Problem Statement

The U.S. Department of Defense (DoD) occupies over 620,000 buildings at over 400 installations in the U.S. spending over $2.5 billion on energy consumption annually. Reductions in energy consumption from these facilities, and utilization of renewable energy sources have become a primary goal of the DoD to:

- Reduce emissions and environmental impacts related to power production and consumption in response to air pollution and climate change issues.
- Reduce costs associated with energy consumption, resulting in additional resources aimed at the DoD primary mission.
- Improve energy security, flexibility, and independence.

Currently, the Air Force alone operates 563 landfills at U.S. Installations. Landfills produce waste gas streams containing methane that is vented, flared, or otherwise destroyed. Aside from wasting a potentially useful renewable fuel source, the methane in landfill gas reduces a significant global warming potential. Methane has been identified as a greenhouse gas from wasting a potentially useful renewable fuel source, the methane in landfill gas represents a significant global warming potential. Methane has been identified as a greenhouse gas from wasting a potentially useful renewable fuel source, the methane in landfill gas represents a significant global warming potential.

Objective

The objective of this proposal project is to demonstrate and verify the economic and environmental potential of using an advanced waste-to-energy technology at DoD landfills. An appropriate microturbine technology provided by Flex Energy is capable of utilizing ultra-low BTU landfill or other waste gases as fuel to provide efficient on-site power production. In addition to landfills, this system has potential application on a variety of DoD sites, including wastewater treatment, VOC remediation systems, and other typical fixed fossil fuel applications. This demo will be completed jointly with the EPRI/ETG Green House Technology Center.

Technology Description

Microturbines:
- Compact, low maintenance, modular, gas engines
- Fuel flexibility
- Gas cleanup systems not necessary when operating on landfill gas

- Unique thermal exhaust allows the Flex to run on gas that is as low as 15 BTU per cubic foot of atmospheric pressure.
- Adapted to varying fuel energy content and quality
- Maximum gross electrical power output of 204 kW
- Simplicity of design and small grid interconnection
- Integration of all required functions
- Remote operation and monitoring

Flex-Microturbine® Design:
- Modified Solar Spartan microturbine
- Fuel system modifications to bias the fuel with air, reducing the BTU content below combustion limits
- No fuel compressor – air mixture through turbine intake compressor
- Use of proprietary thermal absorber and traditional combustion
- Flexible operation abilities for use of low BTU content fuel
- Gas cleanup system not necessary when operating on landfill gas

Potential Solution

- Utilize a waste fuel stream (LFG) to generate on-site electric power
- Eliminate venting or flaring of LFG
- Operating cost will reduce
- Reduce emissions and environmental impacts related to power production
- Reduce emissions and environmental impacts related to power production
- Reduce costs associated with energy consumption
- Improve energy security, flexibility, and independence

Cost Benefits of Technology

<table>
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<tr>
<th>Year</th>
<th>Capital Costs (MWH)</th>
<th>Fuel Cost (Gallons)</th>
<th>kW YTD</th>
<th>Net Revenue (KWH)</th>
<th>Benefit (M$)</th>
<th>Payback (Years)</th>
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Environmental Benefits of Technology

In addition to the potential economic benefits presented by the Flex, several potential environmental benefits as well.

- Reduced emissions and electricity offsets supplied by the utility grid
- Reductions in electricity demand from the grid, offset by on-site power production
- Emission reductions of NOx, PM, and other gases
- 25 Flex microturbines would offset emissions associated with power generation of approximately 4.7T of NOx emissions.

- By venting LFG at the rate of 700 scfm at Fort Benning, the carbon equivalent emission rate would be approximately 12,240 tons of carbon equivalent per year. Prototyping this methane to CO2 through use of 25 Flex microturbine systems would result in an estimated annual carbon equivalent emission rate of 184 tpy by equating to an overall emission reduction on the order of 1,750 tons carbon equivalent.

Economic Analysis Assumptions:

- Substantial cost reductions as volume increases
- Installation costs can be substantially reduced
- Operating costs will reduce
- Gas cleanup costs will increase
- Fuel costs are expected to be zero
- The value of electric power is assumed to be $25/kWh and stable

No value is placed on carbon or NOx credits, waste heat recovery, offset of flare fuel, or other potential benefits.

About Southern Research & the Greenhouse Gas Technology Center

Southern Research operates the Detoxification Gas Technologies Center (DGTC). DGTC has a cooperative agreement with the U.S. Environmental Protection Agency Office of Research and Development’s Environmental Technology Verification Program. The DGTC is leading this mission to further environmental protection by substantially accelerating the acceptance and use of improved and innovative environmental technologies. With performance data developed under this program, technology buyers, financiers from the private sector, and policymakers in the United States and abroad, are better equipped to make informed decisions regarding environmental technology purchase and use.

Our clients range from technology developers that need an independent party to test their technologies to large companies and government agencies that need to “benchmark” multiple technologies to substantiate claims and real-world implications.

Technologies are evaluated using a formal verification process that is guided by stakeholder and peer reviewers. The DGTC Center uses recognized standards, protocols and testing procedures and peer reviewers. The GHG Center uses recognized standards, protocols and testing procedures.

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