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Waste to Energy Power Production at DOE and DOD Sites

January 13, 2011

Overview – Federal Agency Innovations

- DOE: Savannah River Site
  - Biomass Heat and Power
- USAF: Hill Air Force Base
  - Landfill Gas to Energy Generation

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DOE Savannah River Site

- DOE Savannah River Site (DOE-SR)
  - Georgia / South Carolina border
  - 300+ sq miles extending into 3 counties
  - Began operations in 1950s

- Challenges faced by DOE-SR
  - Aging Infrastructure
  - Coal and fuel oil power plants
  - Increased / new clean air requirements
  - New energy efficiency / sustainability requirements

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Business Case Analysis

- Site need for both steam and power
- Repair, renovate, or replace
- Mandates and desire for renewable energy solution
- Appropriated funds not available

- Solution: DOE ESPC program

- Solution: Biomass
  - $34M in first year operational cost savings
  - Provides numerous environmental benefits
  - Results in GHG reductions of over 100,000 tons / year

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Biomass Solution

- ✓ Largest DOE ESPC to date
- ✓ Largest renewable ESPC
- ✓ Largest biomass operation in Federal government

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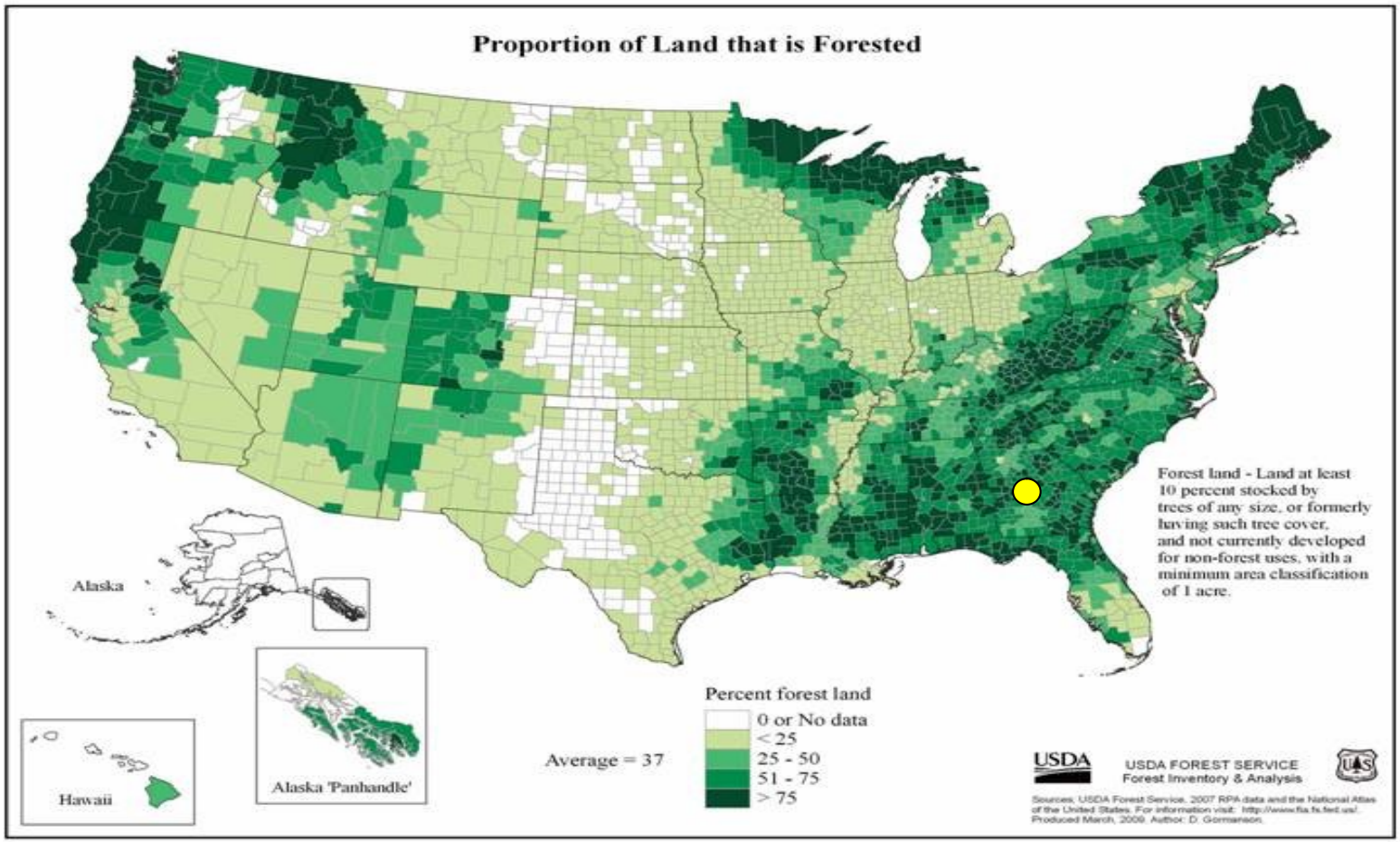
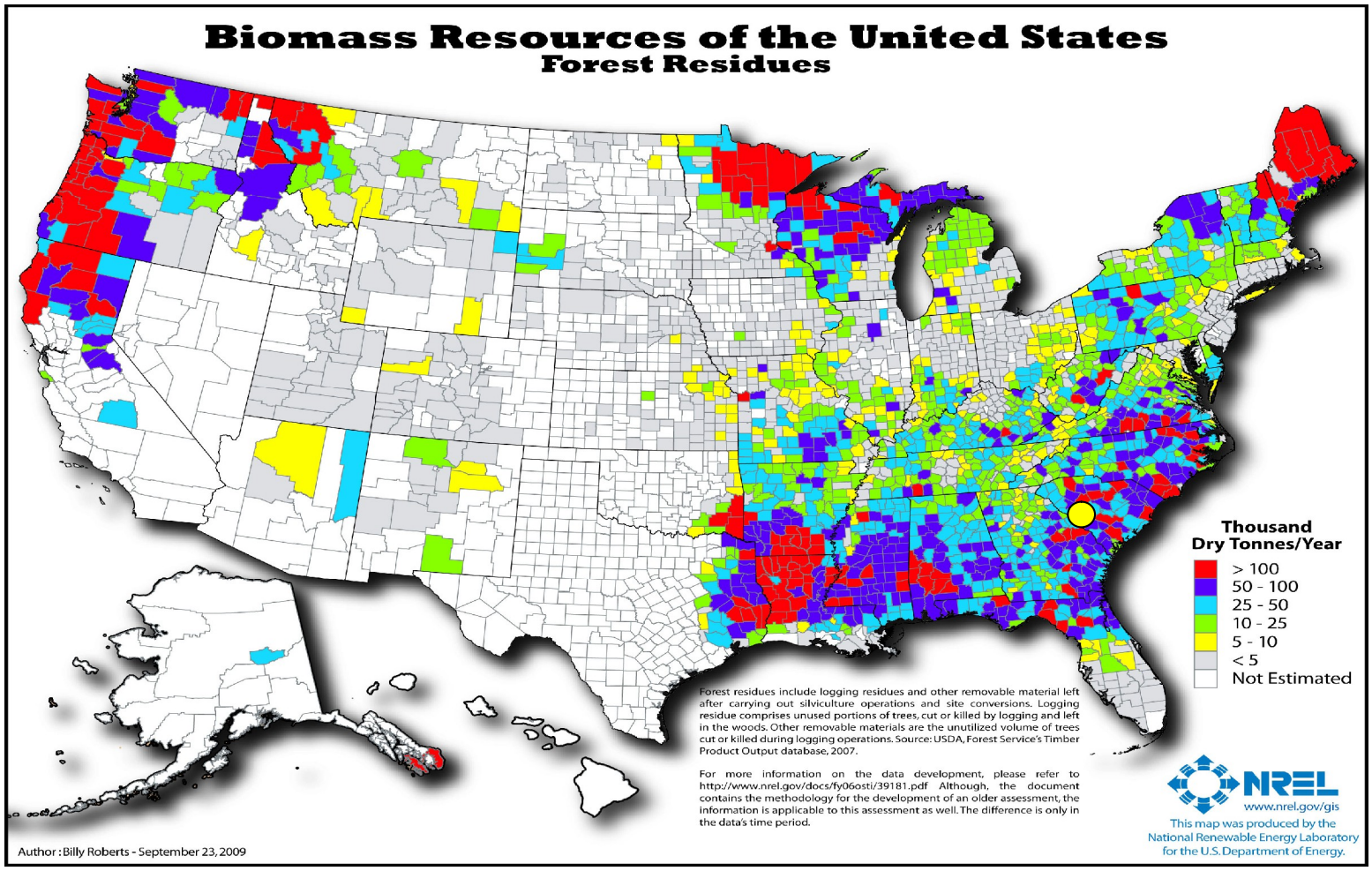
Biomass Availability in U.S.



Biomass Availability in U.S.



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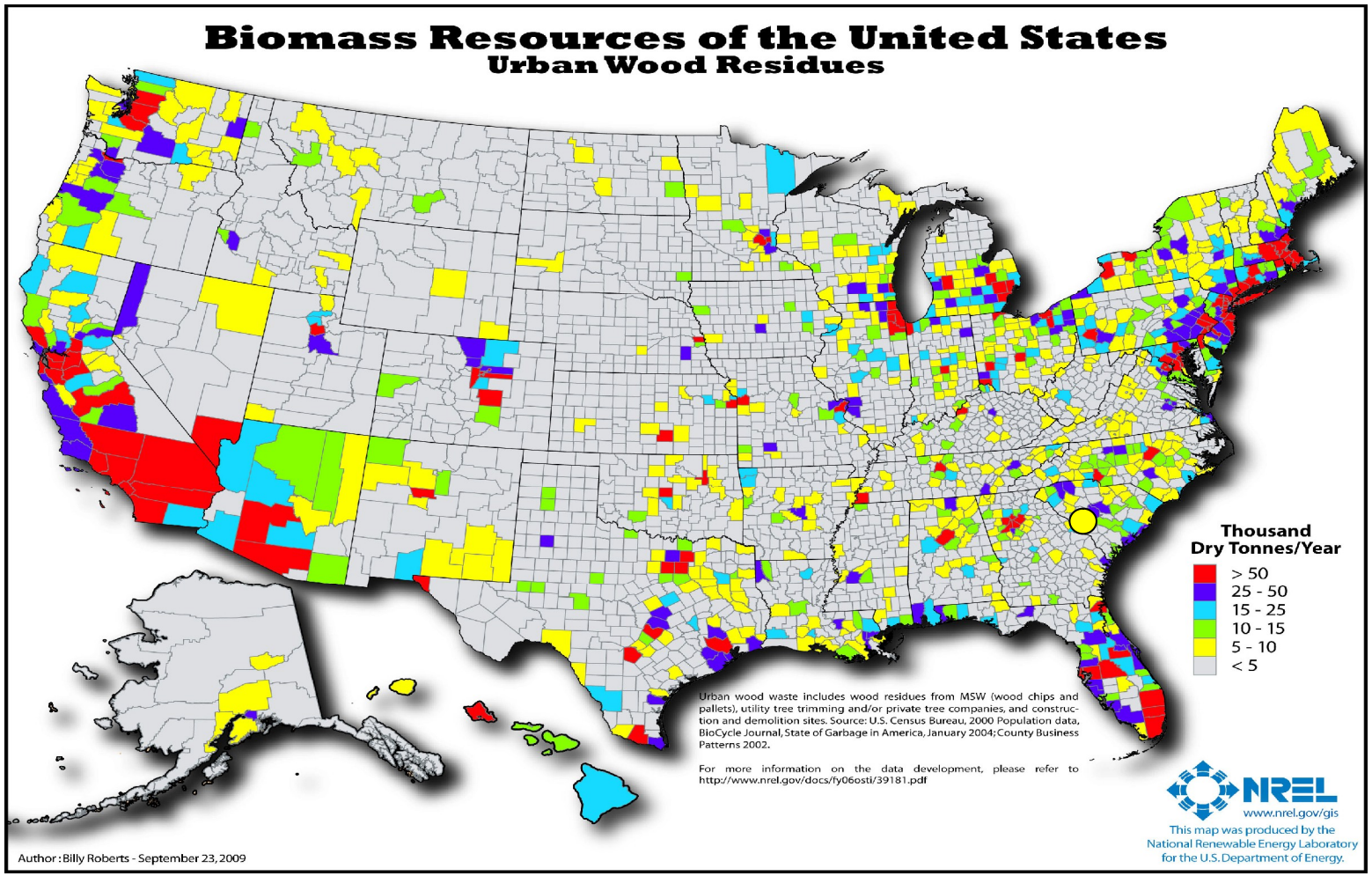

DOE SR – Project Scope

- The project consists of two measures
  - Measure 1 provides for turnkey installation of a new Biomass Cogeneration Facility with a design capacity of 240,000 PPH of steam and 20 MW of electric power
  - Measure 2 includes the turnkey installation of two 10,500 PPH steam heating facilities; one to be located in the K Area and one to be located in the L Area

- Clean biomass will be the primary fuel source for all of the new boilers
  - Measure 1 will also utilize bio-derived fuel to supplement biomass for temperature control
  - Measure 2 will use 100% biomass with fuel oil as back up

DOE SR – Project Scope

- Measure 1 will replace existing coal-fired cogen plant
  - Located closer to end user
  - Will operate 24/7/365
  - Includes a central fuel yard for all three plants
- Measure 2 replaced a fuel oil-fired packaged boiler plant that served both the K and L Areas of the site
  - Eliminates 2.5 mile of steam line
  - Seasonal operation for winter heating beginning Dec 2010

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DOE SR – Cogeneration Plant Construction

Oct 4, 2010

DOE SR – Cogeneration Plant Construction

Nov 5, 2010

DOE SR – Project Benefits

- Dramatic reduction in energy / water consumption and harmful air emissions.
- First-year energy and O&M cost savings in excess of $34M and greenhouse gas emissions will be reduced over 100,000 tons.
- Environmental: The biomass plants will result in an annual reduction of 400 tons of per year of particulate matter, 3,500 tons of sulfur dioxide emissions, and 100,000 tons of carbon emissions.
- Water consumption will be reduced by 1.4 billion gallons.
- Eliminates the burning of 161,000 tons of coal each year.

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Hill AFB Landfill Gas to Energy

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Hill AFB Background

- Hill Air Force Base, Utah
  - Home to many operational and support missions, including a large aircraft depot maintenance activity
  - Very large industrial site with heavy electrical load
  - Utah's largest single site employer
  - Electrical demand of 45+ MW – annual cost more than $26M
  - Comparable to a small city with 16 million square feet of administrative, industrial, commercial, residential space
- The Base has long been a leader in energy innovations
  - More than a dozen contractor-financed energy projects
  - Utility agreements
  - Transport or spot market gas buyer

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Hill AFB Renewable Energy Initiatives

- Landfill Gas to Energy Electrical Generation (LFGTE)
  - First of its kind in the USAF / DOD / Utah
  - First Project Under DOE Biomass Alternative Methane Fuel ESPC Program
  - Numerous awards and recognitions
- Solar Photovoltaic System
- Solar Heat Recovery System

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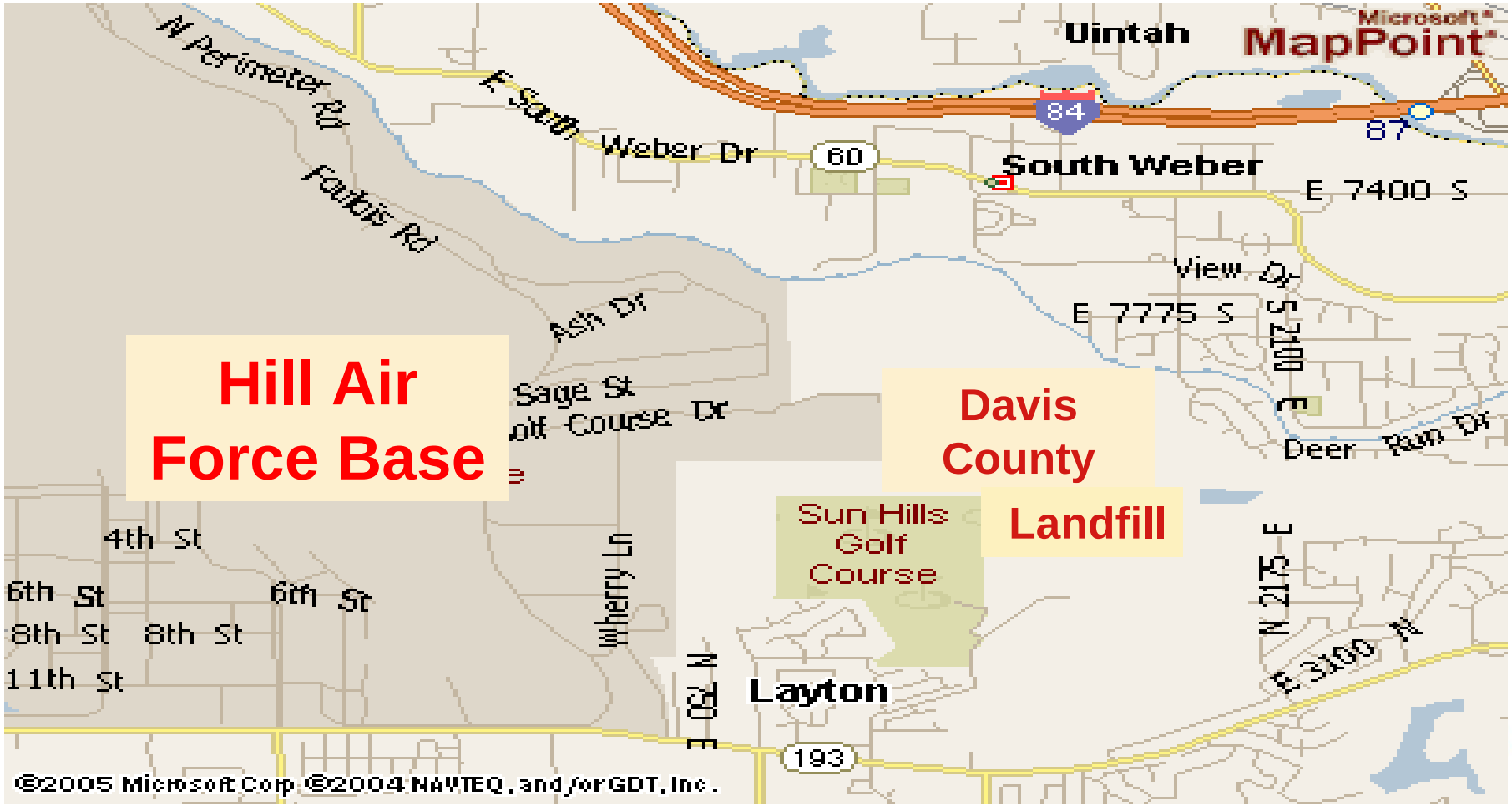
Hill AFB - LFGTE

- Air Force Base is adjacent to the Davis County Landfill



Hill AFB - LFGTE

- Davis County Landfill:
  - ~4.5 M tons of waste in place with collection system and flare
  - ~1.5 miles from flare station to property line with the Base
  - Scheduled closing date of 2026
- LFG is a potent GHG produced from decaying waste
  - 50% methane; 50% carbon dioxide; <1% non methane organics
  - MSW landfills are largest source of GHG emissions in US
- Larger landfills required to collect and dispose the gas
- Heating value of ~ 500 BTU / MCF
  - Natural gas is ~ 1000 BTU / MCF

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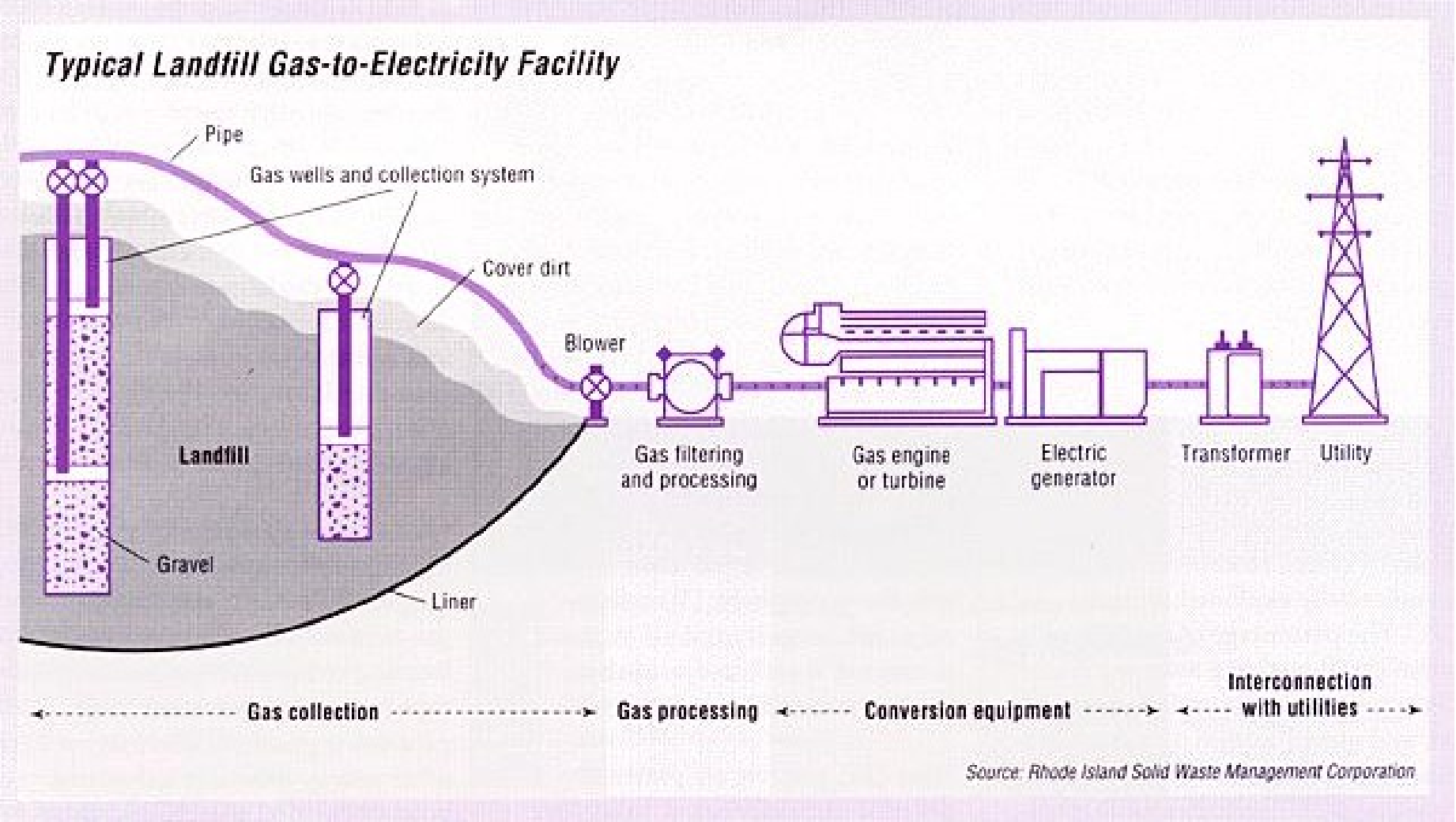
Hill AFB – LFGTE Concept



Hill AFB – LFG Project Details

- Three Internal Combustion Engine Generators
  - Caterpillar 3512 and 3516; GE Jenbacher 320
  - Designed for landfill gas combustion
- Electrical Interconnection
  - Low voltage switchgear connected to transformer to step power up to 12.47 kV
  - High voltage gear connected to Base distribution system via two substations
- Control System
  - Web-based system provides continuous remote monitoring and control with trending capabilities

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Hill AFB – LFGTE

- Project awarded as an ESPC with contractor provided financing and guaranteed annual production minimums
- Plant began operations in Jan 05 with 1250 kW capacity; capacity expanded to 2250 kW in Aug 08
- Contractor purchases gas from landfill and operates plant
- Power input to Base distribution system
- Production monitored and credited to monthly utility bill by the serving electric utility
- Since operations began in Jan 05 more than 50,000,000 kWh produced providing savings of more than $2,000,000

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Hill AFB – LFGTE Plant

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