

Clean CHP Technology

DER – All Power Is Local!

Combined Heat and Power Session

**California Alliance For Distributed Energy Resources
and
California Solar Energy Industries Association**

Santa Clara, California

September 8, 2005

Background

- Emission regulations are driving the pace of low emissions technology
- Tradeoffs exist among emissions, efficiency and cost
- Emission technology of choice depends on prime mover type and size
- Some CHP emission proposals threaten certain prime movers and degrade CHP economics

DG Rule/Guidance Activity

- CARB - SB1298
- SCAQMD
 - Revising Compliance Protocols
 - BACT Rulemaking
- TCEQ – Air Quality Standard Permit for Electric Generating Units
- RAP – National Model Rule
- All Efforts “Output Based” – Encourages System Efficiency (CHP)

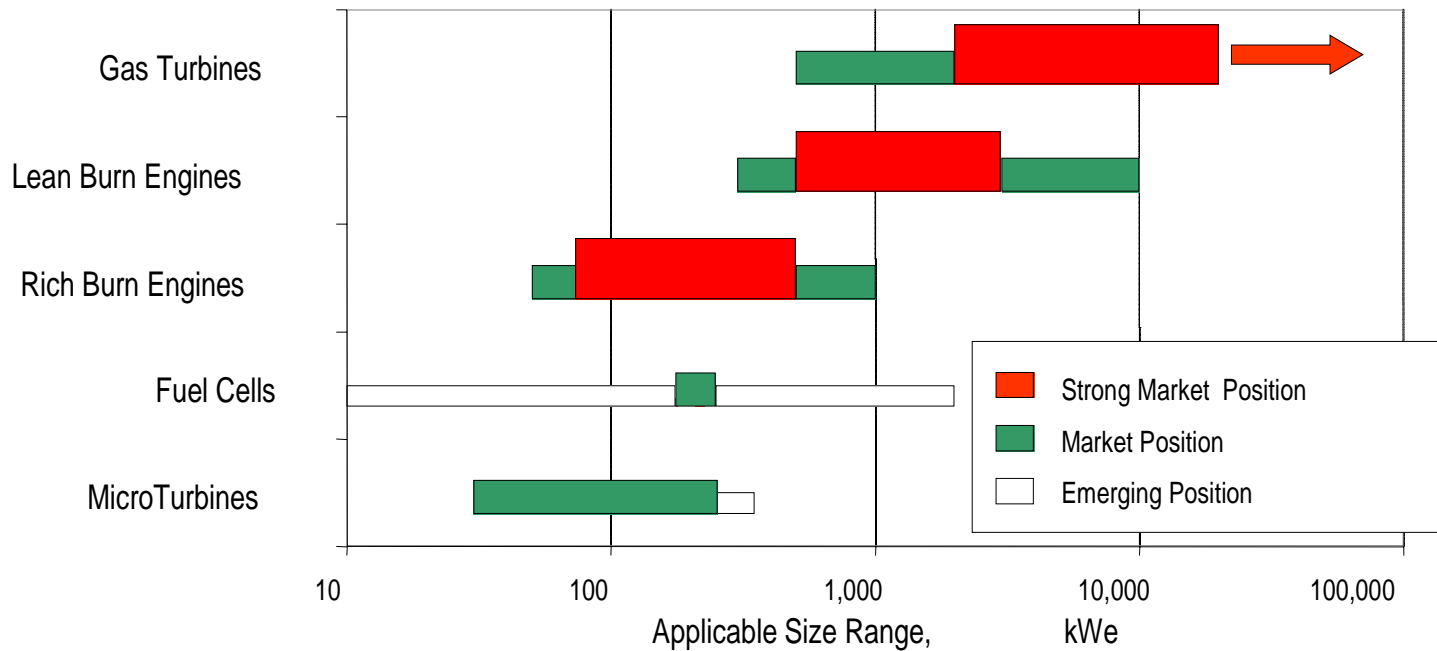
CARB DG/CHP Emission Guidelines

	<u>NOx</u>	<u>CO</u>	<u>VOC</u>
	lb/MW-hr (ppm 15%)		
CC Central	0.07 (2.5)	0.10 (6)	0.02 (2)
DG 2003	0.5 (18)	6.0 (310)	1.0 (85)
DG 2003 CHP	0.7 (25)	6.0 (310)	1.0 (85)
DG 2007	0.07 (2.5)	0.10 (6)	0.02 (2)

Comparison of Output-Based Limits

	East Texas	California Cert./Guidance	RAP Attainment / NA
Minimum Efficiency	55%	60%	55%
Credit Method	Thermal Credit (3413 BTU = kWh)	Thermal Credit (3413 BTU = kWh)	Boiler Emission Credit
Initial NOx Standard (lb/MW-hr)	0.47	0.5	0.6
Final NOx Standard (lb/MW-hr)	0.14	0.07	0.15

Technology vs. Size Coverage



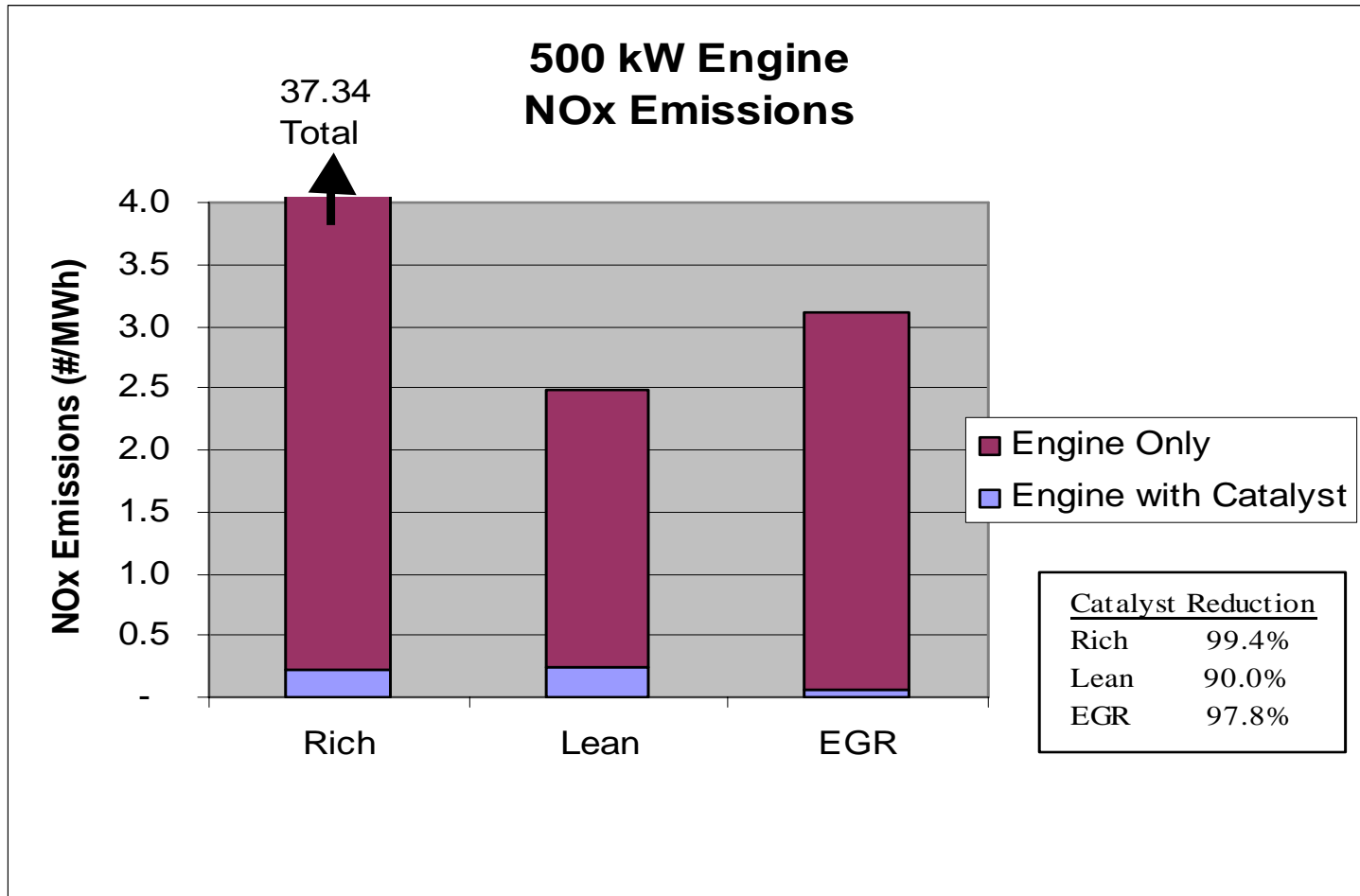
Clean DG Technologies

- Turbines
 - Lean Pre-mix Combustion
 - SCR + Oxidation Catalyst
 - Catalytic Combustion
 - Recuperation
- Reciprocating Engines
 - Lean-burn w/SCR + Oxidation Catalyst
 - Rich-burn w/3-Way Catalyst
 - Exhaust Gas Re-circulation w/3-Way Catalyst
- Microturbines
 - Lean Pre-mix Combustion
- Fuel Cells

Clean Reciprocating Engines

- Rich-burn with 3-Way Catalyst
 - Simple, relatively inexpensive system
 - Huge NO_x producer without after-treatment
 - 3-Way catalyst very effective and modest cost
 - Approaching limits on efficiency, power density and emissions
- Lean-burn with SCR and Oxidation Catalyst
 - Higher efficiency and power density with room to improve
 - Low engine out emissions, but not low enough for stringent emission regions
 - SCR can be a very expensive proposition, particularly on smaller engines
- Cooled EGR with 3-Way Catalyst
 - Blends many of the best features of rich-burn and lean-burn engines

Engine NO_x Control Comparison



Summary

- Trend is to output based standards with credit for heat recovery
- Technology paths exist for all CHP technologies to reach ultra-low emission levels
- After-treatment can significantly impact economics for smaller CHP systems
- Need to keep pace of tightening standards in-sync with CHP technology and cost trajectories

Keith Davidson

DE Solutions, Inc.

(858) 832-1242

kdavidson@de-solutions.com