Capstone Biogas Systems
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www.microturbine.com

Leading Capstone Applications

- ***Oil and Gas***
  - ***Flare Gas Reduction***
  - ***Coal-Bed Methane***
- ***Biogas Utilization***
  - ***Sewage***
  - ***Landfill***
  - ***Agricultural***
  - ***Food Processing***

- ***Hybrid Electric Vehicles***
- ***Combined Heating, Cooling, and Power***

Small, Modular Biopower

- ***99.999% combustion efficiency***
- ***Very low maintenance***
- ***Modular, portable***
- ***Very low emissions***
- ***Low Btu capable***
- ***Sour gas capable (7%)***
- ***Adjustable heat recovery***

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Palmdale Test Site

Puente Hills Test Site

Capstone Biogas Projects

• *Jeannette WWTP, PA*	*1 unit*
• *Colorado Springs WWTP, CO*	*2*
• *Allentown WWTP, PA*	*12 units*
• *San Elijo WWTP, CA*	*3*
• *Inland Empire RP-1 WWTP, CA*	*8*
• *Escondido WWTP, CA*	*12*
• *Lewiston WWTP, NY*	*2*
• *City of Burbank Landfill, CA*	*10*
• *Lopez Canyon Landfill, LA, CA*	*50*
• *Cal Poly SLO Dairy Farm, CA*	*1*
• *Banning, Temecula, and Santa Margarita WWTPs, CA*	*2 units each*
• *Colorado Pork, LLC, CO*	*1*
• *Indianapolis South Side Landfill, IN*	*1*
• *Projects in Japan and UK*	*2*

Jeannette Wastewater Treatment Plant, Pennsylvania

Colorado
Springs
Utilities
'00 12 27

Allentown, PA Wastewater Treatment Plant

San Elijo, CA Wastewater Treatment Plant

Inland Empire, CA Wastewater Treatment Plant RP-1

Escondido, CA Wastewater Treatment Plant

Lewiston, NY Wastewater Treatment Plant

Banning, CA Wastewater Treatment Plant

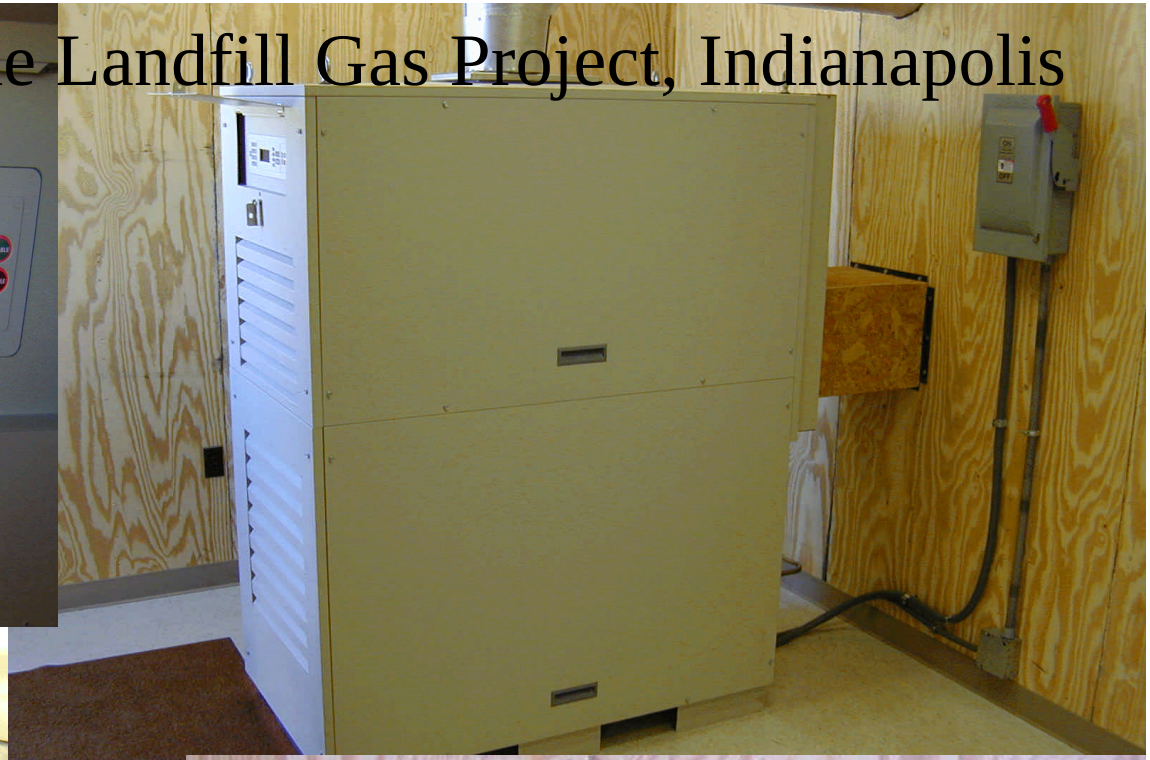
Temecula, CA Wastewater Treatment Plant

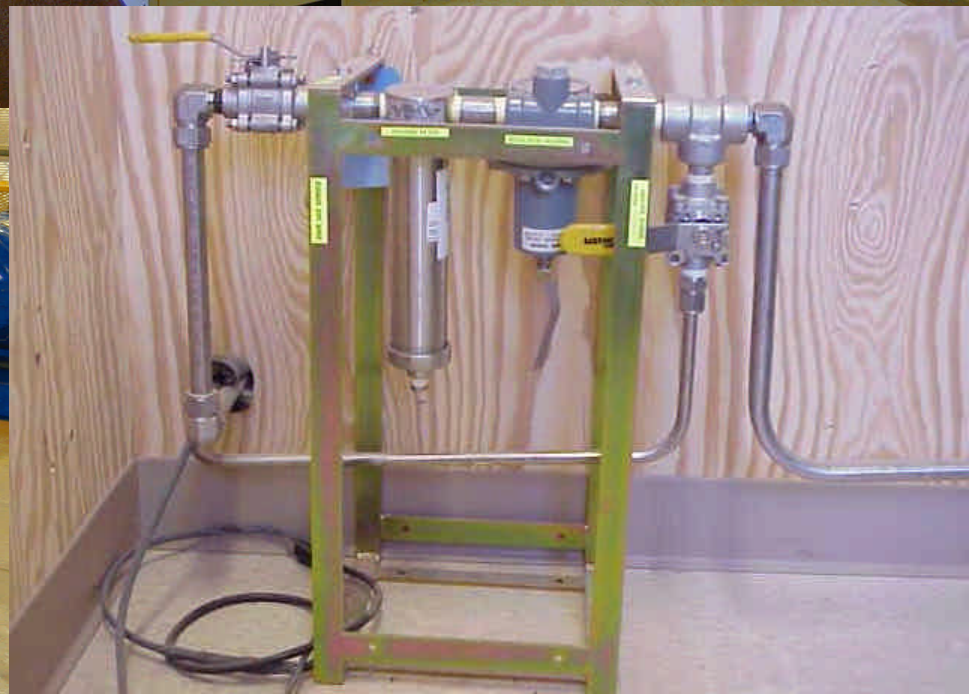
Santa Margarita, CA Wastewater Treatment Plant

Burbank City Landfill #3

Lopez Canyon Landfill – Los Angeles

Granger Energy Southside Landfill Gas Project, Indianapolis





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Colorado Pork, LLC

Meidensha-Sumitomo Installation at Dairy Waste Processing Plant – Bekkai-Cho, Japan

Cal Poly San Luis Obispo – Lagoon Digester

Water – the Enemy!

- ***Capstone fuel injectors and SPVs***
  - ***Replacement rate is prohibitive***
- ***Problems occur when gas is wet***
  - ***i.e., 100% humidity (saturated)***
    - √ ***Palmdale, Puente Hills, Jeannette, Allentown***
- ***Fine if gas into microturbine is DRY***
  - ***i.e., dew point is below gas temperature***

Water – the Enemy! (cont'd)

- ***Copeland was VERY water sensitive***
  - ***Approximately 50% failure rate***
  - ***Solution found!***
    - √ ***Temperature control -- water in vapor phase***
    - √ ***Failure rate now ZERO***
    - √ ***Entire fleet has been retrofit***
    - √ ***Thank you -- Allentown (PPL) and Burbank (EMCON)***

Water – the Enemy! (cont'd)

- ***Dryers***
  - ***Deliquescent desiccant dryers (Van Air)***
    - √ ***Level control***
    - √ ***Salt migration***
  - ***Refrigerated dryers***
  - ***Regenerative desiccant dryers***
  - ***Membrane dryers***
- ***KO pots – plumbing – gravity – drains – etc., etc.***

Compressor Sizing

- ***One Copeland is not enough for two 330s***
  - ***On 600 Btu/scf digester gas at <1 psig***
  - ***Ask Allentown or San Elijo***
- ***Be conservative***
  - ***Don't make compressors a bottleneck***
  - ***Or a failure point***
  - ***Provide redundancy and extra capacity***

Siloxanes – the Jury is Out

- ***Siloxane analysis before price quote***
  - ***Creates negative tension with customers***
- ***Do we REALLY need siloxane removal?***
  - ***Allentown – 3,000 hours – no erosion***
    - √ ***But are recuperators fouling?***
  - ***Burbank – one test unit***
  - ***Others?***

The Capstone MicroTurbine.

Power when and where you need it.

Clean and simple.

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