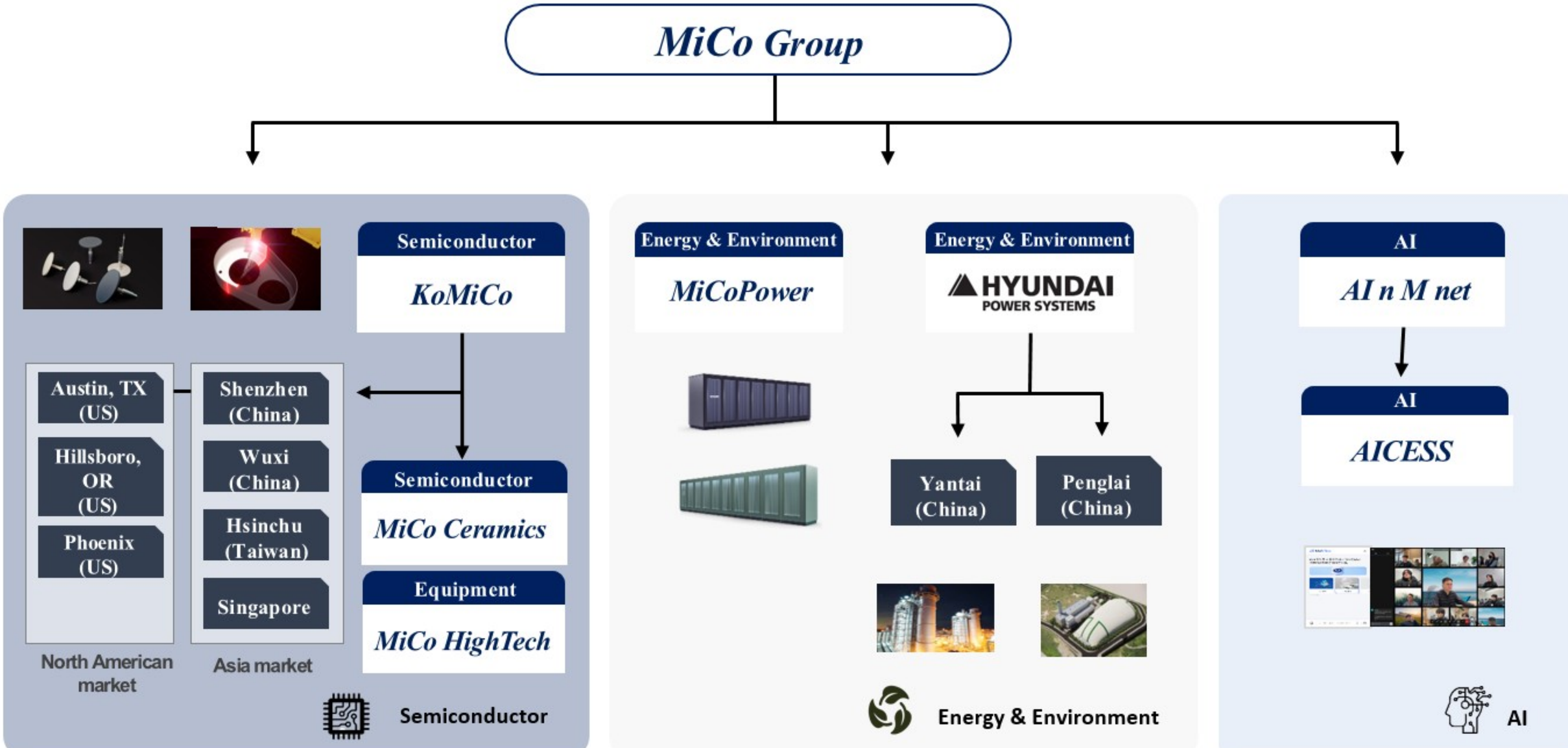
MiCo Group founded in 1996

MiCo delivers innovative solutions across the Semiconductor(coating & packaging), Energy(fuel cell & boiler), and Artificial Intelligence(Generative AI) industries



High-efficiency SOFC system

SOFC system for green hydrogen production

We are levelizing eco-friendly SOFC technologies, which enable to realize the industry's top level overall efficiency over 95% only emitting low carbon or zero carbon.

We have offered the best and reliable SOFC systems in order to lead the shift toward an eco-friendly hydrogen society driven by customer's satisfaction with our own fuelcell stack for over 15 years.

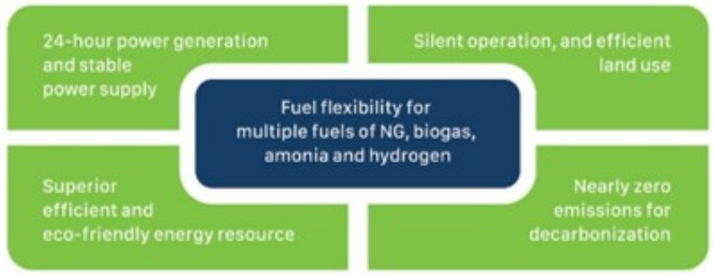
Power output	System power expandable from 50 to 300kW
Electrical efficiency	Electrical efficiency up to 65%
Fuel flexibility	Both city gas and hydrogen fuel are avaliable
Stack tecnhology	Self-made

SOFC Product Specifications

Category	Details
Model Name	TUCY Q150
Stack	MiCoPower
Electrical Specifications	Three-phase, four-wire system, 380VAC/350A
Dimension	9.67x1.77x2.29m
Weight	15.7ton

Electrolyte Type	Ceramic
Fuel Type	All Hydrogen-Containing Fuels (Natural Gas, Biogas etc.)
Average Power Generation Efficiency	55%
Power Output	150KWh
Gas Comsumtion	0.17m³/h

Core advantages of SOFC



Business Model

High-efficiency SOEC System

Renewable Energy

Nuclear Energy

H_2

H_2 Station

Distributed Generation

District Heating

SOEC system for green hydrogen production

SOEC produces green hydrogen with high efficiency.

It can be realized by utilizing surplus power produced through renewable energy.

MiCoPower SOEC system can utilize both water and steam, and be expanded to MW with modularization.

We will provide the best SOEC system that leads the hydrogen society.

Power input	500 kWe to 2MWe
Electrical efficiency	Below 38kWe/kg with steam input
System flexibility	Utilization of hot steam or steam generator
Stack tecnhology	Application of MiCoPower stack optimized for SOEC

Core advantages of SOEC

Green hydrogen production by electricity-driven water splitting

Energy storage using hydrogen produced from excess renewable electricity

Highly efficient Solid Oxide Electrolysis Cell at producing hydrogen from electricity

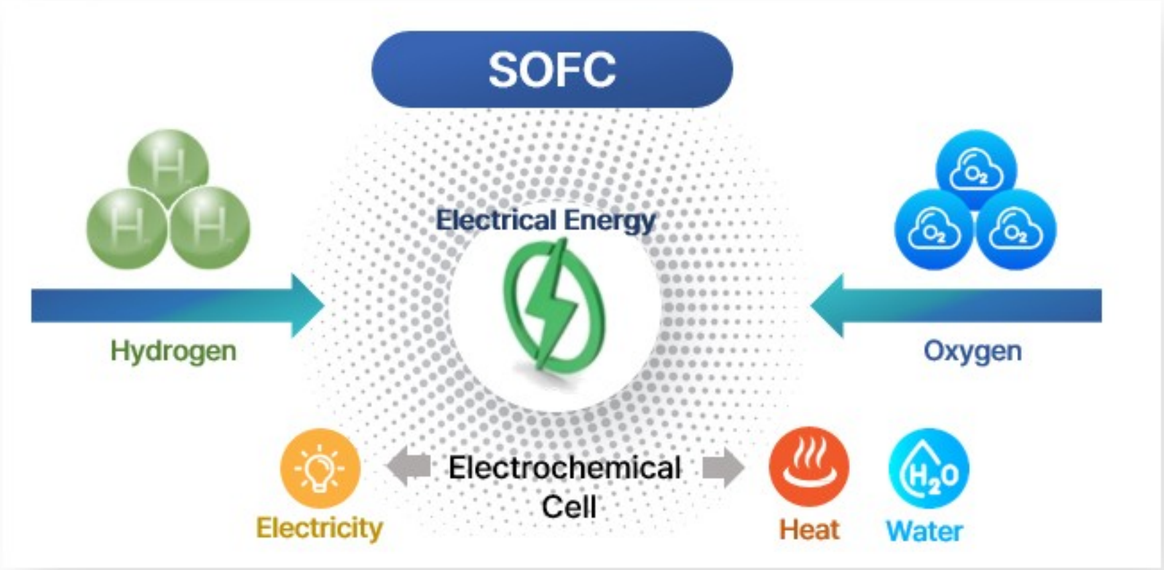
Much less electricity consumption for producing hydrogen using waste steam

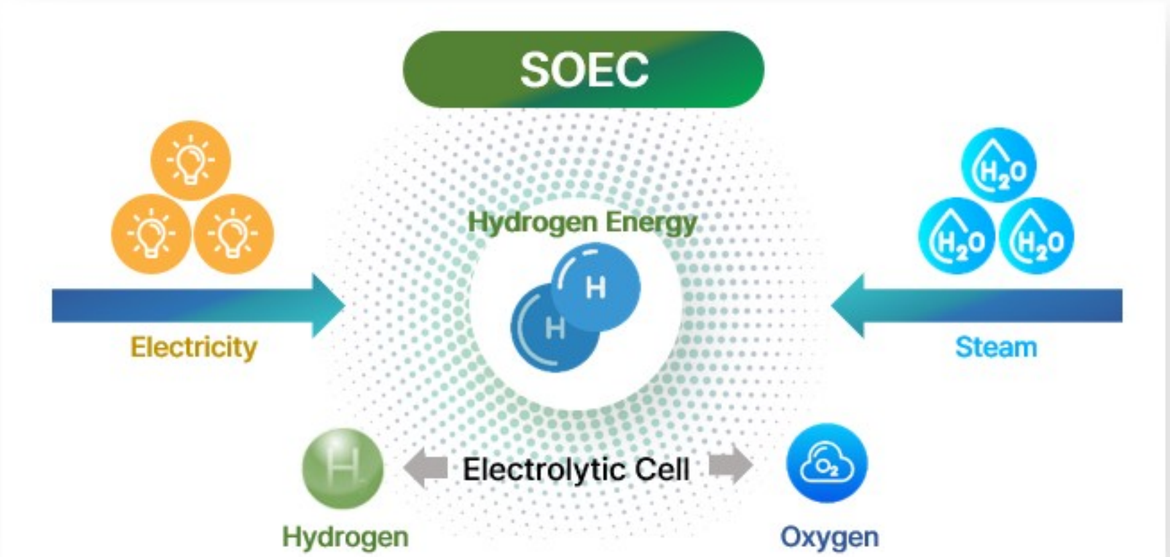
Best solution for Power to X (electricity into hydrogen, synthetic natural gas, liquid fuels or chemicals etc.)

SOFC/SOEC Operating Principle

Solid Oxide Fuel and Electrolysis Cells (SOCs)

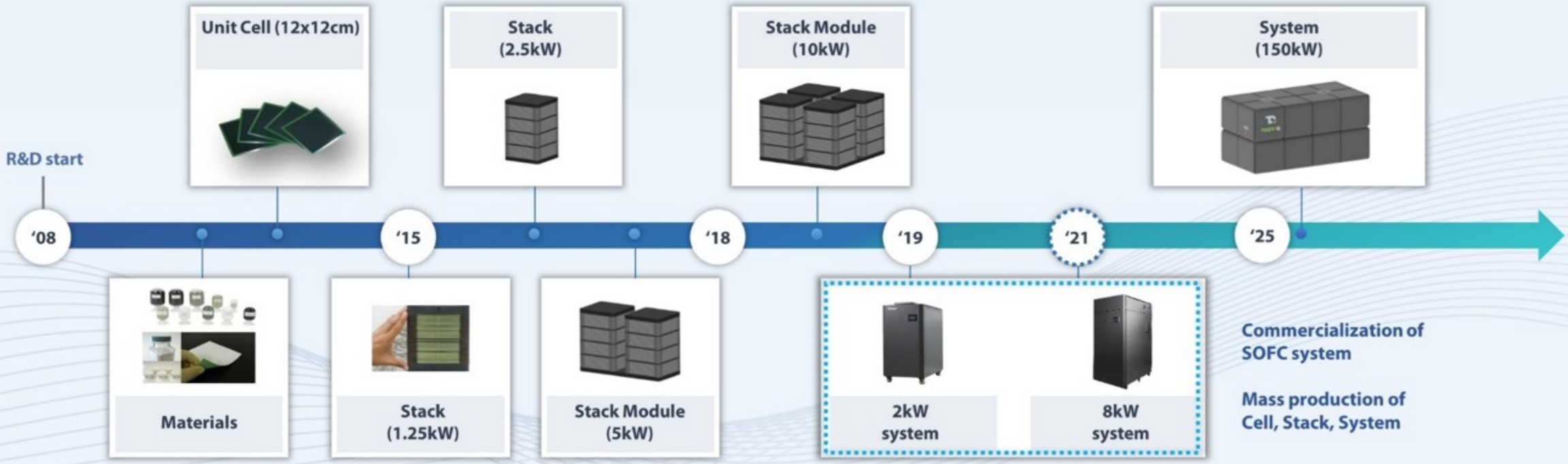
are technologies to generate electrical energy from chemical energy and to store electrical energy as chemical energy





Role of SOFC		Fossil Fuel Society	Transition	Hydrogen Society
Fuel		Natural Gas	Blue Hydrogen	Green Hydrogen
Carbon Reduction	Electrical	NG SOFC with high efficiency Biogas fueled Power, WTE	Blue hydrogen SOFC NG SOFC + CCU	Production of green H_2 (SOEC) Green hydrogen SOFC
	Thermal	Efficient utilization of the heat on sites		

Development of 2kW/8kW scale system in 2021 → repeatable unit modules for 10~100kW scale system



SOFC Advantages

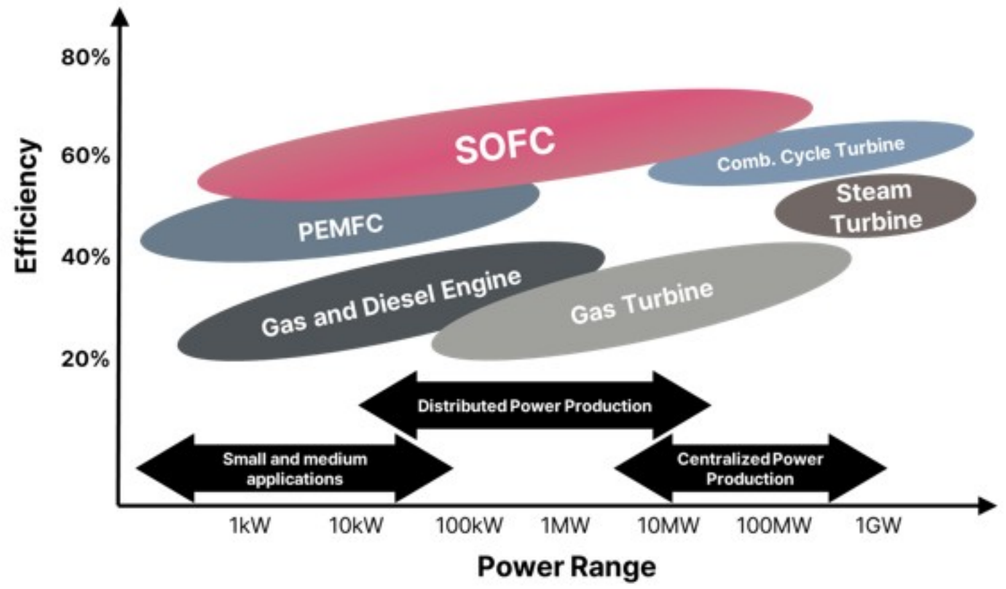
The output of the SOFC system is impressive

The SOFC has high electrical and overall efficiencies, which means that it creates less CO_2 than conventional generators

Comparison of SOFC with Other Fuel Cells

	PAFC	MCFC	PEMFC	SOFC
Electrolyte	Phosphoric acid	Molten carbonate	Polymer	**Ceramics**
Operating Temp.	~ 200°C	600 ~ 700°C	~ 80°C	**650 ~ 800°C**
Fuel	H_2	H_2, CO	H_2	**H_2, CO**
Electrical Efficiency	~ 43%	~ 47%	~ 40%	**60% ~**

Electric efficiency of different power plant types



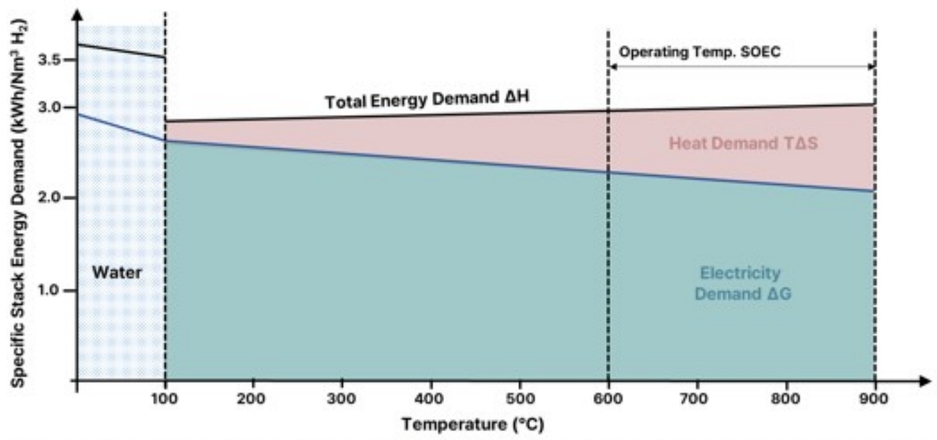
Advantages of solid oxide fuel cells include high combined heat and power efficiency, long-term stability, fuel flexibility and low emissions
Solid oxide fuel cells are suitable for CHP(combined heat and power), CHHP (combined hydrogen, heat and power) and Hybrid/GT cycle

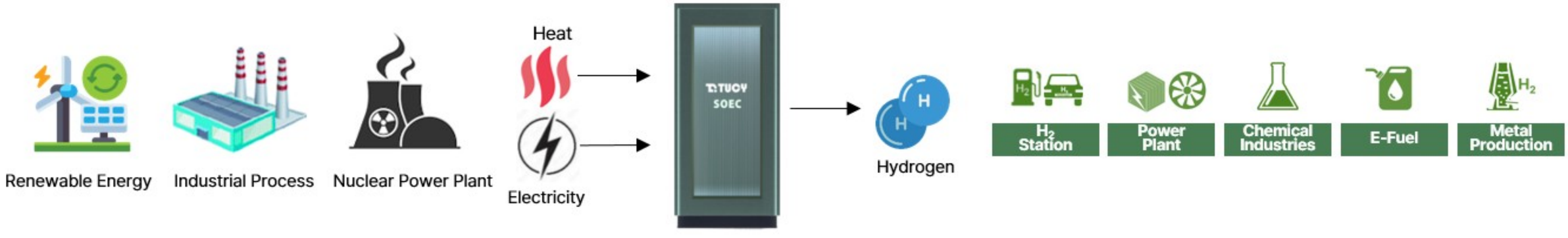
SOFC Advantages

SOEC has higher efficiency due to using steam instead of water

SOEC offers advantages such as low energy consumption, low cost hydrogen production and the ability to utilize intermittent energy sources

		AEC	PEMEC	SOEC
Operating Temperature (°C)		60 ~ 90	50 ~ 80	700 ~ 900
Water Feed	Specific energy consumption (kWh/kg H_2)	55	55	45
	Efficiency (%, LHV)	60	60	74
Steam Feed	Specific energy consumption (kWh/kg H_2)	-	-	40
	Efficiency (%, LHV)	-	-	83





SOFC Advantages

Electricity cost is the most influential factor in LCOH (Levelized Cost of Hydrogen)

An effective way to reduce hydrogen costs is to use cheaper low carbon electricity with highly efficient electrolyzers

				Alkaline	PEM	SOEC
Basic Data	Specific energy consumption		kWh/kg H2	56	53	39
	Hydrogen production rate of 1MW		kg/day	429	453	615
	Annual operating hours		hour	7000	7000	7000
	Capacity required to produce 100,000 tons per year	①	MW	799	756	**557**
CAPEX	System and EPC	②	U$/kW	517	670	715
	CAPEX Total	③=①x②	Million USD	413	507	**398**
	CAPEX ratio compared to SOEC		*%*	*104%*	*127%*	*100%*

Case 1. Nuclear power electricity price in Korea (0.056 USD/kWh) and Industrial electricity price in Kingdom of Saudi Arabia (0.048 USD/kWh)

				Korea			Kingdom of Saudi Arabia		
				Alkaline	PEM	SOEC	Alkaline	PEM	SOEC
OPEX	Electriciy cost	④	USD/kWh		0.0557			0.0476	
	Annual electricity output	⑤	MW	5,593,607	5,293,950	3,895,548	5,593,607	5,293,950	3,895,548
	Annual electricity cost	⑥=④x⑤	Million USD	312	295	217	266	252	185
	O&M cost	⑦	U$/kW	20	26	36	20	26	36
	Annual O&M cost	⑧=①x⑦	Million USD	16	20	20	16	20	20
	OPEX Total	⑥+⑧	Million USD	328	315	**237**	282	272	**205**
	OPEX ratio compared to SOEC			138%	133%	100%	137%	132%	100%
Cost of H_2			USD/kg	3.48	3.40	**2.57**	3.03	2.97	**2.25**
	H_2 cost ratio compared to SOEC			136%	132%	100%	134%	132%	100%

Case 2. Renewable electricity price in Korea (0.119 USD/kWh) and kingdom of Saudi Arabia (0.012 USD/kWh)

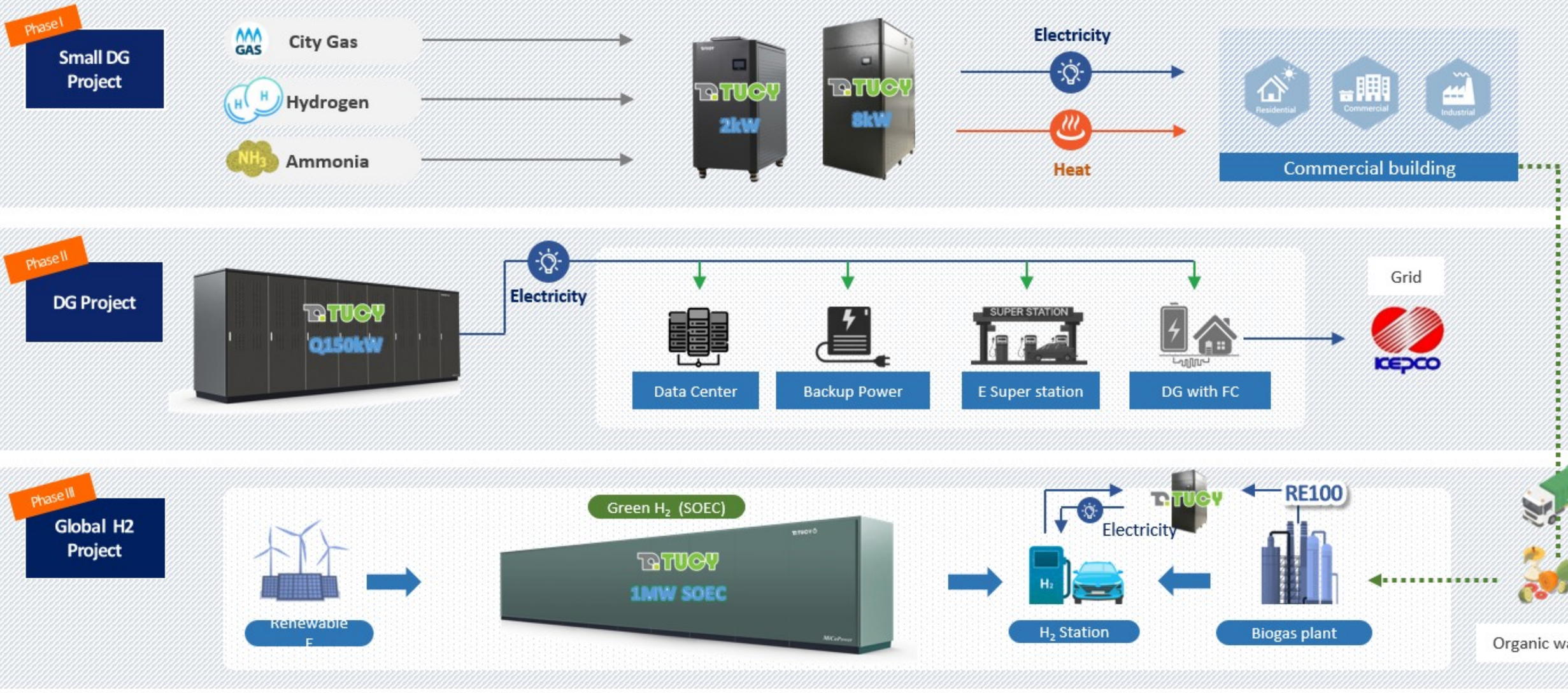
				Korea			Kingdom of Saudi Arabia		
				Alkaline	PEM	SOEC	Alkaline	PEM	SOEC
OPEX	Electricity cost	④	USD/kWh	0.119	0.119	0.119	0.012	0.012	0.012
	Annual electricity output	⑤	MW	5,593,607	5,293,950	3,895,548	5,593,607	5,293,950	3,895,548
	Annual electricity cost	⑥=④x⑤	Million USD	666	630	464	67	64	47
	O&M cost	⑦	U$/kW	20	26	36	20	26	36
	Annual O&M cost	⑧=①x⑦	Million USD	16	20	20	16	20	20
	OPEX Total	⑥+⑧	Million USD	682	650	**484**	83	83	**67**
	OPEX ratio compared to SOEC			141%	134%	100%	124%	125%	100%
Cost of H_2			USD/kg	7.02	6.75	**5.03**	1.04	1.09	**0.87**
	H_2 cost ratio compared to SOEC			139%	134%	100%	120%	125%	100%

The calculation was executed with some assumptions

SOC Business Strategy

To lead global green energy market

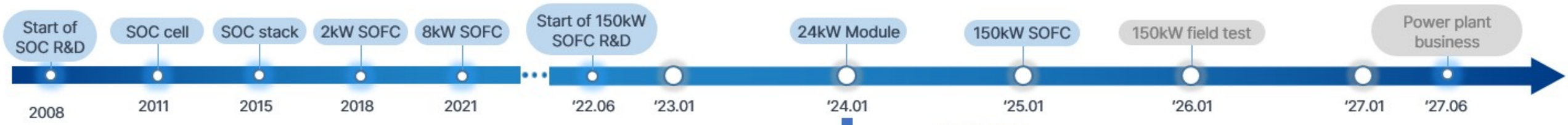
various systems based on own technology will be released, considering fuel infrastructure, trend of policy, and social needs for carbon neutral



SOFC/SOEC R&D Roadmap

Based on advanced stack manufacturing technology

Systematic and strategic market development continues from small distributed FC power market to global H_2 business along with technology development



Cell and stack mass production lines

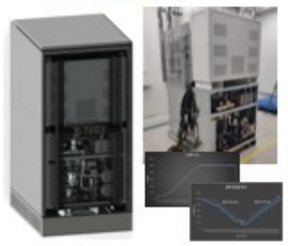
SOC cell Production

SOC stack production

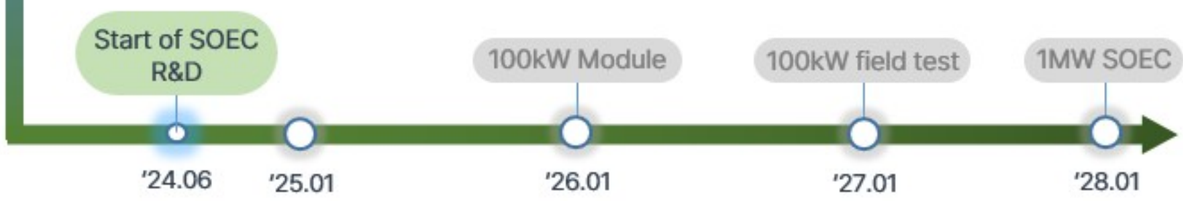
500kW installation of 2kW & 8kW SOFC

Real-time operation monitoring

24kW SOFC module



150kW SOFC System



100kW SOEC module

1MW SOEC System