



## **Ebara Corporation**

EBARA IR Day 2022

July 8, 2022

## Event Summary

<b>[Company Name]</b>	Ebara Corporation	
<b>[Company ID]</b>	6361-QCODE	
<b>[Event Language]</b>	JPN	
<b>[Event Type]</b>	Analyst and Institutional Investor Meeting	
<b>[Event Name]</b>	EBARA IR Day 2022	
<b>[Date]</b>	July 8, 2022	
<b>[Time]</b>	9:30 – 11:26 (Total: 116 minutes, Presentation: 69 minutes, Q&A: 47 minutes)	
<b>[Venue]</b>	Webcast	
<b>[Number of Speakers]</b>	7	
	Shugo Hosoda	Executive Officer, Division Executive, Corporate Strategic Planning, Finance, and Accounting Division
	Takanobu Miyaki	Executive Officer, Responsible for Compressors and Turbines Business, Fluid Machinery and Systems Company; CEO, Elliott Company
	Teruaki Tsukamoto	CP Hydrogen Business Project Manager
	Kazunori Suda	Division Executive, Marketing Division
	Shinya Yoshihama	Marketing Division, Marketing Department Section One Manager
	Akihiro Osaki	Division Executive, Corporate Planning, Corporate Strategic Planning, Finance, and Accounting Division
	Kaoru Tokunaga	Investor Relations and Public Relations Section Manager

---

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support [support@scriptsasia.com](mailto:support@scriptsasia.com)



## Presentation

**Tokunaga:** Thank you very much for your patience. I appreciate you for joining us today at EBARA Corporation IR Day 2022. We will now begin today's session.

First, I would like to introduce our attendees. Mr. Hosoda, Executive Officer, Investor Relations.

**Hosoda:** Hello, I'm Hosoda. Thank you for your time today.

**Tokunaga:** Mr. Osaki, General Manager, Corporate Strategic Planning.

**Osaki:** Hi, I'm Osaki. Thank you for your time today.

**Tokunaga:** My name is Tokunaga, Investor Relations and Public Relations Section Manager. I'm your moderator today. Thank you for your time today.

The presentation materials were distributed in advance via e-mail yesterday. Please have the documents handy during the meeting.

Today's presentation consists of two sessions. Each session is followed by a question-and-answer session. The meeting is scheduled to adjourn at 11:30 AM. For a complete schedule of the presentation, please check the e-mail we sent to you today. Please note that the contents of today's meeting can be viewed on-demand on the Zoom platform. Details will be e-mailed to you after the meeting.

I would like to begin the first session with a few words from Mr. Hosoda, Executive Officer, Investor Relations.

---

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support [support@scriptasia.com](mailto:support@scriptasia.com)



## EBARA's Energy Business and Initiatives toward Decarbonized Society



**Shugo Hosoda**

Executive Officer,  
Division Executive, Corporate Strategic Planning,  
Finance and Accounting Division



**Takanobu Miyaki**

Executive Officer,  
Responsible for Compressors and Turbines Business,  
Fluid Machinery & Systems Company,  
CEO, Elliott Company



**Teruaki Tsukamoto**

Project Manager of CP Hydrogen business project

[Schedule]

9:30	Opening
9:45	Session 1: Initiatives for Decarbonization in the Compressor & Turbine Business Q&A
10:30	Break (10 minutes)
10:40	Session 2: EBARA Group-wide Co-Creation Initiatives for Hydrogen Supply Chain Q&A
11:30	Closing

**Hosoda:** Good morning, everyone. I'm Hosoda, Executive Officer in charge of IR. Thank you very much for taking the time out of your busy schedule to attend our IR Day. We would like to thank you again for your continued interest in the business activities of the Ebara Group.

On the same day exactly one year ago, on July 8 last year, we held our first IR Day. At that time, I made a report and presentation on three topics: precision and electronics business, DX and digital transformation strategy, and chemical recycling.

A year after the event, today's EBARA IR Day 2022 marks the second session. This time, the event theme is "Ebara's Approach to Energy Business and Decarbonized Society."

I would like to review the current status of the Ebara Group's business in the energy market and our long-term vision for the time ahead, which I believe is not so distant in the future.

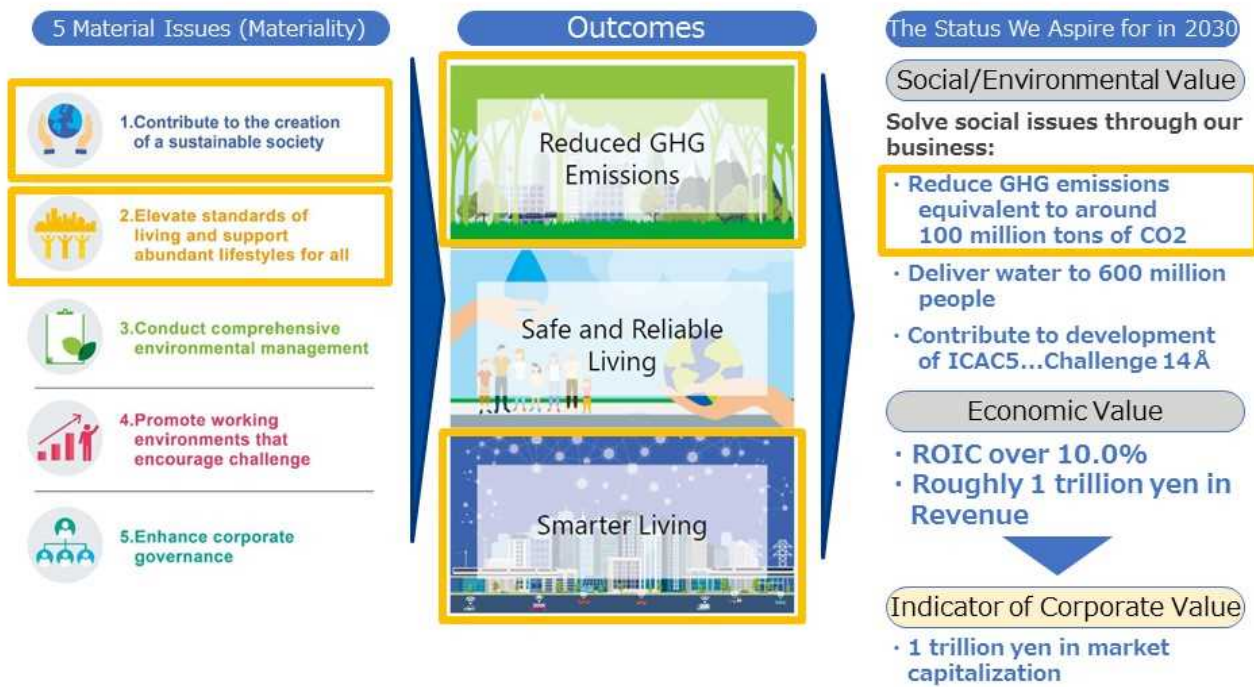
The meeting is in two parts: session one and session two.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com

# Long-term Vision: E-Vision 2030 — The Status We Aspire for in 2030



First, here is a premise for the discussion.

In 2020, we have announced our long-term vision, titled E-Vision 2030.

For our group to solve social issues through our business, we have established five materialities and three outcomes, as well as a vision of what we aspire to be by 2030.

Our efforts, which I will review later today, are represented in these materialities. Number one, contribution to the creation of a sustainable society; and number two, contribution to the creation of evolving and prosperous life. I believe that the outcome of the project will be related to the reduction of greenhouse gas emissions and the evolution of our way of life.

In the future, we will reduce greenhouse gas emissions equivalent to approximately 100 million tons of CO<sub>2</sub> and enhance our corporate value in terms of both social and environmental value and economic value.

## Support

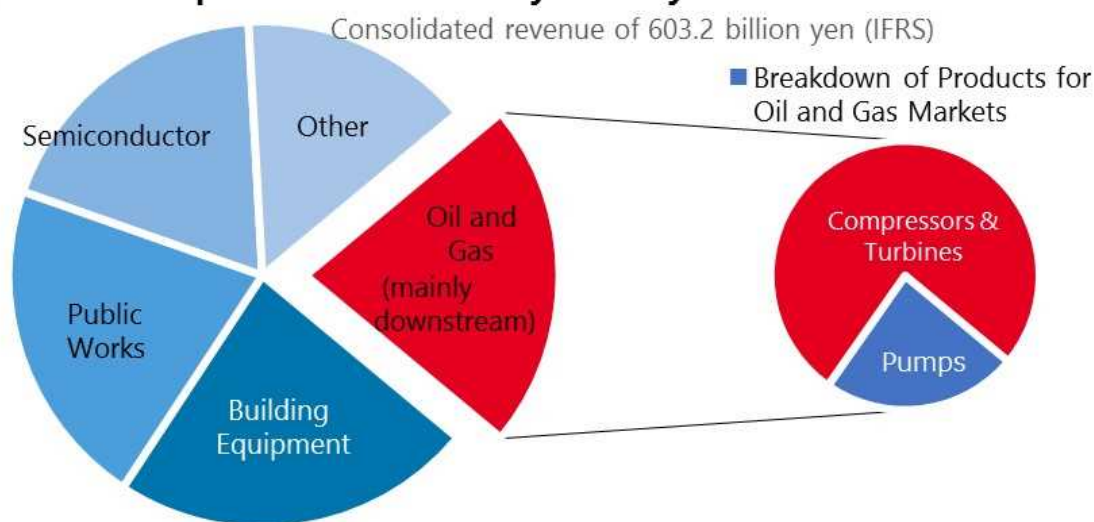
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com

## Composition of Revenue by Industry

- Revenue generated in the oil and gas markets accounts for about 20% of overall revenue on a consolidated basis.
- The popularization of new energies toward decarbonization and changes to the oil and gas markets can provide EBARA with new growth opportunities through the special fluids (gas/liquid) high-pressure send-out technology and expertise, in which EBARA excels.

### ■ FY2021: Composition of Revenue by Industry



This is the composition of the Group's consolidated sales by the market in the last fiscal year.

As shown in the pie chart on the left, our sales in the oil and gas market, mainly in the downstream areas such as petrochemicals, oil production, and LNG, account for about 20% of the total consolidated sales.

Further breakdown is shown in the pie chart on the right. The product group consists of compressors, turbines, and pumps. Of the oil and gas market, the compressors and turbines account for approximately 70% to 80% of the total.

In these markets, our clients handle a wide range of special fluids in their production process: ethylene, LNG, ammonia, and sometimes urea. They may be gaseous, liquid, or sometimes a mixture of gaseous and liquid fluids.

These special fluids can be sometimes used in cryogenic regions. Our products play the role of creating flow in the plant by pressurizing and transporting special fluids in harsh environments. To use the human body as an example, our products are like the human heart that creates blood flow. Our strength and technical area of expertise are in pumping special fluids in customized ways to meet various client needs.

We are convinced that the technological areas and know-how in which we excel will meet the various needs of a changing society and market, as well as the spread of new energy sources, such as hydrogen, for the decarbonization of society. I would like to review these new business opportunities today.

#### Support

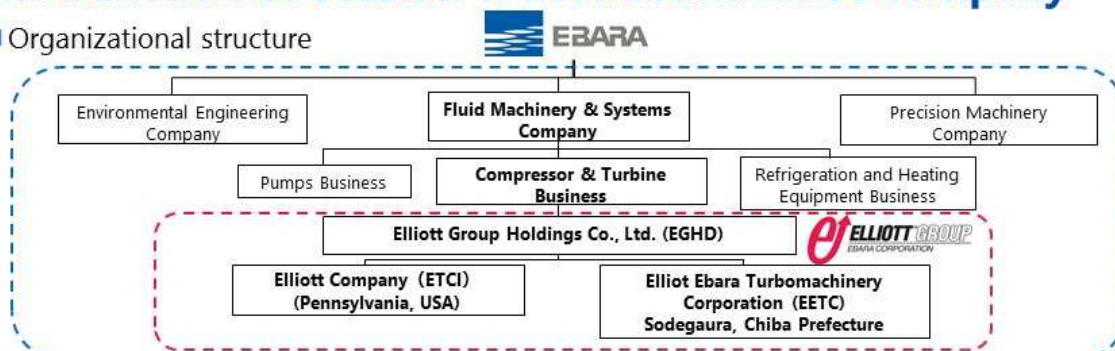
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com

# Introduction of Session 1: EBARA and Elliott Company



## Organizational structure



## History

**1912:** Founded. Inokuty Type Machinery Office was established.

**1920:** Establishment of Ebara Corporation  
**1968:** Entry into technical cooperation with Elliott Company for compressors and steam turbines

**2002:** Establishment of Elliot Ebara Turbomachinery Corporation (EETC)



**1910:** Founded by W.S. Elliott. Elliott Company was established in Pittsburgh, USA.  
**1957-1987:** Placed under the ownership of Carrier Corporation. Became a global leader in compression technology for LNG and ethylene plants thanks to the refrigeration technology of Carrier Corporation

**2000:** Acquisition of Elliott Company of the USA as a wholly-owned company

**2011:** Establishment of Elliott Group Holdings Co., Ltd. (EGHD). Integration of management of business in the USA and Japan. Integration of management of Compressor & Turbine Business run in the two countries

**2018:** Transfer of the cryopump business to the Elliott Group.

First, session one. I will review the current status of our compressor and turbine business, which accounts for 70% to 80% of our current business for the oil and gas market, and our efforts to decarbonize the industry in the future.

Our compressor and turbine business is operated by our wholly-owned subsidiary, Elliott Company, under the Elliott brand, not the Ebara brand. Our company, Ebara Corporation, was founded in 1912, and this year marks its 111th anniversary. Elliott Company was founded in 1910, two years earlier than Ebara, and is one of the companies with a history of 100 years, two years longer than our company.

Elliott Company, a United States century-old enterprise, became a part of our group through M&A in 2000, which leads to the present state. It started as a cross-border M&A, which was not very common at that time, and also started as a form of collaboration in which a Japanese company acquired a US company. After the period it took to integrate, it has become an indispensable part of our group's oil and gas business.

Compressors are critical equipment and the heart of plant operations for our clients. The industry practice of placing a high priority on performance has resulted in almost all inquiries converging in just several companies around the world. Elliott is one of them. It means that no matter where on the planet a plant is built, Elliott can turn it into its business field, and in this sense, it is a business that operates in a truly global market.

While most Japanese companies struggle with global expansion for a variety of cultural and linguistic reasons, Elliott has quickly established a network of offices around the world and has established a global business foundation. While making the most of Elliott's global business platform, we have also been developing our business in this market, including not only Elliott's products, but also our original product line. As we do

## Support

Japan	050.5212.7790	North America	1.800.674.8375
Tollfree	0120.966.744	Email Support	support@scriptsasias.com



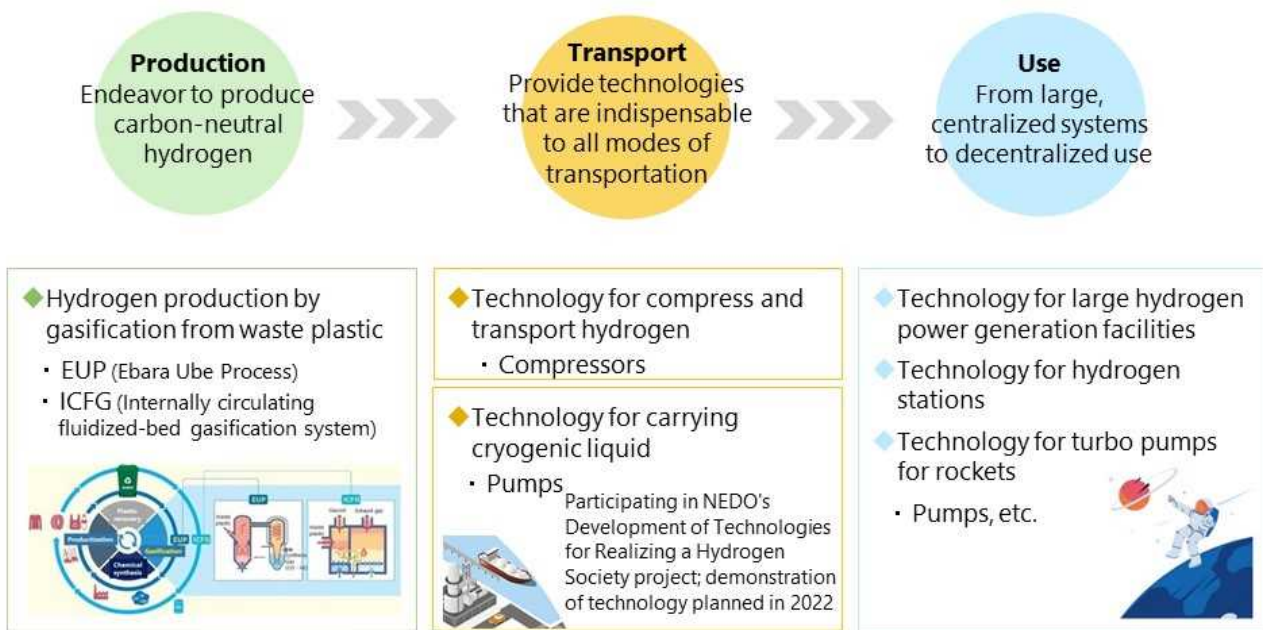
business in the oil and gas market, I would like to review the situation where Elliott's global business infrastructure is under the umbrella of our group, which is a strength for us as a group.

In the first session, Mr. Miyaki, the global manager of this business, will make a presentation on the Group's business development in the oil and gas market, based on Elliott's global platform.

## Introduction of Session 2: Hydrogen Business Project



- A project under the direct control of the President was launched in August.



In session two, as I mentioned earlier, I would like to touch on mid- to long-term initiatives for the not-so-distant future. I will present our efforts to build a hydrogen supply chain through a cooperative effort among the Ebara Group.

As I mentioned earlier, I'm convinced that the elemental technologies we possess, such as our specialty in the area of special fluid pumping technology, have much room to contribute to the coming hydrogen society. To realize this contribution as soon as possible, we have launched and are developing a Company-wide corporate project.

Today, Mr. Tsukamoto, the project manager responsible for this project, would like to review the areas of contribution that can be made by our company, which possesses many related elemental technologies and has a certain track record and presence in the existing energy business market.

Now, without further ado, I would like to move on to the session in the hope that this event will help you deepen your understanding of our efforts in this market.

That's all from me. Thank you.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com





**Tokunaga:** We will now begin session one. Mr. Miyaki, CEO of Elliott Company and General Manager of Compressors and Turbines Business Division, Fluid Machinery and Systems Company, will give a brief presentation.

## EBARA IR Day 2022

<Session 1 >

# Initiatives for Decarbonization in the Compressor & Turbine Business

July 8, 2022

Takanobu Miyaki  
Executive Officer,  
Responsible for Compressors and Turbines Business, Fluid Machinery & Systems  
Company  
CEO, Elliott Company



*The world turns to Elliott*

1

**Miyaki:** Good morning, everyone. I'm Miyaki, Executive Officer in Charge of the Compressors and Turbines Business.

First, I would like to briefly introduce myself. I joined Ebara in 1996, and for the first 17 years, until 2013, I was in charge of the design, planning, and management of waste treatment facilities at the current Environmental Engineering Company.

After a year in the Corporate Planning Office, I transferred to Elliott Group in 2014 and have been in Pennsylvania, USA, where Elliott Group's headquarters functions are located, to this day. I'm actually participating in today's event in the United States. Including my time in the environmental business, I have worked overseas for about 13 years, which is exactly half of my 26 years with the Company. Thank you.

As the title suggests, I would like to begin by reviewing the current status and strengths of our business, and in the second half of the presentation, I would like to discuss how we are tackling the trend toward decarbonization. Thank you for your time today.

### Support

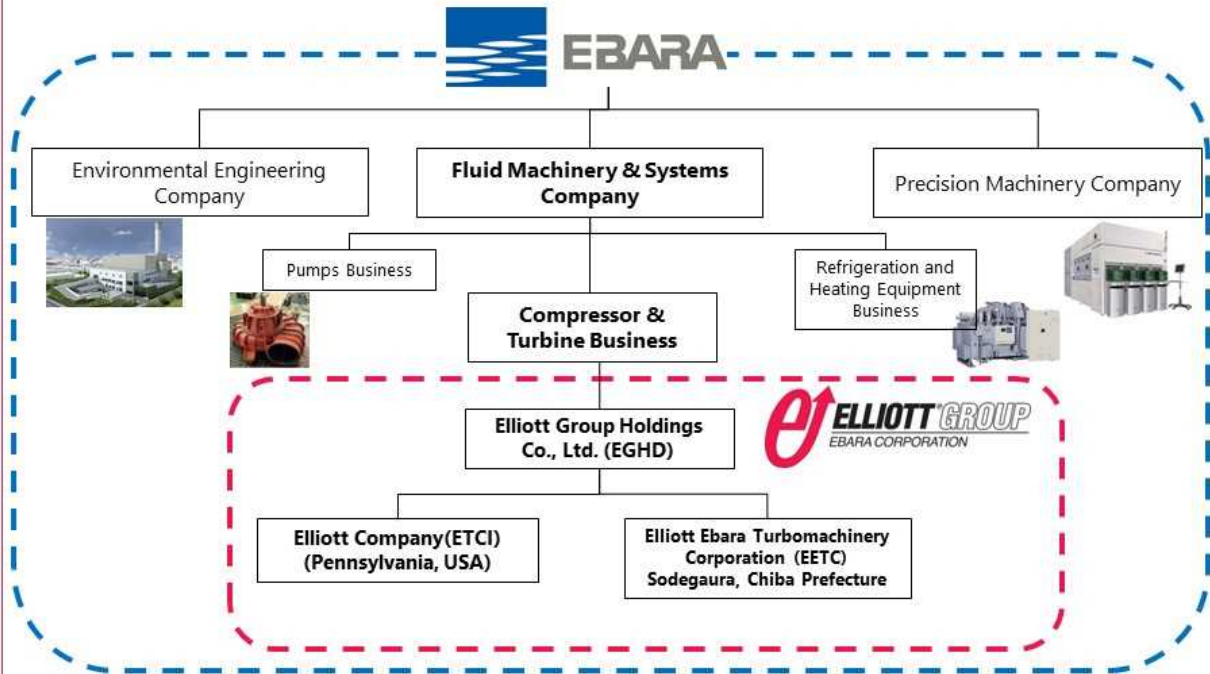
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com



## Organizational Structure of the Elliott Group

- Elliott Group is the organization responsible for the compressor, turbine, and cryogenic pumps businesses within EBARA Group.



*The world turns to Elliott*

2

Mr. Hosoda has already covered this page earlier, so please skip to the next page.

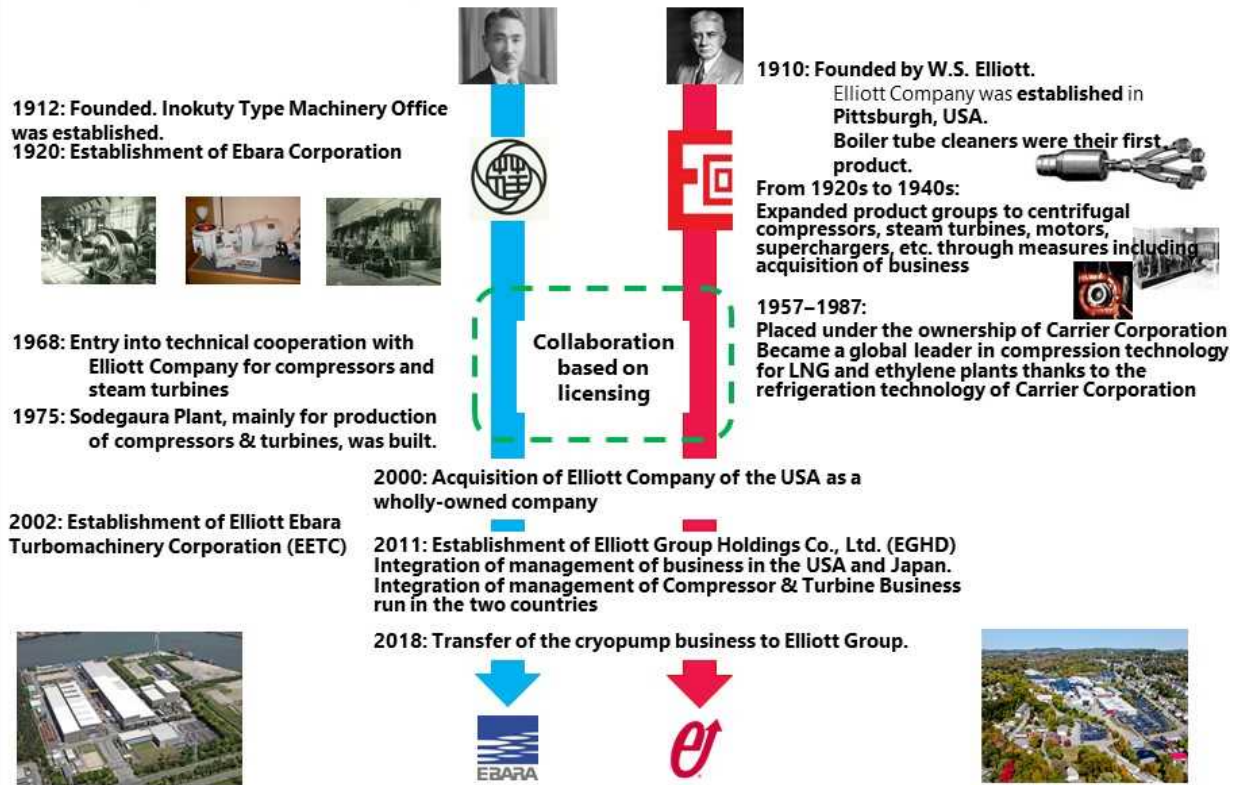
### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptasia.com



## History of EBARA's Compressor & Turbine Business and Elliott Company



*The world turns to Elliott*

I would like to add that Elliott and Ebara's relationship dates back to 1968, when Ebara was licensed by Elliott to manufacture compressors and steam turbines. 54 years have already passed since then.

The cryopump business listed at the bottom was originally part of Ebara, but due to common clients and markets, the cryopump business was transferred to the Elliott Group in 2018 and is now part of the Elliott Group.

### Support

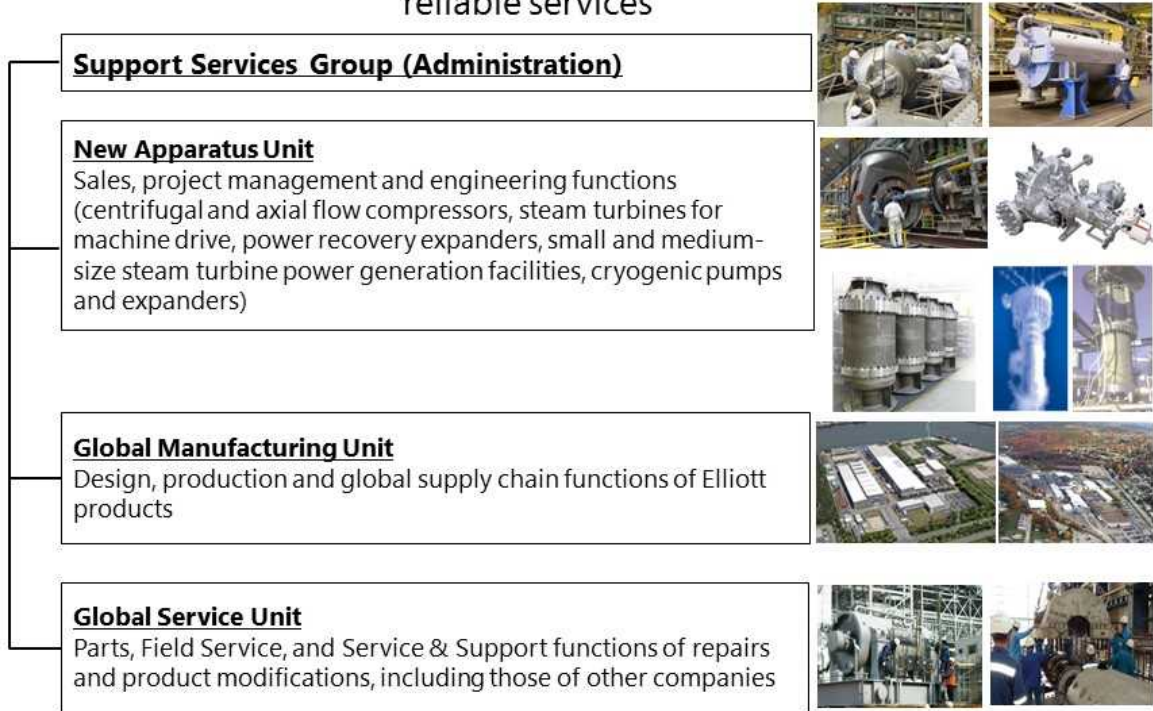
Japan 050.5212.7790  
 Tollfree 0120.966.744

North America 1.800.674.8375  
 Email Support support@scriptsasias.com



# Organization and Functions of Elliott Group

Elliott provides advanced technologies, high-quality products, and reliable services



*The world turns to Elliott*

Here, I would like to review the organization of the Elliott Group.

As shown in the previous diagram, there are many companies belonging to the Elliott Group, but as shown in the diagram, regardless of the company, we are conducting globally integrated business operations, which I believe is a distinctive feature.

In the past, we have operated under a product-specific business unit structure, particularly concerning large compressors, steam turbines, small steam turbines, and cryopumps. Starting this year, the business units have been restructured.

At the top is the corporate, but as you can see in the second, the new apparatus unit integrates new products, the products I mentioned earlier, and in the middle is the global manufacturing unit, which integrates design, production, procurement, and these kinds of things. The one listed at the bottom remains the same as before. It is a global service unit specializing in service and support.

The main purpose of this restructuring is to provide optimal service to our clients' needs, which are changing rapidly, and we are restructuring these business units as you can see now.

**Support**

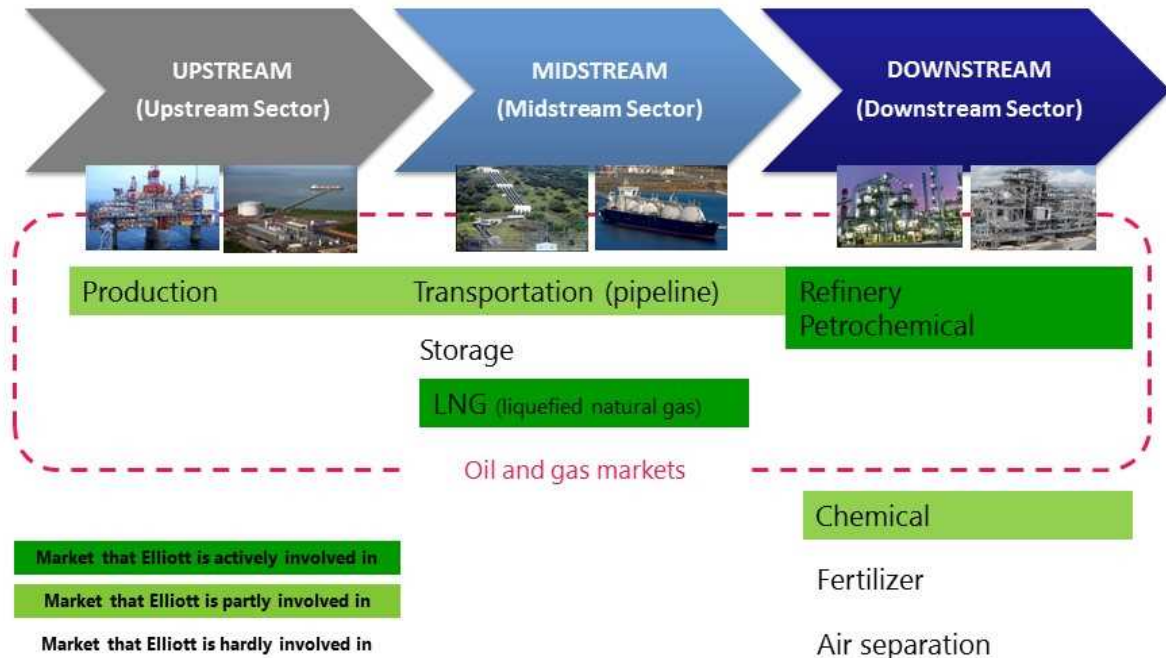
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



## Elliott's Main Markets

- Elliott provides products and services to a wide range of industries.



5

This slide presents the face-to-face market for Elliott businesses.

As shown here, the darker colors are markets in which we are particularly active participants. The lighter colors are markets in which we are partial participants. Most are oil and gas markets.

Among these markets, we are focusing on LNG, as shown in dark color, petroleum refining, and petrochemicals as the third market in which we are particularly strong.

In the slides that follow, I would like to review petrochemicals and LNG in particular.

### Support

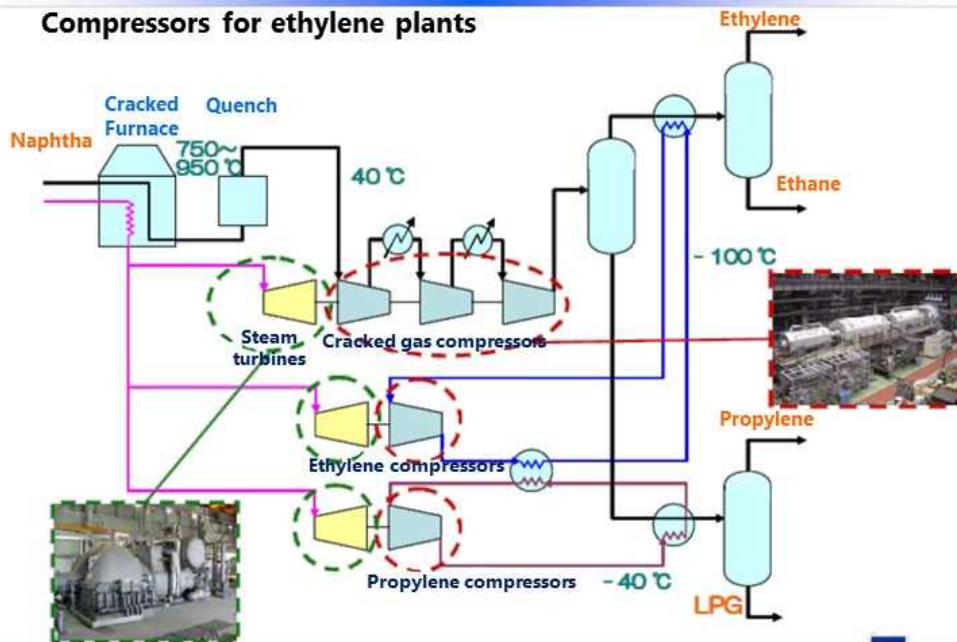
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



## Products for Petrochemical Ethylene Plants (Centrifugal Compressors)

- Elliott has provided high-quality and highly reliable compressor products for more than 60 years



*The world turns to Elliott*

6

First, petrochemicals.

As you can see here, we have acquired approximately 50% of the market share for compressors for ethylene and the steam turbines that drive them.

These compressors, steam turbines, and other equipment are the very heart of the plant and require high quality and reliability not only in terms of new products and products themselves, but also in terms of after-sales service. As I mentioned earlier, we believe that the high market share we have gained is a result of the high quality and reliability of our products, which are highly evaluated by our clients.

### Support

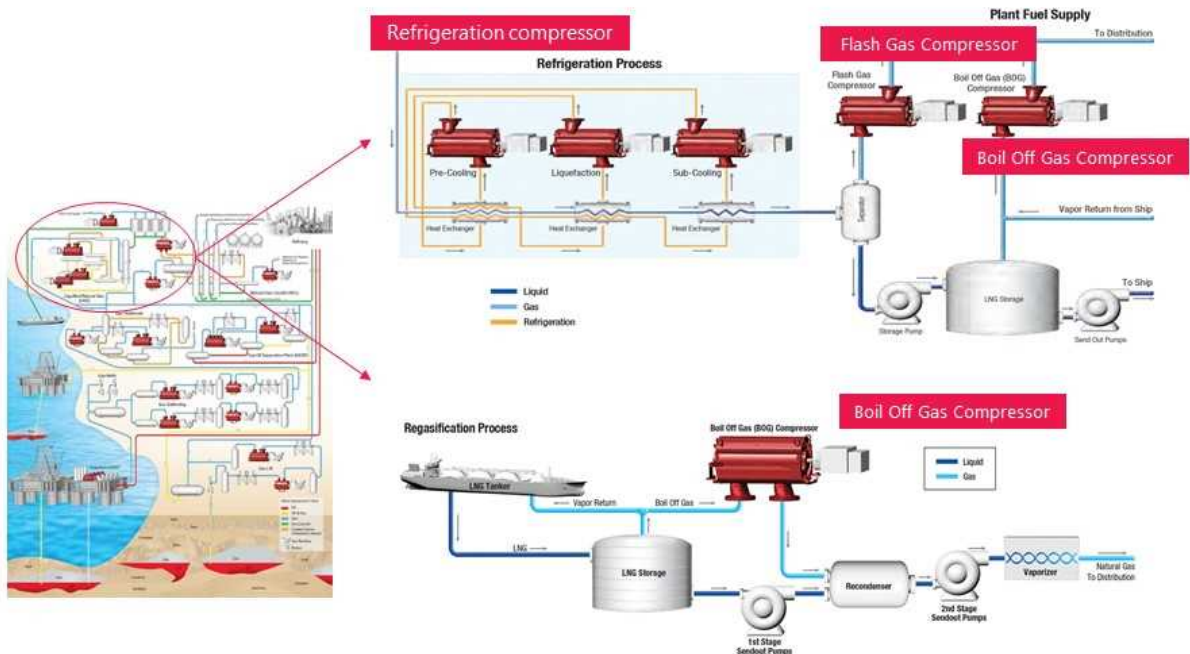
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptasia.com

**SCRIPTS**  
Asia's Meetings, Globally

## Products for LNG (Centrifugal Compressors)

- Elliott has provided high-quality and highly reliable compressor products for more than 50 years



*The world turns to Elliott*

7

Next, for LNG. First, compressors.

The leftmost image shows the whole picture. The middle one is the so-called liquefaction terminal where LNG is produced, and here, it is used for what are called compressors for refrigerant compression, which are used in the refrigeration process to cool methane gas.

To the right and below, our compressors are used for the final liquefaction process and for end-flash gas and boil-off gas, which are used to utilize these gases as process gases and fuels since they partially vaporize in the tanks.

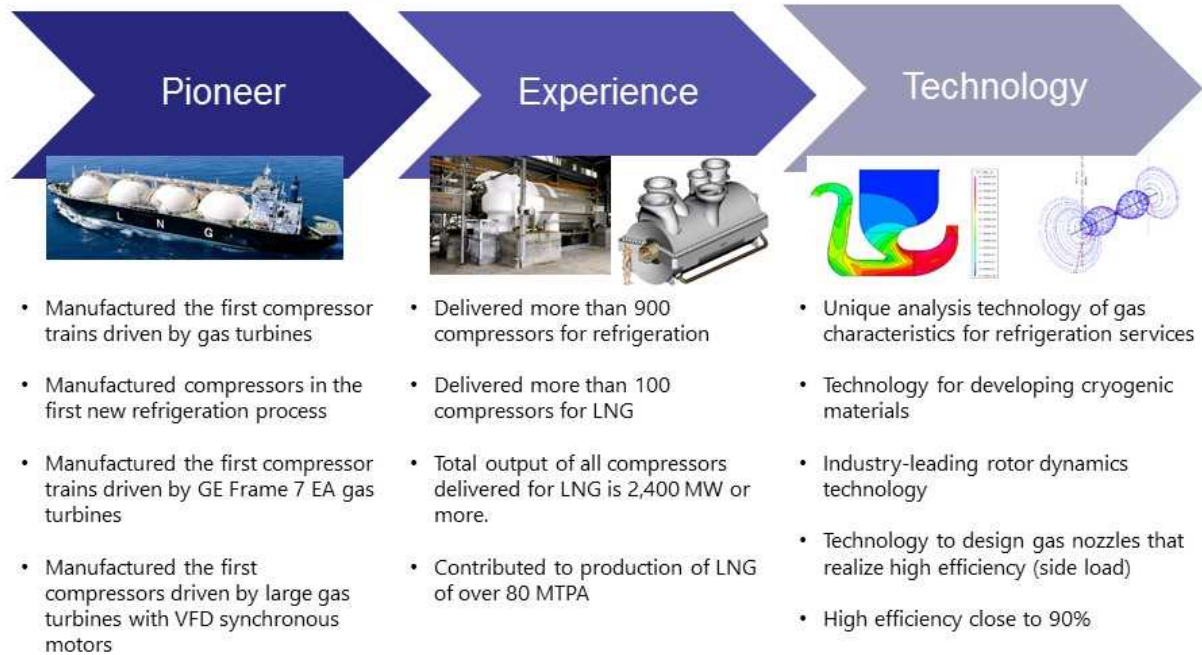
### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com

**SCRIPTS**  
Asia's Meetings, Globally

## Compressors in the LNG Market



*The world turns to Elliott*

8

Here, in this slide, LNG compressor. Well, it's not just about LNG, but I would like to focus on LNG compressor and highlight how Elliott is excellent in the business.

To begin with, as shown on the far left, one point is that it is a pioneer in many aspects. At the same time, Elliott is not only a pioneer, but continues to be chosen by the clients while accumulating achievements.

We believe that the accumulation of such track records not only validates, but also ultimately bolsters our technical capabilities. One of our technological strengths is in, for example, the refrigeration systems or ultra-low temperature applications typically required for LNG. We can handle gas properties analysis as well as the development of materials for ultra-low temperature applications.

In addition, in the case of compressors, since they rotate large objects at very high speeds, we have to pay particularly close technical attention to vibration. We are proud to be the industry leader in rotor dynamics, which we call rotor dynamics technology. We can design and manufacture products that achieve industry-leading efficiency.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

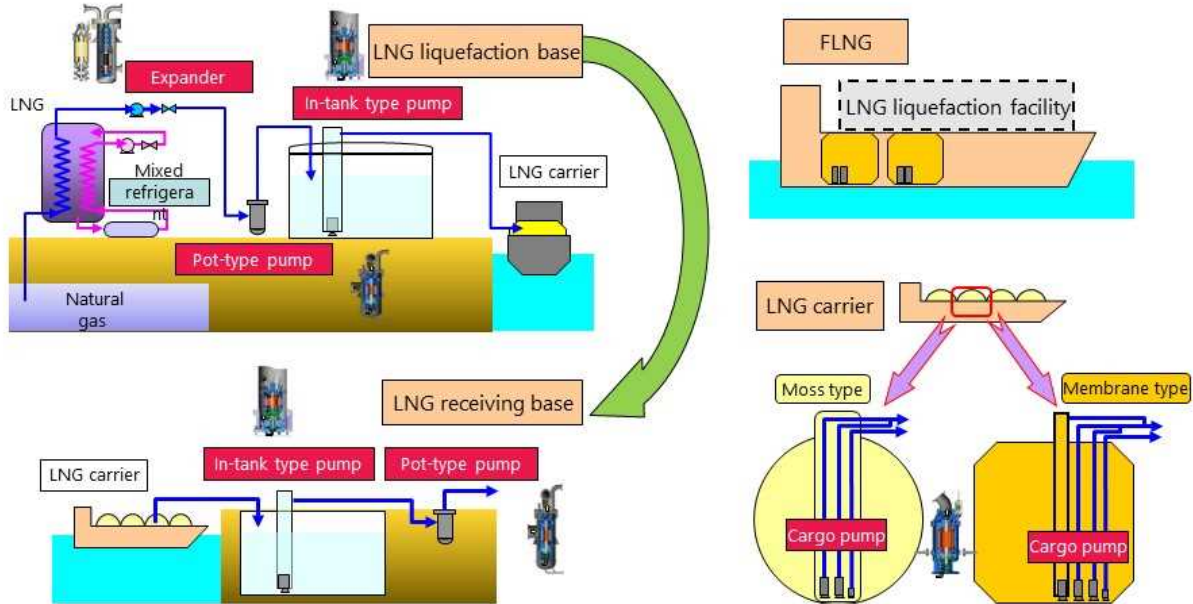
North America 1.800.674.8375  
Email Support support@scriptsasias.com





## Products for LNG (Cryogenic Pumps and Expanders)

- Elliott has provided high-quality and highly reliable cryogenic products for more than 40 years



 *The world turns to Elliott*

9

Next are ultra-low and cryogenic, or cryopumps, for LNG.

First, the liquefaction terminal on the left, then the LNG carrier that transports the LNG from the liquefaction terminal to the receiving terminal on the right, and finally the receiving terminal beyond that, our cryogenic pumps are used throughout the manufacturing and transport processes.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com

 **SCRIPTS**  
Asia's Meetings, Globally



## Elliott Group's Global Network

- Global sales, service, and support network that accommodates the needs and expectations of customers



*The world turns to Elliott*

11

I have focused on our products up to this point, but another of our major strengths is our global network and services, and I will give more details later.

Japan and the US are manufacturing bases for new products: Sodegaura in Chiba, Japan, and Jeannette, Pennsylvania, where I'm located in the US.

In addition to these two major bases, Bangalore, India, will be the manufacturing site for new products.

In addition, we have 17 service centers around the world, mainly located close to where our clients use our products.

These are the main features of our system that allow us to respond quickly to all of our clients' needs, from new products to services.

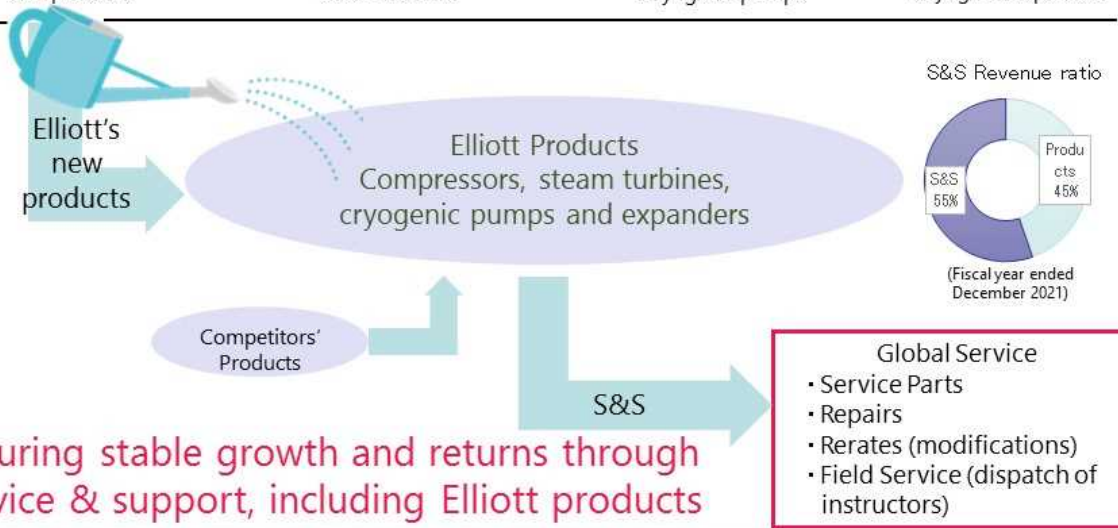
### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptasia.com



# Service & Support throughout the Product Lifecycle



Securing stable growth and returns through service & support, including Elliott products



This is an example of our business model.

We are in a position to support the life cycle of products delivered to our clients.

As you can see in the box highlighted in red at the bottom right, we offer a comprehensive service menu that includes not only parts sales, but also repairs at our service centers, performance improvement, modification to the latest instrumentation, and field service, or as we call it, instructor dispatch.

In other words, we are very close to our clients. On the other hand, in terms of supporting the life cycle, we have to be very close to our clients.

On the other hand, from a business perspective, as shown in the schematic diagram, this is a stock business model, so to speak, where we create added value from the products we have delivered, including not only our own products, but also those of other companies.

As a result, as shown in the pie chart to the right, service and support is where about half or more of the overall sales revenue comes from. This will enable us and our business to secure stable growth and earnings. We believe that this will enable us to provide even greater support to our clients.

## Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



# Delivery Record of Elliott Products



*The world turns to Elliott*

13

As you can see, our compressors, steam turbines, cryopumps, and expanders have been well received by our clients, and we have been able to accumulate a large delivery record worldwide, thanks to the strengths of our products, services, and network, as explained above.

We are proud of our clients and are proud of the many deliveries we have made worldwide. We believe that this track record of delivery will further bolster our strengths. These are the expertise of our company and our business.

In summary, rotor dynamics centered on vibration. In addition, refrigeration and ultra-low temperature technology, materials, and technical aspects.

Third, I reviewed our global network, our service and support capabilities, and our proximity to our clients, as well as our strengths and characteristics in the areas of proximity.

## Support

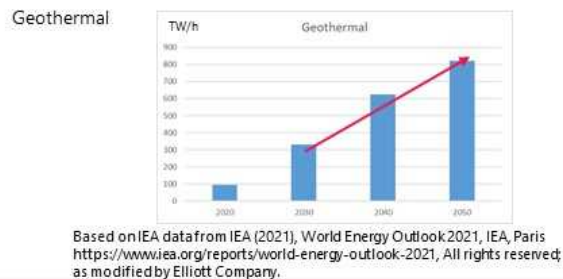
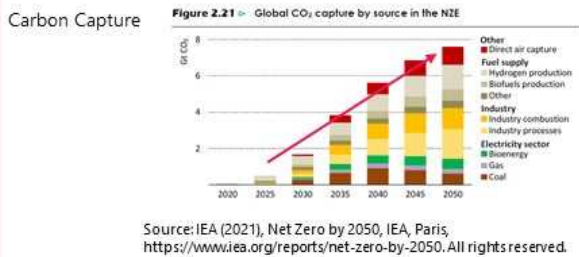
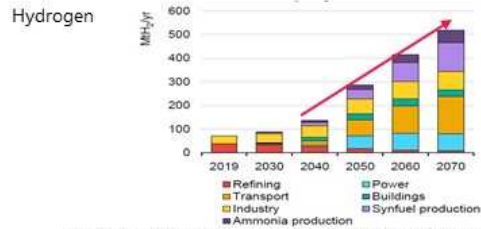
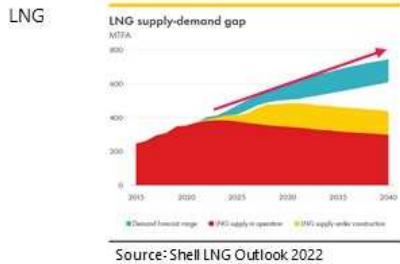
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



# Megatrends in the Market

- The gap between LNG supply and demand is expected to continue until 2040
- Carbon capture volume is forecast to rise sharply after 2030.
- Demand for hydrogen is projected to surge after 2040.
- Geothermal power generation is expected to further increase after 2030.



In the latter half of the presentation, I would like to review what will happen in the future and how our business and our company will be affected by this change.

First is the megatrend.

There are many different forecasts and scenarios, but the common view is that under the keyword "decarbonization," the main energy source will shift from the current oil and gas to renewable and new energy sources. An energy shift will take place. In other words, our world expects the new energy market will rapidly expand in the future.

In particular, as shown in the figure here, one trend is natural gas, which is relatively CO<sub>2</sub> clean among fossil fuels, LNG, and carbon dioxide storage, CCS, which is essential for net-zero CO<sub>2</sub>, hydrogen, and geothermal. Although the time frame for each may vary, all of these areas will continue to expand in the future, based on these megatrends.

## Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



## Decarbonization Initiatives of Major Oil Companies (Examples)

- Elliott customers too are making efforts for energy conversion.

Company name	Major Initiatives for Decarbonization (CCS, hydrogen, etc.)
Shell	<ul style="list-style-type: none"> <li>- Aim to achieve net zero of Scope 1 to 3 of carbon emissions by 2050</li> <li>- Increase the volume of CCS to a minimum of 25 million tons annually by 2035.</li> <li>- Increase production of biofuels, hydrogen, etc. by eightfold or more by 2030 (compared with the level of 2021)</li> </ul>
Exxon Mobil	<ul style="list-style-type: none"> <li>- Aim to achieve net zero of Scope 1 to 2 of carbon emissions by 2050</li> <li>- Make a low-carbon investment of 15 billion dollars (including CCS, hydrogen, and biofuels) by 2027</li> <li>- Plan a hydrogen production plant and a large-scale CCS project at a petrochemical complex in Baytown, Texas, USA</li> </ul>
Chevron	<ul style="list-style-type: none"> <li>- Aim to achieve net zero of Scope 1 to 2 of carbon emissions in the upstream sector by 2050</li> <li>- Make a low-carbon investment of 10 billion dollars or more by 2028. The investments include: 1) increasing hydrogen production to 150,000 tons/year for large customers such as industry and electric power, and 2) raising the volumes of carbon dioxide recovery and offset to 25 million tons a year in cooperation with other companies.</li> </ul>
BP	<ul style="list-style-type: none"> <li>- Aim to achieve net zero of Scope 1 to 2 of carbon emissions by 2050</li> <li>- Plan one of the UK's largest blue hydrogen production projects with a maximum output of 1 GW by 2030.</li> </ul>
Total Energies	<ul style="list-style-type: none"> <li>- Aim to achieve net zero of Scope 1 to 3 of carbon emissions by 2050</li> <li>- Increase the total generation capacity of renewable energy to 100 GW by 2030.</li> </ul>

Sources: Compiled by referring to other companies' websites



*The world turns to Elliott*

On the other hand, I would like to talk about what our clients are doing.

Here is a list of our clients' initiatives as publicized on their websites.

As you can see, each company is an important client of ours, and we can see from their public announcements that they have positioned initiatives to reduce carbon dioxide emissions and to switch to new energy sources as important issues. These are the movements of our clients.

### Support

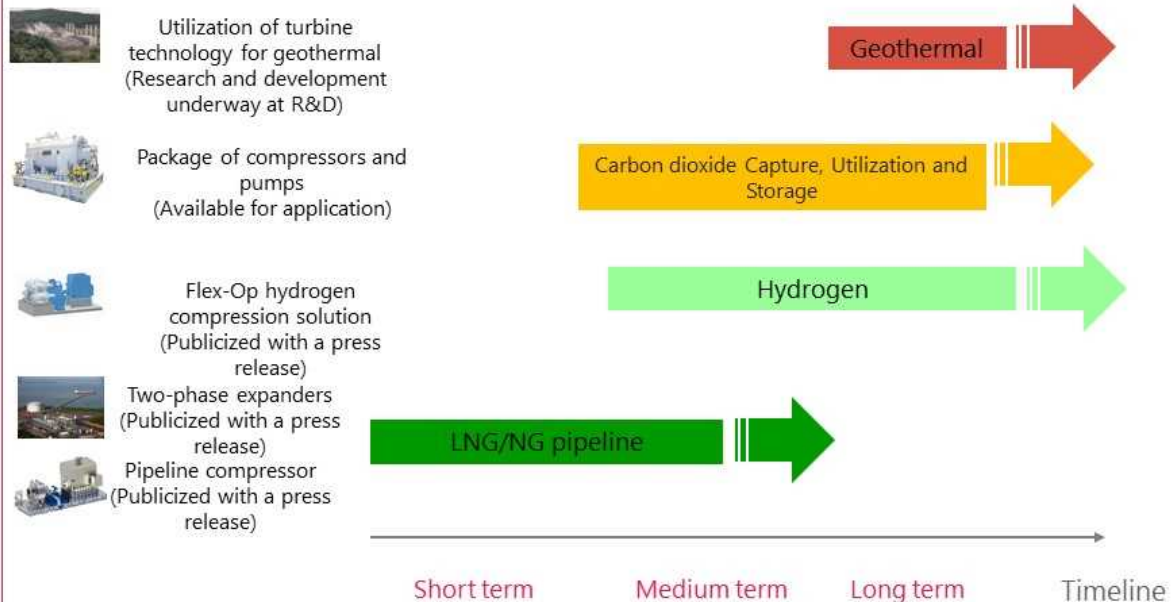
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



## Initiatives for Sustainable Growth

- Maintain and expand business in existing markets and enter new markets by leveraging Elliott's advanced technology and experience.



16

Given these megatrends, and in response to what our clients are doing, what are we going to do about it?

First, from the perspective of increasing demand for relatively CO<sub>2</sub>-free natural gas and LNG in the short to medium term, in addition to the conventional product lines of compressors and cryopumps for LNG that I have just described, we have also recently launched an electric motor-driven pipeline compressor.

Earlier, I reviewed cryopump expanders. We have also launched a two-phase expander, which can recover more power and has a high energy-saving capability. With this lineup, we hope to capture the growth in demand and market growth for LNG in the short to medium term.

In the medium and long term, CCS for net-zero CO<sub>2</sub> emissions and new energy sources, such as hydrogen and geothermal, will be in great demand.

Therefore, we will leverage Elliott's strengths, such as rotor dynamics, ultra-low temperature technology, materials, and proximity to clients, as I reviewed earlier, to introduce services and products in these new fields.

We would like to lead the energy shift from oil and gas to new energy together with our clients, and we would like to be a part of this strategy.

### Support

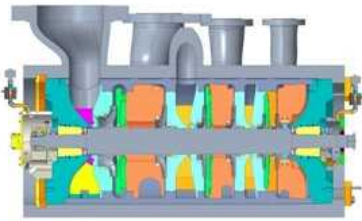
Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com

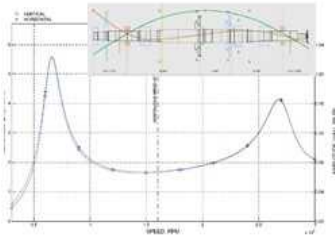




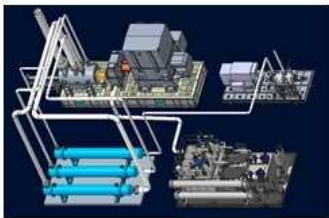
## Carbon Dioxide and Supercritical Carbon Dioxide



- Special design of high-pressure compressors for CO<sub>2</sub>
  - High pressure capability
  - Adoption of interstage cooling
  - Adoption of materials to meet corrosive environments



- High stability of rotor dynamics under super criticality and in high density



- Minimization of energy consumption through a combination of supercritical carbon dioxide compressors and Ebara pumps



*The world turns to Elliott*

17

Now, I would like to review why we can introduce our products and services in this new field, which is a good one.

The first step is CCS, which involves injecting carbon dioxide into deep geological formations and requires a compressor that can achieve high pressure. It is carbon dioxide, but it is CO<sub>2</sub>, so it is about 44. It is a heavy gas with a large molecular weight, where this molecular weight is large, but it needs a more stable performance of the shaft when it turns at high speed.

The other is that the temperature inevitably rises during the compression process, and for the reduction of overall power, intermediate cooling is required as the temperature rises during the compression process. In addition, wet carbon dioxide is corrosive, so materials that can handle it will be required. We believe that we can make the most of the strengths we have cultivated in this area.

Furthermore, as shown in the bottom figure, in the process of increasing pressure, a supercritical fluid is produced. At this state, gas and liquid are indistinguishable. After the supercritical fluid status is reached, the pump is then used to reach the final injection pressure, which reduces power consumption compared to boosting the pressure to the end, by using only a compressor. We believe that this is an energy-saving solution that only the Ebara Group, with its pumps and compressors, can provide.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptasiasia.com

 **SCRIPTS**  
Asia's Meetings, Globally

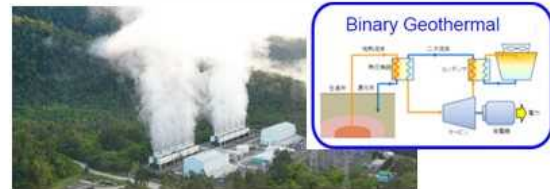
# Sustainable Energy

## Hydrogen



- Delivered more than 600 hydrogen compressors.
- Accumulated refrigeration technology for liquid hydrogen applications
- Flex-Op compressor for hydrogen (low molecular mass)
- Pipeline compressor capable of handling natural gas mixed with hydrogen

## Geothermal



- Enhancement of thermal efficiency using low boiling fluid
- Responsive to high output thanks to axial-flow turbine design
- Industry's pioneer (Elliott produced the industry's first double-flow isobutane turbine in 1980)
- Abundant experience in mixed gas compression



*The world turns to Elliott*

18

Next is hydrogen.

The Elliott Group has delivered more than 600 hydrogen-rich gas compressors to date for oil refineries. Hydrogen, in contrast to carbon dioxide, has a very small molecular weight, but future uses of hydrogen will require hydrogen of high purity as a fuel and compressors to handle it. In response, we have recently introduced a single-shaft, multi-stage compressor called Flex-Op to the market. As I mentioned earlier, we would like to continue to develop further technologies and products to increase the capacity of each plant in the medium to long term as the volume of hydrogen transactions increases.

Geothermal energy is also a very promising new energy source, given the abundance of geothermal heat resources and the fact that they are scattered throughout the world. In this area, the Elliott Group intends to utilize the technology to achieve the high efficiency that it has cultivated in large steam turbines for power generation, as well as the reliability of its products to first work on low and medium temperature geothermal steam turbines for power generation that uses low-boiling point fluids. We are planning to work on this.

In fact, we have already delivered a large-scale low boiling point fluid steam turbine for geothermal power generation in California in 1980, and we have already had some experience in this area since then.

Now, before we get to the final summary, please take a look at the video we have put together, which focuses on the new cryopump test stand that opened last year in Jeannette, Pennsylvania, where Elliott's headquarters is located.

[Video Plays]

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



## Summary

- Megatrends: Decarbonization
  - LNG as the medium- to long-term response
  - CO<sub>2</sub> recovery, hydrogen, and geothermal as the long-term response
- Elliott Strengths
  - A long track record and accumulated trust in important equipment such as compressors for LNG and ethylene, and steam turbines
  - Proximity to end users, EPCs, and process licensors
  - Comprehensive and high-quality service and support
  - Excellent high-speed rotating machinery technology, ultra-low-temperature technology, and material technology

**Elliott will lead an energy shift associated with decarbonization by leveraging its strengths.**



*The world turns to Elliott*

19

**Miyaki:** Finally, a summary.

First is the megatrend. This is decarbonization, and in this context, we see a shift from conventional oil and gas to new energy sources, with LNG as the most promising market in the medium to long term, and CCS, hydrogen, and geothermal in the long term.

We are working hard to address this energy shift, but we are not just saying that we will do our best. We believe that we have a firm grasp of this shift.

We are proud of the strengths that we have built and continue to build on, firstly, our extensive track record and reliability in critical equipment, secondly, our comprehensive and high-quality service and support, and thirdly, our proximity to our clients, including end-users, EPCs, and process licensors.

Furthermore, by fully utilizing our current strengths in outstanding technologies, such as rotor dynamics, ultra-low temperature technology, and materials technology, we would like to be and can be a leader with our clients in realizing the energy shift that accompanies decarbonization.

That is all from me. Thank you very much for your kind attention.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptasia.com



**Tokunaga:** Thank you for your patience. We will now resume EBARA IR Day 2022. Mr. Tsukamoto, the CP Hydrogen Business Project Manager of the Corporate Project, will continue the presentation.

## EBARA IR Day 2022

<Session 2>



# EBARA Group-wide Co-Creation Initiatives for Hydrogen Supply Chain

July 8, 2022

Teruaki Tsukamoto  
Project Manager of CP Hydrogen business project

Looking ahead,  
going beyond expectations  
*Ahead > Beyond*

**Tsukamoto:** Nice to meet you all. My name is Tsukamoto, and I am the project manager for this project. Thank you for your cooperation today.

Today, I would like to explain our efforts to build a hydrogen supply chain to be realized by the entire Ebara Corporation Group.

---

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com



- 1. Hydrogen Market: Future and Trend**
- 2. EBARA's Hydrogen Business: "Production, Transport and Use"**
- 3. EBARA's Technologies and Competitive Advantages**
- 4. Future of EBARA's Hydrogen-related Business**

Today, I would like to explain the global trend toward a hydrogen society, our company's efforts, and our vision for the future, especially through these four items.

As many of you know, in 2015, the Paris Agreement was discussed and adopted to prevent global warming. Efforts to reach the goal of limiting the rise to 2 degrees Celsius above pre-industrial levels and then to within 1.5 degrees Celsius were discussed, and then came into effect the following year, 2016.

At COP26 in 2021, more than 150 countries, including all G20 countries, set time-bound carbon neutrality targets, and countries are now setting numerical targets for 2050 and 2060.

In Japan, for example, the reduction will be 46% in 2030 compared to 2013, and virtually zero in 2050.

The EU, the US, and other countries are also moving to virtually zero by 2050. Such goals were set.

China and other countries have also set a goal of zero emissions by 2060.

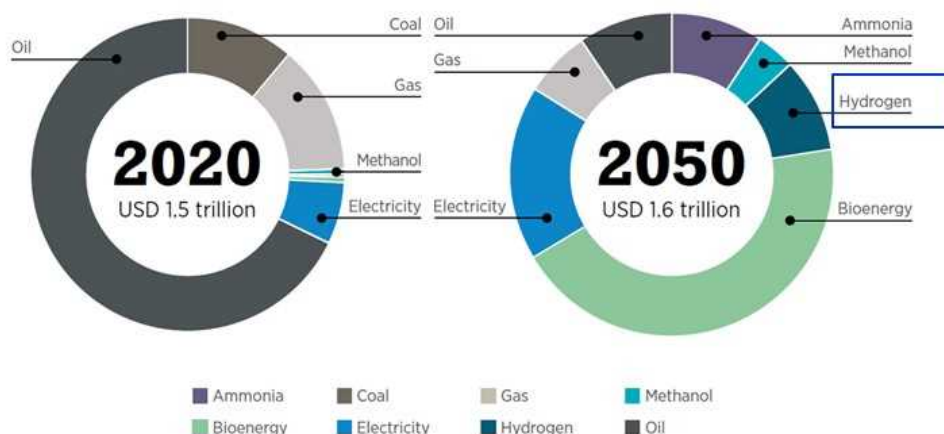
## Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com

# 1. Hydrogen Market: Future and Trend

- **10% in 2050: Hydrogen** portion of **global energy trade volumes**  
- IRENA(The International Renewable Energy Agency) forecast
- **200 trillion yen in 2050: global hydrogen market size**
- **Europe, the United States and China:** countries accelerating decarbonization and energy security
- Possible significant change in existing energy value chain by hydrogen



Citation: IRENA (2022), Geopolitics of the Energy Transformation: The Hydrogen Factor, International Renewable Energy Agency, Abu Dhabi. ISBN: 978-92-9260-370-0

Against this background, as shown in this figure, as published in 2022 by the International Renewable Energy Agency, hydrogen is projected to account for 10% or more of global energy trade by 2050.

In addition, the global hydrogen business market, if perceived in this way, is projected to expand to JPY200 trillion or more.

Countries and companies around the world are now accelerating their efforts. These are said to have the potential to significantly change the existing energy value chain.

## Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com

# 1. Hydrogen Market: Future and Trend



## 500 Mt in 2050 (x5 2020 level): global hydrogen consumption

- IEA (The International Energy Agency) forecast

**x10 power generation sector** From 2030 to 2050

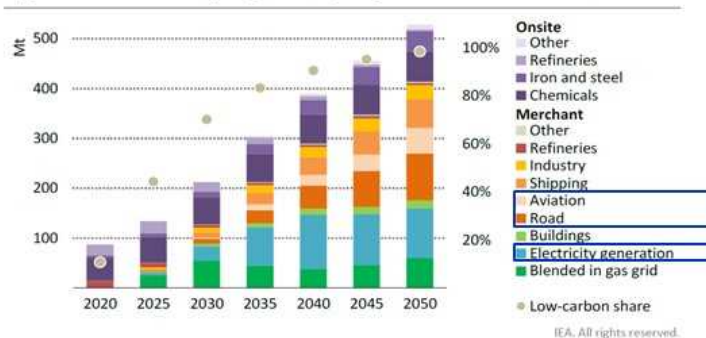
**x40 transportation sector** (large commercial vehicles) From 2030 to 2050

Diversified utilization; Steel-making, Ships and aircraft

**60%:** hydrogen derived from renewable energy (green)

**40%:** coal or natural gas + CCS (blue)

**Figure 2.19** - Global hydrogen and hydrogen-based fuel use in the NZE



The initial focus for hydrogen is to convert existing uses to low-carbon hydrogen; hydrogen and hydrogen-based fuels then expand across all end-uses

Note: Includes hydrogen and hydrogen contained in ammonia and synthetic fuels.



**Figure 3.8** - Global production of hydrogen by fuel and hydrogen demand by sector in the NZE

Source: IEA (2021), Net Zero by 2050, IEA, Paris, <https://www.iea.org/reports/net-zero-by-2050>. All rights reserved.

On the other hand, the International Energy Agency, or IEA, predicts that global hydrogen use in 2050 will expand to 500 million tons or more -- five times or more than the 2020 level.

The power generation sector in particular is expected to grow 10-fold, while the transportation sector, especially large commercial vehicles, is projected to grow 40-fold. The orange area on the left graph shows the transportation sector, and the blue area shows the power generation sector.

As you know, hydrogen itself is used for a variety of purposes, and we expect to see hydrogen steelmaking, hydrogen-fueled ships, and hydrogen-powered aircraft in the future, and we believe that hydrogen use will continue to diversify.

There are also two main methods of hydrogen production. One is hydrogen production by electrolysis using electricity and water derived from renewable energy. For the other, low-grade coal, called lignite, is gasified to produce hydrogen. At the same time, the carbon dioxide generated from the process is buried underground for CO<sub>2</sub>-free hydrogen. These are the two main categories.

In Japan, the government formulated a hydrogen strategy in 2017 and projects a demand for 3 million tons of hydrogen by 2030 and 20 million tons by 2040. Among these plans, the import of hydrogen from overseas is planned to be 300,000 tons in 2030, with a target of 10 million tons in 2040.

We hope to grasp these major trends and develop Ebara's hydrogen business for the future.

## Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com



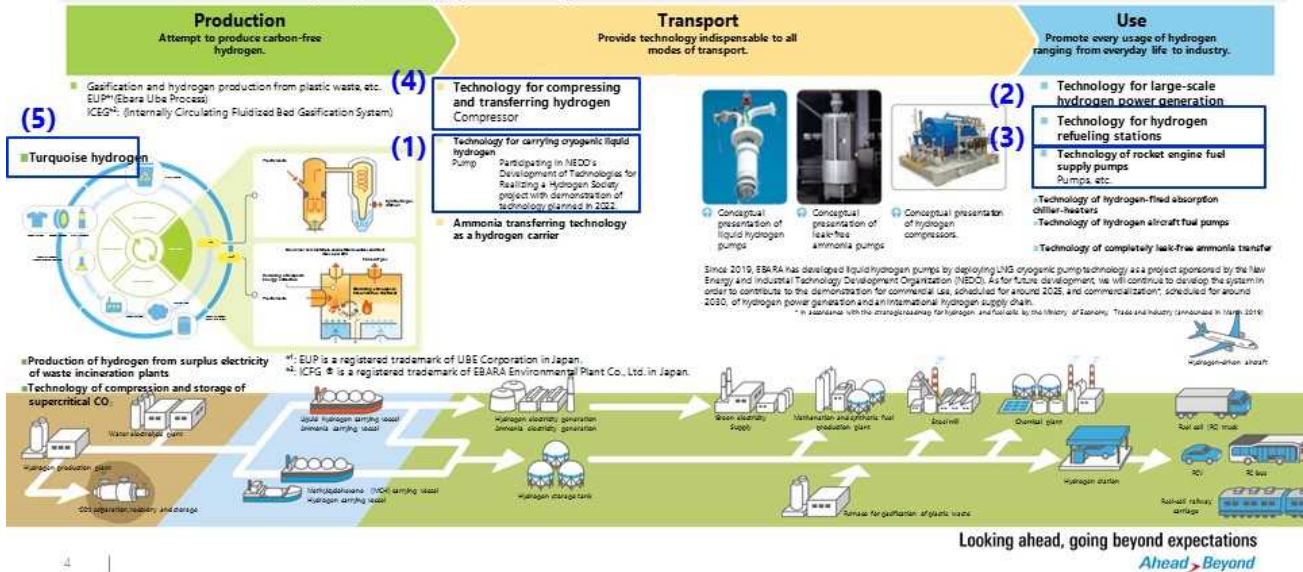
## 2. EBARA's Hydrogen Business: "Production, Transport and Use"



■ August 2021: Launched a corporate project

kicked off a group-wide effort for the creation and co-creation as the fourth pillar

- [Production]** Licensed out the technology of producing hydrogen by gasification of plastic waste (Ebara Ube Process or EUP)  
Developed turquoise hydrogen technology
- [Transport]** Developed pumps handling -253°C liquid hydrogen for liquid transportation  
hydrogen compressors for gas transportation  
canned motor pumps (leak-free structure) for liquid ammonia transportation
- [Use]** Developed liquid pumps for hydrogen refueling stations  
pumps to supply rocket engine fuel



The Ebara Group launched a Corporate Project in August 2021 to create the fourth pillar of the Ebara Group - following Fluid Machinery & Systems, the environmental plants, and precision machinery -- across the entire Group. The Corporate Project is a commercialization project under the direct supervision of the President. It is a Company-wide effort to create a unique business for Ebara, which has created precision and electronics businesses in the past.

As shown here, there are many technological issues and social systems that need to be solved in the various areas of "Production", "Transport", and "Use" in order to build a hydrogen society. The Ebara Group's businesses have many technologies that are highly compatible with this hydrogen-related business. We hope to utilize these technologies to contribute to all areas from "Production" to "Use."

For example, in the area of "Production," hydrogen is produced by gasifying waste plastic. It is considered as one type of chemical recycling. In addition, we already have an EUP gasification plant in Kawasaki that has been in operation since 2003. This has been made possible by utilizing the technologies of the Group's Ebara Environmental Plant.

In the field of "Transport," we also have cryogenic liquid hydrogen pump technology and the compressor technology I mentioned earlier. Various methods of hydrogen transportation have been developed, including liquid hydrogen, compressed hydrogen, and ammonia. We believe that there will be several mixtures because the most efficient method depends on the locality, amount to be transported, and usage. We believe that Ebara has core technologies that can be utilized for many of them.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com





In the area of "Use," we are developing technologies necessary for various hydrogen applications, including hydrogen refueling stations for mobility, which have high growth potential, hydrogen supply pumps for hydrogen power generation facilities, and fuel supply pumps used in commercial rockets.

Today, I would like to introduce some of these topics, especially those that have advanced over the past year.

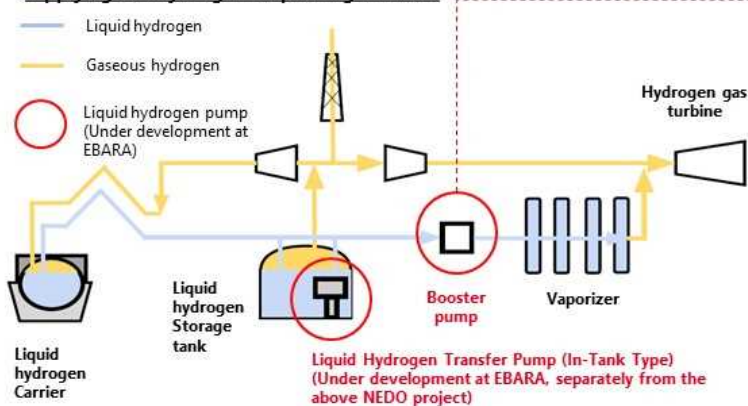
### 3. EBARA's Technologies and Competitive Advantages "Transport and Use" (Liquid Hydrogen Pumps)



#### (1) The world's first "Liquid Hydrogen Fuel Supply Pump" indispensable for hydrogen-powered gas turbines

- Under development as a project sponsored by the New Energy and Industrial Technology Development Organization (NEDO) (since 2019).
- Conducted an LNG test (-162°C) at Elliott facility in the United States (in February)  
\*The measured performance well matched the designed one.
- An actual liquid hydrogen test(-253°C) is scheduled at the JAXA Noshiro Rocket Testing Center.

**Flow chart of the process from receiving liquid hydrogen to supplying fuel hydrogen for power generation**



**Liquid hydrogen fuel supply pump**



The first is the world's first liquid hydrogen fuel supply pump, which is indispensable for hydrogen-powered gas turbines. As I explained earlier, hydrogen power generation is a promising field that is expected to grow in the future. We believe that the hydrogen used for this hydrogen power generation will be mainly imported hydrogen from overseas in general.

Transported liquid hydrogen, the leftmost tank shown in the figure on the left, is brought in from overseas. A process is required to temporarily store this transported liquid hydrogen in domestic storage tanks and then dispense the liquid hydrogen from these tanks to supply hydrogen gas turbines under pressure. A pump is needed at the point where the hydrogen is dispensed and sent to the gas turbine.

However, such a pump is extremely challenging and is not currently commercially available. That is because it would use liquid hydrogen at a cryogenic temperature of minus 253 degrees Celsius, have a large capacity for power generation, and must be a high-pressure pump to feed a gas turbine. We recognize that this is an area where Ebara's experience and technology can be utilized.

#### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com



The photo on the right shows a test conducted this quarter in the US, using LNG at minus 162 degrees Celsius at the Sparks plant, which I explained earlier. We are currently in the process of testing actual liquid hydrogen at minus 253 degrees Celsius.

We will respond to the growth of the hydrogen market from the second half of 2020, to 2030 and beyond, to ensure that we can contribute here.



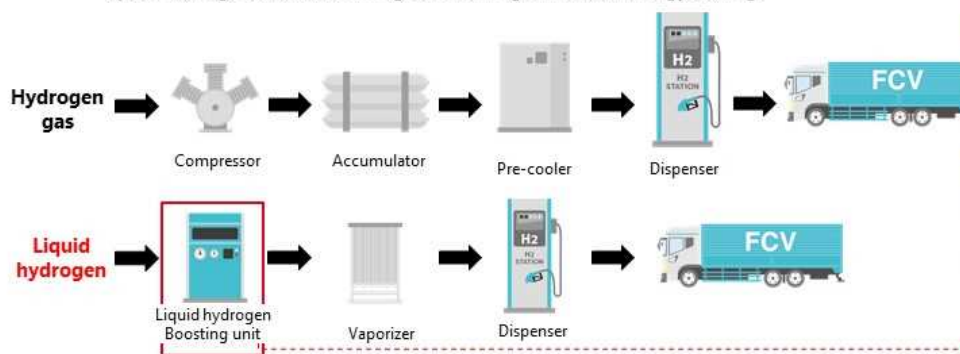
### 3. EBARA's Technologies and Competitive Advantages "Transport and Use" (Liquid Hydrogen Pumps)

#### (2) "Highly Efficient Liquid Hydrogen Plunger Pump" expected to be used in hydrogen refueling stations for large and commercial vehicles

- Developed liquid Hydrogen plunger pumps (reciprocating) and tested components (in November 2021).
- From 2022 to 2023: A test scheduled by using actual liquid hydrogen.

##### Market needs

- Hydrogen refueling stations market: North America, the EU, China and Japan.  
(Example) Several thousands of units each in North America and China in 2030
- Since Liquid Hydrogen type has the following advantages against gas compressors, it is more suitable for large mobility  
- space-saving, continuous filling, short filling time, and energy-saving.



Liquid hydrogen plunger pump

Next up is a hydrogen refueling station for large commercial vehicles, where the highly efficient liquid hydrogen plunger pump is expected to be used. Japan is said to be currently ahead of the rest of the world in the hydrogen station market. We are now seeing that the market does not stop there, and construction plans are being considered around the world, including North America, the EU, and China.

What kind of hydrogen will be filled in what kind of mobility market? I believe this needs to be closely monitored. However, hydrogen fuel cells are said to be superior to battery EVs for large delivery trucks and buses, vehicles that travel long distances or the same route back and forth, and heavy-duty mobility technology that has a high operating ratio and requires immediate refilling. And of these, liquid hydrogen is said to be particularly highly compatible.

We have now developed this plunger pump and have completed element testing. We are now developing a highly efficient pump capable of supplying the large capacity and high pressure demanded by the market, and also reduces so-called boil off gas, which occurs when hydrogen leaks from the pump as gas due to vaporization of liquid, which is one of the difficulties of liquid hydrogen.

#### Support

Japan	050.5212.7790	North America	1.800.674.8375
Tollfree	0120.966.744	Email Support	support@scriptsasia.com



We would like to make the most of the precious hydrogen without wasting it and would like to conduct actual liquid tests with liquid hydrogen in the future to commercialize the product.



### 3. EBARA's Technologies and Competitive Advantages "Transport and Use" (Rocket Pumps and Compressors)

#### (3) "Cryogenic Rocket Fuel Supply Pump" supporting the commercial satellite rocket market growth

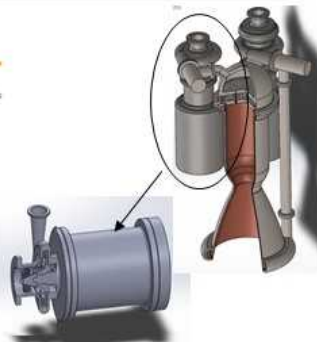
- Collaborated with Muroran Institute of Technology and Interstellar Technologies in the development of turbo pumps for rockets (in September 2021).
- Conducted a components test for turbo pumps (in April 2022).
- Accumulated fuel supply technology and started the development of electric pumps as well.

#### (4) Compact "Hydrogen Compressor" promoted by Elliott and EBARA Group co-creation

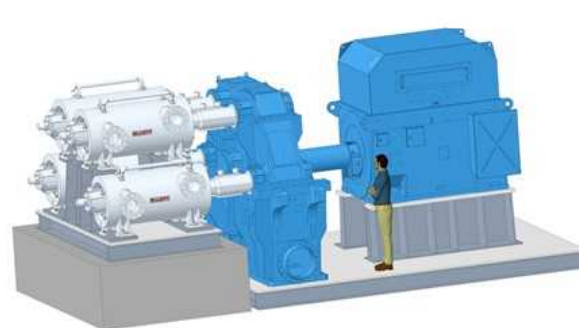
- Developed a new Flex-Op hydrogen compression solution (in March 2022).
- Launched in the first quarter of FY2022.



Testing equipment for components for turbo pumps (water-flow test)  
The photo, provided by: Interstellar Technologies, Inc.



Conceptual presentation of Electric Pump for Rocket Engines



Conceptual presentation of Flex-Op Hydrogen Compressor

Next, I would like to introduce the fuel supply pump for cryogenic rockets, which is used in commercial rockets for satellites; and the hydrogen compressor developed by Elliott, which I introduced earlier. The private sector is becoming more active in the satellite rocket business, and the number of rockets launched by the private sector is expected to grow from the current 30 or so per year to 100 or 200 in the future.

To move toward such a growing market, last September, we participated in the development of a turbo pump for rockets with the Muroran Institute of Technology and Interstellar Technologies Inc. There, we have also been accumulating technical knowledge in this rocket field while utilizing our expertise in cryogenic, high-speed, and lightweight fuel supply pumps.

The pumps mentioned earlier are turbine-driven, but we also need to consider electrification, so we have begun development of electric pumps. The drawing on the left side we are showing you today shows the engine and pump attached to each other. This one engine has two pumps attached to it, one for the oxidizer and the other for the fuel. Currently, liquid methane and liquid hydrogen are the main fuels used in the rocket field. We hope to realize these products by taking advantage of the cryogenic technology we are now advancing.

I also believe that the hydrogen supply chain, which is used in gaseous form, will require compressors. I mentioned earlier that we have delivered many compressors for hydrogen that is not very pure utilizing compressor technology developed by Elliott, and we will be developing compressors that can be used for

#### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com



hydrogen that is more highly purified. The compressor I have shown you here today is Flex-Op, which was launched this fiscal year.

We would like to use this kind of product to further advance the next stage of development, aiming for compressor use in the vaporization process and utilization in the transportation area, such as hydrogen gas pipelines. We also aim to further upgrade our products to achieve higher speeds, space savings, and energy savings in the future.

We expect that a significant percentage of the world's gases will likely be used for distribution. Therefore, we would like to be well prepared for the area of gaseous hydrogen as well as liquid as mentioned earlier.

### 3. EBARA's Technologies and Competitive Advantages "Production"



- The classification of hydrogen depends on Production technology (the classification differs slightly in regions).
- CO2-free hydrogen is an essential for an energy system with net zero emissions, EBARA will build a secure position in this area.
- For future hydrogen demand and supply (Scaling up and distribute application), Ebara makes an approach in this area

Classification of hydrogen	Production technology	Carbon emission
<b>Green hydrogen</b>	Produced via the electrolysis of water: <b>the used electricity must derive from renewable sources</b>	CO2-free hydrogen (clean hydrogen) <small>*Turquoise hydrogen has a carbon fixation characteristic.</small>
<b>Blue hydrogen</b>	Produced <b>using a carbon capture and storage (CCS)</b>	
<b>Turquoise hydrogen</b>	Produced via the <b>thermal splitting of methane (methane pyrolysis)</b>	
<b>Pink hydrogen</b>	Produced via the electrolysis of water: <b>the used electricity from a nuclear power plant</b>	—
<b>Gray hydrogen</b>	Production via <b>the steam reforming of natural gas and fossil fuels (CO<sub>2</sub> is emitted)</b>	Emission of CO <sub>2</sub>

Finally, I would like to introduce a few things about the area of "Production."

What we are showing here, as many of you know, is that hydrogen is defined differently depending on the origin of its production. As shown in the table, hydrogen is classified according to the specific production method and whether or not the hydrogen is CO2-free, by color, such as green, blue, turquoise, pink, or gray.

Green hydrogen, for example, is produced from electricity derived from renewable energy sources, a production method that is particularly beneficial in areas with abundant solar, wind, and hydroelectric power.

The next one, blue hydrogen, is extracted through gasification using low-grade coal or even natural gas. At the same time, the carbon dioxide produced will be made CO2-free by CCS, as I mentioned at the beginning. Such items are available. At this point in time, this blue hydrogen is said to be the cheapest to produce.

#### Support

Japan	050.5212.7790	North America	1.800.674.8375
Tollfree	0120.966.744	Email Support	support@scriptsasia.com



At this time, there are other types of hydrogen that are referred to in various ways, such as hydrogen production using electricity from nuclear power plants, or hydrogen derived from fossil fuels, known as gray hydrogen, which does not use CCS and is not carbon-free.

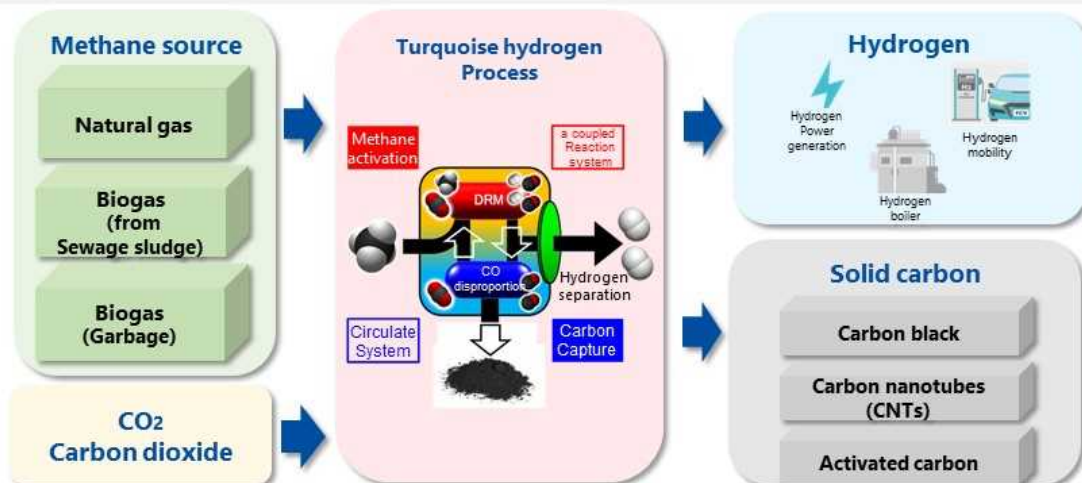
Ebara would like to contribute to the area of CO<sub>2</sub>-free hydrogen and hydrogen that contributes to carbon neutrality, which itself will take various forms depending on the future formation of society, such as large-scale and decentralized hydrogen production.

### 3. EBARA's Technologies and Competitive Advantages "Production" (Development of Turquoise Hydrogen and Solid Carbon)



#### (5) Methane with high Global Warming Potential is separated into hydrogen and solid carbon

- Aim at a commercialization in 2026  
Conducting feasibility study, a medium-scale and a large-scale demonstration.
- NEDO's "Advancement of Hydrogen Technologies and Utilization Project"<sup>\*1</sup>  
Under development and demonstration with NIMS<sup>\*2</sup>, TAIYO KOKO CO., LTD etc
- Recruiting business partners to start cooperation with  
Methane sources (gas and electricity companies, etc.) and hydrogen and carbon suppliers.



<sup>\*1</sup> Advancement of Hydrogen Technologies and Utilization Project/Development of technology for producing hydrogen without CO<sub>2</sub> emissions by use of hydrocarbon, etc./Hydrogen production through reaction field separation of methane activation and carbon deposition

<sup>\*2</sup> National Institute for Materials Science

Copyright © Ebara Corporation. All rights reserved.

Looking ahead, going beyond expectations  
Ahead > Beyond

The next initiative I would like to introduce is turquoise hydrogen. As shown in the middle, this is a device and process for producing hydrogen and solid carbon through the thermal decomposition of methane.

Methane is CH<sub>4</sub>, a compound made of carbon and hydrogen. Of course, it is made from natural gas, but nowadays it can also be generated from sewage sludge and food waste as biogas. On the other hand, methane has a global warming potential 25 times greater than that of carbon dioxide. While reducing CO<sub>2</sub> emissions is important to combat global warming, we believe it is also important to reduce this methane emission.

This process is capable of separating this methane and CO<sub>2</sub> into hydrogen and solid carbon by putting them in a reactor and passing them through a hydrogen production process. Separated hydrogen is expected to be utilized in various hydrogen supply chains, such as hydrogen power generation, hydrogen boilers, and automobiles. We expect this to be useful as a locally distributed hydrogen energy source, which is a bit different from the hydrogen that is imported on a large scale from overseas.

#### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasias.com



The separated solid carbon itself is expected to be utilized as carbon materials, such as carbon black, carbon nanotubes, and activated carbon, which will enable resource conservation in the materials field. If the carbon in methane can be utilized as a material, the process can be expected to produce not only CO<sub>2</sub>-free hydrogen, but also be carbon-negative and CO<sub>2</sub>-negative in turn.

Currently, it is being demonstrated under NEDO's R&D project for hydrogen utilization, etc., with the aim of commercialization in 2026.

### 3. EBARA's Technologies and Competitive Advantages "Production" (Development of Turquoise Hydrogen and Solid Carbon)



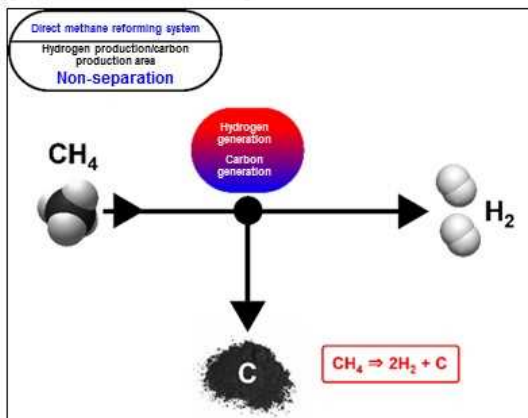
#### ■ Production high value-added carbon

Capable of producing high value-add carbon by separating the reactors of methane decomposition and carbon capture and optimizing temperature, pressure and others. In addition, contribute to long-life catalyst by preventing from the carbon coking of the methane pyrolysis.

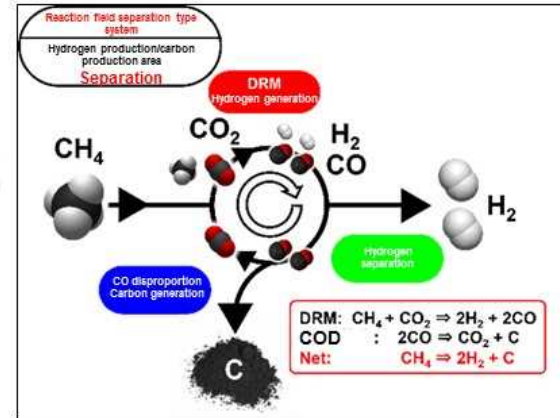
#### ■ High efficient process with low temperatures

Achieve low temperature process by developing catalysts with long-life and low temperature activity.

#### [Conventional Process]



#### [Process adopted by Ebara]



10 | Copyright(c) Ebara Corporation. All rights reserved.

Looking ahead, going beyond expectations  
Ahead > Beyond

This process is characterized by its hydrogen production part and carbon production part, the reciprocal reactions of hydrogen production and CO disproportionation.

The figure on the left shows the conventional process, in which hydrogen and carbon are separated in a single step. In comparison, the system on the right is designed to separate the DRM production field that produces hydrogen and the carbon production field of CO disproportionation in a process-oriented manner. This physically separates the reaction fields so that each field can maintain its appropriate reaction conditions.

This makes it possible for reactions at relatively low temperatures in the reactor for hydrogen production, thereby extending the life of the catalyst. By freely controlling temperature and pressure in the separation reaction that produces carbon, we aim to establish a process for high value-added carbon production and operation control that matches the desired product.

We aim to leverage these advantages to produce hydrogen and carbon at lower cost.

#### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

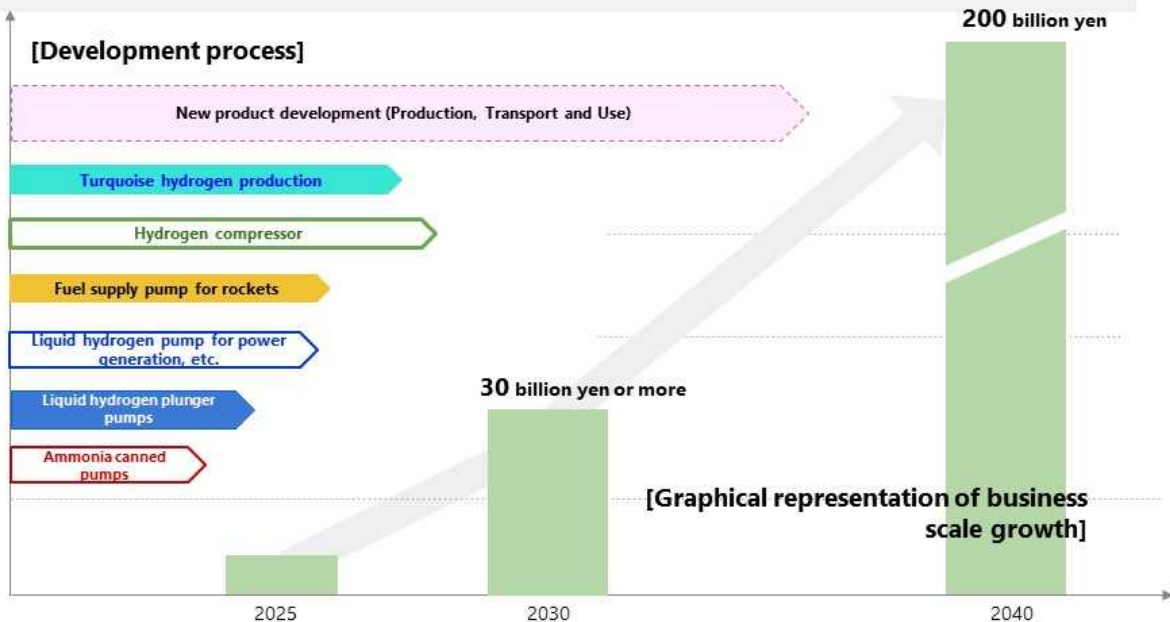
North America 1.800.674.8375  
Email Support support@scriptsasias.com



## 4. Future of EBARA's Hydrogen-related Business



- Complete product development, launch to the market and accelerate the business growth.
- **Contribute to a hydrogen society through CO2-free hydrogen** by developing new products and new business models in all three fields of "Production, Transport and Use".
- Aim to business development with **a revenue of over 200 billion yen in 2040.**



11 | Copyright(c) Ebara Corporation. All rights reserved.

Looking ahead, going beyond expectations  
Ahead, Beyond

I have rushed through the explanation somewhat, but I have introduced five items as recent topics.

We hope to quickly develop and introduce these products under development, commercialize them by mid-2020s, and then accelerate the growth of our business.

In addition, we would like to develop new products and build business models in the various areas of "Production," "Transport," and "Use."

Including the products and services introduced today, we would like to grow our business to more than JPY30 billion by 2030, and to JPY200 billion by 2040.

As I mentioned at the beginning, we at Ebara must create businesses for the next 10 years and the 20 years after that by taking advantage of the technology and experience we have cultivated and our global network.

This Corporate Project for the hydrogen business will be undertaken by the entire Group, and we will challenge ourselves daily to contribute to the creation of a society using CO2-free hydrogen and to commercialize the project as soon as possible.

We appreciate your continued support. That is all from me.

### Support

Japan 050.5212.7790  
Tollfree 0120.966.744

North America 1.800.674.8375  
Email Support support@scriptsasia.com

