

“The world is full of resources ! ”

- * Let's extract magnesium from seawater
- * Let's recycle and fix carbon dioxide
- * Let's realize a hydrogen society

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Our goals in the SDGs

7 AFFORDABLE AND
CLEAN ENERGY



9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



12 RESPONSIBLE
CONSUMPTION
AND PRODUCTION



13 CLIMATE
ACTION



(From UNIC website)

Our strategy

We propose the required carbon dioxide reduction measures for all companies, governments and organizations.

Business Overview

We are currently conducting business under the banner of “Making Japan a Resource-rich Country”.

① Collect magnesium and lithium contained in ocean water and supply purely domestic low-CO₂ magnesium as a component of next-generation core industries such as automobiles and robots.

② Use a power generation method that utilizes a combustion reaction between magnesium and CO₂ to achieve both heat / power supply and CO₂ fixation. Produce hydrogen by thermally decomposing methane and lignite using the 3000° C heat generated during combustion. Water is decomposed by the IS process to produce hydrogen.

③ Make methane and hydrogen, which become renewable energy sources, underground in Japan.

The Japanese government has announced the policy "Achieve substantially zero greenhouse gas emissions by 2050." This project will protect Japan's status as an export nation and at the same time contribute to global climate change countermeasures.

【 "Making Japan a Resource-rich Country!" Mandala 】

Overview ① Magnesium / lithium mining

[New extraction method] [New reduction method]

Japanese Patent Application
"Magnesium recovery method
and magnesium recovery device"

Japanese Patent Application
"Magnesium recovery method
and magnesium recovery device"

Deploy in various industries



Electric power supply



Overview ② Mg + CO₂ combustion power generation / CO₂ fixation

Japanese Patent Application
"Carbon fixation device
for power generation"



[Turbine power generation]

1750°C

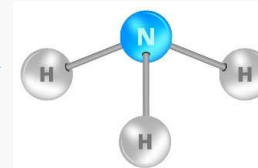


CO₂-free hydrogen / liquid fuel generation

1400°C

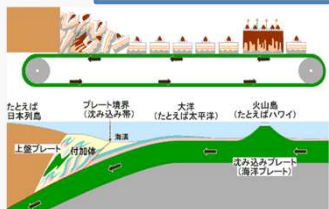


[Ammonia fuel]



Overview ③ Generation of renewable energy hydrogen

"Underground generation of renewable energy methane and hydrogen" Japanese Patent Application

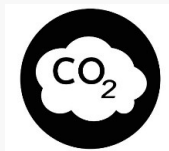


Hydrogen Supply

Realization of a hydrogen society



Promotion of CO₂ dissolution



Problem 1

Does Japan lack resources? ?

Solution

**Create sustainable and
revitalizing domestic resources
to become a resource exporter**

Problem 2

**CO₂ reduction is a global
issue**

Solution

**Promote CO₂ recycling
and fixation**

Ploblem3

Realizing a hydrogen
society

Solution

Supply hydrogen derived
from renewable energy

Part 1

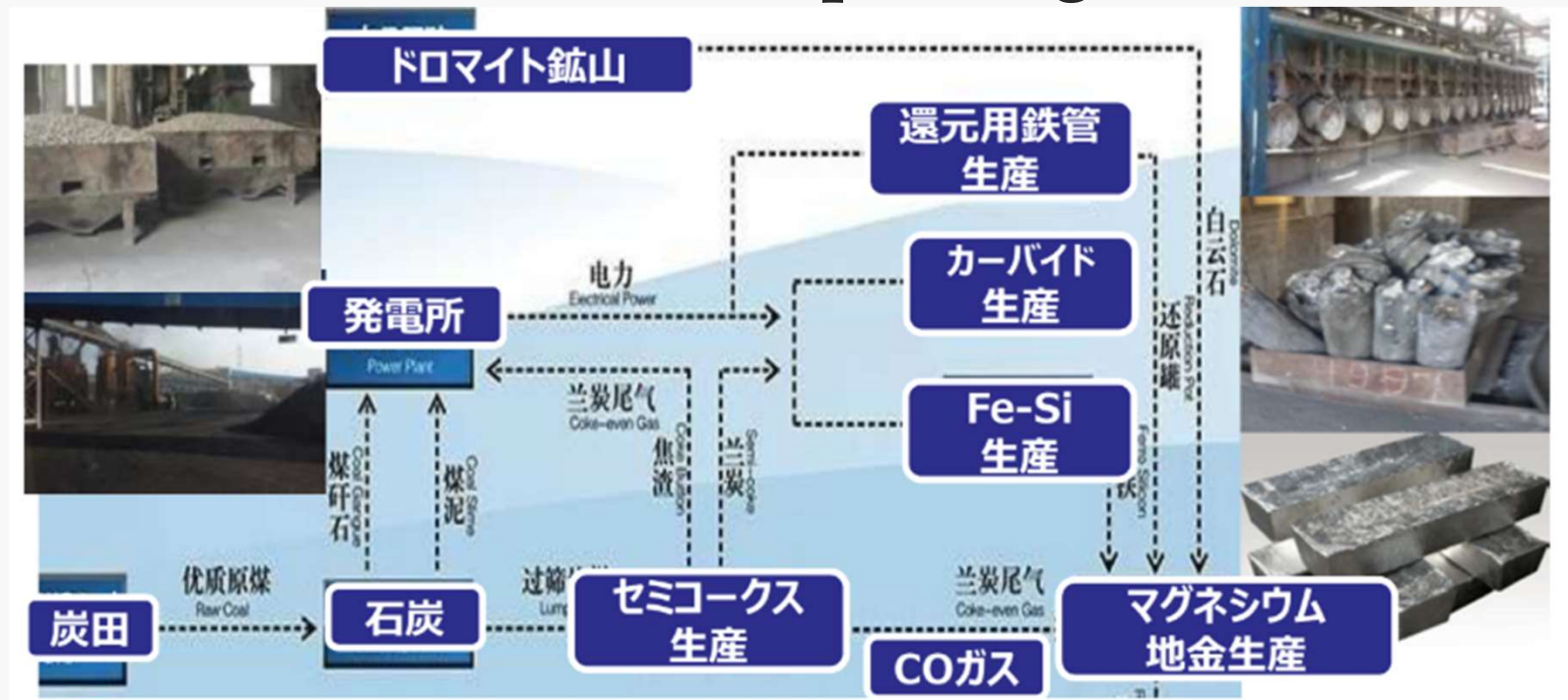
Focus on magnesium, for which there is a strong latent consumer appetite



Applications of Magnesium

Current status of magnesium production

China monopolizes 85% of world production; large amount of CO₂ emitted due to coal fired power generation



2021 Magnesium price hikes

FINANCIAL TIMES

China's magnesium shortage threatens global car industry

Production curbs in the country have hurt stockpiles of a key ingredient to make aluminium in vehicles



Almost 90 per cent of the world's magnesium production comes from China, where the local government ordered roughly 35 of its 50 magnesium smelters to close until the end of the year © AFP via Getty Images

Magnesium delivered to Europe duty unpaid

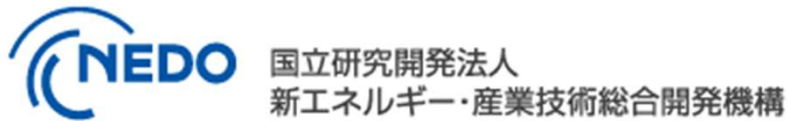
Price (\$)



Source: Argus Media
© FT

**Magnesium is lighter and
stronger than aluminum**

(Example of other groups) NEDO Project Using magnesium for the next Shinkansen




Succeeded in trial production of one of the world's largest partial body structure of a high-speed railway vehicle using flame-retardant magnesium alloy

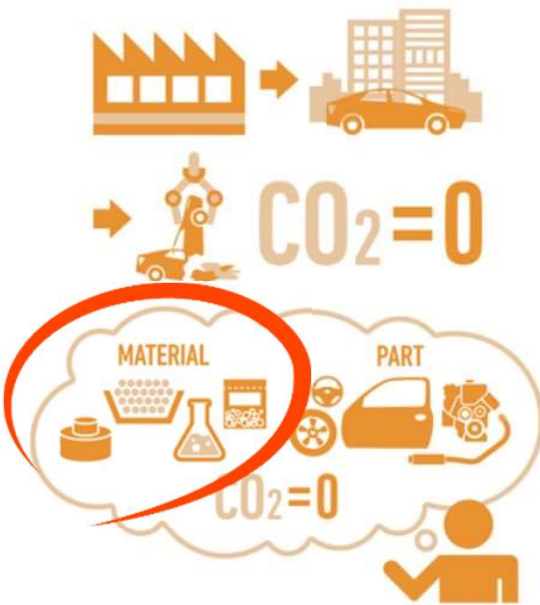



NEDO and the Innovative Structural Materials Association (ISMA) succeeded in prototyping a partial body structure of a high-speed railcar that has the same cross-sectional size as a Shinkansen car, in cooperation with ISMA members Japan Transport Engineering Company, Kawasaki Heavy Industries, Ltd., Sankyo Tateyama Co., Ltd., Gonda Metal Industry Co., Ltd., Sumitomo Electric Industries, Ltd. Fuji Light Metal Co., Ltd., Dai Nippon Toryo Co., Ltd., National Institute of Advanced Industrial Science and Technology, and subcontractors Kinomoto Shinsen Co., Ltd. and Million Chemical Co., Ltd. This body structure is one of the largest structures in the world that uses only flame-retardant magnesium alloy.


By 2050, Toyota will make all cars built and run CO₂-free

Challenge  **Life Cycle Zero CO₂ Emissions Challenge**

– Environmental Challenge
Completely eliminate all CO₂ emissions throughout the entire vehicle life cycle




– 2030 Milestone 

 **25%** Reduce CO₂ emissions by 25% or more throughout the **entire vehicle life cycle** compared to 2013 levels ³

³ by promoting activities for the milestones of Challenges 1 and 3 with support from stakeholders such as suppliers, energy providers, infrastructure developers, governments and customers

Specific measures

We will strive to reduce CO₂ emissions throughout the entire vehicle life cycle including manufacturing to driving and disposal stage from both *sides of technological development and value chain collaboration.*



Develop low-CO₂ materials and expand use of recycled materials

Operate commercial trucks using fuel cell technology

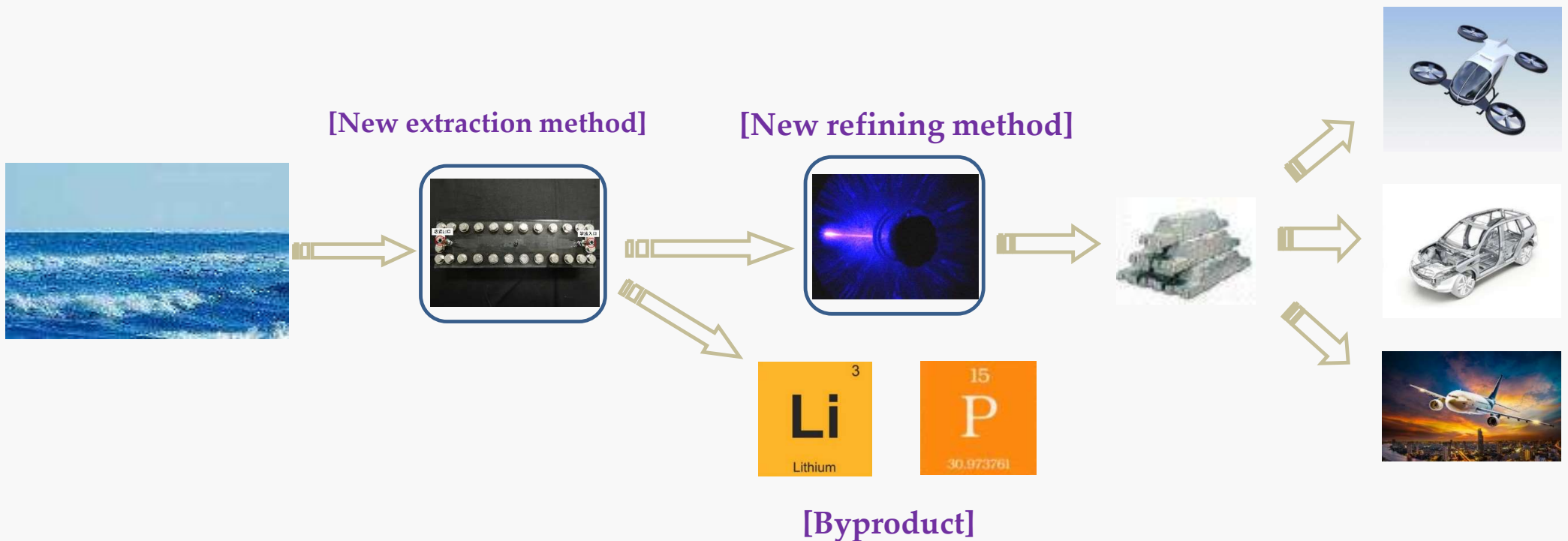
**OK, let's make pure
domestic magnesium
from seawater**

CO₂-free magnesium made from seawater

Japanese Patent Application 2019-199829

"Magnesium recovery method and magnesium recovery device"

[Deployment as a structural material]



Part 2

Let's recycle carbon dioxide

Japan-Scotland Collaborative Technology Development Grant for Ocean Development by Japan foundation 2019

**Yokogawa Electric and
Aonbarr jointly proposed to
adopt CO₂ recycling**



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CO₂ fixation is important

Regarding the publication of the Intergovernmental Panel on Climate Change

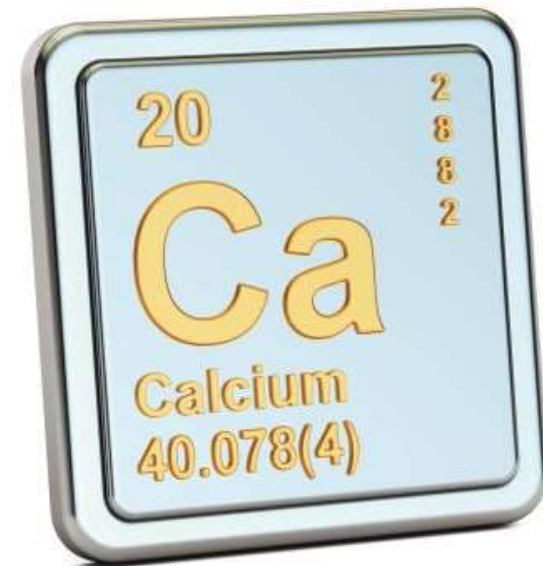
(IPCC) "Special Report Global Warming of 1.5°C (*)"

http://www.env.go.jp/earth/ipcc/6th/ar6_sr1.5_overview_presentation.pdf

[Summary]

A rise of 2 °C is dangerous. It must be kept at 1.5°C. For that purpose, reusing CO₂ is not enough, we have to reduce it from the air!

Let's get carbon dioxide
out of the ocean by calcium & magnesium.
Direct Ocean Capture (DOC) is applied by ARPA-E project too.



Magnesium for the purpose of CO₂ fixation

Forbes JAPAN

"At the conference, the chemical formula for extracting CO₂ from the atmosphere and making it into magnesite was also announced. When CO₂ in the atmosphere is injected into water, it it dissociated, producing carbonic acid.

From there, pure magnesium combines with the carbonic acid to form magnesite (MgCO₃). "

(Excerpt from the article)

New patent applied on 12/March/2021.

The patent shows new Direct Air Capture(DAC) method.



The image is a promotional banner for the XPRIZE Carbon Removal competition. It features a dark blue background with a view of Earth from space on the right and a portrait of Elon Musk. The text is white and pink. At the top left is the XPRIZE logo. The main headline reads '\$100M GIGATON SCALE CARBON REMOVAL'. Below that, it says 'PHASE Announcement'. In the bottom left, there is a logo for 'XPRIZE CARBON REMOVAL' and the name 'ELON MUSK'. At the bottom, there are navigation links: 'OVERVIEW', 'ACTIVITY', and 'SPONSORS & PARTNERS'. On the right, there is a pink button that says 'Enter email for updates'. At the top right, there are navigation links: 'WHO', 'WHAT', 'ACT', and 'STORIES'.

<https://www.xprize.org/prizes/elonmusk>

**OK, let's kill two birds
with one stone**

Power generation by burning magnesium and CO₂

Japanese Patent Application

Killing two birds with one stone:
clean thermal power + power generation

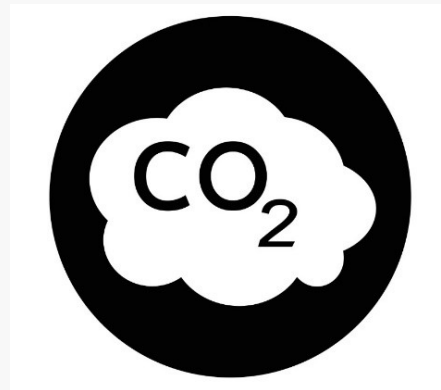
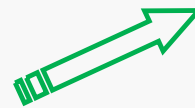


(Chubu Electric Power)

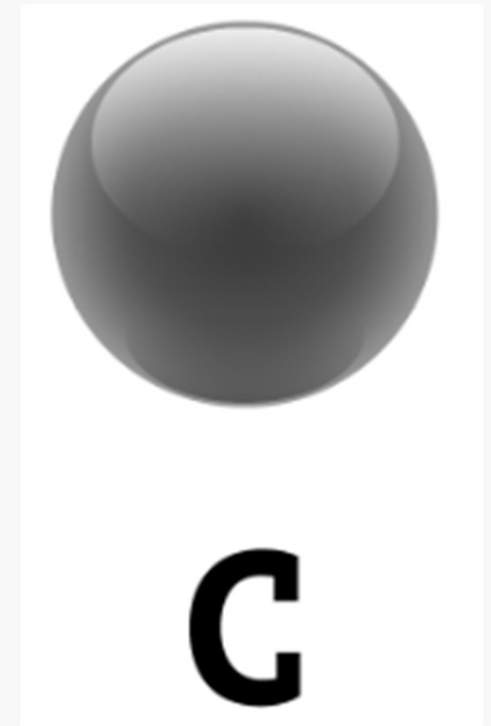


(MHPS)

Fixation of emitted CO₂



CO₂ and magnesium are burned and
Fixed as carbon (C)



Japanese Patent Application

The third wave of CO₂-free power generation

[wind]

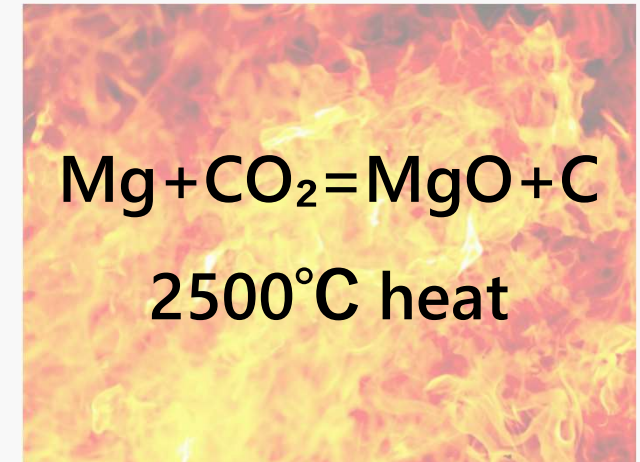


(From METI website)

[solar]



[magnesium]



BONUS

CO₂ reduced

Currently working as a member of
the Carbon Recycling Fund in Japan

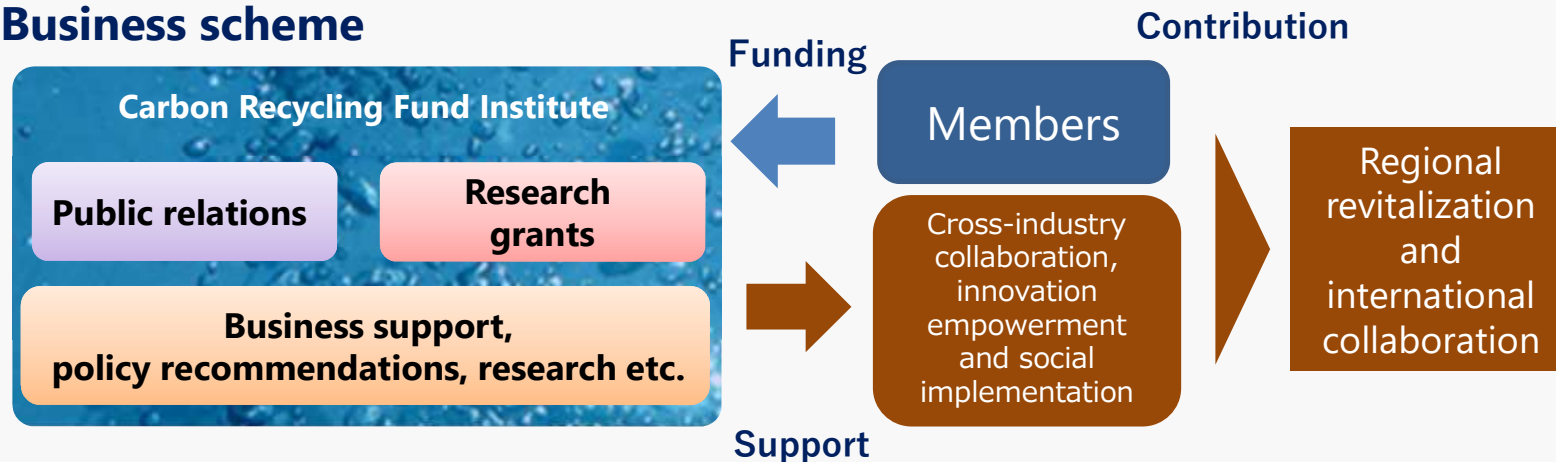


**CARBON
RECYCLING
FUND INSTITUTE**

Outline of Carbon Recycling Fund Institute (CRF)

- History** Established in August 2019, CRF aims to solve the global warming while improving the access to energies in the world at the same time by supporting the creation of innovations that contribute to carbon recycling.
- Mission** Supporting the social implementation of carbon recycling and the private sector's business efforts in collaboration with the government

- Business scheme**



- URL** <https://carbon-recycling-fund.jp/aboutus/en.php>
<https://carbon-recycling-fund.jp/>

**Japanese government
is interested to make
Hydrogen society.**

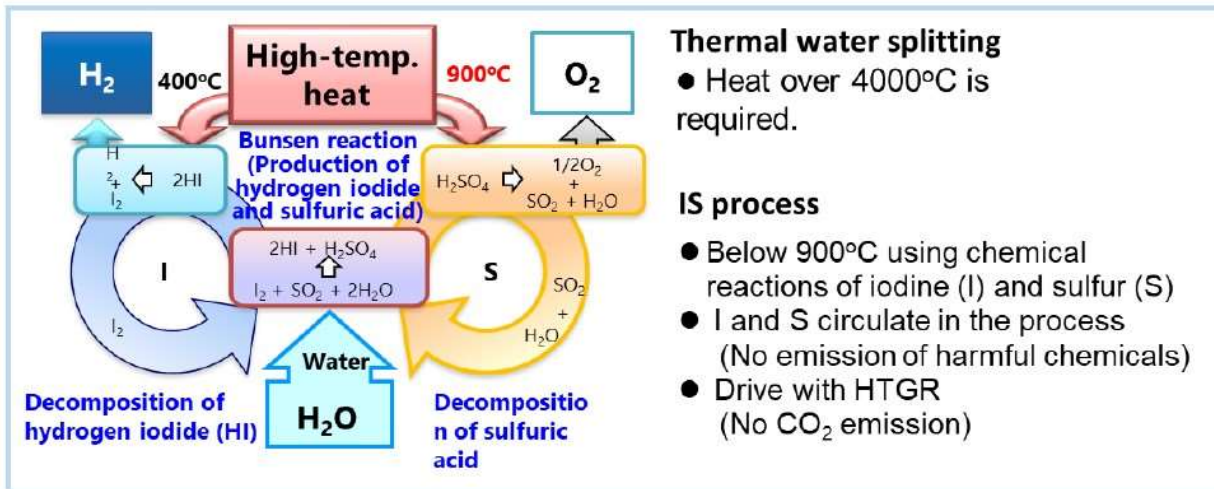
**OK, let's make a
hydrogen by the heat.**

Hydrogen generation using water as a raw material

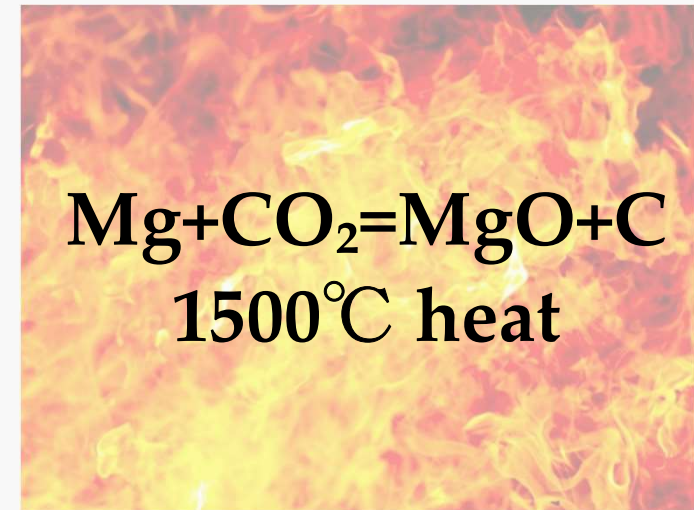
Hydrogen production by means of IS process

IS Process Research and Development

IS Process Research and Development is conducted R&D on hydrogen production technology using a high temperature gas-cooled reactor which is a promising candidate for next generation energy source. The hydrogen production technology named IS process is thermochemical water splitting chemical process using chemical compounds of iodine (I) and sulfur (S).



The world's energy system depends on finite and uneven distribution fossil fuel resources. The hydrogen utilization like a fuel cell can be a candidate to solve this problem. In order to realize the hydrogen energy economy, all of advantage, which is suitability for mass production, economical, and environmental friendly, is essential for the hydrogen production technologies, raw materials, and primary energy. In recent years, water splitting hydrogen production methods powered by nuclear energy and renewable energy have much attention to satisfy all of these requirements.



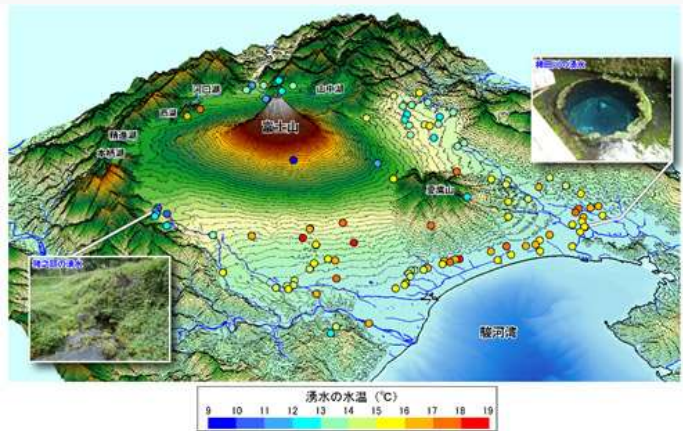
(Cited from JAEA website)

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Liquid fuel production using hydrogen as a raw material

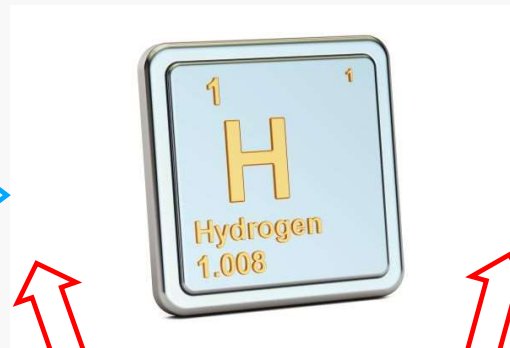
Domestic liquid fuel that utilizes CO₂-reducing hydrogen generation

[Abundant groundwater of Mt. Fuji]

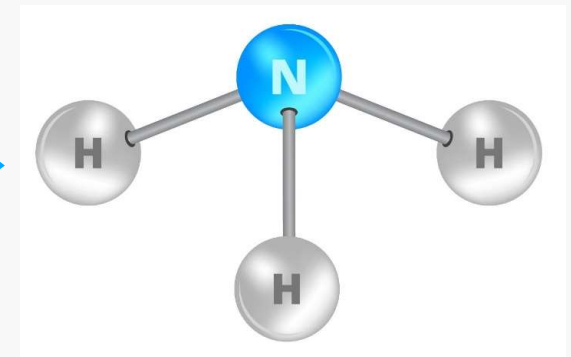


(Cited from AIST website)

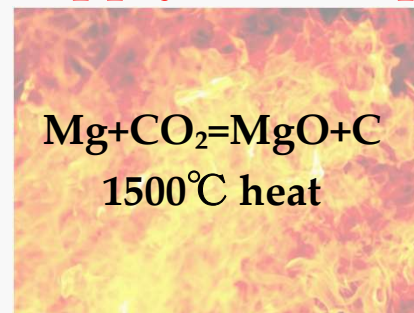
[Hydrogen production]



[Ammonia production]



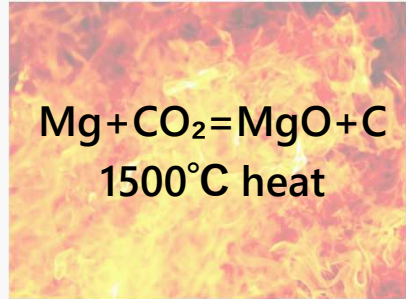
[Heat supply to each process]



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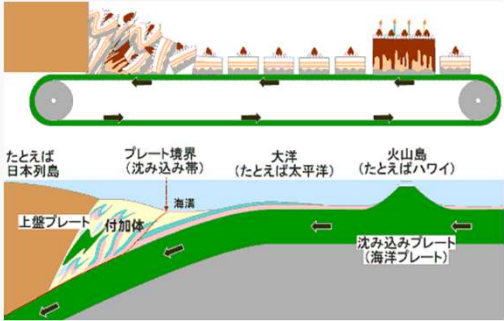
Hydrogen generation with renewable energy-derived raw material

methane



hydrogen

Hydrogen supply



"Underground generation of renewable energy methane and hydrogen"
Patent applied
(Japanese Patent Application No. 2019-076894)



- Established December 13, 2004
- Capital 10 million yen
- Company name: Aonbarr Inc.
- (Founded the company after an early retirement from Yamaha Motor Co., Ltd.)
- President & CEO Shigetoshi Sakurai
- **"Meet the world's demand by pursuing the creation and storage of energy and resources"**



Cancer survivors are afraid of nothing (Onset of chronic myelogenous leukemia in 2012)



July 2012



January 2021

2017 Morning pitch 285th Environmental Special Feature

「日本を資源大国に！」

海水からマグネシウムを、再生可能エネルギー由来水素とCO2から燃料を。

エネルギー・資源分野での革新を図る。



登壇者



アンヴァール株式会社 代表取締役社長 櫻井 重利 氏

ヤマハ発動機に入社後、マリン直売営業・技術商社にて新規事業開発に従事。

40歳で早期退職制度により退社後アンヴァールを創業。

LED販売・小水力発電開発などを手がけつつ、大学や研究機関が持つ優れた技術の実用化を目指す。

7年前に慢性骨髄性白血病を発症するが新型分子標的薬の恩恵で社会復帰に成功し現在も疾走している。

海水から有用物質抽出” "CO2を燃料に” "再生可能エネルギー由来水素の生成” などの実用化に取り組んでいる。

“Making CO₂-free magnesium from seawater” Received Leave a Nest's Marine Tech Grand Prix 2017 JT Award!



Accelerator program



**2018 Development Bank of Japan
Adopted for
"Tokai Open Accelerator".**

"Making CO₂-free magnesium from seawater" Received the 2019 HORIBA Award in the Japan Entrepreneur Award Finals! Science category HORIBA Award



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Accelerator program



経済産業省

Ministry of Economy, Trade and Industry

2018 Adopted for “SIDO Next Innovator”

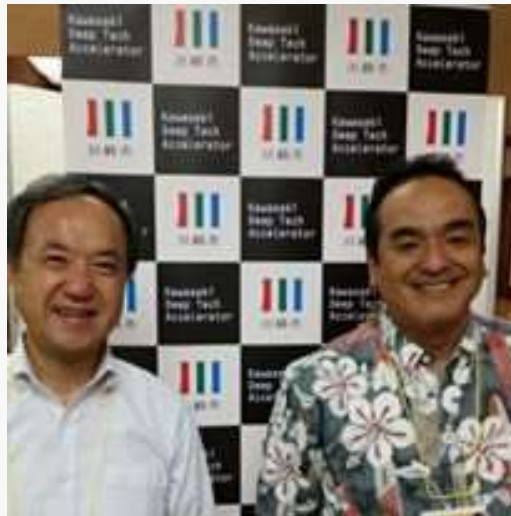


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Accelerator program

 KAWASAKI CITY

2019 Adopted for "Kawasaki Deep Tech Accelerator"



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Accelerator program



**2020 Adopted for "Patent Office
Intellectual Property Acceleration
Program (IPAS)"**

Accelerator program

2020 Adopted for Acceleration Program (FASTAR)

Organization for Small & Medium Enterprises and Regional Innovation



Make Japan a resource-rich country! *To be continued*

...and
The
world,
too!



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