

AIR QUALITY ISSUES AFFECTING DG DEPLOYMENT

**AEE WEST COAST ENERGY MANAGEMENT
CONFERENCE**

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Eric Wong

Business Development Manager

Electric Power Group

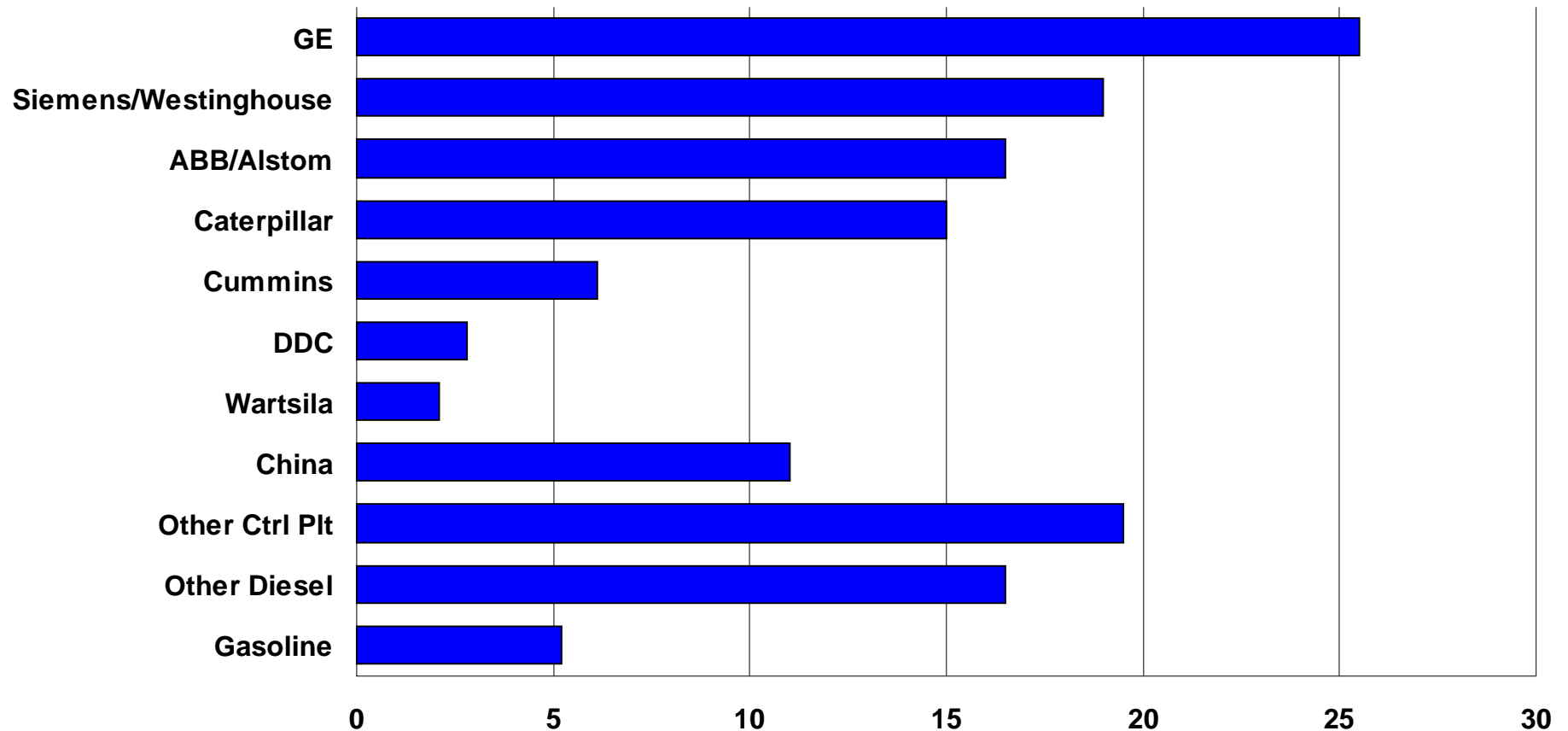
Caterpillar Inc.

- 1999 Sales & Revenues: \$20 billion
- 67,000 employees worldwide; 38,000 in U.S.
- 195 Dealers worldwide with 82,000 employees
- Machinery-\$12 billion
- Engines-\$7 billion
- Electric Power Generation--\$1.8 billion
- EPG ↑. 20 % compounded rate since 1995; up 53 % in 1999.

WHO WE ARE

- **CATERPILLAR ELECTRIC POWER PRODUCTS**
 - Reciprocating Engine Gensets--liquid and natural gas fueled
 - 150 kW up to 20 MW
 - Solar Turbines
 - 4 MW new Mercury (Advanced Turbine System) -- ultra clean (under 10 ppm) and high efficiency (1 40%)
 - 1 - 15 MW size offerings

Electric Power Industry 1999 (GWs)



Note: GE GWs includes licensees, ABB heavy in steam and hydro @ higher \$/kW

DG STRENGTHS

- **Low emissions even in severe non-attainment areas**
- **Economical sound attenuation to meet local zoning restrictions**
- **T&D deferment**



CATERPILLAR®

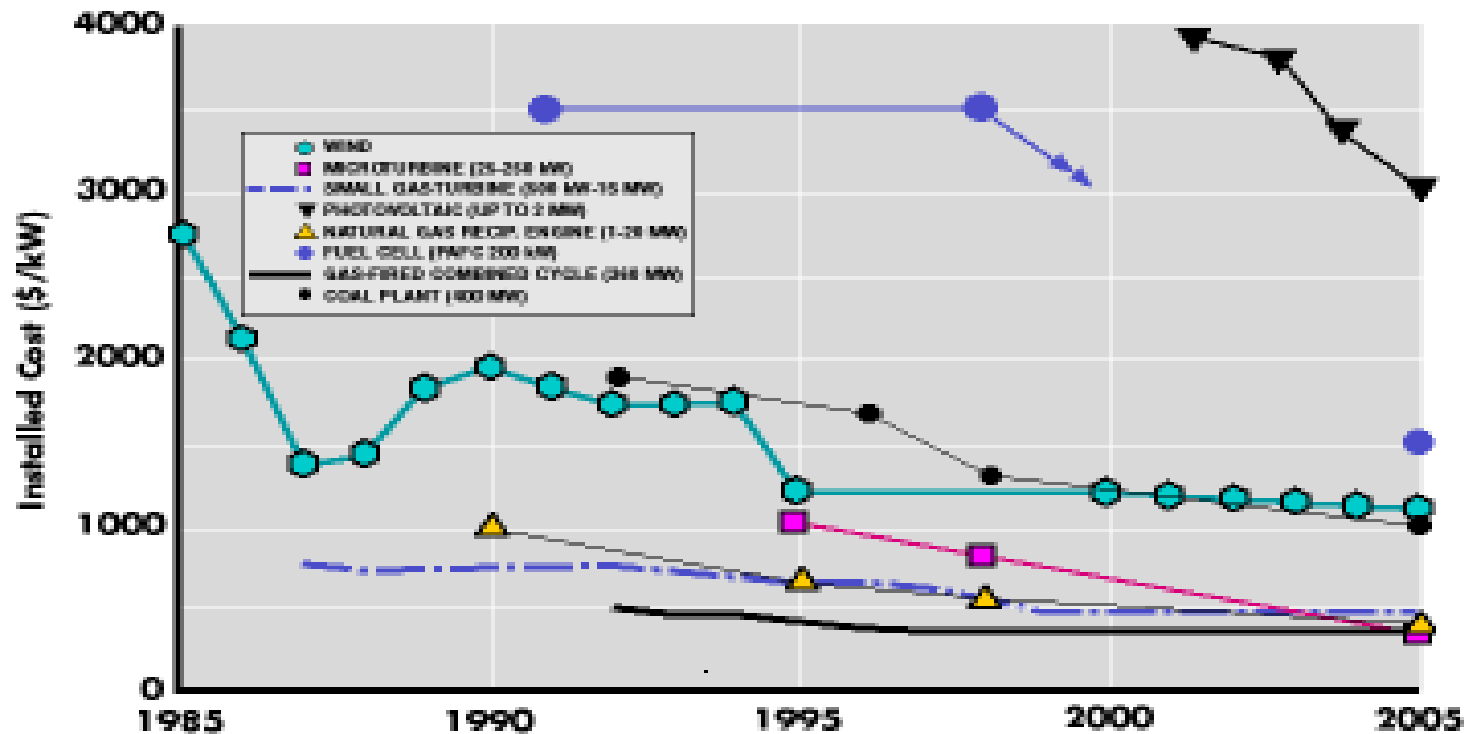
WHERE THE WORLD TURNS FOR POWER

ATTRACTIVE INSTALLATION



DG TECHNOLOGIES

COST TRENDS (1998\$)



Source: CADER Final Report, April 1998. ONSI
Fuel Cell update per ESource, Mar. '99

REGULATORY CONCERNS

- Emissions from fossil fueled DG
- Operation during hours when ozone is peaking
- Penetration/sheer numbers
- Location in urban areas
 - Noise
 - Hazardous wastes
 - Stack height at nose levels
- Capacity under threshold for oversight

CONCERNS TO MANUFACTURES

- Lack of pre-certification
 - Emissions
 - Noise
 - Efficiency
 - Safety
- Fees
 - Interconnection studies, contract
 - Standby rates
- Dispatch
 - Issue for Energy Service Supplier or UDC

Efficiency and Emissions Characteristics of Electric Technologies

Technology	Electric Efficiency (%)	Total Efficiency (%)	NOx (lb./MWh)	NOx (lb./MWh _{e+t})
Steam Turbine	15-45%	<80%	0-2	0-1
SI Engine	25-45%	<85%	2.2-28	1-2
CI Engine	30-50%	<90%	3-33	2-15
Gas Turbine	25-40%	<85%	1-4	0.2-2
CCGT	40-60%	N/A	0.3-3	N/A
Microturbine	20-30%	<75%	0.4-2	0.2-1
Fuel Cells	40-70%	<75%	<0.02	<0.01
Stirling Engine	16-42%	<95%	<0.5	<0.25
Photovoltaics	8-15%*	<30%*	0	0

Source: The Clean Air-Innovative Technology Link. Northeast-Midwest Institute, 1999. Table 4, pg, 40.

* This is the photon conversion efficiency, which is not really comparable with the thermodynamic efficiency listed for the other technologies

REVIEW OF RECENT DG STUDIES

- **USDOE & OAK RIDGE NATIONAL LAB (1999/pending)**
 - **Utility: Central grid competitive with most DG for next decade**
 - Exception is the ATS. In 2010, DG of all types are competitive
 - **Commercial and industrial sector: reduce both customer electric bills and emissions**
 - **National: part of strategy to reduce greenhouse gases and other air emissions**

REVIEW OF RECENT DG STUDIES

- Air Quality Implications of DG (CARB, 2000/pending)
 - Utility: existing grid so clean that economic potential is modest with overall emissions increase
 - Large Customers: economic potential only where electricity prices are high
 - State: CARB future direction not known
- *Perspective*
 - *Single digit NOx imperative*
 - *Ancillary market = revenue stream to reduce 1st cost and improve economics of ownership*

REVIEW OF RECENT STUDIES

- Emissions From DG and Pollution Prevention Policies, (NRDC, Electricity Journal, June 2000)
 - PV and wind clearly superior across range of technologies and pollutants
 - Fuel cells deserve support though not pollution free
 - CHP should be encouraged
- Recommendations
 - Performance Standards
 - Building codes extended to cover DG and encourage CHP
 - Inspection and Maintenance

ACTION ITEMS

- **Pre-certification Standards for DG and CHP**
 - NO_x, noise, optimal cogeneration (not PURPA)
 - staged limits over time.
 - Cross-cut issues: revenue from ancillary and firm services can pay for post-combustion treatment. Lack of offsets
- **Effect of Environmental Standards**
 - ESCOs and ESPs are encouraged to aggregate and go after dirty sources.
 - First cost and pay-back reduced by
 - Consumer choice expanded

MANUFACTURER RESPONSE

- US DOE launch Advanced Reciprocating Engine Systems (ARES) and Microturbine R&D Programs
- ARES Program Goals
 - 0.5 g/bhp-hr NO_x
 - Dual-Fuel capability
 - Cost of power(capital, O&M) 10% less than current
 - 50% efficiency by 2010
 - Reliability and maintainability equal to current