if a blue or bronze-colored low-E film is utilized,the use of this film will cause a large reduction in the solar radiation heat acquisition rate. In the APW430,as a result of seeking the “best balance” between the heat-transfer coefficient and solar radiation heat acquisition rate where the energy reduction effect will become the highest,rather than simply enhancing only the heat-transfer coefficient,two types of triple-glazing were developed utilizing low-E films. (Refer to Fig. 2)

(3)Development of window opening forms,functional parts,and screens that are suited to acquiring breezes and ventilation

Special devices have been incorporated which make it easy to realize energy reductions by opening the windows,such as a "wind-catching multiple window" that positively introduces breezes,and by providing a half-locking function as standard equipment to enable ventilation without worrying about security. In addition,the windows incorporate

YKK AP’s original Clear Net screens which acquire a 20% greater ventilation amount than previous types of window screens,enhancing comfort when the windows are open.

7.Description of improvement

Before improvement

In general houses,the greatest amount of inflow and outflow of heat occurs at the openings. In houses with standard aluminum windows (multilayer glass),as much as 52% of the heat in wintertime flows out through the windows.

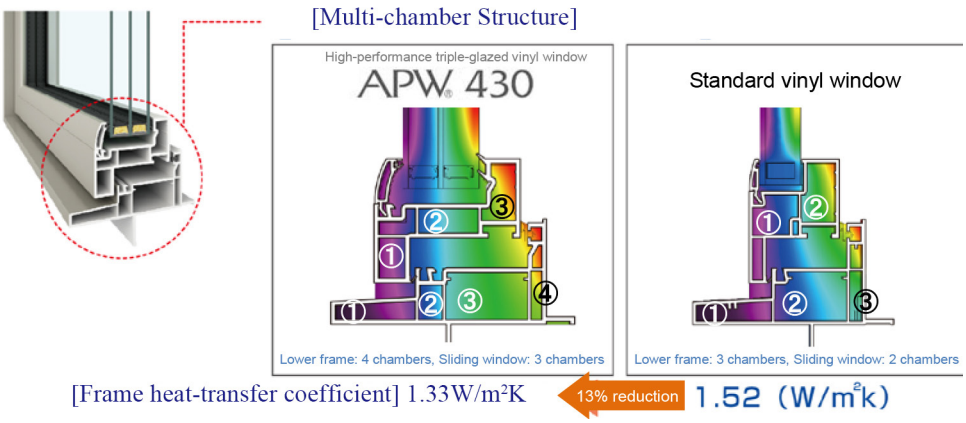


Fig. 1 Improvement in frame thermal insulation performance due to the adoption of a multi-chamber structure

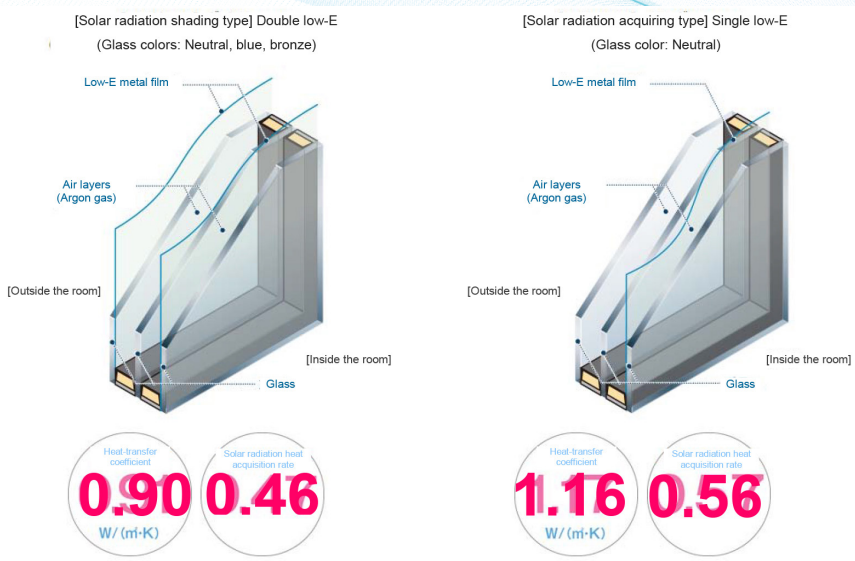


Fig. 2 Glass specifications realizing an outstanding balance between thermal insulation and solar radiation heat acquisition

After improvement

When the high-performance triple-glazed vinyl windows are used,the outflow of heat from the windows is limited to 12%. Refer to Figure 3.

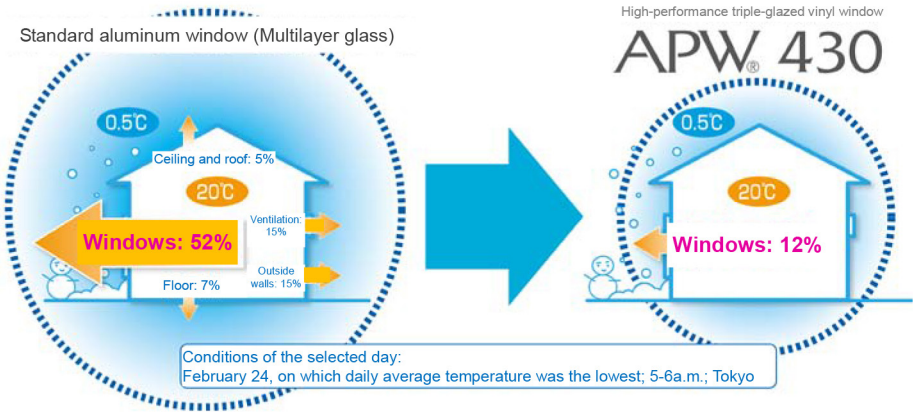
8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio)

As the cooling and heating energy reduction effect,taking the case of Tokyo as an example,APW430 windows are capable of realizing a value of 184MJ/m2,a 32% reduction from the value of 275MJ/m^2 achieved when using aluminum multilayer glass windows. (Converted to an electricity charge,this is a reduction from 71,104 yen/year to 48,388 yen/year.) In the case where the air conditioning is additionally stopped and ventilation is carried out,a value of 152MJ/m^2 is realized by the APW430 windows,which is a reduction of 45%. (When converted to an electricity charge,this is a reduction from 71,104 yen/year to 39,539 yen/year.) There will also be a similar reduction effect on the CO^2 emissions.

9.Economic efficiency and its trend

In the housing design and construction aspects,merits will be realized with regard to resource-saving and to costs. By simply utilizing APW430 windows without needing to change the frame structure,integration and construction methods,it will be possible to realize a large energy reduction effect. For example,in the case of reducing the cooling and heating energy by 10%,which is the standard for certified low carbon housing,when using the method of utilizing aluminum multilayer glass windows while changing the thickness of the wall thermal insulating materials,it is expected that there will be cost increases of 1,000,000 yen or more due to the materials and construction expenses. Implementation will also be difficult from a construction point of view. In contrast,if APW430 windows are utilized instead while leaving the building frame unchanged,it will be possible to realize a 23% reduction in the cooling and heating energy compared to the use of aluminum multilayer glass



[Calculation Conditions] · Housing thermal insulation specification: Level compatible with next-generation energy conservation standards · Housing model: Complies with calculation models in the "Explanation of energy consumption calculation methods in the standards for judgment of residential construction clients",two stories,floor area: 120.08m2,proportion of openings: 21.0% (Regions I and II),26.8% (Regions III to VI) · Used software: AE-Sim/Heat (Building heat environment simulation program)/Architecture Environment Solutions Inc. · Weather data: "Expanded AMeDAS Weather Data"2000 Edition,Reference year/(one company) Architectural Institute of Japan (Tokyo) · Assumed number of residents: 4 persons · Assumedcooling and heating equipment: Air conditioners · Air conditioner settings: Heating 20℃,cooling 27℃60% humidity,all-building integrated operation (Operation in which cooling and heating is implemented continuously 24 hours in each living room and non-residential room,including times when residents are not in the rooms.)

Fig. 3 Proportions of heat outflow in the winter

windows. In addition,the costs will consist only of the difference in window costs,so the amount will be limited to around 500,000 yen. Further,because the thermal insulation performances of the walls and the windows will become closer,it will be possible to achieve uniform temperatures in the rooms. This will not only realize an energy conservation effect,but also creates merits with regard to comfort. (Refer to Fig. 4).

10.Trend in market

(1)Current diffusion rate:

Japan: In the overall industry,the rate of change to the use of vinyl windows in detached housing was 17% in FY2016 and 13% in FY2014. (Survey by the Japan Sash Manufacturers Association)

Overseas diffusion rate: Germany 64%,China 30%,United States 65%

(2)Prediction for 2017 and afterwards

YKK AP has cited the target of achieving a diffusion rate for vinyl windows of 30% of the market by 2020,and is aiming to make further contributions to preserving the earth's environment while realizing people's healthy and comfortable lives.

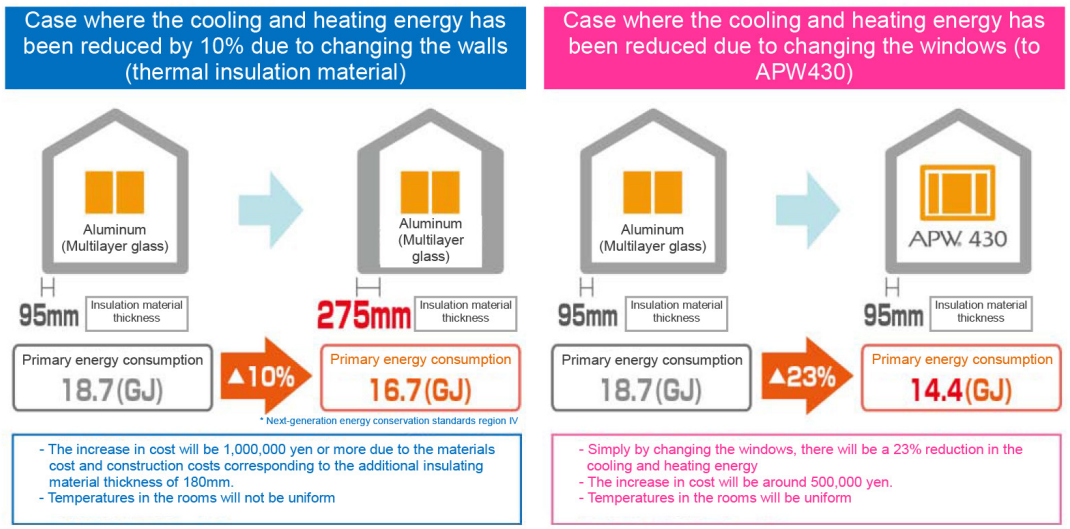


Fig. 4 Resource-saving and cost effectiveness from the housing design and construction aspects

11.Reference information

(1)Social impact

The diffusion of vinyl windows will greatly contribute to the reduction of Japan's overall energy consumption. According to the Energy White Paper 2015,the amount of energy consumed in the household sector made up 14.4% (2,014PJ in FY2013) of Japan's total energy consumption. Out of this amount,25.7% was used in cooling and heating applications,which corresponds to 3.7% of Japan's total energy consumption. Because changing from aluminum windows (multilayer glass) to vinyl windows will result in a 45% energy reduction,the reduction contribution amount will be 3.7% x 0.45 = 1.7% (238PJ). (In the case of nuclear power generation,the calorific value of each reactor is 9.76MJ/kWh (from the Act on the Rational Use of Energy),so 238PJ will equate to 2.44x1010kWh.) This will be equivalent to the energy generated by 3.4 nuclear reactors (when the annual electric power generated by one nuclear reactor is 7 billion kWh (Source: Agency for Natural Resources and Energy)),or the consumption by 6,800,000 general households (when the annual electric power consumption of a general household is 3,600kWh (Calculation by the Federation of Electric Power Companies of Japan)).

(2)Development of APW430Kr windows with a thermal insulating performance further improved from the world top-class APW430

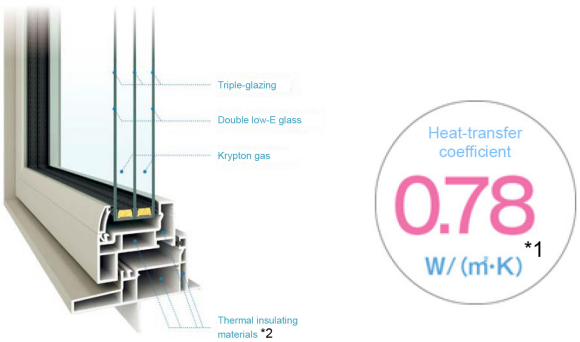
APW430Kr windows were developed,in which thermal insulating materials are inserted inside the APW430 frame,and krypton gas which has an outstanding thermal insulating performance is injected into the air layers. (Refer to Fig. 5) The APW430Kr is a high-performance triple-glazed vinyl window that realizes a heat-transfer coefficient (U-value) of 0.78W/m^{2}K*1,and is available with glass colors of blue and bronze.

(3) Patents,awards,etc.

-Two patent applications submitted [Awards]

-Good Design Award (2011)

Name of awarded item: "Window Business and APW Brand [APW]"



*1: The heat-transfer coefficient is a value that indicates the ease by which heat is transferred,in which smaller numbers indicate a better performance. (In-house method/ Results of in-house testing compliant with JIS A 4710:2004)

*2: The thermal insulation material insertion locations differ depending on the window type.

Fig. 5 APW430Kr

-4th HEAD (Home Environment Advanced Design) Best Selection Award (2014)

-Kitaguni Energy Conservation and New Energy Grand Prize 2015 (Hokkaido Bureau of Economy,Trade and Industry,METI)

-25th Grand Prize for the Global Environment Award,Minister Prize of Economy,Trade and Industry (2016)

12.Implementation sites

Throughout Japan

13.Cited documents

N/A

14.Contact information

YKK AP Inc.

BAT7: High Performance Heat Insulating Plastic Windows

1.Category of industry

Architectural material

2.Category of technology

High performance heat insulating materials

3.Source of energy

N/A

4.Practical application

2014

5.Summary

Generally high-efficiency air conditioners and hot water suppliers are introduced in order to save energy in houses. However,no matter how high the performance of installed air conditioner is,poor performance of heat insulation of house causes leakage of the conditioned air to the outdoors and results in the waste of energy. Thus,improvement of the heat insulating performance of windows,at which the largest heat loss in houses occurs (71% of heat enters in summer and 48% of heat in the warmed up rooms escapes in winter through windows) is quite effective in order to save energy in houses. Accordingly,a plastic sash with high performance and high functionality was developed. The product has high heat insulating performance with thermal transmittance U value of 0.80W/m^{2}K,about 5 times as high as the next-generation standard for window sashes,and provides the additional functions for untroubled living conditions such as high security performance with certified CP mark,disaster preventing ability and sound insulating properties (JIS classification T-2). The products include all types (casement,double sliding,fixed fitting etc.) and size of sashes designed for any part of the house.

6.Principle and operation

(1)Development of the 3-layer glass with optimized midair layer thickness

The product comprises 3 sheets of glass and enhances heat insulating performance by filling 2 midair layers with krypton gas,which has large specific gravity,low thermal conductivity of 2.6 times as high as dry air,1.7 times as high as argon gas,and thermal transmittance of 0.009 W/m^{2}K. The thermal resistance increases in proportion to the thickness of the midair layer,but wider thickness eventually causes convection which suppresses the thermal resistance. Hence,the thickness of 10mm was selected,which results in minimum convection and high thermal resistance,by a computer simulation and an evaluation test using a heat flow meter. Further,the 3-layer glass structure with 2 sheet of Low-E glass and a sheet of laminated glass enables to suppress the resonance and provides the excellent sound insulating properties (JIS classification T-2).

Refer to Figure 1.

(2)Development of plastic spacers

Generally spacers forming a midair layer are made of aluminum to secure strength. The newly developed plastic spacers with adequate strength can eliminate metal members which easily conduct heat and can increase heat insulating performance by 0.1 W/m^{2}K (about 12%).

(3)Using 2 types of Low-E glass with different insolation properties 2 types of Low-E glass with different insolation properties are applied. They are coated with'special metal film',which retains heat in winter and shields heat from sun light in summer. The 'cold area type (solar radiation heat acquisition rate of 0.47)'positively collects solar heat and the 'warm area type (solar radiation heat acquisition rate of 0.31)' shields solar heat,and the performance of the heat insulation and the heat shielding is improved by selecting a proper type of glass depending on the living area. In addition,synergy effect with laminated glass enables filtering out 99% of UV rays.

(4)Development of high performance plastic sashes

The heat insulating performance is improved by expanding dimensions of glasses which have excellent heat insulating efficiency,finding optimum cross sectional design which retains both the strength of plastic members and the heat insulating performance,reducing the ratio of the plastic members and increasing the number of the frame chambers and the midair layers to suppress heat conduction.

7.Description of improvement

Before improvement

-Multi-layer glass

-Single Low-E

-Filling with argon gas

-Aluminum spacer

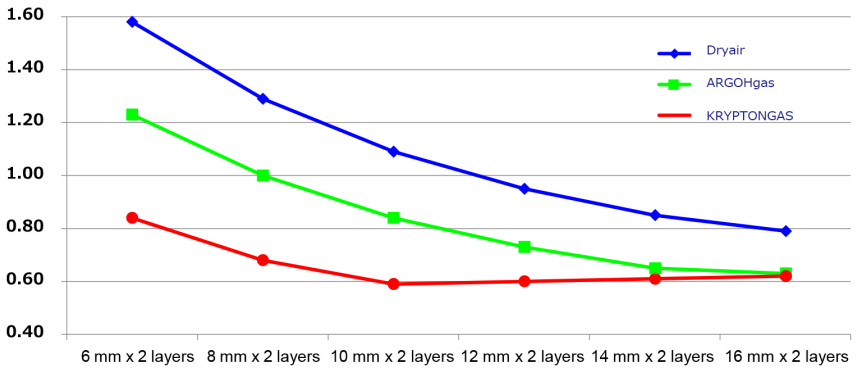
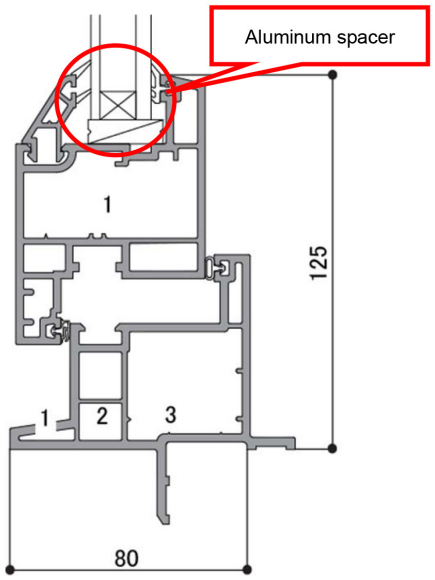


Fig. 1

-Chamber (Sash 1,Frame 3)

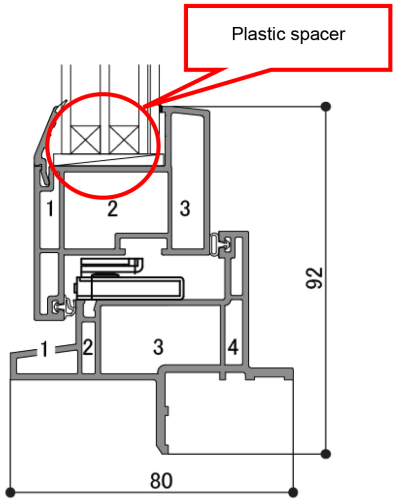


Thermal transmittance U value Casement,Fixed fitting: 1.40 W/m^{2}K Double sliding: 1.50 W/m^{2}K

After improvement

-3-layer glass

-Double Low-E



Thermal transmittance U value Casement,Fixed fitting: 0.80 W/m^{2}K Double sliding: 1.00 W/m^{2}K

-Filling with krypton gas

-Plastic spacer

-Multi-layer chamber (Sash 3,Frame 4)

-Downsizing of plastic frame by 26%

8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio).

Comparison with single glass aluminum sash which is most popular in Japan.

Refer to Table 1.

9.Economic efficiency and its trend

Payback period: 8 years by replacing from the aluminum sash and the single sheet glass.

10.Trend in market

(1)Current diffusion rate

Ichijo Co.,Ltd has a 15% share of the domestic plastic sash supply. However,the domestic plastic sash market is about 17.0% of the total sash market and the adoption rate is still very low.

(2)Prediction for future

Recently,aluminum sash suppliers are changing their main products to the plastic sashes.

Because the adoption rate of the plastic sash is increased 9% more than 3years before,it can be expected that it depends from now on and is being increased.

11.Reference information

Social impact

The crime-prevention laminated glass can secure family

members and household goods by preventing intrusion of sneak thief and protecting from ballistic fragments during abnormal climate (typhoon,tornado).

12.Implementation sites

All over Japan (except Okinawa Prefecture)

13.Cited documents

References

Vinyl Environmental Council,"A study for delightful windows"

Japan Sash Manufacturers Association,"Usage survey of house construction materials"

PVC Windows Industries Association webpage

14.Contact information

Ichijo Co.,Ltd

Table 1

Items	This product	Single glass This productaluminum sash	Difference in performance
Basic primary energy consumption (MJ/year)		18,749	——
Performance of sash (Thermal transmittance)	0.8W/m² • K	6.51W/m² • K	-5.71W/m² • K
Primary energy consumption for refrigerated air conditioning (MJ/year)	12,716	21,596	-8,880
Primary energy consumption for refrigerated air conditioning (kWh/year)	3,533	6,000	-2,467
Electric power charge (yen/year)	95,378	16,198	-79,180
Energy conservation achievement rate (%)	147	87	——
Calculated CO_2 emi-ssions (ton-CO_2/year)	1.88	3.19	-1.31

*1 Calculated with an online program provided by Building Research Institute,using the company's housing specification as the conditions for standard model plans of the business operator.

*2 Calculated using standard unit electricity price of 27 yen/kWh (tax included) based on "About the Revision of 'Standard Unit Electricity Price' "issued by Home Electric Appliances Fair Trade Conference on April 28th 2014.

*3 Calculated using actual CO_2 emission factor of 0.000531 (ton-CO_2/kWh) by Tokyo Electric Power Company,based on "CO_2 Emission Factors by Electric Business Operators (Actual results of FY2013)".

BAT8: Light–Weight, Small–Sized, Low–Cost High Efficiency High–Bay Lighting Fixtures

1.Category of industry

N/A

2.Category of technology

Lighting

3.Source of energy

Electrical equipment

4.Practical application

February 1,2015

5.Summary

These products are LED lighting fixtures for use in buildings with high ceilings. Improvements have been made to applicability by reducing their weight and size and lowering the prices. Although the switch to LED utilization in high-bay lighting fixtures used in factories,warehouses,etc. has been progressing,improvements in the weights and prices of the fixtures and the realization of higher outputs have been required. By changing the unified structure of the previous LED high-bay lighting fixtures to a separate unit structure,and by utilizing an extruded heat sink made from a high-purity aluminum material,these products realized an approximately 66% reduction in weight,51% reduction in size,and a 44% lowering in prices compared to the previous products. In addition,due to the use of an optimum structural design that took advantage of heat simulations,the heat dissipating efficiency was improved to achieve an energy consumption efficiency of 159.4 lm/W (a 49% improvement compared to the previous products),and a high output model lineup was also realized. The improvement in energy conservation efficiency and applicability,together with the reduction in prices realized by these products can be expected to result in promoting the change to utilize LED high-bay lighting fixtures.

6.Principle and operation

(1)Development of compact fixture units with favorable heat

dissipation.

Compact high-output fixture units with favorable heat dissipation were developed. By combining these units,fixtures achieving at most a high flux equivalent to that of 1 kW metal halide lamp fixtures were realized in compact forms that did not exceed the dimensions of high-bay light fixture types with previous light sources. In particular,focus was placed on realizing the optimum heat sink design within the limited dimensions of compact,high-output fixture units,and the design also gave consideration to the ease of production and installation as well as the manufacturing cost. Due to this,the high-output fixture unit realized a favorable heat dissipating performance. Further,by combining high-output fixture units,product variations with various types of light output were developed.

(2)Reduction in weight of the fixture structure

It was attempted to optimize the strength,material quality,and form not only of the heat sink and the surrounding structure,but also the materials of the fixture main frame,etc.,and a structure was realized that secured an adequate functional strength when the fixture has been fixed while still realizing a lightweight structure.

7.Description of improvement

Before improvement

Although the energy conservation efficiency of previous high-bay LED lighting was outstanding when compared to that of previous light sources (such as discharge lamps),there were also inferior elements compared to previous light source products such as the aspects of cost and weight,and these aspects adversely affected the appeal of the product in the sales promotion process. Particularly when used as lighting fixtures for indoor facilities,for the reason that the number of units installed often becomes large,the applicability becomes a key point in addition to the price and performance for increasing the merchantability.

After improvement

It was attempted to make the weight and size smaller than previous products,to enhance the applicability,and also to reduce the costs. In particular,the merchantability was to be improved from the aspect of applicability,which could not be said to be comparable with that of lighting fixtures incorporating previous light sources. This was to allow a strong appeal to be made for the total merchantability of LED lighting which has an outstanding environmental performance. Additionally,the energy conservation performance was further improved to develop lighting fixtures with specifications that will decide the dramatic popularization of the products.

8.Effect of improvement

Improvement of energy consumption intensity (Option for improving energy conservation ratio).

While aiming to reduce the weight and size of products and reduce the costs,it was also intended to improve the energy conservation performance at the same time.

In Phase 1 of the product development,in early 2015 the specific energy consumption efficiency was improved by realizing a 134.9 lm/W LED high-bay lighting fixture (equivalent to a 400 W type mercury lamp lighting fixture). Additionally,in Phase 2 in July 2015 the specific energy consumption efficiency was further improved to 158.8 lm/W due to the utilization of high efficiency LED elements,an optimal LED element arrangement,and a newly designed power source unit.

9.Economic efficiency and its trend

As these products make it possible to replace almost all of the HID lamp high-bay fixtures that are widely used

for lighting indoor facilities with high ceilings,including factories,warehouses,gymnasia and commercial facilities,the marketability is extremely high. In addition,an economic efficiency can be realized that enables recovery of the difference in initial costs in approximately two years,by limiting the initial costs to approximately 2.4 times the amount when compared with mercury lamp ceiling fixtures,and by achieving the running costs of approximately a quarter of the mercury lamp's costs as a result of the 74% energy conservation effect.

The economic effect is shown in figure 1 below,which takes the model in the product lineup with the most outstanding specific energy consumption efficiency as an example. As can be understood from this cost-comparison graph,even in the case with renewal investment,the calculations show that the investment can be recovered in 3.3 years.

10.Trend in market

(1)Actual sales results between April 2015 and September 2015: 25,347 units

(2)Prediction for 2017: 100,000 units/year

11.Reference information

[Example]

Case showing the effect of using these LED high-bay light fixtures instead of 400 W mercury lamp fixtures for 45 high-bay light fixture units in a factory for approximately eight hours a day over a one-year period.

Electric power consumption: Reduction of approximately 40,000 kWh.

Electricity charges: Reduction of approximately 1,100,000 yen

-CO_2: Reduction of approximately 17t.

-Corresponds to the CO_2 annual absorption amount of approximately 1500 beech trees.

-Calculated at the used electricity charge unit price of 27 yen (New Electric Power Charge Standard Unit Price)

-The CO_2 emissions amount is calculated by multiplying the consumed electric power amount by the emissions

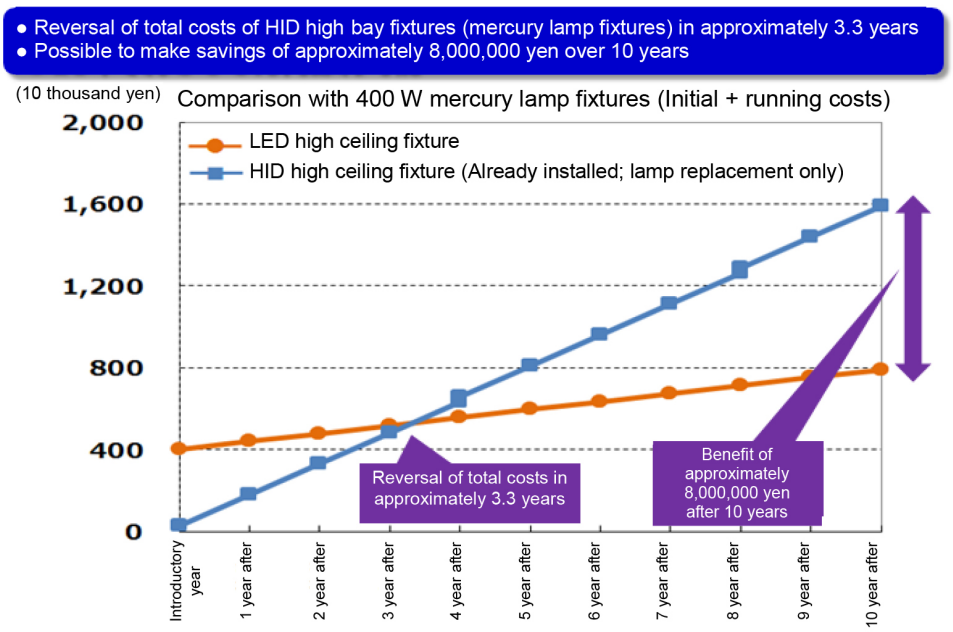


Figure 1

factor of 0.43 kg-CO_2/kWh.

(Based on the Industrial Structural Council,Committee on industrial Science and Technology Policy and Environment,Global Environment Subcommittee,Natural Resources and Energy Working Group of the Ministry of Economy,Trade and Industry in FY2009).

-Calculated from the approximately 11kg annual amount of CO_2 absorbed by a single beech tree.

12.Implementation sites

N/A

13.Cited documents

Announcements made to academic societies and newspapers.

-Dempa Shimbun Daily (LED high-bay lighting fixtures) November 15,2012.

-Nikkei Sangyo Shimbun (Nikkei Industrial Journal) (LED high-bay lighting fixtures) November 16,2012.

-2013 CJK Lighting Conference (Gwangju) (LED high-bay lighting fixtures) August 23,2013.

14.Contact information

Toshiba Lighting & Technology Corporation

Planning Manager,Technical Planning Department,Technology and Product Quality Management Division.

Phone: +81-46-862-2165 FAX: +81-46-861-5164