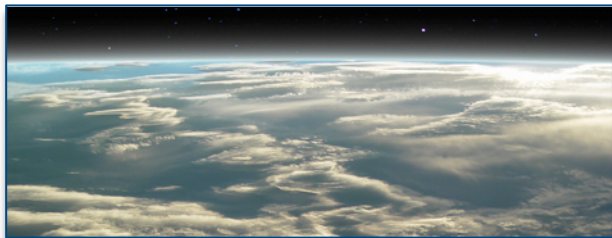


# Waste Heat to Energy

Bruce Brown PE, LEED AP, – O'Brien & Gere

June 15, 2011



# Speaker Introduction

- Bruce A Brown
  - ▶ 30-Years Energy Experience
  - ▶ PE , LEED AP, AEE: CEM, CLEP, CEP, DGCP, GBE
- O'Brien & Gere: Full Service A-E & Project Delivery Firm
- Energy Practice
  - ▶ Supply Side Management
  - ▶ Demand Side Management
  - ▶ Emerging Technologies
- Client Sectors
  - ▶ Federal
  - ▶ Industrial
  - ▶ Institutional
  - ▶ Municipal

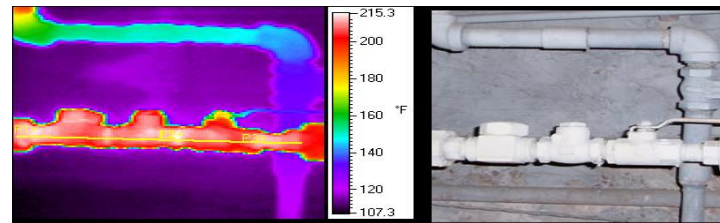


# Presentation Overview

- Waste to Energy: What is it?
- Applications of Waste Energy (recovered)
- How to Look for Opportunity
- How to Assess Opportunity

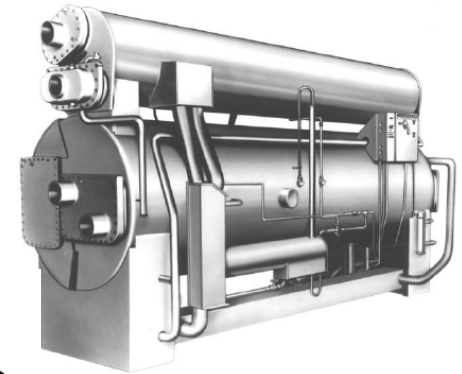
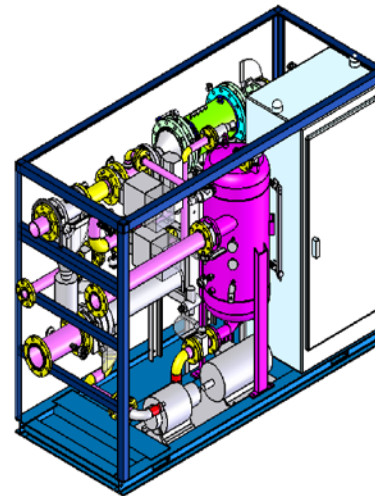
# Waste to Energy: What it is

- WASTE
- Energy emanating from or leaving a system that is serving no further useful purpose
  - ▶ Intensity – How hot or cold, what pressure
  - ▶ Flow – GPM, CFM, BTUH
  - ▶ Frequency – Constant, variable, patterned
  - ▶ Location – Accessible, relative



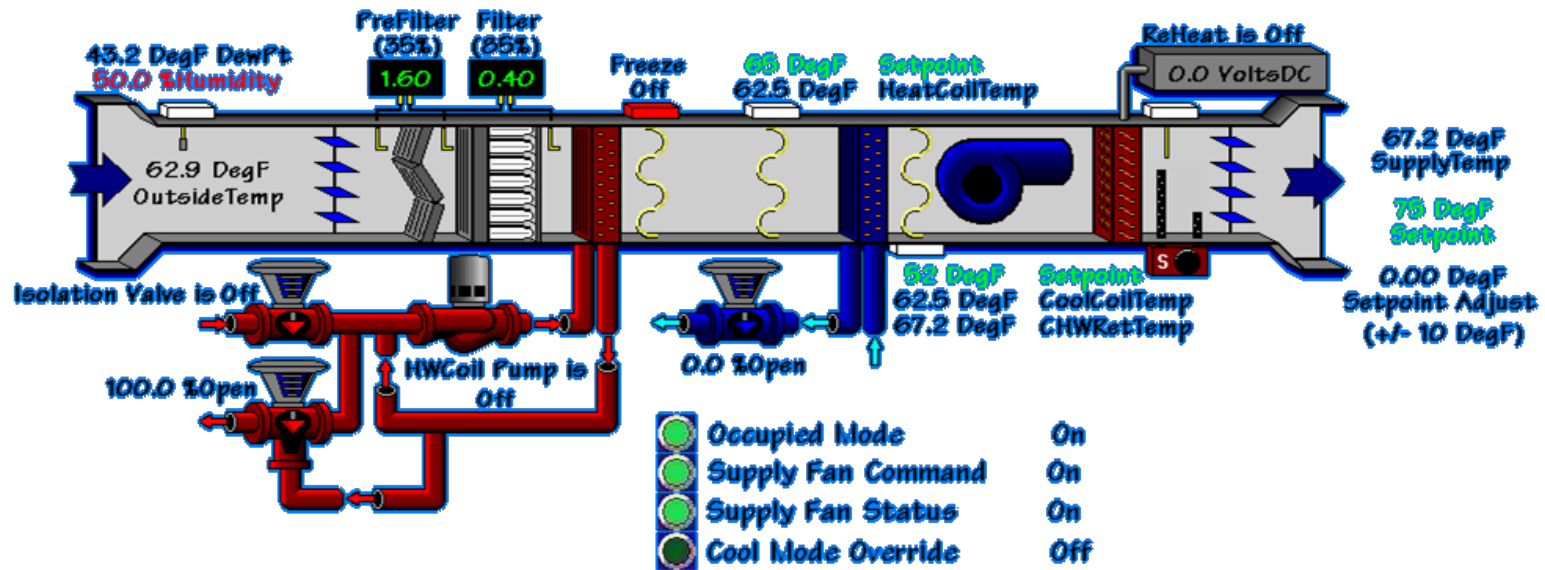
# Waste to Energy: What it is

- to Energy
- Intercepting “waste” for a useful purpose (avoiding consumption of source energy)
- Applications include :
  - ▶ Economizers
  - ▶ Absorption Chiller
  - ▶ Waste Heat Boiler
  - ▶ Process Heaters
  - ▶ Building Make-up Air
  - ▶ Electric Generation



# Applications of Waste Energy (recovered)

## BUILDING SPACE AIR HANDLING UNITS



# ■ Applications of Waste Energy (recovered)

## WASTE HEAT BOILERS

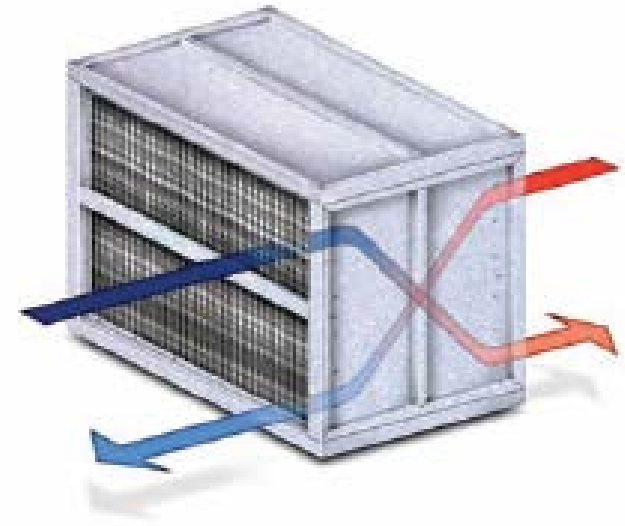
- Steam, Hot Water, or Hot Oil
  - › Pre-Heat Oven Air
  - › Pre-Heat Combustion Air
  - › Pre-Heat Coater Room Exhaust
  - › Distribute Throughout the Plant
  - › Commonly Not Used to Full Potential



## ■ Applications of Waste Energy (recovered)

### AIR TO AIR HEAT EXCHANGERS

- › Pre-Heat Oven Air
- › Pre-Heat Combustion Air
- › Pre-Heat Coater Room Exhaust
- › Useful When Stack Temps Are Relatively Low.

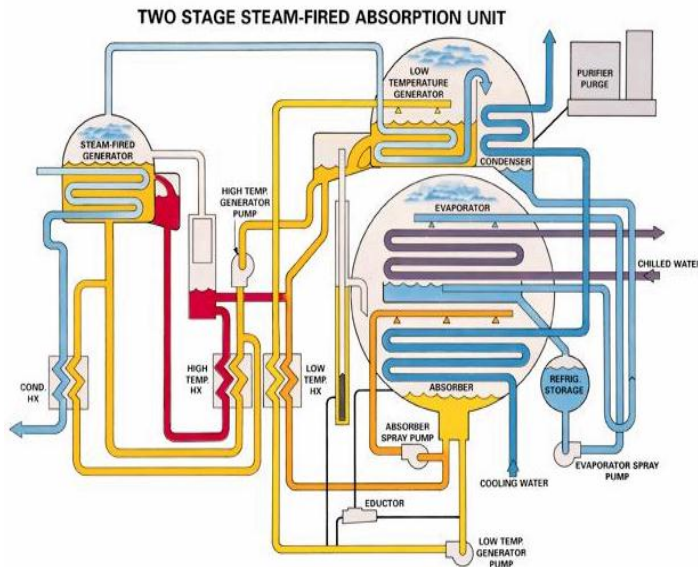


# Exchanger/Economizer

- Can be used to pre-heat air or liquid (water, oil, etc.)
- Pre-heat air can be used for building heat or can be used in production equipment to offset fuel demand
- Pre-heat liquids such as boiler feedwater or domestic hot water
- Offset in main boiler loading allows potential to de-rate boiler and reduce environmental impact/regulatory requirements



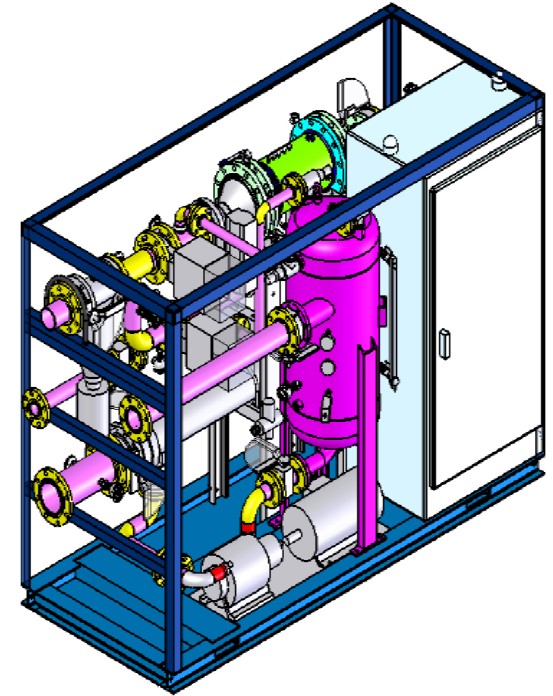
## ■ Application Waste Energy (recovered)



- Absorption chillers can be driven from hot water or steam via waste heat exhaust stream.
- An attractive supplemental or substitute system to existing electric or gas fired chiller systems.
- Chilled water can be used for process or HVAC cooling applications

## ■ Application Waste Energy (recovered)

- Improved skid-mounted systems
- Consumes NO fuel and produces ZERO emissions
- 2.5 MMBTU/hr = 100 KW
  - ▶ Approximately 8,000 SCFM exhaust @ 250F)
- Typical ROI <2 years @ \$0.10/Kw (without grants or tax incentives)
- Parallel systems to maximize heat recovery and energy production
- “Ready for Grid” controls included including safeties & synchronization



# How to Look for Opportunity



## ■ Senses

- ▶ Sight
- ▶ Sound
- ▶ Smell
- ▶ Touch

## ■ Measurements

- ▶ Infrared
- ▶ CFM
- ▶ GPM
- ▶ kW

- System and Equipment Information Searches
  - ▶ Do manufacturers offer energy recovery options?
- Unified Facilities Guide Specifications (May 2011)
  - ▶ 2.6 HEAT RECOVERY SYSTEMS
  - ▶ Heat recovery systems shall be utilized in ventilation units (100 percent outside air units) where the temperature differentials between supply air and exhaust air is significant. Heat recovery systems shall operate at a minimum of 70 percent efficiency. The heat recovery systems shall have factory-installed microprocessor controller that in turn can be connected to a Direct Digital Control (DDC) Building Automation System to monitor temperatures, [wheel operation,] filter cleanliness, defrost control, and other critical conditions.

- Simple redirection can avoid spot cooling

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5.2.5.3 Ventilation. Provide ventilation adequate to dissipate heat given off by transformers and associated equipment and to maintain safe operating temperatures. Gravity ventilation is usually not adequate for indoor substation rooms; in such cases, mechanical ventilation should be provided. In air-conditioned buildings, an economical and positive means of ventilating substation rooms is to exhaust tempered air from conditioned spaces through the substation room.

# How to Look for Opportunity

- Waste Heat from Process Exhausts Offers Significant Opportunity for Operating Cost Reductions
- Typical Waste Heat Sources:
  - ▶ Oxidizers (Direct, Catalytic, Recuperative, Regenerative)
  - ▶ Boilers
  - ▶ Ovens
  - ▶ Baghouses
  - ▶ Turbine Exhaust
  - ▶ Other Process equipment (compressors, chillers)



# How To Assess Opportunity - Beginning

- Perform preliminary assessment of viability
  - ▶ Identify potential heat sources
    - › Operating characteristics
      - ▶▶ Hours of operation
      - ▶▶ Temperature/pressure
  - ▶ Current and Projected Utility Rates
  - ▶ Capacity to Utilize Recovered Energy
  - ▶ Relative location of waste source to energy need
  - ▶ Identify any site-specific constraints



## ■ Important Points:

- ▶ Existing Demand
- ▶ Amount of Energy Available for Recovery
  - › Temperature Constraints
  - › Hours of Operation
- ▶ Utility Rates
- ▶ Site Constraints
  - › Location of Source Relative to Consumers
  - › Obstacles
  - › Occupancy Issues
  - › Production Down-Time

# How to Assess Opportunity – Detailed Analysis

- Perform preliminary assessment
- Compare technologies
  - ▶ Capital
  - ▶ Installation
  - ▶ Operational
  - ▶ Complexity
- Detailed economic comparison to establish ROI
- Identify financial incentives, credits and funding sources



# How to Assess Opportunity - Summary

- Perform simple assessment to identify specific system energy needs, potential sources and waste energy available
- Perform a detailed Technical & Economic Feasibility study to compare attractive technologies , establish capital and operating costs, ROI's and develop budgets.
- Identify sources of funding, incentives and tax credits.

PLEASE CALL

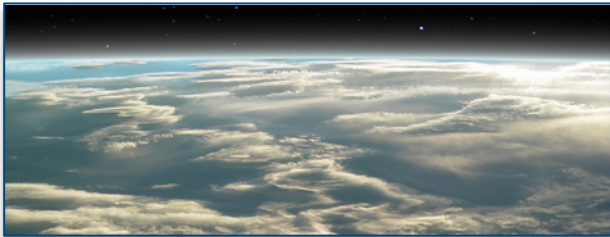
# QUESTIONS?

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<http://www.obg.com>



# THANK YOU





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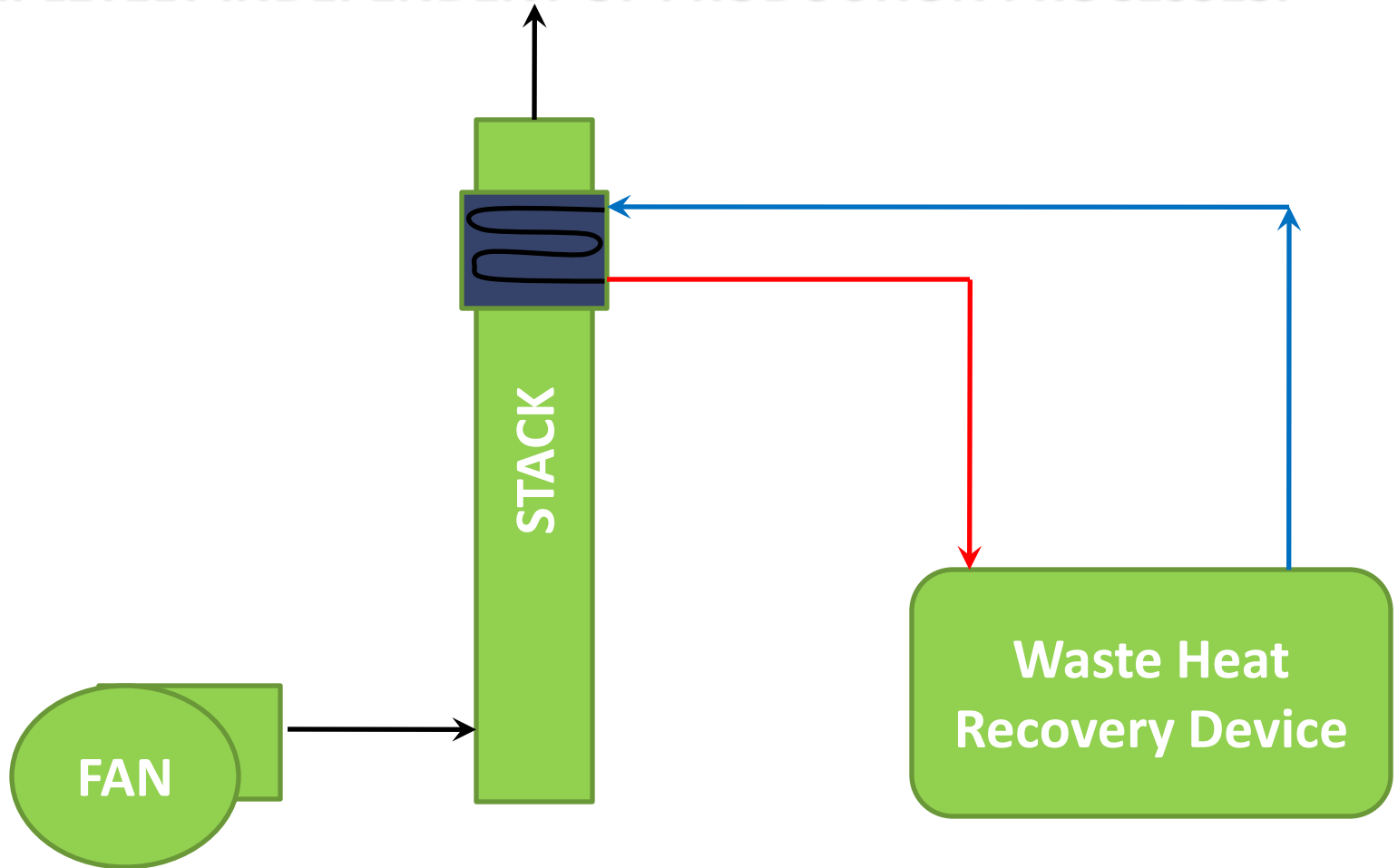
> O'Brien & Gere to Host Seminar on Greenhouse Gases [Full Story](#)

> Lee Davis Named President & COO of O'Brien & Gere [Full Story](#)

> Temple University Selects O'Brien & Gere for Climate Action Plan [Full Story](#)

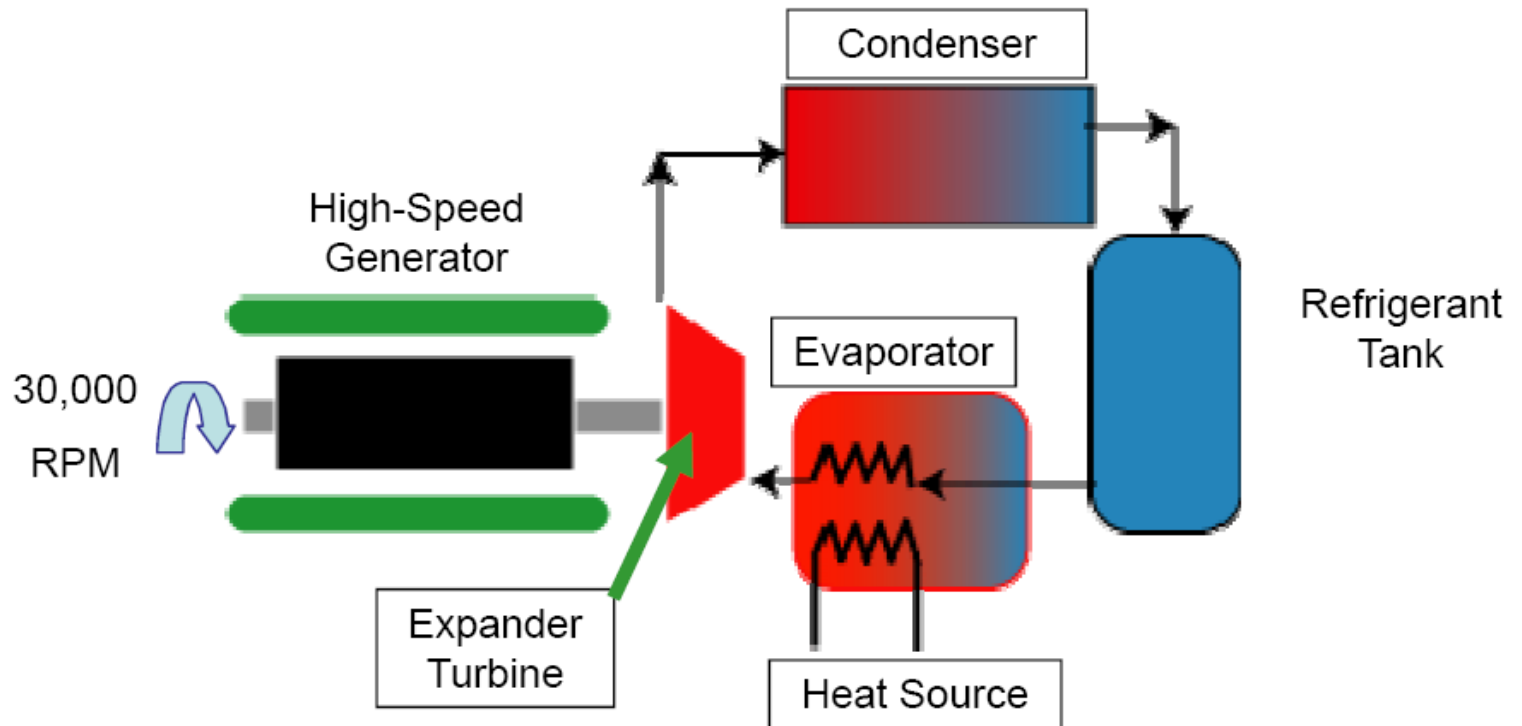
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**MANY STRATEGIES RECOVER HEAT FROM EXHAUST GASES AND ARE COMPLETELY INDEPENDENT OF PRODUCTION PROCESSES.**

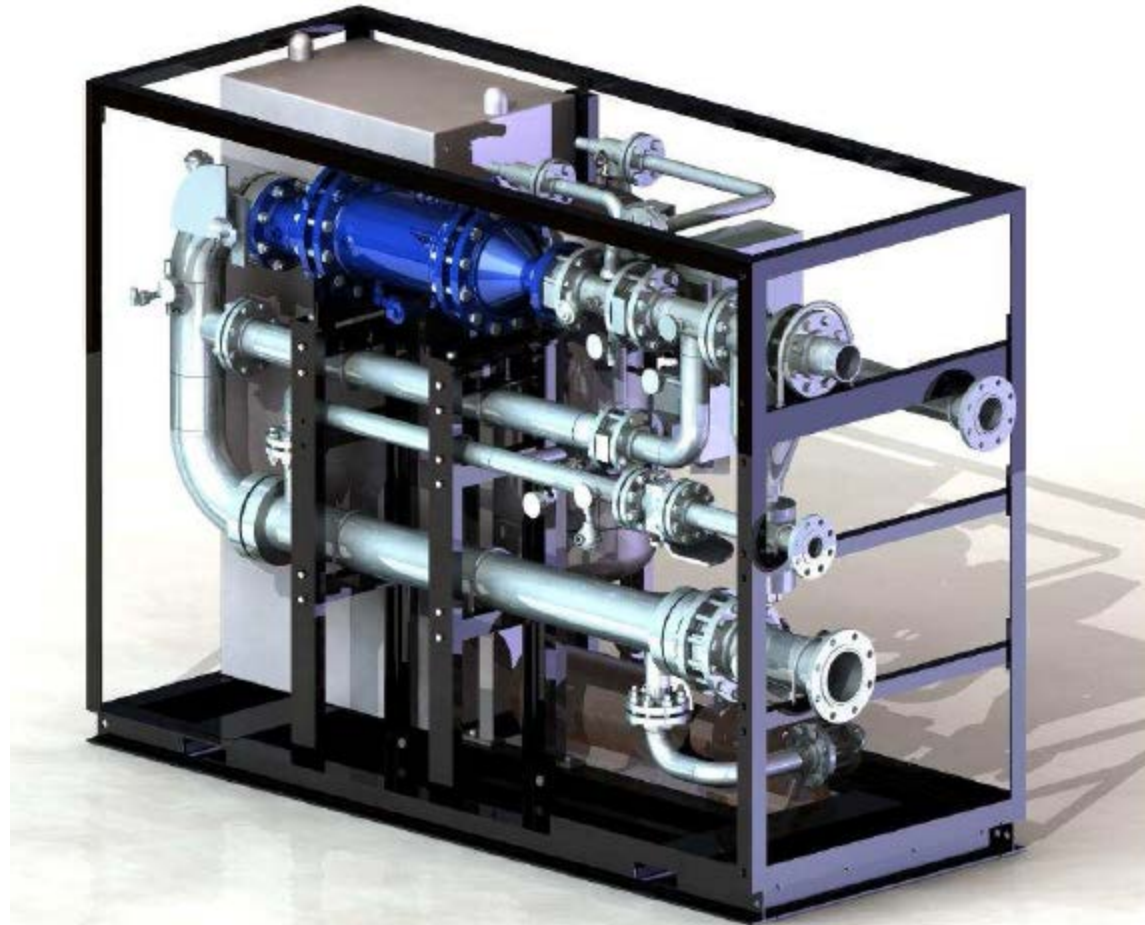


# WASTE HEAT POWER GENERATORS

## Organic Rankine Power Cycle



# WASTE HEAT POWER GENERATORS



# Basic APC Systems and Typical ECM's

APC Technology	Typical Application	Potential ECM
Thermal oxidation	Direct, regenerative, catalytic oxidizer, flare, flameless used for VOC abatement	Preheating process gases Preheating combustion air Preheating boiler feedwater or process water Steam Hot Oil HVAC Spent solvent injection/fossil fuel reduction Absorption Chilling Power Generation
Selective Catalytic Reduction (SCR)	Chemical reactor to reduce NOx emissions	Preheating process gases Preheating combustion air Preheating boiler feedwater or process water Power Generation
Particulate Scrubbers (Wet)	Venturi or collision scrubbers to remove particulate matter	Preheating boiler feedwater or process water
Acid Gas Scrubbers (Wet)	Packed towers to remove acid gases from exhaust streams	Preheating boiler feedwater or process water
Baghouses/Cyclones (Dry)	Filtration or mechanical separation systems for removal of particulate matter	Preheating process gases Preheating combustion air Preheating boiler feedwater or process water Power Generation