MiRESSO

Beryllium resource and it’s stably securing

Masaru NAKAMICHI
MiRESSO Co. Ltd.

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Company Profile

MiRESSO (Mineral Refining and Recycling System Society)

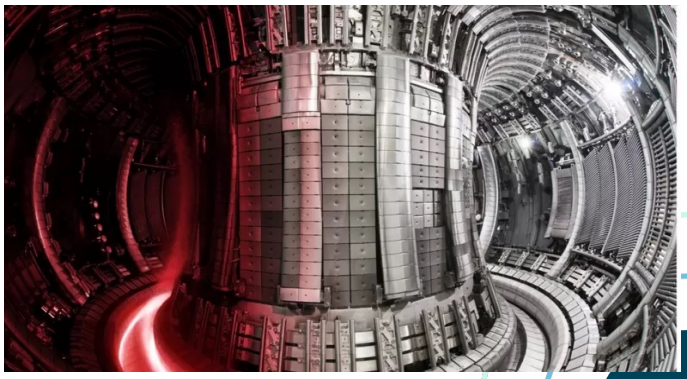
CEO	■ Masaru Nakamichi , Ph. D. (Previous job: Group Leader in the Breeding Functional Materials Development Group, QST)
Head Office	■ Aomori-Pref., Japan
Start-up	■ May, 2023
Business Outline	■ **Production and sales of Beryllium** ■ **Licensing & consultation** for energy saving and CO_2 emission reduction of refining and recycling process with high temperatures

Contribution to social and economic security by stably securing mineral resources

QST (National Institutes for Quantum Science and Technology)

Organization	■ One of eight organizations charged of **Ministry** of Education, Culture, Sports, Science and Technology (MEXT) in Japan.
Support from QST	■ MiRESSO is the **1st certified startup company by QST in the fusion energy institute of QST.** ■ MiRESSO can receive benefits from QST, such as patent licensing and facility rental.

＜Image of fusion reactor＞



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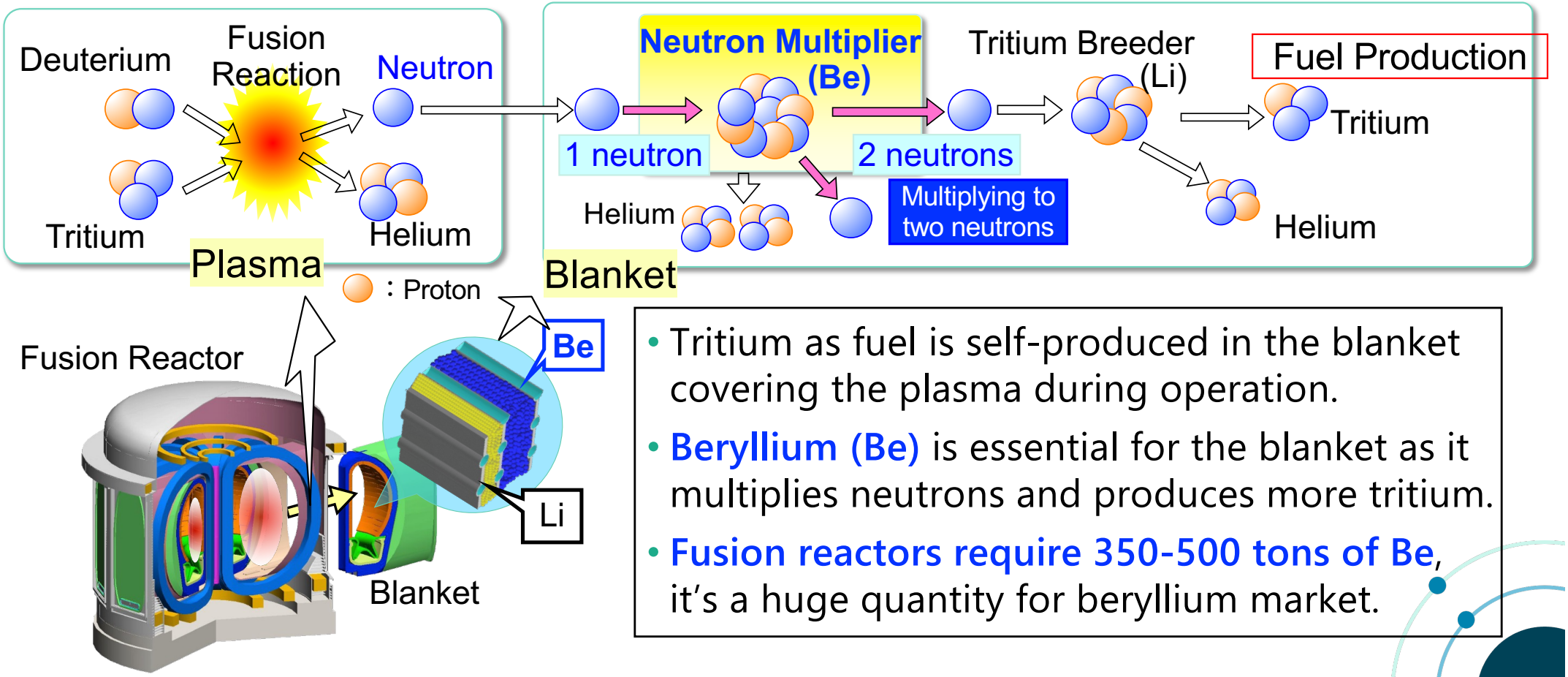
Fusion : Large quantities of beryllium are essential.



- Tritium as fuel is self-produced in the blanket covering the plasma during operation.
- **Beryllium (Be)** is essential for the blanket as it multiplies neutrons and produces more tritium.
- **Fusion reactors require 350-500 tons of Be**, it's a huge quantity for beryllium market.

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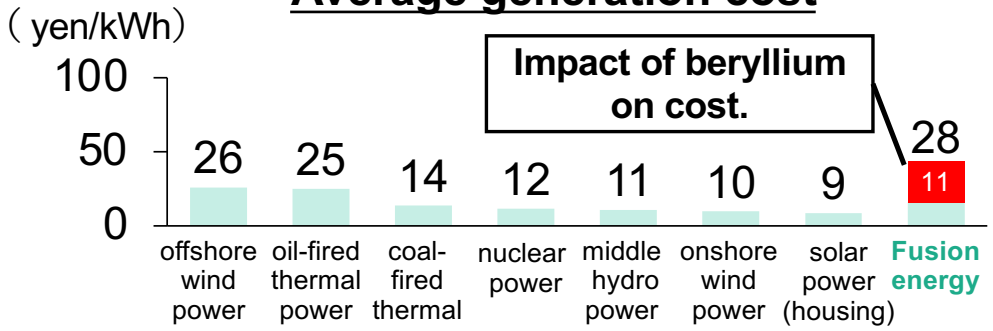
Issues for beryllium procurement

Issues

① Overpriced

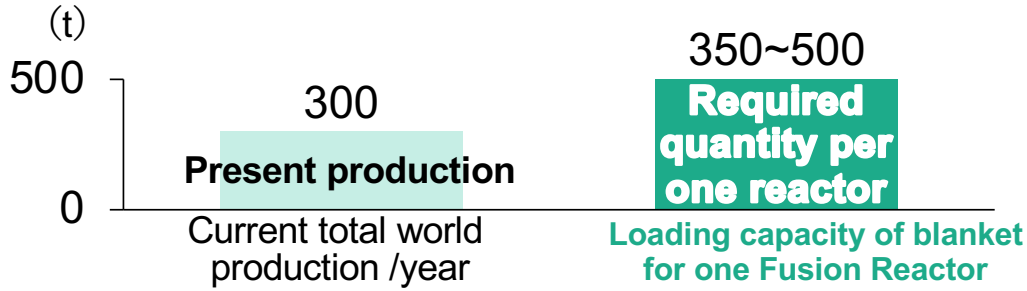
Average generation cost



- Beryllium is **very expensive**.

② Insufficient production

Beryllium production and requirements



- Even one fusion reactor requires more beryllium than annual production (→**shortage**).

Cause

- **Two main difficulties in increasing beryllium production are**
  - High-temperature Refining：**High operating expenditure (OPEX)** for ore dissolution at 2,000˚C
  - Safety management：**High capital expenditure (CAPEX)** for safety handling of specified chemical substances

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Technology Comparison in the Dissolution Process

Conventional

Image: 2,000℃ melting

Beryllium ore (beryl)

High Cost!

Conventional Process

Melting(**2,000˚C**)

Quenching

Sulfation Roasting (250˚C)

Separating & Refining

Products (Be & compounds)

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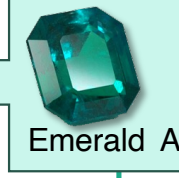
MW: Microwave



Emerald Aquamarine

Beryllium ore (beryl)

Cost Reduction!

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Our innovative process

Base + MW Heating (**300˚C / Normal Press.**)

Acid dissolution (Room Temp. / Normal Press.)

Separating & Refining

Products (Be & compounds)

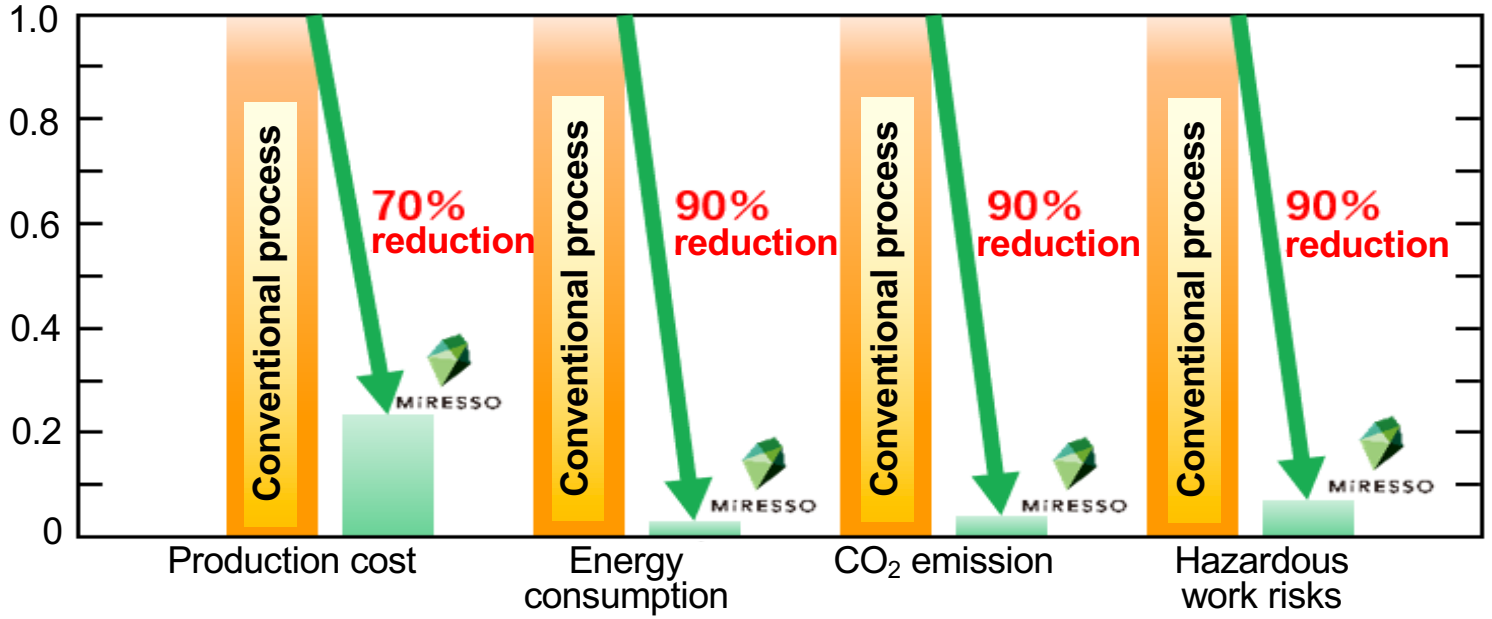
MW Heating at 300˚C

3. The value we can offer in the refining process

Achieving both cost reduction and environmental advantages compared to conventional process of Be ore (Beryl) dissolution.

Comparison of conventional Beryl dissolution process with MiRESSO innovative process:

two-step heating at 2,000 and 250 °C ➡ only one heating by microwave at 300 °C



"Our technology has a positive impact on society in terms of sustainability."

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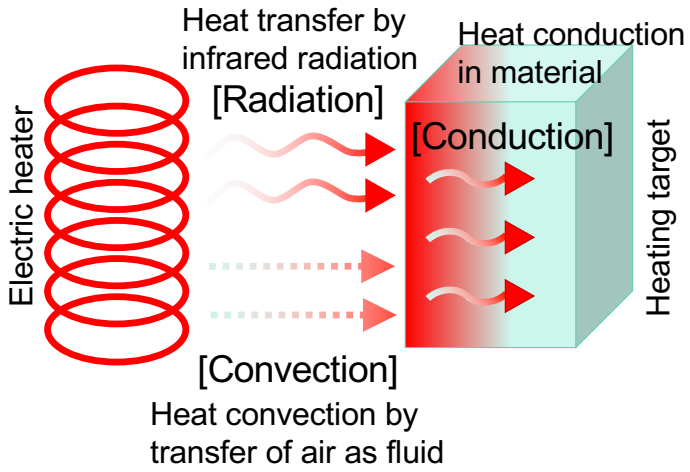
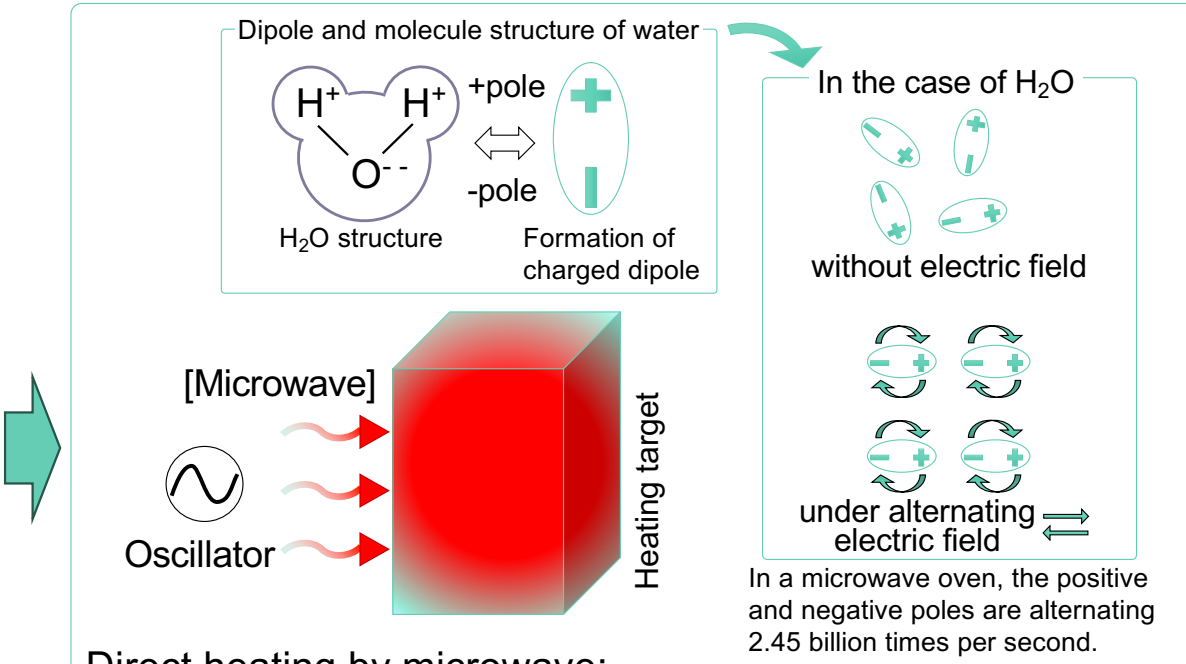
3. The value we can offer in the refining process

Advantages of microwave (MW) heating as direct heating compared with conventional using electric heater as indirect heating



Indirect heating :
Heat from an external heat source such as an electric heater is applied to the heating target from the outer surface through radiation, convection and conduction.



Direct heating by microwave:
In the electric field, the heating target acts itself as heat source by oscillation of its molecules with frequency of microwave.
[Quick and uniform heating, good heating efficiency]

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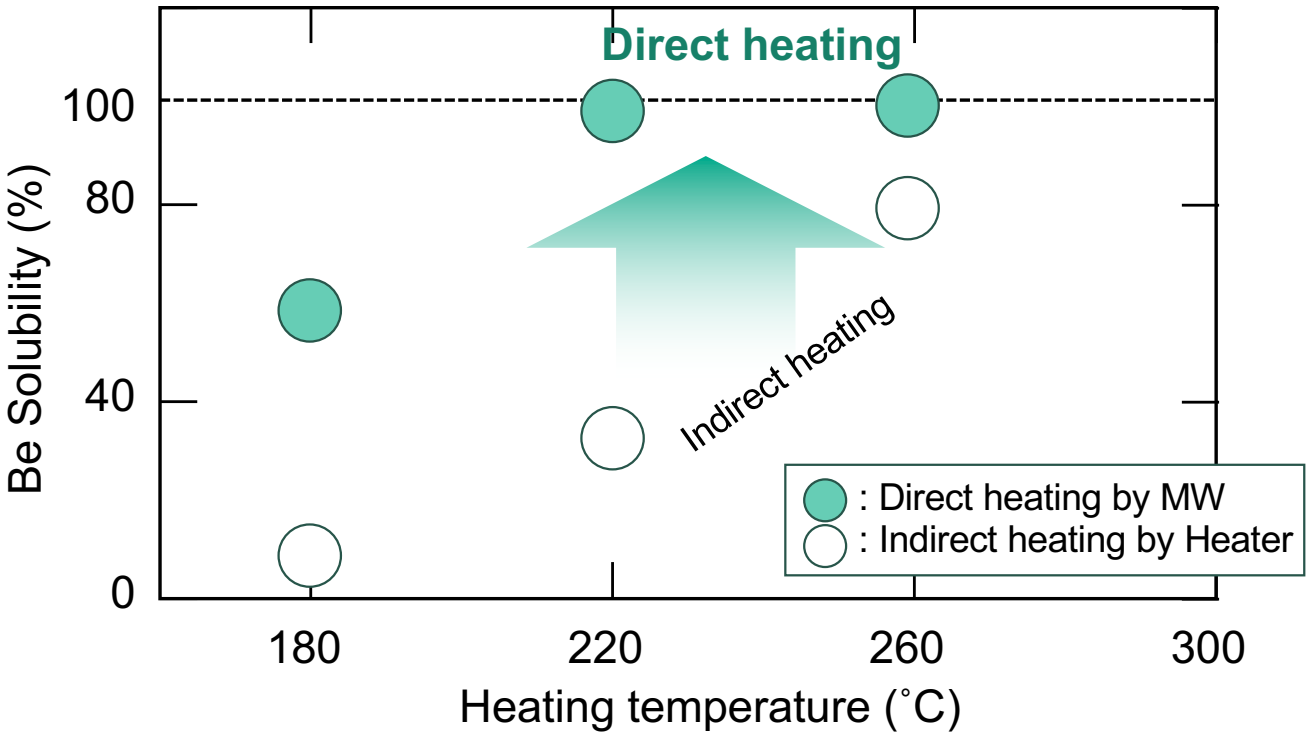
3. The value we can offer in the refining process

Effect of direct heating by microwave (MW) on Be solubility compared with indirect heating by electric heater

The relationship between heating temperature and Be solubility



- ✓ The enhancement of Be dissolution by microwave heating was observed.
- ✓ It is assumed that chemical reactivity is increaced by direct heating of molecules and clusters cased by microwave irradiation.

Advantage on Be solubility by MW heating was observed

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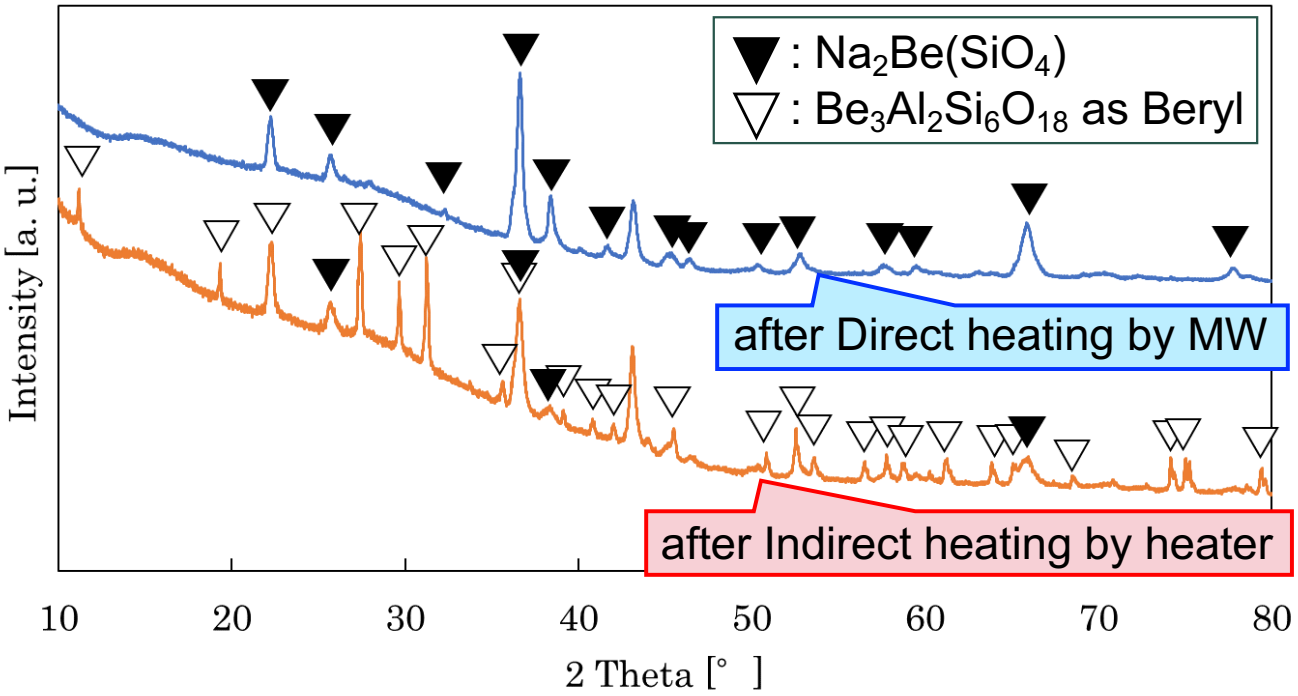
3. The value we can offer in the refining process

Exchange from insoluble to acid soluble composition by microwave (MW) heating with chemical reaction

XRD profiles of reaction product after heating[Heating temperature at 260 ˚C]



Chemical equation of Beryl and base agent

$$Be_3Al_2Si_6O_{18} + 14NaOH \rightarrow 3Na_2Be(SiO_4) + 2Na[Al(OH)_4] + 3Na_2SiO_3 + 3H_2O$$

- ✓ Beryllium Sodium Silicate $Na_2Be(SiO_4)$ ▼ was identified as reaction product after direct and indirect heating.
- ✓ Acid soluble $Na_2Be(SiO_4)$▼ was formed as the result of chemical change of Beryl $Be_3Al_2Si_6O_{18}$ ▽.
- ✓ Beryl was left in reaction product after indirect heating.

Enhancement of chemical reaction between Beryl as ore and base agent was observed by MW heating.

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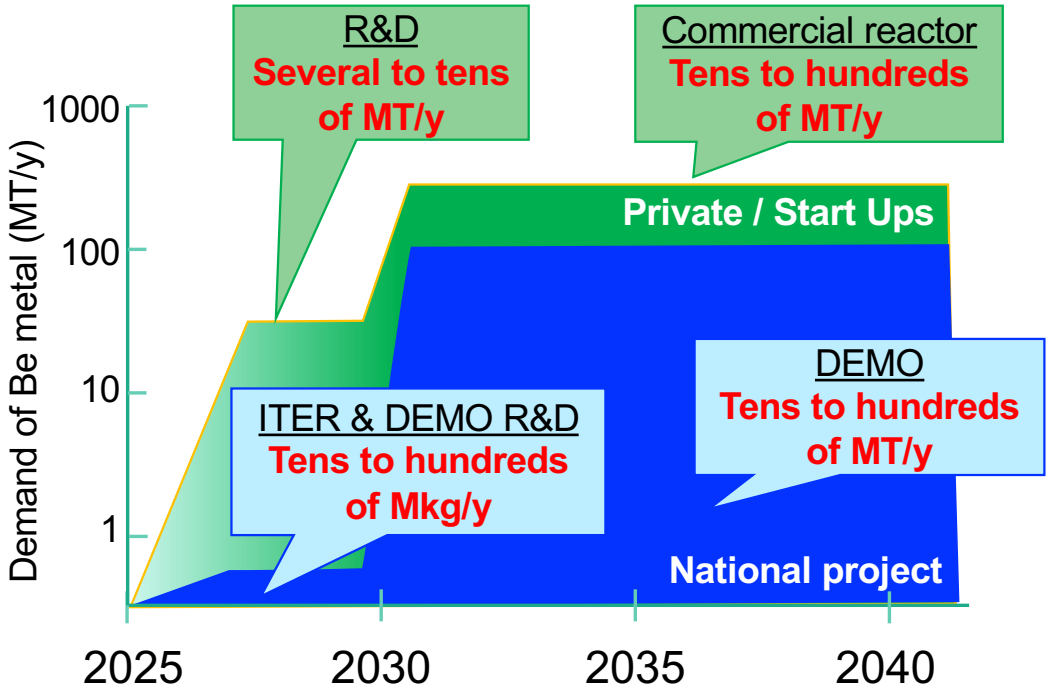
MiRESSO covers Fusion, Fission and Existing Be market

Timeline of Fusion Energy



DEMO : Fusion DEMOnstration Power Plant
MT/y : metric tons per year
Mkg/y : metric kilograms per year

Be related products and Expected sales destination

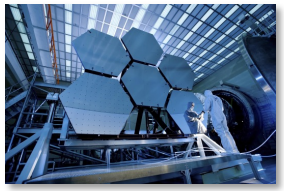
BeCu alloy (< 2 wt.% Be)

Industrial components for Automotive, Telecommunications, etc.
(connector, switch, spring, etc.)

Be metal and Beryllides

Aerospace (structural material, mirror, etc.)

Healthcare
(X-ray transmissive window)



Be mirror of James-Webb Space telescope

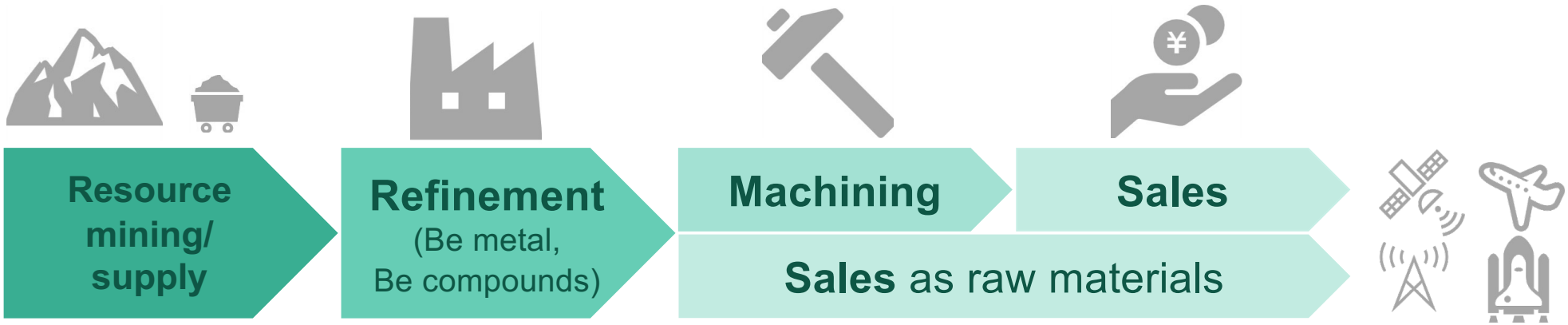
Fission industries

Be compounds (molten salt)

Small Modular Reactors (SMRs)
(coolant, neutron moderators and reflectors)

For demonstration reactors:
purchase : several tons to over ten tons.

Establishment of supply chain for Beryllium



- Resource : **1600 years** of reserves available. Procurement prospects of ore* from the pegmatite mine.
- Refining : Under construction of **pilot plant targeting operation in 2027**.
- Manufacturing : Possessing **Novel Beryllium Manufacturing** and **Processing Technology for Fusion (World's First)**
- Sales : Development of customers and **acquisition of LOIs** (Letter of Intent).

*Beryl (Be) and spodumene (Li) deposits are one of pegmatite (cooled magma).

Free supply of beryl for feasibility study (FS) from a pegmatite mining company in Western Australia.

Funding status

1st Round : SUs acceleration program

1stRound

Univ. Tokyo Innovation Platform Co.,Ltd.

- Receiving up to approx. **70 k USD** (10 mil JPY) in non-equity funding without limits on how the funds are used.
- Support for development tools and facilities such as cloud resources and offices.

SBIR in MEXT Japan (Small Business Innovation Research)

Ministry of Education, Culture, Sports, Science and Technology (MEXT)

SBIR Project (Phase 3)

Fusion Energy Field

(Business theme: Verification of Fusion technologies forward to Fusion Demonstration Reactor (DEMO), etc.)

- Selected for approx. **15 mil USD** (2 bln JPY) as subsidy

We had raised approx. **2mil USD** (0.25 bln JPY) in Seed Round from Japanese companies in March 2024.

Genesia Ventures, JGC, global brain, MS&AD 三井住友海上キャピタル

We have raised approx. **12 mil USD** (1.83 bln JPY) in Series A 1st Close from Japanese companies in August 2025.

Spiral Capital, Genesia Ventures, 大平洋金属株式会社 PACIFIC METALS CO., LTD.

Milestone for Beryllium production

Technology Readiness Level (TRL) : The measure of technical attainment to mass production

The term of SBIR project

Basic Research → Applied Research/Development → Demonstration → Commercialization

2019 [TRL1] Technological Inventions

2020 [TRL2]

2021 [TRL3] Technological Confirmation

2022 [TRL4]

2023 [TRL5] Laboratory Test

2024

2025 [TRL6] Simulated Demonstration

2026

2027 [TRL7] Demonstration in the actual environment

2028 [TRL8] Pilot production

2029

2030 [TRL9] Mass production

The pilot plant of Be refining as BETA is preparing using 15 mil USD (2 bln JPY) subsidy of the SBIR Project

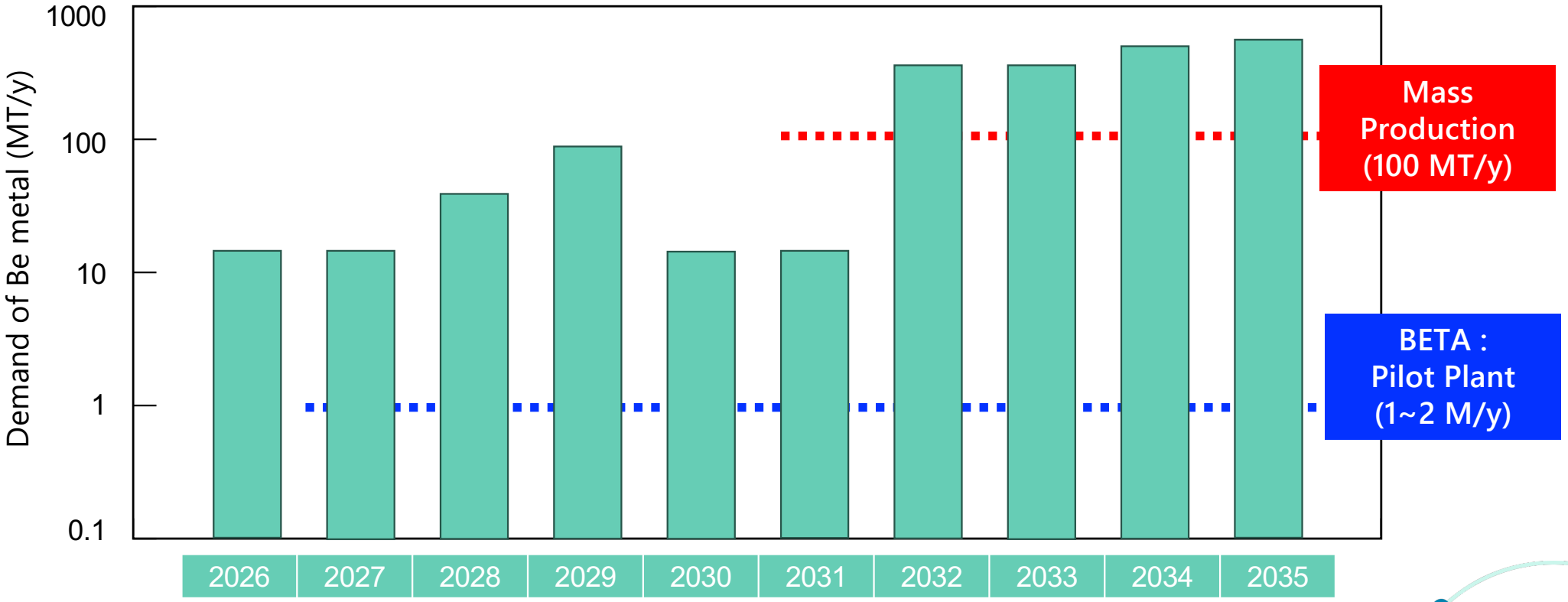
1~2 MT/y

100 MT/y

MT/y: metric tons per year

LOIs* from Potential Fusion and Existing Buyers

LOIs* : Letter of Intent



MiRESSO has a lot of LOIs from customers in not only Fusion industry but also general industry.

MT/y: metric tons per year

Successfully fabricated BeF_2 from Beryl (Be ore)

Beryllium ore (beryl) 

Our innovative process

Base + Microwave Heating
(300˚C • Normal Press.)

Acid dissolution
(Room Temp. • Normal Press.)

Separating & Refining

Products (Be & compounds)

Appearance of synthesized BeF_2 from Beryl

MiRESSO successfully fabricated BeF_2 with high yield from Beryl (Be ore) in the bench-scale.

Government Endorsement – NEDO Leading Research Program

Program :

- NEDO with Ministry of Economy, Trade and Industry (METI) in Japan

Funding (2025~2027) :

- 200 mil JPY (~1.1 mil USD) over 3 years

Research Focus :

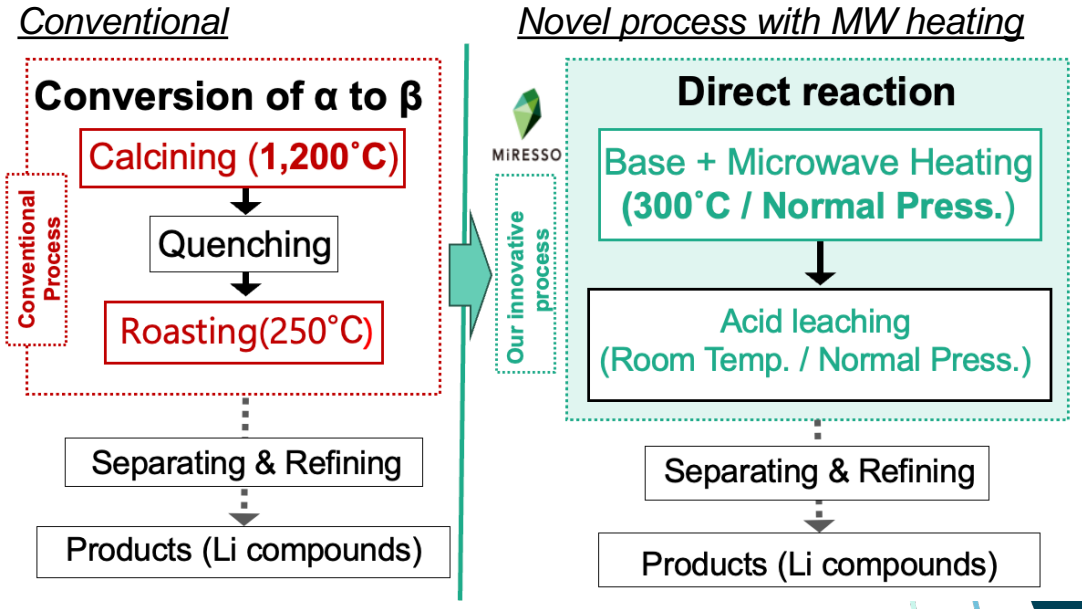
- **"Development of novel lithium refining technology with microwave heating"**

Strategic Significance :

- Supports Japan's critical mineral supply chain resilience
- Contributes to carbon-neutral and decentralized extraction

経済産業省 Ministry of Economy, Trade and Industry

NEDO New Energy and Industrial Technology Development Organization



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Versatility and target market for our refining technology

Ore	Conventional treatment temperature	MiRESSO Tech.	Market of minerals
Beryl (Be)	2,000˚C(Melting)→Quenching→250˚C (Roasting)		Be-Cu alloy, X-ray window, Mirror for 3D printer, Structural material
Spodumene (Li)	1,150˚C(Calcination)→250˚C(Roasting)	less than 300˚C	Battery, Additive for ceramics and glass, Heat-resistance grease
Cobalt rich crust (Co)	900˚C(Reduction)→1,400˚C(Smelting)		Battery, Hard alloy, Plating, Pigment
Manganese nodule (Mn)	900˚C(Reduction)→1,400˚C(Smelting)		Battery, Magnet, Oxygen absorber, Additive
Bastnäsite (REE)	800˚C(Oxidation roasting)		Magnet, LED, Laser, Superconductor, Electrode, Electrolyte
Bauxite (Al)	1,000˚C(Melting)		Structural material, Electronics, Container, Package
Iron ore (Fe)	1,300˚C(Reduction)		Structural material, Machine parts, Container
Rutile (Ti)	1,000˚C(Chloridation)→850˚C(Reduction)		Catalyst, Heat resistant, Corrosion resistant
Zircon sand (Zr)	1,200˚C(Chloridation)→950˚C(Reduction)		Catalyst, Electronics, Fine ceramics
Silica (Si)	1,500˚C(Reduction)		Semiconductor, Battery parts, Ceramics, Resin
Sphalerite (Zn)	1,000˚C(Oxidation)→1,300˚C(Reduction)		Plating, Structural material, Battery, Corrosion resistant

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Versatility and target market for our refining technology

Ore	C[illegible]e	MiRESSO Tech.	Market of minerals
Beryl (Be)	2.0 [illegible]		Be-Cu alloy, X-ray window, Mirror for 3D printer, Structural material
Spodumene (Li)	1,150˚C(Cal[illegible]		Battery, Additive for ceramics and glass, Heat-resistance grease
Cobalt rich crust (Co)	900˚C(Reduc[illegible]		Battery, Hard alloy, Plating, Pigment
Manganese nodule (Mn)	900˚C(Reduction)→1,400˚C(Smelting)		Battery, Magnet, Oxygen absorber, Additive
Bastnäsite (REE)	800˚C(Oxidation[illegible]		[illegible]t, LED, Laser, Superconductor, Electrode, [illegible]olyte
Bauxite (Al)	1,000˚C(Melting)		Structural material, Electronics, Container, Package
Iron ore (Fe)	1,300˚C(Reducti[illegible]		[illegible]ine parts, Container
Rutile (Ti)	1,000˚C(Chlorida[illegible]		Corrosion resistant
Zircon sand (Zr)	1,200˚C(Chlorida[illegible]		[illegible]e ceramics
Silica (Si)	1,500˚C(Reduction)		Semiconductor, Battery parts, Ceramics, Resin
Sphalerite (Zn)	1,000˚C(Oxidation)→1,300˚C(Reduction)		Plating, Structural material, Battery, Corrosion resistant

Lithium ore

Seabed minerals

Rare earth mineral

Applicable to dissolution of synthetic ceramics

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Vision & Mission

Vision

Contribute to the social realization of fusion energy through stably securing of beryllium

Mission

Bring out the potential of mineral resources and connect a bright future to the next generation

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Mineral Refining and Recycling System Society