WASTE HEAT-TO-POWER WORKSHOP

September 25-26, 2007

WOWGen™ / WOWClean™

Waste Heat Recovery Power Plants

Daniel Stinger
Chairman

Mario Romero
President

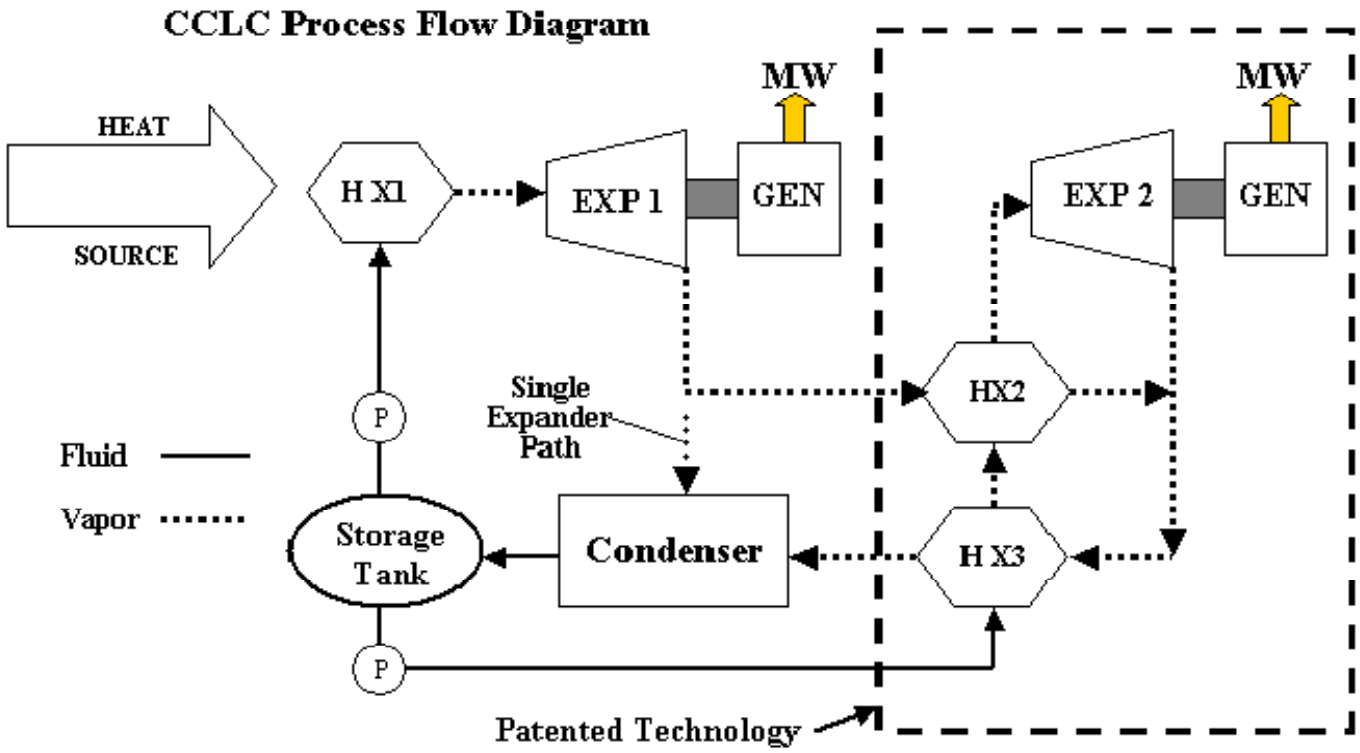
Wow Energy, Inc

Texas Energy Center
1650 Hwy 6, Suite 300
Sugar Land, TX 77478
Tele: 281-340-6726
www.wowenergies.com
email: dstinger@wowenergies.com

WOW Energy, Inc
BUSINESS MODEL

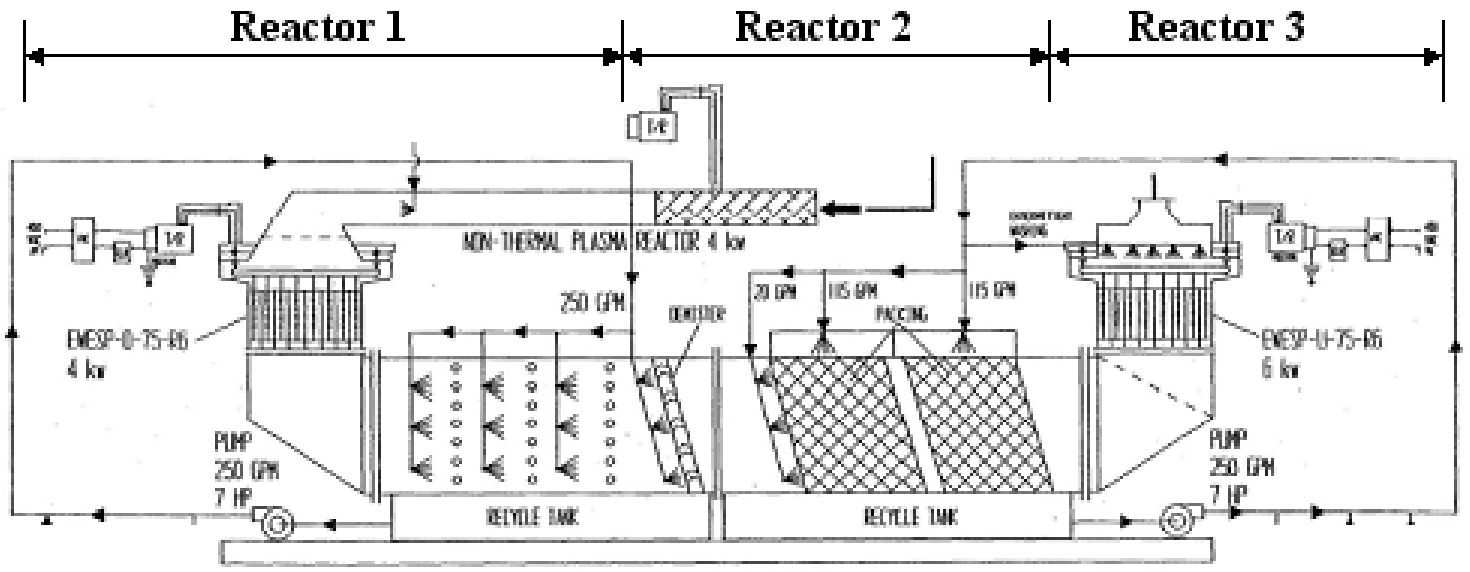
1. Develop technology to convert waste heat to electrical power
   - Technology did not exist to efficiently convert waste heat to power in the 300 F to 800 F temperature range
   - **WOWGen™** combined cycle turbo-expander system – 2 patents issued to date
   - Single stage turbo-expanders for low temperature heat
2. Develop efficient Renewable Energy power plants
   - Solar power plants - **WOWGen™**
   - Solar & Geothermal Energy (SAGE) - **WOWGen™**
   - Biomass power plants - **WOWGen™**
3. Develop multi-pollutant control technology to remove pollutants from flue gases
   - **WOWClean™**

WOWGen™ Cascading Closed Loop Cycle - CCLC



- **Combined cycle "dual" turbo-expander system**
- **Off-the-shelf-components**
- **Converts heat from the combustion of any fuel**
- **Converts waste heat to power**
- **Converts renewable energy to power**

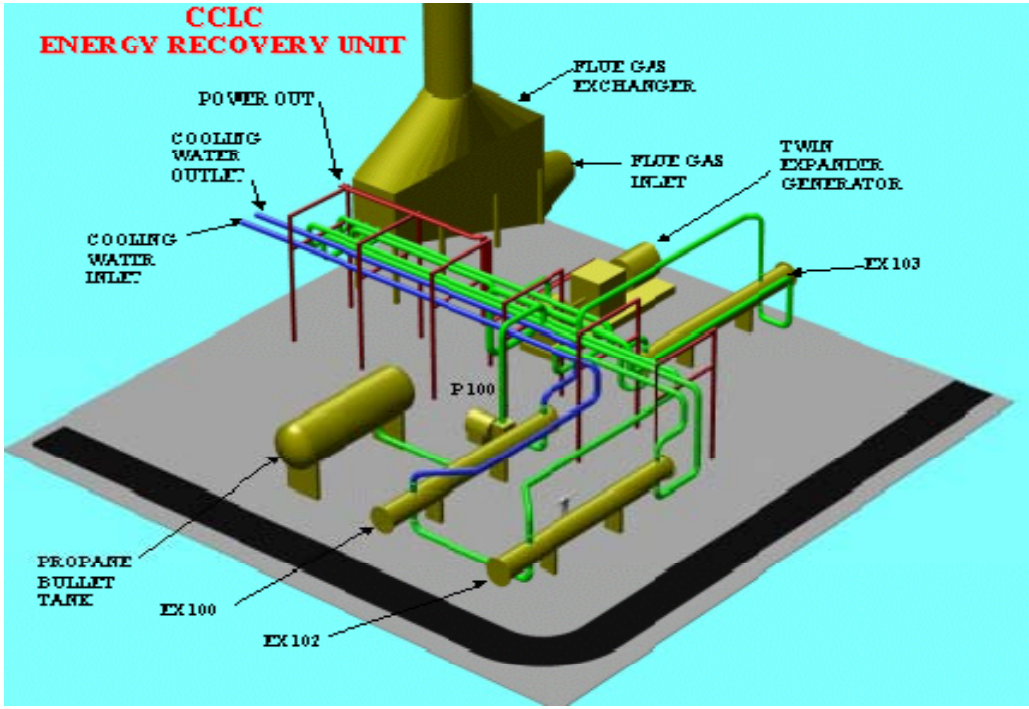
WOWClean™ Features



- 95% NOx & SOx (tested 100% removal)
- 85% Mercury
- 90% Vaporized heavy metals
- 99.5% Particulate removal
- 25% CO_2 (tested 85% removal)

WOWGen™ HEAT RECOVERY SYSTEM

Flue Gas Heat Exchanger (EX101)

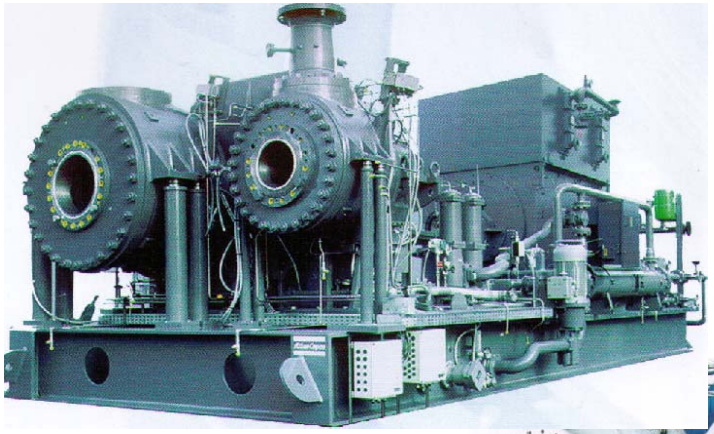


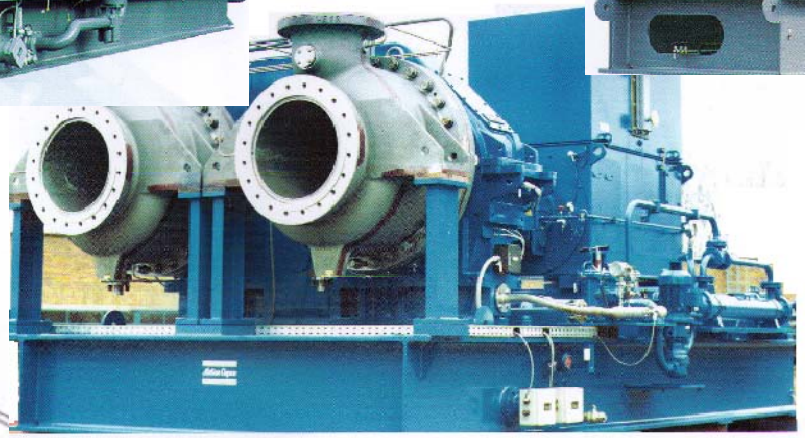
Heat Exchanger (EX102 & 103)

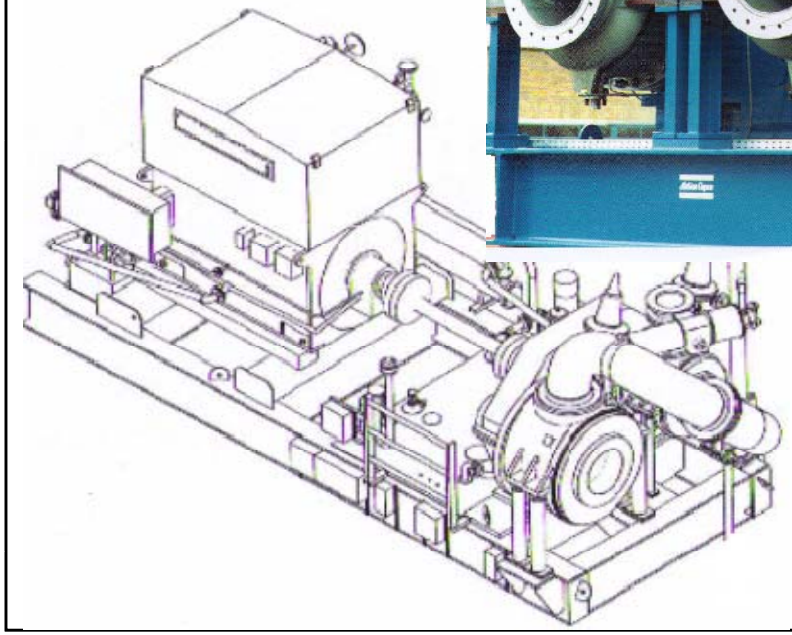
"Meeting the World's Energy & Environmental Challenges"

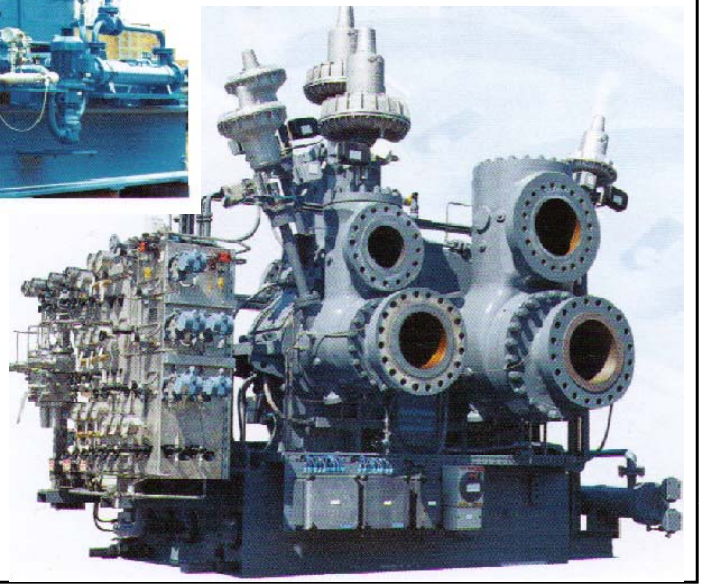
WOW Energies

WOWGen™ SINGLE & COMBINED CYCLE TURBO-EXPANDER GENERATOR SKID

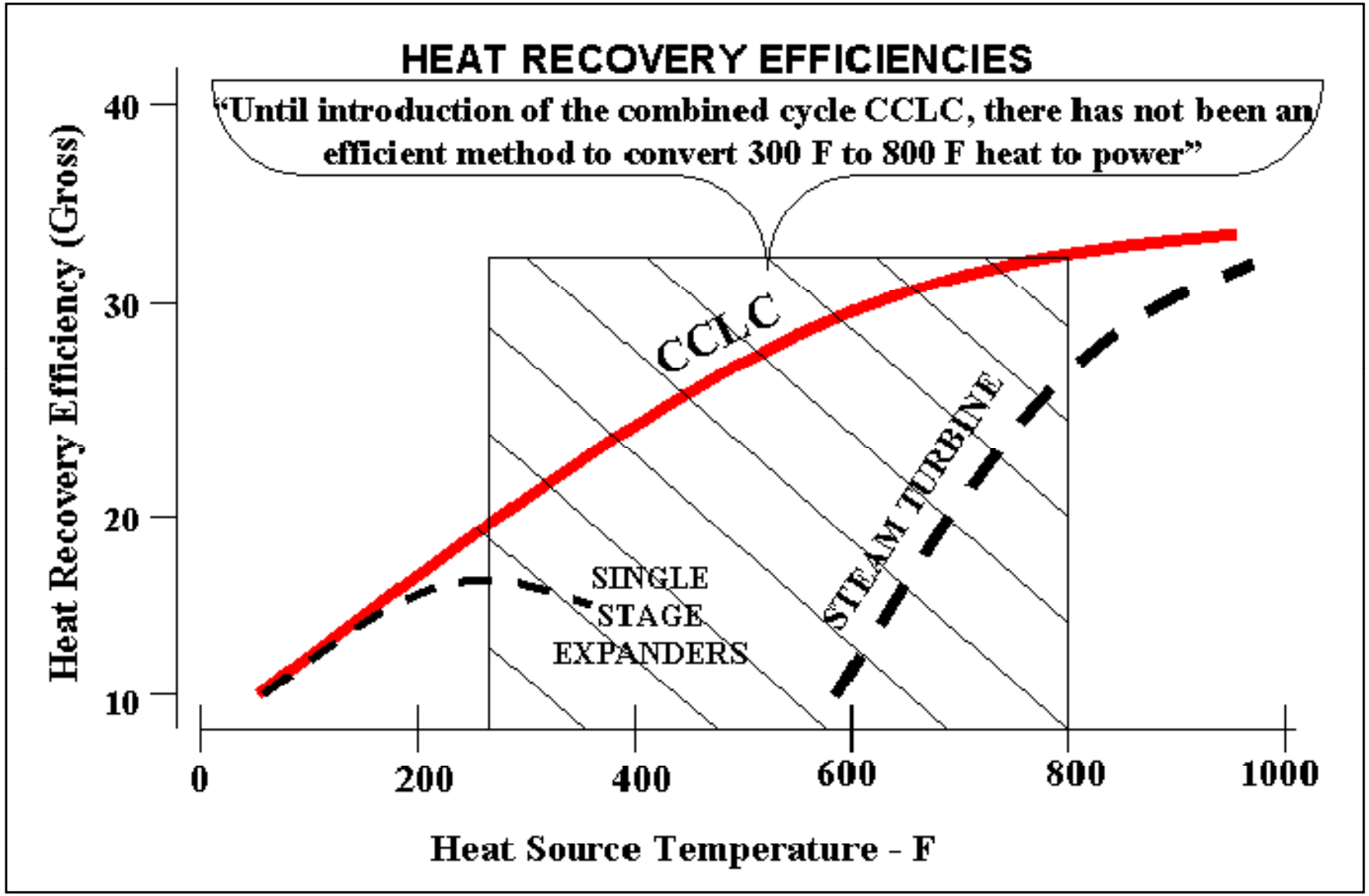








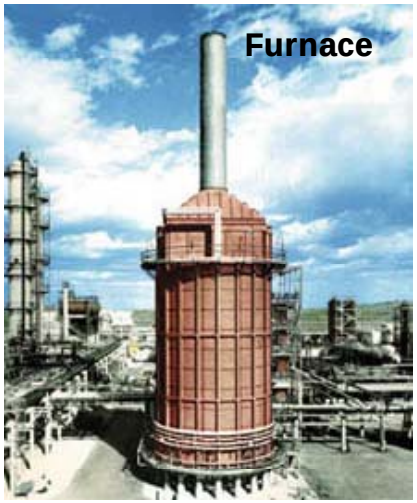
WOWGen™ Generates Electricity From Any Heat Source



"Meeting the World's Energy & Environmental Challenges"

WOW Energies

WASTE HEAT SOURCES



WOW Energies

WOWGen™ Generates Electricity From Any Heat Source

Typical Industries Generating Waste Heat

- Power and Utility Industries
- Heavy Industries: Steel, Aluminum, Copper, Cement, Pulp & Paper, Glass, Soda Ash and Waste Recycle
- Refinery, Petrochemical and Gasification plants
- Chlor-Alkali & Vinyl plants
- Incinerators, Waste to Energy

Typical Waste Heat Sources

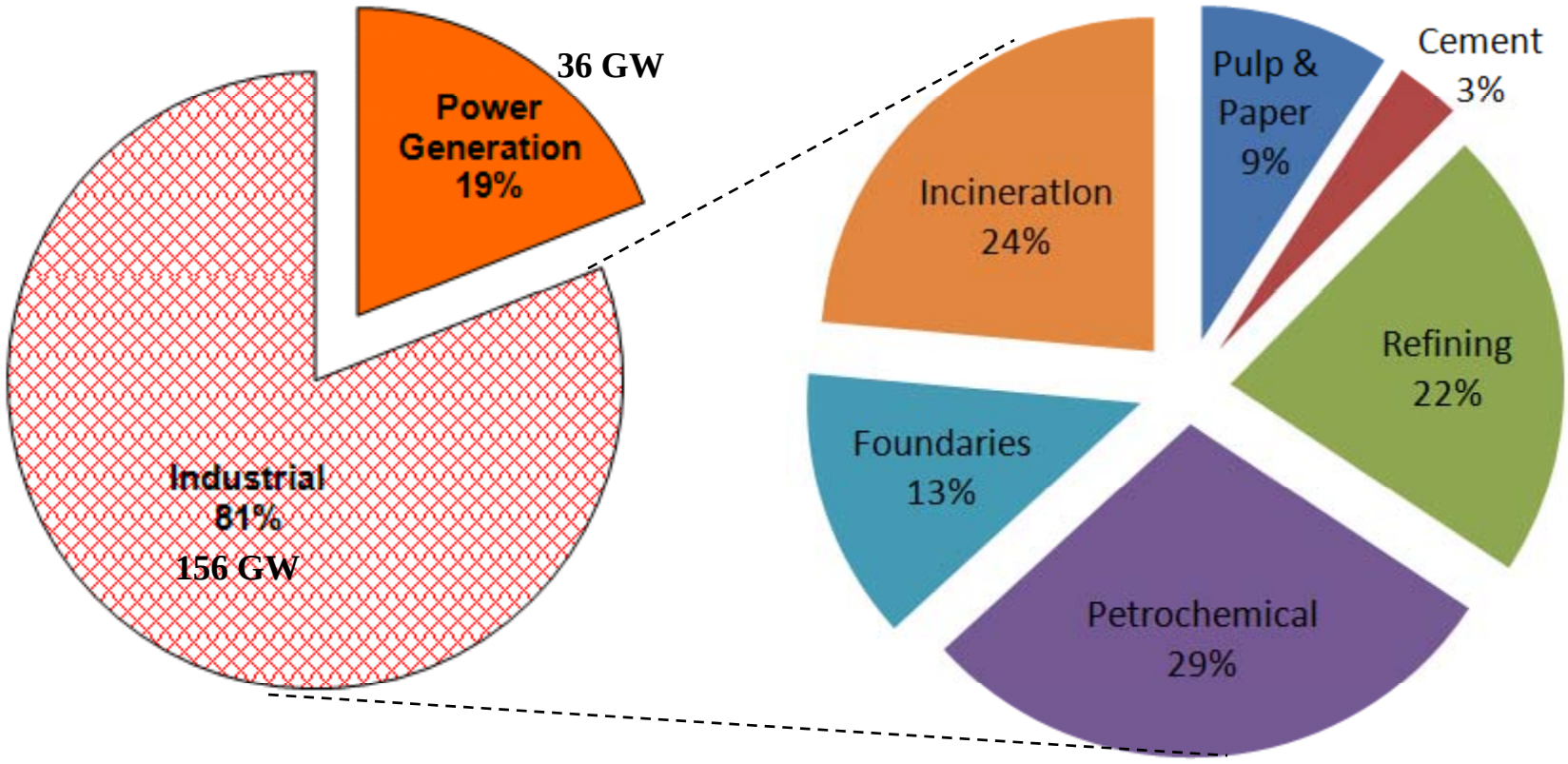
- Fired boilers, gasifiers, heaters/furnaces (gas, diesel, coal, nuclear, refuse, pet coke)
- Gas turbine exhaust - continuous, standby, peaking, combined cycle units
- Steam turbine exhaust: and vented steam
- Internal Combustion (IC) engine exhaust

Renewable Energy Heat Sources

- Solar energy
- Geothermal steam
- Biomass combustion
- Syngases

ELECTRICAL POWER GENERATION POTENTIAL FROM WASTE HEAT RECOVERY

Ref; EIA 2007 Annual Energy Outlook

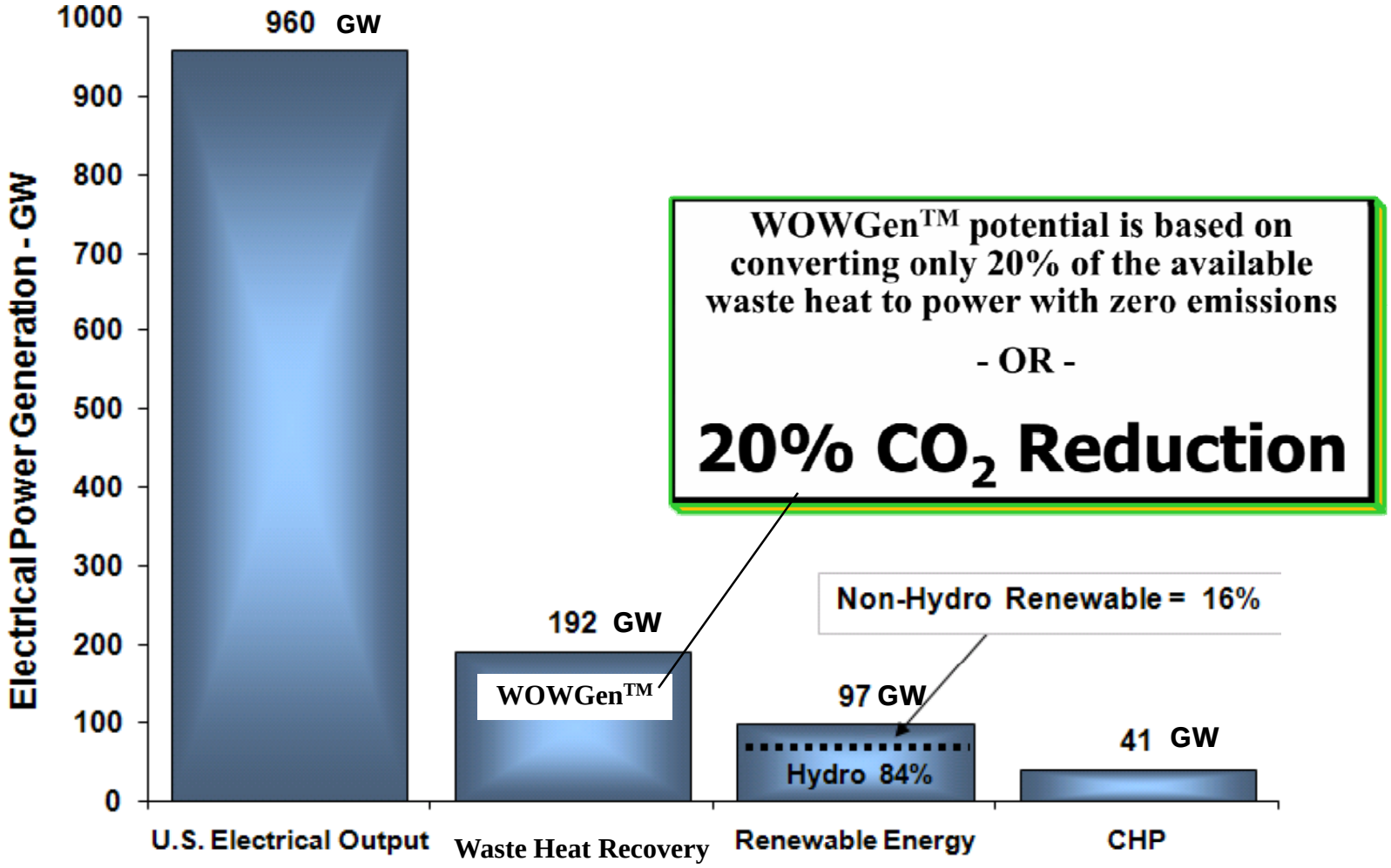


Waste Heat Recovery Potential = 192 GW

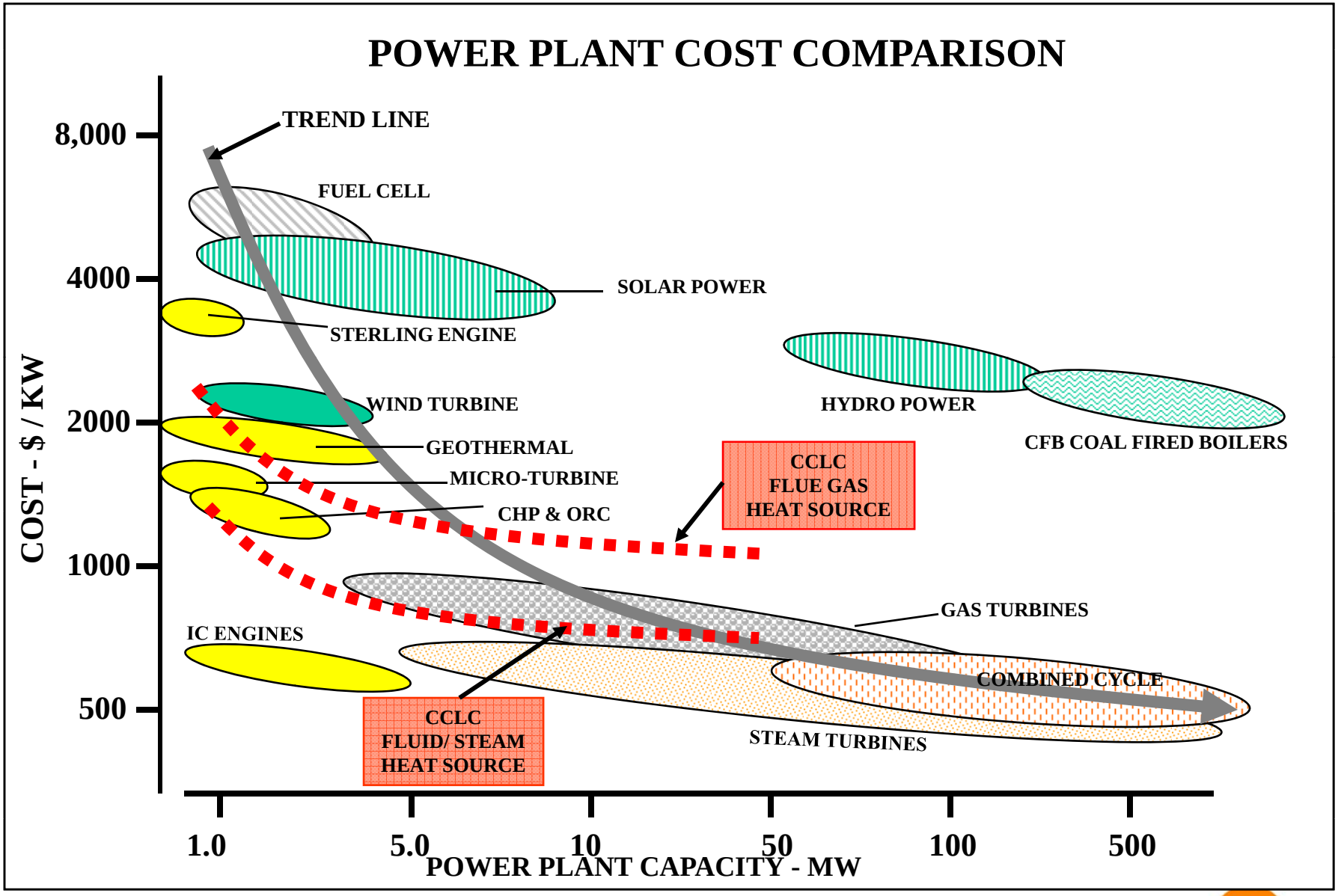
Industrial Waste Heat Potential = 156 GW

ELECTRICAL POWER GENERATION POTENTIAL FROM WASTE HEAT RECOVERY

Ref: EIA 2007 Annual Energy Outlook



WOWGen™ Capital Investment is Competitive



WOW Energies

RENEWABLE / REUSABLE ENERGY

TYPE	ENERGY SOURCE AVAILABILITY	CONVERSION EFFICIENCY	GENERATES EMISSIONS	CAPITAL COST PER KW	CAPITAL COST ADJUSTED FOR AVAILABILITY	TAX CREDITS
RENEWABLE ENERGY:						
SOLAR (CSP) (1)	25%	25% to 35%	NO	$3,000 to $6,000	$12,000 to $24,000	YES
WIND (1)	25%	25% to 35%	NO	$1,500 to $2,500	$6,000 to $10,000	YES
GEOTHERMAL	100%	5% to 15%	NO	$2,000 to $3,000	$2,000 to $3,000	YES
HYDRO (SMALL)	100%	25% to 35%	NO	$1,500 to $2,500	$1,500 to $2,500	YES
BIOMASS (2)	100%	25% to 35%	YES	$1,500 to $2,500	$1,500 to $2,500	YES
REUSABLE ENERGY:						
WASTE HEAT RECOVERY (3)	100%	25% to 35%	NO (4)	$ 600 to $1,800	$ 600 to $1,800	NO

(1) Limited geographically
(2) Dependant on fuel source
(3) Dependant on heat source & power plant size
(4) Can reduce existing emissions

WHY NOT CLASSIFY "REUSABLE ENERGY" AS "RENEWABLE ENERGY"?

Potential Tax Credits, Emission Credits &Incentives

$200/KW Production Tax Credit

- **Max size = 2,000 kw WOWGen™ power plant ($400,000/plant)**
- **Reduces income tax by $80,000/yr for 5 years**
- **Must be installed by 12/31/07**

NOx/SOx/Particulate Emission Credits/Offsets

Provides Ability to Meet CO2 Commitments

- **Generate power with zero Greenhouse Gases**
- **Generate power with zero emissions**

Power Generated Applies to Renewable Portfolio Standards (RPS)

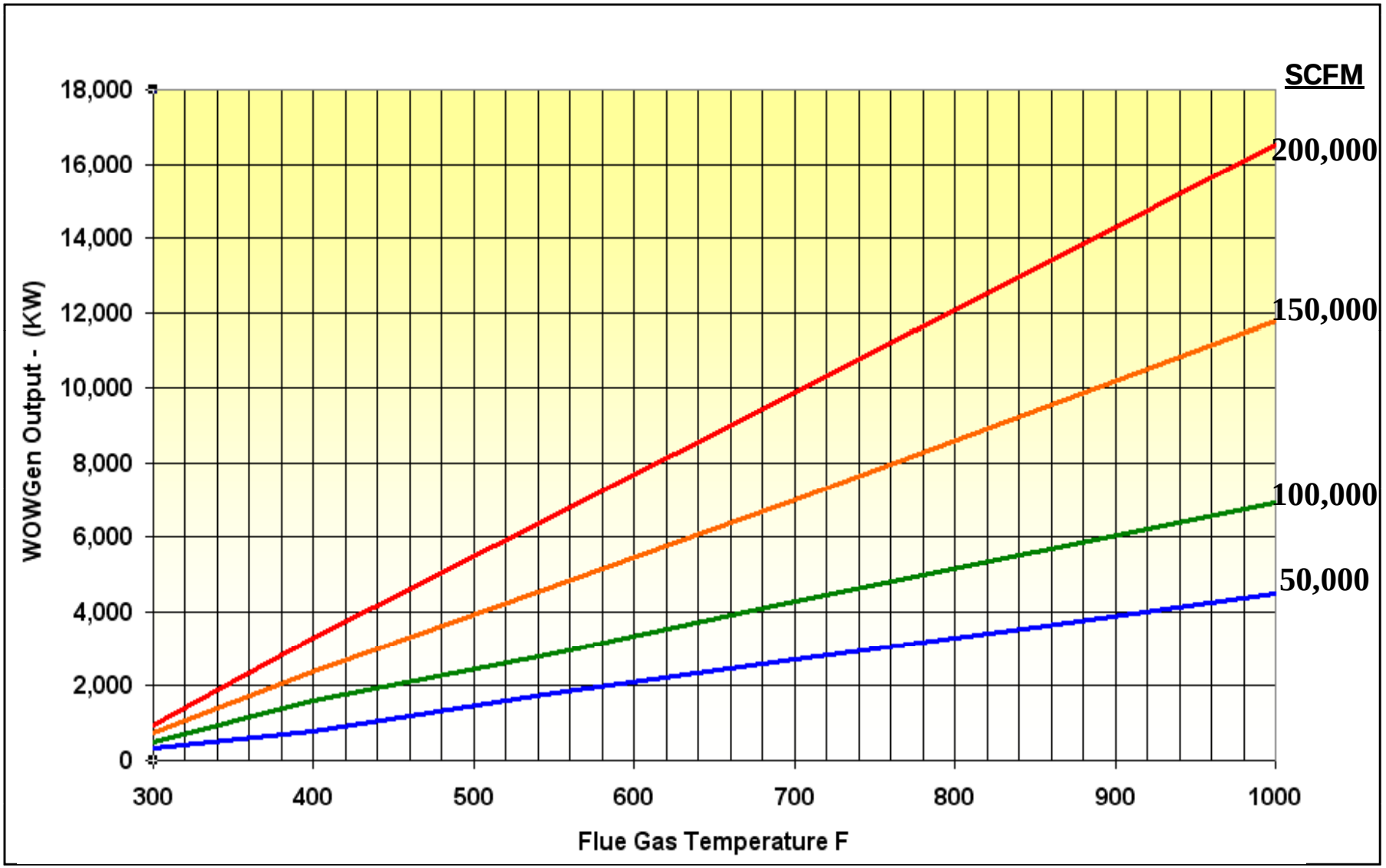
- **Percentage of utility output must come from renewable energy or utility pays fee of cents/kw-hr**
- **States can qualify waste heat recovery as applicable**

Renewable Energy Credits

- **Applies to biomass fuel**
- **$0.9 to 1.9 cents/kw-hr (open vs closed loop)**

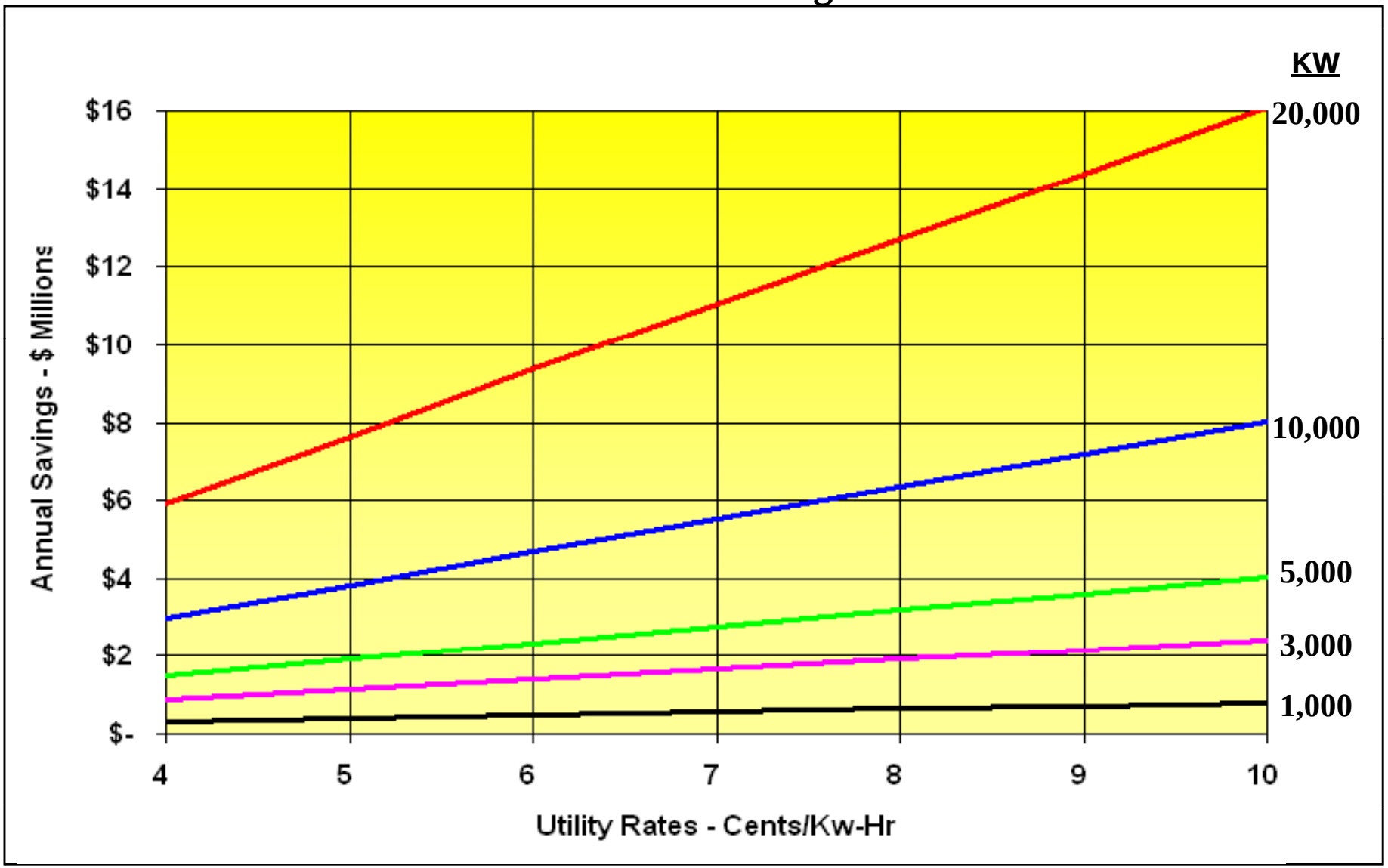
SOx, Hg and Heavy Metals Removal Allows Burning Lower Cost High Sulfur/High Heavy Metals Coal and/or Petcoke

WOWGen™
Net Output vs Flue Gas Temperature & Flow

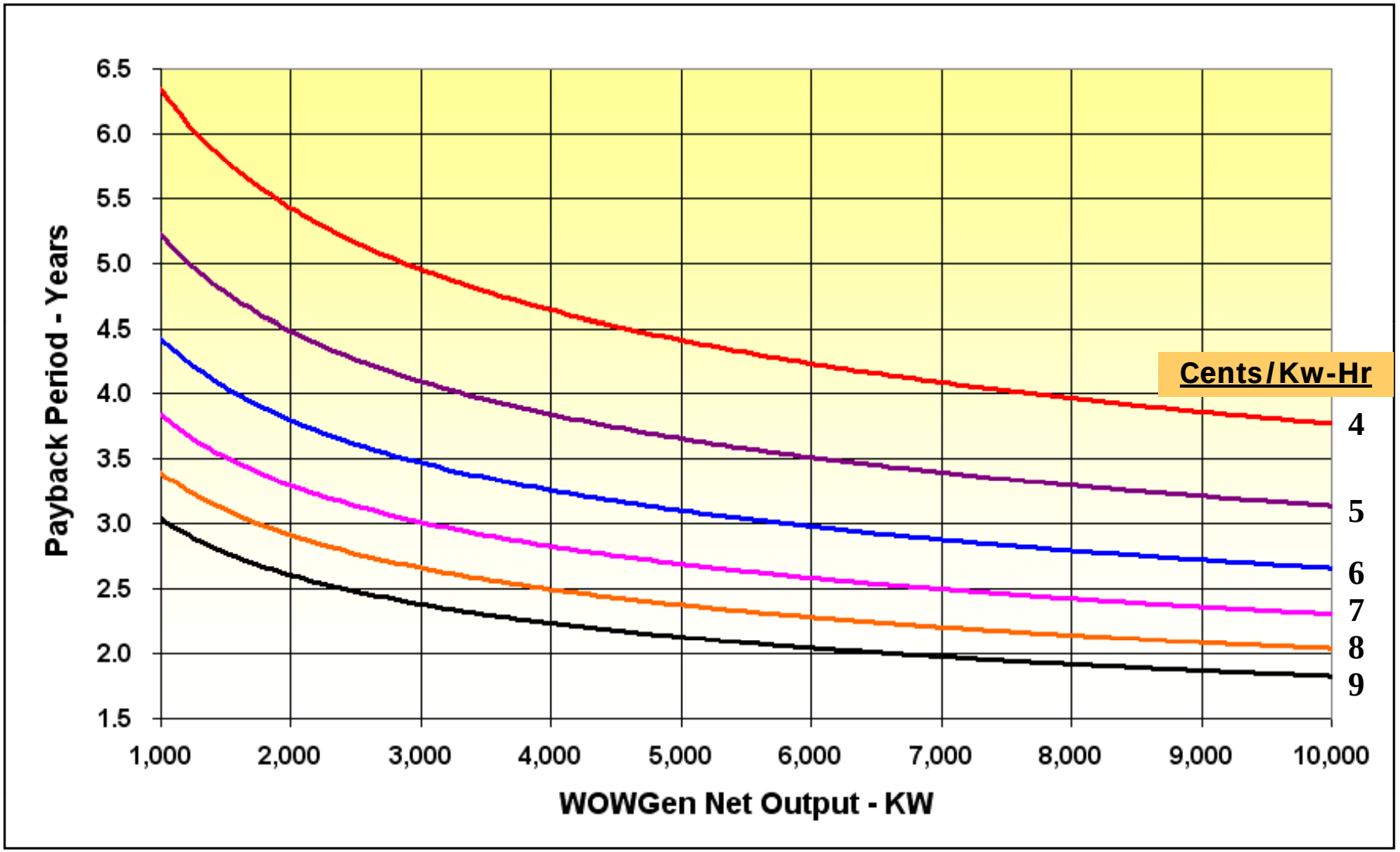


WOW Energies

WOWGen™
Net Annual Power Savings - Millions



WOWGen™
Simple Payback Period - Years



"Meeting the World's Energy & Environmental Challenges"

WOW Energies

WOWGen™ and WOWClean™ are a Reality

- MSW Waste to Energy Gasification Project
  - 8 MW Power Generation
  - Off electrical grid power plant
  - Divert 250 tons/day MSW from landfill
- Waste Heat to Power Funded Projects

– Lime plant	4 MW
– Pulp/paper plant	3 MW
– Gas plant	15 MW
– Steel plant(s)	9 MW/13MW
– Diesel engine, Heavy FuelOil	22 MW

- Projects under consideration
  - Glass, Mining, Lime, Cement, Steel, Biomass, Solar, Reciprocating Engines, Gas Pipeline, Landfill Gas, Geothermal

Project: Steel Reheat Furnace

- Project Description
  - Capture heat from the discharge of reheat furnace and convert to electrical power
    - Flue Gas Temp = 900 F
    - Flue Gas Flow Rate = 745,000 lb/hr
    - WOWGen™ Output = 12.9 MW
- Project Investment and Returns
  - Total Installed Cost = $ 18 Million
  - Avoided cost of power = $ 0.095/kwh
  - After Tax IRR = >20% (unleveraged)
    To 80% Equity Partner

Project: Autoclave

- Project Description
  - Capture heat from the discharge of the autoclave scrubber system and convert it to electrical power.
    - Flue Gas Temp = 200 F
    - Flue Gas Flow Rate = 180,000 lb/hr
    - WOWGen™ Output = 8.5 MW
- Project Investment and Returns
  - Total Installed Cost = $ 16.7 Million
  - Avoided cost of power = $ 5.0 MM @ $ 0.06/kwh
  - Simple Payback = 3.3 Years
  - After Tax IRR = 24.6% (unleveraged)

Project: Lime Kiln

- Project Description
  - Capture heat from the discharge of lime kiln and convert to electrical power.
    - Flue Gas Temp = 475 F
    - Flue Gas Flow Rate = 250,000 lbs/hr
    - WOWGen™ Output = 1.6 MW
- Project Investment and Returns
  - Total Installed Cost = $ 4.0 Million
  - Avoided cost of power = $0.086 /kwh
  - Simple Payback = 3.6 Years
  - After Tax IRR = 19% (unleveraged)
  - After Tax IRR = 20% (unleveraged with microturbine tax credits)

Project: Pipeline Compressor Station

- Project Description
  - Capture heat from the discharge of several gas turbines at pipeline compressor stations
    - Flue Gas Temp = 900 F
    - Flue Gas Flow Rate = 600,000 lb/hr
    - WOWGen™ Output = 9 MW
- Project Investment and Returns
  - Total Installed Cost = $ 16.7 Million
  - Avoided cost of power = $ 0.065/kwh
  - Simple Payback = 4.5 Years
  - After Tax IRR = 14% (unleveraged)

Project: Base Load Diesel Engines

- Project Description
  - Capture waste heat from 9 base loaded diesel engines
    - Flue Gas Temp = 750 F
    - Flue Gas Flow Rate = 2,500,000 lb/hr
    - WOWGen™ Output = 21 MW
- Project Investment and Returns
  - Total Installed Cost = $ 55 Million
  - Avoided cost of power = $ 0.100/kwh
  - Simple Payback = 2.5 Years
  - After Tax IRR = 28% (unleveraged)

WOWGen™ Advantages

- Efficient Power From Flue Gas, Steam, Hot Water/Fluids
- Saves Valuable Water Resources
- High Internal Rates of Return
- Supports Distributed Generation
- Economical for 1 MW to 25 MW Power Plants
- Solar, Biomass & Geothermal Standalone Power Plants
- Power Generated with Zero Emissions
- Combined Cycle Diesel Engine Power Plants
- Renewable Energy Credits
- Each MW of Power Generation (compared to coal fired plant) Eliminates
  - 21 Tons NOx
  - 59 Tons SOx
  - 8615 Tons of CO2

WOWClean™ Advantages

- Integrated Multi-Pollutant Reduction System
  - 95% NOx & SOx (tested 100% removal)
  - 85% Mercury
  - 90% Vaporized heavy metals
  - 99.5% Particulate removal
  - 25% CO_2 (tested 85% removal)
- Low Temperature “end-of-the-line” System
- Standalone or Integrated with WOWGen™
- Zero Emission Power Plants
- Provides Emission Credits