

Initiatives for Decarbonization in the Compressor & Turbine Business

July 8, 2022

Takanobu Miyaki

Executive Officer,

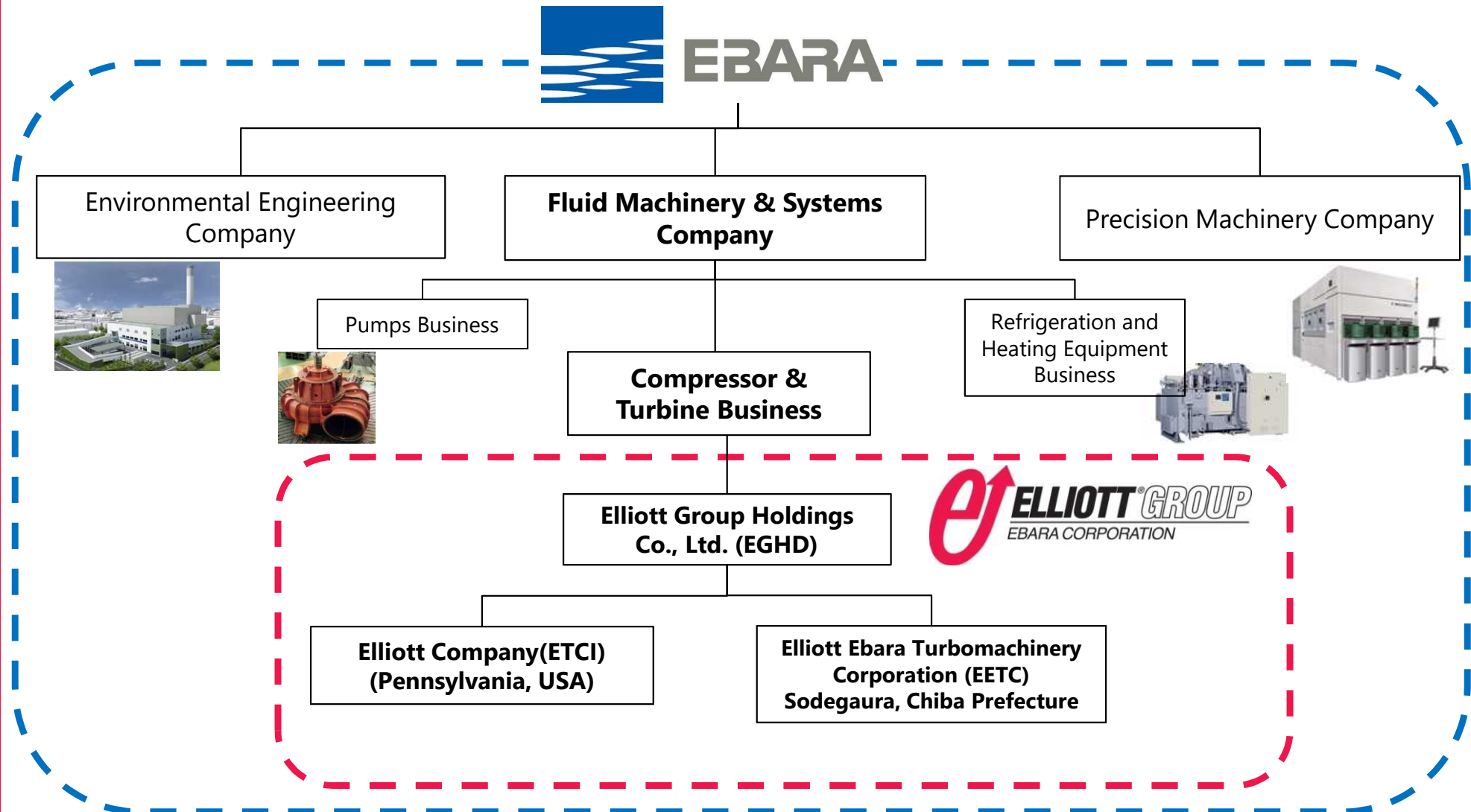
Responsible for Compressors and Turbines Business, Fluid Machinery & Systems
Company,

CEO, Elliott Company



Organizational Structure of the Elliott Group

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



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

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

1975: Sodegaura Plant, mainly for production of compressors & turbines, was built.

2002: Establishment of Elliott Ebara Turbomachinery Corporation (EETC)



1910: Founded by W.S. Elliott.

Elliott Company was **established** in **Pittsburgh, USA.**

Boiler tube cleaners were their first product.



From 1920s to 1940s:

Expanded product groups to centrifugal compressors, steam turbines, motors, superchargers, etc. through measures including acquisition of business



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 Elliott Group.



Organization and Functions of Elliott Group

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

Support Services Group (Administration)

New Apparatus Unit

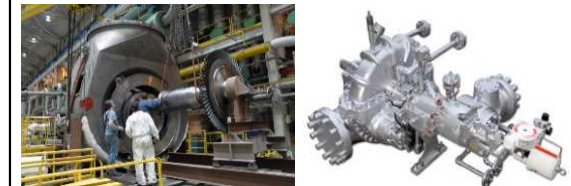
Sales, project management and engineering functions (centrifugal and axial flow compressors, steam turbines for machine drive, power recovery expanders, small and medium-size steam turbine power generation facilities, cryogenic pumps and expanders)

Global Manufacturing Unit

Design, production and global supply chain functions of Elliott products

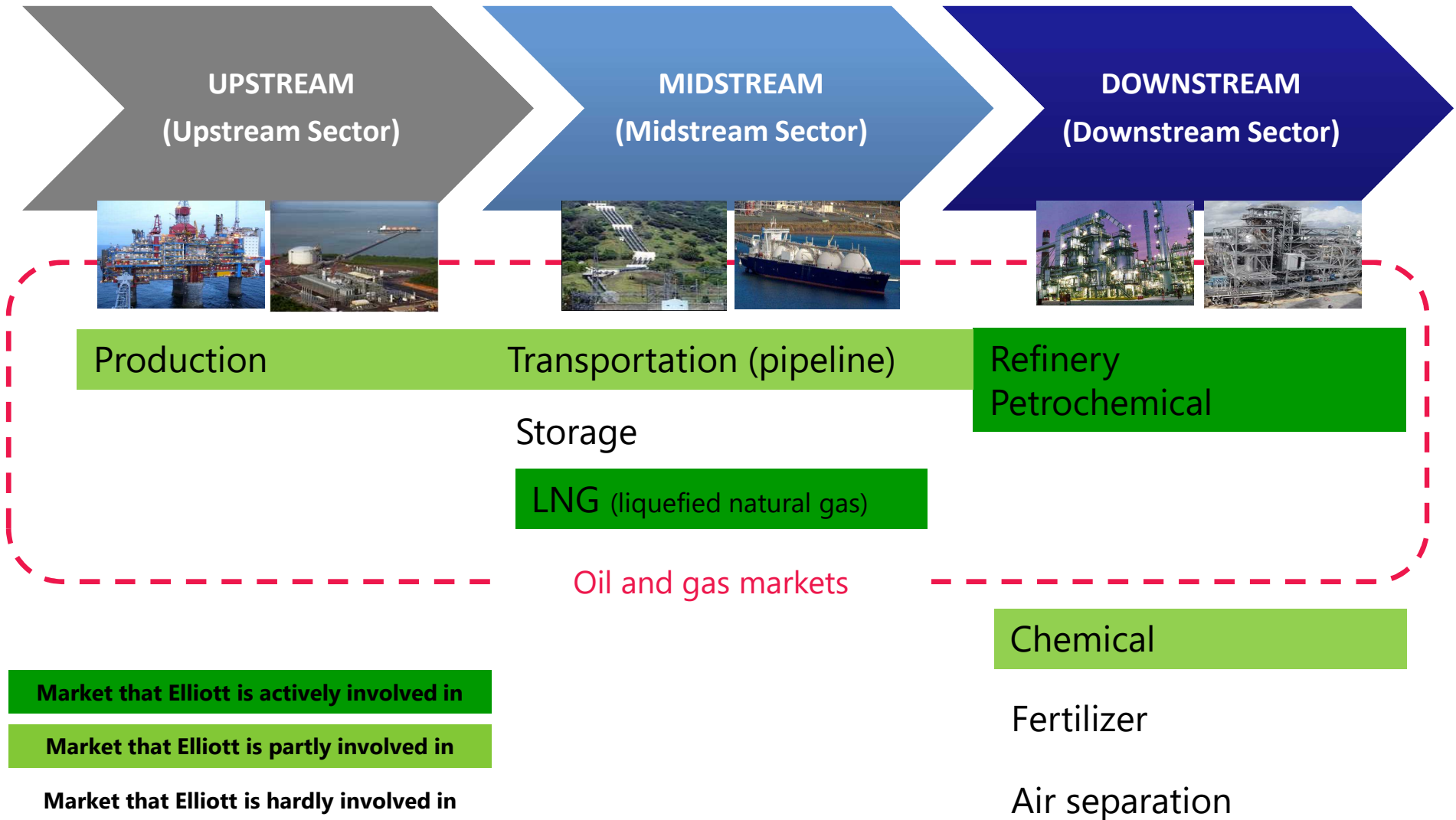
Global Service Unit

Parts, Field Service, and Service & Support functions of repairs and product modifications, including those of other companies



Elliott's Main Markets

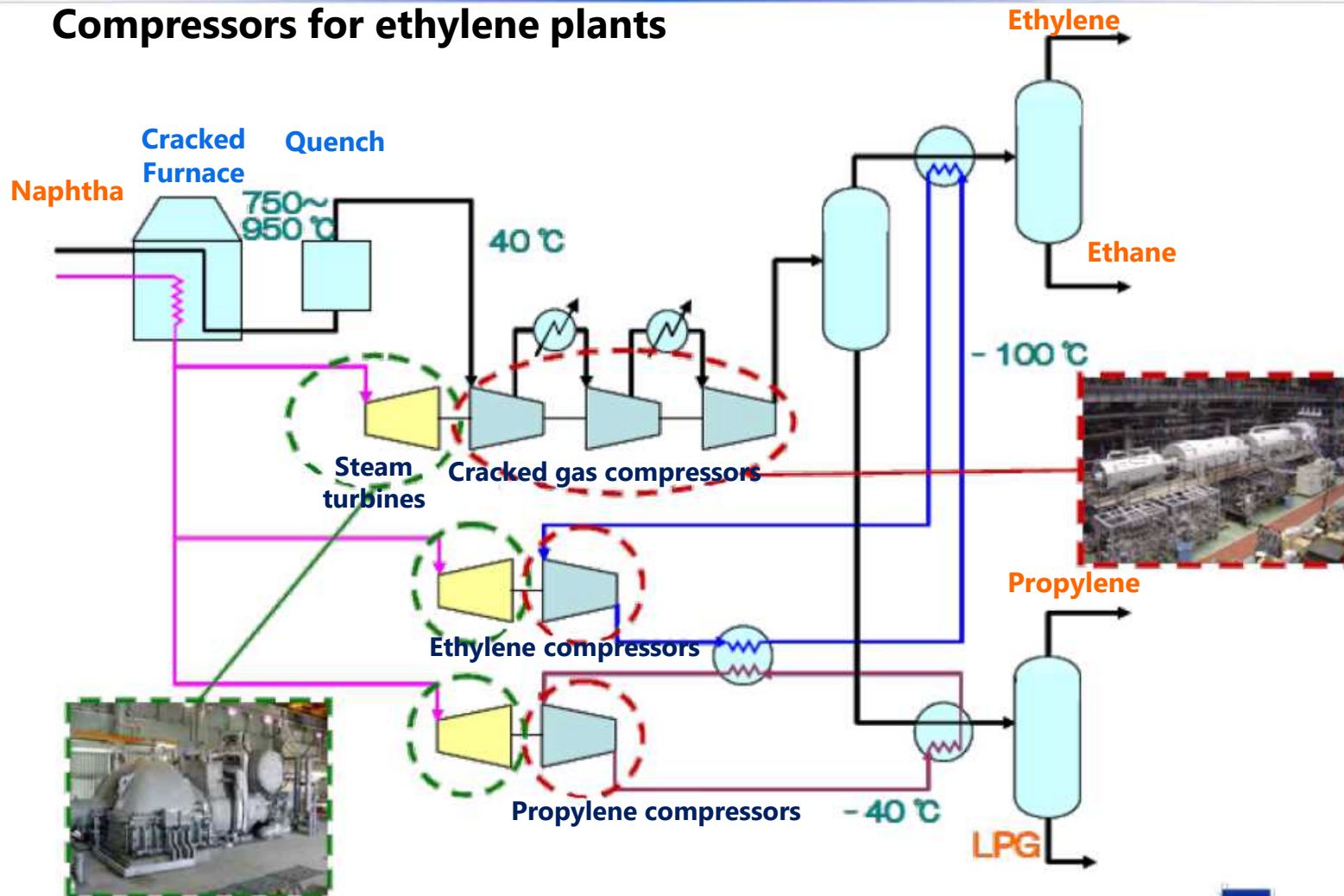
- Elliott provides products and services to a wide range of industries.



Products for Petrochemical Ethylene Plants (Centrifugal Compressors)

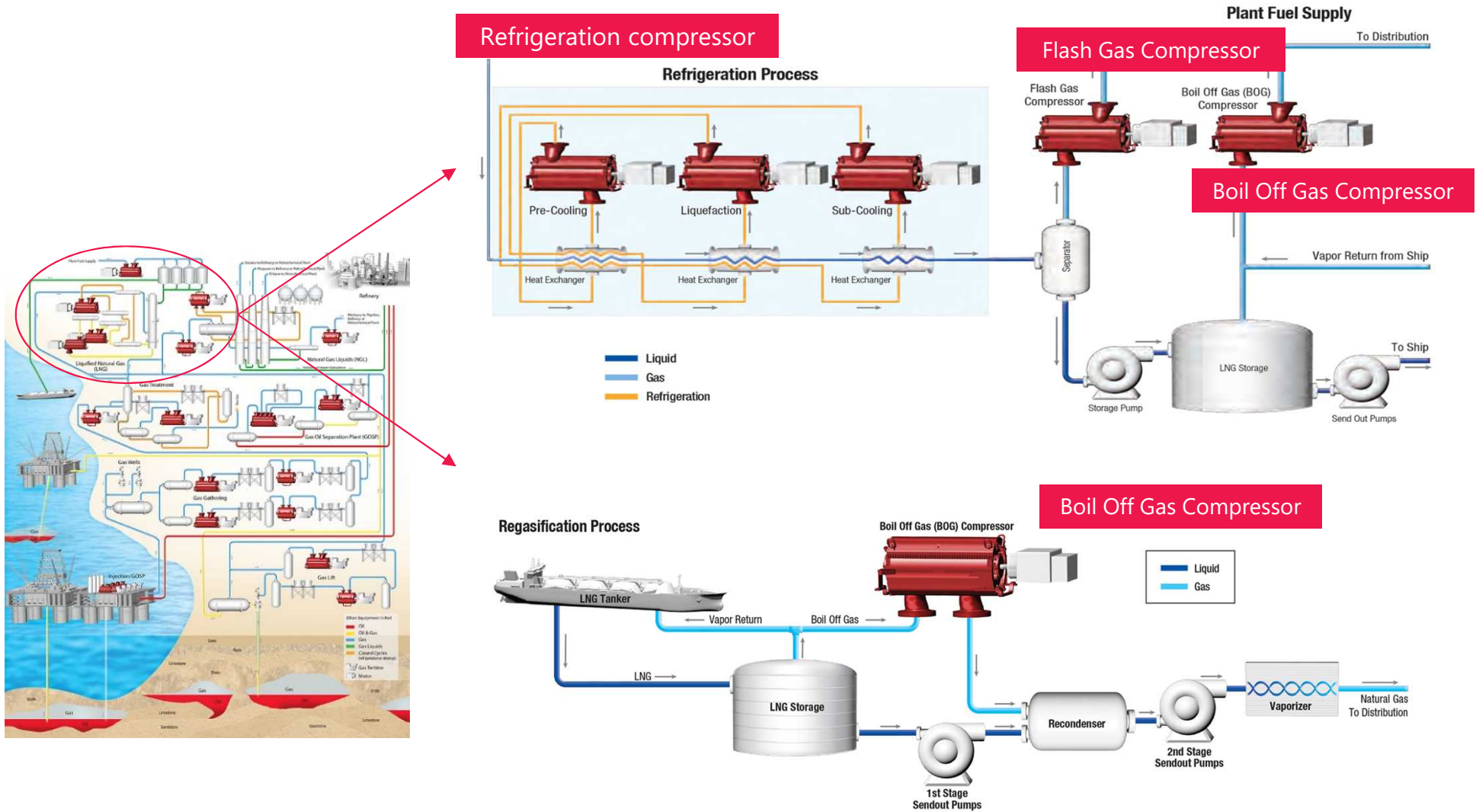
- Elliott has provided high-quality and highly reliable compressor products for more than 60 years

Compressors for ethylene plants



Products for LNG (Centrifugal Compressors)

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



Compressors in the LNG Market

Pioneer



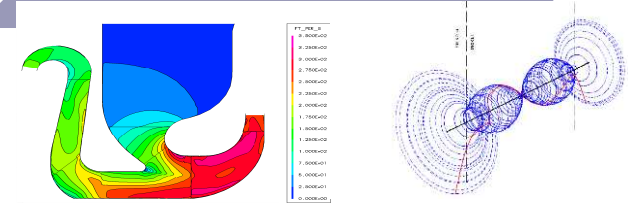
- Manufactured the first compressor trains driven by gas turbines
- Manufactured compressors in the first new refrigeration process
- Manufactured the first compressor trains driven by GE Frame 7 EA gas turbines
- Manufactured the first compressors driven by large gas turbines with VFD synchronous motors

Experience



- Delivered more than 900 compressors for refrigeration
- Delivered more than 100 compressors for LNG
- Total output of all compressors delivered for LNG is 2,400 MW or more.
- Contributed to production of LNG of over 80 MTPA

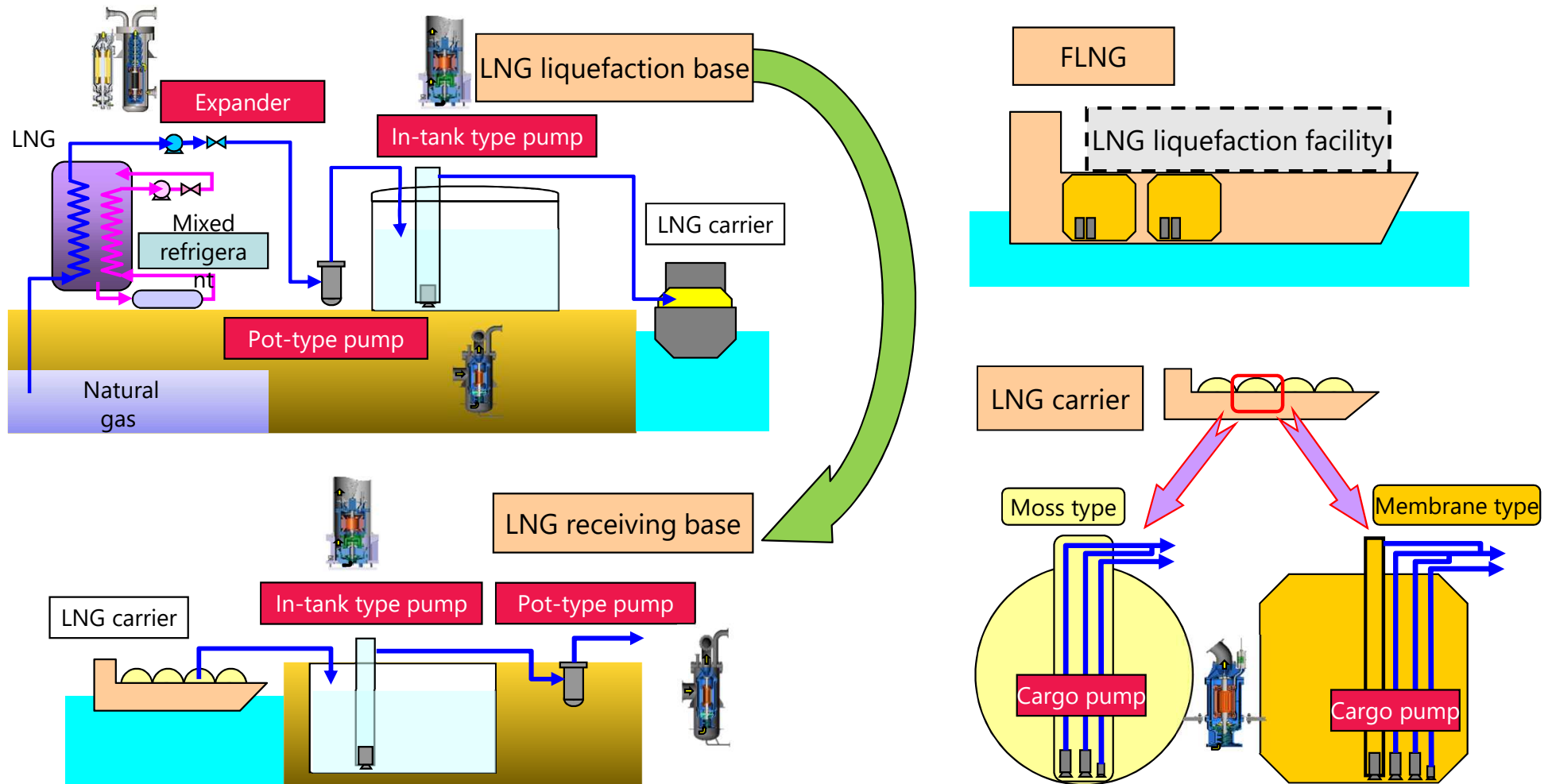
Technology



- Unique analysis technology of gas characteristics for refrigeration services
- Technology for developing cryogenic materials
- Industry-leading rotor dynamics technology
- Technology to design gas nozzles that realize high efficiency (side load)
- High efficiency close to 90%

Products for LNG (Cryogenic Pumps and Expanders)

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



Cryogenic Products in the LNG market

Pumps

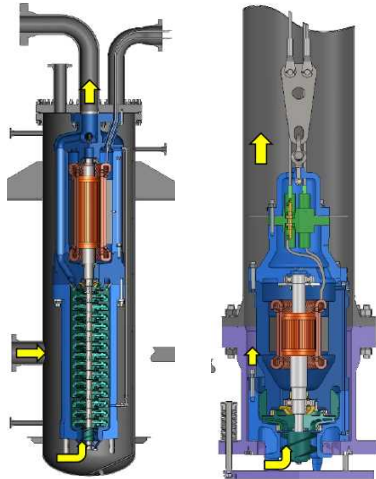
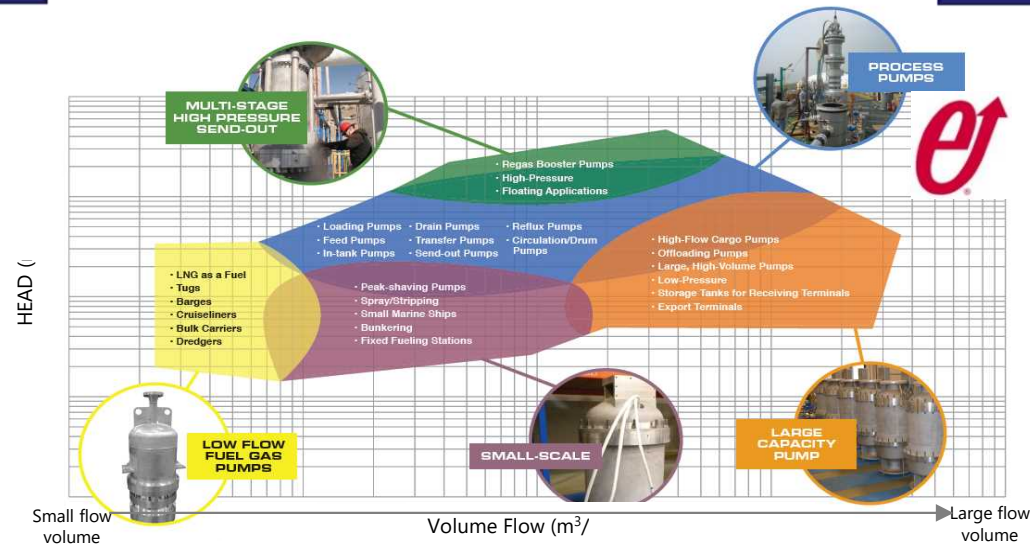
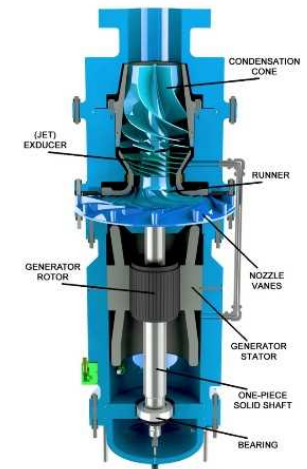


Chart by Pump Application



Expanders



- Capable of meeting all applications for LNG
- Capable of satisfying a design that demands operation at as low as -320° F (-196° C) (-258° F (-161° C) in the case of LNG)
- Optimal design to meet various required specifications
- Manufactured the first 3D printed impellers for LNG

- A pioneer in the market and excellent as a product. Gains good reputation, leading to a 100% market share
- Single-phase and two-phase LNG expanders
- Power recovery and an improvement of 5 to 7% in process efficiency



Elliott Group's Global Network

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

Pennsylvania, USA



Chiba, Japan



Bangalore, India



30 locations



3 manufacturing facilities

17 service centers

- 11 in the Americas region
- 3 in the Europe, Middle East and Africa region
- 3 in the Asia-Pacific region

10 sales and service bases

2,300+ global employees

 Manufacturing Facilities  Service Facilities  Sales & Service Offices



Service & Support throughout the Product Lifecycle



Compressors



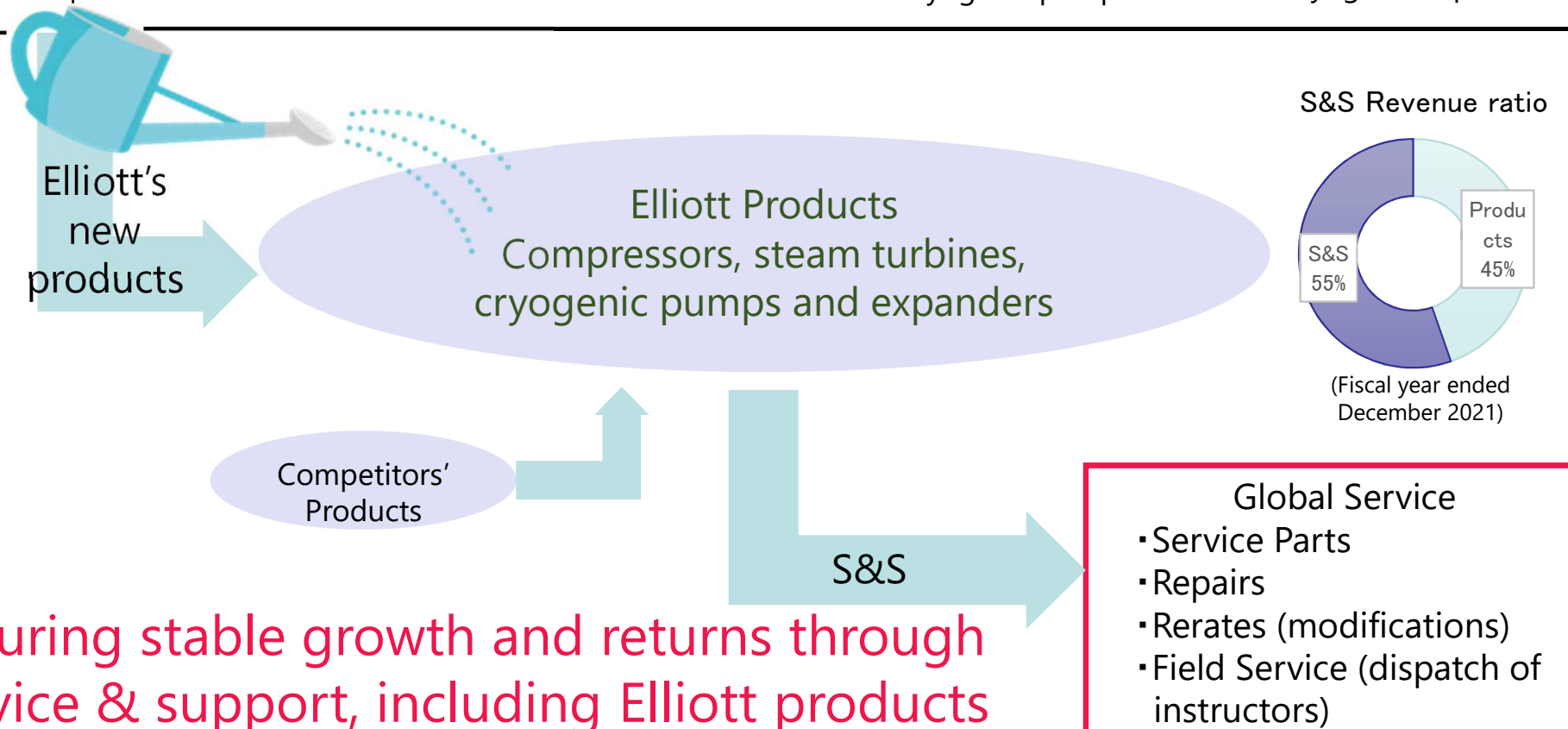
Steam turbines



Cryogenic pumps



Cryogenic expanders



Delivery Record of Elliott Products

Compressors and steam turbines
Americas (North America and South America)

1,800+

Compressors and steam turbines
EMA (Europe, Middle East and Africa)

1,200+

Compressors and steam turbines
Asia Pacific

2,000+

- Engineered compressors: More than 3,500 units (of which, 900 units or more for refrigeration use and 100 units or more for LNG use)
- Engineered steam turbines: More than 1,400 units
- Over 50% market share in compressors for large ethylene plants

Cryogenic Pumps and Expanders

Global: 7,800+

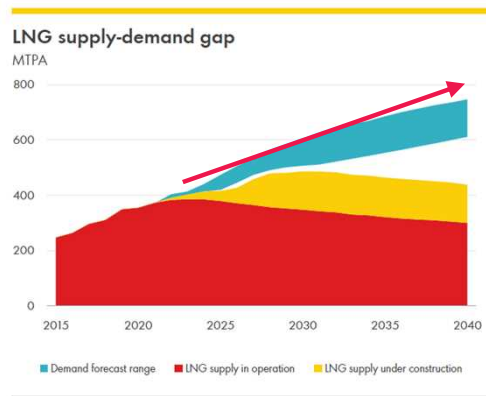
- Cryogenic pumps and expanders: 7,800 units or more (of which, more than 70% are for LNG)
- 100% market share in cryogenic expanders for LNG plants



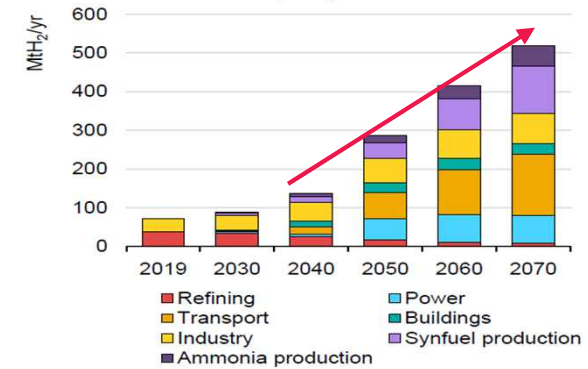
Megatrends in the Market

- 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.

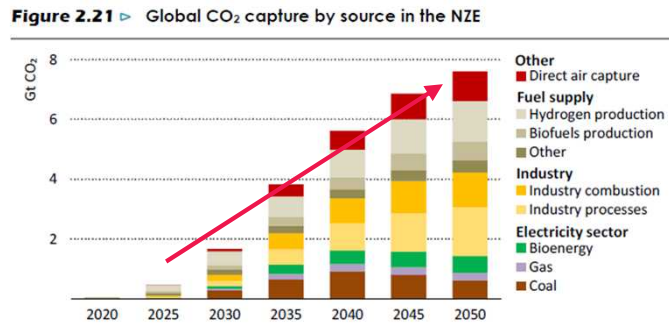
LNG



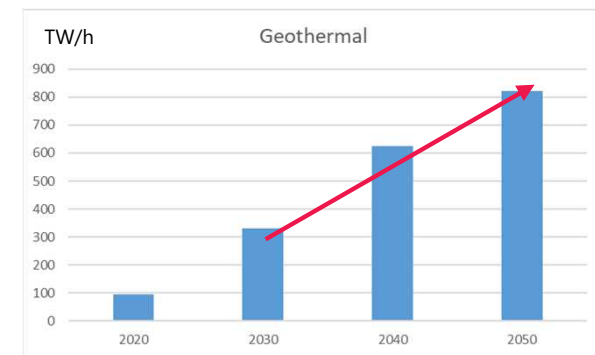
Hydrogen



Carbon Capture



Geothermal



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"> - Aim to achieve net zero of Scope 1 to 3 of carbon emissions by 2050 - Increase the volume of CCS to a minimum of 25 million tons annually by 2035. - Increase production of biofuels, hydrogen, etc. by eightfold or more by 2030 (compared with the level of 2021)
Exxon Mobil	<ul style="list-style-type: none"> - Aim to achieve net zero of Scope 1 to 2 of carbon emissions by 2050 - Make a low-carbon investment of 15 billion dollars (including CCS, hydrogen, and biofuels) by 2027 - Plan a hydrogen production plant and a large-scale CCS project at a petrochemical complex in Baytown, Texas, USA
Chevron	<ul style="list-style-type: none"> - Aim to achieve net zero of Scope 1 to 2 of carbon emissions in the upstream sector by 2050 - 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.
BP	<ul style="list-style-type: none"> - Aim to achieve net zero of Scope 1 to 2 of carbon emissions by 2050 - Plan one of the UK's largest blue hydrogen production projects with a maximum output of 1 GW by 2030.
Total Energies	<ul style="list-style-type: none"> - Aim to achieve net zero of Scope 1 to 3 of carbon emissions by 2050 - Increase the total generation capacity of renewable energy to 100 GW by 2030.

Sources: Compiled by referring to other companies' websites



Initiatives for Sustainable Growth

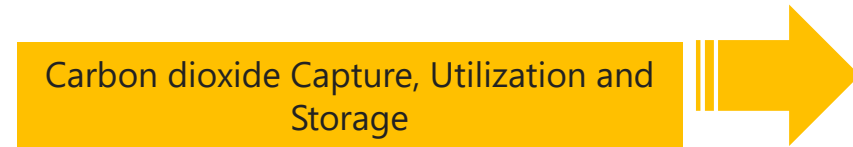
- Maintain and expand business in existing markets and enter new markets by leveraging Elliott's advanced technology and experience.



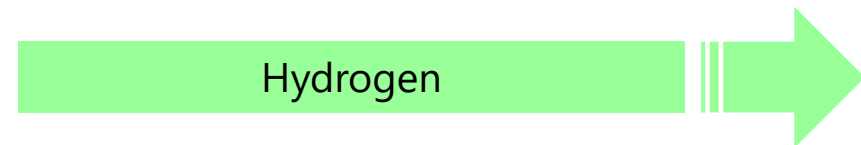
Utilization of turbine technology for geothermal
(Research and development underway at R&D)



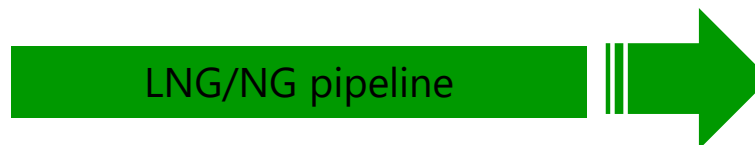
Package of compressors and pumps
(Available for application)



Flex-Op hydrogen compression solution
(Publicized with a press release)



Two-phase expanders
(Publicized with a press release)



Pipeline compressor
(Publicized with a press release)



Short term

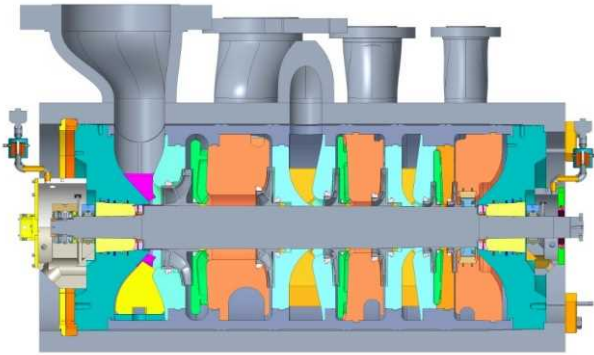
Medium term

Long term

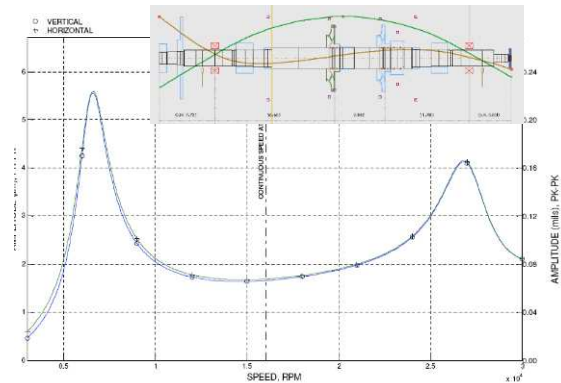
Timeline



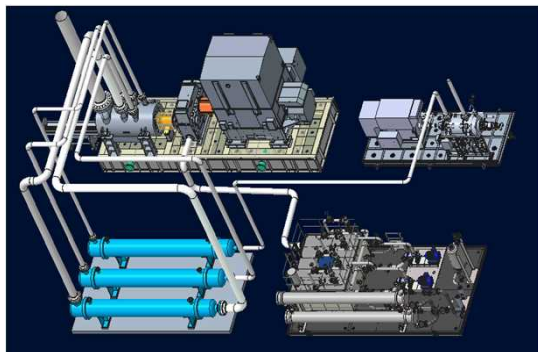
Carbon Dioxide and Supercritical Carbon Dioxide



- Special design of high-pressure compressors for CO₂
 - High pressure capability
 - Adoption of interstage cooling
 - Adoption of materials to meet corrosive environments



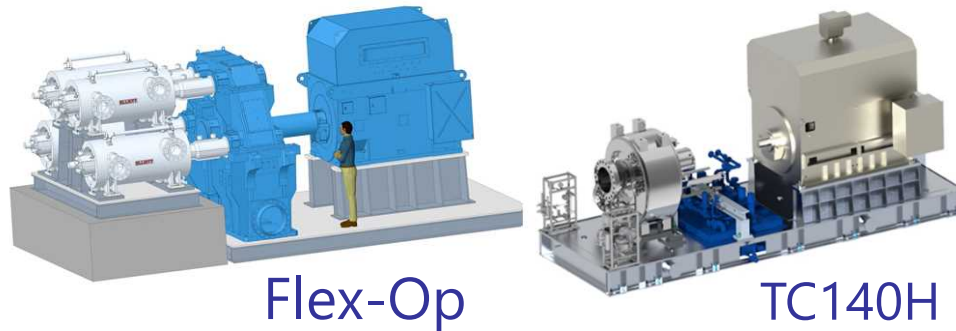
- High stability of rotor dynamics under super criticality and in high density



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

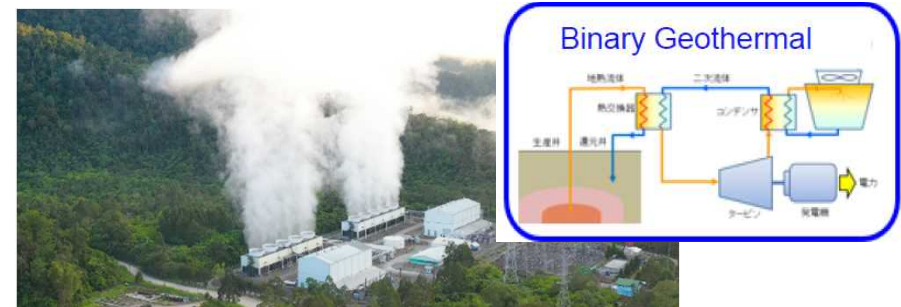
Sustainable Energy

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

Summary

- Megatrends: Decarbonization
 - LNG as the medium- to long-term response
 - CO₂ 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.



This release contains forward-looking statements which involve certain risks and uncertainties that could cause actual results to differ materially from those projected. Readers are cautioned not to place undue reliance on these forward-looking statements which are valid only as of the date thereof. EBARA undertakes no obligation to republish revised forward-looking statements to reflect events or circumstances after the date thereof or to reflect the occurrence of unanticipated events.

This document has been translated from the Japanese original for reference purposes only. In the event of any discrepancy between this translated document and the Japanese original, the original shall prevail.

The Company assumes no responsibility for this translation or for direct, indirect or any other forms of damages arising from the translation.

