WASTE HEAT-TO-POWER WORKSHOP

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WOWGen™ / WOWClean™
Waste Heat Recovery Power Plants

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“MEETING THE WORLDS ENERGY & ENVIRONMENTAL CHALLENGES”
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% CO₂ (tested 85% removal)
WOWGen™ HEAT RECOVERY SYSTEM

Flue Gas Heat Exchanger (EX101)

Heat Exchanger (EX102 & 103)

“Meeting the World’s Energy & Environmental Challenges”
WOWGen™ SINGLE & COMBINED CYCLE TURBO-EXPANDER GENERATOR SKID
WOWGen™ Generates Electricity From Any Heat Source

HEAT RECOVERY EFFICIENCIES

“Until introduction of the combined cycle CCLC, there has not been an efficient method to convert 300 F to 800 F heat to power.”

Heat Recovery Efficiency (Gross)

Heat Source Temperature - F

CCLC

STEAM TURBINE

SINGLE STAGE EXPANDERS
WASTE HEAT SOURCES

Cement Plant

Petrochemical Plant

Coal Fired Power Plant

Refinery

Furnace

“Meeting the World’s Energy & Environmental Challenges”
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™ potential is based on converting only 20% of the available waste heat to power with zero emissions

- OR -

20% CO₂ Reduction

Non-Hydro Renewable = 16%

Hydro 84%

41 GW
WOWGen™ Capital Investment is Competitive

POWER PLANT COST COMPARISON


“Meeting the World’s Energy & Environmental Challenges”
## RENEWABLE / REUSABLE ENERGY

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

(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

Meeting the World’s Energy & Environmental Challenges
WOWGen™
Net Annual Power Savings - Millions

Utility Rates - Cents/Kw-Hr

Annual Savings - $ Millions

KW

$0

$2

$4

$6

$8

$10

$12

$14

$16

4

5

6

7

8

9

10

10,000

5,000

3,000

1,000

"Meeting the World’s Energy & Environmental Challenges"
WOWGen™
Simple Payback Period - Years

“Meeting the World’s Energy & Environmental Challenges”
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% CO₂ (tested 85% removal)
- Low Temperature “end-of-the-line” System
- Standalone or Integrated with WOWGen™
- Zero Emission Power Plants
- Provides Emission Credits