

# VOCGEN CHP Level One Project Feasibility Financial Summary



## Expanded Foam Manufacturing Company State of California DR/SS

| Operational Costs                       | Air Pollution Control<br>Equipment & Utility Supplied<br>Energy | VOCGEN CHP Equipment     |
|---|---|--------------------------|
| Natural Gas                             | (\$387,526)   | (\$405,861)              |
| Electricity                             | (\$94,610)  | \$0                      |
| Maintenance                             | (\$25,000)  | (\$47,250)               |
| Plant Natural Gas                       | (\$412,009)   |                          |
| Plant Electricity                       | (\$477,314)   |                          |
|   | (\$1,396,459)   | (\$453,111)              |
| <b>Annual Savings</b>                   |   | <b>\$943,348</b>         |
| <b>Capital Equipment</b>                |   |                          |
| Regenerative Thermal Oxidizer (RTO)     | (\$2,275,000)   | \$2,275,000              |
| VOCGEN CHP System                       | \$0   | (\$3,489,900)            |
|   | (\$2,275,000)   | (\$1,214,900)            |
| Simple Payback Period                   | None  | <b>1.29-year payback</b> |
| <b>Potential savings over 20-years</b>  |   | <b>\$19,202,056</b>      |
| <b>Internal Rate of Return</b>          |   | <b>78%</b>               |
| <b>Net Present Value (NPV)</b>          |   | <b>\$6,678,689</b>       |
| <b>Carbon Dioxide Emissions (MT)</b>    | 7,180   | 4,568                    |
| <b>Carbon Equivalent Emissions (MT)</b> | 1,958   | 1,246                    |
| <b>Annual Carbon Reduction</b>          |   | <b>63.62%</b>            |



**Expanded Foam Manufacturing Company Example Level One (1)  
Cost Benefit Analysis**

|                   |                  |
|-------------------|------------------|
| VOC loading Rate  | 120 lb/hr        |
| Plant location    | California       |
| Natural Gas Price | \$6.99 USD/MMBtu |
| Electricity Price | \$0.123 USD/kWh  |

US Energy Information Agency - Energy Prices June - 2013..... Pentane - VOC Heat Content 19,500 Btu/tb

**RTO - Regenerative Thermal Oxidizer Air Pollution Control Equipment & Utility Supplied Energy - Option 1**

**VOCGEN CHP Equipment Option 2**

**Equipment Selection**

**VOCGEN Equipment Selection**

**Equipment Option 1**

RTO - Regenerative Thermal Oxidizer (50) KCFM at 80°F  
Other Equipment

|   |         |
|---|---------|
| 1 | Unit(s) |
| 0 | Unit(s) |

**VOCGEN Genset -\*0.560 MW  
VOC Concentrator | HRSG**

\* Nominal rating

560 kW per gas turbine

|   |         |
|---|---------|
| 1 | Unit(s) |
| 1 | Unit(s) |

**Operating Hours**

**VOCGEN Operating Hours**

(RTO - Regenerative Thermal Oxidizer)  
Operating hours

|       |       |
|-------|-------|
| 7,920 | hr/yr |
|-------|-------|

(8hrs/shift, 3shifts/day, 330days/yr)

**Genset(s) Operating hours**

|       |       |
|-------|-------|
| 8,712 | hr/yr |
|-------|-------|

(8hrs/shift, 3shifts/day, 363days/yr)

**Air Flow**

**VOCGEN Air Flow**

System airflow (CFM)

|        |     |
|--------|-----|
| 50,000 | CFM |
|--------|-----|

Other

|  |  |
|--|--|
|  |  |
|--|--|

**VOCGEN Genset(s) - CFM ISO Cond.**

|       |            |
|-------|------------|
| 6,200 | CFM/genset |
| 6,200 | CFM        |

**Elevation: 250 Feet**

**1. Fuel**

**1. VOCGEN Fuel**

System operating hours

|                                       |       |        |
|---------------------------------------|-------|--------|
| (8hrs/shift, 3shifts/day, 330days/yr) | 7,920 | hrs/yr |
|---------------------------------------|-------|--------|

Regenerative Thermal Oxidizer fuel requirement 7.00 MMBtu/hr

Other equipment fuel requirement 0.00 MMBtu/hr

**Estimated Fuel Required**

Annual Carbon Reduction

**Equipment Option 1**

|   |                    |               |
|---|--------------------|---------------|
| RTO - Regenerative Thermal Oxidizer (50) KCFM at 80°F | (\$387,526)        | USD           |
| Other Equipment                                       | \$0                | USD           |
| <b>Total Natural Gas usage by Option 1</b>            | <b>(\$387,526)</b> | <b>USD/yr</b> |

**VOC Energy Contribution**

|                                       |               |                 |
|---------------------------------------|---------------|-----------------|
| Operating hours (VOC production)      | 7,920         | hrs/yr          |
| (8hrs/shift, 3shifts/day, 330days/yr) |               |                 |
| VOC load                              | 120           | lb/hr           |
| Heat content                          | 19,500        | Btu/lb          |
|                                       | <b>18,533</b> | <b>MMBtu/yr</b> |

Natural gas pilot fuel use is regulated by an automated system compensating for VOC heat content contribution.

**Natural Gas Fuel**

|                                  |                      |
|----------------------------------|----------------------|
| <b>VOCGEN Genset(s) 0.560 MW</b> |                      |
| <b>Heat rate</b>                 | 15,700 Btu/kWh       |
|                                  | 8.79 MMBtu/hr/genset |
|                                  | 8.79 MMBtu/yr        |
|                                  | 76,596 MMBtu/yr      |



|  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
|--|--|---|---|---|---|-------------------------------------|-----------------|--------------------------|-------------------------|-----------------|--------------------|-------------------|------------------------|--------------------------------|
| <p><b>Estimated Fuel Required</b></p> <table border="1"> <tr> <td>Natural Gas</td> <td>55,440 MMBtu/yr</td> </tr> <tr> <td><b>Total fuel</b></td> <td><b>(\$387,526) USD/yr</b></td> </tr> </table>                      | Natural Gas  | 55,440 MMBtu/yr   | <b>Total fuel</b>   | <b>(\$387,526) USD/yr</b>                                 | <p><b>Estimated Fuel Required</b></p> <table border="1"> <tr> <td>VOC</td> <td>18,533 MMBtu/yr</td> <td>\$129,544 USD/yr Savings</td> </tr> <tr> <td>Natural Gas</td> <td>58,063 MMBtu/yr</td> <td>(\$405,861) USD/yr</td> </tr> <tr> <td><b>Total fuel</b></td> <td><b>76,596 MMBtu/yr</b></td> <td><b>Cost (\$405,861) USD/yr</b></td> </tr> </table> | VOC                                 | 18,533 MMBtu/yr | \$129,544 USD/yr Savings | Natural Gas             | 58,063 MMBtu/yr | (\$405,861) USD/yr | <b>Total fuel</b> | <b>76,596 MMBtu/yr</b> | <b>Cost (\$405,861) USD/yr</b> |
| Natural Gas  | 55,440 MMBtu/yr  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>Total fuel</b>  | <b>(\$387,526) USD/yr</b>  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| VOC  | 18,533 MMBtu/yr  | \$129,544 USD/yr Savings  |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| Natural Gas  | 58,063 MMBtu/yr  | (\$405,861) USD/yr  |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>Total fuel</b>  | <b>76,596 MMBtu/yr</b>   | <b>Cost (\$405,861) USD/yr</b>  |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p><b>2. Regenerative Thermal Oxidizer Electrical Cost</b></p>   | <p><b>2. VOCGEN Parasitic Loads</b></p>  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
|  | <p><b>VOCGEN Genset(s) 0.560 MW</b></p> <p>Chiller 0 kW/unit<br/>0 kW - parasitic load</p> <p>NG Booster Compressor 50 kW/unit<br/>50 kW - parasitic load</p>                              |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p><b>Estimated RTO Electricity Cost</b><br/><i>Using total motor Hp of 97.5 &amp; power draw of 0kW</i></p> <table border="1"> <tr> <td>772,329 kWh/yr</td> </tr> <tr> <td><b>(\$94,610) USD/yr</b></td> </tr> </table> | 772,329 kWh/yr   | <b>(\$94,610) USD/yr</b>  | <p><b>Estimated Operation Electricity Use From Parasitic Load</b></p> <table border="1"> <tr> <td>50 kW</td> </tr> <tr> <td><b>435,600 kWh/yr</b></td> </tr> </table> | 50 kW   | <b>435,600 kWh/yr</b>   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| 772,329 kWh/yr   |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>(\$94,610) USD/yr</b>   |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| 50 kW  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>435,600 kWh/yr</b>  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p><b>3. Annual Maintenance</b></p>  | <p><b>3. Annual VOCGEN Maintenance</b></p>   |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <table border="1"> <tr> <td><b>(\$25,000) USD/yr</b></td> </tr> </table>   | <b>(\$25,000) USD/yr</b>   | <table border="1"> <tr> <td>(\$3,938) USD/month</td> </tr> <tr> <td><b>(\$47,250) USD/yr</b></td> </tr> </table>  | (\$3,938) USD/month   | <b>(\$47,250) USD/yr</b>                                  |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>(\$25,000) USD/yr</b>   |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| (\$3,938) USD/month  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>(\$47,250) USD/yr</b>   |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p><b>4. Avoided Electrical Requirements of Facility</b></p>   | <p><b>4. VOCGEN Electrical Output Contribution (Less Parasitic Load)</b></p>   |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <table border="1"> <tr> <td>510 kW</td> <td>VOCGEN Cost Avoidance</td> </tr> <tr> <td>3,896,442 kWh/yr</td> <td><b>(\$477,314) USD/yr</b></td> </tr> </table>  | 510 kW   | VOCGEN Cost Avoidance   | 3,896,442 kWh/yr  | <b>(\$477,314) USD/yr</b>                                 | <table border="1"> <tr> <td>(560kW - 50kW)</td> <td>510 kW</td> </tr> <tr> <td></td> <td><b>3,896,442 kWh/yr</b></td> </tr> </table> <p><i>Altitude factor at 250ft is 0.993 of nominal output power<br/>VOCGEN parasitic load deducted from total electrical output</i></p>  | (560kW - 50kW)                      | 510 kW          |                          | <b>3,896,442 kWh/yr</b> |                 |                    |                   |                        |                                |
| 510 kW   | VOCGEN Cost Avoidance  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| 3,896,442 kWh/yr   | <b>(\$477,314) USD/yr</b>  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| (560kW - 50kW)   | 510 kW   |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
|  | <b>3,896,442 kWh/yr</b>  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p><b>5. Avoided Natural Gas Requirements for Heating/Cooling</b></p>  | <p><b>5. VOCGEN Heat Output Contribution</b></p>   |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <table border="1"> <tr> <td>58,943 MMBtu/yr</td> <td>VOCGEN Cost Avoidance</td> </tr> <tr> <td></td> <td><b>(\$412,009) USD/yr</b></td> </tr> </table>   | 58,943 MMBtu/yr  | VOCGEN Cost Avoidance   |   | <b>(\$412,009) USD/yr</b>                                 | <p><b>VOCGEN Genset(s) 0.560 MW</b></p> <p>8.79 MMBtu/hr Fuel<br/>1.85 MMBtu/hr Electrical power<br/>6.95 MMBtu/hr Heat<br/>6.77 MMBtu/hr Heat w/radiated heat loss</p> <table border="1"> <tr> <td><b>58,943 MMBtu/yr nominal heat</b></td> </tr> </table>   | <b>58,943 MMBtu/yr nominal heat</b> |                 |                          |                         |                 |                    |                   |                        |                                |
| 58,943 MMBtu/yr  | VOCGEN Cost Avoidance  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
|  | <b>(\$412,009) USD/yr</b>  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>58,943 MMBtu/yr nominal heat</b>  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p><b>Regenerative Thermal Oxidizer annual operating cost</b></p>  | <p><b>VOCGEN Carbon Emissions Reductions - Potential</b></p>   |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p>(VOCGEN cost avoidance included in Regenerative Thermal Oxidizer annual operating cost below)</p>   | <table border="1"> <tr> <td>Federal Proposed Value</td> <td>712 ton Carbon/year<br/>\$0.00 USD/ton</td> <td><b>\$0 USD/yr</b><br/><b>Not included in total savings</b></td> </tr> </table> | Federal Proposed Value  | 712 ton Carbon/year<br>\$0.00 USD/ton   | <b>\$0 USD/yr</b><br><b>Not included in total savings</b> |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| Federal Proposed Value   | 712 ton Carbon/year<br>\$0.00 USD/ton  | <b>\$0 USD/yr</b><br><b>Not included in total savings</b>   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <p><b>Operational Cost per Year</b></p> <table border="1"> <tr> <td><b>(\$1,396,459) USD/yr</b></td> </tr> </table>  | <b>(\$1,396,459) USD/yr</b>  | <p><b>Operational Cost per Year</b></p> <table border="1"> <tr> <td><b>(\$453,111) USD/yr</b></td> </tr> </table> | <b>(\$453,111) USD/yr</b>   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>(\$1,396,459) USD/yr</b>  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>(\$453,111) USD/yr</b>  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
|  | <p><b>Estimated Annual Savings</b></p> <table border="1"> <tr> <td><b>\$943,348 USD/yr</b></td> </tr> </table>   | <b>\$943,348 USD/yr</b>   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |
| <b>\$943,348 USD/yr</b>  |  |   |   |   |   |                                     |                 |                          |                         |                 |                    |                   |                        |                                |



| 6. Capital Equipment Budget- First year   | 6. VOCGEN Capital Equipment Budget- First year   |
|---|--|
| <p><b>Equipment Option 1</b></p> <p>RTO - Regenerative Thermal Oxidizer (50) KCFM : (\$1,750,000) USD<br/>Other Equipment \$0 USD</p> <p>Two Additional 'RTO' unit(s) will be purchased during the 20-year evaluation period with installation costs included (factor: 1.30): (\$2,275,000) USD</p> | <p><b>Equipment Option 2</b></p> <p>0.560MW VOCGEN Genset cost (\$1,723,000) USD</p> <p>Equipment Package Engineering and Designs w/Specifications and Operations Manual<br/>Skid-mounted equipment enclosure<br/>Natural Gas Booster Compressor and Receiver Tank (optional)<br/>D.I. Water Purification System (optional)<br/>Electric Chiller (300°F to 65°F)<br/>Honeywell Catox Air Purification Catalyst (optional)</p> <p><i>Functional Specification for 4160 VAC 560 kW Gas Turbine Designed by EPSI and Gas Technology Institute 1700 South Mount Prospect Road Des Plaines, IL 60018-1804</i></p> |
| <p><b>Estimated Equipment Costs</b></p> <p style="text-align: right;">(\$1,750,000) USD/yr</p>  | <p><b>Estimated Equipment Cost</b></p> <p style="text-align: right;">(\$1,723,000) USD</p>   |
| <p>Installation (est. 30% of equipment)</p> <p style="text-align: right;">(\$525,000) USD</p>   | <p><b>Estimated Project Costs</b></p> <p>Installation (est. 30% of equipment) (\$516,900) USD<br/>Const. Mgmt., Subcontractors and Suppliers<br/>Engineering, Civil, Mechanical, and Electrical<br/>Heat utilization<br/>VOC Concentrator   HRSG (\$1,500,000) USD</p>   |
| <p><b>Estimated Capital Equipment Costs</b></p> <p style="text-align: right;">(\$2,275,000) USD</p>   | <p><b>Estimated Capital Equipment Costs</b></p> <p style="text-align: right;">(\$3,489,900) USD<br/><i>(Rebate of \$250,000 subtracted from the cost)</i></p>  |
| <p><b>Year Zero Avoided Costs</b></p> <p style="text-align: right;">\$2,275,000 USD</p>   | <p><b>Adjusted First Year Costs</b></p> <p style="text-align: right;">(\$1,214,900) USD</p>  |



7. Cash Flow

|         | Equipment<br>Option 1 | VOCGEN Equip.<br>Option 2 |               |
|---------|-----------------------|---------------------------|---------------|
|         | Each year             | Each year                 | Difference    |
| Year 0  | (\$2,275,000)         | (\$3,489,900)             | (\$1,214,900) |
| Year 1  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 2  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 3  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 4  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 5  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 6  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 7  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 8  | (\$3,671,459)         | (\$1,953,111)             | \$1,718,348   |
| Year 9  | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 10 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 11 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 12 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 13 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 14 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 15 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 16 | (\$3,671,459)         | (\$1,953,111)             | \$1,718,348   |
| Year 17 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 18 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 19 | (\$1,396,459)         | (\$453,111)               | \$943,348     |
| Year 20 | (\$1,396,459)         | (\$453,111)               | \$943,348     |

Simple Payback 1.29 years

Potential savings over 20-years  
\$ 19,202,056

IRR 78%

Example

Discount Rate 10%  
Net Present Value \$6,678,689 USD



### Carbon Emissions Impact

| Emissions from Natural Gas                             |                                     | VOCGEN Natural Gas Emissions                           |   |
|--|-------------------------------------|--|---|
| <b>Equipment Option 1</b>                              |                                     |  |   |
| RTO - Regenerative Thermal Oxidizer (50) KCFM :        | 1,040 MT CO <sub>2</sub> / year     | Total usage  | 17,016,624 kWh/year                         |
| Other Equipment  | MT CO <sub>2</sub> / year           | Carbon emissions from natural gas                      | 0.185 kg CO <sub>2</sub> /kW                |
| CO <sub>2</sub> emissions                              | 1,040 MT CO <sub>2</sub> / year     | CO <sub>2</sub> emissions                              | 3,148,075 kg CO <sub>2</sub> /year          |
|  | 945,791 kg CO <sub>2</sub> / year   | Carbon equivalent                                      | 858,566 kg Carbon/year                      |
| Carbon equivalent                                      | 284 MT Carbon/year                  |  |   |
|  | 257,943 kg Carbon/year              |  |   |
| Emissions Avoided by On-Site Energy Generation         |                                     | VOCGEN VOC Emissions                                   |   |
|  |                                     |  |   |
| Grid supplied electricity avoided                      | 510 kW                              | Total usage  | 5,431,430 kWh/year                          |
|  | 4,443,120 kWh/year                  | Carbon emissions from natural gas                      | 0.185 kg CO <sub>2</sub> /kW                |
|  | 4,443 MWh/year                      | CO <sub>2</sub> emissions                              | 1,004,815 kg CO <sub>2</sub> /year          |
| Carbon emissions from grid electricity                 | 0.537 kg CO <sub>2</sub> / kW       | Carbon equivalent                                      | 274,040 kg Carbon/year                      |
| CO <sub>2</sub> emissions                              | 2,385,955 kg CO <sub>2</sub> / year |  |   |
| Carbon equivalent                                      | 650,715 kg Carbon/year              |  |   |
| Emissions Avoided by On-Site Heat Generation           |                                     | VOCGEN Electricity Generated                           |   |
|  |                                     |  |   |
| Natural gas usage avoided                              | 17,274,380 kWh/year                 | Total electricity generated                            | 510 kW                                      |
| Carbon emissions from natural gas                      | 0.185 kg CO <sub>2</sub> / kW       | Parasitic load   | 50 kW                                       |
| CO <sub>2</sub> emissions                              | 3,195,760 kg CO <sub>2</sub> / year | Theoretical - total electricity available              | 460 kW                                      |
| Carbon equivalent                                      | 871,571 kg Carbon/year              | Actual - total electrical available                    | 456 kW                                      |
|  |                                     |  | 3,976,418 kWh/year                          |
|  |                                     |  | 3,976 MWh/year                              |
|  |                                     |  | No carbon emissions (see natural gas above) |
| Estimated CO <sub>2</sub> emissions (Metric Tons - MT) |                                     | VOCGEN Heat Generated                                  |   |
|  | 6,527,507 kg CO <sub>2</sub> / year |  |   |
|  | 7,180 MT CO <sub>2</sub> / year     |  | 17,274,380 kWh/year                         |
|  |                                     |  | No carbon emissions (see natural gas above) |
| Estimated Carbon equivalent                            |                                     | Estimated CO <sub>2</sub> emissions (Metric Tons - MT) |   |
|  | 1,780,229 kg Carbon/year            |  | 4,152,890 kg CO <sub>2</sub> / year         |
|  | 1,958 MT Carbon/year                |  | 4,568 MT CO <sub>2</sub> / year             |
| Estimated Carbon equivalent                            |                                     | Estimated Carbon equivalent                            |   |
|  | 1,780,229 kg Carbon/year            |  | 1,132,606 kg Carbon/year                    |
|  | 1,958 MT Carbon/year                |  | 1,246 MT Carbon/year                        |
| Net Estimated Annual Savings                           |                                     | Net Estimated Annual Savings                           |   |
|  |                                     |  | 2,612 MT CO <sub>2</sub> / year             |
|  |                                     |  | 712 MT Carbon/year                          |

**VOCGEN CHP Project Feasibility  
Maintenance Schedule**



**Expanded Foam Manufacturing Company**

|         |   |             |
|---------|---|-------------|
| Prices: | US Energy Information Agency - Energy Prices for June, 2013 |             |
|         | Quarterly Service   | \$6,000.00  |
|         | Minor ASE8 engine rebuild                                   | \$70,000.00 |
|         | Major ASE8 engine rebuild                                   | \$85,000.00 |

|         |                                     | <b>Total</b>          |
|---------|-------------------------------------|-----------------------|
| Year 1  | Quarterly Service                   | (\$24,000.00)         |
| Year 2  | Quarterly Service                   | (\$24,000.00)         |
| Year 3  | Quarterly Service and minor rebuild | (\$94,000.00)         |
| Year 4  | Quarterly Service                   | (\$24,000.00)         |
| Year 5  | Quarterly Service                   | (\$24,000.00)         |
| Year 6  | Quarterly Service and major rebuild | (\$109,000.00)        |
| Year 7  | Quarterly Service                   | (\$24,000.00)         |
| Year 8  | Quarterly Service                   | (\$24,000.00)         |
| Year 9  | Quarterly Service and minor rebuild | (\$94,000.00)         |
| Year 10 | Quarterly Service                   | (\$24,000.00)         |
| Year 11 | Quarterly Service                   | (\$24,000.00)         |
| Year 12 | Quarterly Service and major rebuild | (\$109,000.00)        |
| Year 13 | Quarterly Service                   | (\$24,000.00)         |
| Year 14 | Quarterly Service                   | (\$24,000.00)         |
| Year 15 | Quarterly Service and minor rebuild | (\$94,000.00)         |
| Year 16 | Quarterly Service                   | (\$24,000.00)         |
| Year 17 | Quarterly Service                   | (\$24,000.00)         |
| Year 18 | Quarterly Service and major rebuild | (\$109,000.00)        |
| Year 19 | Quarterly Service                   | (\$24,000.00)         |
| Year 20 | Quarterly Service                   | (\$24,000.00)         |
|         | <b>Total over 20-years</b>          | <b>(\$945,000.00)</b> |
|         | Yearly cost                         | (\$47,250.00)         |
|         | Monthly cost                        | (\$3,937.50)          |

**Assumptions and Notes**

|  | Energy    |                |              | Maintenance (k\$) | Annual O&M (\$k) | Capital (k\$) | Annual CO2 Emissions (MT) | Annual Carbon Emissions (MT) |
|--|-----------|----------------|--------------|-------------------|------------------|---------------|---------------------------|------------------------------|
|  | Gas (k\$) | Electric (k\$) | Credit (k\$) |                   |                  |               |                           |                              |
| Thermal Oxidizer ( <i>TO</i> )             | (\$388)   | (\$95)         | \$16         | (\$25)            | (\$602)          | (\$2,275)     | 7,180                     | 1,958                        |
| TO Heat Recovery ( <i>HR</i> )             |           |                |              |                   |                  |               |                           |                              |
| VOCGEN Gas Turbine Oxidizer ( <i>GTO</i> ) | (\$406)   | \$0            | \$889        | (\$47)            | \$436            | (\$3,490)     | 4,568                     | 1,246                        |
| GTO Heat Recovery ( <i>HR</i> )            |           |                |              |                   |                  |               |                           |                              |

**Volatile Organic Compound: Pentane**

|  |   |  |
|--|---|--|
| <b>Total</b>   | 1,045,440 VOC lbs/year  | 50,000 CFM Airflow Total   |
| <b>Drying Exhaust Pentane</b>                        | 10-100 lbs/hr   | 5,000 CFM voc laden air from production plant and voc concentrator                             |
|  |   | 1,200 CFM ambient air flow   |
| Process air temp                                     | 75-100 deg F  |  |
| <b>Destruct Removal Efficiency (DRE) Requirement</b> |   | BACT   |
| <b>VOCGEN Gas Turbine Oxidizer (GTO)</b>             | ASE 8 Gas Turbine VOC   | 6,200 cfm inlet air at 75°F  |
| <b>GTO Recoverable Heat</b>                          | 60°F inlet air Temp   | Exhaust Gas Heat Content ≈6.22 MMBtu/Hr waste heat (<1000°F) for steam; fired to approx. 1300F |
| <b>Natural Gas Fuel</b>                              | 20,100 Btu/lb Lower Heating Value   |  |
| <b>Radiated heat:</b>                                | "radiated, conducted and convected" from the engine at continuous duty - 180,000 Btu/hr |  |

The amount of natural gas required to run the gas turbine is dependent on two process variables: 1) the load placed on the gas engine (kW demand), and 2) the energy content supplied by the VOC laden air stream.

The system's main function is to convert the energy provided primarily from a natural gas supply (and to a lesser extent, the energy provided by a volatile organic compound laden air stream) to produce 525 kW of electrical power at 480 VAC, three-phase, 60 Hz, destroy VOC waste streams, as well as produce approximately 6 MMBTU" recoverable heat. Inlet air combined with a concentration of a volatile organic compound (at a level below 50 % LEL), will be drawn in, compressed and heated in a secondary combustion chamber, then introduced into a primary combustion chamber with natural gas to fuel a combustion process which operates the gas turbine at a speed of 41,730 rpm. The mechanical rotation of the gas turbine drives an AC generator at a rate of 1,800 rpm via a gearbox.

**Maintenance Schedule:** Service checkup including replacing belts, filters and other consumables is required quarterly. Minor rebuild of the ASE8 engine every 2.5 years and major rebuild of the engine every 3 years.