# Trigen Energy Corporation: Industrial and District Energy Systems Applications of Combined Heat and Power Facilities

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## Abstract

Today approximately 46,000 MW of installed electric capacity is integrated into combined heat and power facilities. Estimates indicate the total market for electric production that could be applied to combined heat and power facilities is 150,000 MW.

As recently as 3 years ago, only 15 percent of commercial and industrial steam and electric generators would consider outsourcing their energy needs as a potential option. Today, nearly three times as many would consider outsourcing their energy needs as a potential option.

Industrial steam and electric generators come in a vast range of sizes, applications, and plant configurations, each with its own specific requirements. Many of these applications are ideal fits for combustion turbines. The best fit of combustion turbines may not be the largest or the most state-of-the-art in its class.

Three cases of industrial sites where a combustion turbine was selected to meet the specific needs of the combined heat and power facility are presented below.

**Case One: Grays Ferry Cogeneration Plant**

| | |
|---|---|
| *Thermal Host:* | Trigen's district steam system in Philadelphia. The district energy system supplies steam to nearly 400 customers in Philadelphia, including industrial facilities, hospitals, universities, commercial offices, hotels, and large residential facilities. |
| *Plant Design:* | Combined cycle plant based on Siemens Westinghouse 501D5A. |
| *Basis for Selection:* | The heat-recovery steam generator (HRSG) thermal recovery capabilities of a 501D5A match closely with the steam demand of the steam system. Expectations for continuous reliable operation were imperative. |
| *Benefits:* | 6:1 reduction in emissions ($SO_2$, $NO_X$, CO, PM); 2:1 reduction in $CO_2$; electric production heat rate of 5,500 Btu/kW. |

**Case Two: Lafarge Gypsum**

*Thermal Host:* Lafarge Gypsum — Kentucky Wallboard Plant.

*Plant Design:* Simple cycle plant based on 5-6 MW (yet to be selected) combustion turbine.

*Basis for Selection:* Exhaust heat from a combustion turbine matches the thermal requirements of the gypsum wallboard drying process.

*Benefits:* Eliminated the need for Lafarge to install gas-fired dryers in their new wallboard facility; process thermal efficiency of approximately 95 percent; electric production will be a low-cost producer in the Kentucky coal-fired region.

**Case Three: Trigen-Colorado Metropolitan Wastewater Reclamation District**

*Thermal Host:* Metropolitan Wastewater Reclamation District. The Metro Wastewater Reclamation District provides wastewater treatment for local governments in the Denver area. Thermal energy from the system will provide hot water to the District for use in the anaerobic digesters.

*Plant Design:* Two Solar Centaur 40 (approximately 3,500 kW each) combustion turbines with hot-water heat-recovery units. The combustion turbines will primarily burn methane gas produced in the water treatment process.

*Basis for Selection:* Mature design with successful history of burning poor-quality fuel; size of the combustion turbine matched the fuel availability at the site.

*Benefits:* On-site source of emergency power in the event of a utility power interruption; replacing aging and cost-intensive diesel generators; 106,000 tons annual $NO_X$ reduction; 85 tons annual $SO_2$ reduction; utilizing a renewable resource.

# *Trigen Energy Corporation*

## Industrial and District Energy Systems

## Applications of Combined Heat and Power Facilities

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# *Why Combined Heat and Power?*

**A well designed combined heat and power facility will provide superior heat rates to any of today's most technologically advanced combustion turbine based combined cycle plants.**

**Combined heat and power is a growing market.**

- **Currently, in the United States, approximately 46,000 MW of combined heat and power capacity are installed.**
- **An estimated 150,000 MW of potential combined heat and power capacity remain undeveloped**
- **Three years ago only 15% of all industrial and commercial based steam and electric generating facilities considered outsourcing their energy needs.**
- **Today nearly three time as many facilities would consider outsourcing their thermal and electric energy needs.**

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# *What are the sizes and configurations of combined heat and power facilities?*

**Combined heat and power facilities come in a vast range of**

**Sizes**

**Configurations**

**Applications**

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**A successful combined heat and power facility may not necessarily select the largest or most advanced combustion turbine available in its class!**

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# *Three Cases of Combined Heat and Power Facilities Developed by Trigen Energy Corporation.*

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# Grays Ferry Cogeneration Project

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# *Project Description*

**Trigen Energy Corporation's district steam system in Philadelphia consisting of approximately 400 steam users.**

**Steam Users Include:**

**Industrial facilities**

**Hospitals**

**Universities**

**Commercial Office**

**Hotel**

**High Density Residential**

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# *Plant Design*

**Westinghouse 501D5A combustion turbine with combined cycle application and a stand alone 700,000 pph auxiliary boiler.**

- **Steam Capacity:** 1.5 million pph
- **Electric Capacity:** 170 MW

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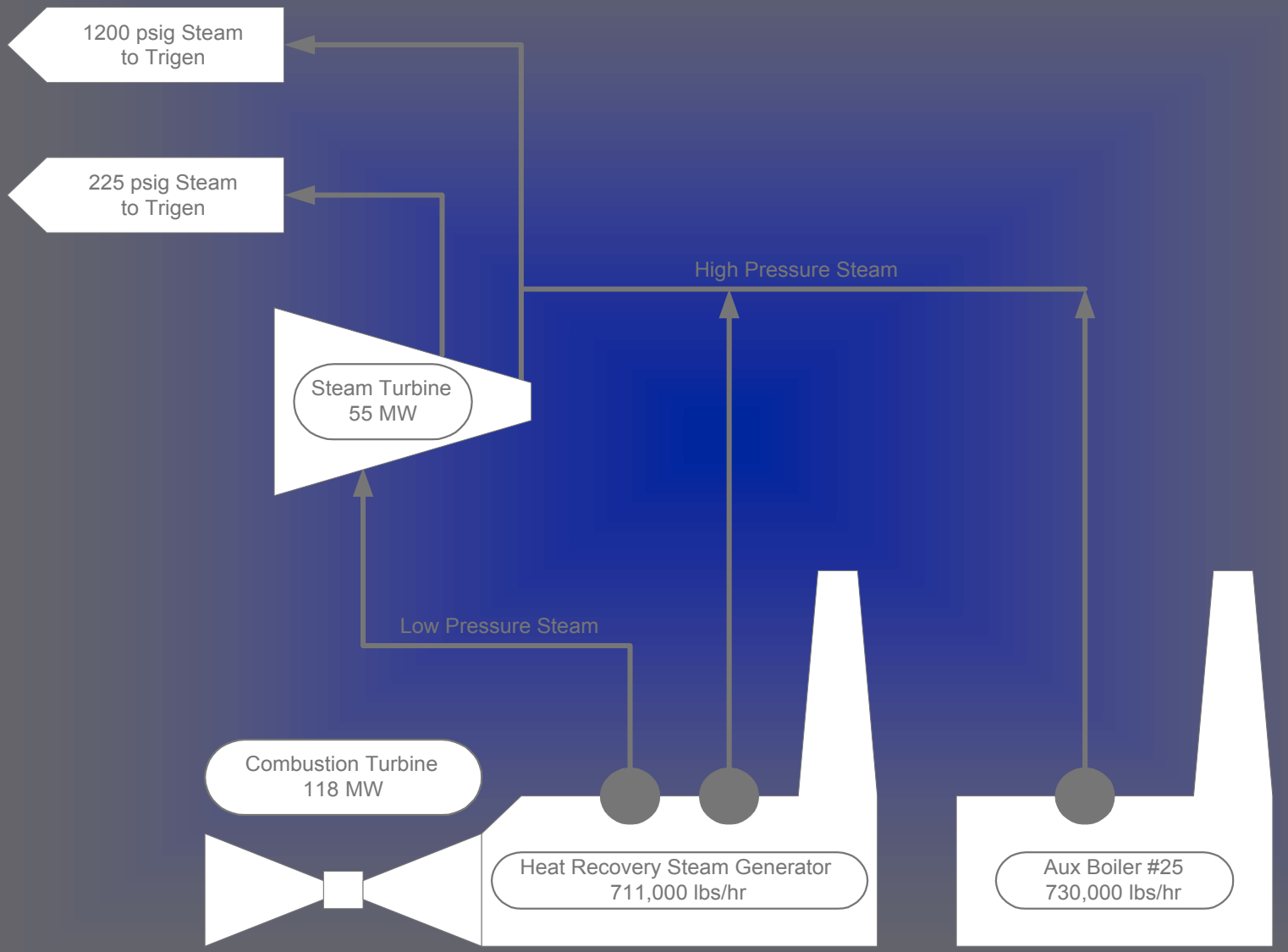
# Grays Ferry Cogeneration Project

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# *Basis for Equipment Selection*

**HRSG thermal recovery matched closely with steam demand.**

**Combustion turbine model was a mature and proven reliable design.**

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# *Benefits of GFCP*

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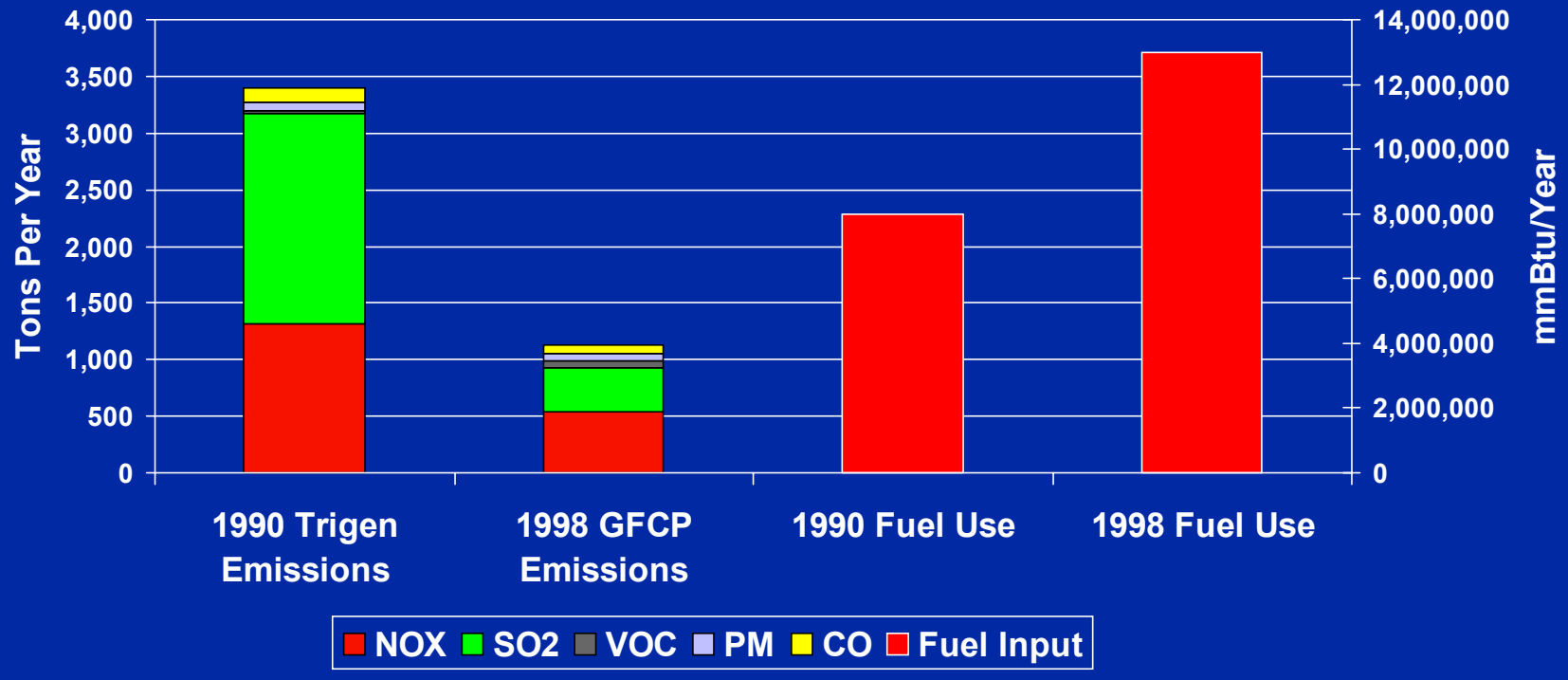
# Nearly a 6 to 1 reduction in criteria pollutant air emissions.

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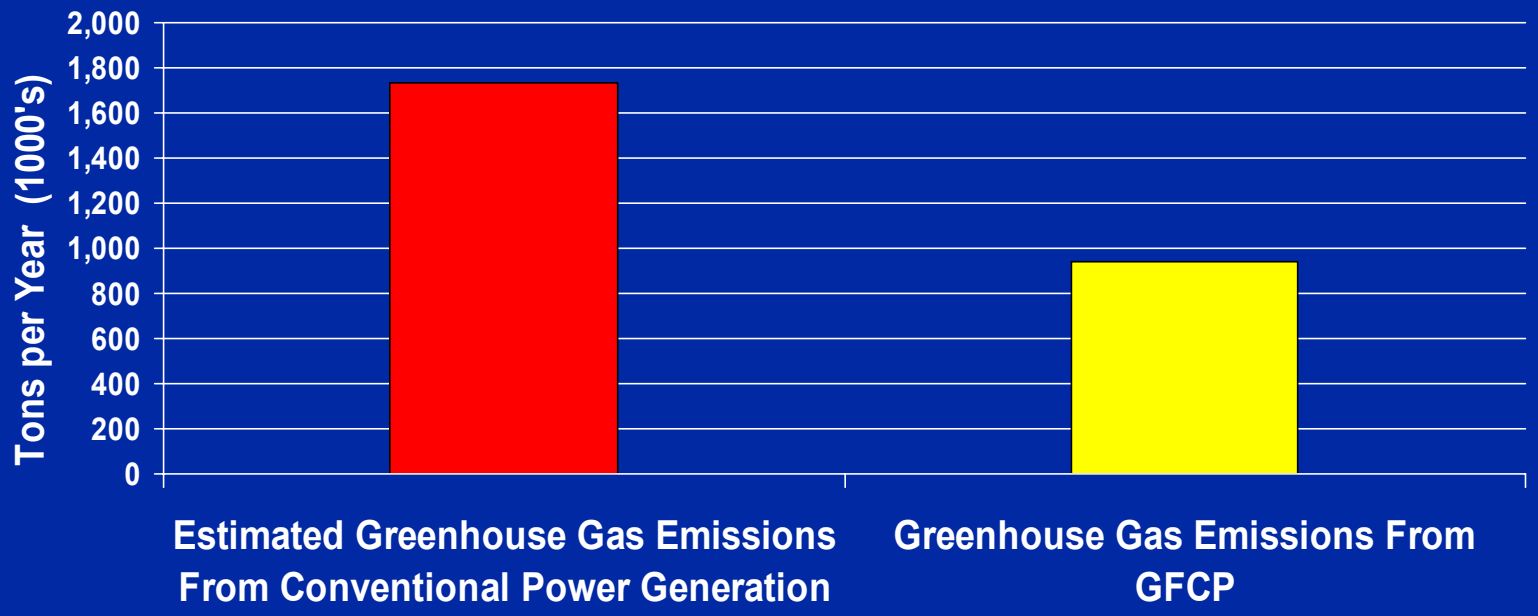
# Nearly a 2 to 1 reduction in green house gas emissions

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# An Electric Production Heat Rate of 5500 btu/kw!

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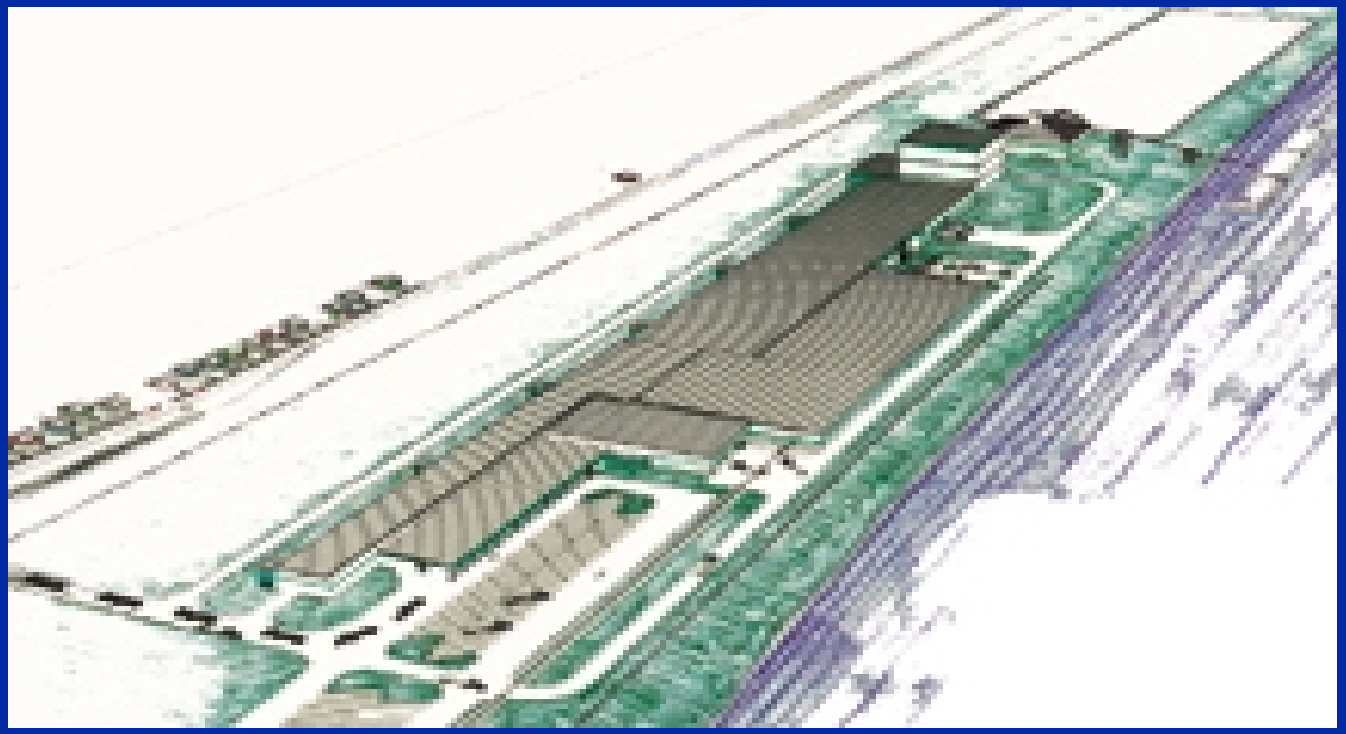
# *Lafarge Gypsum Wallboard Plant*

# *Silver Grove, Kentucky*



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# *Project Description*

**Thermal Host - Lafarge Gypsum - Kentucky wallboard plant.**

**Production capacity of 900 million square feet of wall board annually**

**Waste heat from the combustion turbines will be directed into the facility cage mills.**

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# *Plant Design*

**Combustion turbine arranged in simple cycle mode with exhaust gas ducted directly into gypsum cage mills.**

**Final design selection of the CT has yet to be announced. (CT size is expected to be 5-6 MW.)**

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# *Basis for Equipment Selection*

**CT electric production matches the electric load requirements of the wall board processing plant.**

**Combustion turbine will be a mature and proven design**

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# *Benefits of the Lafarge Gypsum Project*

**Lafarge reduces capital cost of new wallboard plant.**

**Improved Air Quality**

**Low cost producer of electricity**

**95% overall thermal efficiency**

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# *Trigen-Colorado Metropolitan Wastewater Reclamation District*

## Metro District Central Plant

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# *Project Description*

**Metropolitan Wastewater Reclamation District**

**165 MGD wastewater treatment facility that serves several local municipalities in the Denver area.**

**This plant will be fueled by methane off gas produced as a by-product of the waste treatment project.**

**Electricity generated by the project will be sold to Metro Wastewater.**

**Thermal energy recovered from the project will provide hot water to the District for use in the anaerobic digesters and for use in general facility space heating.**

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# *Plant Design*

**Two - Solar Centaur 40**
**(approximately 3500 kw each)**

**With hot water heat recovery steam generators**

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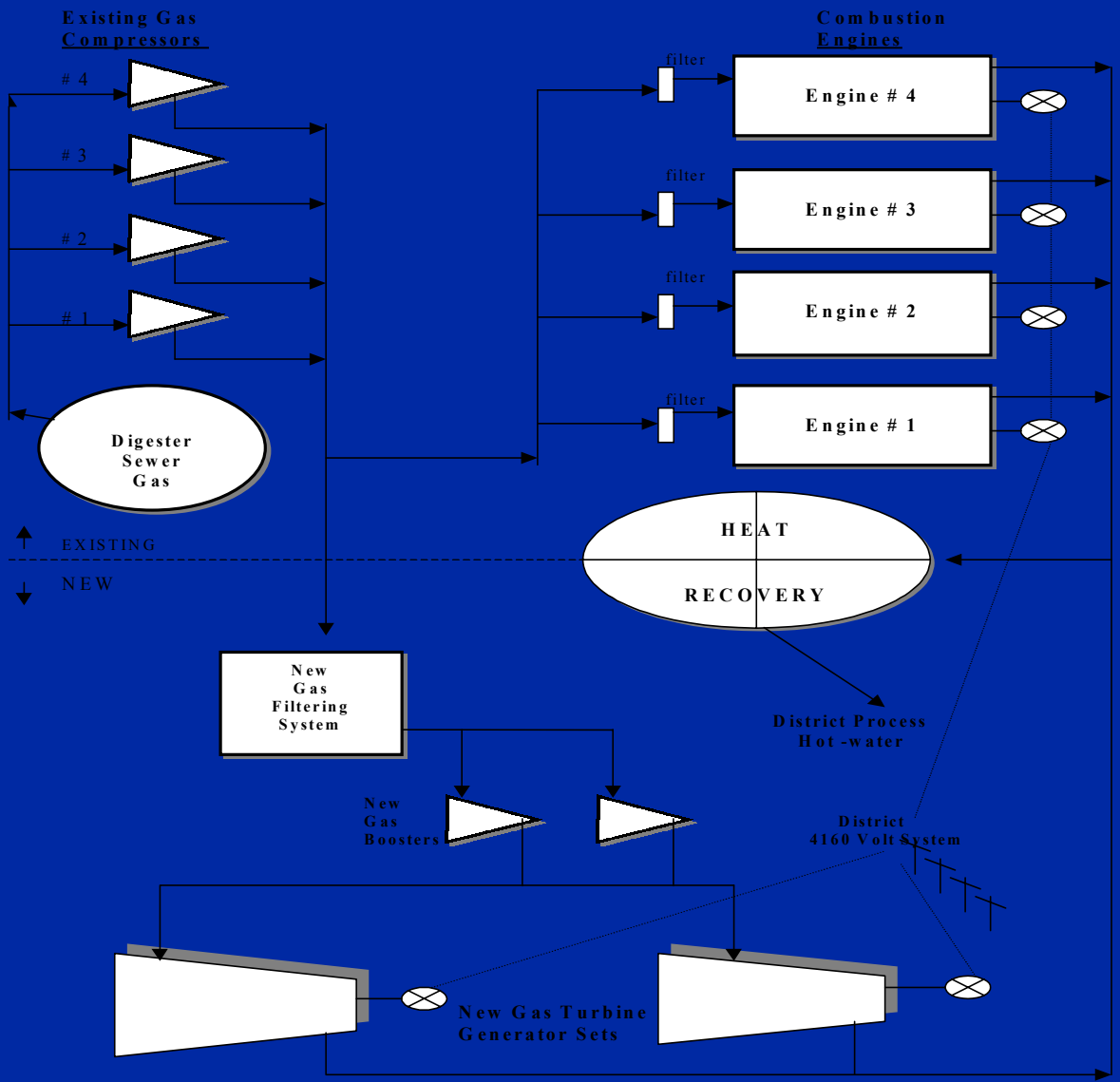
# Metro Cogen Cycle

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# *Basis for Equipment Selection*

**CT has a proven history of reliably burning low btu / poor quality fuel**

**Combustion turbine model is a mature and proven design**

**Size of the combustion turbines match the fuel availability of the site**

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# *Benefits of the Metro Wastewater Project*

- **Improved Air Quality**
  - **106,000 tons annual reduction of $CO_2$**
  - **85 tons annual reduction of NOx**
  - **60 tons annual reduction of $SO_2$**
- **On Site source of emergency power generation**
- **Replacement of aging and cost intensive diesel generators**
- **Low cost producer of electricity**
- **Utilization of a renewable resource**

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# *Summary*

- Three Projects
- Different Sizes
- Different Design Configurations
- Different Fuels
- Different Thermal Hosts
- All are extremely efficient
- All provide a net reduction in air emissions
- All are low cost producers of electricity

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