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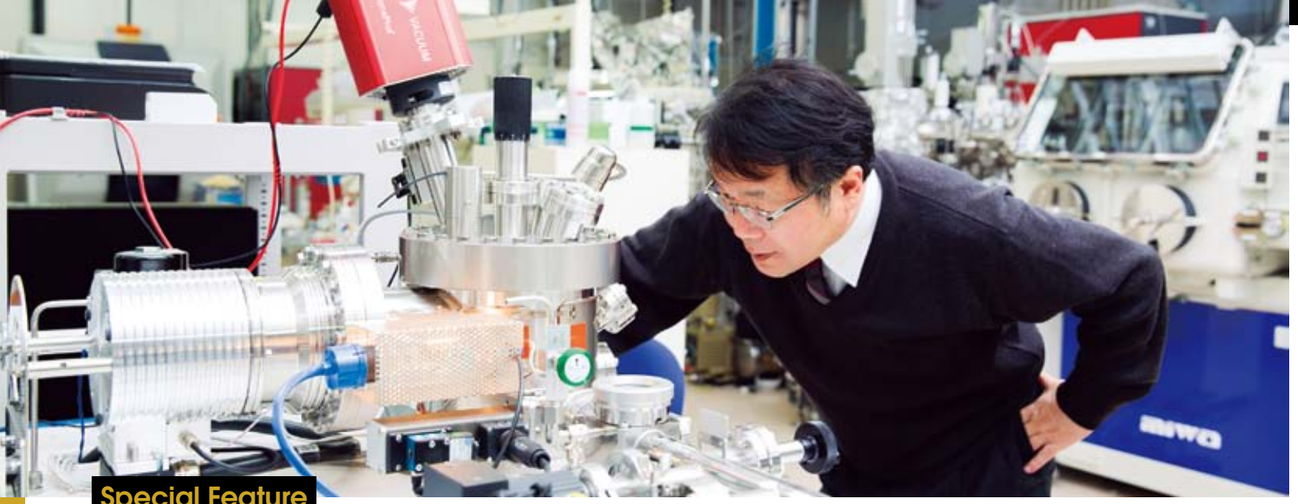
azbil FIELD **Shin-Sapporo ARC City**

azbil MIND **Advanced network instrumentation solutions realize global information sharing, energy conservation, and downtime reduction**

Special Feature

From Japan to the World

A Japanese Technology That Quietly Revolutionized the LCD

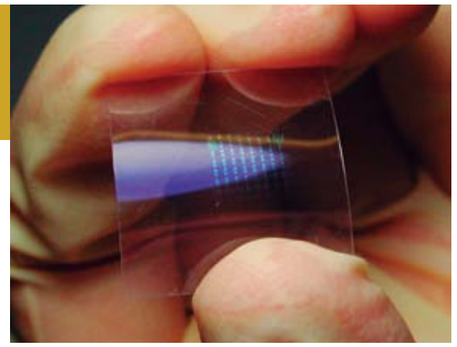


Special Feature

From Japan to the World

A Japanese Technology That Quietly Revolutionized the LCD

Liquid crystal displays (LCDs) are essential devices in TVs, personal computers, smartphones, and tablets used by people the world over. An innovative technology originated in Japan, called "IGZO" (transparent amorphous oxide semiconductors), brought a dramatic evolution to the world of LCDs.



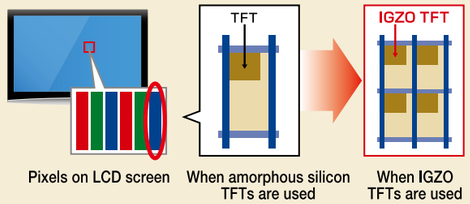
A new technology that achieved significant performance improvements in LCDs

When conventional semiconductors in an LCD are replaced with "IGZO" transparent amorphous oxide semiconductors, the display panel gains dramatic performance improvements in terms of resolution, power efficiency, and sensitivity. IGZO stands for indium gallium zinc oxide, and is a new metal oxide substance. Sharp Corporation, a general manufacturer of electric and electronic products, succeeded in mass production of IGZO panels, and uses them in various LCD products. Today, the term IGZO is widely used to refer to amorphous oxide semiconductors and also to the LCD technologies incorporating them.

LCD devices contain parts called thin-film transistors (TFTs). TFTs are embedded in the pixels in an LCD panel. There are several tens of thousands to several million pixels in an LCD, and TFTs control those pixels, much like switches, to display imagery. In 2004, Professor Hideo Hosono at Tokyo Institute of Technology in Japan created TFTs using IGZO transparent amorphous oxide semiconductors, which surprised semiconductor and LCD engineers around the world.

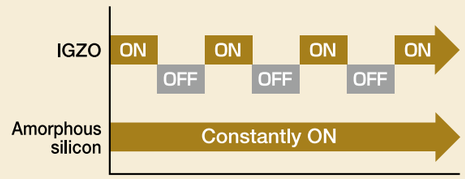
A semiconductor becomes electrically conductive or nonconductive depending on whether an electric field is applied or not.

High-resolution mechanism



IGZO offers a high electron mobility rate of 20 to 50 times faster than that of conventional amorphous silicon semiconductors. This allows for downsizing of thin-film transistor (TFT) size and circuit thinning. As a result, resolution is improved by almost two times.

Power consumption reduction mechanism



Conventional amorphous silicon semiconductors have to overwrite data even for still image displays. IGZO requires virtually no current flow when displaying a still image. This reduces the power consumed by the display device to 1/5 to 1/10.

Advantages of IGZO amorphous oxide semiconductors

LCDs using transparent amorphous oxide semiconductors are superior to LCDs using conventional amorphous silicon semiconductors in many aspects.

1 High resolution — Displays high-density, realistic images.

2 Reduced power consumption — Dramatically reduces power consumption in still image display. Contributes to extended battery life in smartphones and tablets for which demand for longer battery life is growing.

3 High sensitivity — Responds accurately to a narrow-tip touch pen thanks to minimum noise that affects touch panel detector circuits and capable of accurate detection of even the faintest signals generated by touching. As a result, handwriting on the panel is as easy and smooth as writing on paper.

4 Large screen size — Displays true-to-life images on a large screen thanks to reduced deviations among thin-film transistors and minimum display unevenness.

5 Shape flexibility — Heat-sensitive plastics can be used as a substrate because the manufacturing temperature can be lowered to about room temperature. It is possible to produce LCD display panels with a cylindrical curve as well as extremely thin electronic paper.

Professor at Tokyo Institute of Technology

Hideo Hosono

Born in 1953. After obtaining his doctorate degree from the Graduate School, Division of Engineering, Tokyo Metropolitan University, Hideo Hosono became Associate Professor at Nagoya Institute of Technology, at Vanderbilt University in the U.S., then at Tokyo Institute of Technology. In 1999, he became Professor at the Materials & Structures Laboratory, Tokyo Institute of Technology. Presently, he is also Professor at the Frontier Research Center and Director of the Materials Research Center for Element Strategy of Tokyo Institute of Technology.

Semiconductors are essential for control of electric/electronic products. Amorphous silicon is a material commonly used in the manufacture of semiconductors. An amorphous material is an oxide substance with irregular atomic arrangements. Contrarily, a crystal is an oxide substance with regular atomic arrangements. Representative amorphous materials include glass and rubber, which are regarded as being nonconductive. Silicon is an amorphous material but it has a conductive property. This rare and useful material is used in TFTs.

Semiconductors made from supposedly nonconductive glass

Professor Hosono's idea of making semiconductors from glass defied conventional belief. He had long cherished the idea of creating transparent semiconductors, and one particular incident gave insight to the possibility of realizing his idea.

"When I was conducting an experiment, crystal malformation occurred, resulting in an amorphous thin film. A close examination of electron mobility unexpectedly revealed that it had almost the same performance as crystals. The substance was amorphous but it was electrically conductive. This inspired me to use glass to create a semiconductor that is superior to an amorphous silicon semiconductor. I completed a basic model in one day," says Professor Hosono.

In 1993, Professor Hosono began research on transparent amorphous oxide semiconductors, and succeeded. He says he still remembers presenting the research results in the International Conference on Amorphous Semiconductors held in 1995.

"There were some 800 presentations, but I was the only one who gave a presentation on the topic of making a semiconductor from glass. There was no response. Some people even said, 'This is not a place for a glass technician.'"

Even electronic paper is not far from reality

During those years, the use of amorphous silicon semiconductors was beginning to expand in commercial products. So researchers were focused on silicon. Then, LCD panels enlarged in size at accelerated rates, gradually shifting the focus of research from about the year 2000. This generated demand for a semiconductor material alternative to silicon.

Professor Hosono relentlessly pursued his research, and in 2004 he was suddenly in the limelight. The TFT he created with a transparent amorphous oxide semiconductor was clearly a revolutionary invention. Using this technology, curved LCD panels and thin electronic paper just like real paper could be developed thanks to its flexibility. Furthermore, the new technology enabled dramatic improvements in terms of resolution and power efficiency. It could also reduce manufacturing cost.

In the International Conference on Amorphous Semiconductors held in 2005, Professor Hosono delivered the first keynote speech. It took ten years for this great invention to be acknowledged. Samsung Electronics in Korea showed interest ahead of others, and created a prototype LCD, and accelerated its practical application.

"For professional researchers, success means achieving originality. If there is no competitor, victory is granted. If there are competing researchers with ample research funds, taking an ingenious approach can open the door to victory. It is important to discern situations and be determined to win. When I directed my attention to transparent amorphous oxide semiconductors, there was no competitor. There was no one following behind me. There was a sense of isolation. But, success lay ahead of high-quality research activities continuously carried out despite the solitude."

The numerous pixels on an LCD screen are were brought to fruition by the pride of a Japanese professional researcher persistently seeking his research goal while struggling with isolation.

Shin-Sapporo ARC City

Shin-Sapporo ARC City is a commercial complex located in Shin-Sapporo, a sub-center of Sapporo on the island of Hokkaido, Japan. As the equipment in the complex's shopping center began to age, as an ESCO project was planned, involving large-scale renovations, equipment upgrades for some 30 items, and also improvements in operation management. One of the largest ESCO initiatives in Japan, this project successfully achieved 16.2% reduction in energy costs, as compared to the expected rate of 11.5%, thus fulfilling one of its most important objectives.

An ESCO project to improve energy efficiency on equipment replacement after for over 35 years operation

Shin-Sapporo was developed around JR Shin-Sapporo Station in the eastern part of Sapporo City in the early 1970s. In 1974, Sapporo Sub-center Development Public Corporation (hereinafter, SSDPC) was established with investment by the city of Sapporo as a third-sector company (a public-private partnership). Since then, this public corporation has been spearheading the development of the area as well as the administration and management of development projects. In the central district of the area is a commercial complex called Shin-Sapporo ARC City where Sunpiazza shopping center, dUo station building, an aquarium, a performing arts theater, and many other business establishments are located. Some 14 million people visit Shin-Sapporo ARC City annually.

Among the establishments in Shin-Sapporo ARC City, Sunpiazza boasts the largest number of visitors. Since its opening in 1977, the shopping center's infrastructure equipment had been operating for more than 35 years. Therefore, in the summer of 2009, SSDPC began examining the replacement of aged equipment and measures for reducing energy consumption.

"During those years, revenues were declining due to the effects of lingering deflation, and thus cost reduction was the highest priority. With the aim of achieving a large reduction in utility costs, which accounted for a large portion of expenses, we decided to initiate large-scale and drastic upgrades of equipment not only in Sunpiazza but also in the dUo station building," explains Mr. Toshimichi Terashima, Executive Vice President of SSDPC.

"In the planning stage," adds Mr. Hitoshi Shinohara, General Manager of the corporation's Facilities Department, "we decided to conduct a series of operations from equipment design to upgrading, system reconstruction, and operation and management as an ESCO project." *1

A variety of initiatives in pursuit of substantial energy savings

SSDPC made a public announcement to invite energy service companies to submit effective proposals for the ESCO project. These proposals from various companies were examined, and Azbil Corporation's was adopted.

"Azbil's proposal included a variety of improvement initiatives, and aimed to achieve energy conservation in all aspects," says Mr. Terashima. "Azbil also presented remarkably high figures for the energy reduction expected from those initiatives. In addition, Azbil took the Public Corporation's role into consideration, and included initiatives related to business-academia collaboration and an information campaign for promoting regional energy-saving activities. We had a high opinion of the proposal because of its comprehensiveness."

Having decided to adopt Azbil's proposal, SSDPC concluded a shared savings contract for the ESCO project with Azbil. The equipment replacement construction for Sunpiazza was conducted from October 2011 to the end of March 2012, followed by the construction at the dUo building that was completed at the end of March 2013. The large-scale refurbishment construction encompassed 30 items, including an upgrade of the HVAC system by installing an air-cooled heat-pump chiller, replacement of the extra high-voltage transformers in Sunpiazza, installation of a well-water purification system, integration of electric monitor panels, and incorporation of a BEMS*2 into the central monitoring system. For those tasks, a grant-in-aid program of the Ministry of Land, Infrastructure, Transportation and Tourism of Japan was utilized, as suggested by Azbil. Furthermore, Azbil took charge of the operation and management of the new equipment and systems after they began operation.

The well-water purification system supplies water comparable to city tap water in quality to the restaurants and other establishments in the facility. It contributes considerably to the reduction of utility expenses.

The extra high-voltage transformers (two 7,500 kVA units) installed on the side of Sunpiazza integrated the previously separate power receiving systems for Sunpiazza and dUo, supplying power to both Sunpiazza and dUo buildings.

The central monitoring room in Sunpiazza is equipped with the Azbil savic-net™FX building management system and BEMS. It allows bilateral monitoring with the BEMS installed in the central monitoring room for dUo.

Azbil's approach is described by Mr. Takanori Fukuzawa, Facilities Department Assistant Manager at SSDPC: "For the HVAC system, Azbil combined different types of energy sources such as electricity, gas, and hot water from the district heating and cooling systems, and provided a control system that switches heat sources as required to achieve the optimal "best-mix" operation. This enables flexible response to fluctuations in the cost of energy and also to disaster risk. Azbil did not merely install equipment, but also provided appropriate control functions and fine-tuned operations as its unique strengths for maximum efficiency."

"Using the BEMS," adds Mr. Shinohara, "we were able to configure a system that distributes the information on energy used by each business establishment to tenants in real time via the Internet. Furthermore, the 60-inch digital display panels installed in Sunpiazza and dUo show energy consumption in real time to visitors."

Seminars and lectures disseminate information on the successful ESCO project

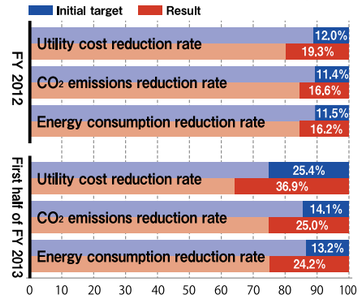
The series of initiatives implemented through the project resulted in a significant reduction in energy use in Shin-Sapporo ARC City. The actual energy reduction rate achieved in its 2012 fiscal year was 16.2% as compared to the expected rate of 11.5%. The utility cost reduction rate was 19.3% as compared to the anticipated rate of 12.0%. Even though both initial reduction targets were set high, the actual results exceeded them to a large degree. The benefit from this reduction is returned to tenants in the form of a decrease in the common service fee.

"'Visualization' of results in comparison to target values has stimulated the managers of tenant business establishments in the facility to view energy consumption and utility costs as important indicators for management," says Mr. Terashima. "At the same time, it helped develop the awareness of energy conservation among employees."

The energy-saving initiatives implemented at Shin-Sapporo ARC City are attracting a great deal of attention from people in various fields because of the scale of the project and the effectiveness achieved. In response to inquiries from companies and organizations, SSDPC is holding seminars and lectures on energy-saving measures and the ESCO project.

"Our corporation is going to continue to develop this Shin-Sapporo sub-center," says Mr. Terashima. "We will also upgrade and rebuild buildings as required. In these efforts, we are looking forward to Azbil's ongoing advice on energy-saving equipment and systems."

Quantitative effects of the ESCO project



Sapporo Sub-center Development Public Corporation

Location
5-7-2, 2-jo, Atsubetsu-chuo, Atsubetsu-ku, Sapporo City, Hokkaido Japan

Date of establishment
May 1, 1974

Business line
Construction, operation, and management of development projects, commercial/business facilities, etc., based on the "Atsubetsu Sub-center Development Basic Plan."

Toshimichi Terashima
Executive Vice President

Hitoshi Shinohara
General Manager, Facilities Department

Takanori Fukuzawa
Assistant Manager, Facilities Department

glossary

1 ▶ *ESCO (energy service company) project
A project in which an energy service company guarantees a certain level of energy savings through the provision of comprehensive services for the reduction of energy consumption in a factory or building. There are two types of contract. In a guaranteed savings contract, the facility owner bears the project cost and the energy service company guarantees the energy savings. In a shared savings contract, energy service company bears the project costs and the customer pays the fee for services for the results of energy-saving measures.

2 ▶ *BEMS (building energy management system)
A system designed to minimize the energy used in an entire energy-consuming facility, such as a building, factory, or district heating and cooling system, by automating and visualizing energy usage based on energy-saving monitoring and control technologies.

azbil MIND vol.15

Advanced network instrumentation solutions realize global information sharing, energy conservation, and downtime reduction

To respond to the manufacturing industry's need to maintain high quality, improve productivity, reduce labor, and conserve energy, Azbil Corporation delivers next-generation solutions based on its Network Instrumentation Modules, which are equipped with advanced control technology and network functions. Our cutting-edge network instrumentation solutions optimize manufacturing equipment operation, process control, and energy consumption. As our customers expand their manufacturing facilities on a global scale, our solutions are helping them to manage production.

Network instrumentation for optimization of manufacturing equipment operation, process control, and energy consumption

Year after year, manufacturers have an increased need to maintain high quality while improving productivity, reducing labor, and saving energy.

To address those concerns, Azbil Corporation provides next-generation solutions based on Network Instrumentation Modules equipped with state-of-the-art control technology and network functions.

Conventionally, controllers have been used to control equipment operations at individual work sites and to measure and collect data of various types. The installation of Network Instrumentation Modules for each piece of production equipment or process not only optimizes the control of each production unit but also enables linking of the control functions of multiple manufacturing equipment units and of the entire process as well as efficient use of energy, thereby maintaining high production quality and achieving energy savings without any adverse effect on productivity.

Visualization of manufacturing status and comprehensive management of production at multiple manufacturing facilities around the world

Network Instrumentation Modules are capable of flexibly interconnecting with diverse types of manufacturing equipment and systems. In addition, instrumentation can be expanded as needed by simply adding more modules. Many of our customers operate production facilities in various countries around the world. By establishing an engineering environment linked with a host system such as a DCS, various control parameters and operation information for each piece of manufacturing equipment and systems can be set and adjusted all at once. As new production bases are launched, various data accumulated at other manufacturing bases can be reused by means of the "visualization" of manufacturing processes, and assistance can be provided from the headquarters in Japan via the network, providing powerful support for the control and management of overseas manufacturing operations in a short time and at a low cost.

Furthermore, if any signs of product quality problems are discovered in the collected data, conditions at the time of manufacture can be analyzed afterwards, and traceability, which is necessary for verification of manufacturing processes, can be assured. Using this data for the analysis of defect-generating tendencies not only allows quick and smooth restoration of production activities, but also reduces production downtime by enabling early discovery of flaws and effective implementation of preventive maintenance.

The network functions provided by the Network Instrumentation Modules can be utilized for global information sharing, fault analysis, and downtime reduction. Other devices can also be connected to the network to improve quality, productivity, and energy conservation.

Through continuing development of the Network Instrumentation Module platform and collaborative work with customers at production sites to implement Network Instrumentation Module applications, Azbil is helping its customers with next-generation production solutions.

Network Instrumentation Modules, which improve productivity by synchronizing the processing of each controller on the network.

Azbil takes up a challenge

Network Instrumentation Modules vs the Extruder

- Achieving highly accurate control under harsh operating conditions -

A 20-year search for the ideal heating and cooling control technology

Three-stripe catheter tube containing contrast agent

Hijiri Manufacturing Ltd. supplies equipment for the manufacture of high-performance, high-quality products such as catheter tubes and other thin-walled tubes for advanced medical applications, optical fiber cables, and ultra-thin micro coaxial cables. Since the company's machines are used to produce expensive products, high-precision production control is required to ensure excellent quality and minimize production waste.

A plastic extrusion molding machine (extruder) melts resin pellets, then extrudes and forms the melted material into a product. Extruders are widely used in the manufacturing industry. For example, they are essential for the production of functional films, optical fibers, medical tubes, and ultra-thin electric wire sheaths.

Heating and cooling control* is one of the most important functions required by extruders. For example, the production of products that demand high processing accuracy, such as ultra-thin cable wires used in high-tech electronic devices, requires highly precise control of temperatures in order to eliminate temperature fluctuation in the extruded resin.

"Extruders' heating and cooling control capability holds the key to maintaining high product quality," says Mr. Ikuo Ito of Hijiri Manufacturing Ltd. "Therefore, the temperature controller provides a critical function. For some 20 years, we had been searching for a temperature controller capable of achieving the level of control precision our company wants, but we could not find one."

Hijiri, a company headquartered in Tokyo, Japan, boasts top-level extruder technology for the manufacture of electrical wires, and in fact was the first company in Japan to manufacture extruders. The company designs and develops extruders in response to requests from manufacturers in a wide range of fields. Mr. Ito is a well-known engineer in the field of extruders, and has been seeking an ideal temperature controller for extruders.

The challenge of meeting Hijiri's requirements was taken up by Azbil's Network Instrumentation Modules. With a track record of many successful implementations to its credit, this product can link multiple pieces of equipment together and provide advanced control. Moreover, it is equipped with original heating and cooling control algorithms developed exclusively for extruders. No surprise, then, that Network Instrumentation Modules took up the challenge of becoming the first product to meet the high-level heating and cooling control requirements that had motivated Mr. Ito's 20-year search.

Previously another leading temperature controller manufacturer had made an attempt to meet Hijiri's requirements. The company attempted to use its product to control the temperature in an extruder operating under the simplified condition of not having any resin supply. Adjustment work took more than a week, but satisfactory control precision could not be achieved, leaving Mr. Ito disappointed.

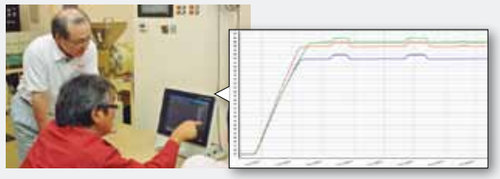
The Azbil product, on the other hand, was able to clear this hurdle in only two days, qualifying it to proceed to the next stage of the challenge, in which the extruder would be operating with a resin supply under conditions similar to those of the actual production process. In an extruder operating on a production line, the resin generates friction heat before it is extruded, greatly complicating the task of temperature control. Before this test, Mr. Ito remarked, "We prepared a resin that is highly prone to generate friction heat, which will make temperature control very difficult." This comment served to marshal the Azbil fighting spirit at the test site.

On the appointed day, our product was put to the test in the trial production room at Hijiri to see if it could meet the goal of "bringing continuously changing resin temperature in the operating extruder to the target temperature in a short time and maintaining and stabilizing the resin temperature."

Start of the Challenge!

1 After Mr. Ito supplied the extruder with resin, the processed plastic started to emerge from the extruder. During this process, the temperature inside the extruder increased due to heat from friction.

2 Mr. Ito observed the experiment closely in order to detect even the slightest temperature change. The graph indicated that the temperature remained within ±0.2 °C of the target, bringing a sigh of relief from the Azbil engineer. When the material was fed in and the operation switch was thrown, the temperature increased momentarily but quickly returned to the target temperature and stabilized there.



The red, blue, and green lines on the graph indicate the temperature at three locations inside the extruder. After the resin was heated to the target temperature and the temperature stabilized, the target temperature setting was increased and then decreased to check if the control function was able to accurately track the changes.

3 At the conclusion of the test, Hijiri awarded Azbil a passing grade and Mr. Ito, with a vigorous handshake, praised Azbil's success.

"We experienced many frustrating years of not being able to control the resin's temperature as we wanted, but today we found the technology and the product that put those years behind us" was Mr. Ito's high evaluation of Azbil's feat.

"However," he continued, "we are not 100% satisfied with today's result. I believe Azbil is capable of advancing its heating and cooling control technology to an even higher level, and we look forward to further improvement of control performance."

Azbil continues to embark on new challenges to meet customers' needs, guided by its philosophy of creating value together with customers at their site.

*A control function for maintaining a material or space at a constant temperature by combining heating and cooling technologies.

Keywords A to Z Vol.1

Keyword FLNG

Acronym for "floating liquefied natural gas." An FLNG facility would float offshore and be used for natural gas liquefaction and regasification.

A shift from land-based natural gas liquefaction plants to ocean-based plants

FLNG stands for "floating liquefied natural gas." An FLNG facility would float offshore and liquefy or regasify natural gas. Another term that is used is LNG-FPSO (floating production, storage and offloading system for LNG).

Conventionally, ocean floor natural gas is supplied through pipelines from fixed natural gas extraction platforms built on the ocean floor to refining and liquefaction facilities on the land for the processing of extracted natural gas into LNG (liquefied natural gas). LNG is then loaded onto LNG carriers for transportation to gas terminals in consuming nations for regasification to produce the final product to be delivered to consumers.

This process, however, is inefficient and time-consuming because it involves the transport of natural gas obtained from the ocean floor up onto land facilities for processing, and then back to the ocean (to LNG carriers) for delivery to customers. Furthermore, it lacks flexibility, since it is necessary to find a suitable site for constructing a refining/liquefaction plant close to the extraction platforms. The FLNG concept aims to streamline the entire production process by consolidating the series of steps beginning with natural gas extraction and continuing to liquefaction, storage on a floating facility, and loading of the finished product onto LNG carriers.

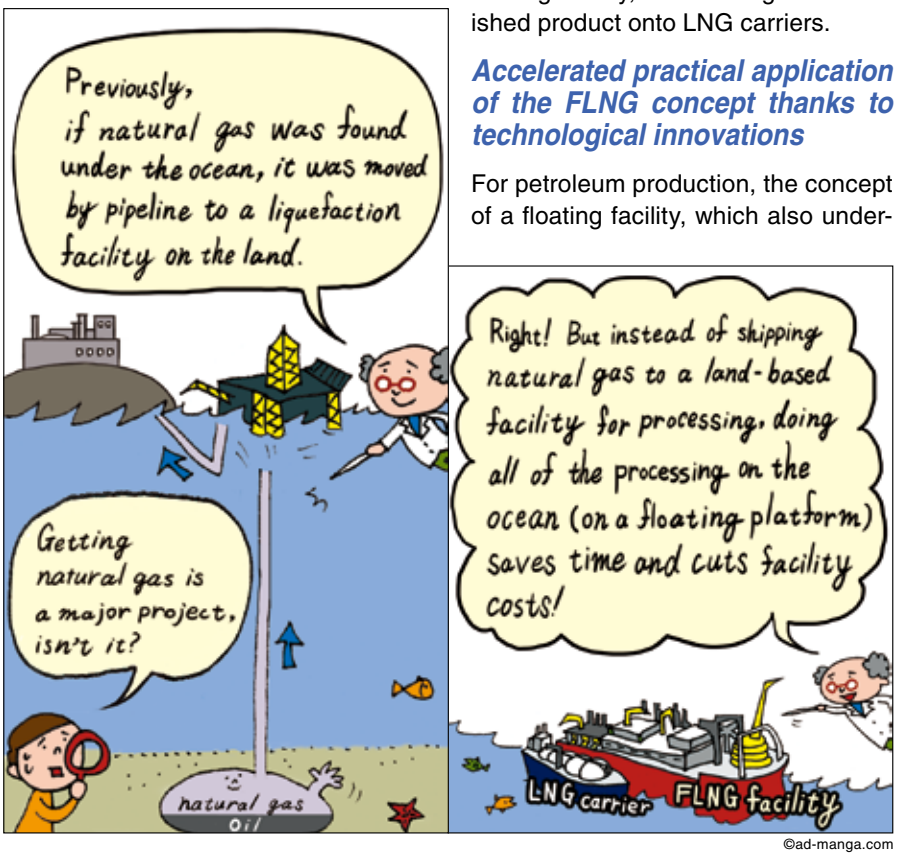
Accelerated practical application of the FLNG concept thanks to technological innovations

For petroleum production, the concept of a floating facility, which also underlies the basic idea of FLNG, was put into practice in the 1990s. In the case of FLNG, however, until several years ago there were a number of technological obstacles in the refining, liquefaction, storage, and delivery processes that prevented practical application.

Recent technological innovations have begun to overcome those obstacles. In fact, Australia has initiated a full-fledged FLNG project with plans to begin production with a processing capacity of 3.6 million tons per year in 2017. Around the world, in countries such as Brazil and Malaysia, other projects are also moving forward.

Prospect of becoming a main energy supply source

Although natural gas holds the prospect of becoming a main energy resource in the future, full-scale land-based extraction of natural gas from underground is possible only in certain areas such as North America and Russia. It is said that most of the natural gas reserves lie under the Middle East, the Atlantic Ocean, and the Pacific Ocean. The FLNG is expected to become one of the main types of energy plant in the future.



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Yamatake Corporation changed its name to Azbil Corporation on April 1, 2012.

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