

US EPA ARCHIVE DOCUMENT

SANITATION DISTRICTS OF LOS ANGELES COUNTY



*A Megawatt Made is a Million Dollars Earned:  
Energy Production from Digester Gas*

*Mark McDannel*

*Los Angeles County Sanitation Districts  
Energy Recovery Engineering Section*

*Innovative Energy Management Workshop  
December 16, 2008*

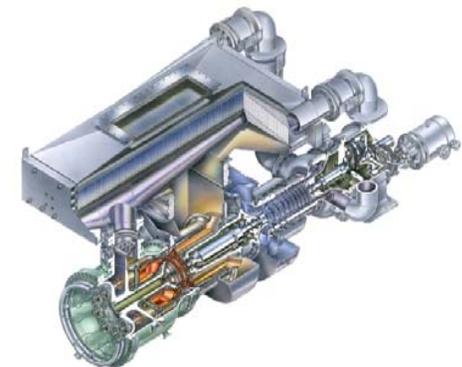
# *Presentation Overview*



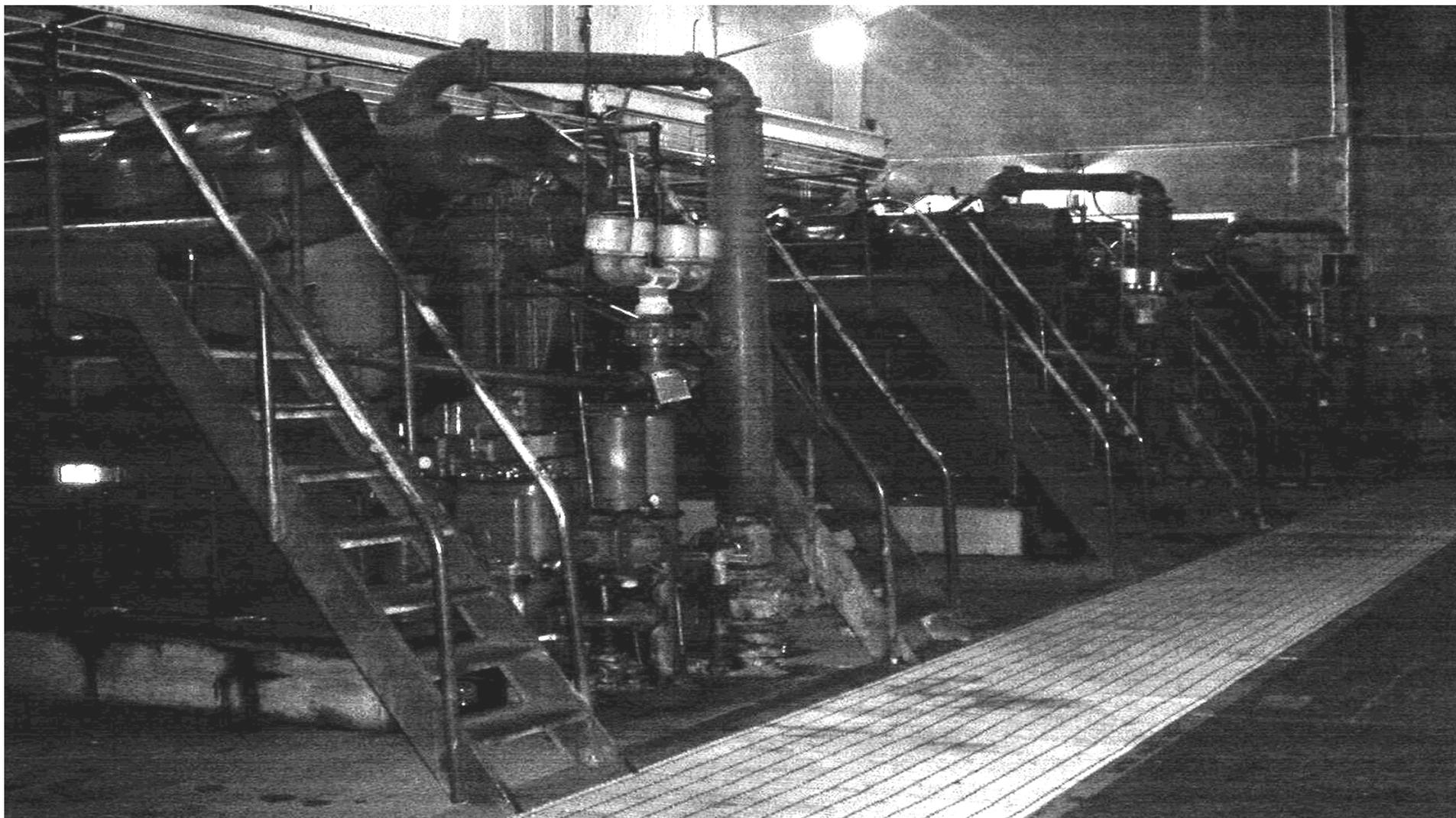
- ⌘ Districts Energy Program
- ⌘ Technology Review
- ⌘ Capital and Operating Costs
- ⌘ Barriers to Energy Recovery
- ⌘ A paper with more details available from the speaker

# *Districts Energy Management Program*

- ⌘ Maximum development of bio-gas resources
- ⌘ Minimize energy usage
- ⌘ Minimize procurement cost and maximize sales income
- ⌘ Demonstrate new technologies that reduce air emissions



*IC POWER ENGINE INSTALLED at  
JWPCP in 1938*

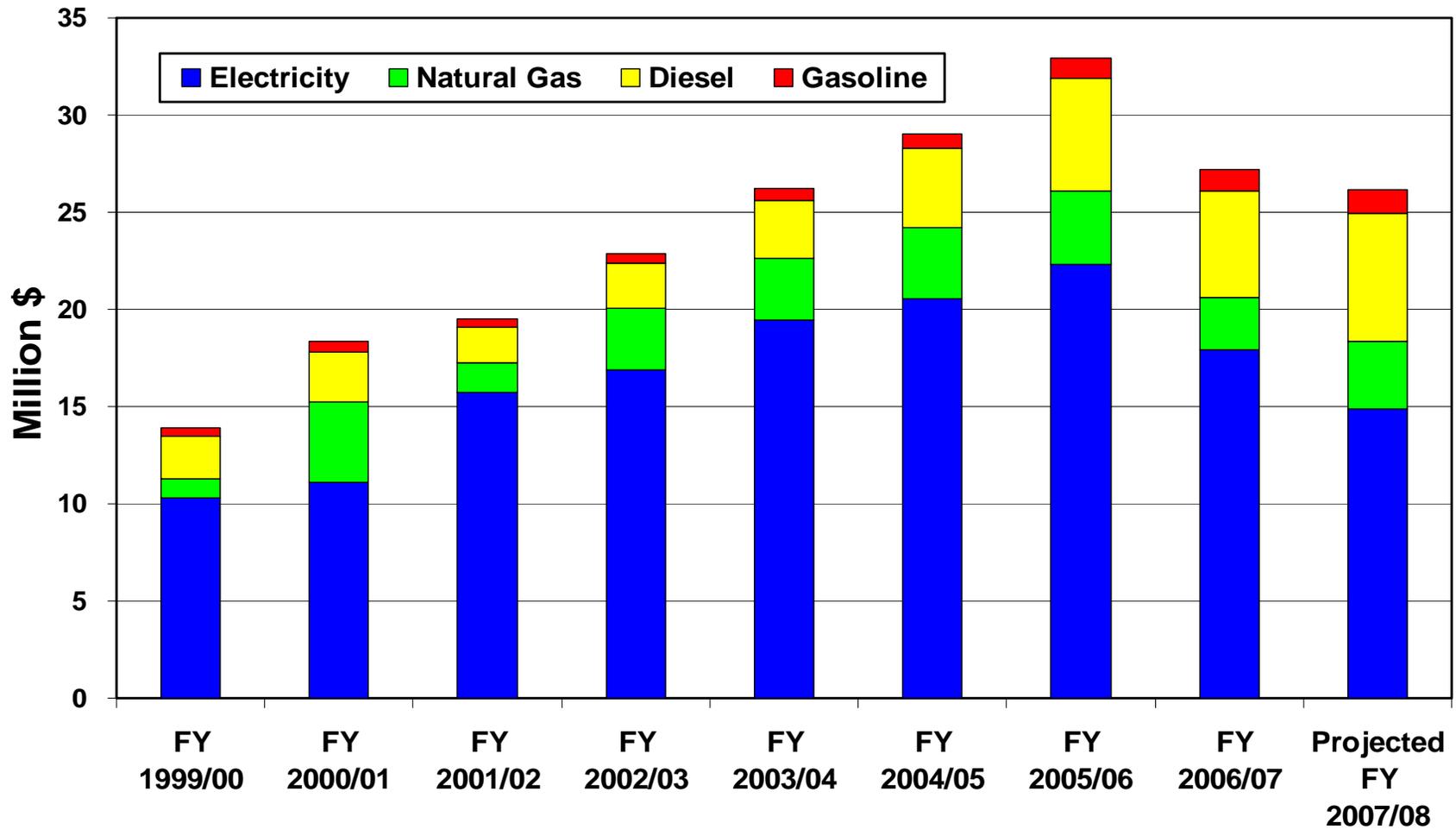


# *Why Self Generation?*

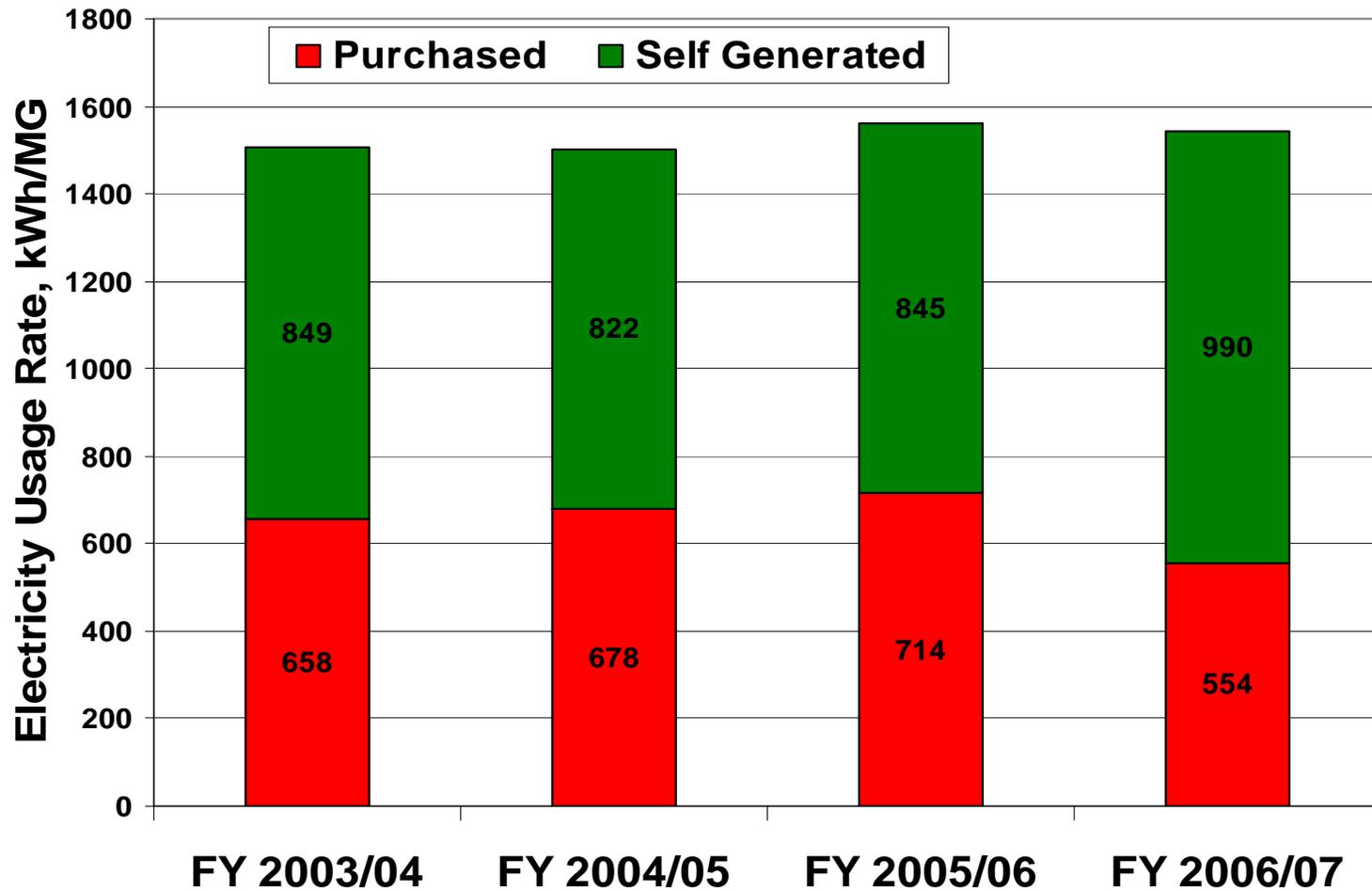


- ⌘ Save and Make Money
  - ☑ Displace Expensive Retail Purchases
  - ☑ Renewable Energy Credits Can Be Sold in 2009
- ⌘ Reduce Emissions
- ⌘ Reduce Global Warming
- ⌘ Increased Redundancy
  - ☑ Digester Heating (Cogeneration)
  - ☑ Decrease Run Hours on Standby Generators

# Historical Energy Expenditures at LACSD



# *System Wide Wastewater Treatment Plant Power Consumption*



# *Existing Districts Digester Gas-Fired Facilities*



## ⌘ Boilers

- ☑ Digester Gas for Heating

## ⌘ Turbines

- ☑ JWPCP 22 MW (400 MGD)

## ⌘ Engines

- ☑ Valencia 0.4 MW (12.5 MGD)

## ⌘ Microturbines

- ☑ Lancaster 250 kW (10 MGD)

## ⌘ Fuel Cell

- ☑ Palmdale 250 kW (15 MGD)

# *Energy Recovery Equipment*



- ⌘ Gas Turbines 1 MW to 15 MW
- ⌘ IC Engines 25 kW to 3 MW
- ⌘ Fuel Cells 200 kW to 2 MW
- ⌘ Microturbines 30 kW to 250 kW
- ⌘ Emerging technology-conversion of digester gas to natural gas (not covered in this presentation)

# *Gas Turbines*

- ⌘ Medium to High Efficiency
- ⌘ Low Operating & Maintenance Cost
- ⌘ Higher Installed Cost
- ⌘ Excellent for Heat Recovery
- ⌘ Island Operation



# *JWPCP Total Energy Facility*



Location - Carson, California  
Combined Cycle Cogeneration  
Power Plant

- ☒ Three 9 MW Solar Mars T-13000 gas turbine generators
- ☒ One 3 MW DeLaval HJT steam turbine generator
- ☒ Offsets \$15-20MM/yr in electricity purchases

# IC Engines

## ⌘ Higher Air Emissions

⊞ SCAQMD Rule 1110.2 may kill market

## ⌘ High Efficiency

## ⌘ Inexpensive

## ⌘ Suppliers

⊞ Waukesha

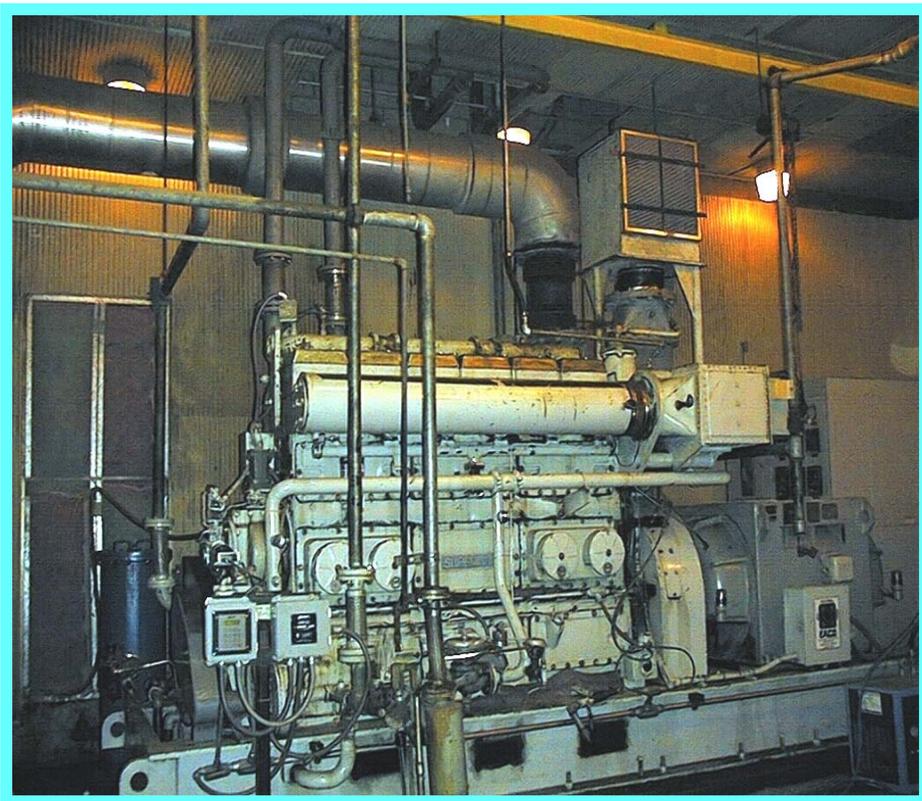
⊞ CAT

⊞ Jenbacher

⊞ Deutz



# *IC Engine Cogeneration Facility at Valencia WRP*



## Location - Valencia, CA

- ⌘ 500 kw Cooper-Superior Model 6GTLA Engine Generator
- ⌘ Steam used to heat digesters
- ⌘ Will be shut down in 2009 due to expense of air compliance



# Palmdale Fuel Cell Project



- ⌘ Fuel Cell Energy molten carbonate fuel cell
- ⌘ 250 kW, 47% efficiency (LHV)
- ⌘ Heat recovery to heat water for digesters
- ⌘ Combined heat and power efficiency 73%
- ⌘ Startup completed Jan 2005
- ⌘ Capital cost \$1.9 million (before 50% rebate)
- ⌘ 50% of cost recovered from SGIP

# *Microturbines*



⌘ Low Air Emissions

⌘ Medium Efficiency – High Temperature Exhaust

⌘ Cost Effective

⌘ Two Suppliers in California

☒ Capstone 30 kW, 60 kW, 200 kW

☒ Ingersoll Rand 70 kW, 250 kW

# *Lancaster Microturbine Project*



- ⌘ Ingersoll Rand microturbine
- ⌘ 250 kW gross, 32% efficiency (LHV)
- ⌘ Heat recovery to heat water for digesters
- ⌘ Combined heat and power efficiency 51%
- ⌘ Capital cost \$684k
- ⌘ 40% of cost recovered from California Self Generation Incentive Program (SGIP)

# *Calabasas Landfill Microturbine Facility- Ten Capstone 30 kW*



# *Digester Gas Cleanup*



- ⌘ Digester gas is not natural gas
- ⌘ Some technologies require removal of gas contaminants
- ⌘ Can add up to 2 cents/kWhr to O&M costs

# *Siloxane Removal*

- ⌘ Required for fuel cells, microturbines, engines or turbines w/ NO<sub>x</sub> or CO catalysts
- ⌘ Optional for turbines or engines w/out catalysts-cost based decision
- ⌘ Sorbents
  - ⊗ Effective
  - ⊗ Need to monitor for breakthrough and replace sorbent
- ⌘ Pressure Swing Absorption
  - ⊗ Continuous operation
  - ⊗ Requires flaring of off gas, loss of 2-8% of fuel heating value
- ⌘ Deep Chilling
  - ⊗ No longer considered commercially available

# *Sorbent Based Fuel Skid*



## *Other Contaminants*



- ⌘ Fuel cell requires removal of sulfur compounds, VOCs, chlorinated VOCs
- ⌘ Future application of catalysts on engines may require removal of S, Cl

# *Self Generation Cost Summary Comparison*

	Installed Cost (\$/kW)	Operating Cost (\$/kWh)	Power Production Cost* (\$/kWh)
Gas Turbines	\$2,000	\$0.010	\$0.04
IC Engines	\$1,700	\$0.015	\$0.04
Microturbines	\$3,000	\$0.016	\$0.06
Fuel Cell	\$8,500	\$0.035	\$0.16

\*10 year write down @5%

# Challenges



## ⌘ Many technologies are new

- ☒ Track record
- ☒ Number of suppliers
- ☒ Experience and resources of some suppliers

## ⌘ Institutional barriers

- ☒ Air agencies
- ☒ Electric utilities

# Contact Info

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