

Validating Innovative Renewable Energy Technologies: ESTCP Demonstrations at Two DoD Facilities



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- Southern Research Institute

Co-Performers:

- U.S. EPA's Environmental Technology Verification (ETV) Program
- FlexEnergy (Microturbine Supplier)
- Vanir Energy (Solar Chiller System Supplier)
- Power Partners (Adsorption Chiller Supplier)

Host Sites:

- Fort Benning, GA – 1st Division Road Landfill
- MCRD Parris Island, SC – Mess Hall

Funding & Support:

- ESTCP – Projects EW-0823 and EW-0928



ESTCP Demonstration of Renewable Energy Technology

- Installation Energy Test Bed Initiative
- Prove out innovative systems via in field demonstration and validation:
 - System Performance
 - Economics
 - Environmental
 - Operability (install, operate, maintain)
 - Regulatory, permitting, approvals
- Encourages adoption and more rapid commercialization and installation
- <http://www.serdp-estcp.org/Featured-Initiatives/Installation-Energy>.

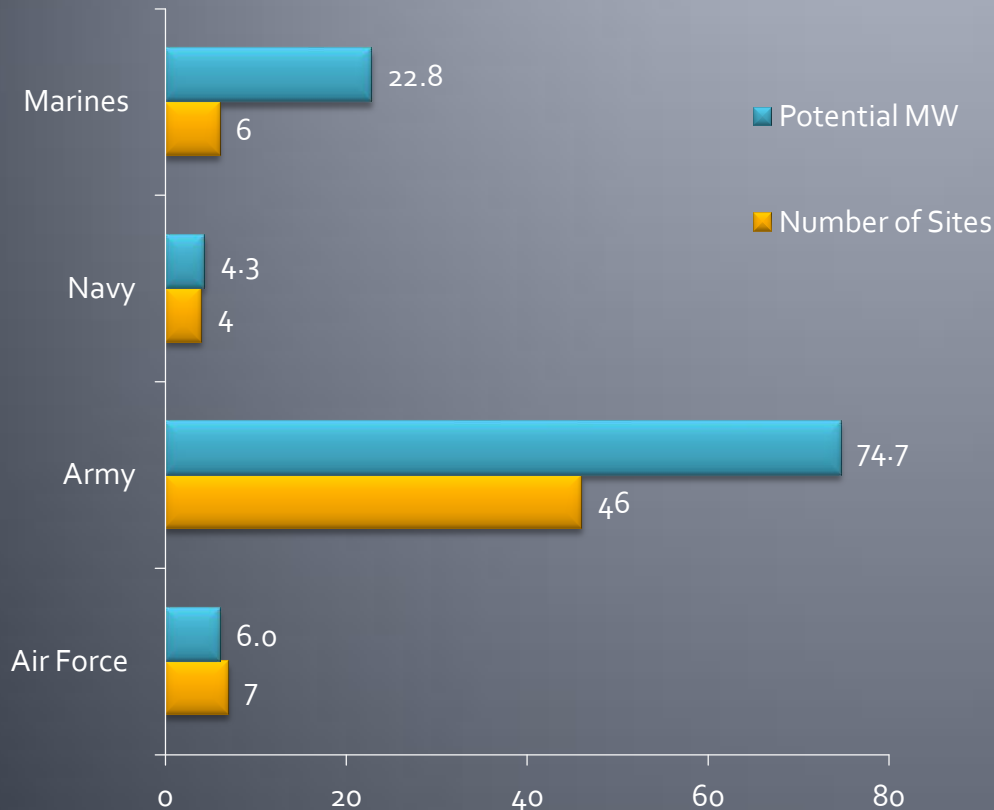


On-Site Renewable Energy from Low Quality Landfill Gas



Potential Energy from DoD Landfills

Potential Power Generation - 300 kw Minimum



- Landfill Gas Issues:
 - Often vented or flared
 - Many sites low quality gas
 - Environmental issues
- Potential Benefits of LFG to Energy:
 - Baseload Renewable Power
 - Reduce Emissions (GHG, other)
 - Independent Energy Source
 - Profitable

Potential LFG Energy Solutions

Figure 1: Traditional Gas Turbine with Required Fuel Cleaning and External Combustion

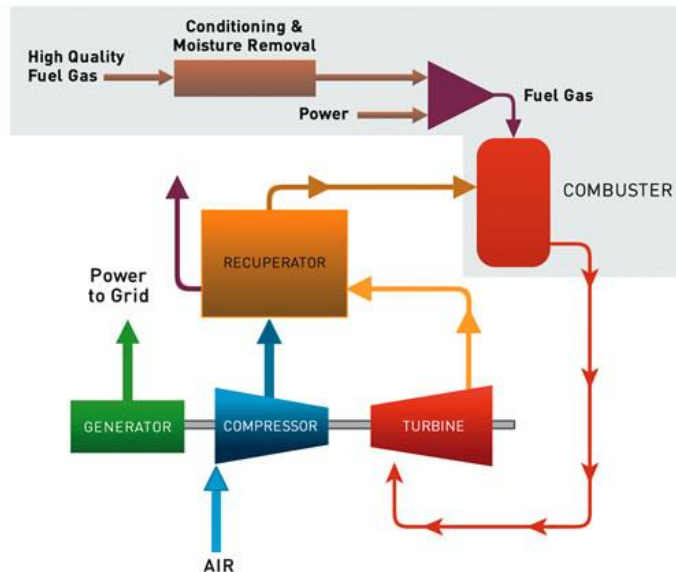
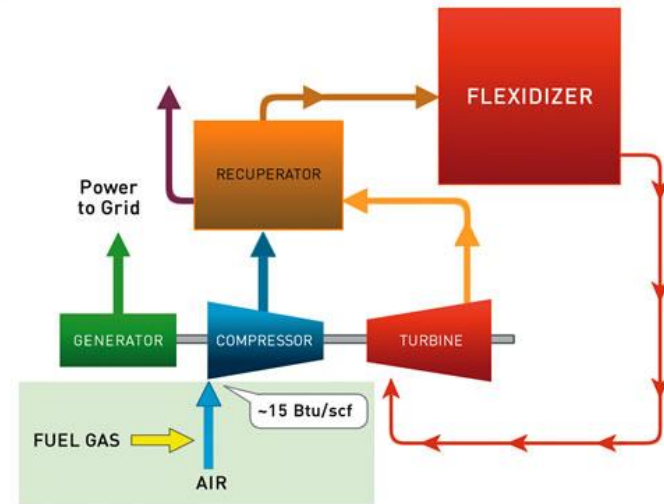


Figure 2: Flex Powerstation™ : Low Btu Gas Solution



- Traditional Systems (Engine or Turbine):
 - 350 BTU/scf
 - May not meet emission standards (CARB)
 - Complex gas conditioning and cleanup

- Flex Powerstation FP 250
 - 50 BTU/scf minimum
 - Very low NOx and CO
 - Minimal, simple gas cleanup
 - No fuel compressor

Flex Powerstation Specifications

Parameter	Specification
Nominal Electrical Output	250 kW
Minimum Fuel Strength	50 Btu/scf
Minimum Fuel Supply Pressure	2-5 psig
NOx , CO Concentration in Exhaust	<1 ppm
Gas Heat Rate	3,750,000 btu/hr
Exhaust Gas Temperature	450-500 F
System Weight	54,000 lbs
System Footprint	20 ft x 12 ft

Ft. Benning 1st Division Road Landfill

- 48 acres – MSW and mixed waste
- 2.3 million cubic yards / 1 million tons waste
- Operated 1985 – 1998
- Methane migrating off site
- 39 collection wells
- Existing LFG flare



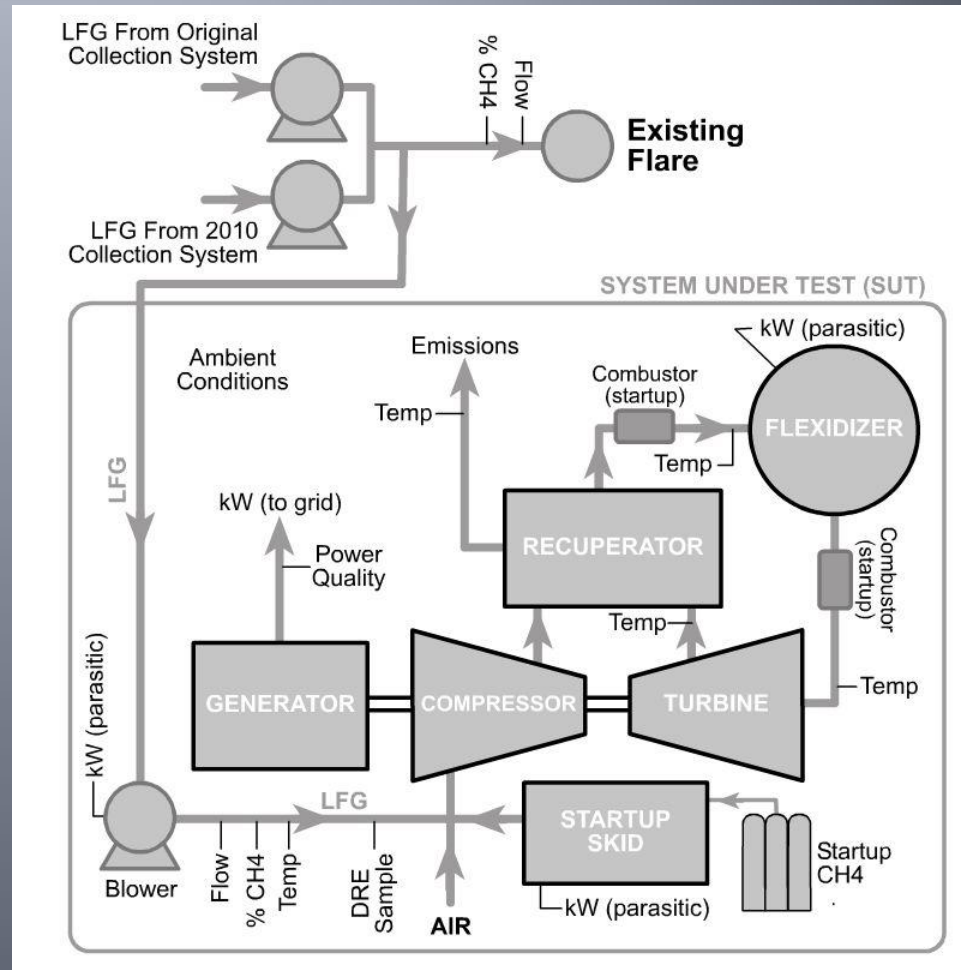
Flex FP250 Installation at Ft. Benning



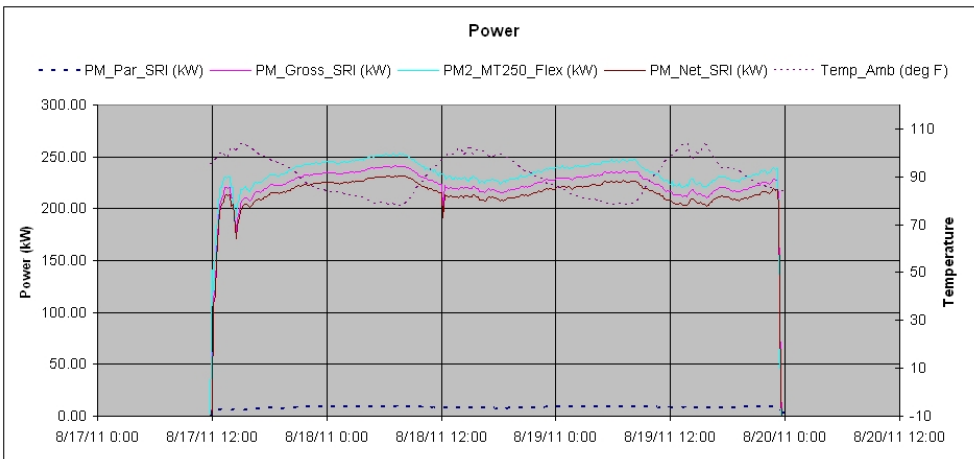
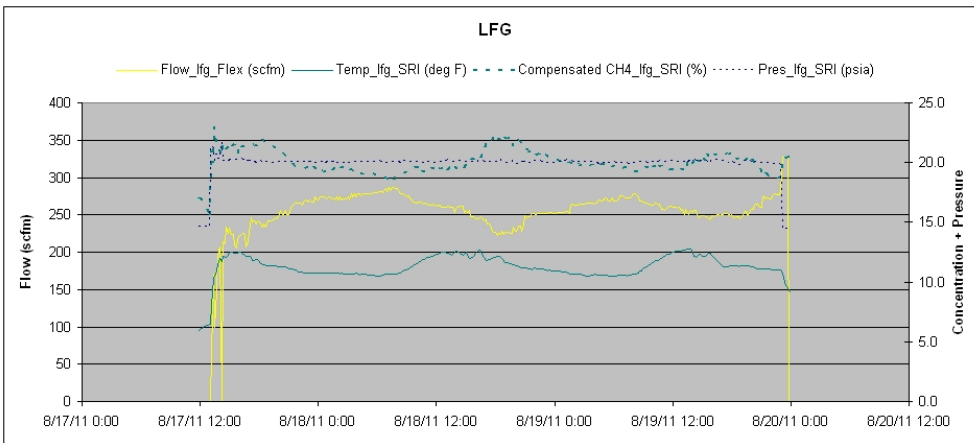
- Commissioned September 29, 2011
- Dedicated November 8, 2011

Demonstration Technical Approach

- Complete independent verification testing
 - Monitor for one year
 - Emissions and destruction efficiency evaluation
 - Economics
 - Reliability
- EPA ETV Generic Protocol for DG-CHP Verification



Preliminary Results – To Date



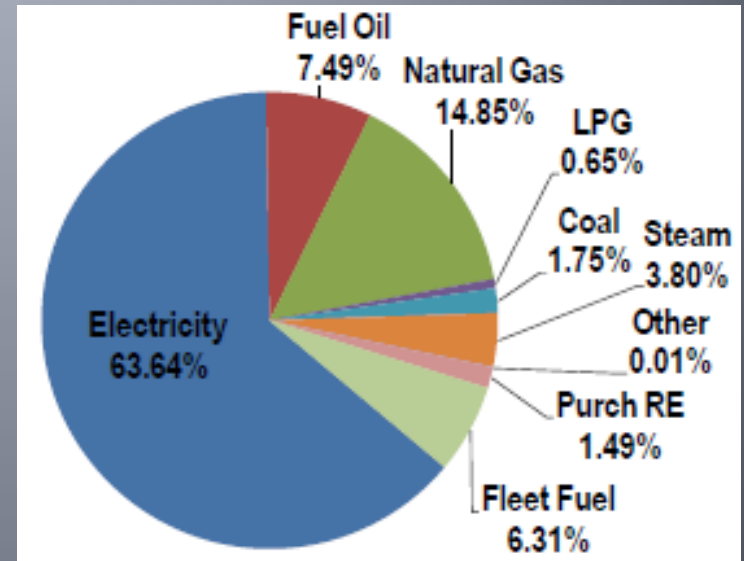
Parameter	Result to Date
Flex Mode Hours	657
Total MWh (Gross)	154
Total MWh (Net)	150
Average Output	201 kW
Avoided CO ₂ e	113 tons
Electricity Savings	\$8,115 (\$14,854)
Projected Annual Savings	\$113,861 (\$196,502)
Projected CO ₂ Avoidance	1285 tpy CO ₂ e

Solar Cooling for DoD Buildings



DoD Building Energy Consumption

- Estimates show that 38% of building electricity use is related to cooling (LBNL)
- Many steam (nat. gas) driven chillers also
- Many opportunities for energy savings



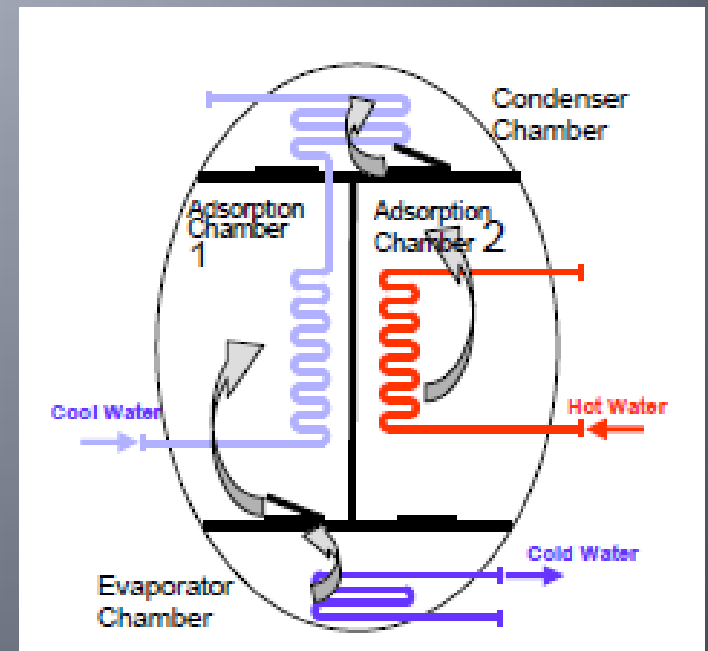
Solar Chiller Solution: Retrofit System by Vanir Energy & Power Partners

- 80 RT adsorption chiller
- 84 roof-mounted evacuated tube collectors
- Supports a max. 38 RT load on chiller
- Steam backup and peaking
- 1,000 gallon hot water storage tank
- Capability for full operation on steam
- New, larger capacity cooling tower
- Pumps, piping, instrumentation, controls
- Existing 60RT electric chiller
- Solar for hot water heating when not chilling



Ecomax Adsorption Chiller

- Use low grade or waste heat
- Water (refrigerant) and silica gel (dessicant)
- Low energy consumption
- Low maintenance
- COP of 0.57; Average hot water = 160 F
 - 76 RT capacity
 - Supply temp = 58F
 - Chilled Water Temp = 49 F (avg.)
- Max RT = 109 @ COP = 0.43



MCRD Parris Island, SC

- Building 590 – 1st Battalion Mess Hall
- Formerly steam for heat, cooling, and hot water
- Steam driven LiBr absorption chiller, supplemental electric compressor chiller
 - Trane Chiller with ~90 RT capacity & nameplate COP of 0.62
- Cool roof & rooftop solar panels reduce cooling requirement to <80 RT



Preliminary Results - Benefits

6-Day Run Analysis (Preliminary)		
Average Output	32	tons
Solar Fraction	17%	
COP	0.43	
Chiller Load Contribution	69%	
Cumulative Array Output	18.2	MMBtu
Cumulative Steam Use	91.1	MMBtu

Economic Benefits			
Solar Fraction	Annual Savings	Payback Period (yrs)	Net Present Value (20 yr life)
50%	\$ 119,328	7.23	\$ 1,160,527
40%	\$ 95,462	9.20	\$ 770,289
30%	\$ 71,596	12.66	\$ 380,051
17%	\$ 40,571	24.87	\$ (127,256)

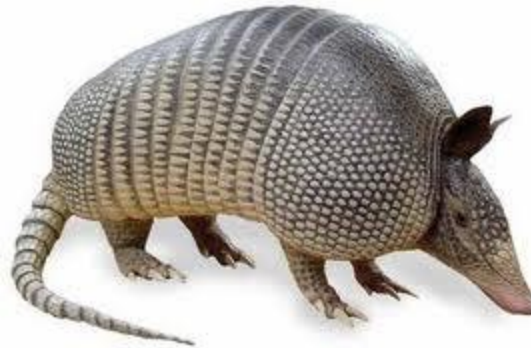
- GHG reduction
 - 203 tpy CO₂ offsets
 - 752 MWh renewable energy equivalent at 50% solar fraction
- Projections yield favorable economics

Future Plans

- Continued Operation and Monitoring
- Flex Emissions Testing – July 2012
- Flex Second installation – finalizing site selection
- Guidance Document development
- System improvements
- Final Reports: Late 2012 / Early 2013

Lessons Learned aka 'This is why we do demos'

- Expect the unexpected
- Baselines are often difficult, and site specific
- Technologies can work well, but...
 - Integration, retrofit, or balance of plant are key
 - Existing equipment can have major impacts
 - Theory or Lab $\neq$ Reality
 - Short term $\neq$ long term
- Approvals ? Permits?
- Site specific results
- Did I mention integration???



Questions?

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