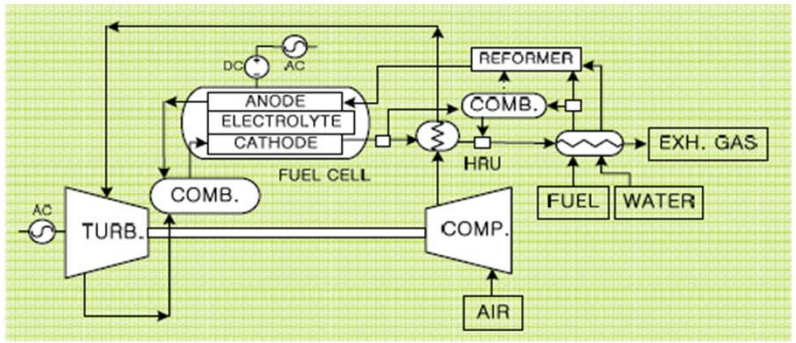
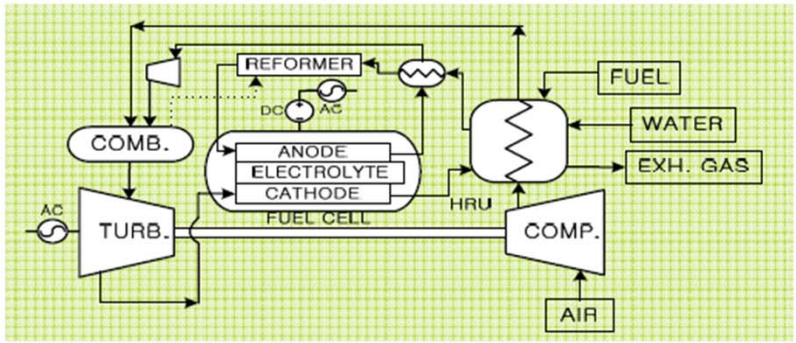
연료전지-가스터빈 하이브리드 시스템 개발

연료전지 하이브리드 시스템 기술 (3)

2014. 하반기 IP (3)

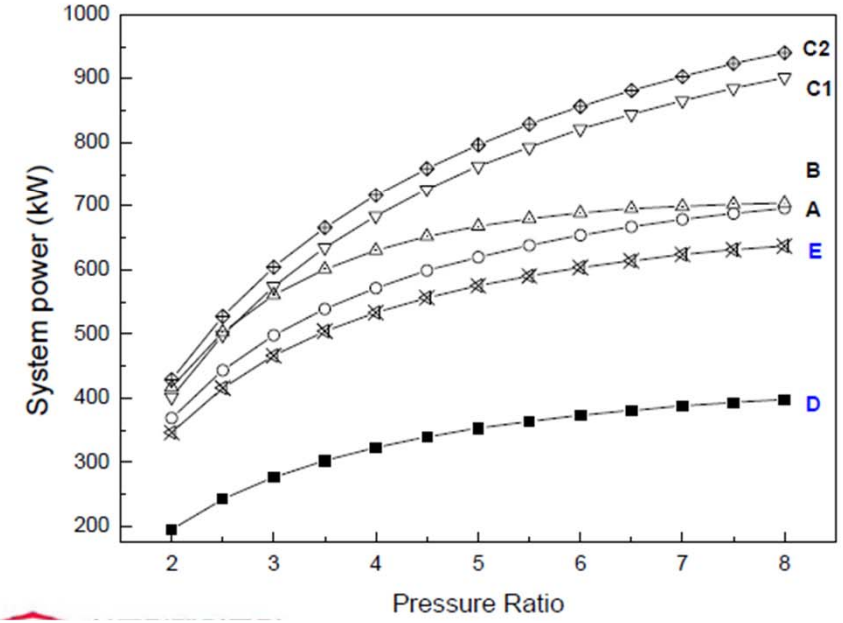


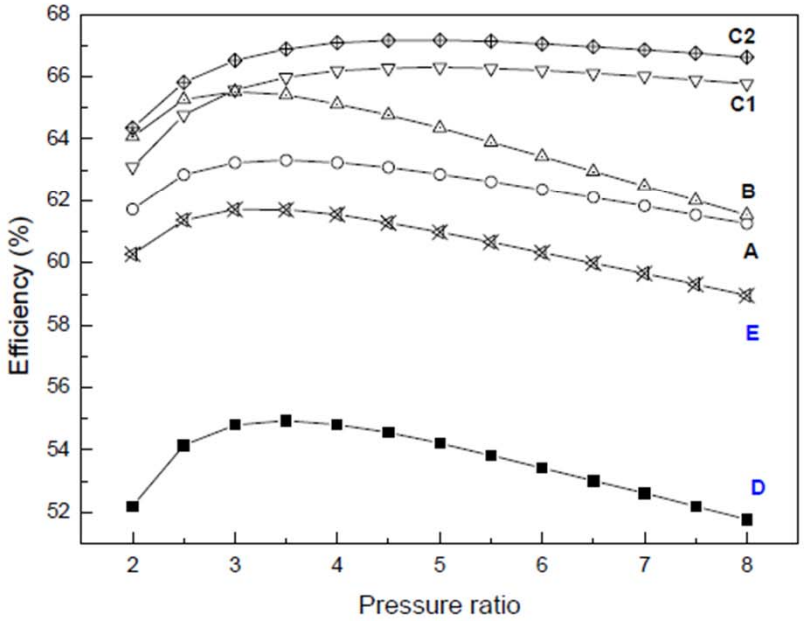
(d) Hybrid / Amb. Pr / ER / IF



(e) Hybrid / Amb. Pr / ER / DF

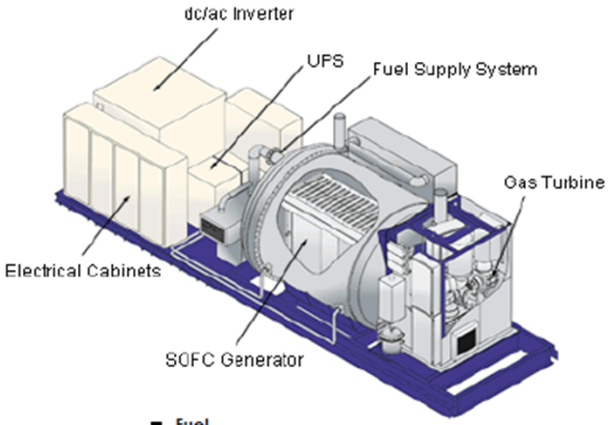
❖ Result

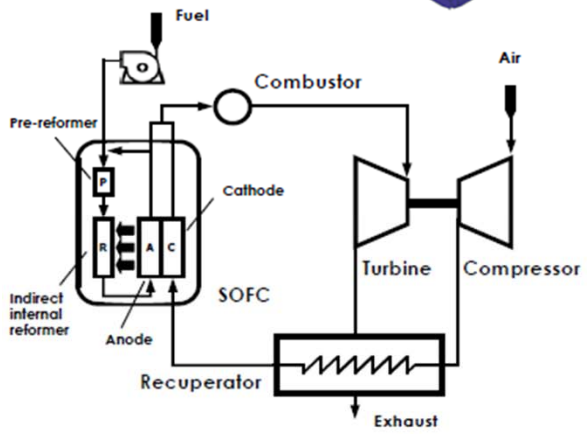




상용 GT – SOFC 하이브리드 시스템

✓ **kW-class SOFC & GT**





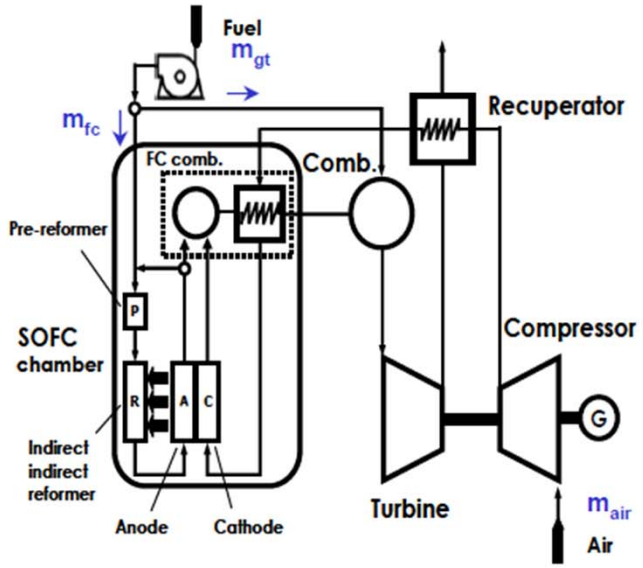
Parameter	Value
SOFC	
Fuel flow rate (kg/s)	0.00738
Current density (A/m^2)	3200
Cell voltage (V)	N/A
Cell temperature (°C)	889.0
SOFC AC Power (MW)	0.176
SOFC efficiency (%)	47.40
Gas turbine	
Air flow rate (kg/s)	0.59
Fuel flow rate (kg/s)	0.0
Pressure ratio	2.9
TIT (°C)	840.0
GT AC power (MW)	0.046
Hybrid System	
Total fuel flow rate (kg/s)	0.00738
System power (MW)	0.220
System efficiency (%)	59.30

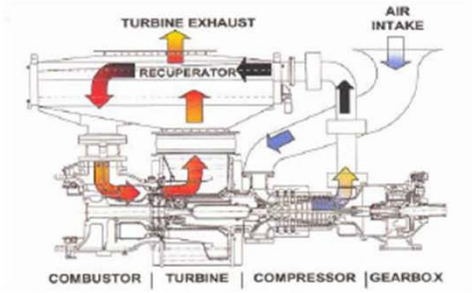
Capstone C-30 model

Source: Song, T.W., Sohn, J.L., Kim, J.H., Kim, T.S., Ro, S.T. and Suzuki, K., 2005, "Performance analysis of a tubular solid oxide fuel cell/micro gas turbine hybrid power system based on a quasi-two dimensional model", Journal of Power Sources, Vol. 142, pp. 30-42, 2005

상용 GT – SOFC 하이브리드 시스템

✓ **Multi-10 MW-class SOFC & GT**





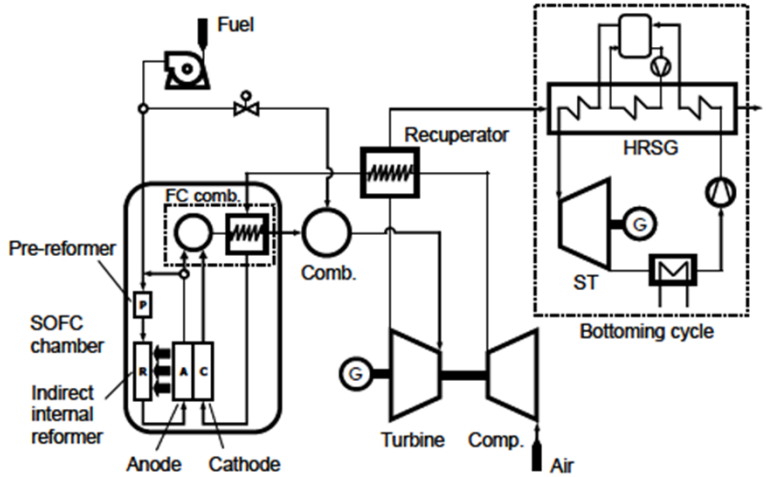
Parameter	Predicted Value
SOFC	
Fuel flow rate (kg/s)	0.261
Current density (A/m²)	3200
Cell voltage (V)	0.69
Cell temp., max (°C)	1020.0
SOFC AC Power (MW)	6.99
SOFC efficiency (%)	53.57
Gas turbine	
Air flow rate (kg/s)	17.80
Fuel flow rate (kg/s)	0.130
Pressure ratio	9.90
TIT (°C)	1130
GT AC power (MW)	4.472
Hybrid System	
Total fuel flow rate (kg/s)	0.391
System power (MW)	11.462
System efficiency (%)	58.62

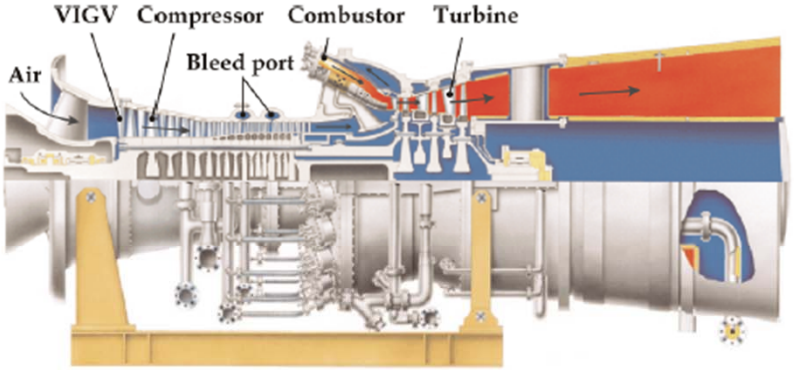
Solar Turbine Mercury 50 model

Source: Song, T.W., Sohn, J.L., Kim, T.S. and Ro, S.T., 2006, "Performance characteristics of a MW-class SOFC/GT hybrid system based on a commercially available gas turbine," Journal of Power Sources, Vol. 158, pp. 361-367

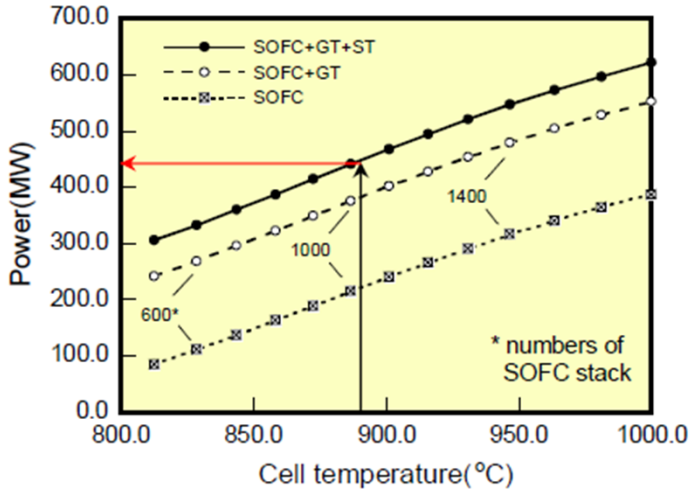
상용 GT – SOFC 하이브리드 시스템

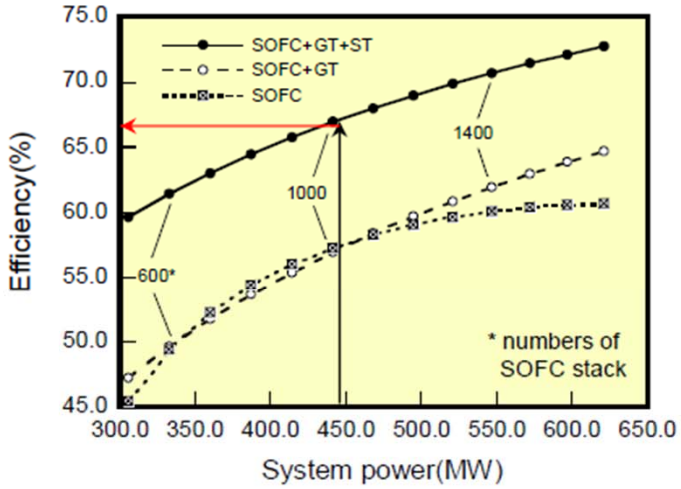
✓ **Multi-100 MW-class SOFC & GT**





GE 7FA+e model

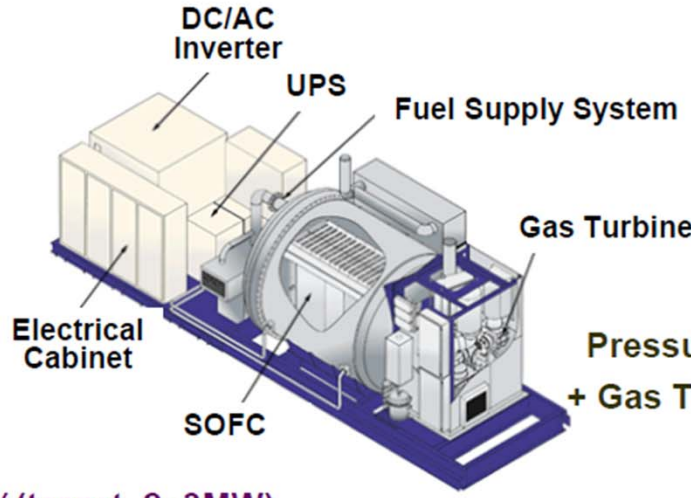




Source: Yang, T.W., Sohn, J.L., and Ro, S.T., 2007, "Performance analysis of a multi-hundreds MW-class SOFC/GT hybrid System based on a commercially available gas turbine," ASME Paper ASME2007-25062

연료전지 하이브리드 시스템 실증

❖ Siemens Power Generation

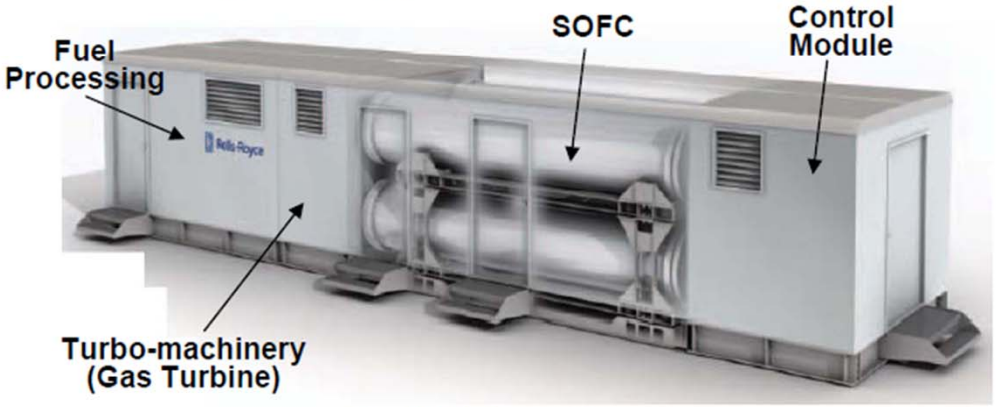


Pressurized SOFC (Siemens)
+ Gas Turbine (Ingersol-Rand)

η_{elec} = 53~55% (250kW)

60% (target ~1MW), 70%(target, 2~3MW)

❖ Rolls-Royce Energy



η_{elec} = 60~70% (target)

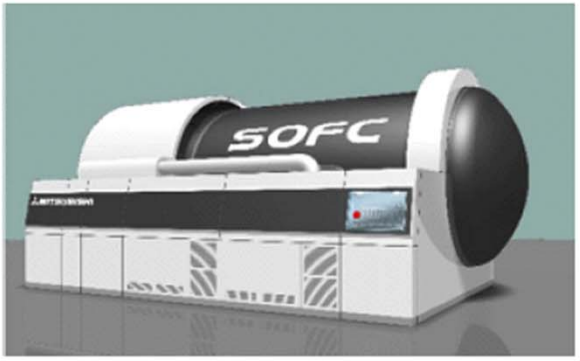
SOFC unit

Turbo-machinery (Gas Turbine)

Pressurized SOFC (Rolls-Royce)
+ Gas Turbine (Rolls-Royce)

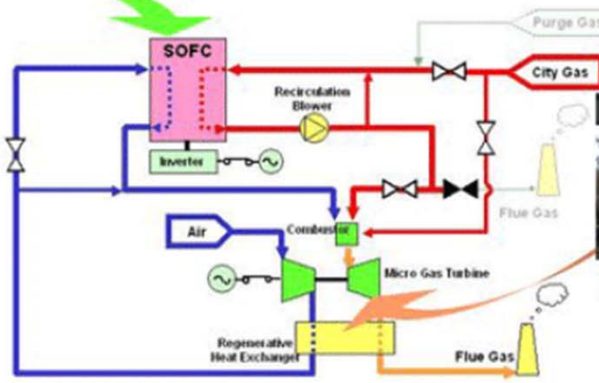
연료전지 하이브리드 시스템 실증

❖ Mitsubishi Heavy Industries, LTD.



η_{elec} = 60% (target 350kW)

SOFC Module



Micro Gas Turbine

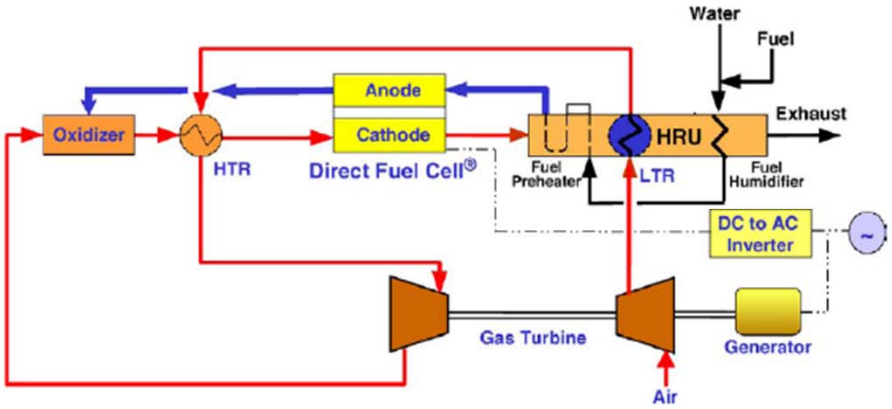
Pressurized SOFC (Mitsubishi)
+ Gas Turbine (Mitsubishi)

❖ Fuel Cell Energy (FCE)

Gas Turbine

MCFC

η_{elec} = 53% (250kW)
62% (target for 13.7MW system)



Ambient Pressure MCFC (FCE)
+ Gas Turbine (Capstone)