# Business strategy briefing

## Energy conservation and decarbonization solutions for chemical process industries (HERO/ *SUPERHIDIC*®)

December 14, 2023

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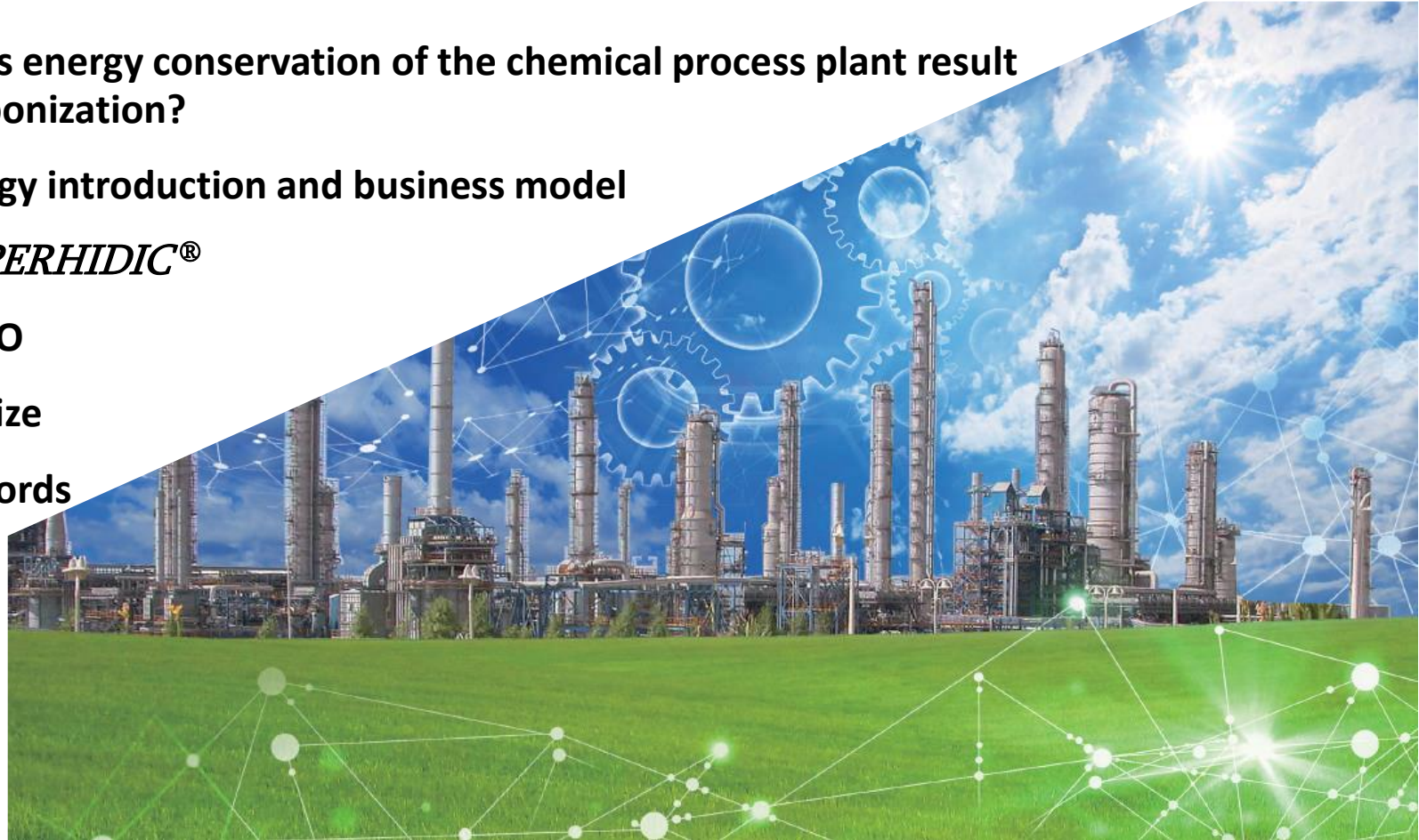
TOYO ENGINEERING

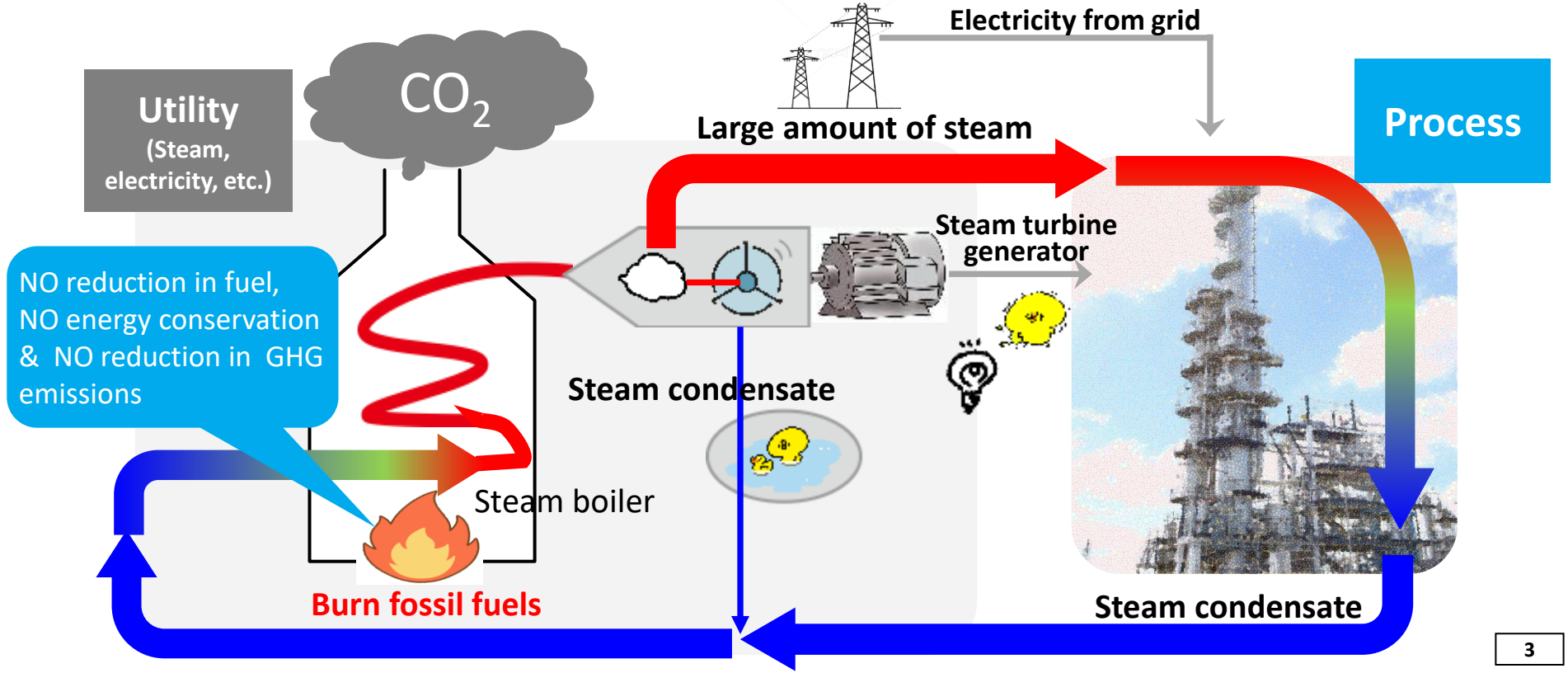
## Today's content

1. **Why does energy conservation of the chemical process plant result in decarbonization?**
2. **Technology introduction and business model**
   - *SUPERHIDIC®*
   - **HERO**
3. **Market size**
4. **Track records**



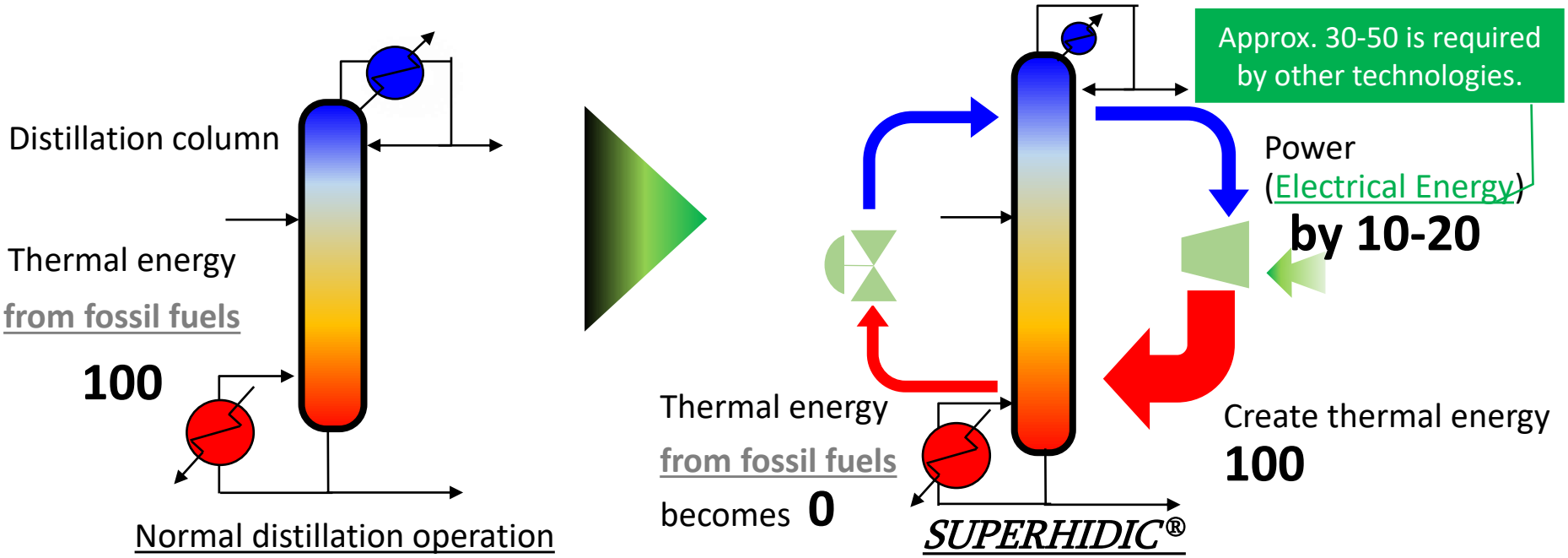
# 1. Why does energy conservation of the chemical process plant result in decarbonization?

Energy source for operating the plant is the heat of combustion of fossil fuels



# 2. Technology introduction and business model - Advantages of our technologies -

**SUPERHIDIC®** - Huge energy-saving and energy-transition technology for distillation operations*1 -

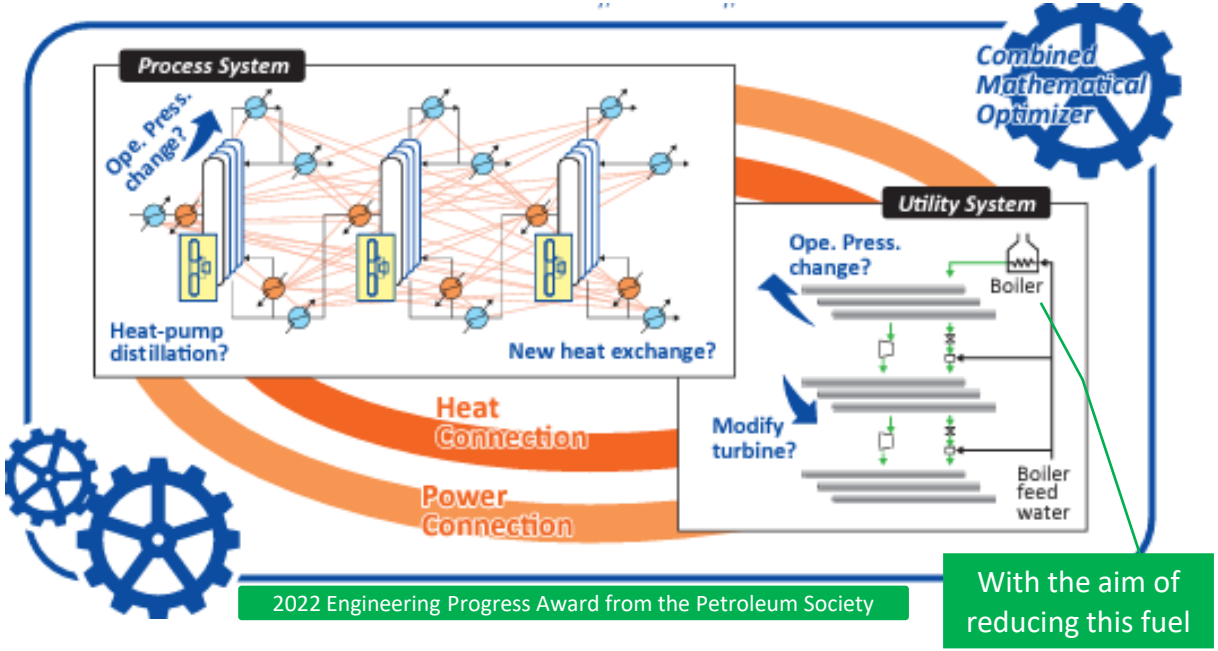



*1 : Although it is the most widely-used separation technology, it is also widely recognized as a unit operation consuming a large amount of thermal energy.

2018 Energy Conservation Grand Award (Minister of Economy, Trade and Industry Prize)
2018 Award for Outstanding Technical Development / The Society of Chemical Engineers, Japan
2018 Award for Technological Progress / The Japan Petroleum Institute
2019 Technical Award/ Society of Separation Process and Engineers, Japan etc.

# 2. Technology introduction and business model - Advantages of our technologies -

**HERO** - Create solutions for energy conservation and GHG emission reduction for the entire plant by mathematical optimization[*1] -




With the aim of reducing this fuel

**Process**

Various operating parameters
X
New heat recovery or not
X
Apply heat pump or not

X

Can be considered at the same time by TOYO Technologies

Operating parameters
X
Additional equipment or not

**utility**

*1 A method of mathematically determining the optimum conditions under which the target index is achieved under certain constraints by expressing the object of consideration in a mathematical formula.
It is also being used to consider the Japanese soccer league, the NFL competition card, and the deployment of tankers.

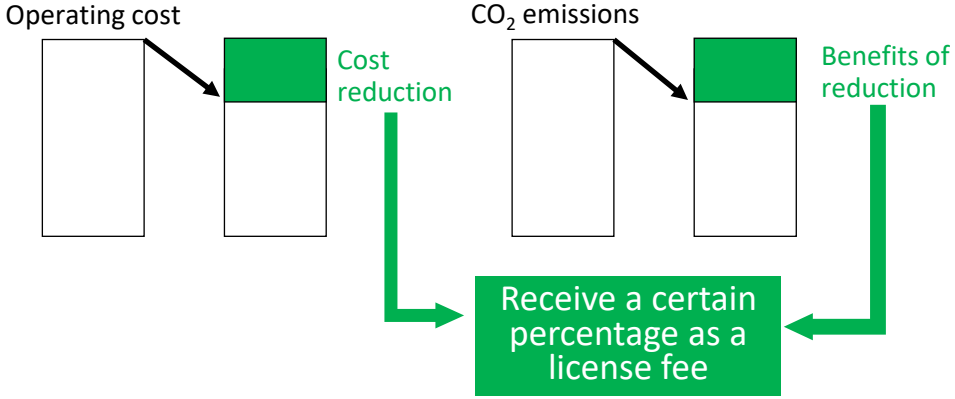
# 2. Technology introduction and business model - Business model -

**SUPERHIDIC®**

Providing design packages

+

License fee




**HERO**

Providing design packages

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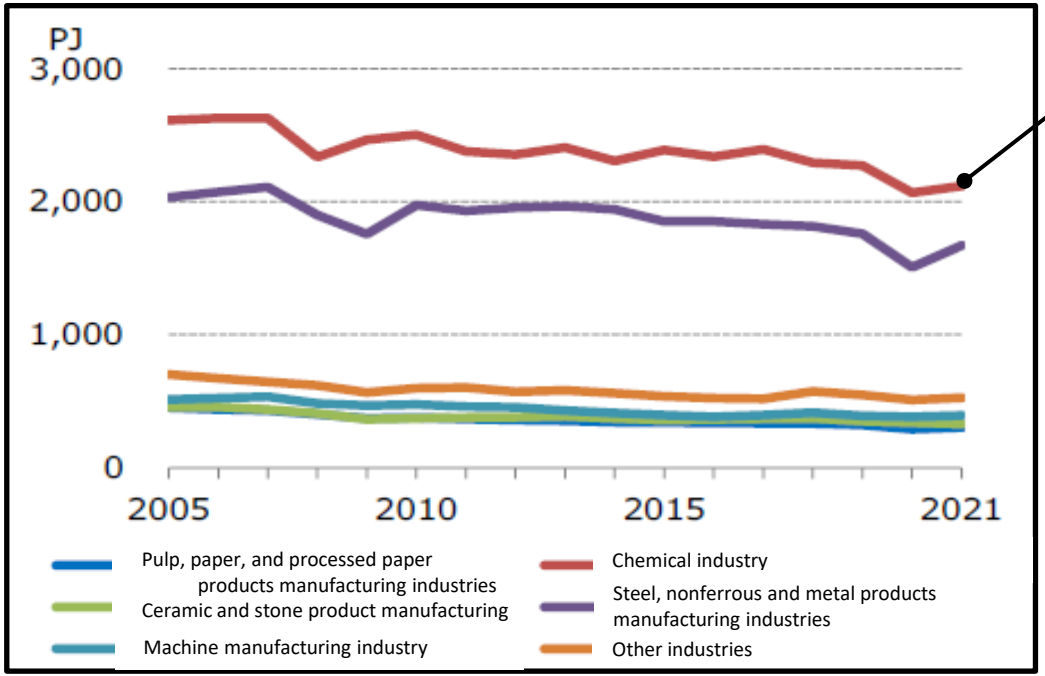
Performance-based reward

# 3. Market size - Energy consumption in the chemical Industry -




Final energy consumption in Japan
$2{,}116 \times 10^{15}$ J (joule)/year

Converted to steam
$1.10 \times 10^{9}$ tons/year

**Cost of creating energy**

$1.10 \times 10^{9} \times 3{,}500$ yen
=about 3.9 trillion yen/year

Assumptions for estimation:
Steam latent heat 535 Wh/kg = 1.926 MJ/kg
Steam cost 3,500 yen/ton

Source: Results of energy demand in 2021 by the Strategic Planning Office, General Affairs Division, Agency for Natural Resources and Energy
https://www.enecho.meti.go.jp/statistics/total_energy/pdf/honbun2021fykaku.pdf

Source: Adapted from the website of the Federation of Electric Power Companies of Japan (Energy Consumption in 2017)
08_k.pdf (fepc.or.jp)

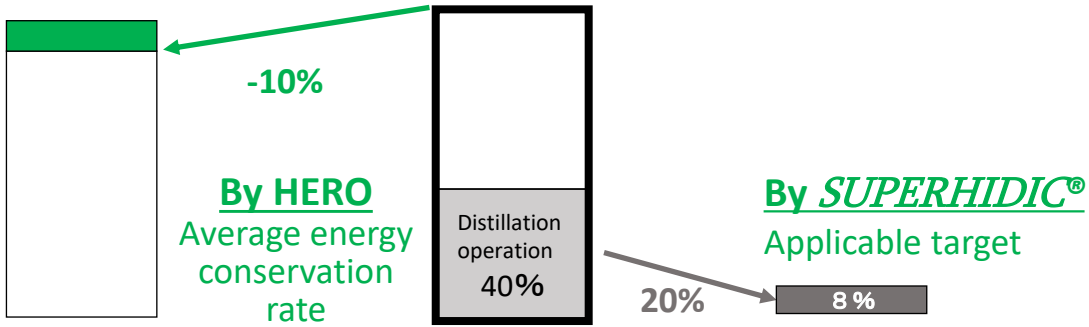
# 3. Market size - Over 6 trillion yen in total -

Comparison of energy consumption between Japan and Europe and Asia [Unit: 100 million tons of oil equivalent]

- ✓ Primary energy consumption in Japan : 4.56
- ✓ Primary energy consumption in Europe : 15.61
- ✓ Primary energy consumption in Asia (excluding Japan and China): 19.93

} Approximately eight times of Japan

**Energy consumption in the chemical industry**

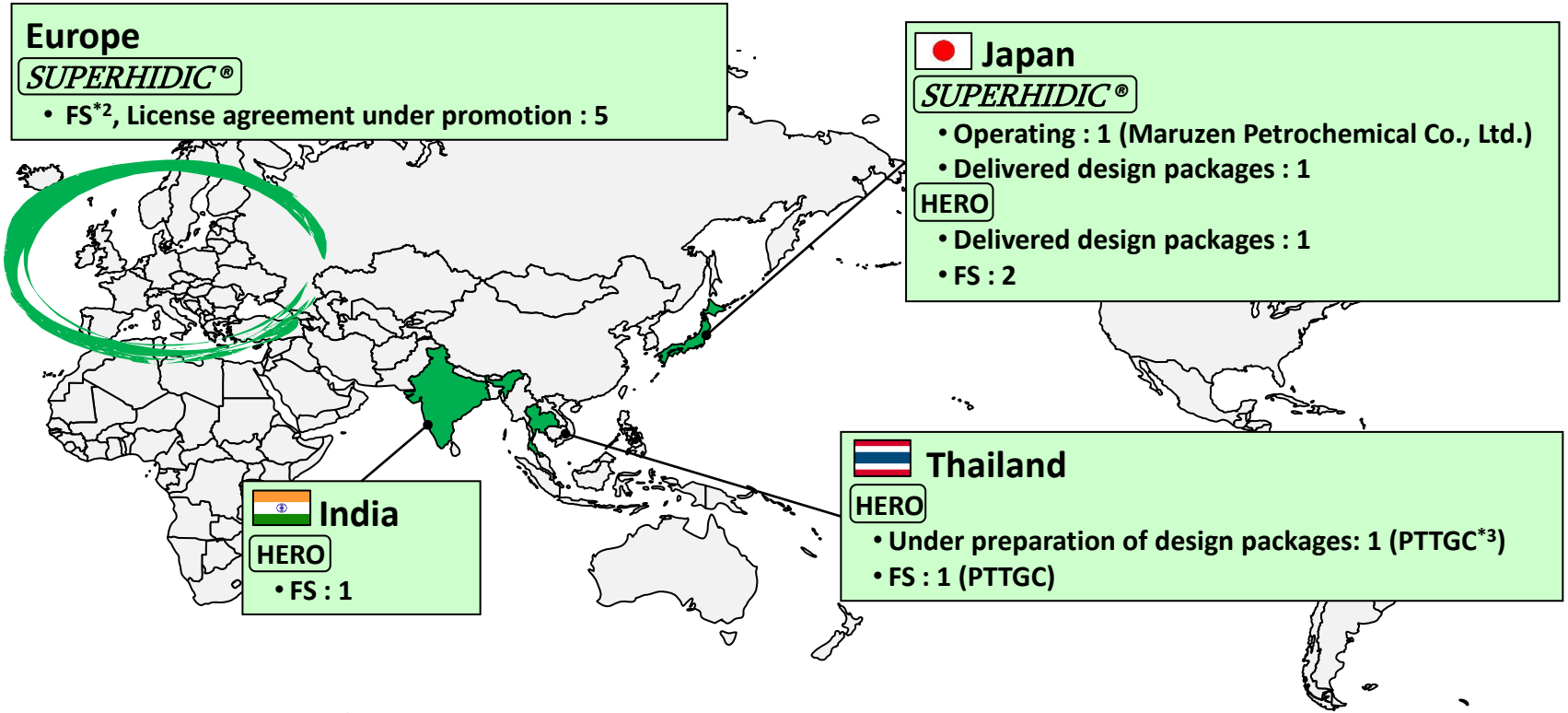



**Scale of markets covered by HERO (potential cost reduction)**
= 3.38 trillion yen

**Scale of markets covered by SUPERHIDIC® (potential cost reduction)**
= 2.71 trillion yen + $CO_2$ reduction benefits

# 4. Track records

## Reduction in $CO_2$ emissions *1 : 110,000 tons
## → 1.9 million tons by 2030 is a target




*1 Total of operated + delivered/under preparation of process design packages *2 Feasibility Study *3 PTT Global Chemical Public Company Limited

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