

# Enjoy an Exciting Ferry Trip on Japan's First LNG-Fueled Ferry "Sunflower Kurenai"!



**Mitsubishi Shipbuilding Co., Ltd.  
Business Department**

*The first two liquefied natural gas (LNG)-fueled ferries in Japan, ordered by Mitsui O.S.K. Lines, Ltd. (MOL), were designed and built by Mitsubishi Shipbuilding Co., Ltd. (hereafter "Mitsubishi Shipbuilding") at Shimonoseki Shipyard & Machinery Works Enoura Plant, Mitsubishi Heavy Industries, Ltd. The first of the two, named Sunflower Kurenai (hereafter "the vessel"), was delivered in December 2022 and has been in service since January 2023 on the Osaka-Beppu route operated by MOL Sunflower Ltd. (The sister vessel, Sunflower Murasaki, has been in service since April 2023.)*

*The vessel not only achieves excellent environmental performance, with CO<sub>2</sub> emissions reduced by approximately 20% compared to conventional vessels and SO<sub>x</sub> (sulfur oxides) emissions virtually zero, but it also realizes an increase in the number of vehicles that can be loaded and the space per passenger in order to respond to the modal shift<sup>\*1</sup> from land transportation to sea in terms of CO<sub>2</sub> reduction, long-distance driver shortages, and work style reforms.*

*The cabins on the vessel are private (or group) rooms, eliminating the traditional shared large rooms. The vessel offers an evolved casual cruise experience through a significant increase in the area per passenger, enhancement of the truck driver rooms, expansion of the large-scale baths and restaurant, and the provision of spacious and open public spaces, including a three-story atrium. As a result, the vessel has received various awards.*

<sup>\*1</sup> Conversion of cargo transportation from trucks and other motor vehicles to railroads and ships, which have a smaller environmental impact.

## 1. Features of Sunflower Kurenai

The vessel is 199.9 m long, 28.0 m wide, 17,114 gross tons, and can accommodate 716 passengers, with a loading capacity of 137 13-meter trucks and 100 passenger cars. The main engines (two Wärtsilä 16V31DF) and main generator engines (three Yanmar Power Technology Co., Ltd. 8EY26LDF) adopt high-performance dual-fuel engines that can use both LNG and fuel oil A, the first for Japanese ferries, which allows the vessel to achieve an excellent environmental performance with a reduction of CO<sub>2</sub> emissions by 20% compared to conventional ferries and of SO<sub>x</sub> emissions to almost zero. As a result, the vessel has received a five-star rating under the Ministry of Land, Infrastructure, Transport and Tourism's "Energy Conservation Rating System for Non-International Coastal Trading Vessels"<sup>\*2</sup>.

The use of LNG fuel has been well received by customers, as has the elimination of the odor characteristic of fuel oil and the almost vibration-free sailing while navigating the Seto Inland Sea.

<sup>\*2</sup> The Maritime Bureau of the Ministry of Land, Infrastructure, Transport and Tourism evaluates the CO<sub>2</sub> emission reduction rate of ships through the introduction of energy-saving and CO<sub>2</sub> emission-reducing equipment, etc., based on applications from coastal shipping operators. The results are presented as a five-level rating, with five stars being the highest.

## 2. LNG fuel supply system

The main components of an LNG-fueled vessel include LNG fuel tanks, gas-fueled engines, a gas fuel supply system, a bunkering system, etc. The vessel employs two independent C-type cylindrical tanks of the vacuum-insulated stainless steel double-shell type for liquid LNG storage. The LNG fuel gas supply system (LNG-FGSS) has an LNG-PAC installed on the stern exposed section of Deck 6, which is a package equipped with a pump to suction LNG, equipment to feed gas fuel converted from LNG by the heat exchanger to the main engine, generator engine, etc., in the engine compartment in the tank connection space (TCS) attached to the LNG tank. In the case of some LNG-fueled ferries in Europe, the LNG-PAC and other equipment are installed around a part of the vehicle decks, but in the case of the vessel, they are placed at an exposed section of the top level to take into account the number of vehicles that can be loaded and the increase in space per passenger for improved comfort as mentioned above.

For the time being, LNG bunkering takes place in the port of Beppu from LNG tanker trucks via the starboard bunker stations (Figure 1). In anticipation of the increased deployment of LNG bunker ships in Japan in the future, a dedicated supply port for bunker ships is provided on the port side along with parts and other equipment for their boarding.

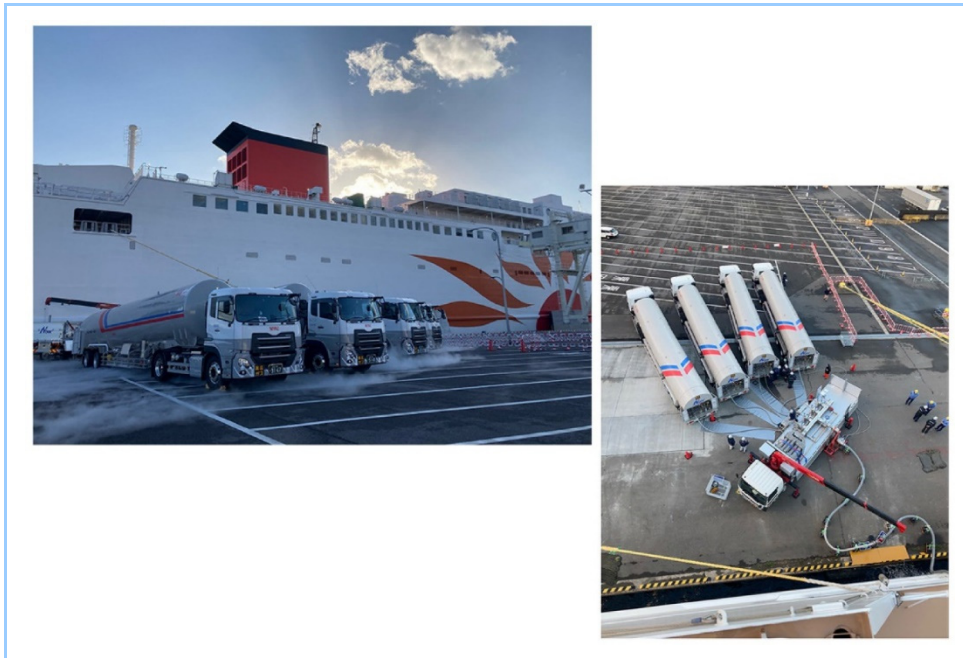


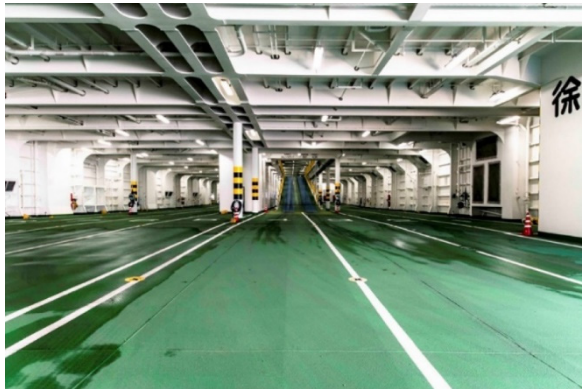
Figure 1 LNG bunkering work (Beppu)

In addition to complying with the ship construction regulations as a JG Class II ship operating in limited coastal areas (Seto Inland Sea) and other relevant laws and regulations, the vessel was designed in accordance with the IGF Code, the international rules for LNG-fueled ships and underwent a risk assessment HAZID (hazard identification study), while being consulted by the DNV (Norwegian classification society), by which a large number of European LNG-fueled ferries are classified. This risk assessment was conducted by JG (Maritime Bureau/Kyushu District Transport Bureau/Shimonoseki Maritime Office), the shipowner, shipyard, and LNG-related manufacturers to analyze the risk (frequency and risk level) and causes for each operation mode. Based on the analysis, the IGF Code compliance status of the vessel was determined and countermeasures were taken to reduce risk as necessary. The risk assessment was completed in about six months by actively utilizing a web conference system for discussions with overseas classification consultants and JG, due to the COVID-19 pandemic and time differences.

### 3. Vehicle decks

There are two floors of passenger car decks (Deck 2 and Deck 3) in front of the engine compartment, which have a total capacity of 100 passenger cars. The truck/trailer decks (Deck 4 and Deck 5) above the passenger car decks, which can be accessed via a ramp (**Figure 2**), have a total capacity of 137 units with a 13-meter chassis or equivalent. Access from the lowest passenger car deck to the accommodation area is via stairs and two elevators directly connected to the upper floors. The No. 2 elevator on the aft side and some cabins are barrier-free.

The vessel berths on the starboard side in both Beppu and Osaka Nanko ports, and is equipped with side ramp doors at the bow and stern for the boarding of vehicles, and each vehicle deck can be accessed by either a fixed inboard ramp or an inboard flip-up ramp.



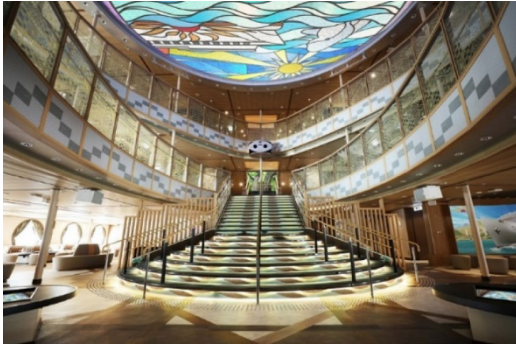
**Figure 2** Vehicle deck

### 4. Accommodation space

Sunflower Kurenai operates on a route between Kansai, a major consuming region, and Beppu, a popular tourist destination known for its onsen (hot spring) resorts. Sunflower Kurenai is named after Kurenai Maru, which was previously called "Queen of the Seto Inland Sea". Sunflower Kurenai and its sister vessel Sunflower Murasaki are both the fourth-generation vessels of the service. The replaced vessels, Sunflower Ivory and Sunflower Cobalt, are 153.0 m in length and 25.0 m in width. Compared to those ships, Sunflower Kurenai provides nearly 70% more space per passenger in the passenger cabins and public rooms due to its larger size and rationalization of passenger capacity. Since the designing of the vessel started in the COVID-19 pandemic that occurred immediately after the contract for the vessel was concluded, large common Japanese-style rooms seen on many past domestic ferries were eliminated, and the cabins are basically private rooms or semi-private rooms for families or groups, and anti-bacterial treatment is applied to the handrails and other points of contact.

The interiors of Decks 6 through 8 are luxuriously designed with the key concept of "kizuna" (enduring bonds between people or close relationships forged through mutual trust and support), and all kinds of decorations for the floors, wall panels, and glass partitions are decorated with kumiko (braided wood) patterns.

To the three-story atrium (Decks 6 through 8), which is a center of the accommodation area (**Figure 3**), passengers boarding on foot are guided via the boarding bridge, while those boarding by vehicle are guided from the vehicle deck via stairs or elevators. The atrium is integrated into an open plan lounge with the main entrance hall to the starboard side, a shop and seating lounge to port side, and a soft play children's playroom forward of the grand staircase, a part of which is circular-shaped. Atop of the atrium is a projection screen with a compact 30,000 lumen 3LCD projector. This projector was developed specifically for vivid theatrical and movie projections or locations with strong ambient light, such as shopping centers and galleries. The projector will be used for the time being to show introductory images of the anchorage site. The 252-seat main buffet-style self-service restaurant (**Figure 4**) is located starboard aft on Deck 6, accessed from the entrance hall.



**Figure 3** Atrium and circular-shaped grand staircase



**Figure 4** Restaurant

Sunflower Kurenai and Sunflower Murasaki depart every day, one from Osaka Nanko Port and the other from Beppu Port, alternately. From Sunday through Thursday, the departures from Osaka Nanko Port and Beppu Port are at 7:05 p.m. and 6:45 p.m., arriving at 6:55 and 6:35 the next morning, respectively. On Fridays and Saturdays, the departures from Osaka Nanko Port and Beppu Port are one hour to 45 minutes later, respectively, and the arrival times shift accordingly. On board, you can enjoy dinner at the restaurant, take a bath in the ocean-view grand bath (**Figure 5**) in the center of Deck 7, cruise through the calm Seto Inland Sea, and, depending on the time of day, view the Honshu-Shikoku bridges. For truck drivers, there are an exclusive lounge and a large-size bath, as well as private rooms on the forward side of Deck 6.

Adjacent to the entrance hall on Deck 6 are barrier-free Japanese-style rooms that can accommodate 19 passengers and eight private twin rooms that are also barrier-free. The women's restroom on Deck 6 is equipped with a powder room with switchable mirror lighting to further enhance the specification as a for-women facility. On Deck 7, aft port side, there are with-pet rooms where you can stay with your pet and a dog run with a foot-washing area, allowing you to enjoy a cruise with your pet. The top floor, Deck 8, has a variety of suite rooms with private balconies, and suite guests can also use the exclusive suite café lounge on the same floor. Thirteen of the 15 suite rooms are Western-style rooms, but two are Japanese-Western-style rooms where a relaxed and luxurious atmosphere is provided (**Figure 6**). There are 19 types of cabins in total, and the vessel and its sister vessel have received the GOOD DESIGN Award 2023 (Category Tag: Mobility, Award Number: 23G110879) as well as the following awards.

- Sunflower Kurenai: Ship of the Year 2022 (Large passenger ship sector)
- Sunflower Kurenai: Grand Prize in the 2023 (42nd) Nikkei Excellent Products and Services Awards
- Sunflower Kurenai/Murasaki: The 24th Logistics Environment Award



**Figure 5** Large-size bath with outside view



**Figure 6** Japanese- and Western-style suite

## 5. Future prospect

MHI Group is strategically working on energy transition. Mitsubishi Shipbuilding is addressing to such transition by helping to make the maritime industry low-carbon by designing and supplying LNG-fueled vessels and FGSS equipment, and by building alternative fuel vessels that reduce environmental impact, thus contributing to the realization of a carbon neutral society. In Japan, a modal shift from land transportation to sea is underway in terms of CO<sub>2</sub> reduction, long-distance driver shortages, and work style reforms, and demand for ferries and RORO ships<sup>\*3</sup> is increasing accordingly, as is the need for larger vessels. As a marine system integrator, we will continue to work with our business partners to solve various problems by building ferries and cargo ships that excel in fuel efficiency and environmental performance and contribute to stable operations.

<sup>\*3</sup> RORO (Roll-on Roll-off) ship: Ship that transport trucks, trailers, etc., with cargo that is driven on and off the ship on its own.