

Increasing Power Reliability via Distributed Generation

Power Quality 2000
October 5, 2000

E.J. Honton

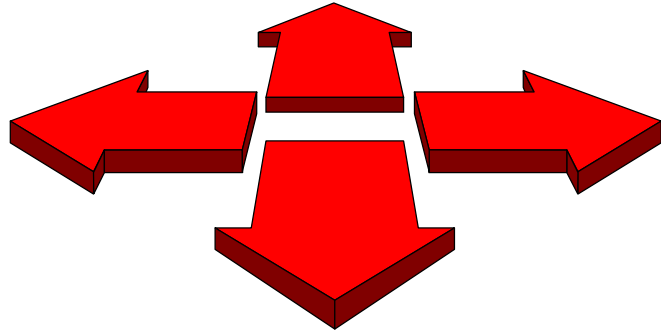
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**RESOURCE
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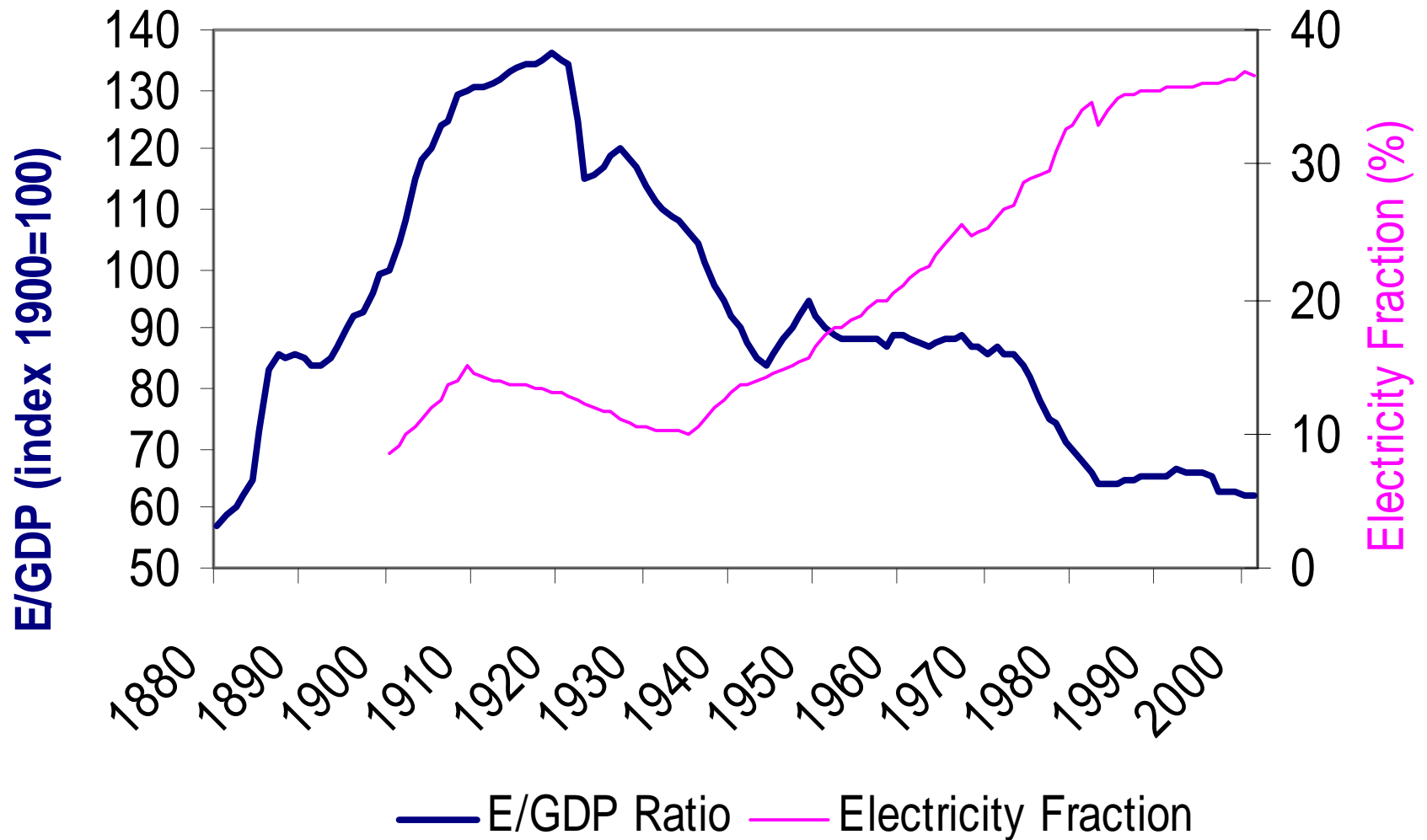
...business solutions for energy markets



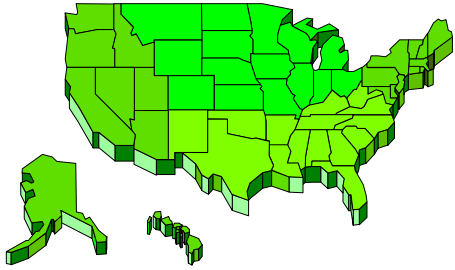
Overview

1. Why Distributed Generation (DG) Now?
2. Compare Evolving DG Technologies
3. DG Regulatory Environment and Air Emissions
4. Reliability and Premium Power Applications
5. Future of DG Technologies and the Marketplace

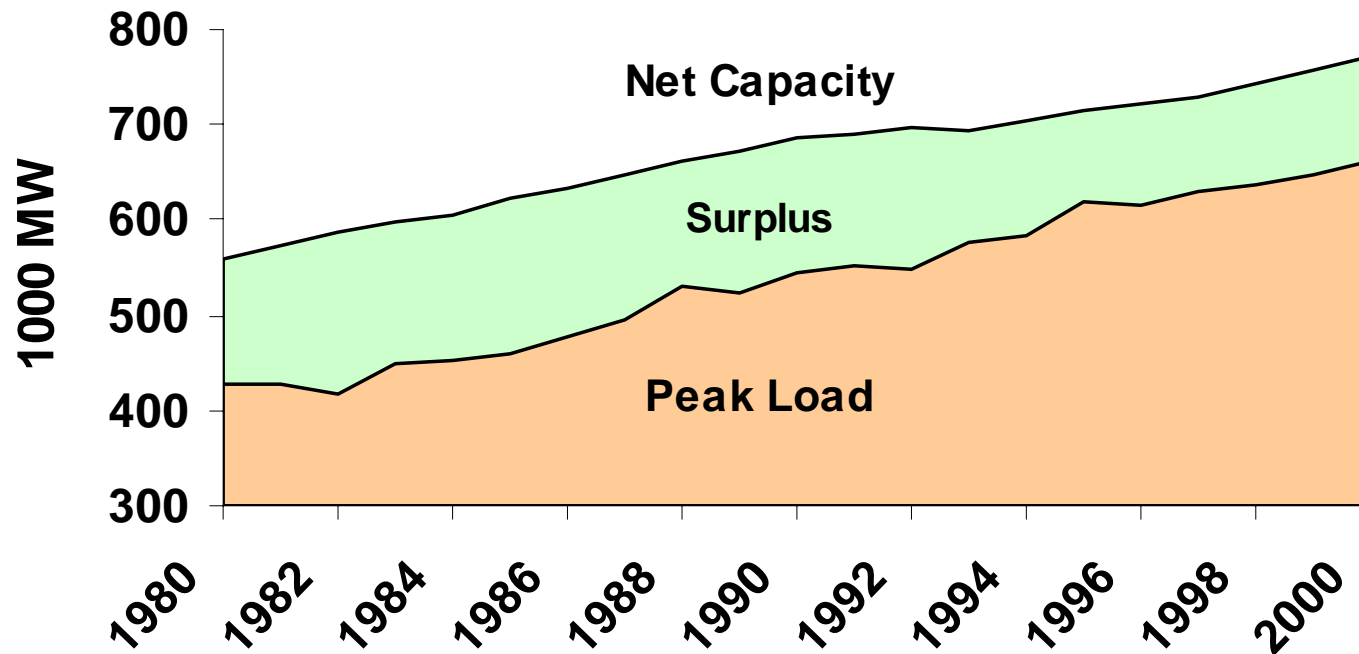
Rising Demand for Electricity



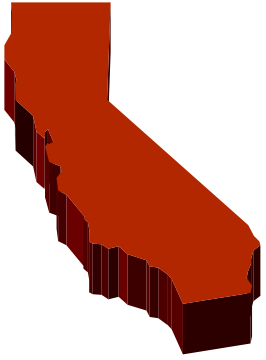
Source: Electric Power Research Institute



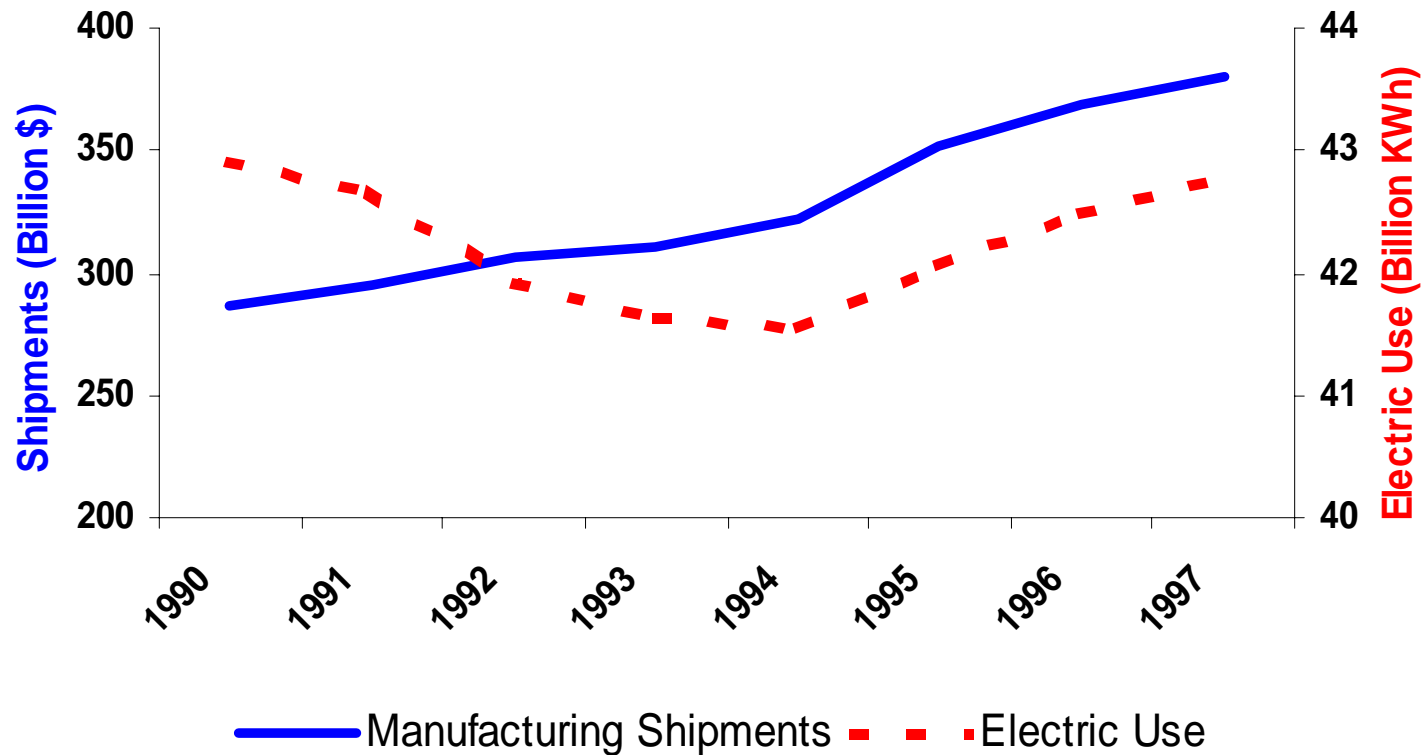
U.S. Peak Summer Electric Supply and Demand



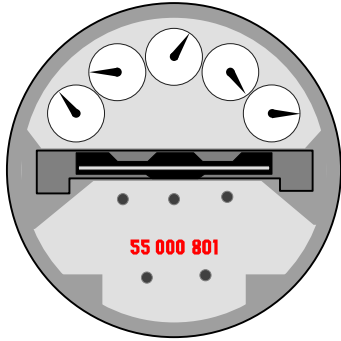
Source: Energy Information Administration



California Manufacturing Output and Electric Use



Source: Energy Information Administration

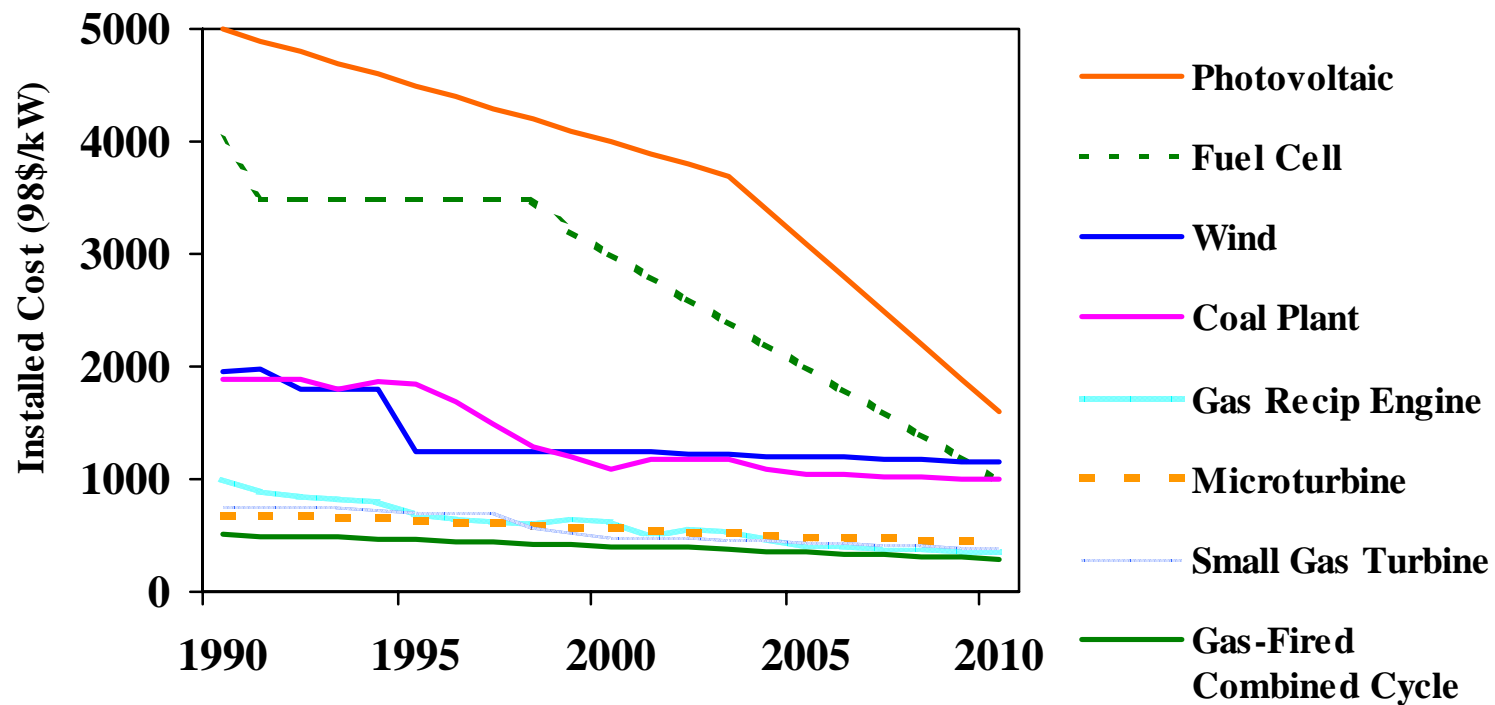


Percent of Electricity Generated On-Site, 1996

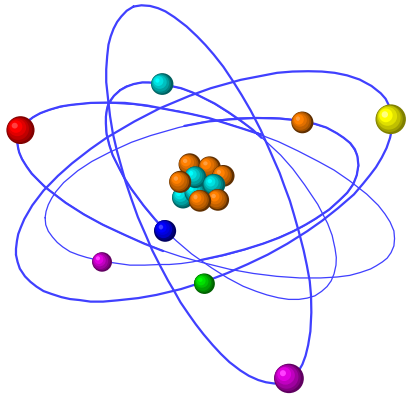
SIC	Industry	CA	U.S.
20	Food products	7.1	10.8
24	Lumber products	29.4	9.1
26	Paper products	27.1	50.5
28	Chemicals	28.7	23.8
29	Petroleum refining	66.8	29.3
32	Rubber/plastic products	4.3	1.0
33	Stone/concrete products	7.1	5.5
35	Electronics/computers	0.1	0.5

Source: RDC calculations based on Energy Information Administration and CEC data

Generation Capital Cost By Technology



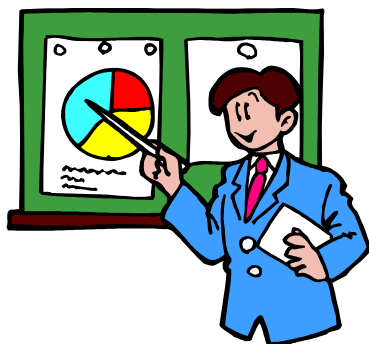
Source: Resource Dynamics Corporation



DG Technology Characteristics

Technology	Diesel Engine	Micro Turbine	Mini Turbine	Fuel Cell
Size (MW)	0.03 - 10	0.03 -0.2	0.5 - 10	0.1 - 3
O&M (\$/kWh)	0.005 - 0.015	0.004-0.010	0.003-0.008	0.002-0.015
% Electric Efficiency	36-43	18-32	21-40	40-57
Usable CHP Temp (Degrees F)	Diesel 180-190, Other IC 400-500	400-650	500-1,100	140-700
% Overall Efficiency	82	82	85	82
Availability	90-97%	90-98%	90-98%	>95%
Footprint (sq ft/kW)	0.25	0.25	0.30	0.90

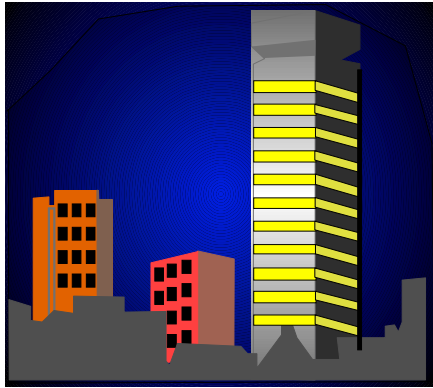
Source: Resource Dynamics Corporation



DG Commercial Status

Technology	Diesel Engine	Micro Turbine	Mini Turbine	Fuel Cell
Commercial Availability	Well established	Evolving industry	Well established	Well established
Fuel Type	Diesel, propane, NG, oil	Propane, NG, distillate	Propane, NG, distillate	Hydrogen, propane
Noise	Moderate to high (requires enclosure)	Moderate (enclosure supplied with unit)	Moderate (enclosure supplied with unit)	Low (no enclosure required)
Typical Duty Cycles	Baseload	Peaking, intermediate, baseload	Baseload, intermediate, peaking	Baseload
Likely Users Next 5 Years	Industrial, commercial, UDC, residential	Industrial, commercial, UDC	Industrial, UDC, commercial	Residential, commercial, industrial, UDC

Source: Resource Dynamics Corporation



DG Regulatory Environment

- Interconnection standards
- Grid use fees
- Net metering laws
- Stranded asset charges
- Power reliability and quality
- Emissions

Uncertainty slows introduction of DG



Air Emissions by Technology

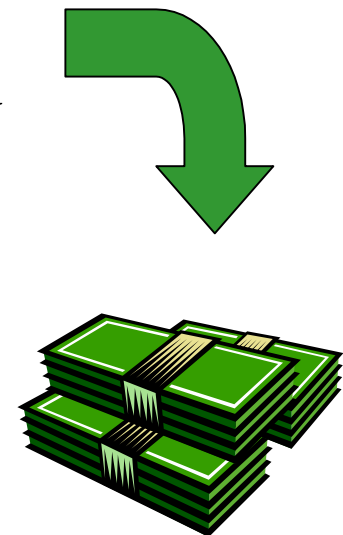
(lb/kWh)

Generation Technology	CO	PM ₁₀	NO _x	SO _x
Distributed Generation				
Recip engines	.004-.006	.0002	.0015-.037	
Miniturbines	.01-.05	.0001-.0002	.007-.009	.0003
Microturbines	.003-.050	.0001-.0002	.0005-.0050	.0003
Fuel cells	.00001	0	.000002 - .000060	0
Photovoltaic	0	0	0	0
Wind turbines	0	0	0	0
Central Station				
Gas steam	.00009	.00001	.00003-.00010	0
New coal plant		.0001	.002	.002-.004
Geothermal	0	0	0	0
Hydropower	0	0	0	0
Nuclear	0	0	0	0

Sources: CADER and Resource Dynamics Corporation based on manufacturers' specifications

Benefits of DG

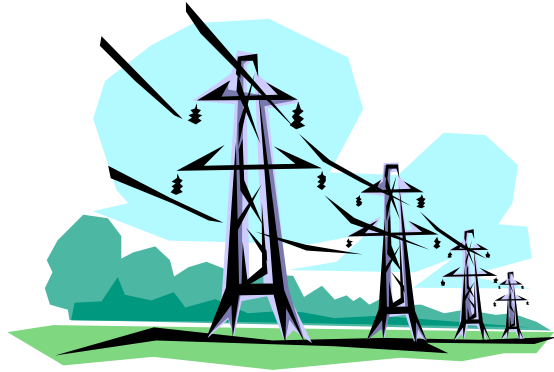
- Improved reliability via disruption prevention
- Wider user choice
- Potentially lower emissions
- May be developed more quickly than central station generators
- Potential to save energy producers and consumers money



Quality Risks With DG



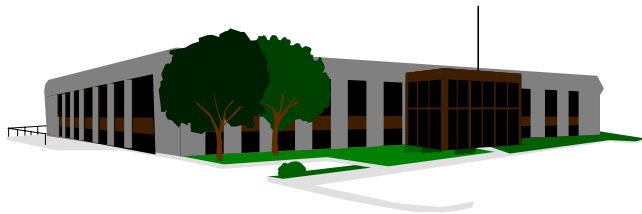
- Inconsistent interconnection standards make it harder to integrate DG with overall grid
- Increasing number of DG generators (and an aging stock) could lead to potential power quality degradation



Several Ways DG Can Improve Reliability

- Industrial on-site generation - backup and baseload
- Energy company purchase during peak periods
- Aggregating backup assets for sale to grid
- Utility provision of premium power
- UDC locate DG to circumvent T&D constraints

Properly installed and operated, DG can increase both end-user and grid reliability



Traditional Premium Power Customers

- | | |
|--|---|
| <ul style="list-style-type: none">✓ Businesses with large mission-critical computer systems (e.g. airlines, banks, depository institutions, brokers, insurance companies, computer processing centers)✓ Communications stations✓ Hospitals, nursing homes, other health care facilities✓ Large photofinishing laboratories✓ Airports✓ Radio and television stations✓ Dairy farms✓ Fire and police stations✓ Military bases | <ul style="list-style-type: none">✓ Natural gas transmission and distribution✓ Prisons✓ Water supply and sewage treatment plants✓ Apartment buildings✓ Hotels✓ Office buildings✓ Other commercial/retail/government buildings✓ Schools✓ Ski resorts✓ Theaters, stadiums, and other public gathering places✓ Various industrial facilities (e.g., SICs 2221, 2262, 2281, 2621, 2631, 2671, 2711-2761, 2810-3089) |
|--|---|

Interruption Cost for Some Traditional Premium Power Users

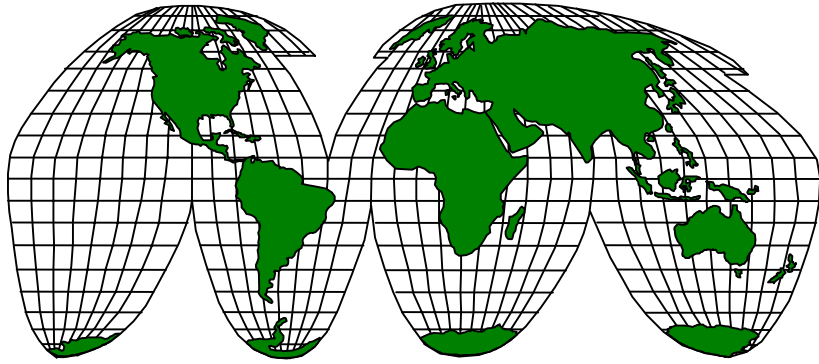
Customer Segment	Average Cost of 1 Hour Interruption
Cellular Communication	\$41,000
Telephone Ticket Sales	\$72,000
Air Reservation System	\$90,000
Semiconductor Manufacturer	\$2,000,000
Credit Card Operation	\$2,580,000
Brokerage Operation	\$6,480,000



Market for Traditional and Non-Traditional Premium Power

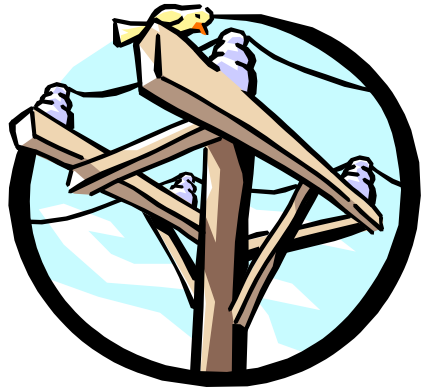


Customer Segment	Potential Number of DG Units
Traditional	
Commercial	220,000
Industrial	25,000
Non-Traditional	
Commercial	380,000
Industrial	5,000
Total	630,000



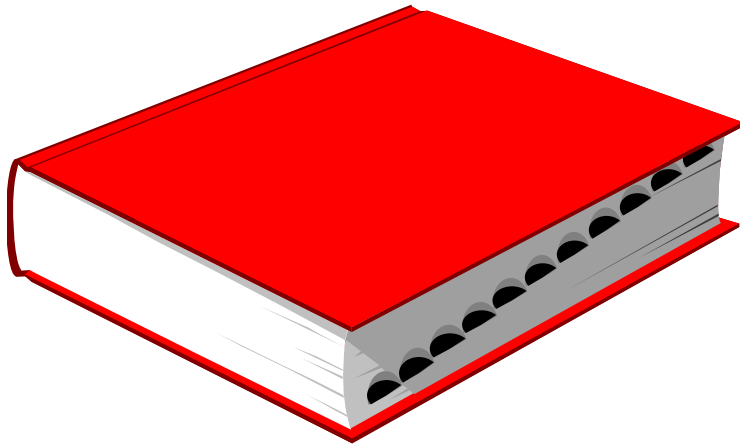
Future of DG Technologies

- Technology improves - efficiency, durability, and reliability
- Acceptable emission levels obtained through controlling technologies
- Lower costs through mass production
- Global market
- Overseas technology shakedown/improvement



Future of DG Marketplace

- Diminishing DG regulatory uncertainty
- Increasing capacity and T&D shortages reduce grid reliability
- Major energy end-users apply DG for reliability and power quality
- Key investments by large players
- DG industry consolidation



For More Information

- www.distributed-generation.com

