

# Non-electric Application of Nuclear Energy in Korea

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## Introduction

- Among the energy consumption mix, carbon reduction in an industrial sector takes up a big part of the target value
- Carbon emissions from process heat is important to completely decarbonize the industrial sector to meet the NetZero
- Nuclear energy can be used as a resource for carbon-free or carbon-less electricity, and even further can replace heat resources in the industrial sector
- In this context, small modular reactor (SMR) can be a proper option to directly utilize the heat integrating with industrial process or complex

## Discussion

### NDC Targets and Industrial Heat Demand in Korea

Table 1. 2030 NDC Targets in Korea

Items	Sectors	Emission in 2018 <sup>1</sup>	2030 emissions <sup>3</sup>	
			Previous NDC	Revised NDC
Total emissions		727.6	436.6 (40.0%)	436.6 (40.0%)
Emissions [MMtCO <sub>2</sub> eq.]	Transition	269.6	149.9 (44.4%)	145.9 (45.9%)
	Industry	260.5	222.6 (14.5)	230.7 (11.4%)
	Buildings	52.1	35.0 (32.8%)	35.0 (32.8%)
	Transportation	98.1	61.0 (37.8%)	61.0 (37.8%)
	Others <sup>2</sup>	47.3	-31.9 (-)	-36.0 (-)

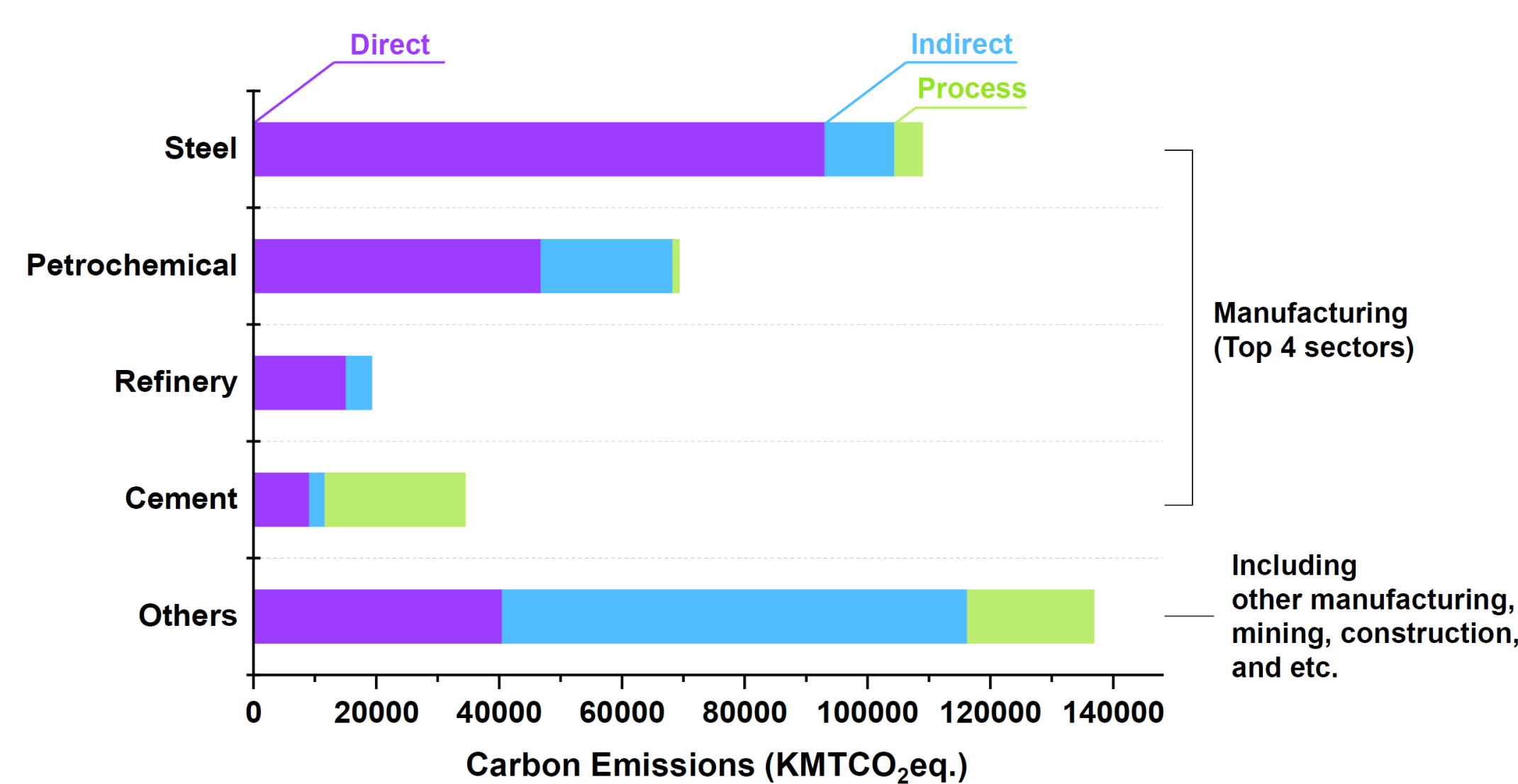


FIG. 1. Carbon Emissions by Industry Sector in Korea(2020)

Table 2. Final Energy Consumption by Industry Sector in Energy Balance (2022)

Energy supply-based consumption			Amount of consumption [ktoe]	Ratio (%) <sup>1</sup>
Chemical and Petrochemical	Coal		657.5	
	Petroleum		495.4	
	Gas		2,083.8	-
	Biofuels and waste		628.8	
	Heat		2,538.8	
Sum			6,404.3	12.7
Manufacturing	Coal		3,440.8	
	Petroleum		55.5	
	Gas		1,533.1	-
	Biofuels and waste		3.3	
	Heat		6.4	
Sum			5,039.1	10.0
Total final energy consumption by manufacturing			50,556.6	
Total final energy consumption by industry sector			54,541.8	
Total final energy consumption			194,161.7	

<sup>1</sup> Ratio (%) = (Sum of energy consumption by each sector)/(Total final energy consumption by manufacture).

- In the manufacturing sector, 62.9% of carbon emissions in 2020 were derived from steel (29.6%), petrochemical (18.8%), refinery (5.2%), and cement (9.3%) industries

- Alternative direct heat sources with carbon neutrality can decarbonize about 23% of the required energy in the manufacturing sector (21.0% in the entire industry sector)

### Alliance for Nuclear Heat Utilization in Korea



KAERI, a Local government, 6 Plant construction companies, 4 Chemical companies, 1 Steel-making company

#### Tasks

- Developing technologies for nuclear heat supply and utilization
- Exchanging information on nuclear heat business
- Establishing nuclear heat business framework
- Accelerating demonstration of nuclear heat supply system

### Public-Private SMR Project in Korea

Public-Private Partnership Project for Advanced SMR

Yr	~'24	'24	'25	'26	'27	'28 ~	'34~
Classification	Government R&D	PPP Development Project				Demonstration Project	Commercialization Project
Leading Organizations	Government	Government 50 Private Sector 50					Private Sector
Project Details	Development of Technologies	(1 <sup>st</sup> Phase) Conceptual Design	(2 <sup>nd</sup> Phase) Basic Design			PSAR · EIA, Detail Design (FSAR) Site Selection · CP · OP	Business



2024~2028

Goal

Basic Design of High Temperature Gas-cooled Reactor (90 MWth / Outlet Temp. 750 °C)

FIG. 2. Public-Private Partnership Project for Advanced SMR

- One of the SMR projects (for HTGR development) is focused on providing the process heat for other chemical processes, on which candidates are hydrogen production (reforming, NH<sub>3</sub> cracking or SOEC), steel production (HyREX\*), and petrochemical industrial complex (such as Yeosu industrial complex)

\*HyREX : Hydrogen Reduction Process

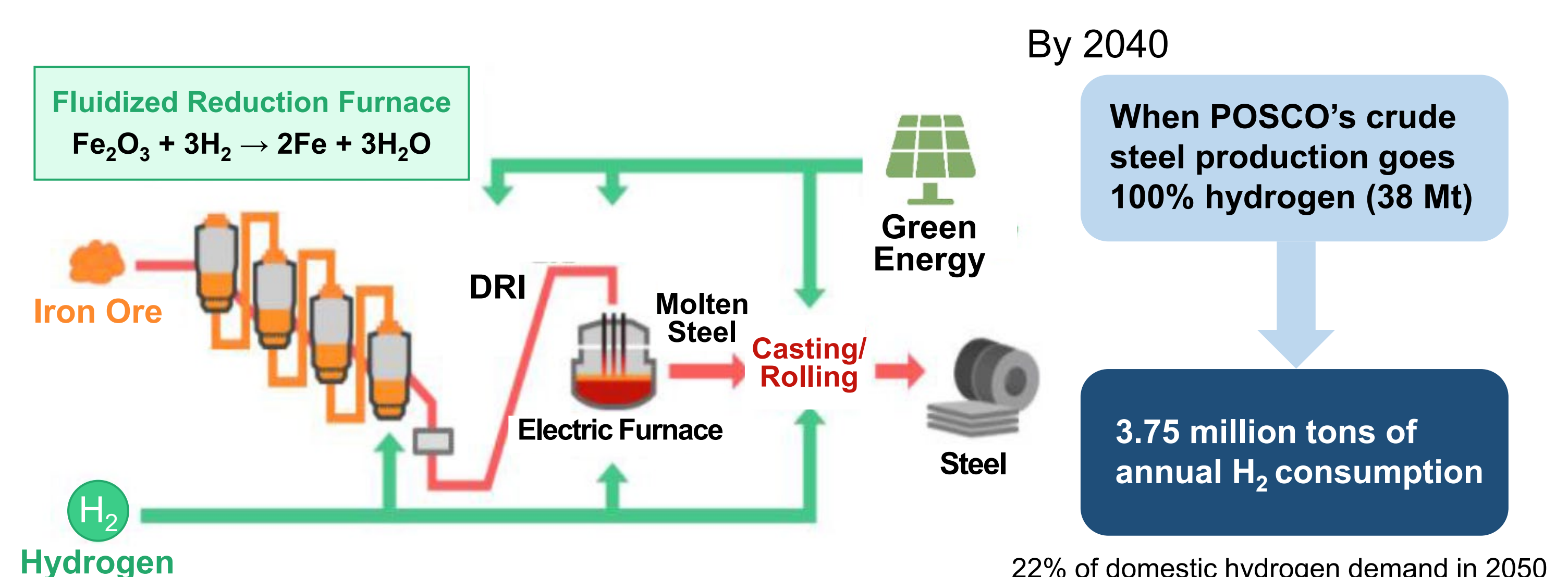


FIG. 3. Hydrogen Reduction Steelmaking Technology of POSCO

### Other Project for Non-electric Application of SMR

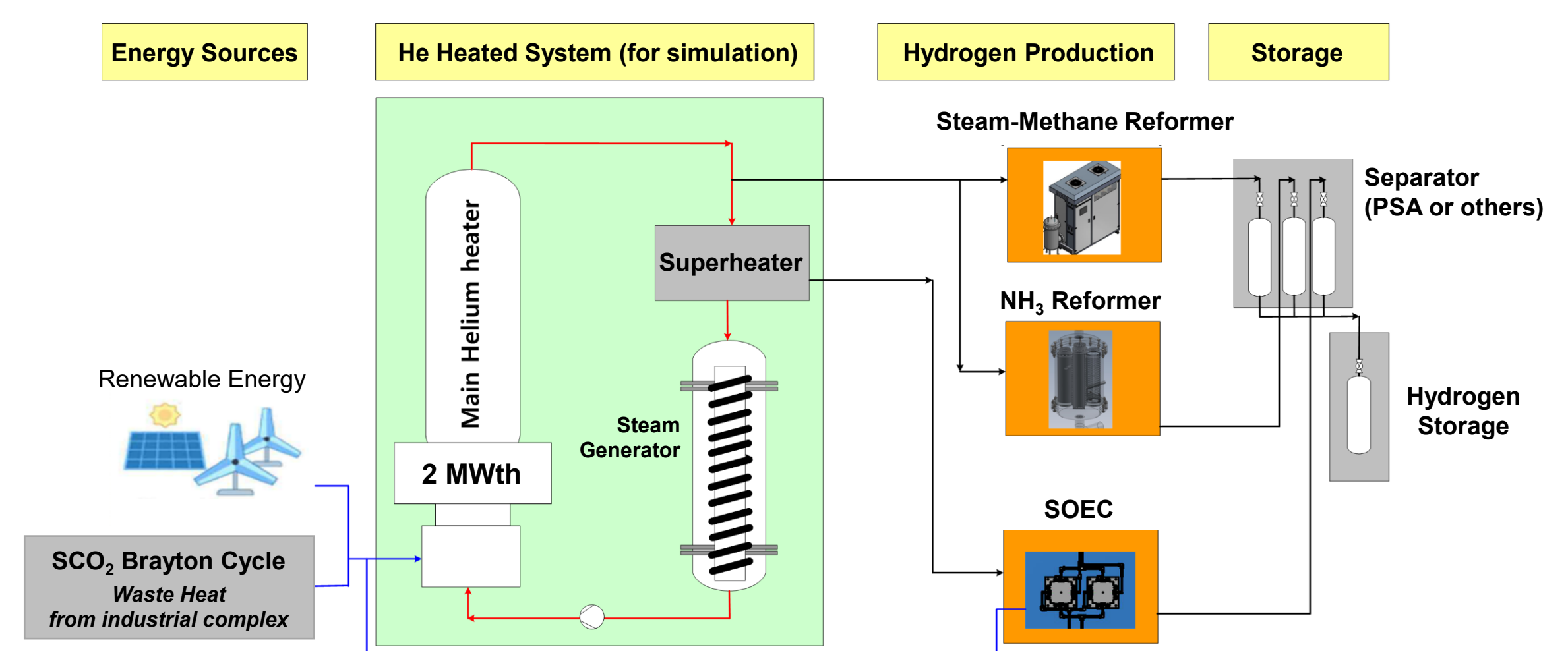


FIG. 4. Carbon-Neutral Process Test with High Temperature Helium-heated Loop (draft)

- Recently, the projects on system integration to utilize nuclear heat has been proposed by using a He loop simulating the behavior of HTGR

## Conclusion

- In Korea, SMR projects have presented to decarbonize electricity or replace the energy from the fossil fuels, especially for the Generation IV reactors
- To attain the non-electric application of SMR on the commercial stage, further endeavors are necessary including international cooperation