분산발전기술로서 열병합 발전의 역할과 전망

오 시 덕

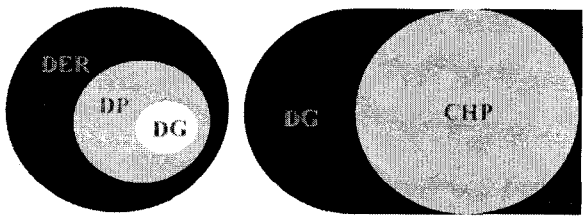
HYOSUNG CORPORATION

Definition of Distributed Resources

✓ **Distributed Generation (DG)**
: Any technology that produces power outside of the utility grid

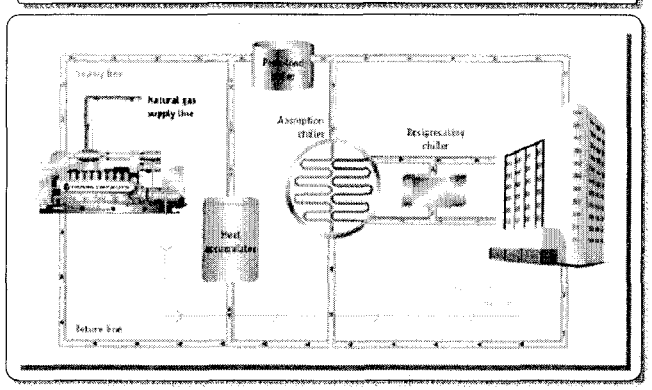
✓ **Distributed Power (DP)**
: Any technology that produces power or stores power

✓ **Distributed Energy Resources (DER)**
: Any technology that is included in DG and DP as well as demand -side measures

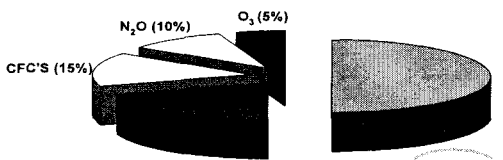


기술의 정의 및 개념_열병합발전

하나의 에너지원으로부터 전력과 열을 동시에 발생, 이론적으로 33% 이상 에너지절약



온실가스별 지구온난화 기여도

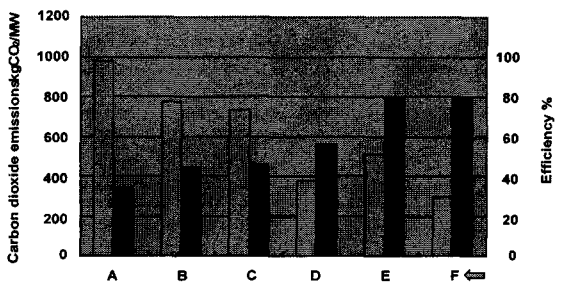


CH_4 (20%)
(16%) Biomass Burning
(14%) Fossil Fuels
(26%) Rice Cultivation
(22%) Wetlands
(22%) Other

CO_2 (50%)
(2%) Cement Production
(25%) Deforestation
(73%) Fossil Fuels

-한국의 경우 : CO_2 가 87.7%로 대부분을 차지하고, CH_4는 10.9%를 차지함.

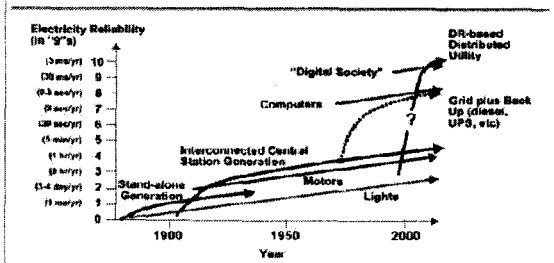
발전수단별 CO_2 배출량 및 효율비교



Electricity Requirements in the Digital Society

- ✓ Digital Society require over 99.9999% power reliability
- ✓ Internet related consumption is over 60% in US power demand by 2010

Evolution of Reliability



Source : EPRI

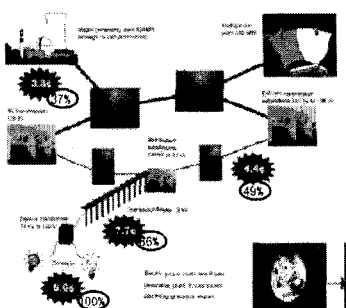
Power Reliability VS Damage of Cost

Power Reliability	99.9%	99.99%	99.9999999%
Power Disruption per Year	8.8 hrs	53 Min	0.03 Sec
Generally Acceptable for:	Homes	Hospitals Airports	Online Markets

INDUSTRY	AVERAGE HOURLY COST ($US)
Cellular Communications	41,000
Telephone Ticket Sales	72,000
Airline Reservations	90,000
Credit Card Operations	2,580,000
Brokerage Operations	6,480,000

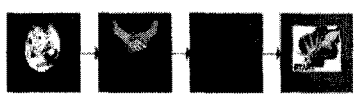
It's not the cost of power that matters, but the cost of *not* having power!

Structure of Electric Power Cost



Middle Area in USA, (MW Consumer)

Easily Upgradable of DG



Source : ABB Review 3/2000

Estimated Cost of Expanding T&D

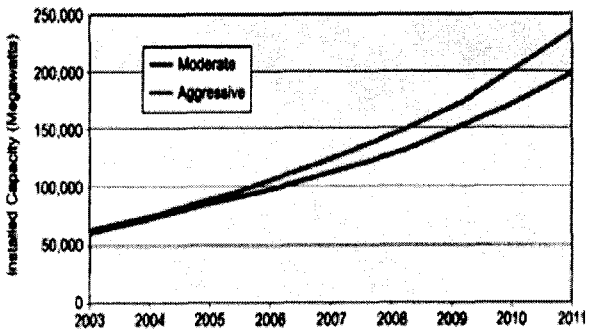
✓ Estimated cost of expanding T&D peak load incrementally

Utility	Low($/kW)	High($/kW)
United States-Northeast	166	925
United States-Southeast	45	729
United States-Central Plains	82	336
United States-West Coast	64	610
Central America-Urban system	51	300
Central America-Rural system	51	920
South America-Urban system	129	438
Caribbean	65	518
Europe-North Central urban system	290	846
Southeast Asia-Urban system	29	400
Southeast Asia-Rural system	40	2000

Source : H.Lee Willis, Walter G. Scott, "Distributed Power Generation", Marcel Dekker, Inc., 2000

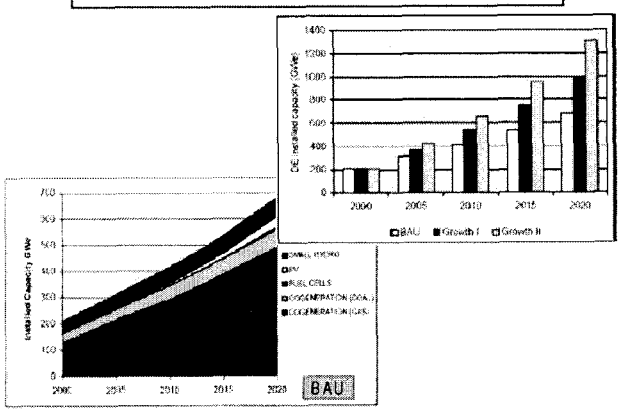
Distributed Generation Market Growth

✓ **Global installed DG capacity is projected to nearly triple to 200,000MW by 2011**



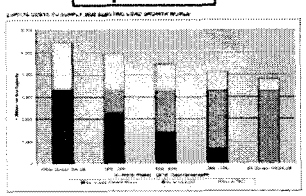
Source : ABI Research, March 16, 2003

Distributed Generation Market Growth

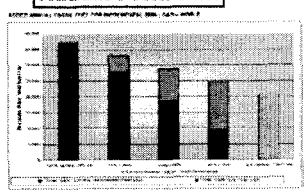


Source : WADE, World Survey of Decentralized Energy 2002/2003

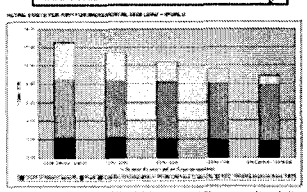
Capital Cost



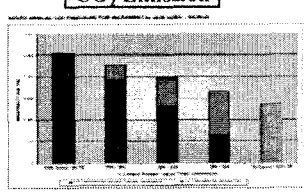
Annual Fossil Fuel



Retail Cost of Electricity



CO_2 Emission



Source : 2004 World Survey of Decentralized Generation, 2004, World Alliance for Decentralized Energy

Evaluation of DG in relation to security of supply

Overview of the evaluation results for decentralised technologies

	Substitution of imported fuels	Availability	Flexibility	Economic attractiveness	Financial risks	Vulnerability
Wind power	High	Low	High	Low/ Neutral	Low/ Neutral	Low
Photovoltaics	High	Low	High	Low	Low/ Neutral	Low
Biomass	High/ Neutral	Neutral	High/ Neutral	Neutral/ Low	Neutral/ High	Low
Small hydro	High	High/ Neutral	High	Neutral	Low/ Neutral	Low
CHP	Neutral	High/ Neutral	High/ Neutral	High/ Neutral	Low/ Neutral	Low
Fuel cells	Neutral/ High	High/ Neutral	High	Low/ Neutral	Neutral	Low

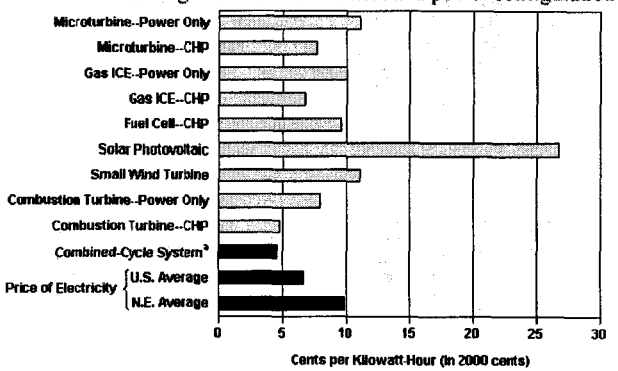
Source : Decentralized Generation : Development of EU policy, Oct. 2002, ECN-C-02-075

Reliability of Natural-Gas-Powered Cogeneration Systems

	Reciprocating Engines			Gas Turbine Engines			Electric Utility
Operational Reliability Measure	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	1986-1990
Power	60 kW	80-800 kW	>800 kW	1-5 MW	5-25 MW	>25 MW	
Availability Factor (%)	95.8	94.5	91.2	92.7	90.0	93.3	85.9
Forced Outage Rate (%)	5.9	4.7	6.1	4.8	6.5	2.1	24.7
Scheduled Outage Factor (%)	0.2	2.0	3.5	3.0	4.8	4.8	9.9

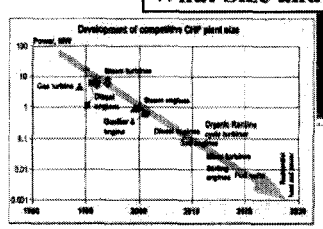
Levelized Cost of selected Distributed Generation Technologies

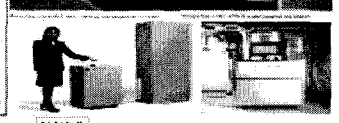
✓ The most cost competitive distributed generation technology is fossil-fuel engines in combined heat and power configuration

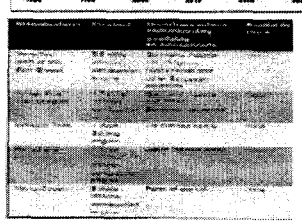


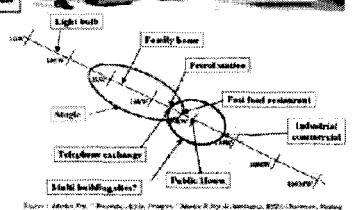
Source : Prospects for Distributed Electricity Generation, A CBO(Congressional Budget office) Paper, 9 2003

What Size and Applications ?



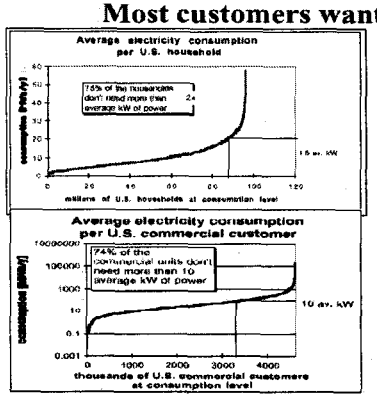






미국의 Micro-CHP 전망

What's the right size for the job?
Most customers want kW, not GW

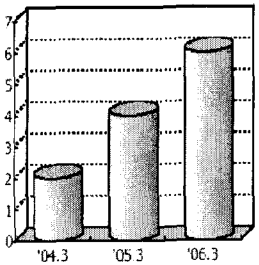


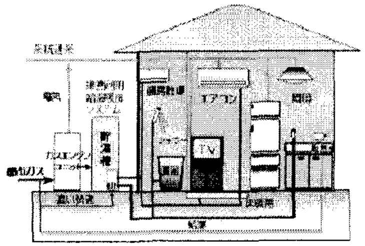
Three-fourths of U.S. households have average loads not exceeding 2.4 kW (EIA statistical sample, 7/93)

Three-fourths of U.S. commercial customers have average loads not exceeding 10 kW (EIA statistical sample, 1992, Note: logarithmic vertical axis)

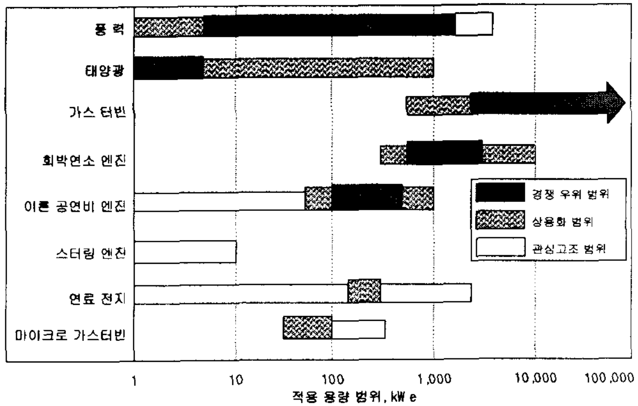
- 商品名「ECOWILL」(エコウィル)、03年3月販売開始予定。
- 本田技研開発のガスエンジンと、当社他3社で共同開発したエンジンの排熱利用システムの組合せ。
- 家庭用電気需要の40%(200m3/台)を獲得、当初3年間(04.3-06.3月期)で1万2千台の販売計画

販売計画(千台)



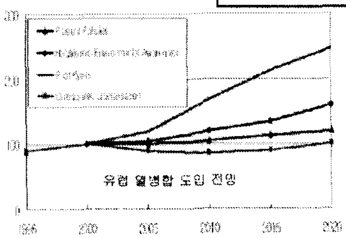


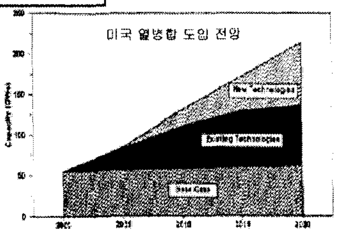
Status and competitive range of selected distributed generation



Source : 오 시 덕, "열병합 발전 기술," pp. 34~40, 기계저널 제34권 제 10호, 2003

국외 열병합 발전 보급 전망

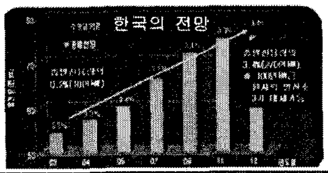




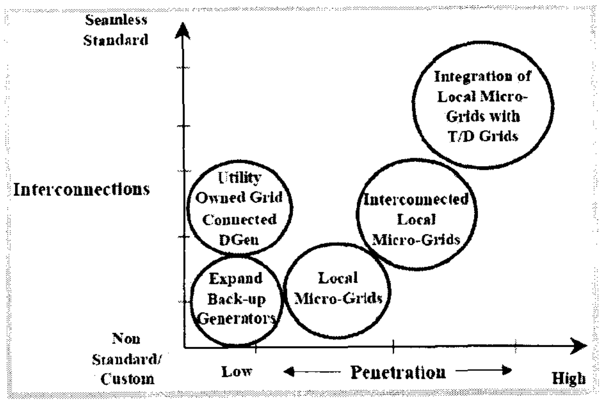
일본 열병합 발전 보급 목표

	1999년도 (실적)	2010년도 현행계획 유지 시	2010년도 목표 수준	2010/1999
천연가스 열병합발전 시스템[1)]	[illegible]	344만kW	[illegible]	약 3배
연료전지 시스템	1.2만kW	[illegible]	220만kW	약 183배

◇ 2012년까지 총 발전용량의 3.4%수준인 270만kW 보급



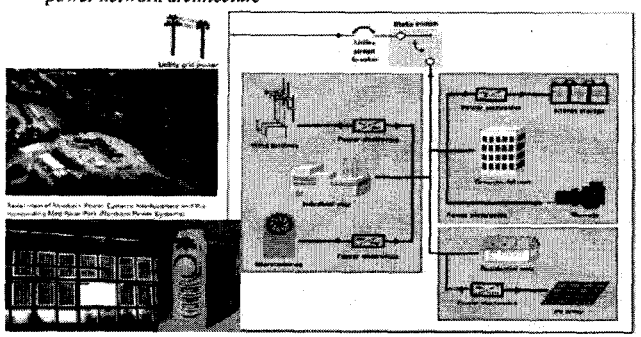
Distributed Generation market Scenarios



Source : Vikrams S. Budhraja, President, Electric Power Group, LLC

Schematic of the Micro Grid Concept

✓ Northern Power Systems has applied its power systems integration background, experience with renewable energy systems, and its expertise with systems control and power electronics to develop the 'Micro Grid' power network architecture



Source : Jonathan Lynch, "Micro Grid power networks", pp. 39~45, Cogeneration and On-Site Power Production may-june 2004

Back to Edison – Energy Security and Reliability