Biogas Technology Applications

Novi Sad ISWA Beacon Workshop

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(a contractor to US EPA)

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Why Use Biogas (LFG)?

- Local, available fuel source
- Easy to capture and use
- Source of renewable energy
- Constant supply - 24 hours a day, 7 days a week
- Reliable technologies exist for using landfill gas - >90% up time
- Uses a source of energy that otherwise would have been wasted
- Helps the global environment by reducing uncontrolled emissions.

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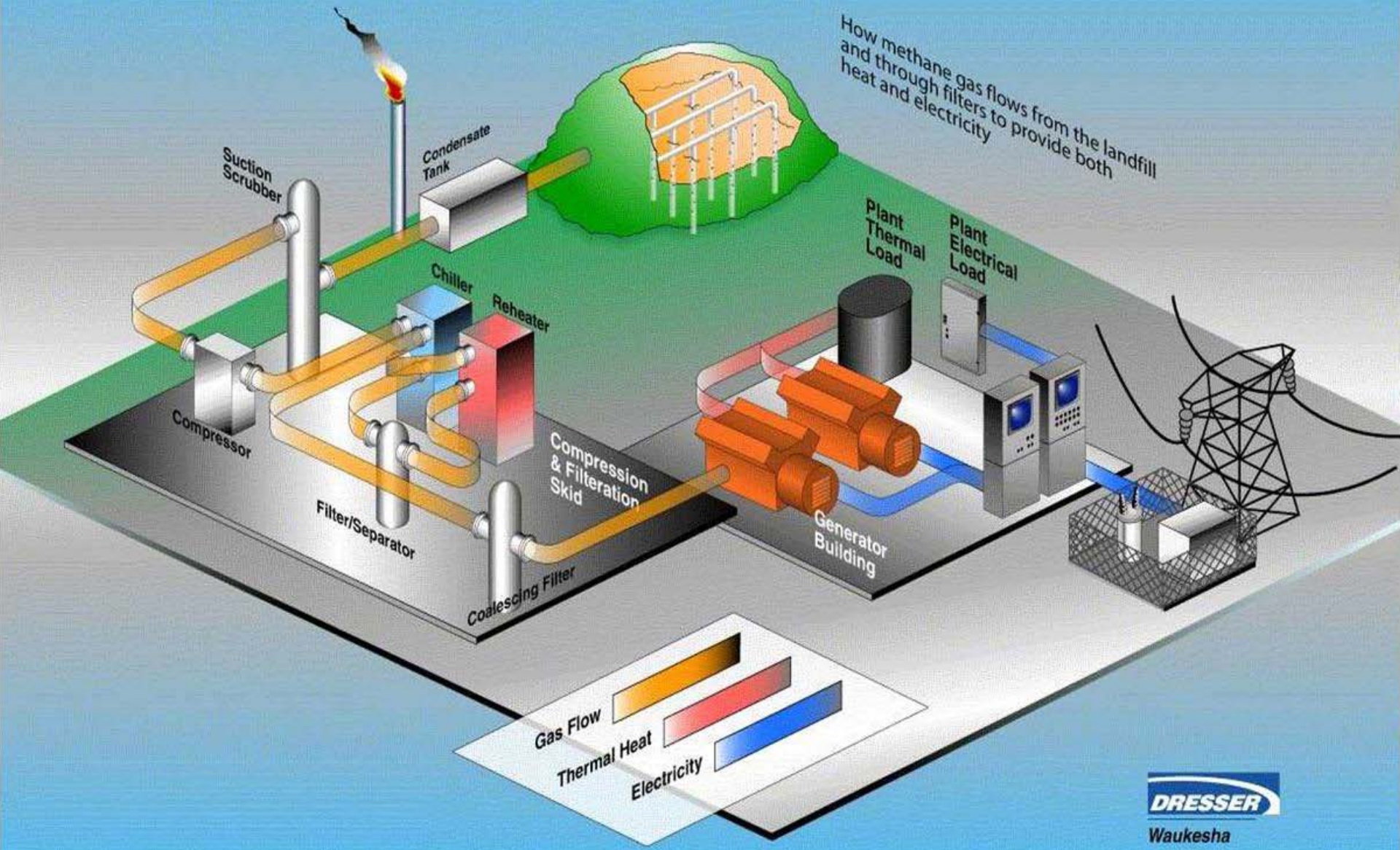
Landfill Gas to Energy



LFGE Project Benefits

- Destroys methane and other organic compounds in LFG
- Offsets use of non-renewable resources
- Each 1 MW of generation capacity:
  - Annual environmental equivalent to planting 4,900 hectare of trees or removing the CO_2 emissions of 9,000 cars, or powering more than 650 homes.

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Possible Uses

- Direct Use
- Combined Heat and Power
- Electricity Production
- Alternate Fuels

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Landfill Gas has been used to help produce…?

- Flowers and tomatoes
- Pottery and glass
- Cars and trucks
- Pharmaceuticals
- Bricks and concrete
- Steel
- Orange and apple juice
- Snack food
- Biodiesel and ethanol
- Consumer goods and containers
- Fiberglass, nylon and paper
- Denim
- Electronics
- Chemicals
- Chocolate
- Dried wastewater sludge
- Soy-based products
- Carpet
- Infrared heat
- Green power
- Cost savings
- Increased sustainability

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Direct Gas Utilization

- Community-Based End-Uses
  - Improve life in local communities
    - Reduce odors
    - Offset fuel costs
  - Examples include:
    - LFG used to fuel boilers to heat schools or hospitals
    - Waste heat from engines heat greenhouses or aquaculture installations
    - Leachate evaporation to reduce leachate treatment and hauling costs
    - Pyrolisis furnace

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Direct Gas Utilization

- **Boilers**
- **Direct thermal applications – kilns, furnaces**
- **Innovative applications**
  - Greenhouses
  - Infrared heaters
  - Pottery kilns
  - Leachate evaporation
  - Medical waste Incinerators and autoclave

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Direct Gas Utilization

- Gas piped to a nearby customer for use in boiler, kiln or other process
- 120 projects in the US
- Around 20 projects in the EU
- Pipeline length range from 0.6 to 15 kilometers
  - less than 5 kilometers is most feasible
- Gas used at off-site end user

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Direct Use Applications

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Greenhouses

- Use both electricity and heat.
- Carbon dioxide can be used to grow greenhouse plants.
- 6 operational greenhouse projects in the U.S.

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Infra-red Heating

- Infrared Heating Technology
  - Consume 4 - 50 m^3/hr
  - Benefit local government services by providing comfort heating for landfill workers and offset fossil fuel use
  - Minimal gas well drilling
  - On-site use requiring short pipeline distance and minimal gas compression
  - Limited clean-up of landfill gas
    - Condensate trap often only treatment needed

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Infra-red Heating
Case Study: Escobar, Argentina

- Grantee: Argentina's Solid Waste Association (ARS)
- 2007 Grant for $125,000 from US EPA
- Three extraction wells connected to small 7.5 hp blower and solar flare
- Began operation September 2009
- Infrared heater can operate on as little as 4 m^3/hr

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Pyrolysis
Case Study: Olavarría, Argentina

- Grantee: National University of the Central Province of Buenos Aires
- 2008 Grant combined with funds from municipality of Olavarría
- LFG used to fuel furnace to combust medical waste
- Furnace moved from city center to the outskirts of town, reducing waste combustion-derived emissions in the concentrated urban center
- Phase 1 completed January 2010: 35 m^3/hr extraction rate
- Phase 2: additional wells will increase gas flow to 50 m^3/hr

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Electricity Generation

- Most prevalent type of project in the US
  - In US, 1,650 MW of capacity from over 385 operational projects
  - In UK, nearly 1000MW, over 450 projects, 1/3rd of UK's renewable energy
- Electricity sold to utility, cooperative or nearby customer
- Typical project size: 4 MW

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Electricity Generation

- Internal Combustion Engines
- Turbines
- Microturbines

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Internal Combustion Engine

- **Sizing**
  - 50kW to 3 MWs
  - Typically 1MW Units
- Proven and reliable

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Electricity Generation
Site Use

- Lviv, Alushta & Yalta, Ukraine
- Small natural gas engines converted to LFG
- Used for operation of flaring system

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Simeprodeso
Monterrey, Mexico

- Jenbacher Engines
- 7.4MW initially and expanded to 12MW
- 6 Gas Pumps
- More than 500 gas wells

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Simeprodeso
Monterrey, Mexico

Current generation capacity of 12 MW.

Third phase under development to increase capacity to 17 MW.

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Innovative Electricity Generation

- Micro-turbines
- Low emissions
- Low maintenance costs
- 30kW to 100kW typical per unit
- High Capital Cost
- Low efficiency unless in CHP project.

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High Btu Projects

- Gas cleaning to separate CH_4 and CO_2 and remove trace contaminants
  - Membrane technology
  - Pressure swing absorption, carbon pretreatment, & H_2S removal

University of New Hampshire project fuels campus combined heat and power turbine

- Cleaned gas can be injected into natural gas pipeline or used to fuel electric generating equipment

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Governments are interested!

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