

## AIR CONDITIONING MARKET FOCUS SHIFTS TO AIR QUALITY

### —THE CURRENT STATUS AND FUTURE POTENTIAL OF JAPANESE COMPANIES—

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#### SUMMARY

- The COVID-19 pandemic is resulting in more people spending time indoors, which coupled with the growing attention to maintaining health, is raising concerns over indoor air quality (IAQ).
- The global air conditioning market is valued at JPY 21.8 trillion, of which the market segment referred to as the “air quality market”, consisting of equipment and services that measure and manage the indoor air quality of homes and commercial buildings, is believed to account for JPY 3.1 trillion. The air quality market is expected to grow by 6% or more annually going forward, and its share of the total air conditioning market is increasing.
- As for future growth of Japanese companies active in the air quality market, there is the potential to expand their customer base in their existing business as well as to expand into the energy management business, such as HEMS and BEMS, and the healthcare business, mainly in the presymptomatic and preventive healthcare sector.

#### EMERGING NEW DEMANDS

The COVID-19 pandemic is resulting in more people spending time indoors, and this, coupled with the growing attention to maintaining health, is raising concerns over indoor air quality (IAQ). Indoor air quality is a term used in the air conditioning and other environment-related industries. It encompasses aspects such as temperature, humidity, carbon dioxide, cleanliness, and airflow. It is used as a means of evaluating the quality of the air surrounding people from the perspectives of health and comfort. According to the United States Environmental Protection Agency, pollutant concentration levels are generally two to five times higher indoors than outdoors due to interior decorations and building materials. Moreover, people take in more air in a day than any other substance (air: 18kg/person, water: 1.2kg, food: 1.3kg)<sup>1</sup>, and there are many factors associated with air that affect health. Research conducted at Harvard University has suggested a correlation between a deterioration in air quality and higher illness and mortality rates. The Ministry of Health of Italy<sup>2</sup>, a research team at Germany's Johannes Gutenberg University, Indian epidemiologists, and a research team at Kyoto University have all suggested that there is a similar correlation between air pollution and increased COVID-19 severity and mortality<sup>3</sup>.

Under this changing environment, the role of air conditioning equipment is also undergoing a change, from providing a function to eliminate the discomfort caused by heat or cold to the fulfillment of other needs, such as providing good quality, safe, worry-free air. Amidst the COVID-19 pandemic, the Singaporean venture company uHoo has developed a device that can measure nine air quality parameters, including temperature, humidity, carbon dioxide, and nitrogen dioxide. In June 2020, it launched a service that informs users of the virus activation levels based on the measurement

<sup>1</sup> Iwao Uchiyama (The National Institute of Public Health) “Air and Human Beings: From the Physiological Viewpoint”, 1999

<sup>2</sup> Setti, Leonardo, et al. “The Potential Role of Particulate Matter in the Spreading of COVID-19 in Northern Italy: First Evidence-based Research Hypotheses.” medRxiv, Cold Spring Harbor Laboratory, April 17, 2020, <https://www.medrxiv.org/content/10.1101/2020.04.11.20061713v1.article-info>.

<sup>3</sup> “New Delhi's Toxic Air Exacerbates Coronavirus Threat” (*UK Financial Times*), *Nihon Keizai Shimbun*, November 19, 2020  
“A Partial Explanation of the Mechanism by which Air Pollution Causes the Onset and Severity of COVID-19”, Kyoto University website, February 4, 2021: <https://www.kyoto-u.ac.jp/ja/research-news/2021-02-04>

results. The company is offering its customers the ability to see to what extent the measured air quality poses a risk to health. At CES 2021 (held online in January 2021), the world's most influential tech event, there were a large number of exhibitions on the theme of air quality that attracted a great deal of interest, including an in-flight air purification system and an integrated home ventilation system presented by Panasonic, and systems presented by the US venture company Airthings to alert users to the risk of viruses spreading in indoor spaces and to detect the concentration of cancer-causing radon in the air.

This report looks at the potential and the future outlook for Japanese companies while analyzing the new air quality demands in various countries and the trends among the players competing for this market.

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## INDUSTRIAL STRUCTURE

### Market scale and growth factors

The global air conditioning market is valued at JPY 21.8 trillion<sup>4</sup>, of which the market segment referred to as the “air quality market”, consisting of equipment and services that measure and manage the indoor air quality of homes and commercial buildings, is believed to account for JPY 3.1 trillion<sup>5</sup>. The air quality market is expected to grow by 6% or more annually going forward, and its share of the total air conditioning market is increasing.

The air conditioning market is divided into the household segment, providing air conditioners for residential use, and the commercial segment, providing air conditioners for commercial buildings such as offices. The largest demand for household air conditioners is seen in China, while the greatest demand for commercial air conditioners is in North America. Global demand for household air conditioners is 96.07 million units (86.6% of the total demand)<sup>6</sup>, and for commercial air conditioners it is 14.9 million units (13.4%)<sup>7</sup>. While household use predominates on a unit basis, commercial usage is the larger on a monetary basis, accounting for 60% of the total. In the air quality market, no distinction is made between household and commercial use. In addition to the global air conditioning equipment companies described below, a variety of startup companies are competing to capture the demand in each region.

At the same time, income and climate have acted as factors contributing to the spread of air conditioning equipment. For example, the use of air conditioning equipment is becoming widespread in Vietnam, Indonesia, Thailand, the Philippines, and India as income levels in those countries rise, making them promising markets. In Europe, demand was boosted by extreme weather in 2003, when temperatures were high enough to cause 10,000 deaths in France. In particular, in relation to the rapid spread of air conditioning equipment accompanying rising incomes in emerging countries, the IEA (International Energy Agency) published a report in 2018 forecasting that there will be a three-fold rise in the number of air conditioning units in operation globally in the next 30 years.<sup>8</sup>

### Representative players

Representative air conditioning equipment companies answering the demand for air quality include Carrier Global (US), Johnson Controls International (US), and Trane Technologies (US), which are conglomerates that have acquired specialized air conditioning companies, Mitsubishi Electric (Japan), Panasonic (Japan), LG Electronics (South Korea), Samsung Electronics (South Korea), Midea Group (China), and Hisense (China), major home appliance manufacturers that manufacture air conditioners as one of their range of products, and specialist air conditioner equipment manufacturers Daikin Industries (Japan), Fujitsu General (Japan), Gree (China), and Lennox International (US) (Fig. 1). While Chinese companies rank highest in terms of market share on a monetary basis, the air conditioning market is characterized by local production for local consumption. There are not many companies that can expand globally in the way that Japanese companies such as Daikin do.

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<sup>4</sup> Calculated based on data from Technavio, MarketsandMarkets, and other sources.

<sup>5</sup> See footnote <sup>4</sup>.

<sup>6</sup> The Japan Refrigeration and Air Conditioning Industry Association

<sup>7</sup> See footnote <sup>6</sup>.

<sup>8</sup> <https://www.iea.org/news/air-conditioning-use-emerges-as-one-of-the-key-drivers-of-global-electricity-demand-growth>

**Fig. 1 Major air conditioning equipment companies and their performance**

Country	Company	Sales (JPY mil.)	Operating margin	Operating profit (JPY mil.)	Sector	FYE
US	Lennox International	415,099	12.90%	44,561	Commercial/Household	December 2019
US	Carrier Global	2,028,828	12.10%	193,637	Commercial/Household	December 2019
US	JCI (Johnson Controls International)	2,407,105	7.80%	68,059	Commercial	September 2020
US	TT (Trane Technologies)	1,809,776	12.20%	153,830	Commercial	December 2019
Japan	Daikin Industries	2,550,305	10.40%	170,731	Commercial/Household	March 2020
Japan	Mitsubishi Electric	4,462,509	5.80%	221,834	Commercial/Household	March 2020
Japan	Fujitsu General	262,117	5.70%	5,765	Commercial/Household	March 2020
Japan	Panasonic	7,490,601	3.90%	225,707	Household	March 2020
S. Korea	LG Electronics	5,837,520	3.90%	2,931	Household	December 2019
China	Gree Electric Appliances	3,164,241	13.60%	389,740	Commercial/Household	December 2019
China	Midea Group	4,408,930	9.20%	382,080	Commercial/Household	December 2019
China	Hisense Home Appliances	591,050	1.60%	28,306	Commercial/Household	December 2019

Source: Created by MGSSI based on each company's IR material.

### Trends in energy saving

The IEA report mentioned above pointed out that the increase in demand for electricity over the next 30 years is expected to be comparable to the current total electricity generation capacity of the US, Europe, and Japan, and that energy efficiency standards should be tightened. In order to improve energy conservation, the Japan Refrigeration and Air Conditioning Industry Association believes that in addition to improving the efficiency of individual equipment, it is necessary to reduce overall energy consumption as a system, and that the issue is integration with home energy management systems (HEMS) and building energy management systems (BEMS).<sup>9</sup>

In the air conditioning market, which is expected to continue to see high growth, improvements in technological capabilities that will enable a reduction in energy consumption will, of course, enhance a company's competitiveness, and because of the importance of regularly maintaining equipment, irrespective of whether it is for household or commercial use, building a sales and after-sales service network for that purpose will determine competitiveness. In the US and Chinese markets, in particular, local companies that have the advantage of being able to build sales and after-sales service networks account for a large share of the market, and this tendency is distinctly pronounced. The air conditioning markets in each region have different characteristics determined by differences in climate, architectural style, taste, and other factors.<sup>10</sup> The companies vying for the newly emerging air quality market will also need to proceed in accordance with the market characteristics of their respective countries.

## MARKET OVERVIEW BY COUNTRY

Viewed by region, China has the largest air conditioning market with a value of JPY 6.3 trillion, followed by North America at JPY 5.7 trillion, Europe at JPY 4.1 trillion, Asia and Australia (including Japan and India, and excluding China) at JPY 3.9 trillion, and the remaining regions at JPY 1.8 trillion<sup>11</sup> (Fig. 2). Changes in the awareness of air quality are beginning to appear in each region as a result of the COVID-19 pandemic. According to a Chinese consumer survey<sup>12</sup>, air conditioning equipment that contributes to health is ranked as the number-one health-related

<sup>9</sup> Japan Refrigeration and Air Conditioning Industry Association "Environmental Action Guidelines and Action Plan", <https://www.jraia.or.jp/eco/plan/utilise.html>

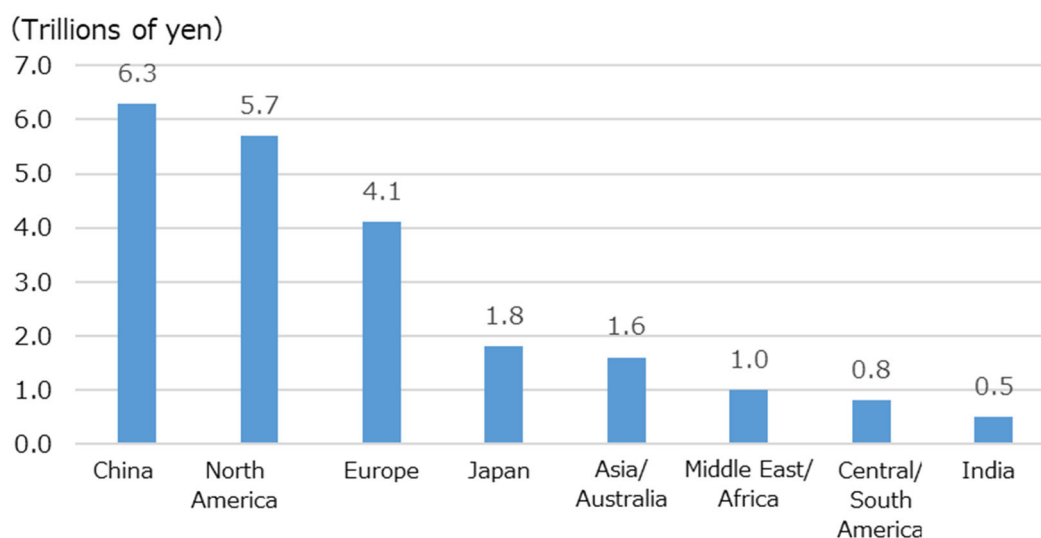
<sup>10</sup> Daikin Industries' presentation material: <https://www.daikin.co.jp/investor/personal/schedule/data/normal.pdf>

<sup>11</sup> Calculated based on data from Technavio, MarketsandMarkets, and other sources.

<sup>12</sup> According to the survey of consumers' attitudes towards health-related appliances conducted by AVC (All View Cloud) in December 2020, air conditioning equipment that is good for health was the health-related appliance most desired by respondents. Refrigerators to keep produce fresher came second, followed by washing machines with a sterilization function, and beauty hair dryers. This demonstrates a high degree of interest in air quality. The functions of this healthy air conditioner include a ventilation function, a self-cleaning filter, and automatic temperature and humidity adjustment, and the fact that models possessing all these functions have not yet been available in the Chinese market shows that demand is changing. According to AVC, from 2021, the trend of the Chinese air conditioning market is expected to change from one of competition on price to competition on functionality. While the number of units sold is expected to increase slightly year on year, sales revenue is expected to grow due to the demand for high-priced products. (<http://www.avc-mr.com/index.php?m=content&c=index&a=show&catid=49&id=6327>)

appliance that people most desire, while in the US, there have been calls for improved air quality in school facilities<sup>13</sup>. In Europe and India, air quality is attracting attention due to its correlation with the severity of COVID-19.

**Fig. 2 Air conditioning market scale by region**



Source: Created by MGSSI based on data from Technavio, MarketsandMarkets, and other sources

## China

The Chinese market, which is the world's largest household air conditioning market, is characterized by polarization between the mainstream inexpensive air conditioners and high-value-added high-end models. While wall-mounted air conditioners cost about JPY 30,000 per unit, high-end models known as residential multi-split air conditioners<sup>14</sup> cost about JPY 2 million, and Daikin holds about half of the market share in these models. In the high-end market, further demand for models focusing on improved air quality is expected in future.

Concern over air quality in the Chinese market has been very high for some time due to the effects of PM2.5, which was at one point said to kill three million people every year. Now that air quality has been greatly improved through government initiatives, concerns over air quality have shifted from PM2.5 to other harmful substances such as formaldehyde. In a corporate brand image survey relating to improvement of air quality conducted in China<sup>15</sup>, foreign companies received high praise, with Panasonic and Honeywell taking first and second place, respectively. Following the results, Panasonic immediately announced that it will start selling a new air quality system (an air conditioner augmented by the addition of a humidity control unit capable of finely controlling the degree of humidification) for the Chinese residential market in April 2021, ahead of its release in Japan. In the future, the application of IoT, an area in which China excels, is expected to gain ground in the development of air conditioning equipment. There are expectations that Japanese companies will leverage their brand power in the air quality field to present new concepts.

## North America

In North America, the world's largest market for commercial air conditioning, most commercial and household air conditioners are duct-type systems (including unitary systems). This presents a barrier to entry for Japanese companies that mainly produce ductless systems. North American companies account for a large share of the market, and the shift towards the use of inverters is not progressing (Fig. 3), which has led to poor power efficiency. The delay in bringing about energy saving is also a reason why many North American air conditioning companies are not recognized as advanced companies, and in this respect, there is likely to be scope for Japanese companies to exert

<sup>13</sup> In September 2020, a council of 6,400 elementary, junior high, and high school managers in New York City voted to delay the reopening of schools until they could be sure that the air quality was at a level that would ensure the safety of students. The council said that old air conditioning systems are in use in at least 1,800 schools and expressed concern that the ventilation systems are not good enough to reduce the spread of COVID-19.

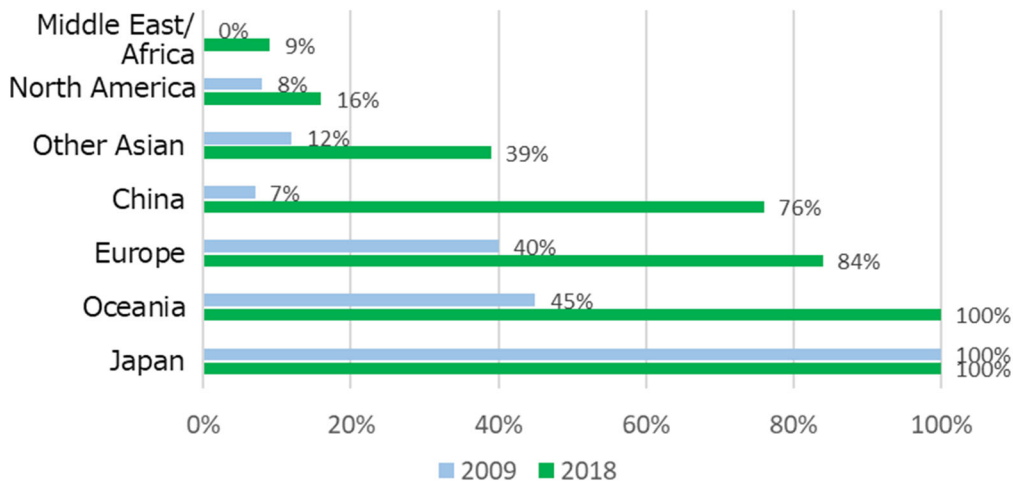
Wall Street Journal, August 25, 2020: <https://www.wsj.com/articles/air-quality-is-safety-focus-for-new-yorks-schools-11598396348>

<sup>14</sup> A multi-split is a type of air conditioner that enables indoor units to be installed in several rooms using a single outdoor unit.

<sup>15</sup> <https://www.chinapp.com/paihang/xinfengxitong>

their technological capabilities in the North American market. Because the COVID-19 pandemic has raised appreciation of mask wearing in North America, where people had previously been opposed to wearing masks, and has also engendered increased sensitivity towards the need for clean air, demand is also expected to grow in the region's air quality market.<sup>16</sup>

**Fig. 3 Household air conditioner inverterization rate in major regions (from 2009 to 2018)**



Source: Created by MGSSI based on Daikin Industries' Sustainability Report 2020

At a shareholders' meeting in September 2020, Tesla CEO Elon Musk indicated his willingness to enter the household air conditioner market. It is believed that the know-how in in-vehicle air conditioners used in the company's EV vehicles would be converted for use in household air conditioners, and that Tesla's CEO is also looking beyond that to the HEMS business. The power consumption efficiency of EV in-vehicle air conditioners directly affects the vehicle's driving range. When he looks at the North American market where inverterization is not taking place, it is natural that Elon Musk believes that Tesla has the odds in its favor in the household air conditioner market. The reason that air conditioning equipment with poor energy efficiency has been used is the low cost of electricity in North America, but it can also be said that users took no interest in energy efficiency in the first place.

## Europe

In Europe, to counter the cold of winter, the use of heating appliances to circulate hot water is more common than the use of air conditioners that emit hot air. The penetration rate of household air conditioners is low at between 20% and 25% in Southern Europe, and between 10% and 15% in Central Europe, including Germany. With the recent expansion of teleworking brought about by the COVID-19 pandemic, a demand is emerging for the introduction of air conditioning in the home to counter the summer heat. At the same time, because there was no move towards the use of air conditioners until the large number of deaths from high temperatures caused by abnormal weather conditions in the 2000s, there are no leading local air conditioning companies, and Japanese companies enjoy a large presence.

Furthermore, the market for air quality improvement is expanding due to the high level of environmental awareness and the introduction of environmental regulations by European governments. For example, the EU-funded BRIMEE<sup>17</sup> project is conducting research and development of building materials that absorb indoor pollutants using nanostructured materials. Building materials that contribute to improving air quality developed in this project have been certified and measures have been taken to actively use them not only in new construction, but also in old

<sup>16</sup> In the COVID-19 crisis, the American Society of Heating, Refrigerating and Air Conditioning Engineers' (ASHRAE) recommended adequate ventilation, 24-hour operation of air conditioning systems, installation of air cleaners using HEPA filters capable of collecting 99% or more of minute particles of 0.3 μm, and adoption of UVGI (ultraviolet germicidal irradiation) in high-density spaces, which also contributed to an increase in air quality-related demand. <https://www.ashrae.org/technical-resources/resources>

<sup>17</sup> Cost-effective and sustainable Bio-Renewable Indoor Materials with high potential for customisation and creative design in Energy Efficient buildings

buildings. In addition, the EU is implementing the INTASENSE (Integrated Air Quality Sensor for Energy Efficient Environment Control) sensor development project for identifying minute pollutants. In the UK, where it has been reported that air pollution kills 36,000 people every year, a large-scale campaign called “Clean Air Day” is held in June every year by a private organization that aims to achieve further air quality improvement, helping to boost interest in air quality.

### **Other regions of interest**

Other regions of interest are Southeast Asia, which is currently experiencing remarkable growth, and India, which has great market potential. As mentioned in the section on industrial structure, income levels in many ASEAN countries have reached a phase in which air conditioners are becoming widespread, and the Asian air conditioner market (excluding Japan and China) grew by 34.3% between 2011 and 2016. Demand for air conditioning equipment is expected to continue growing in emerging markets in tropical and sub-tropical regions where income levels are expected to increase.

In particular, interest in improving air quality is increasing in ASEAN countries due to factors such as escalating environmental pollution in Singapore, Malaysia, and elsewhere. Assessments of air quality and health risk conducted by the non-governmental organization Asia-Pacific Research Center for Indoor Environment (APARCIE), and the market is expected to grow further in the future along with these needs propelled by the COVID-19 pandemic.

In addition, the IEA expects India to become the world’s largest market for air conditioning by 2050. Given India’s climate and large population, it is expected to enter a phase of rapid expansion in the future. Furthermore, preventive measures introduced as policy initiatives by the government in response to increasing levels of air pollution, including implementation of a National Clean Air Programme (monitoring air pollution in rural areas, and promoting response at the state level), have raised awareness among consumers and contributed to market expansion.

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## **CURRENT STATUS AND FUTURE POTENTIAL OF JAPANESE COMPANIES**

The new demand for air quality that is emerging around the world can likely be explained by the strong need for solutions that provide safe, worry-free, good quality air with good energy efficiency. These needs can be said to provide a tailwind for Japanese air conditioning companies such as Daikin, Fujitsu General, Mitsubishi Electric, and Panasonic.

These companies have a head start in terms of manufacturing capabilities, including energy-saving technology, control technology, and refrigeration technology accumulated thus far. As a specialized manufacturer, Daikin has strengths in areas such as refrigeration technology and heat exchangers, which are the core technologies of air conditioning. As a general home appliance manufacturer, Panasonic has the capability of developing air conditioning equipment, while Mitsubishi’s strength lies in its control technology. In the air cleaner sector, companies have developed technological capabilities and products in response to the requirements of Japanese consumers who demand a higher degree of cleanliness to address issues such as pollution, as well as influenza and pollen that occur every year. Demand for Japanese products is high, even during the COVID-19 pandemic, and Daikin has expanded its production capacity for air cleaners from 420,000 units to 550,000 units globally. Panasonic’s air disinfection and deodorization device that uses hypochlorous acid is selling so well that production has been unable to catch up, resulting in a temporary suspension of shipments.

The inverterization, heat pump, and other technologies possessed by Japanese companies put them in a strong position to respond to the tightening of environmental regulations in advanced countries. Although inverterization is underway in China and Europe, installation of inverter air conditioners in the US and Asia remains low, presenting a good opportunity for Japanese companies with the know-how accumulated in response to stricter energy conservation regulations. On the customer service front, the global sales networks built up by Japanese companies to date will also serve well. Having established sales networks in China and in major Asian markets, Japanese companies are also well placed to respond flexibly to the new demand for air quality.

## FUTURE OUTLOOK

In addition to the fact that air conditioning is a growth market, Japanese affiliated companies can be expected to achieve growth in the following three directions going forward. First, the customer base in their existing business operations will grow along with the market's expansion. Taking advantage of their strength in providing high air quality, they will expand their global customer base by meeting the new demand emerging in land-based public transportation, commercial facilities, aircraft, and shipping, all areas in which air quality is a concern, in addition to the residential housing, offices, hospitals, and factories that they have served up to now. Secondly, as demonstrated by Tesla's appetite for entering the air conditioning business, there is a possibility of expanding into the energy management business such as HEMS and BEMS by leveraging energy-saving air conditioning equipment. Thirdly, by collecting and analyzing various data on the effects of air quality on health, there is potential for expanding into the healthcare sector by contributing to people's health in the area of presymptomatic and preventative healthcare.

In order to secure new business opportunities, companies will need to provide high-added-value to customers through the service/solutions business, rather than via sales of air conditioning equipment alone. In this respect, collaboration with various other types of business, including with IT companies, will increase the possibility of success.

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