www.haltenergy.com

To halt climate change
We focus on energy

HALT ENERGY

HALTENERGY Co., Ltd.

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Halt Energy Co., Ltd. will take the lead in preventing the climate crisis by creating sustainable hydrogen with a plastic pyrolysis oil hydrogen extractor.

Halt Energy has a solution that stably hydrogenates unevenly distributed fuel oil.
Is this too difficult to explain? To put it simply, the plastics we conveniently use cause environmental problems when disposed of. The emulsified oil produced in the process of decomposing and decomposing waste plastics is called 'waste plastic pyrolysis oil.' The market for this pyrolysis oil is limited due to corrosion of equipment caused by chlorine and uneven distribution.
Therefore, to solve this problem, Halt Energy extracts hydrogen from pyrolysis oil and regenerates it into fuel, and aims to achieve the expected effects of increased economic value and a 30% reduction in carbon emissions.
We are a company focused on energy to prevent climate change.
We will create many achievements and create sustainable growth.

Milestone

Creating solutions for a sustainable energy ecosystem.

2023. 09. 06.	Founding a company
2023. 10. ~ 12.	Award 5 competitions including Ulsan Startup Festa TOP5
2024. 03. 06.	Korea Investment Accelerator Seed Investment and Barundonghaeng 5th Selection
2024. 03. ~ 05.	Ulsan Youth Entrepreneurship Academy 14th Class Secures $112,124 in Funds for 5 Businesses Including New Technology Entrepreneurship Activation
2024. 05. 30.	loan $224,164 from KOREA CREDIT GUARANTEE FUND STEP-UP
2024. 06.12.	ULSAN - UN CITYPRENEURS GRAND Prize
2024. 07. 11	Venture Investment Type Venture Business Certification

What?

What is plastic pyrolysis oil?

Annual plastic consumption per person:1,312 per person3.6 per day
Total domestic consumption: approximately 5.3 billion

1 **Waste plastic** → 2 **pyrolysis** → 3 **Pyrolysis oil**

The oil made by heating plastic waste that is difficult to recycle at high temperatures of 300~500℃ in an oxygen-free environment is called "pyrolysis oil." This pyrolysis oil can replace crude oil as a fuel for heating or power generation facilities, and can also be used to extract hydrogen and charge fuel cells and hydrogen cars. Pyrolysis oil production through pyrolysis technology is expanding its market as a new energy and new industry not only in the domestic market but also in the global market.

Global Industry Trends	Expanding to 3.3 million tons by 2030 with annual growth of 19%
Domestic policy trends	Expanding waste plastic pyrolysis processing capacity from 310,000 tons in 25 years to 900,000 tons in 30 years

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Low-quality pyrolysis oil will be hydrogenated and used as new industrial and energy fuel, and the residue will be used as a recycled solid fuel.

Produced from waste plastic pyrolysis oil

Sustainable Hydrogen(SH)

Hydrogen

Waste plastic pyrolysis oil
Oil 3L = $1

Sustainable Hydrogen
H2 1kg = $6

Economic value	6 times increase in economic value
Environmental value	Reduces CO2 emissions by up to 30% (compared to plastic incineration)

Produced from waste plastic pyrolysis residue

Resource recycling solid fuel

Fuelization

Pyrolysis residue
$146/ton
Processing cost incurred

solid fuel
$146/ton
Sales Revenue Generation

Economic value	Reduce costs and create economic value through solid fuel sales
Environmental value	Creating environmental value by reducing the amount of landfilled

Why?

Why do you need a pyrolysis oil hydrogen extractor?

Countries around the world are implementing policies to fundamentally suppress plastic production due to environmental issues after using plastic.In addition, the waste plastics that are generated are basically being recycled in an environmentally friendly way.
We must also consider ways to secure economic feasibility in recycling methods.

Problem

1. The pyrolysis oil currently produced contains chlorine, which causes corrosion of equipment and uneven properties
2. Carbon dioxide generation problem due to boiler combustion

Solution

1. Secure transportation and storage safety by using liquid as a hydrogen storage medium
2. Build on-site supply infrastructure and reduce operating costs

Solution for stable hydrogenation of non-uniform pyrolysis oil

waste plastic recycling → un-uniform pyrolysis oil

environmental friendliness
low cost economics
raw material unevenness
quality Variability

Technological Differentiation

pre-treatment: composition analysis, removing impurities
efficiency improvement: microparticles, viscosity drop
Hydrogen extraction: optimal control, long life catalyst

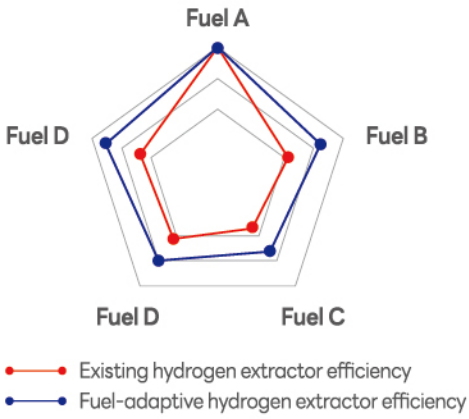
→ Hydrogen energy

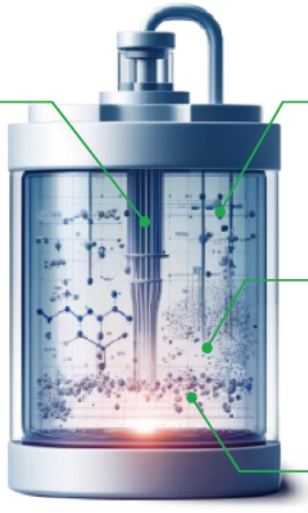
hydrogen charging station
fuel cell power generation
high added value

Halt Energy Co., Ltd. creates solutions for a sustainable energy ecosystem through its pyrolysis oil adaptive hydrogen extractor.

FEATHER (FuEl-AdapTive Hydrogen ExtractoR)

Composition analysis
Pyrolysis oil composition Derivation of stable reaction conditions through analysis




< FEATHER >

Data Analysis
Cloud DB of Extracted Gas Data to Update Optimal Recipe

Removing impurities
Removal of impurities such as chlorine and sulfur through activated carbon adsorption and ultrasonic treatment

Microparticles
Reduced viscosity and improved reactivity through micro-particleization

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The 'Fuel Adaptive Hydrogen Extractor (FEATHER),' the main core device of Halt Energy, is currently in the R&D stage, and is being researched and developed using the CMD(Catalytic Methane Decomposition) method to extract high-concentration hydrogen that does not emit carbon dioxide.

When pyrolysis oil is fed into the hydrogen extractor, the first step is to remove impurities and analyze the composition in the preprocessing module, and the second step is to inject the pyrolysis oil into small-scale particles through a specific nozzle device, lowering the viscosity to improve reactivity, and finally, the hydrogen extraction module is optimally controlled to extract hydrogen.

The hydrogen extracted in this way is stored in a liquid state and can be extracted according to demand, enabling stable hydrogen storage and operation and cost reduction, and can be used in various ways such as fuel cell power generation and hydrogen charging stations.

Target

Growing with diverse target customers

Target ① Pyrolysis Company

- [Pain point1] Need to increase the value of pyrolysis oil
- [Pain point2] Reduced cost of pyrolysis residue disposal
- [VALUE] Sales increased approximately 4 times

GS Caltex, HD HYUNDAI OILBANK, SK geo centric, LG Chem, ecoin energy, LDC Life, re-Defined, ECO CREATION

Target ② Power·Oil·Steel Company

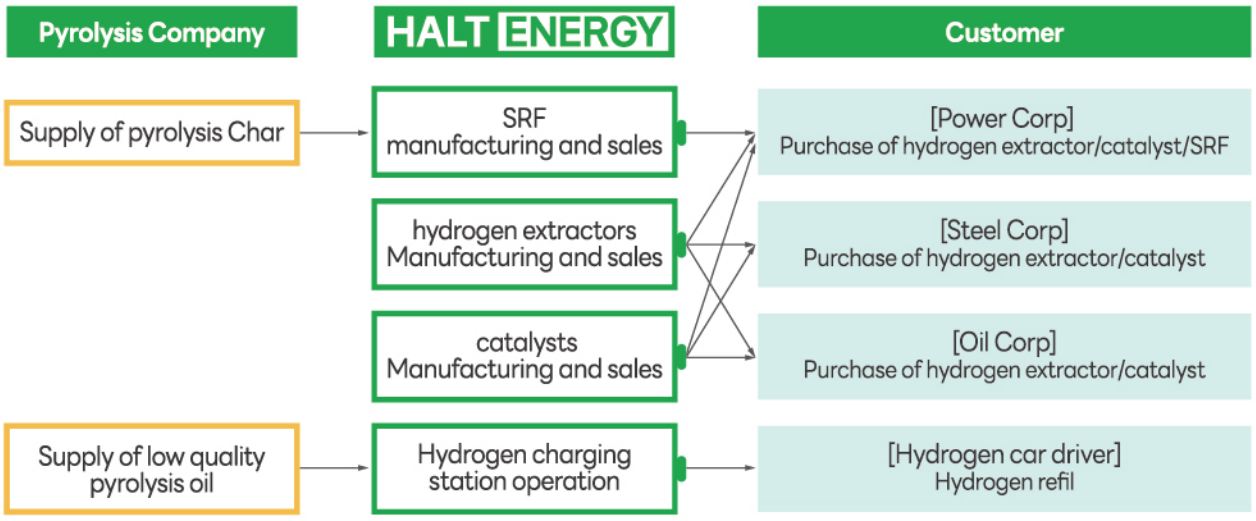
- [Pain point1] Need for stable hydrogen supply
- [Pain point2] Reduce material costs and carbon emissions
- [VALUE] Storage safety and stable hydrogen production

KOEN, Samchully, EWP, KOSPO, cwp, KOMIPO, S-OIL, SK energy, posco, HYUNDAI STEEL

Products developed in this way can solve the **pain points** of target customers.

For the first customer, a recycling resource pyrolysis business operator with a scale of 20 tons/day, the expected economic effects before and after the introduction of Holt Energy's hydrogen extractor are expected to create an effect of increasing sales by about 3.7 times and increasing operating profit by more than 5 times.

For the second customer, the hydrogen user company, the stable operation of Daegyoo infrastructure equipment is possible by utilizing oil as a hydrogen storage medium, and it also contributes to policy goals such as mandatory hydrogen power generation and activation of thermal decomposition.



Market

Waste plastic recycling market and Targeting the growth of the hydrogen production market

Plastic Recycling Market

CAGR 7%

Hydrogen Production Market

JAPAN	GERMANY	CHINA	USA
10.3%	9.6%	9.3%	9.1%

*CAGR (Average annual growth rate)

Future market size comparison

※ reason: PwC(2022) market forecast data, Using McKinsey&Company (2018), refer to the figures for growth by technology in 2030 compared to 2016.

	2024년	2027년
Domestic plastic pyrolysis market	$987 billion	$1,205.8 billion
Domestic plastic recycling market	$2.3275 trillion	$2.8436 trillion
Global Plastic Recycling Market	$69,451.2 billion	$85.224 trillion

pyrolysis

60%

10ton/day
1,470site

hydrogenation

30%

200kg/day
10,000site

Domestic waste plastic generation
(As of 2022, 10.79 million tons/year)

Korea Circulation Resource Distribution Center's target waste plastic
(As of 2022, 4.41 million tons/year)

Domestic pyrolysis oil production
(As of 2022, 6.47 million tons/year)

Korea Circulation Resource Distribution Center's target waste plastic
(As of 2022, 264 thousand tons/year)

Capable of producing hydrogen by converting domestic pyrolysis oil
(1.94 million tons)

Korea Circular Resources Distribution Center Grand Prize Capable of producing hydrogen from waste plastic
(792,000 tons)

Policy target

1. Waste plastic pyrolysis oil treatment
   - 310,000 tons in 2025
   - 900,000 tons in 2030
2. Pyrolysis oil market
   - 186,000 tons in 2025
   - 540,000 tons in 2030
3. Sustainable Hydrogen
   - 55,800 tons in 2025
   - 162 thousand tons in 2030
4. Green hydrogen market
   - 250,000 tons in 2030
   - 3 million tons tons in 2050
5. Blue hydrogen market
   - 310,000 tons in 2025
   - 2 million tons in 2030

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