Staff Report

RESOURCE RECOVERY GASIFICATION OPTIONS
&
ELECTRIC POWER SUPPLY OPTIONS

March 11, 2012

As you will recall, City staff has been working with two separate consulting firms to develop options regarding the possible gasification of Refuse Derived Fuel at the Resource Recovery Plant and the strategies for meeting our electric supply needs at the Power Plant during the next 25 years. It was critical that the two studies were performed at the same time as we plan for the future, because the operations of our Resource Recovery and Electric Power Plants are interdependent. Due to new regulations and a changing marketplace, the status quo operation of the Power and Resource Recovery Plants is not an option. Because of the importance of these two utilities to the quality of life of our citizens, these will be some of the most important decisions that an Ames City Council has been asked to make.

As you review the information that will be presented over the course of a number of meetings, it is important to consider the following questions before a final decision is made.

- Continuing Local Energy Independence
  How important is having the ability to locally generate power?

- Transforming Refuse To Power
  Do we still want to transform our refuse to an alternate fuel source (RDF) that produces electricity? If a decision is made to no longer produce, then difficult choices will have to be made about how waste will be disposed of in Story County.

- Making Decisions In An Uncertain World
  How comfortable is the City Council in selecting a future course of action in the face of a constantly evolving regulatory environment?

- Prioritizing Community Values
  How will the City Council prioritize the cost, environmental issues, and associated levels of risk in determining the preferred course of action? The ultimate direction might differ based on this prioritization.

- Charting Our Own Course
  How willing is the City Council to chart a course that is "uniquely" Ames, even if interests on the broader national stage disagree?

After reviewing the information provided by our two consultants to date, staff has concluded that there is no one ideal strategy that the Council might want to pursue. Reaching such a decision is very challenging because:

- The requirement to operate our boilers in order to burn RDF results in higher costs to our which often cannot take advantage of the lower cost energy available on the Grid.

- The uncertainty of the **costs** for both coal and natural gas makes it extremely difficult to quantify the future costs of the various options being considered.

- The uncertainty of future **environmental regulations** for both fuels makes it extremely difficult to quantify the future costs of the various options are being considered.

- The absence of proven technology to guarantee that the options being considered will work in our Power and Resource Recovery Plants.

NO ACTION EXPECTED AT WORKSHOP

The City Council should consider the March 11, 2012 workshop to be the first in what might turn out to be, at least, three meetings regarding this important topic. The workshop is designed to review a number of options that are being explored and introduce the complex issues that are involved with each option. No decisions by the City Council will be expected at this workshop! In fact, as late as this week a new federal rule has caused the consultant to analyze an additional option that will not be completed by March 11th.

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The following two sections are meant to summarize the work done by our two consulting firms to date.

HDR STUDY – GASIFICATION OPTIONS FOR REFUSE DERIVED FUEL

BACKGROUND:

Ames and the surrounding communities of Story County currently produce approximately 56,000 tons of municipal solid waste (MSW) per year, 200 tons per day (TPD) on average. The Resource Recovery Plant (RRP) recycles and diverts from landfills over 70%, of the entire waste stream. About 67% of the MSW is processed into refuse-derived fuel (RDF). RDF is co-combusted in either of the two coal fired boilers, Unit 7 or Unit 8 at the City's Electric Generation Plant.

In 2011, the retained the URS corporation to analyze alternative methods of processing RDF in the hope that new processes could improve the storage, handling, and negative impact on the Power Plant. The study identified gasification as the most feasible alternative to our current process. Gasification involves heating RDF in an oxygen-controlled environment to produce a combustible gas called syngas.

Gasification has been in use worldwide, with multiple feedstocks for years. **However, the gasification of municipal solid waste in North America is a newer and evolving technology and there is no operation in place that utilizes this technology.** Gasification would allow for additional diversion of current MSW destined to the landfill due to greater recovery rates, and would also eliminate power plant RDF ash disposal.

HDR's study is intended to determine costs for different configurations of gasification equipment that would be compatible with any option that could be selected as the result of the Energy Resource Option Study. Seven scenarios are analyzed. Of this group, the first two scenarios utilize co-firing within the Power Plant boilers. The next three utilize new, stand-alone

generation equipment. The last two evaluate build-out and operation of a mass burn to energy facility, which burns refuse without supplemental fuel.

The Seven Scenarios that were considered include:

Scenario 1: **Syngas into Coal–fired Boiler** – Gasification of RDF to produce syngas and inject the syngas as a supplemental fuel into each of the City's existing coal-fired boilers. Syngas conditioning would include cooling the syngas.

Scenario 2: **Syngas into Natural Gas–fired Boiler** – Gasification of RDF to produce syngas and inject the syngas as a supplemental fuel into each of the City's existing boilers, which in this scenario are presumed to have been converted to natural gas. Syngas conditioning would include cooling the syngas.

Scenario 3: Syngas into Natural Gas–fired Combustion Turbine Generator Set – Gasification of RDF to produce syngas and inject the syngas as a supplemental fuel into a new combustion turbine generator set connected to the electrical distribution grid. Syngas conditioning would include cooling, acid gas removal, and particulate control.

Scenario 4: Syngas into Internal Combustion Engine Generator Set – Gasification of RDF to produce syngas and combust it in a dedicated internal combustion generator set connected to the electrical distribution grid. Syngas conditioning would include cooling, acid gas removal, and particulate control.

Scenario 5: Syngas into Package Boiler Generator Set – Gasification of RDF to produce syngas and combust it in a dedicated package boiler generator set connected to the electrical distribution grid. Direct combustion of the syngas will not require any conditioning.

Scenario 6A: **Mass Burn/Raw MSW-Electric Generation** – Retire RRP and construct a Mass Burn to Energy facility that would generate electricity using raw MSW**.**

Scenario 6B: Mass Burn/Shredded MSW-Electric Generation – Retire RRP and construct a Mass Burn to Energy facility that would generate electricity using shredded MSW.

Equipment was sized to facilitate operations well into the future to accommodate the growth of the community. Daily throughput would be 300 tons per day. As laid out in the study, a 100% redundancy has been included in the cost analyses due to the evolving technologies being proposed. Overall project cost could be reduced if complete redundancy is not desired.

Avoided costs are included as separate line items as they relate to the individual entities for each scenario. **However, it is important to note that it is assumed that the avoided costs identified in the study are not be used to reduce the O & M costs in the existing utilities, but instead are designated as a continuing contribution to the new gasification operation.**

The following table reflects the seven options, or scenarios, that were examined. **Capital Expense** (CAP EX) for Scenario 1 through Scenario 5 relates to 300 tons per day redundant systems, or a total of 600 ton per day maximum capacity. **Debt Service** covers CAP EX not Operations & Maintenance (O&M). **O&M** is the first year cost for Operations & Maintenance and recurs annually. Revenues are produced the sale of the syngas that is generated to the Electric Plant or some other entity yet to be identified. **Avoided costs** are savings realized by

individual department budget for that scenario. **Net Revenue/Expense** (Net Rev/Exp) is the anticipated annual subsidy required for the next 20 years to responsibly dispose of municipal solid waste in Story County Iowa. The last four columns show two options to cover these net expenses. The **All Per Capita** column reflects if the entire shortfall was covered by the per capita for all of the Net Rev/Exp, and the increase percentage column shows the increase of the per capita. The **All Tip Fee** column reflects if the entire shortfall was covered by the Tipping fee for all of the Net Rev/Exp, and the increase percentage column shows the increase of the tipping fee.

CONCLUSION:

As reflected in the following table, the seven options would require a capital investment between $34.5 million to $85.3 million and yield an annual "loss" of anywhere from $3.2 million to $6.2 million, even after contributing the avoided cost back to the annual O & M requirement for the gasification process.

In order to assure that revenues are sufficient to cover expenditures for any of the seven options one of the following strategies must be implemented:

- The annual Per Capita subsidy (property tax support) would have to be increased from the current rate of $9.10 to $43.73 ($3.1 million) up to $111.48 ($9.2 million); or

- The Tipping Fee to garbage haulers would have to increase from the current rate of $52.75 per ton to $105.65 per ton up to $209.18 per ton; or

- Any combination of the above.

Given the extreme costs associated with any of the proposed scenarios related to gasifying our RDF and the lack of proven technology to process municipal solid waste, it is difficult to justify pursuing the gasification option at this time. However, staff will continue to research the possibility of a smaller, prototype facility to prove its viability.

HDR Data Overview Initial Year Operating Projection

Method of Combustion	Reference HDR Page #	Year Operational	FTE	Capital Expense	Debt Service	Operating & Maintenance	Revenue	Avoided Cost	Net Rev/Exp	All Per Capita	Increase Percentage	All Tip Fee	Increase Percentage
Current Per Capita $9.10 and Current Tipping Fee $52.75													
Utilize Power Plant Boilers													
SC 1	SYNGAS/COAL-FIRED BOILERS	8, 15, 20, 27, 30, 39, 44, 45	2017	11.5	$34,500,000	$3,936,000	$3,696,000	$1,102,000	$4,434,000	($3,198,000)	44.63$	490%	107.05$	203%
SC 2	SYNGAS/NATURAL GAS-FIRED BOILERS	9, 16, 21, 27, 30, 39, 44, 45	2017	11.5	$33,800,000	$3,855,000	$3,696,000	$1,102,000	$4,434,000	($3,116,000)	43.72$	480%	105.65$	200%
New RRP Electrical Generation													
SC 3	SYNGAS/NATURAL GAS-FIRED TURBINE GENERATOR SET	10, 16, 22, 28, 32, 41, 44, 45	2017	16.5	$59,200,000	$6,981,000	$4,970,000	$1,404,000	$7,414,000	($5,053,000)	65.24$	717%	138.54$	263%
SC 4	SYNGAS/INTERNAL COMBUSTION GENERATOR SET	11, 16, 23, 28, 33, 41, 44, 45	2017	16.5	$77,300,000	$9,115,000	$4,730,000	$1,277,000	$7,287,000	($7,048,000)	87.41$	961%	172.41$	327%
SC 5	SYNGAS/DEDICATED PACKAGE BOILER AND GENERATOR	12, 16, 24, 29, 34, 41, 44, 45	2017	28.5	$79,100,000	$9,650,000	$6,090,000	$1,151,000	$7,161,000	($9,214,000)	111.48$	1225%	209.18$	397%
Replace RRP with New Mass Burn Facility													
SC6A	MASS BURN ELECTRIC GENERATION (RAW MSW)	13, 17, 25, 29, 34, 42, 44, 46	2019	37	$80,500,000	$9,381,000	$7,110,000	$6,650,000	$12,100,000	($5,443,000)	69.58$	765%	139.15$	264%
SC6B	MASS BURN ELECTRIC GENERATION (SHREDDED MSW)	13, 17, 26, 29, 37, 42, 44, 46	2019	38.5	$85,300,000	$9,940,000	$7,340,000	$6,618,000	$12,068,000	($6,298,000)	79.08$	869%	152.72$	290%
Retool Unit 7 to improve co-firing of RDF													

Electric Services to cover

The above table compares the seven different scenarios. Each scenario includes the initial capital expense along with the anticipated yearly operating and maintenance budget for the gasifier. As noted each scenario would require additional funding such as increasing the per capita rate and/or raising the per ton tipping fee. The table above shows the increase in the "All Per Capita" column if 100% of the shortfall was covered by per capita and no change to the tipping fee. The "All Tip Fee" column shows the effect if 100% of the shortfall was covered by the tipping fee and no change was made to the per capita. The final changes would probably be a combination of the two and not be covered by just one.

Gasification has been in use worldwide, with multiple feedstocks for years; however, the gasification of municipal solid waste in North America is a newer and evolving technology.

BLACK AND VEATCH STUDY – ENERGY RESOURCE OPTIONS

BACKGROUND:

The Energy Resource Options Study assesses the electric generating and power supply options to satisfy the City of Ames' future electrical power requirements over the next 25 years. This study takes into consideration the following three important issues:

- The Environmental Protection Agency (EPA) in the last few years has developed new environmental rules that are in various stages of adoption. The two recent environmental regulations with the most impact on the City of Ames generation are the MATS and CSAPR (temporarily vacated). The MATS rule imposes emission limitations on mercury, acid gases and other hazardous air pollutants that are emitted from coal fired steam units. By April 16, 2015 the City of Ames must comply with these rules, with the options of one or two year extensions.

- In recent years, the price of natural gas has decreased, and the ability to extract more from the ground has increased. However, the increase in gas is due to a controversial method of "fracking" which could have negative environmental impacts. Natural gas has become the most widely used fuel for new generation as well have for "fuel switching" in existing coal-fired boilers.

- Since 1975, municipal solid waste from the City and the majority of the other municipalities in Story County is processed into refuse-derived fuel (RDF) and co-fired in our two coal units. If the coal units are unable to co-fire RDF, the City will need to find alternatives for disposing of its MSW.

In its Request for Proposal, Electric Services outlined 3 alternatives for Unit #7 and Unit #8 – Coal Retrofit, Natural Gas Conversion, and Retire w/new generation. The combination of these alternatives ultimately led to 16 distinct options. Black & Veatch, our selected consultant, was able to demonstrate a study methodology which carried four options forward for further technical analysis. Another, (the retirement option) was analyzed during Phase 3.

The five options include:

Option 1 – Operate #8 on Coal
Operate #7 on Coal (minimum operation)

Option 2 – Operate #8 on Coal
Convert #7 to Natural Gas

Option 3 – Convert #8 to Natural Gas
Convert #7 to Natural Gas

Option 4 – Operate #8 on Coal
Operate #7 on Coal

Option 5 – Retire #8 & #7
Install new Combustion Turbine(s)

The Energy Resource Options study was executed in three phases.

Phase 1 – Analyzed the environmental regulations proposed and identified the MATS and the CSAPR as the two primary regulatory drivers impacting the City. Screened potential energy resource plans to arrive at a short list of options to meet those regulations.

Phase 2 – Developed cost, performance and emission estimates for units #7 and #8. Two options were considered for each; one using coal as a fuel and one using natural gas as a fuel. The options reflect inclusion of all equipment and systems required for CSAPR and MATS compliance. (CSAPR compliance can also be met through a "Cap & Trade" program which was studied in Phase 3.)

Phase 3 – Ran an economic comparison of the options develop in Phase 2 together with a new option of retiring the units and installing new combustion turbine generators. *Strategist*, an optimum generation expansion model, was used to select the least-cost combination of generating resources subject to environmental and transmission constraints. Forecasts of electric load growth, electric energy market prices in the Midwest, delivered fuel prices, and emission allowance market prices were used in the economic compassion of options. In addition, alternative forecasts of key market inputs were used to check sensitivity of the base case comparisons.

FINDINGS:
As reflected in Table 1, **if the City is to continue to co-fire RDF, the least-cost plan is to continue operating Unit #8 on coal, which will require the addition of emissions control systems.** This scenario will include:

- The initial investment requirement for this plan is estimated to be $29.9 million.

- The addition of dry sorbent injection and powdered activated carbon injection, and make the required changes to the unit #8 electrostatic precipitator to comply with the emission limits contained in MATS.

- The purchase NOx allowances as a lower cost option than installing equipment to meet CSAPR.

- The level of emissions control equipment investment on Unit #7 is dependent on our choice to maintain the unit for electric generating capacity or to burn RDF when Unit #8 is off line.

Table 1 **CONTINUING TO BURN RDF AT POWER PLANT**

Description of the Option	Initial Capital Investment	Present Value Fixed & Variable Costs 2012-2037
Status Quo (for comparison purposes only)		$832,000,000
Option 1 - Unit #8 on Coal Minimum cost Unit 7 on Coal (minimum use of Unit #7 only when Unit #8 is not available)	$22,049,000 $7,820,000 **$29,869,000**	$1,290,000,000
Option 2 - Unit 8 on Coal Unit 7 on Natural Gas	$22,049,000 $37,920,000 **$59,969,000**	$1,308,000,000
Option 3 - Unit 8 on Natural Gas Unit 7 on Natural Gas	$34,990,000 $16,540,000 **$51,530,000**	$1,309,000,000
Option 4 - Unit 8 on Coal Unit 7 on Coal	$22,049,000 $15,054,000 **$37,103,000**	$1,302,000,000

As reflected in Table 2, **if the City opts to discontinue co-firing RDF in our Power Plant boilers, the least-cost plan would include converting both Units #7 and #8 to burn natural gas.** This scenario will include:

- The initial investment requirement for this plan is estimated at $51.5 million.

Table 2 **DISCONTINUE BURNING RDF IN POWER PLANT BOILERS**

Description of the Option	**Initial Capital Investment**	**Present Value Fixed & Variable Costs 2012-2037**
Option 1 - Unit #8 on Coal Minimum cost Unit 7 on Coal (minimum use of Unit #7 only when Unit #8 is not available)	$22,049,000 $7,820,000 **$29,869,000**	$1,077,000,000
Option 2 - Unit 8 on Coal Unit 7 on Natural Gas	$22,049,000 $37,920,000 **$59,969,000**	$1,077,000,000
Option 3 - Unit 8 on Natural Gas Unit 7 on Natural Gas	$34,990,000 $16,540,000 **$51,530,000**	$1,049,000,000
Option 5 -Retire Unit 7 & 8 New Combustion Turbines (100MW)	**$138,000,000**	$1,104,000,000

To test the robustness of the results, the consultant hypothesized plausible forecasts of alternative future conditions that might change the results above. The alternative assumptions represent tests of the sensitivity of the option ranking. The sensitivity cases included:

- The presence of no future mandated CO2 control program, eliminating CO2 prices and reducing the forecast of future energy market prices.

- 20 percent higher natural gas prices.

Table 3 considered no CO2 or higher natural gas prices if the City continues to burn RDF. Table 4 considered no CO2 or higher natural gas prices if RDF is not burned in the plant. As you can see from these tables, the low cost options did not change even when the other variables are introduced.

Table 3 **SENSITIVITY ANALYSIS IF CONTINUE TO BURN RDF**

Description of the Option	Present Value Fixed & Variable Costs 2012-2037	No CO2 Allowance Cost	20% Higher Natural Gas Cost
Option 1 - Unit #8 on Coal Minimum cost Unit 7 on Coal (minimum use of Unit #7 only when Unit #8 is not available)	$1,290,000,000	$949,000,000	$1,295,000,000
Option 3 - Unit 8 on Natural Gas Unit 7 on Natural Gas	$1,309,000,000	$1,055,000,000	$1,390,000,000

Table 4 **SENSITIVITY ANALYSIS IF NO BURNING OF RDF**

Description of the Option	Present Value Fixed & Variable Costs 2012-2037	No CO2 Allowance Cost	20% Higher Natural Gas Cost
Option 1 - Unit #8 on Coal Minimum cost Unit 7 on Coal (minimum use of Unit #7 only when Unit #8 is not available)	$1,077,000,000	$837,000,000	$1,079,000,000
Option 2 - Unit 8 on Coal Unit 7 on Natural Gas	$1,077,000,000	$838,000,000	$1,079,000,000
Option 3 - Unit 8 on Natural Gas Unit 7 on Natural Gas	$1,049,000,000	$813,000,000	$1,051,000,000

NEXT STEPS:

There is one issue which gives staff "pause" before it can make a recommendation – a new proposed EPA rule. In late February 2013, the EPA came out with a new proposed rule which looks to add environmental limits during operating events such as "startup", "shut down" and "malfunction" of boilers. Today, power plants in 39 states are exempt from such limits. Staff and the consultant are reviewing what impact this could have on the proposed equipment needed to retrofit Unit #8 and Unit #7 to continue to burn coal, and will likely change the recommended equipment if the rule goes into effect as written. Staff will present a new "Option 6" at a future Council meeting. This option will no doubt be the most costly of those we are considering.

Gasification Financial Modeling

February 6, 2013

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1.0 EXECUTIVE SUMMARY

Since 1975 the City of Ames (City) has utilized a refuse derived fuel (RDF) process at its Arnold O. Chantland Resource Recovery Plant (RRP) to process municipal solid waste (MSW) from the City and the surrounding Story County to produce and maximize the amount of RDF used in the City's Electric Generating Plant (EGP). The EGP currently co-combusts the RDF product in either of two coal fired boilers, Unit 7 or Unit 8.

The annual amount of MSW received at the RRP is approximately 56,000 tons or about 200 tons per day. Of the amount received, approximately 8% is bypass waste or non-processible waste directed to the landfill. From the remaining 52,000 tons per year (tpy) processed by the RRP, an average of 4.3% is recovery of ferrous metals and non-ferrous, an average of 67% becomes RDF utilized by the EGP, and the remainder is landfilled. Without the RRP, all of the MSW would have to be landfilled.

The City has previously studied alternatives for producing syngas from the RDF and utilizing the syngas in the coal-fired units rather than directly using the RDF. In this report, financial evaluations have been developed for the following scenarios. Scenarios 1 through 5 include gasification of RDF to produce syngas and treatment of the syngas required for the firing equipment. Availability to process MSW and the reliable operation of the RRP are critical to the gasification financial models. Scenarios 6a and 6b are mass burn waste-to-energy facilities. Section 3 contains more detailed descriptions of all the scenarios. Per the City's direction, all of the systems were sized to accommodate 300 tons per day (tpd) of RDF or MSW. Due to the nature of the evolving technologies, in Scenarios 1 through 5, the gasification units were modeled with redundancy to facilitate a more reliable system; total capacity could approach 600 tpd if both gasification units were in operation at the same time and if auxiliary and power generation equipment were sized for the increased capacity.

- Scenario 1 consists of gasification of RDF and combustion of the syngas in the City's existing coal-fired boilers. Syngas conditioning would include cooling the syngas.
- Scenario 2 consists of gasification of RDF to produce syngas and inject the syngas as a supplemental fuel into each of the City's existing boilers which are presumed in this scenario to have been converted to natural gas-fired. Syngas conditioning would include cooling the syngas.
- Scenario 3 considers gasification of RDF to produce syngas and inject syngas as a supplemental fuel in a natural gas-fired combustion turbine generator set connected to electrical distribution grid. Syngas conditioning will include cooling, acid gas removal and particulate control.

- Scenario 4 includes gasification of RDF to produce syngas and combustion of syngas in a dedicated internal combustion generator set connected to electrical distribution grid. Syngas conditioning will include cooling, acid gas removal and particulate control.
- Scenario 5 consists of gasification of RDF to produce syngas and combustion of syngas in a dedicated package boiler with associated generator set connected to electrical distribution grid. Owing to the direct combustion of the syngas, no conditioning equipment will be required.
- Scenario 6a considers construction and operation of a mass burn electrical generation plant using raw MSW.
- Scenario 6b considers construction and operation of a mass burn electrical generation plant using shredded MSW.

The potential permitting requirements for each of the scenarios are described in Section 4 of this report. Based on the current plan to develop the gasification system at their existing EGP site by the coal yard, the City would not qualify for the small power production facility exemption when combined with EGP output (total facility capacity must be less than 80 MW). Scenarios 1 through 5 will provide syngas for electrical generation varying from approximately 4 MW to 8 MW depending upon RDF gasification up to 300 tpd. If at some point in the future the existing coal fired plant ceased operation and no other electric generation on the site, development begun at that time may be eligible for the exemption. All scenarios will require construction permits from IDNR. Scenarios 1 and 2 are not expected to trigger the Prevention of Significant Deterioration (PSD) preconstruction permitting program; applicability of PSD to Scenarios 3, 4 and 5 is unknown at this point; and Scenarios 6a and 6b are anticipated to trigger PSD review and require installation of advanced pollution control equipment.

While the HDR scope of work does not include evaluation of greenhouse gases (GHG), Section 4.6 offers a brief discussion of GHGs on the various scenarios. GHGs such as CO2 are not currently a regulated pollutant, but may become regulated in the future. Electrical generating facilities that utilize wastes achieve GHG emission reductions primarily through four processes, one of which is avoidance of CO2 emissions from fossil fuel fired power plants on the local grid resulting from the energy-from-waste facility generating renewable electrical power or steam. However, it is unknown whether the full value of CO2 emission offsets will be allowed for the projects since the City has combusted RDF for energy recovery since 1975.

The probable capital costs for each scenario are summarized in Section 5 with estimate details provided in Appendix A. Table E-1 below presents the probable capital costs (in 2012$) for each scenario. For the “Base Case” financial analyses, the scenario capital costs were escalated from an assumed notice to proceed date (January 1, 2013 in the analyses) by a reasonable number of months for siting/local approval and planning/permitting/design with project

financing assumed to be tax-exempt revenue bonds. The financing assumptions for the Base Case are described in Section 8 and the revenue bond sizing runs are included in Appendix D.

TABLE E-1

Summary of Capital, Operating & Maintenance Costs[1]
Present Value (2012$)

Scenarios	Tonnage Throughput[2] TPY	TPD[3]	Capital Cost[4] (2012$)	Annual Net Debt Service	Annual O&M[5] (2012$)
Gasification Systems					
1	46,000	148	$34,500,000	$3,940,000	$3,350,000
2	46,000	148	$33,800,000	$3,860,000	$3,350,000
3	46,000	148	$59,200,000	$6,980,000	$4,970,000
4	46,000	148	$77,300,000	$9,120,000	$4,730,000
5	46,000	148	$79,100,000	$9,650,000	$6,090,000
Mass-Burn Facilities					
6a	63,000	203	$80,500,000	$9,380,000	$7,110,000
6b	63,000	203	$85,300,000	$9,940,000	$7,340,000

Notes:
1. Cost estimates are conceptual and thus annual costs rounded to nearest $10,000.
2. Tonnage throughput corresponds to projected first year of facility operations; RDF for the Gasification Systems; MSW and yard waste for the Mass Burn Facilities.
3. Tons per day assume system availability of 85% (310 processing days per year).
4. Probable Capital Costs include permitting, design/engineering, construction and 20% contingency.
5. Present Value of first year operating expenses, assuming discount of 2% per annum.

Due to the scarcity of MSW gasification operating facilities, the operating and maintenance cost estimates for Scenarios 1 to 5 are based on limited data and relies on limited information obtained from proposals (different feedstocks and/or larger facility sizes) and HDR's knowledge and experience with mass burn waste-to-energy facilities and the power industry. Section 7 describes the operating and maintenance cost assumptions for each scenario along with quantities inputs, energy revenues, and avoided costs assumptions. First year operating costs and revenue projections for each scenario are provided in Section 8. Detailed operating assumptions and inputs are contained in Appendix B for the gasification system scenarios and Appendix C for the mass burn facilities. Table E-1 above includes the first year annual operating and maintenance cost estimates for each scenario considered, converted to present value (2012$) for comparison purposes. Section 9 further discusses the comparison of results.

The energy revenues for each scenario are based on the performance estimates described in Section 6 and shown in Tables E-2 and E-3 below. Due to the scarcity of operating facilities, the performance estimates for options other than 6a and 6b are based on very limited data. The energy content of the syngas represents approximately 65% of the energy in the RDF.

TABLE E-2

Scenarios 1 - 5 Gasification Systems
Summary of Avoided Costs, Energy Revenues, and Required System Revenues[1]
Present Value (2012$)

Scenarios	Net Energy Generation		Avoided Costs[2] (2012$)	Annual Energy Revenues[3] (2012$)	Net Revenues/(Expenses)[4] (2012$)	
	Syngas MMBtu/ ton RDF	kWh/ ton RDF			Net w/out Avoided Costs	Net w/ RRP & EGP Avoided Costs
1	6.7		$3,080,000	$1,050,000	($6,210,000)	($3,040,000)
2	6.7		$3,080,000	$1,050,000	($6,140,000)	($2,960,000)
3		431	$5,920,000	$1,340,000	($10,530,000)	($4,810,000)
4		555	$5,920,000	$1,220,000	($12,420,000)	($6,710,000)
5		500	$5,920,000	$1,100,000	($14,490,000)	($8,770,000)

Notes:
1. Cost estimates are conceptual and thus costs/revenues rounded to nearest $10,000.
2. Avoided Costs based on City provided data and includes avoided RRP and EGP costs.
3. Energy revenues assume value of Syngas at $3.568/MMBtu and electric revenue rate at $0.05/kWh.
4. The net expenses are the additional revenues required to break even; present value of first year net operations.

The business case analyses (20-year pro formas) are based on the assumptions described in this report and further detailed in the scenario assumptions and pro forma modeling (Appendix B and C). Section 8 provides detailed summaries of estimated first year operating revenues and expenses for each scenario. The gasification and mass-burn scenarios were then compared based on the net revenues/(expenses) with and without the selected EGP avoided costs.

Table E-2 above presents the avoided costs, energy revenues and required system revenues with and without RRP/EGP avoided costs (in 2012$) for the gasification system Scenarios 1 to 5. All scenarios show that additional revenues are required annually to fund the Gasification System. The pro formas show Scenario 2, syngas co-fired with natural gas in the City's existing boilers, as the least cost option for RDF gasification.

Table E-3 below presents the avoided costs, energy revenues, tipping fee revenue, per capita revenue, and additional required system revenues with and without avoided costs (in 2012$) for the mass-burn facilities Scenarios 6a to 6b. Under Scenarios 6a or 6b, the RRP would cease to operate and be replaced with the mass burn facility. Based on net expenses in the table below, the calculated additional tipping fee required for the Scenario 6a mass burn waste-to-energy facility could range from $83 to $167 per ton assuming 61,000 tons (in 2012) of waste deliveries to the facility (includes yard waste). Supplemental waste deliveries, additional per capita assessments, and/or higher energy revenues would lower this required additional, calculated per ton tip fee. The City's current tipping fee at the RDF facility is $52.75 per ton and the Boone County Landfill out-of-county tip fee is $44.50 per ton plus hauling costs.

TABLE E-3

Scenarios 6a and 6b - Mass Burn Facilities
Summary of Avoided Costs, Revenues, and Additional Required System Revenues[1]
Present Value (2012$)

Scenarios	Net Energy Generation		Avoided Costs[3] (2012$)	Annual Energy Revenues[4] (2012$)	Tip Fee & Per Capita Revenues[5] (2012$)	Add'l Net Revenues/(Expenses)[6]	
	Annual kWh/yr[2]	kWh/ ton MSW				Net w/out Avoided Costs	Net w/ Avoided Costs
6a	35,280,000	600	$5,410,000	$1,760,000	$4,040,000	($10,160,000)	($5,080,000)
6b	34,692,000	590	$5,410,000	$1,730,000	$4,040,000	($10,960,000)	($5,870,000)

Notes:

1. Cost estimates are conceptual and thus costs/revenues rounded to nearest $10,000.
2. Annual shown based on 2012 projected tonnage; will vary annually depending upon waste combusted.
3. Avoided Costs based on City provided data and includes avoided yard waste management and EGP costs.
4. Energy Revenues assume $0.05/kWh. Potential value of electric capacity not included.
5. Tip Fee & Per Capita Revenues assume current RRP $52.75/ton on 2012 tonnages and $9.10 per capita.
6. The net expenses are the additional tipping fee revenues required to break even.
   Present Value of first year net expenses (required add'l revenues), assuming discount of 1% per annum.

2.0 INTRODUCTION

The City of Ames (City) operates municipal utilities which include power generation and distribution. Since 1975 the City has utilized a refuse derived fuel (RDF) process at its Arnold O. Chantland Resource Recovery Plant (RRP). The Municipal Solid Waste (MSW) received for processing by the RRP comes from all of Story County. The annual amount of MSW received at the RRP is approximately 56,000 tons; with about 4,000 to 5,000 tons bypass waste or non-processible waste directed to the landfill. From the remaining approximately 52,000 tons, an average of 67 percent is processed into RDF. The RDF is burned in conjunction with pulverized coal in electric-generating boilers at an approximately 10/90 percent ratio respectively on heat value basis. The Electric Generating Plant (EGP) handles the RDF product in either of two coal fired boilers, Unit 7 or Unit 8.

The City of Ames' Arnold O. Chantland Resource Recovery Plant was built in 1975 to process MSW from the City and the surrounding Story County and produce as much RDF as possible for use in the Electric Generating Plant. Without the RRP, the MSW would have to be landfilled. Typically, of the total MSW received at the RRP (includes direct bypass and non-processible wastes), approximately 66 percent is used as electric generating fuel or recovered and recycled (i.e., metals), while only about 34 percent is landfilled.

As with any MSW facility a major portion of the facility's revenue is generated by tipping fees. Therefore, any time MSW cannot be processed at the facility and has to be diverted to the landfill it represents a financial loss to the plant and an increased environmental impact of the landfill. Availability to process MSW and the reliable operation of the RRP are critical to the RRP's gasification financial models.

MSW collected by independent haulers is delivered to the RRP between 6:00 a.m. and 3:30 p.m., Monday through Friday, and 8:00 a.m. and noon on Saturday. The material is typically processed into RDF between 9:00 p.m. and 11:00 a.m., four days per week, Sunday thru Thursday. Friday operations are from 7:00 a.m. until 3:00 p.m. On Saturday there is no scheduled processing unless required due to seasonal spikes in material flow or operational difficulties. The average quantity of MSW received is 200 tons per day; the quantity on Monday and Tuesday is greater than at the end of the week. The actual amount of daily RDF processing time depends on the availability of RRP equipment, currently exceeding 98% reliability over the past three years, and the availability of the EGP to use the RDF as fuel.

RDF produced by the RRP is conveyed pneumatically and stored in a bin located approximately 300 feet from the RRP and about halfway to the EGP. The storage bin acts as the operational buffer between the two facilities. RDF is transferred from the bin and delivered pneumatically to the boilers of the EGP.

The EGP houses two fossil-fired units. Unit 7 and Unit 8 were built in 1967 and 1982, respectively. Unit 7 has a nominal output capacity of 33 MW while Unit 8 is rated at 65 MW.

Unit 7 is a Combustion Engineering (now Alstom) tangentially fired subcritical boiler capable of operating on coal. Igniters and warm-up guns fire fuel oil. Unit 7 was modified to burn 20 percent RDF when the Resource Recovery Plant was built in 1975.

Unit 8 is a Babcock and Wilcox front-wall fired subcritical designed to fire western sub-bituminous coal and up to 20 percent RDF, by heat input. It also has oil igniters. The City also has a 29 MW simple-cycle gas turbine set. The Unit 8 boiler design capacity indicates that it can use approximately 20 percent of its fuel heat input as RDF. These percentages could be impacted by new greenhouse gas compliance and MATS rules, and perhaps CASPR too, pending EPA implementation (potentially 10%).

The City has previously studied alternatives for producing syngas from the RDF and utilizing the syngas in the coal-fired units rather than directly using the RDF (URS Study 2011). HDR was selected to perform a financial analysis of this gasification alternative and several others as described in Section 3.0 below. This report presents the results of the analysis. The report begins with an executive summary, followed by this introduction and is divided into the following sections:

- The Gasification Scenarios section describes the various scenarios that were evaluated.
- The Permitting Review section discusses applicable regulations and the likely impact of the regulations on the scenarios being considered.
- The Probable Capital Costs section presents the capital cost estimates, the basis for the estimates and certain limitations of the estimates.
- The Expected Performance section presents the expected performance of the scenarios and the basis upon which the analysis was developed.
- Operating and Maintenance Costs are presented in the section by that name together with a discussion of the estimates.
- The Business Case Analyses section presents the results of the Analyses together with the strengths, weaknesses, threats and opportunities associated with each scenario.
- The comparison of results section summarized the information presented in the other sections in a comparative format.

3.0 GASIFICATION SCENARIOS

The following are definitions of the scenarios for which the financial evaluations and business plans have been developed. The definitions were provided to the City for review and concurrence. The scenario descriptions have been edited to reflect the financial analysis that follows. All of the systems would be sized to accommodate 300 tons per day of MSW. Due to the nature of the evolving technologies, Scenarios 1 through 5 were modeled with redundancy to facilitate a more reliable system; total capacity could approach 600 tons per day if both gasification units were in operation at the same time.

3.1 Scenario 1 – Syngas/Coal-Fired Boilers

Scenario 1 consists of gasification of RDF and combustion of the syngas in the City's existing coal-fired boilers.

Waste will continue to be delivered to the RRP and processed into RDF. The processing system will be operated to deliver a larger percentage of the incoming waste to the gasification system, thus reducing the quantity of material delivered to the landfill. RDF will continue to be delivered to the storage bin and transferred from the storage bin for delivery to a new gasification system. The existing storage bins and blower system will be retained but piping will be provided to deliver the RDF to the metering bins of two full capacity gasifiers. Two full capacity gasifiers are provided to limit downtime inherent in use of evolving technologies.

The gasifiers will include air system, auxiliary fuel system, mechanical, electrical, controls and associated accessories. When developing the cost estimates, the quoted gasification equipment included limited ash and char handling equipment so the estimate provides for quenching and conveying bottom ash (char) to trucks for disposal.

Syngas conditioning includes cooling the gas to approximately 750°F to protect downstream equipment and compressing the gas to allow for proper operation of the burners and emergency dump equipment. The actual processes to be used and temperatures and pressures would be determined during design if this option were selected to move forward.

Scenario 1 is based on modifying the existing coal burners by adding a syngas gun to each burner. Each burner will be fitted with a stationary gas gun assembly which is designed for positioning flexibility in the secondary air annulus of the existing burner. The system will include a syngas burner with flame scanner in each coal fired burner. For each unit a main syngas header would be provided with a fuel flow meter, manual isolation valve, automatic safety shut off valve, flow control valve, vent valve, and safety switches as required by NFPA 85. The burner supplier would provide syngas firing burner management system (BMS) logic to be integrated into the existing BMS as part of the installation.

Syngas dump equipment interconnected with BMS will be provided. The dump equipment will consist of an enclosed ground flare.

The system would also require auxiliary cooling water, waste water system, fire protection, compressed air system, and service water system.

For the purpose of this analysis the gasification equipment will be assumed to be located near the RDF storage bin. If this scenario is selected for further consideration, locating the gasification equipment in the area presently occupied by Units 5 and 6 may prove to be of benefit. Within the capital cost opinion, this could create a savings of approximately $200,000 to $250,000 in piping reduction costs (Appendix A, Page A-3 of 22). Consideration of the demolition and asbestos abatement required for that location is beyond the scope of this study.

Syngas combustion, steam generation or power generation is not required other than for emergency syngas dump equipment described above. No electrical interconnection for export power is required.

3.2 Scenario 2 – Syngas/Natural Gas-Fired Boilers

Scenario 2 consists of gasification of RDF to produce syngas and inject syngas as a supplemental fuel into each of the City's natural gas-fired boilers. This analysis presumes that such natural gas boilers exist. The physical construction for this scenario will differ from Scenario 1 only to the extent that the burner modifications will be different.

Waste will continue to be delivered to the RRP and processed into RDF. The processing system will be operated to deliver a larger percentage of the incoming waste to the gasification system, thus reducing the quantity of material delivered to the landfill. RDF will continue to be delivered to the storage bin and transferred from the storage bin for delivery to a new gasification system. The existing storage bins and blower system will be retained but piping will be provided to deliver the RDF to the metering bins of two full capacity gasifiers. Two full capacity gasifiers are provided to limit downtime inherent in use of evolving technologies.

The gasifiers will include air system, auxiliary fuel system, mechanical, electrical, controls and associated accessories. When developing the cost estimates, the quoted gasification equipment included limited ash and char handling equipment so the estimate provides for quenching and conveying bottom ash (char) to trucks for disposal.

Syngas conditioning includes cooling the gas to approximately 750°F to protect downstream equipment and compressing the gas to allow for proper operation of the burners and emergency dump equipment. Syngas would need to be compressed to beyond the pressure of the natural gas supplied to the burners. The actual processes to be used and temperatures and pressures would be determined during design if this option were selected to move forward.

The estimate is based on modifying existing gas burners by supplementing the natural gas supplied to the burners with syngas. For each unit a main syngas header would be provided with a fuel flow meter, manual isolation valve, automatic safety shut off valve, flow control valve, vent valve, and safety switches as required by NFPA 85. The burner supplier would provide syngas firing burner management system (BMS) logic to be integrated into the existing BMS as part of the installation.

Syngas dump equipment interconnected with the BMS will be provided. The dump equipment will consist of an enclosed ground flare.

The system would also require auxiliary cooling water, waste water system, fire protection, compressed air system, and service water system.

For the purpose of this analysis the gasification equipment will be assumed to be located near the RDF storage bin. If this scenario is selected for further consideration, locating the gasification equipment in the area presently occupied by Units 5 and 6 may prove to be of benefit. Within the capital cost opinion, this could create a savings of approximately $200,000 to $250,000 in piping reduction costs (Appendix A, Page A-6 of 22). Consideration of the demolition and asbestos abatement required for that location is beyond the scope of this study.

Syngas combustion, steam generation or power generation is not required other than for emergency syngas dump equipment described above. No electrical interconnection for export power is required.

3.3 Scenario 3 – Syngas/Natural Gas-Fired Turbine Generator Set

Scenario 3 considers gasification of RDF to produce syngas and inject syngas as a supplemental fuel in a natural gas-fired combustion turbine generator set connected to the electrical distribution grid.

Waste will continue to be delivered to the Resource Recovery Plant (RRP) and processed into refuse derived fuel (RDF.) The processing system will be operated to deliver a larger percentage of the incoming waste to the gasification system, thus reducing the quantity of material delivered to the landfill. RDF will continue to be delivered to the storage bin and transferred from the storage bin for delivery to a new gasification system. The existing storage bins and blower system will be retained but piping will be provided to deliver the RDF to the metering bins of two full capacity gasifiers. Two full capacity gasifiers are provided to limit downtime inherent in use of evolving technologies.

The gasifiers will include air system, auxiliary fuel system, mechanical, electrical, controls and associated accessories. The quoted equipment included limited ash and char handling equipment so the estimate provides for quenching and conveying bottom ash and char to trucks for disposal.

Gas conditioning will include cooling, acid gas removal and particulate control. Gas compression equipment will be provided to compress both the natural gas and the syngas. Owing to the relatively low quality of the syngas, the syngas will be supplemented with natural gas.

Combustion turbine equipment includes two nominal 5 MW units similar to Siemens SGT-100. Thermal modeling software with an integral cost database was used in the analysis.

Syngas dump equipment interconnected with the combustion turbine controls will be provided. The dump equipment will consist of an enclosed ground flare.

For the purpose of this analysis the gasification equipment will be assumed to be located near the RDF storage bin. If this scenario is selected for further consideration, locating the gasification equipment in the area presently occupied by Units 5 and 6 may prove to be of benefit. Consideration of the demolition and asbestos abatement required for that location is beyond the scope of this study.

The electrical interconnection includes step up transformers and switchyard equipment.

3.4 Scenario 4 – Syngas/Internal Combustion Generator Set

Scenario 4 includes gasification of RDF to produce syngas and combustion of syngas in a dedicated internal combustion generator set connected to electrical distribution grid.

Waste will continue to be delivered to the Resource Recovery Plant (RRP) and processed into refuse derived fuel (RDF.) The processing system will be operated to deliver a larger percentage of the incoming waste to the gasification system, thus reducing the quantity of material delivered to the landfill. RDF will continue to be delivered to the storage bin and transferred from the storage bin for delivery to a new gasification system. The existing storage bins and blower system will be retained but piping will be provided to deliver the RDF to the metering bins of two full capacity gasifiers. Two full capacity gasifiers are provided to limit downtime inherent in use of evolving technologies.

The gasifiers will include air system, auxiliary fuel system, mechanical, electrical, controls and associated accessories. The quoted equipment included limited ash and char handling equipment so the estimate provides for quenching and conveying bottom ash and char to trucks for disposal.

Gas conditioning will include cooling, acid gas removal and particulate control. Gas compression/blower equipment will be provided to compress the syngas to the pressure required for operation of the engines.

The conceptual cost was developed based on six (one spare) nominal 1.9 MW Jenbacher JMS 620 engines.

Syngas dump equipment interconnected with the internal combustion generator set controls will be provided. The dump equipment will consist of an enclosed ground flare. If this alternative is

selected for further analysis, design may determine that a flare is not required owing to the reliability afforded by multiple internal combustion engines.

For the purpose of this analysis the gasification equipment will be assumed to be located near the RDF storage bin. If this scenario is selected for further consideration, locating the gasification equipment in the area presently occupied by Units 5 and 6 may prove to be of benefit. Consideration of the demolition and asbestos abatement required for that location is beyond the scope of this study.

The electrical interconnection includes step up transformers and switchyard equipment.

3.5 Scenario 5 – Syngas/Dedicated Package Boiler and Generator Set

Scenario 5 consists of gasification of RDF to produce syngas and combustion of syngas in a dedicated package boiler with associated generator set connected to electrical distribution grid.

Waste will continue to be delivered to the Resource Recovery Plant (RRP) and processed into refuse derived fuel (RDF.) The processing system will be operated to deliver a larger percentage of the incoming waste to the gasification system, thus reducing the quantity of material delivered to the landfill. RDF will continue to be delivered to the storage bin and transferred from the storage bin for delivery to a new gasification system. The existing storage bins and blower system will be retained but piping will be provided to deliver the RDF to the metering bins of two full capacity gasifiers. Two full capacity gasifiers are provided to limit downtime inherent in use of evolving technologies.

The gasifiers will include air system, auxiliary fuel system, mechanical, electrical, controls and associated accessories. The quoted equipment included limited ash and char handling equipment so the estimate provides for quenching and conveying bottom ash and char to trucks for disposal.

A thermal oxidizer followed by a waste heat boiler is used for this analysis. Air quality control system will include a wet electrostatic precipitator (WESP.)

Owing to the direct combustion of the syngas, no conditioning equipment or dump flare will be required.

Typical steam cycle equipment will include steam turbine generator and accessories, auxiliary cooling water system, condensate system, chemical feed, circulating water system, waste water system, water treatment, fire protection, feedwater system, compressed air system, service water system, steam piping, steam turbine, and emission control equipment. For the purposes of this analysis this equipment will be assumed to be located near the gasification equipment.

The electrical interconnection includes step up transformer and switchyard equipment.

3.6 Scenario 6a – Mass Burn Electric Generation (Raw MSW)

Scenario 6a considers construction and operation of a mass burn electrical generation plant using raw MSW.

The waste will be delivered directly to a storage pit sized for four days of storage. Overhead cranes will transfer the waste and feed it into hoppers of two refuse fired waterwall boilers. Steam produced in the boilers will be used to generate electricity.

Typical steam cycle equipment will include steam turbine generator and accessories, auxiliary cooling water system, condensate system, chemical feed, circulating water system, waste water system, water treatment, fire protection, feedwater system, compressed air system, service water system, steam piping, steam turbine, and emission control equipment. For the purposes of this analysis this equipment will be assumed to be located near the gasification equipment.

The electrical interconnection includes step up transformer and switchyard equipment.

The analysis assumes that the plant will be located on an unidentified undeveloped property.

3.7 Scenario 6b – Mass Burn Electric Generation (Shredded MSW)

Scenario 6b considers construction and operation of a mass burn electrical generation plant using shredded MSW. Scenario 6b is identical to 6a with the exception that shredding equipment is included.

4.0 PERMITTING REVIEW

The following is a discussion of the permitting requirements of the scenarios identified above. The business case analyses are based on the permitting requirements identified herein.

4.1 Introduction and Background

One question that arises is whether or not a RDF to syngas system constitutes a Municipal Waste Combustor (MWC) for regulatory purposes. 40 CFR Part 60, Subpart Eb (new, large unit MWC rule) defines a number of key terms, as follows:

> "*Municipal waste combustor, MWC,* or *municipal waste combustor unit:* (1) Means any setting or equipment that combusts solid, liquid, or gasified municipal solid waste including, but not limited to … pyrolysis/combustion units."
>
> "*Municipal solid waste* or *municipal-type solid waste* or *MSW* means household, commercial/retail, and/or institutional waste. … Household, commercial/retail, and institutional wastes include … Refuse-derived fuel …"
>
> "*Pyrolysis/combustion unit* means a unit that produces gases, liquids, or solids through the heating of municipal solid waste, and the gases, liquids, or solids produced are combusted and emissions vented to the atmosphere."

In a March 30, 2010 policy memo, EPA found that a gasification system proposed in Nevada (Fulcrum Energy) is not a MWC. Although this memo at first seems favorable, close review of the memo reveals the following:

- EPA found that the gasification process itself (i.e., just the part of the process where the waste is gasified) is neither combustion nor pyrolysis in and of itself. This determination was made because it allows EPA to say that the portion of the Fulcrum Energy system that produces syngas that goes to ethanol production (i.e., that is not combusted) is not a MWC.
- A portion of the Fulcrum syngas is to be sent to a combustion turbine to generate electricity. In this case, EPA did not say that this part of the process was neither combustion nor pyrolysis. Instead they found that the syngas is a homogeneous waste and that based on the capacity of the facility, it could qualify for either the small power production facility exemption or the small cogeneration facility exemption. This interpretation implies that the Fulcrum syngas system/combustion turbine combination is a pyrolysis/combustion unit and so is a MWC, but that they are exempt from rule applicability as a small power or cogeneration facility.
- EPA determined that the project flare is a control device and not a MWC.

Based on the current plan to develop the gasification system at their existing facility, the City would not qualify for the small power production facility exemption (total facility capacity must be less than 80 MW). They would also not be eligible for the cogeneration exemption because the facility is primarily engaged in the generation or sale of electrical power. If at some point in the future the existing coal fired plant ceased operation, development begun at that time may be eligible for the exemption.

As a final note, a 600 tpd gasification facility permitted in 2010 in St. Lucie County, Florida, was classified as a MWC. That facility was designed to combust the syngas in a multistage thermal oxidizer after which the exhaust gas would pass through a heat recovery steam generator (HRSG) to produce steam that would drive a steam turbine to produce electricity. The St. Lucie facility sets a precedent for gasification systems that will be hard to overcome, regardless of the combustion device (i.e., boiler, turbine, IC engine, etc.) in which the syngas is ultimately combusted. The permitted facility design included a hot side electrostatic precipitator (ESP), selective catalytic reduction (SCR), flue gas desulfurization (FGD), powdered activated carbon (PAC) injection, and a fabric filter baghouse. The control equipment was used to meet the requirements of Subpart Eb, as well as to avoid the applicability of the Prevention of Significant Deterioration (PSD) preconstruction permitting requirements.

4.2 Scenario 1

Scenario 1 involves gasification of RDF to produce combustion-ready syngas and inject syngas as a supplemental fuel into each of the City's current coal-fired boilers.

Under this scenario, HDR anticipates that the existing coal-fired boilers would not be classified as new large unit MWCs subject to the provisions of 40 CFR Part 60, Subpart Eb. 40 CFR §60.50b(j) exempts cofired combustors, which is defined as a unit combusting MSW with non-MSW and subject to a federally enforceable permit limit limiting the unit to combusting a fuel stream that is 30 percent or less (by weight) MSW, measured on a calendar quarter basis.

The 300 tpd of MSW capacity system corresponds to a rate of 12.5 tons per hour. Using the hourly coal mass inputs listed above, this corresponds, on a weight basis, to 50% of the hourly mass fuel capacity of Boiler #7, 28% of Boiler #8, and 17.8% of the two boilers combined. Based on these values, the current coal-fired boilers can meet the definition of cofired combustors (as long as the input to Boiler #7 is controlled to the 30% threshold) and not be classified as MWCs.

Although the existing boilers are currently permitted to cofire RDF, a construction permit will be required from the Iowa Department of Natural Resources Environmental Services Division Air Quality Bureau (IDNR) to allow the combustion of syngas (i.e., a new fuel), to implement the 30% limit, and to install the syngas flare. The project is not expected to trigger the Prevention of Significant Deterioration (PSD) preconstruction permitting program or IDNR's non-PSD

modeling requirements. The cost of obtaining a construction permit for Scenario 1 is estimated at $25,000. If non-PSD modeling is triggered, the estimated permitting cost is $50,000.

4.3 Scenario 2

Scenario 2 involves gasification of RDF to produce combustion-ready syngas and inject syngas as a supplemental fuel into each of the City's natural gas-fired boilers.

Under this scenario, HDR anticipates that the natural gas-fired boilers would be classified as new large unit MWCs subject to 40 CFR Part 60, Subpart Eb. The following discussion is based on the understanding that this scenario involves modification of the current coal-fired boilers to gas-fired units with no change in unit heat input capacity.

At the rated heat inputs of the boilers burning natural gas, the weight of gasified MSW would be more than 30 percent of the weight of fuel combusted by each boiler. As such, the boilers would be classified as large unit MWCs subject to the requirements of 40 CFR Part 60, Subpart Eb. Note that this result is based upon the interpretation that the 30 percent applicability threshold is based on the weight of MSW that is gasified rather than the weight of the combusted syngas.

Conversion of the current boilers from coal-firing to natural gas-firing is anticipated to create enough emission reductions to allow the modified boilers to avoid PSD. However, as large unit MWCs, the natural gas-fired boilers would potentially require the installation of acid gas and particulate controls to meet the limits of Subpart Eb. Under current rules, continuous emission monitoring system (CEMs) would be required on the combustion device for nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and carbon dioxide (CO_2). The facility would be required to comply with the staff training and certification requirements under Subpart Eb, conduct annual stack testing, and prepare and public notice a material separation plan and siting analysis as part of the permitting.

The facility would be required to obtain construction permits to modify the boilers to combust natural gas and syngas and to install the syngas flare. The costs of this permitting are anticipated to be $60,000.

The applicability of EPA's MWC rules to gasification has not been fully developed because of the relatively new use of the technology, and verification of this interpretation is recommended.

4.4 Scenarios 3, 4, and 5

From a regulatory standpoint Scenarios 3, 4 and 5 are similar. These scenarios are described as follows: Gasification of RDF to produce combustion-ready syngas and inject syngas as a supplemental fuel in a natural gas-fired combustion turbine (Scenario 3); combustion of syngas in a dedicated internal combustion generator set (Scenario 4); or combustion of syngas in a dedicated package boiler (Scenario 5.)

Under these scenarios, HDR anticipates that each combustion device would be classified as a new large unit MWC subject to 40 CFR Part 60, Subpart Eb. Dependent on the heat input capacity of the combustion device and how much non-MSW fuel would be also be fired (which is not defined at this point), it is assumed that the combustion device will not meet the definition of cofired as discussed in Scenario 1. Subpart Eb does contain an exemption for qualifying small power production facilities. However, the definition of small power production facilities [per 16 USC 796(17)(C)] is a facility that has a power production capacity which, together with any other facilities located at the same site (as determined by the Commission), is not greater than 80 megawatts (MW). Because the Steam Electric Plant capacity is greater than 80 MW, the combustion device under these scenarios would not qualify as a small power production facility.

It is unknown at this point whether or not the emissions of the combustion device would trigger the applicability of PSD. However, as a large unit MWC, the unit would potentially require the installation of acid gas and particulate controls to meet the limits of Subpart Eb. NOx control would be required either as part of a PSD review or to allow the facility to avoid PSD. Under current rules, CEMs would be required on the combustion device for NOx, SO2, CO, and CO2. The facility would be required to comply with the staff training and certification requirements under Subpart Eb and conduct annual stack testing.

Assuming that the combustion device is equipped with control equipment sufficient to meet Subpart Eb requirements and to avoid PSD, the facility would be required to obtain a construction permit to install the device and the syngas flare. The costs of this permitting are the same as outlined above for Scenario 2.

The applicability of EPA's MWC rules to gasification has not been fully developed because of the relatively new use of the technology, and verification of this interpretation is recommended.

4.5 Scenarios 6a and 6b

From a regulatory standpoint Scenarios 6a and 6b are similar. These scenarios are described as follows: Construction and operation of a mass burn electrical generation plant using raw MSW (Scenario 6a) or shredded MSW (Scenario 6b), and connected to an electrical distribution grid.

Under either of these scenarios, the system will be classified as a new large MWC unit under Subpart Eb. As a large unit MWC, the system would require the installation of advanced pollution control equipment to meet the limits of Subpart Eb, and is anticipated to trigger PSD review for SO_2, NO_x, and $PM_{2.5}$ under either scenario. Under current rules, CEMs would be required on the combustion device for NO_x, SO_2, CO, and CO_2. The facility would be required to comply with the staff training and certification requirements under Subpart Eb and conduct annual stack testing.

The cost to obtain a PSD permit for either scenario is estimated at $125,000.

4.6 Greenhouse Gases

While the HDR scope of work does not include evaluation of greenhouse gases (GHG), we offer the following discussion as it relates to the impact of various scenarios on GHGs.

Since GHGs such as carbon dioxide (CO2) are not currently a regulated pollutant, these emissions can be classified as more of a social concern rather than an environmental factor. Any time a new facility is implemented, it will have some impact on GHG emissions. These impacts can be categorized in three areas:

- Project or facility direct impacts (such as gasification of RDF or mass burn options)
- Material or product related impacts
- Avoided or reduced emission impacts

Electrical generating facilities that utilize solid wastes achieve GHG emission reductions primarily through four processes:

1. Avoidance of landfill methane emissions from the continued landfilling of solid waste, including methane that would not have been captured by landfill collection systems;
2. Avoidance of CO2 emissions from fossil fuel fired power plants on the local grid resulting from the energy-from-waste facility generating renewable electrical power or steam;
3. Avoidance of extraction and manufacturing GHG emissions due to enhanced ferrous and non-ferrous (aluminum) metal recovery and recycling at waste facilities; and
4. Avoidance of fuel use associated with landfill disposal operations and transportation GHGs from long hauling of MSW to landfills.

Currently, by processing waste that would otherwise be landfilled and combusting the RDF to generate power, the existing system used by the City benefits from all four of the processes described above. Each of the scenarios would have differing affects on the current GHG avoidance represented by each of these four processes as the following table describes.

Scenario	Landfill GHG Avoidance	Power Plant GHG Avoidance	Metal Recovery GHG Avoidance	Fuel Use GHG Avoidance
Existing System	Base	Base	Base	Base
Scenario 1	More Landfill Avoidance	More Waste processed but lower efficiency	Similar	More Landfill Avoidance
Scenario 2	More Landfill Avoidance	More Waste processed but lower efficiency	Similar	More Landfill Avoidance
Scenario 3	More Landfill Avoidance	More Waste processed but lower efficiency	Similar	More Landfill Avoidance
Scenario 4	More Landfill Avoidance	More Waste processed but lower efficiency	Similar	More Landfill Avoidance
Scenario 5	More Landfill Avoidance	More Waste processed but lower efficiency	Similar	More Landfill Avoidance
Scenario 6A	More Landfill Avoidance	More Waste processed, less residue, higher efficiency	Slightly Higher	More Landfill Avoidance
Scenario 6B	More Landfill Avoidance	More Waste processed, less residue, higher efficiency	Slightly Higher	More Landfill Avoidance

5.0 PROBABLE CAPITAL COSTS

5.1 Scenario 1

The following table presents a summary of the expected cost of a gasification system and equipment to deliver the syngas to the City's existing coal fired boilers. Details of the estimate are provided in Appendix A.

Pricing of Scenario 1 is based on locating the system near the existing RDF Storage bin and piping the cooled, compressed syngas to Units 7 and 8. An enclosed ground flare is provided to vent the syngas from the gasifier and the piping to the boiler in the event of an unscheduled shutdown.

Owing to the evolving nature of the gasification equipment and the consequent low availability that would be expected, redundant gasifiers are included in the estimate. The estimate includes reuse of the RDF storage bin and transfer equipment and assumes that pneumatic RDF delivery piping is provided to fuel feed bins provided by the gasifier supplier. Budget pricing was obtained from ICM for gasification equipment, from Zeeco for the ground flare and from Coen for the syngas burners. HDR used industry experience, information from other pricing databases and similar projects to estimate the remaining costs.

TABLE 1

GASIFICATION WITH COMBUSTION OF SYNGAS IN EXISTING COAL BOILERS
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$22,700,000
IV.	BUILDINGS	$1,700,000
V.	POWER BLOCK EQUIPMENT	$1,780,000
	SUBTOTAL CONSTRUCTION	$27,000,000
	PERMITTING	$50,000
	DESIGN/ENGINEERING (8%)	$2,000,000
	CONTINGENCY (20%)	$5,400,000
	TOTAL CAPITAL COST	$34,500,000

5.2 Scenario 2

Scenario 2 is similar to Scenario 1 except that the presumption is that the syngas is fired in existing gas fired units. Equipment provided would be the same as for Scenario 1 with the exception of the individual syngas burners provided in the gas fired units.

A summary of the capital cost estimate is provided below and details are provided in Appendix A.

TABLE 2

GASIFICATION WITH COMBUSTION OF SYNGAS IN EXISTING NATURAL GAS BOILERS
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$22,700,000
IV.	BUILDINGS	$1,700,000
V.	POWER BLOCK EQUIPMENT	$1,200,000
	SUBTOTAL CONSTRUCTION	$26,400,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$2,000,000
	CONTINGENCY (20%)	$5,300,000
	TOTAL CAPITAL COST	$33,800,000

5.3 Scenario 3

Scenario 3 includes the same fuel feed and gasification equipment as the previous two scenarios and additional syngas cleanup equipment and greater syngas compression for firing the syngas in combustion turbines. The estimate also includes provisions for supplementing the syngas with natural gas owing to the low heat content of the syngas.

Performance and cost of the combustion turbines was developed using Thermoflow, a commercial heat balance program. The performance and cost were based on two Siemens SGT-100 units. The heat balance program includes a Project Engineering and Construction Estimator (PEACE) database that was used to provide pricing related to the combustion turbine island. Some of the data from the database were also used in other estimates. Budget pricing was obtained from ICM for gasification and syngas cleanup equipment and from Zeeco for the ground flare.

A summary of the capital cost estimate is provided below and details are provided in Appendix A.

TABLE 3

GASIFICATION WITH COMBUSTION OF SYNGAS IN NEW COMBUSTION TURBINE
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$30,400,000
IV.	BUILDINGS	$2,800,000
V.	POWER GENERATION EQUIPMENT	$11,880,000
	SUBTOTAL CONSTRUCTION	$45,900,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$4,000,000
	CONTINGENCY (20%)	$9,200,000
	TOTAL CAPITAL COST	$59,200,000

5.4 Scenario 4

Scenario 4 includes the same fuel feed and gasification equipment as the previous scenarios, similar syngas cleanup equipment to that of Scenario 3 and somewhat less syngas compression for firing the syngas in internal combustion engines. Jenbacher was contacted to obtain performance and capital cost estimates for their equipment. The estimate was based on six Jenbacher JMS 680 units with SCR catalyst. Five engines would be sufficient to utilize all of the syngas produced under all but the maximum output conditions. Budget pricing was obtained from ICM for gasification and syngas cleanup equipment and from Zeeco for the ground flare. Output from the PEACE database was used to prepare portions of the estimate.

A summary of the capital cost estimate is provided below and details are provided in Appendix A.

TABLE 4

GASIFICATION WITH COMBUSTION OF SYNGAS IN INTERNAL COMBUSTION ENGINES
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$29,900,000
IV.	BUILDINGS	$4,200,000
V.	POWER GENERATION EQUIPMENT	$25,320,000
	SUBTOTAL CONSTRUCTION	$60,200,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$12,000,000
	TOTAL CAPITAL COST	$77,300,000

5.5 Scenario 5

Scenario 5 includes the same gasification equipment as previous scenarios but provides for direct combustion of the syngas and recovery of heat from the syngas in the form of steam. A steam turbine generator cycle is provided for power generation. Owing to the direct combustion of the syngas, a dump system with a flare is not required for this scenario. A thermal oxidizer followed by a waste heat boiler and air quality control equipment are provided. Air quality control equipment includes a WESP.

Budget pricing obtained from ICM and Cleaver Brooks were used in the estimate.

TABLE 5

GASIFICATION WITH COMBUSTION IN NEW BOILERS WITH STEAM TURBINE CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$800,000
III.	GASIFICATION EQUIPMENT	$17,700,000
IV.	BUILDINGS	$3,700,000
V.	POWER BLOCK EQUIPMENT	$39,350,000
	SUBTOTAL CONSTRUCTION	$61,700,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$12,300,000
	TOTAL CAPITAL COST	$79,100,000

5.6 Scenario 6a

Scenario 6a is for a new mass burn facility located on an unidentified site. The capital cost estimate is based on historical costs for these types of facilities. Owing to the comparatively large amount of available examples, the estimates for cost of this scenario should be considered to be more reliable. The costs were based on HDR experience with these types of facilities. An allowance for land acquisition is included in the estimate together with generic site development costs. These would need to be adjusted to reflect actual conditions if a site were identified.

TABLE 6
CONCEPTUAL MASS BURN FACILITY
CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$335,000
II.	SITE IMPROVEMENTS	$1,500,000
III.	GASIFICATION EQUIPMENT	$0
IV.	BUILDINGS	$9,100,000
V.	POWER BLOCK EQUIPMENT	$51,830,000
	SUBTOTAL CONSTRUCTION	$62,800,000
	PERMITTING	$125,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$12,600,000
	TOTAL CAPITAL COST	$80,500,000

5.7 Scenario 6b

Scenario 6b is essentially identical to 6a with the addition of shredding equipment to provide for shredding incoming MSW.

TABLE 7
CONCEPTUAL MASS BURN w SHREDDED MSW FACILITY
CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$335,000
II.	SITE IMPROVEMENTS	$1,500,000
III.	PROCESSING EQUIPMENT	$3,700,000
IV.	BUILDINGS	$9,500,000
V.	POWER BLOCK EQUIPMENT	$51,770,000
	SUBTOTAL CONSTRUCTION	$66,800,000
	PERMITTING	$125,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$13,400,000
	TOTAL CAPITAL COST	$85,300,000

6.0 EXPECTED PERFORMANCE

Performance estimates are provided in this section. Due to the scarcity of operating facilities, the performance estimates for options other than 6a and 6b are based on very limited data. An estimate of the gasifier performance is provided in the section for Scenarios 1 and 2. The results of that analysis are applicable to Scenarios 3, 4 and 5 as well.

6.1 Scenarios 1 and 2

The gasifier operates with limited excess air which produces incomplete combustion where much of the carbon in the RDF is converted to CO rather than CO_2. Similarly, a portion of the hydrogen in the fuel reports as hydrogen in the syngas rather than H_2O.

The following approximation of the products of the gasification process was developed for use in this analysis. More detailed review of data from an actual unit would be warranted before proceeding to conceptual design.

TABLE 8
Products of Gasification

Products of Combustion	lb/lb fuel @ 100 % Total Air	Flue Gas Flow @ 25,000 lb/hr Fuel Flow (2)	Percent by Wt. Flue Gas (2)
CO2	0.067	1,672	2.536
CO	0.571	14,285	21.669
H	0.010	245	0.372
H2O	0.557	13,925	21.123
SO2	0.004	112	0.170
HCl	0.006	140	0.212
O2	0.000	0	0.000
N2	1.422	35,545	53.919
Wt. wet	2.637	65,923	100.000
Wt. dry	2.080	51,998	------

Approximately 2.6 pounds of syngas is expected to be produced per pound of RDF. Based on the composition above, the higher heating value (HHV) of the syngas is expected to be approximately 1,400 Btu/lb. Subtracting the latent heat of evaporation of the moisture in the syngas results in a lower heating value (LHV) of 1,180 Btu/lb. The LHV is used in the performance calculations for certain scenarios we are considering.

The energy content of the syngas represents approximately 65% of the energy in the RDF.

6.2 Scenario 3

For Scenario 3 the syngas produced above will be delivered to combustion turbines together with natural gas. This analysis is based on two Siemens STG100 combustion turbines in a simple cycle configuration. Owing to the lower quality of the syngas in comparison with typical combustion turbine fuel, natural gas will be used to supplement the syngas to the full output of the combustion turbines. Excluding the power used by the gasification and syngas cleanup equipment, the net heat rate of the combustion turbines is 12,202 Btu/kWh on an LHV basis. At 300 tpd the RDF would provide approximately 75% of the heat input to the combustion turbines. This would drop to about 50% of the required heat input at 200 tpd. At loads associated with 150 tpd, one CT would be operating with the syngas again providing 75% of the heat input. The following table presents the performance levels used in the economic analysis.

TABLE 9
Projected Scenario 3 Performance

RDF Input to Gasifier (tpd)	300	250	200	150
Required Natural Gas, MCF/hr	32	47	63	16
Net Power Output, kW	8,050	8,050	8,050	3,775
Net Power from RDF, kW	5,888	4,824	3,759	2,694
kWh/ton of RDF	471	463	451	431

6.3 Scenario 4

For Scenario 4 the syngas produced above will be delivered to up to six Jenbacher internal combustion engines. Excluding the power used by the gasification equipment and syngas cleanup and compression equipment, the net heat rate of the Jenbacher engines is 9,698 Btu/kWh on an LHV basis. It is expected that the syngas will be of sufficient quality to be a self sustaining fuel for the internal combustion engines. In other words, the analysis is based on not providing supplemental fuel to the engines. At 300 tpd five engines would be utilized with one in standby. At lower loads, fewer engines would be operating. The following table presents the performance levels used in the economic analysis.

TABLE 10
Projected Scenario 4 Performance

RDF Input to Gasifier (tpd)	300	250	200	150
Available Heat Input, MMBtu/hr	78	65	52	39
Engine Net Output, kW	8037	6698	5358	4019
Engines operating	5	5	4	3
Net Power Output, kW	7487	6148	4808	3469
kWh/ton of RDF	599	590	577	555

6.4 Scenario 5

Because Scenario 5 considers direct combustion of the syngas and generation of steam used in a Rankine cycle to produce electricity the performance estimate is more straightforward. An average net power output of 500 kWh per ton of RDF is used in the economic evaluation.

6.5 Scenario 6a

Because Scenario 6a considers mass burn combustion where greater actual data exist, the performance is based on HDR's experience. An average net power output of 600 kWh per ton of MSW is used in the economic evaluation.

6.6 Scenario 6b

Scenario 6b differs from 6a only in the amount of parasitic power used by the processing equipment. An average net power output of 590 kWh per ton of MSW is used in the economic evaluation.

7.0 OPERATING AND MAINTENANCE COSTS

The following is a discussion of the operating and maintenance costs assumptions for each of the scenarios identified above. Due to the scarcity of MSW gasification operating facilities, the operating and maintenance cost estimates for Scenarios 1 to 5 are based on limited data and relies on limited information obtained from proposals (different feedstocks and/or larger facility sizes) and HDR's knowledge and experience with mass burn waste-to-energy facilities and the power industry. The business case analyses (20-year pro formas) are based on the revenues and operating costs identified herein. These expenses are subject to annual escalation adjustment which for the purpose of HDR's analysis is assumed to be 2 percent per annum.

7.1 Scenarios 1 and 2

As described in Section 3.0 above, Scenarios 1 and 2 consist of gasification of RDF and combustion of the syngas in the City's existing coal-fired boilers or these boilers converted to natural gas-fired boilers, respectively. The primary operating assumptions for the gasification system and supply of syngas include:

- Quantities Input Assumptions (developed from City provided data)
    - MSW available to RDF plant 56,000 tpy (in 2012), escalating 1% annually
    - Bypass and non-processible waste at 8% of MSW received
    - Recovered ferrous metals at 4.1% of processed MSW
    - Recovered non-ferrous at 0.2% of processed MSW
    - RDF to gasification system at 85% of processed MSW (compared to historical 5-year average of 67% currently directed to RDF storage bins and feed into existing coal-fired boilers) – equals 43,800 tpy (in 2012)
    - Ash residue/char from gasification of RDF at 12% on dry basis (15% wet basis with assumed 20% moisture) – based on data from 7-day RDF gasification demonstration of City's RDF
- Operating Revenue Assumptions
    - RDF higher heating value of 5,180 Btu/lb, based on City's RDF analysis in 2012, and energy content of the syngas will represent 65% of RDF heating value (see Section 6.1)
    - Syngas energy revenue of $3.568 per MMBtu, based on City's average coal price in 2012
    - No renewable energy credits available for publicly owned projects – RDF eligible for renewable generating capacity under Iowa's Renewables Portfolio Standard (RPS) for the two investor-owned utilities
    - Carbon credit pricing assumed at $2 per ton carbon equivalent (CO2e); however, carbon offsets may not be allowed for the projects since the RDF has been

combusted for energy recovery since 1975 (Base Case analyses assumes no carbon offsets)

- Ferrous and non-ferrous material revenues are kept with the RRP operating budget; no additional metals recovery from the gasification ash residue

- Avoided Costs Assumptions
  - With the gasification system, the City has indicated that more RDF is available and could be directed to the gasification system – based on the quantity assumptions above, 85% of the MSW processed at the RRP is estimated to be gasified, avoiding haul and landfill disposal costs on approximately 9,300 tons per year of RDF – based on City provided data this is estimated to be savings of approximately $546,000 per year (in 2012$)
  - The EGP will avoid bottom ash removal and disposal costs associated with co-firing the RDF in the existing coal-fired boilers – based on City provided data this is estimated to be savings of approximately $120,000 per year (in 2012$)
  - The EGP will avoid the cost of operating and maintaining the RDF storage bins and pneumatic conveyance system – this is included as an operating expense for the Gasification System
  - The EGP will avoid boiler and bottom ash line maintenance costs on Units 7 and 8 associated with co-firing the RDF in these existing coal-fired boilers – the City has estimated the RDF related annual maintenance costs with the 10-year annual average of $1,034,000
  - The EGP will avoid the need to combust more coal in order to directly combust RDF, thus avoiding extra cost of generating electricity when purchased power is less – the City has estimated this savings to be $1,383,000 per year (in 2012$) when syngas is combusted within the existing boilers
- Operating Expenses Assumptions
  - Operations assume 8-hour shifts, 3 shifts per day and 310 days per year (estimated 85% gasification system availability with two units, redundant system)
  - Labor of 11 full time equivalent (FTE) for operators, mechanic, electrician, and allocated 0.5 FTE of existing personnel for general administration – 5% overtime assumed for operators and maintenance personnel
  - Routine maintenance, including capital replacement, assumed at 2% annually of system equipment and building capital cost
  - Purchase of RDF from the RRP assumed at $750,000 per year (in 2012$) as provided by the City, escalating at 1% annually to correspond with waste growth rate
  - Utilities include electricity purchase (gasification system electric load and reduced load during system outages), fuel oil usage for start-ups/flare, water usage, and wastewater

- Chemical consumption for air pollution control assumed to be zero for gasification system only.
- Miscellaneous general administration, supplies, tools, and expendables assumed at 5% of annual labor cost based on City RRP budget data
- Insurance estimated at 0.15% of total capital cost
- RDF storage bins operations and maintenance costs of $161,000 (in 2012$) based on recent 4-year average of City provided data of EGP costs
- Contingency of 10% on total operating expenses, excluding purchase of RDF

Detailed operating assumptions and inputs are contained in Appendix B.

7.2 Scenario 3

Scenario 3 includes the gasification of RDF to produce combustion-ready syngas (same as Scenarios 1 and 2), with injection of the syngas as a supplemental fuel in a natural gas-fired combustion turbine. The primary operating assumptions for the gasification system, supply of syngas, and natural gas-fired combustion turbine include:

- Quantities Input Assumptions – same as Scenarios 1 and 2
- Operating Revenue Assumptions – same as Scenarios 1 and 2 except for following,
  - Net heat rate of 431 kWh per ton RDF, supplemented by natural gas to full output of combustion turbine(s) – net power output of 3.8 MW (one unit) after in-house facility power usage [Note that capital cost includes two combustion turbines for 300 tpd RDF]
  - Electric revenue rate of $0.05/kWh – the gasification system will have intrinsic electric capacity value to the City with such value determined by the City for inclusion in their rates; current market conditions have resulted in very low electric capacity values which could change over the long term
- Avoided Costs Assumptions – same as Scenarios 1 and 2 except for following,
  - The EGP will avoid the need to combust more coal in order to directly combust RDF [and syngas], thus avoiding extra cost of generating electricity when purchased power is less – the City has estimated this savings to be $4,061,100 per year in 2015, increasing to $6,879,100 in year 2020 and escalating annually thereafter to $10,838,400 in year 2035
- Operating Expenses Assumptions – same as Scenarios 1 and 2 except for the following,
  - Additional labor of 5 FTE for supervisor, operators, and maintenance personnel for combustion turbine(s)
  - Routine maintenance, including capital replacement, assumed at 2% annually of gasification system equipment and building capital cost and combustion turbine(s)
  - Utilities include electricity purchase (during system outages and start-ups), natural gas supplemental fuel and usage for start-ups/flare, water usage, and wastewater

- Chemical consumption for air pollution control assumed to be approximately half of the chemical costs for Scenario 5

Detailed operating assumptions and inputs are contained in Appendix B.

7.3 Scenario 4

Scenario 4 includes the gasification of RDF to produce combustion-ready syngas (same as Scenarios 1 and 2), with combustion of syngas in a dedicated internal combustion generator set. The primary operating assumptions for the gasification system, supply of syngas, and internal combustion generator set include:

- Quantities Input Assumptions – same as Scenarios 1 and 2
- Operating Revenue Assumptions – same as Scenarios 1 and 2 except for following,
  - Net heat rate of 555 kWh per ton RDF – net power output of approximately 3.5 MW (three units) after in-house facility power usage [Note that capital cost includes six Jenbacher internal combustion engines for 300 tpd RDF]
  - Electric revenue rate of $0.05/kWh – the gasification system will have intrinsic electric capacity value to the City with such value determined by the City for inclusion in their rates; current market conditions have resulted in very low electric capacity values which could change over the long term
- Avoided Costs Assumptions – same as Scenarios 1 and 2 except for following,
  - The EGP will avoid the need to combust more coal in order to directly combust RDF [and syngas], thus avoiding extra cost of generating electricity when purchased power is less – the City has estimated this savings to be $4,061,100 per year in 2015, increasing to $6,879,100 in year 2020 and escalating annually thereafter to $10,838,400 in year 2035
- Operating Expenses Assumptions – same as Scenarios 1 and 2 except for the following,
  - Additional labor of 5 FTE for supervisor, operators, and maintenance personnel for internal combustion generator set
  - Routine maintenance, including capital replacement, assumed at 2% annually of gasification system equipment and building capital cost and IC engines
  - Utilities include electricity purchase (during system outages and start-ups), fuel oil usage for start-ups/flare, water usage, and wastewater
  - Chemical consumption for air pollution control assumed to be approximately half of the chemical costs for Scenario 5

Detailed operating assumptions and inputs are contained in Appendix B.

7.4 Scenario 5

Scenario 5 includes the gasification of RDF to produce combustion-ready syngas (same as Scenarios 1 and 2), with combustion of syngas in a dedicated package boiler. The primary operating assumptions for the gasification system, supply of syngas, and dedicated package boiler include:

- Quantities Input Assumptions – same as Scenarios 1 and 2
- Operating Revenue Assumptions – same as Scenarios 1 and 2 except for following,
    - Net heat rate of 500 kWh per ton RDF [Note that dedicated package boiler/steam turbine sized for combustion of syngas produced from 300 tpd RDF]
    - Electric revenue rate of $0.05/kWh – the gasification system will have intrinsic electric capacity value to the City with such value determined by the City for inclusion in their rates; current market conditions have resulted in very low electric capacity values which could change over the long term
- Avoided Costs Assumptions – same as Scenarios 1 and 2 except for following,
    - The EGP will avoid the need to combust more coal in order to directly combust RDF, thus avoiding extra cost of generating electricity when purchased power is less – the City has estimated this savings to be $4,061,100 per year in 2015, increasing to $6,879,100 in year 2020 and escalating annually thereafter to $10,838,400 in year 2035
- Operating Expenses Assumptions – same as Scenarios 1 and 2 except for the following,
    - Additional labor of 17 FTE for supervisor, operators, and maintenance personnel for dedicated package boiler/steam turbine
    - Routine maintenance, including capital replacement, assumed at 2% annually of gasification system equipment, building(s) capital cost and dedicated package boiler/steam turbine
    - Utilities include electricity purchase (during system outages and start-ups), fuel oil usage for start-ups/flare, water usage, and wastewater
    - Chemical consumption for air pollution control includes ammonia, activated carbon, and lime at usage rates per ton of waste similar to mass burn facilities

Detailed operating assumptions and inputs are contained in Appendix B.

7.5 Scenario 6a

As described in Section 3.0 above, Scenario 6a considers construction and operation of a mass burn electrical generation system using raw MSW. The primary operating assumptions for the mass burn electrical generation system include:

- Quantities Input Assumptions (developed from City provided data)

- MSW available at 56,000 tpy (in 2012), escalating 1% annually
- Yard waste available at 5,000 tpy (in 2012), escalating 1% annually – assumes with the mass burn facility City will direct yard waste currently managed separately to the facility for energy recovery
- Other sources of supplemental MSW at 0 tpy (in 2012) – note that up to an additional 35,000 tpy needed to maximize the 300-tpd facility capacity
- Bypass and non-processible waste at 4% of MSW received
- Post-combustion recovery of ferrous metals at 4% of combusted MSW
- Post-combustion recovery of non-ferrous at 0.2% of combusted MSW
- Ash residue estimated at 28% of combusted MSW, after recovery of ferrous and non-ferrous metals

- Operating Revenue Assumptions
  - Tipping fee revenue at current RRP tip fee of $52.75/ton with no escalation
  - Per capita revenue at current assessment of $9.10 per capita and approximate 90,000 people, with no escalation
  - Net electric generation at 600 kWh/ton of combusted raw MSW
  - Electric revenue rate of $0.05/kWh – a mass burn facility will have intrinsic electric capacity value to the City with such value determined by the City for inclusion in their rates; current market conditions have resulted in very low electric capacity values which could change over the long term
  - No renewable energy credits available for publicly owned projects – waste mass burn facilities eligible as renewable generating capacity under Iowa's Renewables Portfolio Standard (RPS) for the two investor-owned utilities
  - Carbon offsets assumed zero in Base Case analyses – carbon credits potential for mass burn scenarios compares combustion of organic fraction to landfilling (the alternative if no energy from waste recovery) – carbon credit pricing assumed at $2 per ton carbon equivalent (CO2e)
  - Ferrous and non-ferrous material revenues based on quantity assumptions and City's unit revenues from fiscal year 2011/2012 – net revenues assume ferrous at $120/ton and non-ferrous at $1,000/ton (in 2012$)
- Avoided Costs Assumptions
  - With yard waste directed to mass burn facility, separate program management of yard waste will be avoided – the City's fiscal year 2012/2013 expenses include yard waste management at $31,800 annually
  - The EGP will avoid bottom ash removal and disposal costs associated with co-firing the RDF in the existing coal-fired boilers – based on City provided data this is estimated to be savings of approximately $120,000 per year (in 2012$)

- The EGP will avoid the cost of operating and maintaining the RDF storage bins and pneumatic conveyance system – based on City provided data this is estimated to be savings of approximately $161,000 per year (in 2012$) escalated
- The EGP will avoid boiler and bottom ash line maintenance costs on Units 7 and 8 associated with co-firing the RDF in these existing coal-fired boilers – the City has estimated the RDF related annual maintenance costs with the 10-year annual average of $1,034,000
- The EGP will avoid the need to combust more coal in order to directly combust RDF [and syngas], thus avoiding extra cost of generating electricity when purchased power is less – the City has estimated this savings to be $4,061,100 per year in 2015, increasing to $6,879,100 in year 2020 and escalating annually thereafter to $10,838,400 in year 2035
- Under the mass burn scenarios, it is assumed that the RRP would not continue to operate and such budget would be replaced with the mass burn facility – thus avoided costs by the RRP are not included herein

- Operating Expenses Assumptions
  - Operations assume:
    - Waste receiving 5.5 days per week less holidays (280 days per year)
    - Waste processing/combustion 7 days per week and 85% facility availability (310 days per year) – facility availability expected to range from 85% to 90%
    - Administration functions 5 days per week (260 days per year)
  - Labor assumptions for waste receiving facility, rolling stock and equipment maintenance, administration, and power block results in total estimated 37 FTE personnel – 5% overtime assumed for operators and maintenance personnel
  - Facilities maintenance assumed at 1% annually of building capital cost
  - Stationary equipment, routine maintenance/capital replacement assumed at 2% annually of system equipment
  - Rolling stock maintenance based on estimated operating hours and unit rates for mobile equipment
  - Annual rolling stock equipment replacement fund equal to estimated total rolling stock capital cost divided by average number of years before replacement
  - Fuel costs based on rolling stock estimated operating hours, fuel consumption, and $4 per gallon diesel fuel
  - Utilities include electricity purchase (during system outages and start-ups), natural gas usage for start-ups, water usage, wastewater, and telephone
  - Chemical consumption for air pollution control includes ammonia, activated carbon, and lime at usage rates per ton of waste combusted
  - Annual stack testing estimated at $150,000 (in 2012$)

- Miscellaneous general and administration, legal, accounting, supplies, tools, and expendables assumed at 5% of annual labor cost
- Insurance estimated at 0.15% of total capital cost
- Overhead and profit assumed to be zero – City owned and operated facility
- Property taxes assumed to be zero – City owned and operated facility
- Contingency of 10% on total operating expenses

Detailed operating assumptions and inputs are contained in Appendix C.

7.6 Scenario 6b

Scenario 6b considers construction and operation of a mass burn electrical generation system (similar to Scenario 6a) with the addition of a shredder for combusting shredded MSW. The primary operating assumptions for the shredded MSW, mass burn electrical generation system include:

- Quantities Input Assumptions – same as Scenario 6a
- Operating Revenue Assumptions – same as Scenario 6a except for the following
  - Net electric generation at 590 kWh/ton of combusted shredded MSW
- Avoided Costs Assumptions – same as Scenario 6a
- Operating Expenses Assumptions – same as Scenario 6a except for the following
  - Additional labor of one equipment operator (1 FTE) and one-half maintenance (0.5 FTE) for MSW shredding operations.
  - Utilities include electricity purchase (during system outages and start-ups, including shredder operations), natural gas usage for start-ups, water usage, wastewater, and telephone

Detailed operating assumptions and inputs are contained in Appendix C.

8.0 BUSINESS CASE ANALYSES

For economic evaluation purposes, an implementation schedule was assumed for each scenario from a notice to proceed date (assumed January 1, 2013 in the analyses). Based on the scenario descriptions in Section 3.0 above, a reasonable number of months were assigned to periods for siting/local approval, planning/permitting/design, and construction/start-up. The gasification scenarios 1 to 5 are assumed to be sited on the existing power plant site, whereas the mass burn scenarios 6a and 6b are expected to require extensive siting and likely land purchase. A breakdown of the timing for each scenario is shown in Table 11.

TABLE 11

Implementation Schedule Assumptions

	Scenarios						
	1	**2**	**3**	**4**	**5**	**6a**	**6b**
Siting & Local Approval Period	0	0	0	0	0	24	24
Planning, Permitting & Design Period	18	18	18	18	18	18	18
Construction & Start-Up Period	18	18	24	24	30	30	30
Total Estimated Months from NTP	**36**	**36**	**42**	**42**	**48**	**72**	**72**

Actual notice to proceed and other schedule impacts (i.e. coordination with power plant decisions, siting issues, funding/financing, construction delays, etc.) can extend the schedule and business case pro formas.

Financing

Although there are several financing mechanisms that might be available for this project, the "base case" business case analyses assumes the City will finance the project using tax-exempt revenue bonds. The revenue bond sizing runs are included in Appendix D. Interest revenues on reserve amounts in the construction fund, capitalized interest fund and debt service reserve fund to be deposited in the Project fund are expected to fund a portion of the capital. These interest revenues are included in the calculation of the net annual debt service. The primary financing assumptions include:

- 20-year amortization period
- tax-exempt revenue bond interest rate of 6 percent for gasification scenarios (perceived higher risk) and 5 percent for mass burn scenarios
- bond issuance fees of 4 percent
- long-term and short-term reinvestment rates of 2 percent
- escalation of capital costs to start of construction by 4 percent annually
- funded one-year debt service reserve with annual interest earnings reducing the annual debt service (i.e., net annual debt service)

The Trust Indenture for some bond financings may require a reserve and contingency fund balance funded in amounts at least equal to 10 percent of the current year debt service; thus providing an annual debt service coverage. This has not been included in the Base Case bond sizing runs. Table 12 summarizes the calculated financed capital, bond issue size and net annual debt service for each scenario.

TABLE 12

Revenue Bond Sizing - Base Case

	Scenarios						
	1	**2**	**3**	**4**	**5**	**6a**	**6b**
Financed Capital	$36,591,000	$35,848,000	$62,787,000	$81,984,000	$83,893,000	$92,345,000	$97,851,000
Bond Issue Size	$46,063,000	$45,128,000	$81,699,000	$106,678,000	$112,939,000	$119,289,000	$126,402,000
Net Annual Debt Service	$3,936,000	$3,855,000	$6,981,000	$9,115,000	$9,650,000	$9,381,000	$9,940,000

The availability of and application for grant funds to offset a portion of the Project costs would reduce the development and construction costs requiring financing. Iowa Energy Bank or Revolving Loan Program incentive loans with low interest rate could also reduce financing costs and interest payments. However, these incentive loans are limited in size and appear to not include RDF or MSW in the eligible renewables. It is not known at this time whether or not the City can receive any grant funding or low interest incentive loans, therefore the base case analyses does not include these funds. Sensitivity analyses may be run to evaluate the affect of grant funding and/or low interest loans, however if equally available to each gasification scenario, the comparison results remain the same.

Business Case Pro Formas

The pro formas for the business case analyses are projected for 20 years from the assumed start of operations developed from the implementation schedules presented above. The revenues and expenses were subject to annual escalation adjustments which are further detailed in the scenario assumptions (Appendix B and C). For the purpose of the business case analyses, the escalation is assumed to be 2 percent per annum. Material revenues are escalated at 2 percent per annum, while avoided costs are conservatively assumed at no escalation, except for the haul and disposal avoided costs and the RDF storage bins maintenance. The first full year system operating revenues and expenses projections common to the scenarios are presented in the sections below.

8.1 Scenarios 1 and 2

Based on the operating assumptions, implementation schedules, and financing described above, the first year operating projections for Scenarios 1 and 2 are presented in Table 13. The Net Revenues/(Expenses) are presented two ways: (1) with only the energy revenues (along with any renewable energy credits) and carbon credits included as revenue (i.e., no avoided costs) and (2) with all avoided costs included as revenue.

TABLE 13

Common Initial Year Operating Projections (2017$)

	Scenario 1	Scenario 2
Materials Quantities		
MSW Deliveries to RRP (tons)	58,900	58,900
Less, Bypass/Nonprocessible Wastes (tons)	4,700	4,700
MSW Processed (tons)	54,200	54,200
RDF Combusted (tons)	46,000	46,000
Ash Residue/Char (tons)	6,900	6,900
Syngas Energy Generation (MMBtu)	308,900	308,900
Gasification System Revenues		
Energy Revenues	$1,102,000	$1,102,000
Carbon Credits	$0	$0
Subtotal Revenues	**$1,102,000**	**$1,102,000**
RRP: Avoided RDF Haul & Disposal Costs	$604,000	$604,000
EGP: Avoided RDF Ash Removal & Disposal Costs	$133,000	$133,000
EGP: Avoided RDF Storage Bins O&M	$178,000	$178,000
EGP: Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000
EGP: Avoided Extra Power Generation Costs to Burn RDF	$1,383,000	$1,383,000
Subtotal Revenues w/ Avoided Costs	**$4,434,000**	**$4,434,000**
Gasification System Expenses		
Purchase of RDF	$788,000	$788,000
Labor	$1,238,000	$1,238,000
Routine Maintenance/Replacement	$539,000	$539,000
Utilities	$151,000	$151,000
Chemicals Consumption	$0	$0
Ash Residue Haul & Disposal	$419,000	$419,000
Misc. G&A, Supplies, Tools, Expendables	$62,000	$62,000
Insurance	$57,000	$56,000
RDF Storage Bins O&M	$178,000	$178,000
Contingency (10%)	$264,000	$264,000
Subtotal Expenses	**$3,696,000**	**$3,695,000**
Net Debt Service	**$3,936,000**	**$3,855,000**
Net Revenues (Expenses)	**($6,530,000)**	**($6,448,000)**
Net Revenues (Expenses) w/ Avoided Costs	**($3,198,000)**	**($3,116,000)**

8.2 Scenarios 3 to 5

Based on the operating assumptions, implementation schedules, and financing described above, the first year operating projections for Scenarios 3, 4 and 5 are presented in Table 14. The Net Revenues/(Expenses) are presented two ways: (1) with only the energy revenues (along with any renewable energy credits) and carbon credits included as revenue (i.e., no avoided costs) and (2) with all avoided costs included as revenue.

TABLE 14

Common Initial Year Operating Projections (2017$)

	Scenario 3	Scenario 4	Scenario 5
Materials Quantities			
MSW Deliveries to RRP (tons)	58,900	58,900	58,900
Less, Bypass/Nonprocessible Wastes (tons)	4,700	4,700	4,700
MSW Processed (tons)	54,200	54,200	54,200
RDF Combusted (tons)	46,000	46,000	46,000
Ash Residue/Char (tons)	6,900	6,900	6,900
Syngas Heat Input (MMBtu)	287,000	287,000	287,000
Natural Gas Input (MMBtu)	101,100	0	0
Net Electric Generation (kWh)	28,086,000	25,546,000	23,015,000
Gasification System Revenues			
Energy Revenues	$1,404,000	$1,277,000	$1,151,000
Carbon Credits	$0	$0	$0
Subtotal Revenues & RDF Avoided Costs	**$1,404,000**	**$1,277,000**	**$1,151,000**
RRP: Avoided RDF Haul & Disposal Costs	$604,000	$604,000	$604,000
EGP: Avoided RDF Ash Removal & Disposal Costs	$133,000	$133,000	$133,000
EGP: Avoided RDF Storage Bins O&M	$178,000	$178,000	$178,000
EGP: Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000
EGP: Avoided Extra Power Generation Costs to Burn RDF	$4,061,000	$4,061,000	$4,061,000
Subtotal Revenues w/ EPG Avoided Costs	**$7,414,000**	**$7,287,000**	**$7,161,000**
Gasification System Expenses			
Purchase of RDF	$788,000	$788,000	$788,000
Labor	$1,806,000	$1,806,000	$3,007,000
Routine Maintenance/Replacement	$996,000	$1,312,000	$1,343,000
Utilities	$618,000	$30,000	$33,000
Chemicals Consumption	$66,000	$66,000	$136,000
Ash Residue Haul & Disposal	$419,000	$419,000	$419,000
Misc. G&A, Supplies, Tools, Expendables	$90,000	$90,000	$150,000
Insurance	$98,000	$128,000	$131,000
RDF Storage Bins O&M	$178,000	$178,000	$178,000

Contingency (10%)	$427,000	$403,000	$540,000
Subtotal Expenses	**$5,486,000**	**$5,220,000**	**$6,725,000**
Net Debt Service	**$6,981,000**	**$9,115,000**	**$9,650,000**
Net Revenues (Expenses)	**($11,063,000)**	**($13,058,000)**	**($15,224,000)**
Net Revenues (Expenses) w/ EPG Avoided Costs	**($5,053,000)**	**($7,048,000)**	**($9,214,000)**

8.3 Scenarios 6a and 6b

Based on the operating assumptions, implementation schedules, and financing described above, the first year operating projections for Scenarios 6a and 6b are presented in Table 15. Required revenues were calculated for the additional MSW tipping fees necessary to break even and are presented in dollars per ton MSW delivered to the facility. Additional supplemental MSW to maximize the capacity of the facility would increase the MSW combusted, thereby reducing the required additional tipping fee per ton.

TABLE 15
First Year Operating Projections (2019$)

	Scenario 6a	Scenario 6b
Material Quantities		
MSW Combusted (tons)	63,000	63,000
Ash Residue (tons)	17,600	17,600
Metals Recovery (tons)	2,400	2,400
Bypass/Non-Processible Waste (tons)	2,400	2,400
Net Electric Generation (kWh)	37,794,000	37,164,000
System Revenues		
Tipping Fee Revenue (@ $52.75/ton)	$3,449,000	$3,449,000
Per Capita Revenue (@ $9.10 per capita)	$819,000	$819,000
Energy Revenues (@ $0.05/kWh)	$1,890,000	$1,858,000
Carbon Credits	$0	$0
Ferrous & Non-Ferrous Revenues	$492,000	$492,000
Subtotal Revenues	**$6,650,000**	**$6,618,000**
Avoided Yard Waste Costs	$32,000	$32,000
EGP: Avoided RDF Storage Bins & Ash Removal Costs	$323,000	$323,000
EGP: Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000
EGP: Avoided Extra Power Generation Costs to Burn RDF	$4,061,000	$4,061,000
Subtotal Revenues w/ EPG Avoided Costs	**$12,100,000**	**$12,068,000**
System Expenses		
Labor	$3,649,000	$3,787,000

Facilities, Equipment & Rolling Stock Maint.	$1,497,000	$1,584,000
Fuel Costs	$210,000	$210,000
Utilities	$100,000	$100,000
Chemicals Consumption	$194,000	$194,000
Ash Residue Disposal	$1,115,000	$1,115,000
Bypass/Non-Processible Waste Disposal	$162,000	$162,000
Annual Stack Testing	$172,000	$172,000
Misc. G&A, Tools, Supplies, Expendables	$183,000	$189,000
Insurance	$139,000	$147,000
Contingency (10%)	$742,000	$766,000
Subtotal Operating Expenses	**$8,163,000**	**$8,426,000**
Net Debt Service	**$9,381,000**	**$9,940,000**
Net Revenues (Expenses)	**($10,893,000)**	**($11,748,000)**
Add'l Required MSW Tip Fee ($/ton)	**$167**	**$180**
Net Revenues (Expenses) w/ Avoided Costs	**($5,443,000)**	**($6,298,000)**
Add'l Required MSW Tip Fee ($/ton)	**$83**	**$96**

9.0 COMPARISON OF RESULTS

9.1 Capital and O&M Costs

The capital costs and operating and maintenance costs for each scenario considered are summarized in Table 16 below. The annual net debt service is based on the financing assumptions described in Section 8.0 and escalation of capital cost to projected start of construction. The annual operating and maintenance costs are from the varying first year operating costs presented in Sections 8.1, 8.2 and 8.3 converted to present value (2012$) for comparison purposes.

TABLE 16

Summary of Capital, Operating & Maintenance Costs[1]
Present Value (2012$)

Scenarios	Tonnage Throughput[2] TPY	Tonnage Throughput[2] TPD[3]	Capital Cost[4] (2012$)	Annual Net Debt Service	Annual O&M[5] (2012$)
Gasification Systems					
1	46,000	148	$34,500,000	$3,940,000	$3,350,000
2	46,000	148	$33,800,000	$3,860,000	$3,350,000
3	46,000	148	$59,200,000	$6,980,000	$4,970,000
4	46,000	148	$77,300,000	$9,120,000	$4,730,000
5	46,000	148	$79,100,000	$9,650,000	$6,090,000
Mass-Burn Facilities					
6a	63,000	203	$80,500,000	$9,380,000	$7,110,000
6b	63,000	203	$85,300,000	$9,940,000	$7,340,000

Notes:

1. Cost estimates are conceptual and thus annual costs rounded to nearest $10,000.
2. Tonnage throughput corresponds to projected first year of facility operations.
   Scenarios 1 to 5 - RDF from City's RRP (see Section 7.1 for assumptions).
   Scenario 6a - raw MSW and yard waste; additional sources of MSW may be obtained.
   Scenario 6b - shredded MSW and yard waste; additional sources of MSW may be obtained.
3. Tons per day assume system availability of 85% (310 processing days per year).
4. Probable Capital Costs include permitting, design/engineering, construction and 20% contingency.
   Scenarios 1 to 5 assume facility developed on existing EGP site.
   Scenarios 6a and 6b assume facility on unknown site and include estimate for land purchase.
5. Present Value of first year operating expenses, assuming discount of 2% per annum.

9.2 Required Revenues – Scenarios 1 thru 5

The gasification scenarios were compared based on the net revenues/(expenses) with and without the selected avoided costs. When comparing these scenarios to the EGP options, the City needs to be cautious that these avoided costs are not counted twice. Energy revenues were assumed at $3.568/MMBtu for syngas and $0.05/kWh for net electric generation. All scenarios show that additional revenues are required annually to fund the Gasification System. The pro formas show Scenario 2, syngas co-fired with natural gas in the existing boilers, as the least cost option for RDF gasification. For the City's information, the last column in Table 17 shows the net expenses (i.e., required additional revenues) after including all of the RRP and EGP avoided costs as system revenues. As the projected EGP avoided power generation costs increase in the pro formas under Scenarios 3, 4 and 5, the net expenses will decrease when including all avoided costs as revenue (see Appendix B). The annual revenues and net expenses are from the varying first year operation projections presented in Sections 8.1 and 8.2 converted to present value (2012$) for comparison purposes.

TABLE 17

Scenarios 1 - 5 Gasification Systems
Summary of Avoided Costs, Energy Revenues, and Required System Revenues[1]
Present Value (2012$)

Scenarios	Net Energy Generation		Avoided Costs[2] (2012$)	Annual Energy Revenues[3] (2012$)	Net Revenues/(Expenses)[4] (2012$)	
	Syngas MMBtu/ ton RDF	kWh/ ton RDF			Net w/out Avoided Costs	Net w/ RRP & EGP Avoided Costs
1	6.7		$3,080,000	$1,050,000	($6,210,000)	($3,040,000)
2	6.7		$3,080,000	$1,050,000	($6,140,000)	($2,960,000)
3		431	$5,920,000	$1,340,000	($10,530,000)	($4,810,000)
4		555	$5,920,000	$1,220,000	($12,420,000)	($6,710,000)
5		500	$5,920,000	$1,100,000	($14,490,000)	($8,770,000)

Notes:

1. Cost estimates are conceptual and thus costs/revenues rounded to nearest $10,000.
2. Avoided Costs based on City provided data and includes avoided RRP and EGP costs.
3. Energy revenues assume value of Syngas at $3.568/MMBtu and electric revenue rate at $0.05/kWh.
   Present value of first year energy revenues; assumes discount of 1% per annum, equal to tonnage growth. Potential value of electric capacity not included.
4. The net expenses are the additional revenues required to break even.
   Present Value of first year net expenses (required revenues); assumes discount of 1% per annum.

9.3 Required Revenues – Scenarios 6a and 6b

The mass burn scenarios were also compared based on the net revenues/(expenses) with and without the avoided costs. The annual revenues and net expenses are from the first year operation projections presented in Section 8.3 converted to present value (2012$) for comparison purposes. Energy revenues were assumed at $0.05/kWh. Tip fee and per capita revenues were calculated at the current rates of $52.75/ton and $9.10 per capita and 2012 tonnages.

Avoided costs included the EGP avoided costs associated with RDF and the yard waste management program, which assumes yard waste is not managed separately and is directed to the mass burn facility. When comparing these scenarios to the EGP options, the City needs to be cautious that the EGP avoided costs are not counted twice. For the City's information, the last column in Table 18 shows the net expenses (i.e., required additional revenues) after including all of the EGP avoided costs and avoided yard waste management program as system revenues. As the projected EGP avoided power generation costs increase in the pro formas, the net expenses will decrease when including all avoided costs as revenue (see Appendix C).

Under Scenarios 6a or 6b, the RRP would cease to operate and be replaced with the mass burn facility. For comparison of all scenarios evaluated in this report, the net revenues/(expenses) (i.e., additional required revenues) in Scenarios 6a and 6b should be compared to the system net revenues/(expenses) for Scenarios 1 to 5 in Table 17 above. Based on net expenses in Table 18 below, the calculated additional tipping fee required for the Scenario 6a mass burn waste-to-energy facility could range from $83 to $167 per ton assuming 61,000 tons (in 2012) of waste deliveries to the facility (includes yard waste). Supplemental waste deliveries, additional per capita assessments, and/or higher energy revenues would lower this required additional, calculated per ton tip fee. The City's current tipping fee at the RDF facility is $52.75 per ton and the Boone County Landfill out-of-county tip fee is $44.50 per ton plus haul costs.

TABLE 18

Scenarios 6a and 6b - Mass Burn Facilities
Summary of Avoided Costs, Revenues, and Additional Required System Revenues[1]
Present Value (2012$)

Scenarios	Net Energy Generation		Avoided Costs[3] (2012$)	Annual Energy Revenues[4] (2012$)	Tip Fee & Per Capita Revenues[5] (2012$)	Add'l Net Revenues/(Expenses)[6]	
	Annual kWh/yr[2]	kWh/ ton MSW				Net w/out Avoided Costs	Net w/ Avoided Costs
6a	35,280,000	600	$5,410,000	$1,760,000	$4,040,000	($10,160,000)	($5,080,000)
6b	34,692,000	590	$5,410,000	$1,730,000	$4,040,000	($10,960,000)	($5,870,000)

Notes:

1. Cost estimates are conceptual and thus costs/revenues rounded to nearest $10,000.
2. Annual shown based on 2012 projected tonnage; will vary annually depending upon waste combusted.
3. Avoided Costs based on City provided data and includes avoided yard waste management and EGP costs.
   Note: The RRP budget replaced with mass burn facility O&M and debt service.
4. Energy Revenues assume $0.05/kWh. Potential value of electric capacity not included.
5. Tipping Fee & Per Capita Revenues assume $52.75/ton and $9.10 per capita, respectively, on 2012 tonnages.
6. The net expenses are the additional tipping fee revenues required to break even.
   Present Value of first year net operating expenses (required add'l revenues), assuming discount of 1% per annum.
   Required tip fee per ton of waste will vary depending upon tonnages received/ per capita assessment.

APPENDIX A
CAPITAL COST ESTIMATES

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

SCENARIO 1 - GASIFICATION WITH COMBUSTION OF SYNGAS IN EXISTING COAL BOILERS
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$22,700,000
IV.	BUILDINGS	$1,700,000
V.	POWER BLOCK EQUIPMENT	$1,780,000
	SUBTOTAL CONSTRUCTION	$27,000,000
	PERMITTING	$50,000
	DESIGN/ENGINEERING (8%)	$2,000,000
	CONTINGENCY (20%)	$5,400,000
	TOTAL CAPITAL COST	$34,500,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

I. SITEWORK

Item	Quantity	Units	Unit Price	Item Cost	Total
Geotechnical Services	1	LS	$20,000	$20,000	
Surveying	1	LS	$15,000	$15,000	
Mobilization	1	LS	$100,000	$100,000	
Const. Access, Parking and Laydowr	1	LS	$50,000	$50,000	
Subtotal I					$185,000

II. SITE IMPROVEMENTS

Item	Quantity	Units	Unit Price	Item Cost	Total
Earthwork					
General Earthwork(1)	3,000	cy	$7	$21,000	
Finishing Grading	3,000	sy	$0.50	$1,500	
Roadways (2)	2,133	sy	$40	$85,000	
Asphalt Pavement, Parking	333	sy	$40	$13,300	
Site Utilities(3)					
Fire Protection Loop	640	lf	$75	$48,000	
Hydrants	4	ea	$3,500	$14,000	
Water Supply	1,000	lf	$45	$45,000	
Natural Gas Supply	2,000	lf	$60	$120,000	
Sewer System	1	LS	$100,000	$100,000	
Electrical	1	LS	$100,000	$100,000	
Site Drainage	1	LS	$20,000	$20,000	
Fencing	0	lf	$15	$0	
Landscaping	0	LS	$50,000	$0	
Subtotal II					$568,000

Notes:

(1) Assumes 3 ft of earthwork over area surrounding building.

(2) 800 ft of 24 ft wide asphalt road

(3) Utilities unit price includes excavation, bedding material, piping installed, backfill, etc. Assumes water and gas near site.

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

III. GASIFICATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Purchase[1]	2	LS	$4,500,000	$9,000,000	
Gas Cooling System[2]	2	LS	$1,500,000	$3,000,000	
Gas Compressor	1	LS	$600,000	$600,000	
Enclosed Flare[3]	1	LS	$500,000	$500,000	
RDF Feed to Gasifier Bin	1	LS	$150,000	$150,000	
Duct to Plant[4]					
Piping	650	LF	$350	$227,500	
Insulation and lagging	1	LS	$57,000	$57,000	
Supports	1	LS	$182,000	$182,000	
Valves & Fittings	1	LS	$113,750	$113,800	
Fly Ash Handling	2	LS	$75,000	$150,000	
Bottom Ash (Char) Handling	2	LS	$300,000	$600,000	
Equipment Installation (Labor&Mat'l)	1	LS	$5,600,000	$5,600,000	
Electrical and Controls (Labor&Mat'l)	1	LS	$1,400,000	$1,400,000	
Foundations	1	LS	$840,000	$840,000	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal III					$22,720,000

Notes:
(1) Second unit for redundancy, equipment price based on quote from ICM.
(2) Required to protect downstream equipment.
(3) Provided to dump syngas in the event of a malfunction or trip. Duct to plant would be emptied through the flare. Pricing based on quote from Zeeco.
(4) Estimated based on elevated, insulated and lagged, 24" pipe to the plant.
(5) General note, estimate based on locating the gasifier equipment near the existing RDF Storage bin.

IV. BUILDINGS

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Bldg	12,000	SF	$140	$1,680,000	
Subtotal IV					$1,680,000

V. POWER BLOCK EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
New Burners Unit 8 [1]	1	LS	$600,000	$600,000	
New Burners Unit 7	1	LS	$290,340	$290,000	
Installation	1	LS	$712,000	$712,000	
Electrical and controls [2]	1	LS	$178,000	$178,000	
Subtotal V					$1,780,000

Notes:
(1) Based on quote from Coen to modify burners to add a syngas gun to each burner .
(2) Quote for burners included flame scanners. Syngas firing BMS logic (Boolean type) to be integrated into

Subtotal I through V	$26,933,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

SCENARIO 2 - GASIFICATION WITH COMBUSTION OF SYNGAS IN EXISTING NATURAL GAS BOILERS CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$22,700,000
IV.	BUILDINGS	$1,700,000
V.	POWER BLOCK EQUIPMENT	$1,200,000
	SUBTOTAL CONSTRUCTION	$26,400,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$2,000,000
	CONTINGENCY (20%)	$5,300,000
	TOTAL CAPITAL COST	$33,800,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

I. SITEWORK

Item	Quantity	Units	Unit Price	Item Cost	Total
Geotechnical Services	1	LS	$20,000	$20,000	
Surveying	1	LS	$15,000	$15,000	
Mobilization	1	LS	$100,000	$100,000	
Const. Access, Parking and Laydov	1	LS	$50,000	$50,000	
Subtotal I					$185,000

II. SITE IMPROVEMENTS

Item	Quantity	Units	Unit Price	Item Cost	Total
Earthwork					
General Earthwork(1)	3,000	cy	$7	$21,000	
Finishing Grading	3,000	sy	$0.50	$1,500	
Roadways (2)	2,133	sy	$40	$85,000	
Asphalt Pavement, Parking	333	sy	$40	$13,300	
Site Utilities(3)					
Fire Protection Loop	640	lf	$75	$48,000	
Hydrants	4	ea	$3,500	$14,000	
Water Supply	1,000	lf	$45	$45,000	
Natural Gas Supply	2,000	lf	$60	$120,000	
Sewer System	1	LS	$100,000	$100,000	
Electrical	1	LS	$100,000	$100,000	
Site Drainage	1	LS	$20,000	$20,000	
Fencing	0	lf	$15	$0	
Landscaping	0	LS	$50,000	$0	
Subtotal II					$568,000

Notes:

(1) Assumes 3 ft of earthwork over area surrounding building.

(2) 800 ft of 24 ft wide asphalt road

(3) Utilities unit price includes excavation, bedding material, piping installed, backfill, etc. Assumes water and gas near site.

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

III. GASIFICATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Purchase[1]	2	LS	$4,500,000	$9,000,000	
Gas Cooling System[2]	2	LS	$1,500,000	$3,000,000	
Gas Compressor	1	LS	$400,000	$400,000	
Enclosed Flare[3]	1	LS	$500,000	$500,000	
RDF Feed to Gasifier Bin	1	LS	$150,000	$150,000	
Duct to Plant[4]					
Piping	1,000	LF	$350	$350,000	
Insulation and lagging	1	LS	$88,000	$88,000	
Supports	1	LS	$280,000	$280,000	
Valves & Fittings	1	LS	$175,000	$175,000	
Fly Ash Handling	2	LS	$75,000	$150,000	
Bottom Ash (Char) Handling	2	LS	$300,000	$600,000	
Equipment Installation (Labor&Mat'l	1	LS	$5,520,000	$5,520,000	
Electrical and Controls (Labor&Mat'	1	LS	$1,380,000	$1,380,000	
Foundations	1	LS	$828,000	$828,000	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal III					$22,721,000

Notes:
(1) Second unit for redundancy, equipment price based on quote from ICM.
(2) Required to protect downstream equipment.
(3) Provided to dump syngas in the event of a malfunction or trip. Duct to plant would be emptied through the flare. Pricing based on quote from Zeeco.
(4) Estimated based on elevated, insulated and lagged, 24" pipe to the plant.
(5) General note, estimate based on locating the gasifier equipment near the existing RDF Storage bin.

IV. BUILDINGS

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Bldg	12,000	SF	$140	$1,680,000	
Subtotal IV					$1,680,000

V. POWER BLOCK EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
New Burners	2	LS	$300,000	$600,000	
Installation	1	LS	$480,000	$480,000	
Electrical and controls [2]	1	LS	$120,000	$120,000	
Subtotal V					$1,200,000
Subtotal I through V					$26,354,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

SCENARIO 3 - GASIFICATION WITH COMBUSTION OF SYNGAS IN NEW COMBUSTION TURBINE
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$30,400,000
IV.	BUILDINGS	$2,800,000
V.	POWER GENERATION EQUIPMENT	$11,880,000
	SUBTOTAL CONSTRUCTION	$45,900,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$4,000,000
	CONTINGENCY (20%)	$9,200,000
	TOTAL CAPITAL COST	$59,200,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

I. SITEWORK

Item	Quantity	Units	Unit Price	Item Cost	Total
Geotechnical Services	1	LS	$20,000	$20,000	
Surveying	1	LS	$15,000	$15,000	
Mobilization	1	LS	$100,000	$100,000	
Const. Access, Parking and Laydov	1	LS	$50,000	$50,000	
Subtotal I					$185,000

II. SITE IMPROVEMENTS

Item	Quantity	Units	Unit Price	Item Cost	Total
Earthwork					
General Earthwork(1)	5,000	cy	$7	$35,000	
Finishing Grading	5,000	sy	$0.50	$2,500	
Roadways (2)	2,133	sy	$40	$85,000	
Asphalt Pavement, Parking	333	sy	$40	$13,300	
Site Utilities(3)					
Fire Protection Loop	770	lf	$75	$57,800	
Hydrants	5	ea	$3,500	$17,500	
Water Supply	1,000	lf	$45	$45,000	
Natural Gas Supply	2,000	lf	$60	$120,000	
Sewer System	1	LS	$100,000	$100,000	
Electrical	1	LS	$100,000	$100,000	
Site Drainage	1	LS	$20,000	$20,000	
Fencing	0	lf	$15	$0	
Landscaping	0	LS	$50,000	$0	
Subtotal II					$596,000

Notes:
(1) Assumes 3 ft of earthwork over area surrounding building.
(2) 800 ft of 24 ft wide asphalt road
(3) Utilities unit price includes excavation, bedding material, piping installed, backfill, etc. Assumes water and gas near site.

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

III. GASIFICATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Purchase[1]	2	LS	$4,500,000	$9,000,000	
Gas Cooling and Cleanup System[2	1	LS	$8,000,000	$8,000,000	
Enclosed Flare[3]	1	LS	$500,000	$500,000	
RDF Feed to Gasifier Bin	1	LS	$150,000	$150,000	
Duct and piping to CTs[4]	1	LS	$900,000	$900,000	
Fly Ash Handling	2	LS	$75,000	$150,000	
Bottom Ash Handling	2	LS	$300,000	$600,000	
Equipment Installation (Labor&Mat'l	1	LS	$7,720,000	$7,720,000	
Electrical and Controls (Labor&Mat'	1	LS	$1,930,000	$1,930,000	
Foundations	1	LS	$1,158,000	$1,158,000	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal III					$30,408,000

Notes:
(1) Second unit for redundancy, equipment price based on quote from ICM.
(2) Required to protect downstream equipment, pricing based on ICM quote.
(3) Provided to dump syngas in the event of a malfunction or trip. Pricing based on quote from Zeeco.
(4) Fuel piping, filters and accessories for combustion turbine is stainless steel.

IV. BUILDINGS

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasification Bldg	18,500	SF	$140	$2,590,000	
Admin/Control/Maint Shop/Wareho	1,330	SF	$140	$186,200	
Subtotal IV					$2,776,000

Notes:
(1) A building for combustion turbines is not provided because the gas turbine package costs include enclosu

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

V. POWER GENERATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Gas Turbine Package	2	Ea	$3,332,000	$6,664,000	
Gas Compressor	2	Ea	$528,000	$1,056,000	
CO Catalyst	2	Ea	$400,000	$800,000	
CEM Equipment	2	Ea	$104,500	$209,000	
Trans Brkrs, Subst and Line	1	LS	$95,000	$95,000	
Generator Voltage Equipment	2	ls	$35,000	$70,000	
Transformers	2	ls	$100,000	$200,000	
Circuit Brkrs, MCCs and other LV E	2	ls	$25,000	$50,000	
Lube Oil Pumps	4	Ea	$4,600	$18,400	
Fuel Compressor Coolant Pumps	4	Ea	$1,300	$5,200	
CT Fin Fan Cooler	4	Ea	$15,500	$62,000	
Fuel Compressor Fin Fan Cooler	4	ls	$4,000	$16,000	
Air Compressors	2	ls	$12,000	$24,000	
Instrumentation	1	ls	$70,000	$70,000	
Mechanical Installation (Labor&Mat	1	ls	$1,121,000	$1,121,000	
Electrical Installation (Labor)	1	ls	$374,000	$374,000	
Foundations	1	ls	$747,168	$747,168	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal V					$11,882,000

Notes:

(1) Entire power generation equipment estimate is based on Thermoflow PEACE output for Siemens SGT-10

Subtotal I through V	$45,847,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

SCENARIO 4 - GASIFICATION WITH COMBUSTION OF SYNGAS IN INTERNAL COMBUSTION ENGINES
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$600,000
III.	GASIFICATION EQUIPMENT	$29,900,000
IV.	BUILDINGS	$4,200,000
V.	POWER GENERATION EQUIPMENT	$25,320,000
	SUBTOTAL CONSTRUCTION	$60,200,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$12,000,000
	TOTAL CAPITAL COST	$77,300,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

I. SITEWORK

Item	Quantity	Units	Unit Price	Item Cost	Total
Geotechnical Services	1	LS	$20,000	$20,000	
Surveying	1	LS	$15,000	$15,000	
Mobilization	1	LS	$100,000	$100,000	
Const. Access, Parking and Laydov	1	LS	$50,000	$50,000	
Subtotal I					$185,000

II. SITE IMPROVEMENTS

Item	Quantity	Units	Unit Price	Item Cost	Total
Earthwork					
General Earthwork(1)	7,000	cy	$7	$49,000	
Finishing Grading	7,000	sy	$0.50	$3,500	
Roadways (2)	2,133	sy	$40	$85,000	
Asphalt Pavement, Parking	333	sy	$40	$13,300	
Site Utilities(3)					
Fire Protection Loop	770	lf	$75	$57,800	
Hydrants	5	ea	$3,500	$17,500	
Water Supply	1,000	lf	$45	$45,000	
Natural Gas Supply	2,000	lf	$60	$120,000	
Sewer System	1	LS	$100,000	$100,000	
Electrical	1	LS	$100,000	$100,000	
Site Drainage	1	LS	$20,000	$20,000	
Fencing	0	lf	$15	$0	
Landscaping	0	LS	$50,000	$0	
Landscaping	0	LS	$50,000	$0	
Subtotal II					$611,000

Notes:
(1) Assumes 3 ft of earthwork over area surrounding building.
(2) 800 ft of 24 ft wide asphalt road
(3) Utilities unit price includes excavation, bedding material, piping installed, backfill, etc. Assumes water and gas near site.

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

III. GASIFICATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Purchase[1]	2	LS	$4,500,000	$9,000,000	
Gas Cooling and Cleanup System[2]	1	LS	$8,000,000	$8,000,000	
Enclosed Flare[3]	1	LS	$500,000	$500,000	
RDF Feed to Gasifier Bin	1	LS	$150,000	$150,000	
Duct and piping to Engines	1	LS	$800,000	$800,000	
Fly Ash Handling	2	LS	$75,000	$150,000	
Bottom Ash Handling	2	LS	$300,000	$600,000	
Equipment Installation (Labor&Mat'l	1	LS	$7,380,000	$7,380,000	
Electrical and Controls (Labor&Mat'	1	LS	$1,845,000	$1,845,000	
Foundations	1	LS	$1,152,000	$1,152,000	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal III					$29,877,000

Notes:
(1) Second unit for redundancy, equipment price based on quote from ICM.
(2) Required to protect downstream equipment, pricing based on ICM quote.
(3) Provided to dump syngas in the event of a malfunction or trip. Pricing based on quote from Zeeco.

IV. BUILDINGS

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Bldg	18,500	SF	$140	$2,590,000	
Admin/Control/Maint Shop/Wareho	1,330	SF	$140	$186,200	
Jenbacher Enclosure	10,400	SF	$140	$1,456,000	
Subtotal IV					$4,232,000

V. POWER GENERATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Jenbacher JMS 620	6	Ea	$2,975,000	$17,850,000	
SCR Catalyst	6	Ea	$250,000	$1,500,000	
CEM Equipment	6	Ea	$90,000	$540,000	
Transformers	1	ls	$375,000	$375,000	
Trans Brkrs, Subst and Line Circuit Brkrs, MCCs and other LV Equip					
Radiator/Fin Fan Cooler	6	Ea	$20,000	$120,000	
Air Compressors	2	ls	$12,000	$24,000	
Instrumentation	1	ls	$100,000	$100,000	
Mechanical Installation (Labor&Mat	1	ls	$2,462,000	$2,462,000	
Electrical Installation (Labor&Mat'l))	1	ls	$821,000	$821,000	
Foundations	1	ls	$1,231,000	$1,231,000	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal V					$25,323,000
Subtotal I through V					$60,228,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

SCENARIO 5 - GASIFICATION WITH COMBUSTION IN NEW BOILERS WITH STEAM TURBINE
CONCEPTUAL CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$185,000
II.	SITE IMPROVEMENTS	$800,000
III.	GASIFICATION EQUIPMENT	$17,700,000
IV.	BUILDINGS	$3,700,000
V.	POWER BLOCK EQUIPMENT	$39,350,000
	SUBTOTAL CONSTRUCTION	$61,700,000
	PERMITTING	$60,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$12,300,000
	TOTAL CAPITAL COST	$79,100,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

I. SITEWORK

Item	Quantity	Units	Unit Price	Item Cost	Total
Geotechnical Services	1	LS	$20,000	$20,000	
Clear and Grub	1	LS	$15,000	$15,000	
Mobilization	1	LS	$100,000	$100,000	
Const. Access, Parking and Laydov	1	LS	$50,000	$50,000	
Subtotal I					$185,000

II. SITE IMPROVEMENTS

Item	Quantity	Units	Unit Price	Item Cost	Total
Earthwork					
General Earthwork(1)	5,000	cy	$7	$35,000	
Finishing Grassing & Grading	8,000	sy	$0.50	$4,000	
Roadways (2)	2,133	sy	$40	$85,300	
Asphalt Pavement, Parking	500	sy	$40	$20,000	
Site Utilities(3)					
Fire Protection Loop	2,000	lf	$75	$150,000	
Hydrants	8	ea	$3,500	$28,000	
Water Supply	1,000	lf	$45	$45,000	
Natural Gas Supply	2,000	lf	$60	$120,000	
Sewer System	1	LS	$100,000	$100,000	
Electrical	1	LS	$100,000	$100,000	
Site Drainage	1	LS	$100,000	$100,000	
Fencing	0	lf	$15	$0	
Landscaping	0	LS	$50,000	$0	
Subtotal II					$787,000

Notes:
(1) Assumes 3 ft of earthwork over area surrounding building.
(2) 800 ft of 24 ft wide asphalt road
(3) Utilities unit price includes excavation, bedding material, piping installed, backfill, etc. Assumes water and gas near site.

III. GASIFICATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Equipment Purchase[(1)]	2	LS	$4,500,000	$9,000,000	
RDF Feed to Gasifier Bin	1	LS	$150,000	$150,000	
Fly Ash Handling	2	LS	$75,000	$150,000	
Bottom Ash (Char) Handling	2	LS	$300,000	$600,000	
Equipment Installation (Labor&Mat'l	1	LS	$5,940,000	$5,940,000	
Electrical and Controls (Labor&Mat'	1	LS	$990,000	$990,000	
Foundations	1	LS	$594,000	$594,000	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal III					$17,724,000

Notes:
(1) Second unit for redundancy, equipment price based on quote from ICM.
(2) Estimate based on locating the gasifier equipment near the existing RDF Storage bin.

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Near Existing Storage Bin in Ames

IV. BUILDINGS

Item	Quantity	Units	Unit Price	Item Cost	Total
Gasifier Bldg	12,000	SF	$140	$1,680,000	
Power Block	9,165	SF	$220	$2,016,300	
Subtotal IV					$3,696,000

V. POWER BLOCK EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Thermal Oxidizer	2	ls	$1,500,000	$3,000,000	
Waste Heat Boiler	2	ea	$2,160,000	$4,320,000	
Aux Cooling Water System	1	ls	$59,000	$59,000	
Condensate System	1	ls	$263,000	$263,000	
Chem Feed	1	ls	$50,000	$50,000	
Circulating Water System	1	ls	$184,000	$184,000	
Waste Water System	1	ls	$231,000	$231,000	
Water Treatment	1	ls	$210,000	$210,000	
Fire Protection	1	ls	$184,000	$184,000	
Feedwater System	1	ls	$168,000	$168,000	
Compressed Air System	1	ls	$54,000	$54,000	
Service Water System	1	ls	$45,000	$45,000	
Steam Piping	1	ls	$100,000	$100,000	
Steam Turbine	1	ls	$4,203,000	$4,203,000	
AQCS	2	ls	$4,500,000	$9,000,000	
Ductwork, ID Fans and Stack	2	ls	$1,400,000	$2,800,000	
Installation (Labor and Mat'l)	1	ls	$11,110,000	$11,110,000	
Electrical Installation (Labor and Ma	1	ls	$1,307,000	$1,307,000	
Foundations	1	ls	$1,766,000	$1,766,000	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal V					$39,354,000
Subtotal I through V					$61,746,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Undetermined Site in Ames

SCENARIO 6a - CONCEPTUAL MASS BURN FACILITY
CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$335,000
II.	SITE IMPROVEMENTS	$1,500,000
III.	GASIFICATION EQUIPMENT	$0
IV.	BUILDINGS	$9,100,000
V.	POWER BLOCK EQUIPMENT	$51,830,000
	SUBTOTAL CONSTRUCTION	$62,800,000
	PERMITTING	$125,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$12,600,000
	TOTAL CAPITAL COST	$80,500,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Undetermined Site in Ames

I. SITEWORK

Item	Quantity	Units	Unit Price	Item Cost	Total
Land Acquisition	1	LS	$150,000	$150,000	
Geotechnical Services	1	LS	$20,000	$20,000	
Surveying	1	LS	$15,000	$15,000	
Mobilization	1	LS	$100,000	$100,000	
Const. Access, Parking and Laydov	1	LS	$50,000	$50,000	
Subtotal I					$335,000

II. SITE IMPROVEMENTS

Item	Quantity	Units	Unit Price	Item Cost	Total
Earthwork					
General Earthwork(1)	52,000	cy	$7	$364,000	
Finishing Grassing & Grading	10,000	sy	$0.50	$5,000	
Roadways (2)	7,040	sy	$40	$281,600	
Scales	1	ea	$100,000	$100,000	
Asphalt Pavement, Parking	1,000	sy	$40	$40,000	
Concrete pavement	267	sy	$40	$10,700	
Site Utilities(3)					
Fire Protection Loop	2,000	lf	$75	$150,000	
Hydrants	8	ea	$3,500	$28,000	
Water Supply	1,000	lf	$45	$45,000	
Natural Gas Supply	2,000	lf	$60	$120,000	
Sewer System	1	LS	$100,000	$100,000	
Electrical	1	LS	$100,000	$100,000	
Site Drainage	1	LS	$100,000	$100,000	
Fencing	2,000	lf	$15	$30,000	
Landscaping	1	LS	$50,000	$50,000	
Subtotal II					$1,524,000

Notes:
(1) Assumes 3 ft of earthwork over 10 acres and pit excavation
(2) 1/2 mile of 24 ft wide asphalt road
(3) Utilities unit price includes excavation, bedding material, piping installed, backfill, etc. Assumes water and gas near site.

III. GASIFICATION EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Equipment Purchase	0	LS	$0	$0	
Equipment Installation	0	LS	$0	$0	
Electrical	0	LS	$0	$0	
Foundations	0	LS	$0	$0	
Subtotal III					$0

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Undetermined Site in Ames

IV. BUILDINGS

Item	Quantity	Units	Unit Price	Item Cost	Total
MSW Receiving Bldg	17,625	SF	$140	$2,467,500	
Storage Pit Concrete	1,048	CY	$500	$524,074	
Pit and crane bldg	8,460	SF	$200	$1,692,000	
Cranes	1	LS	$2,340,000	$2,340,000	
Scale House	350	SF	$250	$87,500	
Power Block	9,165	SF	$220	$2,016,300	
Subtotal IV					$9,127,000

V. POWER BLOCK EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
MSW fired Boiler	2	ls	$9,000,000	$18,000,000	
Bottom Ash Handling	1	ls	$500,000	$500,000	
Flyash Handling/Conditioning	1	ls	$200,000	$200,000	
Aux Cooling Water System	1	ls	$65,000	$65,000	
Condensate System	1	ls	$250,000	$250,000	
Chem Feed	1	ls	$65,000	$65,000	
Circulating Water System	1	ls	$400,000	$400,000	
Waste Water System	1	ls	$256,878	$256,878	
Water Treatment	1	ls	$233,525	$233,525	
Fire Protection	1	ls	$204,335	$204,335	
Feedwater System	1	ls	$186,820	$186,820	
Compressed Air System	1	ls	$60,000	$60,000	
Service Water System	1	ls	$50,000	$50,000	
Steam Piping	1	ls	$100,000	$100,000	
Steam Turbine	1	ls	$4,000,000	$4,000,000	
AQCS	2	ls	$4,500,000	$9,000,000	
Ductwork, ID Fans and Stack	2	ls	$1,400,000	$2,800,000	
Mechanical (Labor and Mat'l)	1	ls	$10,949,000	$10,949,000	
Electrical (Labor and Mat'l)	1	ls	$2,738,000	$2,738,000	
Foundations	1	ls	$1,474,293	$1,474,293	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal V					$51,833,000
Subtotal I through V					$62,819,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Undetermined Site in Ames

SCENARIO 6b - CONCEPTUAL MASS BURN w SHREDDED MSW FACILITY
CAPITAL COST ESTIMATE SUMMARY

I.	SITEWORK	$335,000
II.	SITE IMPROVEMENTS	$1,500,000
III.	PROCESSING EQUIPMENT	$3,700,000
IV.	BUILDINGS	$9,500,000
V.	POWER BLOCK EQUIPMENT	$51,770,000
	SUBTOTAL CONSTRUCTION	$66,800,000
	PERMITTING	$125,000
	DESIGN/ENGINEERING (8%)	$5,000,000
	CONTINGENCY (20%)	$13,400,000
	TOTAL CAPITAL COST	$85,300,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Undetermined Site in Ames

I. SITEWORK

Item	Quantity	Units	Unit Price	Item Cost	Total
Land Acquisition	1	LS	$150,000	$150,000	
Geotechnical Services	1	LS	$20,000	$20,000	
Surveying	1	LS	$15,000	$15,000	
Mobilization	1	LS	$100,000	$100,000	
Const. Access, Parking and Laydov	1	LS	$50,000	$50,000	
Subtotal I					$335,000

II. SITE IMPROVEMENTS

Item	Quantity	Units	Unit Price	Item Cost	Total
Earthwork					
General Earthwork(1)	52,000	cy	$7	$364,000	
Finishing Grassing & Grading	10,000	sy	$0.50	$5,000	
Roadways (2)	7,040	sy	$40	$281,600	
Scales	1	ea	$100,000	$100,000	
Asphalt Pavement, Parking	1,000	sy	$40	$40,000	
Concrete pavement	267	sy	$40	$10,700	
Site Utilities(3)					
Fire Protection Loop	2,000	lf	$75	$150,000	
Hydrants	8	ea	$3,500	$28,000	
Water Supply	1,000	lf	$45	$45,000	
Natural Gas Supply	2,000	lf	$60	$120,000	
Sewer System	1	LS	$100,000	$100,000	
Electrical	1	LS	$100,000	$100,000	
Site Drainage	1	LS	$100,000	$100,000	
Fencing	2,000	lf	$15	$30,000	
Landscaping	1	LS	$50,000	$50,000	
Subtotal II					$1,524,000

Notes:
(1) Assumes 3 ft of earthwork over 10 acres and pit excavation
(2) 1/2 mile of 24 ft wide asphalt road
(3) Utilities unit price includes excavation, bedding material, piping installed, backfill, etc. Assumes water and gas near site.

III. PROCESSING EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
Equipment Purchase	1	LS	$2,100,000	$2,100,000	
Equipment Installation	1	LS	$1,050,000	$1,050,000	
Electrical	1	LS	$420,000	$420,000	
Foundations	1	LS	$168,000	$168,000	
Subtotal III					$3,738,000

Project:	Ames Gasification Financial Analysis
Estimator:	KJF
Reviewer:	JRN
Date:	1-Feb-13
Estimate Basis:	Conceptual
Costs:	2012$
Location:	Undetermined Site in Ames

IV. BUILDINGS

Item	Quantity	Units	Unit Price	Item Cost	Total
MSW Receiving Bldg	20,269	SF	$140	$2,837,625	
Storage Pit Concrete	1,048	CY	$500	$524,074	
Pit and crane bldg	8,460	SF	$200	$1,692,000	
Cranes	1	LS	$2,340,000	$2,340,000	
Scale House	350	SF	$250	$87,500	
Power Block	9,165	SF	$220	$2,016,300	
Subtotal IV					$9,497,000

V. POWER BLOCK EQUIPMENT

Item	Quantity	Units	Unit Price	Item Cost	Total
MSW fired Boiler	2	ls	$9,000,000	$18,000,000	
Bottom Ash Handling	1	ls	$500,000	$500,000	
Flyash Handling/Conditioning	1	ls	$200,000	$200,000	
Aux Cooling Water System	1	ls	$65,000	$65,000	
Condensate System	1	ls	$250,000	$250,000	
Chem Feed	1	ls	$65,000	$65,000	
Circulating Water System	1	ls	$400,000	$400,000	
Waste Water System	1	ls	$256,878	$256,878	
Water Treatment	1	ls	$233,525	$233,525	
Fire Protection	1	ls	$204,335	$204,335	
Feedwater System	1	ls	$186,820	$186,820	
Compressed Air System	1	ls	$60,000	$60,000	
Service Water System	1	ls	$50,000	$50,000	
Steam Piping	1	ls	$60,000	$60,000	
Steam Turbine	1	ls	$4,000,000	$4,000,000	
AQCS	2	ls	$4,500,000	$9,000,000	
Ductwork, ID Fans and Stack	2	ls	$1,400,000	$2,800,000	
Mechanical (Labor and Mat'l)	1	ls	$10,933,000	$10,933,000	
Electrical (Labor and Mat'l)	1	ls	$2,734,000	$2,734,000	
Foundations	1	ls	$1,471,893	$1,471,893	
Shop Tools & Equip.	1	Allowance	$100,000	$100,000	
Spare Parts	1	Allowance	$200,000	$200,000	
Subtotal V					$51,770,000
Subtotal I through V					$66,864,000

APPENDIX B
OPERATING COST ESTIMATES
SCENARIOS 1 TO 5

APPENDIX B - PRINCIPAL OPERATING ASSUMPTIONS, SCENARIOS 1 - 5
Ames, IA Gasification Project Financial Review

Items in red may be reviewed and changed for sensitivity runs.

Annual Escalation Rates

Construction Capital Cost Escalation	4.0%	*Base Case*	NPV Rate	2.0% *Base Case*
Labor Cost Escalation	2.0%	*Base Case*		
O&M Costs Escalation	2.0%	*Base Case*		
Haul & Disposal Costs	2.0%	*Base Case*		
Electricity Purchase Rates	2.0%	*Base Case*		
Natural Gas Rates	2.0%	*Base Case*		
Fuel Oil & Diesel Rates	2.0%	*Base Case*		
Materials Sales	2.0%	*Base Case*		
Carbon Credit Escalation	2.0%	*Base Case*		
Energy Sales Escalation	0.0%	*Base Case*	*Used in equation for supplemental tip fee revenues*	
Avoided Costs Escalation	0.0%	*Base Case*	*For avoided costs, except for haul & disposal and RDF bins O&M*	

Financing & Capital Costs Summary

CREB Interest Rate	0.0%	*IRS currently not accepting applications for new CREB bond volume (Sept. 2012)*		
Incentive Loan Interest Rate	1.0%	*Iowa Energy Bank interest rate w/ 2.25% fees and 15-year payment period*		
	0.0%	*Iowa Alt Energy Revolving Loan Program w/ max $1M and 20-year term*		
Interest Rate (G.O. Bonds)	3.0%			
Interest Rate (Revenue Bonds)	6.0%	*Base Case*	Long-Term Reinvestment Rate =	2.0%
Bond Issuance Fees	4.0%	*Base Case*	Short-Term Reinvestment Rate =	2.0%
Amortization Period	20	years		
Grant Funds Available	$0	*Base Case*	*or grant as % of capital cost*	

Gasification - Scenario 1 & 2 **See separate Capital Cost Spreadsheet for details** *$ in year 2012*

Sc1: Gasification, Bldgs & Power Block Capital Cost	$34,500,000	*HDR est.*		
Sc1: Capital Debt Service	$3,936,000	per year	at Total Capital Financed (2012$) =	$34,500,000
Sc2: Gasification, Bldgs & Power Block Capital Cost	$33,800,000	*HDR est.*		
Sc2: Capital Debt Service	$3,855,000	per year	at Total Capital Financed (2012$) =	$33,800,000

Gasification - Scenario 3

Gasification System & Bldgs Capital	$43,900,000	*HDR est.*		
Power Generation Equip - CT Capital	$15,300,000	*HDR est.*		
Sc3: Capital Debt Service	$6,981,000	per year	at Total Capital Financed (2012$) =	$59,200,000

Gasification - Scenario 4

Gasification System & Bldgs Capital	$44,800,000	*HDR est.*		
Power Generation Equip - ICE Capital	$32,500,000	*HDR est.*		
Sc4: Capital Debt Service	$9,115,000	per year	at Total Capital Financed (2012$) =	$77,300,000

Gasification - Scenario 5

Gasification System & Bldgs Capital	$28,700,000	*HDR est.*		
Power Generation Equip - Boilers/Steam Turbine Capital	$50,400,000	*HDR est.*		
Sc5: Capital Debt Service	$9,650,000	per year	at Total Capital Financed (2012$) =	$79,100,000

Scheduling

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Planning, Permitting & Design Period (months)	18	18	18	18	18
Construction & Start-Up (months)	18	18	24	24	30
Assumed Project Notice to Proceed	1/1/2013	1/1/2013	1/1/2013	1/1/2013	1/1/2013

APPENDIX B - PRINCIPAL OPERATING ASSUMPTIONS, SCENARIOS 1 - 5
Ames, IA Gasification Project Financial Review

Waste Quantities Inputs

MSW to RDF Plant, tpy	56,000 tpy	*5-yr average from City provided data*			
MSW Annual Growth Projections =	1.0%	*annually*			
Supplemental MSW, tpy	0,000 tpy	*City input amount if known*			
Bypass & Non-Processible Waste	8%	*5-yr average % from City data*	4,500 tpy	*City provided data*	
Processed Tons	51,500 tpy				
Recovered Ferrous/Front-end Metals	4.1%	*5-yr avg % processed, City data*	2,100 tpy	*City provided data*	
Recovered Non-Ferrous	0.2%	*avg % of MSW processed*	100 tpy	*City provided data*	
RDF, % of Processed Tons	67%	*pre-gasification, 5-yr average % from City provided data*			
RDF, % of Processed Tons	**85%**	***w/ gasification system, per City more RDF directed to gasification***			
RDF Combusted in Coal Boilers, tpy	34,500	*5-yr average from City provided data*			
RDF Available to Gasification, tpy	43,800	*current yr estimate*	RDF projections year 2035		55100 tpy
Operations:	**310**	**days/yr**	141 tpd	to	178 tpd
	7440	hrs/yr	6 tph	Existing RDF bin storage is	
Gasification System Rated Capacity	300	tpd		300 tons	practical storage
				500 tons	max storage
Capacity Factor	85%	*2 Units for redundancy/availability - otherwise reduce factor to 60%*			
Facility Throughput Capacity	93,080 tpy	*At capacity factor x 300 tpd x 365 days/yr*			
Ash Residue/Char, %RDF gasified	12%	*dry basis*	*from City provided data (7-day RDF gasification demonstration)*		
	15%	*wet basis, at assumed 20% moisture*			

Tipping Fees & Haul

Boone County Sanitary Landfill	$44.50 $/ton	*Out-of-County tip fee 2012*		
Bypass Waste Haul Cost	$14.28 $/ton	*to Boone Cnty LF;*	*assume same as process rejects haul*	
Process Residue/Rejects Haul Cost	$14.28 $/ton	*to Boone Cnty LF;*	*from City 2012/2013 budget cost*	
Metro Waste Authority Landfill	$34.00 $/ton	*Iowa Statewide Landfill Tip Fees 2011*		*Base Case gasification*
MWA tip fee for coal ash as cover	$0.00 $/ton	*per City;*		
Ash Haul Cost to MWA Landfill	$21.00 $/ton	*per City EGP, Jan-Apr 2012*		*Base Case gasification*

Operating Revenues Assumptions

Energy Generation & Pricing

RDF Higher Heating Value, HHV	5180 Btu/lb	*5180 Btu/lb from City 2012 monthly RDF analysis (Jan-Oct)*		
Syngas Generation (@300tpd):	65923 lb gas/hr	2.64 lb syngas/RDF	1400 Btu/lbsyngas	
Syngas LHV =	1182			

See separate Combustion Calcs Spreadsheet for details

Gasification - Scenario 1 & 2

% Recovery of RDF Heating Value	65%
Syngas Heating Value per Ton RDF	6.7 MMBtu Syngas per ton RDF
Electric Generation from Syngas	*Generated in the existing boilers w/ either coal or natural gas*

Gasification - Scenario 3	per ton RDF	Net Power Gen	Heat Input Req'd	Natural Gas Fuel Req'd
Net Power Output (at 250 tpd) =	463 kWh/ton	8050 kW	104 MMBtu/hr	47 MCF/hr
Net Power Output (at 200 tpd) =	451 kWh/ton	8050 kW	104 MMBtu/hr	63 MCF/hr
Net Power Output (at 150 tpd) =	431 kWh/ton	3775 kW	52 MMBtu/hr	16 MCF/hr
Gasification - Scenario 4	per ton RDF			
Net Power Output (at 250 tpd) =	590 kWh/ton	6148 kW	65 MMBtu/hr	
Net Power Output (at 200 tpd) =	577 kWh/ton	4808 kW	52 MMBtu/hr	
Net Power Output (at 150 tpd) =	555 kWh/ton	3469 kW	39 MMBtu/hr	
Gasification - Scenario 5	per ton RDF			
Net Power Output =	500 kWh/ton			

Electric Revenue Rate	$0.05 $/kWh	*Provided by City*	*Use for value of energy revenues*	
Electric Capacity Payment	$0 $/kW	*This cell tied to annual payment in energy revenues-Scenarios 3,4,5*		
Avg Coal Energy Cost =	$3.568 $/MMBtu	*from City 2012 monthly data; use for value of Syngas-Scenarios 1 & 2*		
Renewable Energy Credit	$0.000 $/kWh	*Iowa Code Ch. 476C, 1.5 ¢/kWh renewable tax credits, corporate*		
Carbon Credits Pricing	$2 $/ton CO2e	*RGGI, Inc. Marketing Sector Report Sept. 2012 (NE&mid-Atlantic states)*		
Project Carbon Offsets	0 ton CO2e per MMBtu		*Base Case*	
	0 ton CO2e per kWh		*Base Case*	

Net Tip Fee Revenues

Supplemental MSW Tip Fee	$0 $/ton	*To be identified by City*	
RRP Cost to Operate	$0 $/ton	*To be identified by City for processing waste into RDF*	
Net Tip Fee - Supplemental MSW	$0 $/ton	*Revenues determined by City to be applied to Gasification Project*	

APPENDIX B - PRINCIPAL OPERATING ASSUMPTIONS, SCENARIOS 1 - 5
Ames, IA Gasification Project Financial Review

Avoided Annual Costs

Avoided RDF Landfill Haul & Disposal Costs		$546,654	*calculated from City provided data 2012$*
RDF redirected to gasification	9,300	tpy	
Avoided RDF Ash Disposal Costs		$120,220	*calculated from City provided data 2012$*
RDF ash, co-fired boilers, dry basis	10.8%	*w/ 20% fly ash and 80% bottom ash;*	*bottom ash beneficial use to disposal 10:1*
Bottom ash removal expenses	$124,710	*80% RDF ash at bottom ash removal $41.25/tonx(10/11)+ $46.00/tonx(1/11)*	
Reduced RDF flyash sales	-$4,490	*20% RDF ash at $6.00 per ton*	
Avoided RDF Storage Bins O&M Costs		$161,000	*From City - See O&M expense below*
Avoided Boiler Maintenance Costs		$1,034,000	*City provided data (10-yr avg)-not reviewed by HDR*
Avoided Extra Cost of Power to Burn RDF - Sc 1&2		$1,383,070	*City provided data for Syngas in existing boilers-not reviewed by HDR*
Avoided Extra Cost of Power to Burn RDF - Sc 3,4,5		$4,061,147	*City provided data for no RDF/Syngas (2015)-not reviewed by HDR*
Avoided Extra Cost of Power (Yr 2020 Increase)		$2,817,943	*City provided data for one-time increase assuming cap & trade*
Annual Escalation (Yr 2020 to 2035)		3.1%	*Based on City provided data, average annual over the period*

RDF Facility MSW tip fee= $52.75 per ton

Operating Expenses Assumptions

Labor

Gasification - Scenario 1 & 2

Gasification Operator Time per shift	8	hours per shift		
Number of shifts	3	shifts per day		
Gasification Operations	7	days/week		
	85%	Gasification System Availability		
			Hourly rates provided by City	
Plant Manager/Supervisor	0	FTE, existing	Supervisor Rate	$55 *per hr, incl. % benefits*
Equipment Operators	7	FTE	Operator Rate	$45 *per hr, incl. % benefits*
Maintenance - Mechanic	2	FTE	Mechanic Rate	$40 *per hr, incl. % benefits*
Maintenance - Electrician	2	FTE	Electrician Rate	$45 *per hr, incl. % benefits*
General Administration	0.5	FTE	Admin Labor	$31 *per hr, incl. % benefits*
Ash/Char Marketing	0	FTE	Marketer Labor	$31 *per hr, incl. % benefits*
Overtime - Operators & Maintenance	5%	per year =	1144 hrs at 1.5X rate	
Benefits Rate	26%	*Provided by City*		

Gasification - Scenario 3 Combustion Turbine Operations Labor (Add to Gasification Scenario 1&2 labor)

Supervisor	1	FTE	Supervisor Rate	$55 *per hr, incl. % benefits*
Equipment Operators	3	FTE	Operator Rate	$45 *per hr, incl. % benefits*
Maintenance - Mech/Electr	1	FTE	Mech/Electr Rate	$43 *per hr, incl. % benefits*
Overtime - Operators & Maintenance	5%	per year =	416 hrs at 1.5X rate	

Gasification - Scenario 4 IC Engine Operations Labor (Add to Gasification Scenario 1&2 labor)

Supervisor	1	FTE	Supervisor Rate	$55 *per hr, incl. % benefits*
Equipment Operators	3	FTE	Operator Rate	$45 *per hr, incl. % benefits*
Maintenance - Mech/Electr	1	FTE	Mech/Electr Rate	$43 *per hr, incl. % benefits*
Overtime - Operators & Maintenance	5%	per year =	416 hrs at 1.5X rate	

Gasification - Scenario 5 Boiler/Steam Turbine Operations Labor (Add to Gasification Scenario 1&2 labor)

Supervisor	1	FTE	Supervisor Rate	$55 *per hr, incl. % benefits*
Equipment Operators	7	FTE	Operator Rate	$45 *per hr, incl. % benefits*
Maintenance - Mech/Electr	7	FTE	Mech/Electr Rate	$43 *per hr, incl. % benefits*
Mechanics Helper	2	FTE	Mech Help Rate	$25 *per hr, incl. % benefits*
Overtime - Operators & Maintenance	5%	per year =	1664 hrs at 1.5X rate	

Routine Maintenance/Capital Replacement

Gasifier Routine Maintenance	2%	*of system capital cost of equipment & building*	
Gasifier System-**Scenario 1**	$488,000	*per year @ % of gasification equip. & bldg capital; esc.*	$24,400,000
Gasifier System-**Scenario 2**	$488,000	*per year @ % of gasification equip. & bldg capital; esc.*	$24,400,000
Gasifier & CT-**Scenario 3**	$902,000	*per year @ % of gasification & power block equipment, bldg; esc.*	$45,100,000
Gasifier & IC Engine-**Scenario 4**	$1,188,000	*per year @ % of gasification & power block equipment, bldg; esc.*	$59,400,000
Gasifier & Boiler Package-**Scenario 5**	$1,216,000	*per year @ % of gasification & power block equipment, bldg; esc.*	$60,800,000

Cost of RDF

RDF Revenue Required, annual =	$750,000	*(2012$), provided by the City*
Annual Escalation =	1.0%	*Match MSW growth rate*

APPENDIX B - PRINCIPAL OPERATING ASSUMPTIONS, SCENARIOS 1 - 5
Ames, IA Gasification Project Financial Review

Utilities Usage & Pricing

Electricity Purchase Price	$0.030	$/kWh	*City's 2009- 2011 average weighted purchase price*
Natural Gas Purchase	$5.29	$/ MMBtu	*NYMEX 12-month strip (October 2012 - September 2013) plus estimated distribution costs*
Fuel Oil Purchase	$3.19	$/gal	*City's 2011 average purchase price, escalated*
Water Price	$0.0215	$ per cf	*City's Sup #2012-3, Sec. 28.201, Rev. 07-01-12 - avg com'l rate*
Water Minimum Charge	$538	per month	*City's Sup #2012-3, Sec. 28.201, Rev. 07-01-12 - 4" meter*
Wastewater	$2.21	$ per 100 cf	*City's Sup #2012-3, Sec. 28.304, Rev. 07-01-12*
Stormwater Drainage Charge	$3.45	per month	*City's Sup #2011-3, Sec. 28.802, Rev. 07-01-11*

Gasification - Scenario 1 & 2

Electric Load - Gasification System	500	kW	*System electric load purchased*
Add'l Electric Purchase (outages)	66000	kWh	*Maint/lighting during downtimes - Assume 10% of parasitic load*
Fuel Oil Usage	2000	gal/year	*For start-ups and flare*
Water Usage	10000	gal per day operating	*7.48 gal per cf conversion*
Wastewater	1000	gal per day operating	*Assume 10% of water usage*

Gasification - Scenario 3

Electric Purchase (outages)	132000	kWh	*Assume double of Scenarios 1 & 2 downtime electric load*
Natural Gas	960	MMBtu/year	*(Gas burners 96 hrs/yr at 10 MMBtu/hr) - equiv to 12 cold starts plus maint.*
Natural Gas Fuel (at 150 tpd) =	120600	MMBtu/year	*Calculated; 1MCF = 1.023MMBtu (2011 avg. www.eia.gov)*
Water Usage	10000	gal per day operating	
Wastewater	1000	gal per day operating	*Assumes 10% of water usage*

Gasification - Scenario 4

Electric Purchase (outages)	132000	kWh	*Assume double of Scenarios 1 & 2 downtime electric load*
Fuel Oil Usage	2000	gal/year	*For start-ups and flare*
Water Usage	10000	gal per day operating	
Wastewater	1000	gal per day operating	*Assumes 10% of water usage*

Gasification - Scenario 5

Electric Purchase (start-ups/maint)	132000	kWh	*Assume double of Scenarios 1 & 2 downtime electric load*
Fuel Oil Usage	2000	gal/year	*For start-ups and flare*
Water Usage	13000	gal per day operating	
Wastewater	1300	gal per day operating	*Assumes 10% of water usage*

Chemicals Consumption Usage & Pricing

Gasification - Scenario 1 & 2	0	lbs/ton RDF	*Assume none - air pollution control within EGP*
Gasification - Scenario 3 & 4	$1.30	per ton RDF	*Assume chemical consumption cost half of Scenario 5*
Gasification - Scenario 5			

Aqueous Ammonia (28%)	7.5	lbs/ton RDF	$160	$/ton	*HDR estimate*
Activated Carbon	0.66	lb/ton RDF	$0.60	$/lb carbon	*HDR estimate*
Lime	24	lbs/ton RDF	$140	$/ton lime	*HDR estimate*

Misc. G&A, Supplies, Tools, Expendables	5%	*of labor cost*	*Estimated from City RRP budget*
Insurance	0.15%	*of Total Capital Cost, estimate*	

RDF Storage Bins O&M

Storage bins maintenance	$161,000	*Provided by City, recent 4-yr avg from costs incurred by power plant*
New Feed System O&M	$0	*Included with the Gasifier System O&M above*

Syngas Injection System O&M

Routine and Major Maintenance	$0	*Included with the Gasifier System O&M above*

O&M Contingency

10%

Sensitivities? ---- TO BE DETERMINED

Carbon Credits	$2	$/ton CO2e	*RGGI, Inc. Marketing Sector Report Sept2012 (NE&mid-Atlantic states)*		
Natural Gas Factor	0.0143	MTCE/MMBtu	1 MTCO2e =	0.27	MTCE
Electricity Generation	1.629	lbs CO2/kWh	CO2 Emission Factor for MROW West subregion		
	207.69	lbs CO2/MMBtu	Iowa		
			Source: Year 2009 eGrid2012 Version 1.0		

Scenario 1 - Gasification of RDF, Syngas Supplemental Fuel to City's Coal-Fired Boilers

BASE CASE	2012	2016	2017	2018	2019	2020	2021	2022
OPERATIONS								
Gasification Operating Days/Year	0	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	0	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES								
Waste Deliveries (tons)								
MSW to RDF Plant	56,000	58,280	58,860	59,450	60,040	60,640	61,250	61,860
Supplemental MSW	0	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	4,500	4,660	4,710	4,760	4,800	4,850	4,900	4,950
Ferrous & Non-Ferrous Recovery[2]	2,200	2,310	2,330	2,360	2,380	2,400	2,430	2,450
RDF Process Residue (Oversize & Fines)	14,800	5,730	5,790	5,840	5,910	5,970	6,020	6,090
Process Outputs (tons)								
RDF Combusted	34,500	45,580	46,030	46,490	46,950	47,420	47,900	48,370
Combustion Residue/Char	3,740	6,840	6,900	6,970	7,040	7,110	7,190	7,260
Energy Outputs								
Syngas to Boilers (MMBtu)		305,830	308,850	311,940	315,030	318,180	321,400	324,550
Carbon Offsets (tonnes CO2e)		0	0	0	0	0	0	0
SYSTEM REVENUES								
Energy Revenues - Syngas[3]		$1,091,200	$1,101,900	$1,113,000	$1,124,000	$1,135,200	$1,146,700	$1,158,000
Renewable Energy Credits		$0	$0	$0	$0	$0	$0	$0
Carbon Credits		$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)		$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]		$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues		**$1,091,200**	**$1,101,900**	**$1,113,000**	**$1,124,000**	**$1,135,200**	**$1,146,700**	**$1,158,000**
Avoided RDF Landfill Haul & Disposal Costs		$591,700	$603,600	$615,600	$627,900	$640,500	$653,300	$666,400
Avoided RDF Ash Removal & Disposal Costs		$130,100	$132,700	$135,400	$138,100	$140,900	$143,700	$146,500
Avoided RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Avoided Boiler Maintenance Costs		$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF		$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100
Subtotal Revenues w/ Avoided Costs		**$4,404,400**	**$4,433,100**	**$4,462,400**	**$4,492,000**	**$4,522,300**	**$4,553,200**	**$4,584,300**
SYSTEM EXPENSES								
Purchase of RDF[5]		$780,500	$788,300	$796,100	$804,100	$812,100	$820,300	$828,500
Gasification System/Syngas Injection O&M								
Labor[6]		$1,214,200	$1,238,400	$1,263,200	$1,288,500	$1,314,300	$1,340,500	$1,367,300
Routine Maintenance/Replacement		$528,200	$538,800	$549,600	$560,600	$571,800	$583,200	$594,900
Utilities - Electricity		$123,500	$125,900	$128,400	$131,000	$133,600	$136,300	$139,000
Utilities - Fuel Oil		$6,900	$7,000	$7,200	$7,300	$7,500	$7,600	$7,800
Utilities - Water		$16,600	$17,000	$17,300	$17,600	$18,000	$18,400	$18,700
Utilities - Sewer		$1,000	$1,100	$1,100	$1,100	$1,100	$1,100	$1,200
Chemicals Consumption		$0	$0	$0	$0	$0	$0	$0
Gasification Ash Residue Haul & Disposal		$407,200	$419,000	$431,700	$444,800	$458,200	$472,600	$486,700
Misc. G&A, Supplies, Tools, Expendables[7]		$60,700	$61,900	$63,200	$64,400	$65,700	$67,000	$68,400
Insurance		$56,000	$57,100	$58,300	$59,400	$60,600	$61,800	$63,100
RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Contingency (10%)		$258,900	$264,400	$270,100	$276,000	$281,900	$288,100	$294,300
Subtotal Expenses		**$3,628,000**	**$3,696,700**	**$3,767,500**	**$3,839,700**	**$3,913,400**	**$3,989,300**	**$4,066,200**
CAPITAL COSTS/DEBT SERVICE								
Gasification Project Net Debt Service[8]		$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000
Subtotal Debt Service		**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**
NET REVENUES (EXPENSES)[9]		**($6,472,800)**	**($6,530,800)**	**($6,590,500)**	**($6,651,700)**	**($6,714,200)**	**($6,778,600)**	**($6,844,200)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]		**($3,159,600)**	**($3,199,600)**	**($3,241,100)**	**($3,283,700)**	**($3,327,100)**	**($3,372,100)**	**($3,417,900)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Syngas energy revenues at $3.568 per MMBtu (average 10-month coal value in 2012) with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, syngas injection, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 1 - Gasification of RDF, Syngas Supplemental Fuel to City's Coal-Fired Boilers

BASE CASE	2023	2024	2025	2026	2027	2028	2029
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	62,480	63,100	63,730	64,370	65,010	65,660	66,320
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,000	5,050	5,100	5,150	5,200	5,250	5,310
Ferrous & Non-Ferrous Recovery[2]	2,480	2,500	2,530	2,550	2,580	2,600	2,630
RDF Process Residue (Oversize & Fines)	6,140	6,210	6,260	6,330	6,390	6,460	6,520
Process Outputs (tons)							
RDF Combusted	48,860	49,340	49,840	50,340	50,840	51,350	51,860
Combustion Residue/Char	7,330	7,400	7,480	7,550	7,630	7,700	7,780
Energy Outputs							
Syngas to Boilers (MMBtu)	327,840	331,060	334,420	337,770	341,130	344,550	347,970
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Syngas[3]	$1,169,700	$1,181,200	$1,193,200	$1,205,100	$1,217,100	$1,229,300	$1,241,500
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,169,700**	**$1,181,200**	**$1,193,200**	**$1,205,100**	**$1,217,100**	**$1,229,300**	**$1,241,500**
Avoided RDF Landfill Haul & Disposal Costs	$679,700	$693,300	$707,200	$721,300	$735,700	$750,400	$765,400
Avoided RDF Ash Removal & Disposal Costs	$149,500	$152,500	$155,500	$158,600	$161,800	$165,000	$168,300
Avoided RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100
Subtotal Revenues w/ Avoided Costs	**$4,616,200**	**$4,648,300**	**$4,681,300**	**$4,714,500**	**$4,748,400**	**$4,782,800**	**$4,817,700**
SYSTEM EXPENSES							
Purchase of RDF[5]	$836,800	$845,100	$853,600	$862,100	$870,700	$879,400	$888,200
Gasification System/Syngas Injection O&M							
Labor[6]	$1,394,700	$1,422,600	$1,451,000	$1,480,100	$1,509,700	$1,539,900	$1,570,700
Routine Maintenance/Replacement	$606,800	$618,900	$631,300	$643,900	$656,800	$669,900	$683,300
Utilities - Electricity	$141,800	$144,700	$147,500	$150,500	$153,500	$156,600	$159,700
Utilities - Fuel Oil	$7,900	$8,100	$8,200	$8,400	$8,600	$8,800	$8,900
Utilities - Water	$19,100	$19,500	$19,900	$20,300	$20,700	$21,100	$21,500
Utilities - Sewer	$1,200	$1,200	$1,200	$1,300	$1,300	$1,300	$1,300
Chemicals Consumption	$0	$0	$0	$0	$0	$0	$0
Gasification Ash Residue Haul & Disposal	$501,300	$516,200	$532,200	$547,900	$564,800	$581,400	$599,200
Misc. G&A, Supplies, Tools, Expendables[7]	$69,700	$71,100	$72,600	$74,000	$75,500	$77,000	$78,500
Insurance	$64,300	$65,600	$66,900	$68,300	$69,600	$71,000	$72,500
RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Contingency (10%)	$300,700	$307,200	$313,900	$320,700	$327,700	$334,800	$342,100
Subtotal Expenses	**$4,144,500**	**$4,224,400**	**$4,306,600**	**$4,389,900**	**$4,475,600**	**$4,562,200**	**$4,651,300**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000
Subtotal Debt Service	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**
NET REVENUES (EXPENSES)[9]	**($6,910,800)**	**($6,979,200)**	**($7,049,400)**	**($7,120,800)**	**($7,194,500)**	**($7,268,900)**	**($7,345,800)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($3,464,300)**	**($3,512,100)**	**($3,561,300)**	**($3,611,400)**	**($3,663,200)**	**($3,715,400)**	**($3,769,600)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Syngas energy revenues at $3.568 per MMBtu (average 10-month coal value in 2012) with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, syngas injection, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 1 - Gasification of RDF, Syngas Supplemental Fuel to City's Coal-Fired Boilers

BASE CASE	2030	2031	2032	2033	2034	2035
OPERATIONS						
Gasification Operating Days/Year	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES						
Waste Deliveries (tons)						
MSW to RDF Plant	66,980	67,650	68,330	69,010	69,700	70,400
Supplemental MSW	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,360	5,410	5,470	5,520	5,580	5,630
Ferrous & Non-Ferrous Recovery[2]	2,650	2,680	2,710	2,740	2,760	2,790
RDF Process Residue (Oversize & Fines)	6,590	6,660	6,720	6,780	6,860	6,930
Process Outputs (tons)						
RDF Combusted	52,380	52,900	53,430	53,970	54,500	55,050
Combustion Residue/Char	7,860	7,940	8,010	8,100	8,180	8,260
Energy Outputs						
Syngas to Boilers (MMBtu)	351,460	354,950	358,500	362,130	365,680	369,370
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0
SYSTEM REVENUES						
Energy Revenues - Syngas[3]	$1,254,000	$1,266,400	$1,279,100	$1,292,000	$1,304,700	$1,317,900
Renewable Energy Credits	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,254,000**	**$1,266,400**	**$1,279,100**	**$1,292,000**	**$1,304,700**	**$1,317,900**
Avoided RDF Landfill Haul & Disposal Costs	$780,800	$796,400	$812,300	$828,500	$845,100	$862,000
Avoided RDF Ash Removal & Disposal Costs	$171,700	$175,100	$178,600	$182,200	$185,900	$189,600
Avoided RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100
Subtotal Revenues w/ Avoided Costs	**$4,853,500**	**$4,889,500**	**$4,926,300**	**$4,963,800**	**$5,001,700**	**$5,040,500**
SYSTEM EXPENSES						
Purchase of RDF[5]	$897,100	$906,100	$915,100	$924,300	$933,500	$942,900
Gasification System/Syngas Injection O&M						
Labor[6]	$1,602,100	$1,634,100	$1,666,800	$1,700,100	$1,734,100	$1,768,800
Routine Maintenance/Replacement	$697,000	$710,900	$725,100	$739,600	$754,400	$769,500
Utilities - Electricity	$162,900	$166,200	$169,500	$172,900	$176,300	$179,900
Utilities - Fuel Oil	$9,100	$9,300	$9,500	$9,700	$9,900	$10,100
Utilities - Water	$21,900	$22,400	$22,800	$23,300	$23,800	$24,200
Utilities - Sewer	$1,400	$1,400	$1,400	$1,500	$1,500	$1,500
Chemicals Consumption	$0	$0	$0	$0	$0	$0
Gasification Ash Residue Haul & Disposal	$617,400	$636,200	$654,600	$675,200	$695,500	$716,400
Misc. G&A, Supplies, Tools, Expendables[7]	$80,100	$81,700	$83,300	$85,000	$86,700	$88,400
Insurance	$73,900	$75,400	$76,900	$78,400	$80,000	$81,600
RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900
Contingency (10%)	$349,600	$357,200	$364,900	$373,000	$381,100	$389,400
Subtotal Expenses	**$4,742,400**	**$4,835,400**	**$4,929,100**	**$5,027,000**	**$5,125,700**	**$5,226,600**
CAPITAL COSTS/DEBT SERVICE						
Gasification Project Net Debt Service[8]	$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000	$3,936,000
Subtotal Debt Service	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**	**$3,936,000**
NET REVENUES (EXPENSES)[9]	**($7,424,400)**	**($7,505,000)**	**($7,586,000)**	**($7,671,000)**	**($7,757,000)**	**($7,844,700)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($3,824,900)**	**($3,881,900)**	**($3,938,800)**	**($3,999,200)**	**($4,060,000)**	**($4,122,100)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Syngas energy revenues at $3.568 per MMBtu (average 10-month coal value in 2012) with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, syngas injection, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 2 - Gasification of RDF, Syngas Supplemental Fuel to City's Natural Gas Boilers

BASE CASE	2012	2016	2017	2018	2019	2020	2021	2022
OPERATIONS								
Gasification Operating Days/Year	0	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	0	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES								
Waste Deliveries (tons)								
MSW to RDF Plant	56,000	58,280	58,860	59,450	60,040	60,640	61,250	61,860
Supplemental MSW	0	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	4,500	4,660	4,710	4,760	4,800	4,850	4,900	4,950
Ferrous & Non-Ferrous Recovery[2]	2,200	2,310	2,330	2,360	2,380	2,400	2,430	2,450
RDF Process Residue (Oversize & Fines)	14,800	5,730	5,790	5,840	5,910	5,970	6,020	6,090
Process Outputs (tons)								
RDF Combusted	34,500	45,580	46,030	46,490	46,950	47,420	47,900	48,370
Combustion Residue/Char	3,740	6,840	6,900	6,970	7,040	7,110	7,190	7,260
Energy Outputs								
Syngas to Boilers (MMBtu)		305,830	308,850	311,940	315,030	318,180	321,400	324,550
Carbon Offsets (tonnes CO2e)		0	0	0	0	0	0	0
SYSTEM REVENUES								
Energy Revenues - Syngas[3]		$1,091,200	$1,101,900	$1,113,000	$1,124,000	$1,135,200	$1,146,700	$1,158,000
Renewable Energy Credits		$0	$0	$0	$0	$0	$0	$0
Carbon Credits		$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)		$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]		$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues		**$1,091,200**	**$1,101,900**	**$1,113,000**	**$1,124,000**	**$1,135,200**	**$1,146,700**	**$1,158,000**
Avoided RDF Landfill Haul & Disposal Costs		$591,700	$603,600	$615,600	$627,900	$640,500	$653,300	$666,400
Avoided RDF Ash Removal & Disposal Costs		$130,100	$132,700	$135,400	$138,100	$140,900	$143,700	$146,500
Avoided RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Avoided Boiler Maintenance Costs		$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF		$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100
Subtotal Revenues w/ Avoided Costs		**$4,404,400**	**$4,433,100**	**$4,462,400**	**$4,492,000**	**$4,522,300**	**$4,553,200**	**$4,584,300**
SYSTEM EXPENSES								
Purchase of RDF[5]		$780,500	$788,300	$796,100	$804,100	$812,100	$820,300	$828,500
Gasification System/Syngas Injection O&M								
Labor[6]		$1,214,200	$1,238,400	$1,263,200	$1,288,500	$1,314,300	$1,340,500	$1,367,300
Routine Maintenance/Replacement		$528,200	$538,800	$549,600	$560,600	$571,800	$583,200	$594,900
Utilities - Electricity		$123,500	$125,900	$128,400	$131,000	$133,600	$136,300	$139,000
Utilities - Fuel Oil		$6,900	$7,000	$7,200	$7,300	$7,500	$7,600	$7,800
Utilities - Water		$16,600	$17,000	$17,300	$17,600	$18,000	$18,400	$18,700
Utilities - Sewer		$1,000	$1,100	$1,100	$1,100	$1,100	$1,100	$1,200
Chemicals Consumption		$0	$0	$0	$0	$0	$0	$0
Gasification Ash Residue Haul & Disposal		$407,200	$419,000	$431,700	$444,800	$458,200	$472,600	$486,700
Misc. G&A, Supplies, Tools, Expendables[7]		$60,700	$61,900	$63,200	$64,400	$65,700	$67,000	$68,400
Insurance		$54,900	$56,000	$57,100	$58,200	$59,400	$60,600	$61,800
RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Contingency (10%)		$258,800	$264,300	$270,000	$275,800	$281,800	$288,000	$294,200
Subtotal Expenses		**$3,626,800**	**$3,695,500**	**$3,766,200**	**$3,838,300**	**$3,912,100**	**$3,988,000**	**$4,064,800**
CAPITAL COSTS/DEBT SERVICE								
Gasification Project Net Debt Service[8]		$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000
Subtotal Debt Service		**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**
NET REVENUES (EXPENSES)[9]		**($6,390,600)**	**($6,448,600)**	**($6,508,200)**	**($6,569,300)**	**($6,631,900)**	**($6,696,300)**	**($6,761,800)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]		**($3,077,400)**	**($3,117,400)**	**($3,158,800)**	**($3,201,300)**	**($3,244,800)**	**($3,289,800)**	**($3,335,500)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Syngas energy revenues at $3.568 per MMBtu (average 10-month coal value in 2012) with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, syngas injection, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 2 - Gasification of RDF, Syngas Supplemental Fuel to City's Natural Gas Boilers

BASE CASE	2023	2024	2025	2026	2027	2028	2029
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	62,480	63,100	63,730	64,370	65,010	65,660	66,320
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,000	5,050	5,100	5,150	5,200	5,250	5,310
Ferrous & Non-Ferrous Recovery[2]	2,480	2,500	2,530	2,550	2,580	2,600	2,630
RDF Process Residue (Oversize & Fines)	6,140	6,210	6,260	6,330	6,390	6,460	6,520
Process Outputs (tons)							
RDF Combusted	48,860	49,340	49,840	50,340	50,840	51,350	51,860
Combustion Residue/Char	7,330	7,400	7,480	7,550	7,630	7,700	7,780
Energy Outputs							
Syngas to Boilers (MMBtu)	327,840	331,060	334,420	337,770	341,130	344,550	347,970
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Syngas[3]	$1,169,700	$1,181,200	$1,193,200	$1,205,100	$1,217,100	$1,229,300	$1,241,500
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,169,700**	**$1,181,200**	**$1,193,200**	**$1,205,100**	**$1,217,100**	**$1,229,300**	**$1,241,500**
Avoided RDF Landfill Haul & Disposal Costs	$679,700	$693,300	$707,200	$721,300	$735,700	$750,400	$765,400
Avoided RDF Ash Removal & Disposal Costs	$149,500	$152,500	$155,500	$158,600	$161,800	$165,000	$168,300
Avoided RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100
Subtotal Revenues w/ Avoided Costs	**$4,616,200**	**$4,648,300**	**$4,681,300**	**$4,714,500**	**$4,748,400**	**$4,782,800**	**$4,817,700**
SYSTEM EXPENSES							
Purchase of RDF[5]	$836,800	$845,100	$853,600	$862,100	$870,700	$879,400	$888,200
Gasification System/Syngas Injection O&M							
Labor[6]	$1,394,700	$1,422,600	$1,451,000	$1,480,100	$1,509,700	$1,539,900	$1,570,700
Routine Maintenance/Replacement	$606,800	$618,900	$631,300	$643,900	$656,800	$669,900	$683,300
Utilities - Electricity	$141,800	$144,700	$147,500	$150,500	$153,500	$156,600	$159,700
Utilities - Fuel Oil	$7,900	$8,100	$8,200	$8,400	$8,600	$8,800	$8,900
Utilities - Water	$19,100	$19,500	$19,900	$20,300	$20,700	$21,100	$21,500
Utilities - Sewer	$1,200	$1,200	$1,200	$1,300	$1,300	$1,300	$1,300
Chemicals Consumption	$0	$0	$0	$0	$0	$0	$0
Gasification Ash Residue Haul & Disposal	$501,300	$516,200	$532,200	$547,900	$564,800	$581,400	$599,200
Misc. G&A, Supplies, Tools, Expendables[7]	$69,700	$71,100	$72,600	$74,000	$75,500	$77,000	$78,500
Insurance	$63,000	$64,300	$65,600	$66,900	$68,200	$69,600	$71,000
RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Contingency (10%)	$300,600	$307,100	$313,800	$320,600	$327,600	$334,700	$342,000
Subtotal Expenses	**$4,143,100**	**$4,223,000**	**$4,305,200**	**$4,388,400**	**$4,474,100**	**$4,560,700**	**$4,649,700**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000
Subtotal Debt Service	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**
NET REVENUES (EXPENSES)[9]	**($6,828,400)**	**($6,896,800)**	**($6,967,000)**	**($7,038,300)**	**($7,112,000)**	**($7,186,400)**	**($7,263,200)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($3,381,900)**	**($3,429,700)**	**($3,478,900)**	**($3,528,900)**	**($3,580,700)**	**($3,632,900)**	**($3,687,000)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Syngas energy revenues at $3.568 per MMBtu (average 10-month coal value in 2012) with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, syngas injection, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 2 - Gasification of RDF, Syngas Supplemental Fuel to City's Natural Gas Boilers

BASE CASE	2030	2031	2032	2033	2034	2035
OPERATIONS						
Gasification Operating Days/Year	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES						
Waste Deliveries (tons)						
MSW to RDF Plant	66,980	67,650	68,330	69,010	69,700	70,400
Supplemental MSW	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,360	5,410	5,470	5,520	5,580	5,630
Ferrous & Non-Ferrous Recovery[2]	2,650	2,680	2,710	2,740	2,760	2,790
RDF Process Residue (Oversize & Fines)	6,590	6,660	6,720	6,780	6,860	6,930
Process Outputs (tons)						
RDF Combusted	52,380	52,900	53,430	53,970	54,500	55,050
Combustion Residue/Char	7,860	7,940	8,010	8,100	8,180	8,260
Energy Outputs						
Syngas to Boilers (MMBtu)	351,460	354,950	358,500	362,130	365,680	369,370
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0
SYSTEM REVENUES						
Energy Revenues - Syngas[3]	$1,254,000	$1,266,400	$1,279,100	$1,292,000	$1,304,700	$1,317,900
Renewable Energy Credits	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,254,000**	**$1,266,400**	**$1,279,100**	**$1,292,000**	**$1,304,700**	**$1,317,900**
Avoided RDF Landfill Haul & Disposal Costs	$780,800	$796,400	$812,300	$828,500	$845,100	$862,000
Avoided RDF Ash Removal & Disposal Costs	$171,700	$175,100	$178,600	$182,200	$185,900	$189,600
Avoided RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100	$1,383,100
Subtotal Revenues w/ Avoided Costs	**$4,853,500**	**$4,889,500**	**$4,926,300**	**$4,963,800**	**$5,001,700**	**$5,040,500**
SYSTEM EXPENSES						
Purchase of RDF[5]	$897,100	$906,100	$915,100	$924,300	$933,500	$942,900
Gasification System/Syngas Injection O&M						
Labor[6]	$1,602,100	$1,634,100	$1,666,800	$1,700,100	$1,734,100	$1,768,800
Routine Maintenance/Replacement	$697,000	$710,900	$725,100	$739,600	$754,400	$769,500
Utilities - Electricity	$162,900	$166,200	$169,500	$172,900	$176,300	$179,900
Utilities - Fuel Oil	$9,100	$9,300	$9,500	$9,700	$9,900	$10,100
Utilities - Water	$21,900	$22,400	$22,800	$23,300	$23,800	$24,200
Utilities - Sewer	$1,400	$1,400	$1,400	$1,500	$1,500	$1,500
Chemicals Consumption	$0	$0	$0	$0	$0	$0
Gasification Ash Residue Haul & Disposal	$617,400	$636,200	$654,600	$675,200	$695,500	$716,400
Misc. G&A, Supplies, Tools, Expendables[7]	$80,100	$81,700	$83,300	$85,000	$86,700	$88,400
Insurance	$72,400	$73,900	$75,300	$76,800	$78,400	$79,900
RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900
Contingency (10%)	$349,400	$357,100	$364,800	$372,800	$381,000	$389,300
Subtotal Expenses	**$4,740,700**	**$4,833,800**	**$4,927,400**	**$5,025,200**	**$5,124,000**	**$5,224,800**
CAPITAL COSTS/DEBT SERVICE						
Gasification Project Net Debt Service[8]	$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000	$3,855,000
Subtotal Debt Service	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**	**$3,855,000**
NET REVENUES (EXPENSES)[9]	**($7,341,700)**	**($7,422,400)**	**($7,503,300)**	**($7,588,200)**	**($7,674,300)**	**($7,761,900)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($3,742,200)**	**($3,799,300)**	**($3,856,100)**	**($3,916,400)**	**($3,977,300)**	**($4,039,300)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Syngas energy revenues at $3.568 per MMBtu (average 10-month coal value in 2012) with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, syngas injection, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 3 - Gasification of RDF, Syngas Supplemental Fuel to Natural Gas Turbine Generator Set

BASE CASE	2012	2016	2017	2018	2019	2020	2021	2022
OPERATIONS								
Gasification Operating Days/Year	0	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	0	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES								
Waste Deliveries (tons)								
MSW to RDF Plant	56,000	58,280	58,860	59,450	60,040	60,640	61,250	61,860
Supplemental MSW	0	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	4,500	4,660	4,710	4,760	4,800	4,850	4,900	4,950
Ferrous & Non-Ferrous Recovery[2]	2,200	2,310	2,330	2,360	2,380	2,400	2,430	2,450
RDF Process Residue (Oversize & Fines)	14,800	5,730	5,790	5,840	5,910	5,970	6,020	6,090
Process Outputs (tons)								
RDF Combusted	34,500	45,580	46,030	46,490	46,950	47,420	47,900	48,370
RDF Combusted (TPD)		147	148	150	151	153	155	156
Combustion Residue/Char	3,740	6,840	6,900	6,970	7,040	7,110	7,190	7,260
Energy Outputs								
Syngas to Turbine Generator (MMBtu)		284,230	287,040	289,910	292,780	295,710	298,700	301,630
Natural Gas to Turbine Generator (MMBtu)		103,870	101,060	98,190	95,320	92,390	89,400	86,470
Electrical Generation - Net (kWh/year)		28,086,000	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000
Carbon Offsets (tonnes CO2e)		0	0	0	0	0	0	0
SYSTEM REVENUES								
Energy Revenues - Electricity[3]		$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300
Renewable Energy Credits		$0	$0	$0	$0	$0	$0	$0
Carbon Credits		$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)		$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]		$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues		**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**
Avoided RDF Landfill Haul & Disposal Costs		$591,700	$603,600	$615,600	$627,900	$640,500	$653,300	$666,400
Avoided RDF Ash Removal & Disposal Costs		$130,100	$132,700	$135,400	$138,100	$140,900	$143,700	$146,500
Avoided RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Avoided Boiler Maintenance Costs		$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF		$4,061,100	$4,061,100	$4,061,100	$4,061,100	$6,879,100	$7,090,800	$7,309,000
Subtotal Revenues w/ Avoided Costs		**$7,395,500**	**$7,413,500**	**$7,431,700**	**$7,450,300**	**$10,287,400**	**$10,518,500**	**$10,756,500**
SYSTEM EXPENSES								
Purchase of RDF[5]		$780,500	$788,300	$796,100	$804,100	$812,100	$820,300	$828,500
Gasification System/Power Block O&M								
Labor[6]		$1,770,800	$1,806,200	$1,842,300	$1,879,200	$1,916,800	$1,955,100	$1,994,100
Routine Maintenance/Replacement		$976,400	$995,900	$1,015,800	$1,036,100	$1,056,800	$1,078,000	$1,099,500
Utilities - Electricity		$4,300	$4,400	$4,500	$4,600	$4,700	$4,800	$4,800
Utilities - Natural Gas		$600,300	$595,900	$590,700	$585,000	$578,600	$571,300	$563,800
Utilities - Water		$16,600	$17,000	$17,300	$17,600	$18,000	$18,400	$18,700
Utilities - Sewer		$1,000	$1,100	$1,100	$1,100	$1,100	$1,100	$1,200
Chemicals Consumption		$64,100	$66,100	$68,100	$70,100	$72,200	$74,400	$76,700
Gasification Ash Residue Haul & Disposal		$407,200	$419,000	$431,700	$444,800	$458,200	$472,600	$486,700
Misc. G&A, Supplies, Tools, Expendables[7]		$88,500	$90,300	$92,100	$94,000	$95,800	$97,800	$99,700
Insurance		$96,100	$98,000	$100,000	$102,000	$104,000	$106,100	$108,200
RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Contingency (10%)		$420,000	$427,200	$434,500	$441,900	$449,500	$457,200	$465,000
Subtotal Expenses		**$5,400,100**	**$5,487,200**	**$5,575,500**	**$5,665,400**	**$5,756,400**	**$5,849,500**	**$5,943,200**
CAPITAL COSTS/DEBT SERVICE								
Gasification Project Net Debt Service[8]		$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000
Subtotal Debt Service		**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**
NET REVENUES (EXPENSES)[9]		**($10,976,800)**	**($11,063,900)**	**($11,152,200)**	**($11,242,100)**	**($11,333,100)**	**($11,426,200)**	**($11,519,900)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]		**($4,985,600)**	**($5,054,700)**	**($5,124,800)**	**($5,196,100)**	**($2,450,000)**	**($2,312,000)**	**($2,167,700)**
		1/2 year start						

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, combustion turbine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 3 - Gasification of RDF, Syngas Supplemental Fuel to Natural Gas Turbine Generator Set

BASE CASE	2023	2024	2025	2026	2027	2028	2029
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	62,480	63,100	63,730	64,370	65,010	65,660	66,320
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,000	5,050	5,100	5,150	5,200	5,250	5,310
Ferrous & Non-Ferrous Recovery[2]	2,480	2,500	2,530	2,550	2,580	2,600	2,630
RDF Process Residue (Oversize & Fines)	6,140	6,210	6,260	6,330	6,390	6,460	6,520
Process Outputs (tons)							
RDF Combusted	48,860	49,340	49,840	50,340	50,840	51,350	51,860
RDF Combusted (TPD)	158	159	161	162	164	166	167
Combustion Residue/Char	7,330	7,400	7,480	7,550	7,630	7,700	7,780
Energy Outputs							
Syngas to Turbine Generator (MMBtu)	304,690	307,680	310,800	313,920	317,030	320,220	323,400
Natural Gas to Turbine Generator (MMBtu)	83,410	80,420	77,300	74,180	71,070	67,880	64,700
Electrical Generation - Net (kWh/year)	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Electricity[3]	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**
Avoided RDF Landfill Haul & Disposal Costs	$679,700	$693,300	$707,200	$721,300	$735,700	$750,400	$765,400
Avoided RDF Ash Removal & Disposal Costs	$149,500	$152,500	$155,500	$158,600	$161,800	$165,000	$168,300
Avoided RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$7,533,900	$7,765,700	$8,004,700	$8,251,000	$8,504,900	$8,766,600	$9,036,300
Subtotal Revenues w/ Avoided Costs	**$11,001,600**	**$11,254,000**	**$11,514,000**	**$11,781,600**	**$12,057,400**	**$12,341,300**	**$12,633,700**
SYSTEM EXPENSES							
Purchase of RDF[5]	$836,800	$845,100	$853,600	$862,100	$870,700	$879,400	$888,200
Gasification System/Power Block O&M							
Labor[6]	$2,034,100	$2,074,800	$2,116,200	$2,158,600	$2,201,800	$2,245,800	$2,290,700
Routine Maintenance/Replacement	$1,121,500	$1,144,000	$1,166,800	$1,190,200	$1,214,000	$1,238,300	$1,263,000
Utilities - Electricity	$4,900	$5,000	$5,100	$5,200	$5,400	$5,500	$5,600
Utilities - Natural Gas	$554,900	$546,000	$535,500	$524,500	$512,800	$499,900	$486,400
Utilities - Water	$19,100	$19,500	$19,900	$20,300	$20,700	$21,100	$21,500
Utilities - Sewer	$1,200	$1,200	$1,200	$1,300	$1,300	$1,300	$1,300
Chemicals Consumption	$79,000	$81,300	$83,800	$86,300	$89,000	$91,600	$94,400
Gasification Ash Residue Haul & Disposal	$501,300	$516,200	$532,200	$547,900	$564,800	$581,400	$599,200
Misc. G&A, Supplies, Tools, Expendables[7]	$101,700	$103,700	$105,800	$107,900	$110,100	$112,300	$114,500
Insurance	$110,400	$112,600	$114,900	$117,200	$119,500	$121,900	$124,300
RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Contingency (10%)	$472,800	$480,900	$489,000	$497,200	$505,600	$514,000	$522,600
Subtotal Expenses	**$6,037,900**	**$6,134,500**	**$6,232,300**	**$6,331,100**	**$6,432,400**	**$6,533,500**	**$6,637,100**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000
Subtotal Debt Service	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**
NET REVENUES (EXPENSES)[9]	**($11,614,600)**	**($11,711,200)**	**($11,809,000)**	**($11,907,800)**	**($12,009,100)**	**($12,110,200)**	**($12,213,800)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($2,017,300)**	**($1,861,500)**	**($1,699,300)**	**($1,530,500)**	**($1,356,000)**	**($1,173,200)**	**($984,400)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, combustion turbine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 3 - Gasification of RDF, Syngas Supplemental Fuel to Natural Gas Turbine Generator Set

BASE CASE	2030	2031	2032	2033	2034	2035	2036
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	66,980	67,650	68,330	69,010	69,700	70,400	71,100
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,360	5,410	5,470	5,520	5,580	5,630	5,690
Ferrous & Non-Ferrous Recovery[2]	2,650	2,680	2,710	2,740	2,760	2,790	2,820
RDF Process Residue (Oversize & Fines)	6,590	6,660	6,720	6,780	6,860	6,930	6,990
Process Outputs (tons)							
RDF Combusted	52,380	52,900	53,430	53,970	54,500	55,050	55,600
RDF Combusted (TPD)	169	171	172	174	176	178	179
Combustion Residue/Char	7,860	7,940	8,010	8,100	8,180	8,260	8,340
Energy Outputs							
Syngas to Turbine Generator (MMBtu)	326,640	329,880	333,190	336,550	339,860	343,290	346,720
Natural Gas to Turbine Generator (MMBtu)	61,460	58,220	54,910	51,550	48,240	44,810	41,380
Electrical Generation - Net (kWh/year)	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000	28,086,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Electricity[3]	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300	$1,404,300
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**	**$1,404,300**
Avoided RDF Landfill Haul & Disposal Costs	$780,800	$796,400	$812,300	$828,500	$845,100	$862,000	$879,300
Avoided RDF Ash Removal & Disposal Costs	$171,700	$175,100	$178,600	$182,200	$185,900	$189,600	$193,400
Avoided RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900	$259,000
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$9,314,400	$9,601,000	$9,896,400	$10,201,000	$10,514,800	$10,838,400	$11,171,900
Subtotal Revenues w/ Avoided Costs	**$12,935,100**	**$13,245,300**	**$13,564,800**	**$13,894,000**	**$14,233,000**	**$14,582,200**	**$14,941,900**
SYSTEM EXPENSES							
Purchase of RDF[5]	$897,100	$906,100	$915,100	$924,300	$933,500	$942,900	$952,300
Gasification System/Power Block O&M							
Labor[6]	$2,336,500	$2,383,200	$2,430,900	$2,479,500	$2,529,100	$2,579,700	$2,631,300
Routine Maintenance/Replacement	$1,288,300	$1,314,000	$1,340,300	$1,367,100	$1,394,500	$1,422,400	$1,450,800
Utilities - Electricity	$5,700	$5,800	$5,900	$6,000	$6,100	$6,300	$6,400
Utilities - Natural Gas	$471,600	$456,100	$439,200	$421,000	$402,400	$381,800	$360,300
Utilities - Water	$21,900	$22,400	$22,800	$23,300	$23,800	$24,200	$24,700
Utilities - Sewer	$1,400	$1,400	$1,400	$1,500	$1,500	$1,500	$1,500
Chemicals Consumption	$97,300	$100,200	$103,200	$106,300	$109,500	$112,900	$116,300
Gasification Ash Residue Haul & Disposal	$617,400	$636,200	$654,600	$675,200	$695,500	$716,400	$737,800
Misc. G&A, Supplies, Tools, Expendables[7]	$116,800	$119,200	$121,500	$124,000	$126,500	$129,000	$131,600
Insurance	$126,800	$129,400	$132,000	$134,600	$137,300	$140,000	$142,800
RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900	$259,000
Contingency (10%)	$531,400	$540,200	$549,100	$558,300	$567,500	$576,800	$586,300
Subtotal Expenses	**$6,742,100**	**$6,848,700**	**$6,955,200**	**$7,065,100**	**$7,176,100**	**$7,287,800**	**$7,401,100**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000	$6,981,000
Subtotal Debt Service	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**	**$6,981,000**
NET REVENUES (EXPENSES)[9]	**($12,318,800)**	**($12,425,400)**	**($12,531,900)**	**($12,641,800)**	**($12,752,800)**	**($12,864,500)**	**($12,977,800)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($788,000)**	**($584,400)**	**($371,400)**	**($152,100)**	**$75,900**	**$313,400**	**$559,800**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed, combustion turbine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 4 - Gasification of RDF, Syngas to Dedicated IC Engines

BASE CASE	2012	2016	2017	2018	2019	2020	2021	2022
OPERATIONS								
Gasification Operating Days/Year	0	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	0	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES								
Waste Deliveries (tons)								
MSW to RDF Plant	56,000	58,280	58,860	59,450	60,040	60,640	61,250	61,860
Supplemental MSW	0	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	4,500	4,660	4,710	4,760	4,800	4,850	4,900	4,950
Ferrous & Non-Ferrous Recovery[2]	2,200	2,310	2,330	2,360	2,380	2,400	2,430	2,450
RDF Process Residue (Oversize & Fines)	14,800	5,730	5,790	5,840	5,910	5,970	6,020	6,090
Process Outputs (tons)								
RDF Combusted	34,500	45,580	46,030	46,490	46,950	47,420	47,900	48,370
Combustion Residue/Char	3,740	6,840	6,900	6,970	7,040	7,110	7,190	7,260
Energy Outputs								
Electrical Generation - Net (kWh/year)		25,296,000	25,546,000	25,801,000	26,057,000	26,317,000	26,584,000	26,845,000
Carbon Offsets (tonnes CO2e)		0	0	0	0	0	0	0
SYSTEM REVENUES								
Energy Revenues - Electricity[3]		$1,264,800	$1,277,300	$1,290,100	$1,302,900	$1,315,900	$1,329,200	$1,342,300
Renewable Energy Credits		$0	$0	$0	$0	$0	$0	$0
Carbon Credits		$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)		$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]		$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues		**$1,264,800**	**$1,277,300**	**$1,290,100**	**$1,302,900**	**$1,315,900**	**$1,329,200**	**$1,342,300**
Avoided RDF Landfill Haul & Disposal Costs		$591,700	$603,600	$615,600	$627,900	$640,500	$653,300	$666,400
Avoided RDF Ash Removal & Disposal Costs		$130,100	$132,700	$135,400	$138,100	$140,900	$143,700	$146,500
Avoided RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Avoided Boiler Maintenance Costs		$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF		$4,061,100	$4,061,100	$4,061,100	$4,061,100	$6,879,100	$7,090,800	$7,309,000
Subtotal Revenues w/ Avoided Costs		**$7,256,000**	**$7,286,500**	**$7,317,500**	**$7,348,900**	**$10,199,000**	**$10,443,400**	**$10,694,500**
SYSTEM EXPENSES								
Purchase of RDF[5]		$780,500	$788,300	$796,100	$804,100	$812,100	$820,300	$828,500
Gasification System/Power Block O&M								
Labor[6]		$1,770,800	$1,806,200	$1,842,300	$1,879,200	$1,916,800	$1,955,100	$1,994,100
Routine Maintenance/Replacement		$1,285,900	$1,311,600	$1,337,900	$1,364,600	$1,391,900	$1,419,800	$1,448,200
Utilities - Electricity		$4,300	$4,400	$4,500	$4,600	$4,700	$4,800	$4,800
Utilities - Fuel Oil		$6,900	$7,000	$7,200	$7,300	$7,500	$7,600	$7,800
Utilities - Water		$16,600	$17,000	$17,300	$17,600	$18,000	$18,400	$18,700
Utilities - Sewer		$1,000	$1,100	$1,100	$1,100	$1,100	$1,100	$1,200
Chemicals Consumption		$64,100	$66,100	$68,100	$70,100	$72,200	$74,400	$76,700
Gasification Ash Residue Haul & Disposal		$407,200	$419,000	$431,700	$444,800	$458,200	$472,600	$486,700
Misc. G&A, Supplies, Tools, Expendables[7]		$88,500	$90,300	$92,100	$94,000	$95,800	$97,800	$99,700
Insurance		$125,500	$128,000	$130,600	$133,200	$135,900	$138,600	$141,300
RDF Storage Bins O&M		$174,300	$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Contingency (10%)		$394,500	$402,900	$411,400	$420,100	$429,100	$438,300	$447,600
Subtotal Expenses		**$5,120,100**	**$5,219,700**	**$5,321,600**	**$5,425,600**	**$5,531,900**	**$5,641,200**	**$5,751,600**
CAPITAL COSTS/DEBT SERVICE								
Gasification Project Net Debt Service[8]		$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000
Subtotal Debt Service		**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**
NET REVENUES (EXPENSES)[9]		**($12,970,300)**	**($13,057,400)**	**($13,146,500)**	**($13,237,700)**	**($13,331,000)**	**($13,427,000)**	**($13,524,300)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]		**($6,979,100)**	**($7,048,200)**	**($7,119,100)**	**($7,191,700)**	**($4,447,900)**	**($4,312,800)**	**($4,172,100)**
		1/2 year start						

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed system, IC engine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 4 - Gasification of RDF, Syngas to Dedicated IC Engines

BASE CASE	2023	2024	2025	2026	2027	2028	2029
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	62,480	63,100	63,730	64,370	65,010	65,660	66,320
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,000	5,050	5,100	5,150	5,200	5,250	5,310
Ferrous & Non-Ferrous Recovery[2]	2,480	2,500	2,530	2,550	2,580	2,600	2,630
RDF Process Residue (Oversize & Fines)	6,140	6,210	6,260	6,330	6,390	6,460	6,520
Process Outputs (tons)							
RDF Combusted	48,860	49,340	49,840	50,340	50,840	51,350	51,860
Combustion Residue/Char	7,330	7,400	7,480	7,550	7,630	7,700	7,780
Energy Outputs							
Electrical Generation - Net (kWh/year)	27,117,000	27,383,000	27,660,000	27,938,000	28,215,000	28,498,000	28,781,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Electricity[3]	$1,355,900	$1,369,200	$1,383,000	$1,396,900	$1,410,800	$1,424,900	$1,439,100
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,355,900**	**$1,369,200**	**$1,383,000**	**$1,396,900**	**$1,410,800**	**$1,424,900**	**$1,439,100**
Avoided RDF Landfill Haul & Disposal Costs	$679,700	$693,300	$707,200	$721,300	$735,700	$750,400	$765,400
Avoided RDF Ash Removal & Disposal Costs	$149,500	$152,500	$155,500	$158,600	$161,800	$165,000	$168,300
Avoided RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$7,533,900	$7,765,700	$8,004,700	$8,251,000	$8,504,900	$8,766,600	$9,036,300
Subtotal Revenues w/ Avoided Costs	**$10,953,200**	**$11,218,900**	**$11,492,700**	**$11,774,200**	**$12,063,900**	**$12,361,900**	**$12,668,500**
SYSTEM EXPENSES							
Purchase of RDF[5]	$836,800	$845,100	$853,600	$862,100	$870,700	$879,400	$888,200
Gasification System/Power Block O&M							
Labor[6]	$2,034,100	$2,074,800	$2,116,200	$2,158,600	$2,201,800	$2,245,800	$2,290,700
Routine Maintenance/Replacement	$1,477,100	$1,506,700	$1,536,800	$1,567,500	$1,598,900	$1,630,900	$1,663,500
Utilities - Electricity	$4,900	$5,000	$5,100	$5,200	$5,400	$5,500	$5,600
Utilities - Fuel Oil	$7,900	$8,100	$8,200	$8,400	$8,600	$8,800	$8,900
Utilities - Water	$19,100	$19,500	$19,900	$20,300	$20,700	$21,100	$21,500
Utilities - Sewer	$1,200	$1,200	$1,200	$1,300	$1,300	$1,300	$1,300
Chemicals Consumption	$79,000	$81,300	$83,800	$86,300	$89,000	$91,600	$94,400
Gasification Ash Residue Haul & Disposal	$501,300	$516,200	$532,200	$547,900	$564,800	$581,400	$599,200
Misc. G&A, Supplies, Tools, Expendables[7]	$101,700	$103,700	$105,800	$107,900	$110,100	$112,300	$114,500
Insurance	$144,200	$147,100	$150,000	$153,000	$156,100	$159,200	$162,400
RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Contingency (10%)	$457,100	$466,800	$476,800	$486,900	$497,300	$507,900	$518,700
Subtotal Expenses	**$5,864,600**	**$5,979,700**	**$6,097,900**	**$6,217,800**	**$6,341,400**	**$6,466,200**	**$6,594,300**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000
Subtotal Debt Service	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**
NET REVENUES (EXPENSES)[9]	**($13,623,700)**	**($13,725,500)**	**($13,829,900)**	**($13,935,900)**	**($14,045,600)**	**($14,156,300)**	**($14,270,200)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($4,026,400)**	**($3,875,800)**	**($3,720,200)**	**($3,558,600)**	**($3,392,500)**	**($3,219,300)**	**($3,040,800)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed system, IC engine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 4 - Gasification of RDF, Syngas to Dedicated IC Engines

BASE CASE	2030	2031	2032	2033	2034	2035	2036
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	66,980	67,650	68,330	69,010	69,700	70,400	71,100
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,360	5,410	5,470	5,520	5,580	5,630	5,690
Ferrous & Non-Ferrous Recovery[2]	2,650	2,680	2,710	2,740	2,760	2,790	2,820
RDF Process Residue (Oversize & Fines)	6,590	6,660	6,720	6,780	6,860	6,930	6,990
Process Outputs (tons)							
RDF Combusted	52,380	52,900	53,430	53,970	54,500	55,050	55,600
Combustion Residue/Char	7,860	7,940	8,010	8,100	8,180	8,260	8,340
Energy Outputs							
Electrical Generation - Net (kWh/year)	29,070,000	29,359,000	29,653,000	29,953,000	30,247,000	30,552,000	30,857,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Electricity[3]	$1,453,500	$1,468,000	$1,482,700	$1,497,700	$1,512,400	$1,527,600	$1,542,900
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,453,500**	**$1,468,000**	**$1,482,700**	**$1,497,700**	**$1,512,400**	**$1,527,600**	**$1,542,900**
Avoided RDF Landfill Haul & Disposal Costs	$780,800	$796,400	$812,300	$828,500	$845,100	$862,000	$879,300
Avoided RDF Ash Removal & Disposal Costs	$171,700	$175,100	$178,600	$182,200	$185,900	$189,600	$193,400
Avoided RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900	$259,000
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$9,314,400	$9,601,000	$9,896,400	$10,201,000	$10,514,800	$10,838,400	$11,171,900
Subtotal Revenues w/ Avoided Costs	**$12,984,300**	**$13,309,000**	**$13,643,200**	**$13,987,400**	**$14,341,100**	**$14,705,500**	**$15,080,500**
SYSTEM EXPENSES							
Purchase of RDF[5]	$897,100	$906,100	$915,100	$924,300	$933,500	$942,900	$952,300
Gasification System/Power Block O&M							
Labor[6]	$2,336,500	$2,383,200	$2,430,900	$2,479,500	$2,529,100	$2,579,700	$2,631,300
Routine Maintenance/Replacement	$1,696,800	$1,730,700	$1,765,300	$1,800,600	$1,836,600	$1,873,400	$1,910,800
Utilities - Electricity	$5,700	$5,800	$5,900	$6,000	$6,100	$6,300	$6,400
Utilities - Fuel Oil	$9,100	$9,300	$9,500	$9,700	$9,900	$10,100	$10,300
Utilities - Water	$21,900	$22,400	$22,800	$23,300	$23,800	$24,200	$24,700
Utilities - Sewer	$1,400	$1,400	$1,400	$1,500	$1,500	$1,500	$1,500
Chemicals Consumption	$97,300	$100,200	$103,200	$106,300	$109,500	$112,900	$116,300
Gasification Ash Residue Haul & Disposal	$617,400	$636,200	$654,600	$675,200	$695,500	$716,400	$737,800
Misc. G&A, Supplies, Tools, Expendables[7]	$116,800	$119,200	$121,500	$124,000	$126,500	$129,000	$131,600
Insurance	$165,600	$168,900	$172,300	$175,700	$179,300	$182,800	$186,500
RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900	$259,000
Contingency (10%)	$529,800	$541,200	$552,700	$564,600	$576,700	$589,000	$601,600
Subtotal Expenses	**$6,725,300**	**$6,859,100**	**$6,994,400**	**$7,134,700**	**$7,276,900**	**$7,422,100**	**$7,570,100**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000	$9,115,000
Subtotal Debt Service	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**	**$9,115,000**
NET REVENUES (EXPENSES)[9]	**($14,386,800)**	**($14,506,100)**	**($14,626,700)**	**($14,752,000)**	**($14,879,500)**	**($15,009,500)**	**($15,142,200)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($2,856,000)**	**($2,665,100)**	**($2,466,200)**	**($2,262,300)**	**($2,050,800)**	**($1,831,600)**	**($1,604,600)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system, RDF feed system, IC engine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 5 - Gasification of RDF, Syngas to Dedicated Boiler Package

BASE CASE	2012	2016	2017	2018	2019	2020	2021	2022
OPERATIONS								
Gasification Operating Days/Year	0	0	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	0	0	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES								
Waste Deliveries (tons)								
MSW to RDF Plant	56,000	58,280	58,860	59,450	60,040	60,640	61,250	61,860
Supplemental MSW	0	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	4,500	4,660	4,710	4,760	4,800	4,850	4,900	4,950
Ferrous & Non-Ferrous Recovery[2]	2,200	2,310	2,330	2,360	2,380	2,400	2,430	2,450
RDF Process Residue (Oversize & Fines)	14,800	15,410	5,790	5,840	5,910	5,970	6,020	6,090
Process Outputs (tons)								
RDF Combusted	34,500	35,900	46,030	46,490	46,950	47,420	47,900	48,370
Combustion Residue/Char	3,740	3,890	6,900	6,970	7,040	7,110	7,190	7,260
Energy Outputs								
Electrical Generation - Net (kWh/year)	0	0	23,015,000	23,245,000	23,475,000	23,710,000	23,950,000	24,185,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0	0
SYSTEM REVENUES								
Energy Revenues - Electricity[3]			$1,150,800	$1,162,300	$1,173,800	$1,185,500	$1,197,500	$1,209,300
Renewable Energy Credits			$0	$0	$0	$0	$0	$0
Carbon Credits			$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)			$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]			$0	$0	$0	$0	$0	$0
Subtotal Revenues			**$1,150,800**	**$1,162,300**	**$1,173,800**	**$1,185,500**	**$1,197,500**	**$1,209,300**
Avoided RDF Landfill Haul & Disposal Costs			$603,600	$615,600	$627,900	$640,500	$653,300	$666,400
Avoided RDF Ash Removal & Disposal Costs			$132,700	$135,400	$138,100	$140,900	$143,700	$146,500
Avoided RDF Storage Bins O&M			$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Avoided Boiler Maintenance Costs			$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF			$4,061,100	$4,061,100	$4,061,100	$6,879,100	$7,090,800	$7,309,000
Subtotal Revenues w/ Avoided Costs			**$7,160,000**	**$7,189,700**	**$7,219,800**	**$10,068,600**	**$10,311,700**	**$10,561,500**
SYSTEM EXPENSES								
Purchase of RDF[5]			$788,300	$796,100	$804,100	$812,100	$820,300	$828,500
Gasification System/Power Block O&M								
Labor[6]			$3,007,400	$3,067,600	$3,128,900	$3,191,500	$3,255,300	$3,320,400
Routine Maintenance/Replacement			$1,342,600	$1,369,400	$1,396,800	$1,424,700	$1,453,200	$1,482,300
Utilities - Electricity			$4,400	$4,500	$4,600	$4,700	$4,800	$4,800
Utilities - Fuel Oil			$7,000	$7,200	$7,300	$7,500	$7,600	$7,800
Utilities - Water			$19,900	$20,300	$20,700	$21,100	$21,600	$22,000
Utilities - Sewer			$1,400	$1,400	$1,400	$1,400	$1,500	$1,500
Chemicals Consumption - Ammonia			$30,500	$31,400	$32,400	$33,300	$34,300	$35,400
Chemicals Consumption - Activated Carbon			$20,100	$20,700	$21,400	$22,000	$22,700	$23,300
Chemicals Consumption - Lime			$85,400	$88,000	$90,600	$93,300	$96,200	$99,100
Gasification Ash Residue Haul & Disposal			$419,000	$431,700	$444,800	$458,200	$472,600	$486,700
Misc. G&A, Supplies, Tools, Expendables[7]			$150,400	$153,400	$156,400	$159,600	$162,800	$166,000
Insurance			$131,000	$133,600	$136,300	$139,000	$141,800	$144,600
RDF Storage Bins O&M			$177,800	$181,300	$184,900	$188,600	$192,400	$196,300
Contingency (10%)			$539,700	$551,100	$562,700	$574,500	$586,700	$599,000
Subtotal Expenses			**$6,724,900**	**$6,857,700**	**$6,993,300**	**$7,131,500**	**$7,273,800**	**$7,417,700**
CAPITAL COSTS/DEBT SERVICE								
Gasification Project Net Debt Service[8]			$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000
Subtotal Debt Service			**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**
NET REVENUES (EXPENSES)[9]			**($15,224,100)**	**($15,345,400)**	**($15,469,500)**	**($15,596,000)**	**($15,726,300)**	**($15,858,400)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]			**($9,214,900)**	**($9,318,000)**	**($9,423,500)**	**($6,712,900)**	**($6,612,100)**	**($6,506,200)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system/RDF feed, boiler package/steam turbine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 5 - Gasification of RDF, Syngas to Dedicated Boiler Package

BASE CASE	2023	2024	2025	2026	2027	2028	2029
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	62,480	63,100	63,730	64,370	65,010	65,660	66,320
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,000	5,050	5,100	5,150	5,200	5,250	5,310
Ferrous & Non-Ferrous Recovery[2]	2,480	2,500	2,530	2,550	2,580	2,600	2,630
RDF Process Residue (Oversize & Fines)	6,140	6,210	6,260	6,330	6,390	6,460	6,520
Process Outputs (tons)							
RDF Combusted	48,860	49,340	49,840	50,340	50,840	51,350	51,860
Combustion Residue/Char	7,330	7,400	7,480	7,550	7,630	7,700	7,780
Energy Outputs							
Electrical Generation - Net (kWh/year)	24,430,000	24,670,000	24,920,000	25,170,000	25,420,000	25,675,000	25,930,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Electricity[3]	$1,221,500	$1,233,500	$1,246,000	$1,258,500	$1,271,000	$1,283,800	$1,296,500
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,221,500**	**$1,233,500**	**$1,246,000**	**$1,258,500**	**$1,271,000**	**$1,283,800**	**$1,296,500**
Avoided RDF Landfill Haul & Disposal Costs	$679,700	$693,300	$707,200	$721,300	$735,700	$750,400	$765,400
Avoided RDF Ash Removal & Disposal Costs	$149,500	$152,500	$155,500	$158,600	$161,800	$165,000	$168,300
Avoided RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$7,533,900	$7,765,700	$8,004,700	$8,251,000	$8,504,900	$8,766,600	$9,036,300
Subtotal Revenues w/ Avoided Costs	**$10,818,800**	**$11,083,200**	**$11,355,700**	**$11,635,800**	**$11,924,100**	**$12,220,800**	**$12,525,900**
SYSTEM EXPENSES							
Purchase of RDF[5]	$836,800	$845,100	$853,600	$862,100	$870,700	$879,400	$888,200
Gasification System/Power Block O&M							
Labor[6]	$3,386,800	$3,454,600	$3,523,600	$3,594,200	$3,666,100	$3,739,400	$3,814,200
Routine Maintenance/Replacement	$1,511,900	$1,542,200	$1,573,000	$1,604,500	$1,636,600	$1,669,300	$1,702,700
Utilities - Electricity	$4,900	$5,000	$5,100	$5,200	$5,400	$5,500	$5,600
Utilities - Fuel Oil	$7,900	$8,100	$8,200	$8,400	$8,600	$8,800	$8,900
Utilities - Water	$22,400	$22,900	$23,300	$23,800	$24,300	$24,800	$25,300
Utilities - Sewer	$1,500	$1,600	$1,600	$1,600	$1,700	$1,700	$1,700
Chemicals Consumption - Ammonia	$36,500	$37,500	$38,700	$39,900	$41,100	$42,300	$43,600
Chemicals Consumption - Activated Carbon	$24,100	$24,800	$25,500	$26,300	$27,100	$27,900	$28,800
Chemicals Consumption - Lime	$102,100	$105,100	$108,300	$111,600	$115,000	$118,400	$122,000
Gasification Ash Residue Haul & Disposal	$501,300	$516,200	$532,200	$547,900	$564,800	$581,400	$599,200
Misc. G&A, Supplies, Tools, Expendables[7]	$169,300	$172,700	$176,200	$179,700	$183,300	$187,000	$190,700
Insurance	$147,500	$150,500	$153,500	$156,600	$159,700	$162,900	$166,100
RDF Storage Bins O&M	$200,200	$204,200	$208,300	$212,400	$216,700	$221,000	$225,400
Contingency (10%)	$611,600	$624,500	$637,800	$651,200	$665,000	$679,000	$693,400
Subtotal Expenses	**$7,564,800**	**$7,715,000**	**$7,868,900**	**$8,025,400**	**$8,186,100**	**$8,348,800**	**$8,515,800**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000
Subtotal Debt Service	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**
NET REVENUES (EXPENSES)[9]	**($15,993,300)**	**($16,131,500)**	**($16,272,900)**	**($16,416,900)**	**($16,565,100)**	**($16,715,000)**	**($16,869,300)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($6,396,000)**	**($6,281,800)**	**($6,163,200)**	**($6,039,600)**	**($5,912,000)**	**($5,778,000)**	**($5,639,900)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system/RDF feed, boiler package/steam turbine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

Scenario 5 - Gasification of RDF, Syngas to Dedicated Boiler Package

BASE CASE	2030	2031	2032	2033	2034	2035	2036
OPERATIONS							
Gasification Operating Days/Year	310	310	310	310	310	310	310
Gasifier Hours Operation/Year[1]	7,440	7,440	7,440	7,440	7,440	7,440	7,440
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW to RDF Plant	66,980	67,650	68,330	69,010	69,700	70,400	71,100
Supplemental MSW	0	0	0	0	0	0	0
Bypass & Non-Processible Waste	5,360	5,410	5,470	5,520	5,580	5,630	5,690
Ferrous & Non-Ferrous Recovery[2]	2,650	2,680	2,710	2,740	2,760	2,790	2,820
RDF Process Residue (Oversize & Fines)	6,590	6,660	6,720	6,780	6,860	6,930	6,990
Process Outputs (tons)							
RDF Combusted	52,380	52,900	53,430	53,970	54,500	55,050	55,600
Combustion Residue/Char	7,860	7,940	8,010	8,100	8,180	8,260	8,340
Energy Outputs							
Electrical Generation - Net (kWh/year)	26,190,000	26,450,000	26,715,000	26,985,000	27,250,000	27,525,000	27,800,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Energy Revenues - Electricity[3]	$1,309,500	$1,322,500	$1,335,800	$1,349,300	$1,362,500	$1,376,300	$1,390,000
Renewable Energy Credits	$0	$0	$0	$0	$0	$0	$0
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ash/Char Markets (assumes no markets)	$0	$0	$0	$0	$0	$0	$0
Net Tip Fee Revenues - Supplemental MSW[4]	$0	$0	$0	$0	$0	$0	$0
Subtotal Revenues	**$1,309,500**	**$1,322,500**	**$1,335,800**	**$1,349,300**	**$1,362,500**	**$1,376,300**	**$1,390,000**
Avoided RDF Landfill Haul & Disposal Costs	$780,800	$796,400	$812,300	$828,500	$845,100	$862,000	$879,300
Avoided RDF Ash Removal & Disposal Costs	$171,700	$175,100	$178,600	$182,200	$185,900	$189,600	$193,400
Avoided RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900	$259,000
Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
Avoided Extra Cost of Power to Burn RDF	$9,314,400	$9,601,000	$9,896,400	$10,201,000	$10,514,800	$10,838,400	$11,171,900
Subtotal Revenues w/ Avoided Costs	**$12,840,300**	**$13,163,500**	**$13,496,300**	**$13,839,000**	**$14,191,200**	**$14,554,200**	**$14,927,600**
SYSTEM EXPENSES							
Purchase of RDF[5]	$897,100	$906,100	$915,100	$924,300	$933,500	$942,900	$952,300
Gasification System/Power Block O&M							
Labor[6]	$3,890,500	$3,968,200	$4,047,600	$4,128,500	$4,211,100	$4,295,300	$4,381,300
Routine Maintenance/Replacement	$1,736,700	$1,771,500	$1,806,900	$1,843,100	$1,879,900	$1,917,500	$1,955,900
Utilities - Electricity	$5,700	$5,800	$5,900	$6,000	$6,100	$6,300	$6,400
Utilities - Fuel Oil	$9,100	$9,300	$9,500	$9,700	$9,900	$10,100	$10,300
Utilities - Water	$25,800	$26,300	$26,800	$27,300	$27,900	$28,400	$29,000
Utilities - Sewer	$1,800	$1,800	$1,800	$1,900	$1,900	$1,900	$2,000
Chemicals Consumption - Ammonia	$44,900	$46,200	$47,600	$49,100	$50,600	$52,100	$53,700
Chemicals Consumption - Activated Carbon	$29,600	$30,500	$31,400	$32,400	$33,400	$34,400	$35,400
Chemicals Consumption - Lime	$125,700	$129,500	$133,400	$137,400	$141,500	$145,800	$150,200
Gasification Ash Residue Haul & Disposal	$617,400	$636,200	$654,600	$675,200	$695,500	$716,400	$737,800
Misc. G&A, Supplies, Tools, Expendables[7]	$194,500	$198,400	$202,400	$206,400	$210,600	$214,800	$219,100
Insurance	$169,500	$172,900	$176,300	$179,800	$183,400	$187,100	$190,800
RDF Storage Bins O&M	$229,900	$234,500	$239,200	$244,000	$248,900	$253,900	$259,000
Contingency (10%)	$708,100	$723,100	$738,300	$754,100	$770,100	$786,400	$803,100
Subtotal Expenses	**$8,686,300**	**$8,860,300**	**$9,036,800**	**$9,219,200**	**$9,404,300**	**$9,593,300**	**$9,786,300**
CAPITAL COSTS/DEBT SERVICE							
Gasification Project Net Debt Service[8]	$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000	$9,650,000
Subtotal Debt Service	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**	**$9,650,000**
NET REVENUES (EXPENSES)[9]	**($17,026,800)**	**($17,187,800)**	**($17,351,000)**	**($17,519,900)**	**($17,691,800)**	**($17,867,000)**	**($18,046,300)**
NET REVENUES (EXPENSES) w/ Avoided Costs[10]	**($5,496,000)**	**($5,346,800)**	**($5,190,500)**	**($5,030,200)**	**($4,863,100)**	**($4,689,100)**	**($4,508,700)**

Notes:

[1] Gasifier operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery allocated to RDF plant operations.

[3] Electric energy revenues at $0.05 per kWh with no escalation.

[4] Tip fee revenues from supplemental MSW delivered to the RRP, net of RRP cost to process waste into RDF.

[5] Purchase of RDF from the RRP based on City-provided annual required revenues for RRP operations.

[6] Allocated personnel time to the Gasification System operation. Existing personnel from power plant (i.e. avoided power plant maint.) may be used. Labor allocation from other operations should be deducted from such operations budget.

[7] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, etc.

[8] Includes capital costs for gasification system/RDF feed, boiler package/steam turbine, permitting, engineering services (design & construction period), start-up, and contingency at 20%.

[9] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[10] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

APPENDIX C
OPERATING COST ESTIMATES
SCENARIOS 6A AND 6B

APPENDIX C - PRINCIPAL ASSUMPTIONS SCENARIOS 6a - 6b
Ames, IA Gasification Project Financial Review - Mass Burn Scenarios

Items in red may be reviewed and changed for sensitivity runs.

Annual Escalation Rates

Construction Capital Cost Escalatior	4.0%	*Base Case*	Base Year for Costs/Revenues=	2012
Labor Cost Escalation	2.0%	*Base Case*		
O&M Costs Escalation	2.0%	*Base Case*		
Haul & Disposal Costs	2.0%	*Base Case*		
Utilities Escalation	2.0%	*Base Case*		
Fuel Oil & Diesel Rates	2.0%	*Base Case*		
Materials Sales	2.0%	*Base Case*		
Carbon Credit Escalation	2.0%	*Base Case*		
Energy Sales Escalation	0.0%	*Base Case*		
Avoided Costs Escalation	0.0%	*Base Case*	*For avoided costs, except for haul & disposal and RDF bins O&M*	

Financing & Capital Costs Summary

Interest Rate (G.O. Bonds)	3.0%	*Not used in Base Case - Option for Scenarios*		
Interest Rate (Revenue Bonds)	5.0%	*Base Case*	Long-Term Reinvestment Rate =	2.0%
Bond Issuance Fees	4.0%	*Base Case*	Short-Term Reinvestment Rate =	2.0%
Amortization Period	20	years		
Grant Funds Available	$0	*Base Case*	*or grant as % of capital cost*	

Mass Burn - Scenario 6a **See separate Capital Cost Spreadsheet for details** *$ in year 2012*

Mass Burn System Capital Cost $80,500,000 *HDR est.*

Sc6a: Capital Debt Service	$9,381,000	per year	at Total Capital Financed (2012$)=	$80,500,000

Mass Burn w/ Shredded MSW - Scenario 6b

Mass Burn System Capital Cost	$80,600,000	*HDR est.*
Shredder Processing Capital	$4,700,000	*HDR est.*

Sc6b: Capital Debt Service	$9,940,000	per year	at Total Capital Financed (2012$)=	$85,300,000

Scheduling

	Scenario 6a	Scenario 6b
Siting & Local Approval (months)	24	24
Planning, Permitting & Design Period (months)	18	18
Construction & Start-Up (months)	30	30
Assumed Project Notice to Proceed	1/1/2013	1/1/2013

Operations Data

Administration Days per Year	260	
Receiving Days per Year	280	*5.5 days per week less holidays*
Processing Days per Year	310	*based on availability/capacity factor*
Processing Hours per Day	24	
Availability/Capacity Factor	85%	

Waste Quantities Inputs

Annual MSW, tpy	56,000 tpy	*5-yr average delivered to RDF plant from City provided data*
Yard Waste, tpy	5,000 tpy	*per City*
MSW Annual Growth Projections =	1.0%	*annually*
Bypass & Non-Processible Waste	4%	*assume less bypass w/ mass burn plant; 5-yr avg for RDF plant 8% from City data*

Waste Available to WTE, tpy	**59,000**	***current yr est.***	**Waste projections year 2035**	**74,000 tpy**
Other Sources MSW?	**NO**	*input YES or NO*		
Supplemental MSW, tpy	**0**	*input amount if known; can be '0' with YES*		
System Rated Capacity	300	tpd		
Available Annual Capacity	93,080	tpy		
Ash Residue, % MSW Combusted	28%	*HDR estimate, after recovery of ferrous & non-ferrous*		

For Avoided Cost Calculations - Bypass & RDF Process Rejects, if utilized

RDF Combusted in Coal Boilers, tpy	34,500	*5-yr average from City provided data*		
RDF Processed Tons	51,500 tpy			
Recovered Ferrous/Front-end Metals	4.1%	*5-yr avg % processed, City data*	2,100 tpy	*City provided data*
Recovered Non-Ferrous	0.2%	*avg % of MSW processed*	100 tpy	*City provided data*

APPENDIX C - PRINCIPAL ASSUMPTIONS SCENARIOS 6a - 6b
Ames, IA Gasification Project Financial Review - Mass Burn Scenarios

Tipping Fees - Disposal & Haul

Boone County Sanitary Landfill	$44.50	$/ton	*Out-of-County tip fee 2012*
Bypass Waste Haul Cost	$14.28	$/ton	*to Boone Cnty LF; assume same as process rejects haul*
Process Residue/Rejects Haul Cost	$14.28	$/ton	*to Boone Cnty LF; from City 2012/2013 budget cost*
Metro Waste Authority Landfill	$34.00	$/ton	*Iowa Statewide Landfill Tip Fees 2011* *Base Case*
MWA tip fee for coal ash as cover	$0.00	$/ton	*per City;*
Ash Haul Cost to MWA Landfill	$21.00	$/ton	*per City, Jan-Apr 2012* *Base Case*

Operating Revenues Assumptions

Tipping Fee Revenue

Current RRP Tipping Fee	$52.75	per ton	*Provided by City; tip fee for 2012*
Tipping Fee Escalation	0.0%	*Base Case*	

Per Capita Revenue

Current Per Capita Fee	$9.10	per capita	*Provided by City*
	90,000	people	*Provided by City*
Per Capita Fee Escalation	0.0%	*Base Case*	

Energy Generation & Pricing

MSW Higher Heating Value, HHV	5180	Btu/lb	*from City 2012 monthly RDF analysis data (Jan - Oct)*
	Assume range from 4500 Btu/lb to 6000 Btu/lb		

Gasification - Scenario 6a

Net Electric Generation = 600 kWh/ton *estimate parasitic load 12% - 15%*

Gasification - Scenario 6b

Net Electric Generation = 590 kWh/ton *additional parasitic load with shredder system*

Electric Revenue Rate	$0.05	$/kWh	*Provided by City*
Electric Capacity Payment	$0	$/kW	*This cell tied to annual payment in energy revenues-Scenarios 6a/6b*
Avg Coal Energy Cost	$3.568	$/MMBtu	*from City 2012 monthly data (Jan - Oct)*
Renewable Energy Credit	$0.000	$/kWh	*Iowa Code Ch. 476C, 1.5 ¢/kWh renewable tax credits, corporate*
Carbon Credits	$2	$/ton CO2e	*RGGI, Inc. Marketing Sector Report Sept. 2012 (NE&mid-Atlantic states)*
Project Carbon Offsets	0	ton CO2e per kWh	*Base Case*

Potential carbon offset on organic fraction mass burn as compared to landfilling if no WTE project.

Recovered Metals Revenue

Recovered Ferrous Metals	4%	*City RDF plant 5-yr avg 4.1% of MSW processed*				
Yr2011-2012, ferrous sales=	$282,359	ferrous tons=	2048	Ferrous $/T		$138
Yr2011-2012, non-ferrous sales=	$44,254	non-ferrous =	112	Non-Ferrous $/T		$395
Unit ferrous price, $/ton	$120	*provided by City - Jan 2013*				
Recovered Non-Ferrous Metals	0.2%	*City RDF plant avg 0.21% of MSW processed*				
Unit non-ferrous price, $/ton	$1,000	*provided by City - Jan 2013*				

Avoided Annual Costs

1	**Avoided Yard Waste Management Costs**	$31,800	*from City 3-year contract awarded Nov. 2012*

Item 2 assumed to be accounted for in replacement of RRP budget and not included herein. Confirm EGP avoided costs in EGP budget expenses.

2	**Avoided Bypass/RDF Landfill Haul&Disposal $**	$1,134,500	*calculated from City provided data 2012$*
	Bypass & RDF Process Rejects	19,300 tpy	
3	**Avoided RDF Ash Disposal Costs**	$120,200	*calculated from City provided data 2012$*
	RDF ash, co-fired boilers, dry basis	10.8%	*w/ 20% fly ash and 80% bottom ash; bottom ash beneficial use to disposal 10:1*
	Bottom ash removal expenses	$124,710	*80% RDF ash at bottom ash removal $41.25/tonx(10/11)+ $46.00/tonx(1/11)*
	Reduced RDF flyash sales	-$4,488	*20% RDF ash at $6.00 per ton*
4	**Avoided RDF Storage Bin/Feed System O&M**	$161,000	*Provided by City, 4-yr avg from costs incurred by power plant*
5	**Avoided Boiler Maintenance Costs**	$1,034,000	*City provided data*
6	**Avoided Extra Cost of Power to Burn RDF**	$4,061,147	*City provided data for no RDF/Syngas (2015)-not reviewed by HDR*
	Avoided Extra Cost of Power (Yr 2020 Increase)	$2,817,943	*City provided data for one-time increase assuming cap & trade*
	Annual Escalation (Yr 2020 to 2035)	3.1%	*Based on City provided data, average annual over the period*

RDF Facility MSW tip fee= $52.75 per ton

APPENDIX C - PRINCIPAL ASSUMPTIONS SCENARIOS 6a - 6b
Ames, IA Gasification Project Financial Review - Mass Burn Scenarios

Operating Expenses Assumptions

Labor

Mass Burn - Scenario 6a & 6b

Labor Cost + Overtime	$3,177,000	**See Labor Cost Spreadsheet tab for details**

Mass Burn - Scenario 6b add'l labor

Shredder Equipment Operator	1.0 FTE	Operator Rate	$37	*per hr, incl. % benefits*
Maintenance	0.5 FTE	Maint. Rate	$40	*per hr, incl. % benefits*

	Scenario 6a	Scenario 6b	
Facilities Maintenance			
Building Maint (as % capital)	$91,000	$95,000	**See Maint & Fuel sheet tab for details**
Stationary Equipment Maintenance/Replacement			
Equipment Maint (as % capital)	$1,037,000	$1,109,000	**See Maint & Fuel sheet tab for details**
Rolling Stock Maintenance			
Maintenance (based on est hrs ops)	$99,000	$99,000	**See Maint & Fuel sheet tab for details**
Rolling Stock Equipment Replacement - Annual			
Annual Equipment Replacement	$76,000	$76,000	**See Equip Assumpt'ns sheet tab**
Fuel			
Fuel Costs for Rolling Stock	$183,000	$183,000	**See Maint & Fuel sheet tab for details**
Utilities Usage & Pricing			
Electricity	$3,600	$3,600	**See Utilities sheet tab for details**
Natural Gas	$52,900	$52,900	**See Utilities sheet tab for details**
Water	$24,300	$24,300	**See Utilities sheet tab for details**
Sewer	$1,400	$1,400	**See Utilities sheet tab for details**
Telephone	$5,000	$5,000	**See Utilities sheet tab for details**
Utilities Total	$87,200	$87,200	

Chemicals Consumption Usage & Pricing					
Aqueous Ammonia (28%)	7.5	lbs/ton RDF	$160	$/ton	*HDR estimate*
Activated Carbon	0.66	lb/ton RDF	$0.60	$/lb carbon	*HDR estimate*
Lime	24	lbs/ton RDF	$140	$/ton lime	*HDR estimate*

General & Admin, Legal, Accounting, Supplies, Tools, Expendables	5%	*of labor cost*
Annual Stack Testing	$150,000	*HDR estimate*
Overhead & Profit	0%	*Assumes City owned/operated facility*
Use only if private operations:	20%	*of operating costs, if private operations*
Insurance	0.15%	*Estimate as % of Capital Cost*
Property Taxes	$0	*Assumes City owned/operated facility*
O&M Contingency	10%	

APPENDIX C - PRINCIPAL ASSUMPTIONS SCENARIOS 6a - 6b
Ames, IA Gasification Project Financial Review - Mass Burn Scenarios

Facilities & Equipment

Scenario 6a - Mass Burn Raw MSW

Item	Unit Cost	Number	Total Cost
FACILITIES - BUILDINGS			
Total Building Costs	$9,100,000	1	$9,100,000
STATIONARY EQUIPMENT			
Total Equipment Costs	$51,830,000	1	$51,830,000
ROLLING STOCK			
Roll-off truck	$110,000	1	$110,000
Front End Loader	$300,000	1	$300,000
Front End Loader (used-backup)	$100,000	1	$100,000
Roll-off boxes	$7,000	4	$28,000
Forklift	$50,000	1	$50,000
Bobcat	$30,000	2	$60,000
Utility pick-up truck	$25,000	3	$75,000
Mini-Sweeper	$40,000	1	$40,000
Total Rolling Stock Cost			$763,000

Annual Replacement Costs $76,300

Avg number yrs replacement 10 years

Scenario 6b - Mass Burn Shredded MSW

Item	Unit Cost	Number	Total Cost
FACILITIES - BUILDINGS			
Total Building Costs	$9,500,000	1	$9,500,000
STATIONARY EQUIPMENT			
Total Equipment Costs	$55,470,000	1	$55,470,000
ROLLING STOCK			
Roll-off truck	$110,000	1	$110,000
Front End Loader	$300,000	1	$300,000
Front End Loader (used-backup)	$100,000	1	$100,000
Roll-off boxes	$7,000	4	$28,000
Forklift	$50,000	1	$50,000
Bobcat	$30,000	2	$60,000
Utility pick-up truck	$25,000	3	$75,000
Mini-Sweeper	$40,000	1	$40,000
Total Rolling Stock Cost			$763,000

Annual Replacement Costs $76,300

Avg number yrs replacement 10 years

APPENDIX C - PRINCIPAL ASSUMPTIONS SCENARIOS 6a - 6b
Ames, IA Gasification Project Financial Review - Mass Burn Scenarios

Maintenance & Fuel

Scenario 6a - Mass Burn Raw MSW

FACILITIES - BUILDINGS		
Total Capital Cost - Buildings		$9,100,000
Assume Annual Maintenance at % Capital	1.0%	$91,000
STATIONARY EQUIPMENT		
Total Capital Cost - Stationary Equipment		$51,830,000
Assume Annual Maintenance at % Capital	2.0%	$1,037,000

Scenario 6b - Mass Burn Shredded MSW

FACILITIES - BUILDINGS			
Total Capital Cost - Buildings		$9,500,000	
Assume Annual Maintenance at % Capital	1.0%	$95,000	
STATIONARY EQUIPMENT			
Total Capital Cost - Stationary Equipment		$55,470,000	
Assume Annual Maintenance at % Capital	2.0%	$1,109,000	Shredder maintenance at RDF plant avg = $52K

Scenarios 6a and 6b

ROLLING STOCK			
Item		**Hrs/Wk**	
OPS HRS per WEEK	**Availability**		
Roll-off truck	80%	40	Used extensively when receiving and 2 additional hours per week for maintenance; short haul
Front End Loader	80%	52	Used extensively when receiving waste
Front End Loader (used-backup)	50%	32	Used when receiving waste
Forklift	50%	36	
Bobcat	35%	100	Used during receiving & processing
Utility pick-up truck	15%	21	
Mini-Sweeper	85%	12	Two hours per processing day for maintenance
		Cost	
ANNUAL MAINTENANCE COSTS	**$/hr**		
Roll-off truck	$5.00	$10,448	
Front End Loader	$10.00	$26,880	
Front End Loader (used-backup)	$10.00	$16,800	
Forklift	$8.00	$14,892	
Bobcat	$5.00	$26,061	
Utility pick-up truck	N/A	$3,000	
Mini-Sweeper	N/A	$1,000	
Total Maintenance Costs		$99,081	
ANNUAL FUEL COSTS	**gal/hr**		
Roll-off truck	3	$25,075	estimate
Front End Loader for Faciity	5	$53,760	From CAT Manual - 950-972 Series medium consumption
Backup Front End Loader	5	$33,600	From CAT Manual - 950-972 Series medium consumption
Forklift (6,000 lb, pneumatic tires)	2	$14,892	estimate
Bobcat	2	$41,698	From CAT Manual - skid steer medium consumption
Utility pick-up truck	2	$8,935	estimate
Mini-Sweeper	2	$4,950	estimate
Total Fuel Costs		$182,910	

Assumptions:

Fuel costs - diesel ($/gal)	$4.00

APPENDIX C - PRINCIPAL ASSUMPTIONS SCENARIOS 6a - 6b
Ames, IA Gasification Project Financial Review - Mass Burn Scenarios

Labor

Personnel	Hourly Rate w/o Benefits	Hourly Rate w/ Benefits	Hrs per Shift	No. of Shifts	No. of Personnel per Shift	Annual Cost	Overtime Cost
Receiving Facility							
Supervisor per shift	$44	$55	8	1	1	$124,298	$0
Equipment operators per shift	$30	$37	8	1.5	1	$125,865	$9,440
Rolling stock operators per shift	$28	$36	8	1.5	1	$120,404	$9,030
General laborer per shift	$10	$13	8	1.5	1	$42,336	$3,175
Scalehouse Clerk	$15	$19	8	1.5	1	$63,504	$4,763
Rolling Stock and Equipment Maintenance							
Mechanics per shift	$32	$40	8	1	0	$0	$0
Mechanics helper per shift	$20	$25	8	1	0	$0	$0
Electricians per shift	$36	$45	8	1	0	$0	$0
Administration							
Facility manager	$50	$63	8	1	1	$131,040	$0
Operations manager	$44	$55	8	1	0	$0	$0
Env Coordinator	$35	$44	8	1	0	$0	$0
Accounting/personnel manager	$25	$32	8	1	1	$65,520	$0
Maintenence supervisor	$35	$44	8	1	1	$91,728	$0
Marketing manager	$25	$32	8	1	0	$0	$0
General administration/secretary	$25	$31	8	1	1	$65,468	$0
Clerk	$15	$19	8	1	0	$0	$0
Power Block							
Supervisor per shift	$44	$55	8	3	1	$413,182	$0
Mechanics per shift	$32	$40	8	3	1	$296,939	$22,270
Mechanics helper per shift	$20	$25	8	3	1	$187,639	$14,073
Electricians per shift	$36	$45	8	3	1	$336,062	$25,205
Crane Operator	$30	$37	8	3	1	$278,926	$20,919
Plant Operators per shift	$36	$45	8	3	2	$674,375	$50,578
Total Personnel per Shift					16		
Total Personnel (FTE)					**37**	**$ 3,017,285**	**$ 159,454**

(a) Labor rates include percentage for overhead, benefits. and worker's compensation.
(b) Overtime estimated at 10% of Facility personnel labor time. Excludes administration staff.
(c) Adminstration staff works 260 days per year, 8 hours per day.
(d) Mechanics and helpers normally not available for operating shifts, 3 each on the maintenance shift.

ASSUMPTIONS:

Overhead and benefits	1.26	
Overtime rate	1.5	
Overtime	5%	Excludes Administration
Administration Days/Year	260	days
Receiving Days/Year	280	days
Processing Days/Year	310	days

APPENDIX C - PRINCIPAL ASSUMPTIONS SCENARIOS 6a - 6b
Ames, IA Gasification Project Financial Review - Mass Burn Scenarios

Utilities

Item	Scenario 6a Mass Burn Raw MSW	Scenario 6b Mass Burn Shredded MSW	Purchase Price	
Annual Electric Usage				
Parasitic Load (kW)	900	900		
Plant Downtime Usage(kwh)	118,260	118,260		*Assumes 10% parasitic load during downtimes*
Total Electric Cost	$3,563	$3,563	$0.030 $/kWh	*City's 2009- 2011 average weighted power purchase price*
Natural Gas Usage (MMBtu/yr)	10,000	10,000		
Total Natural Gas Cost	$52,900	$52,900	$5.29 $/ MMBtu	*NYMEX 12-month strip (October 2012 - September 2013) plus estimated distribution costs*
Water Usage (cf/yr)	631,000	631,000		*Assume 80 gals/ton and 7.48 gal per cf conversion*
Water Minimum Charge	$10,756	$10,756	$896 per month	*City's Sup #2012-3, Sec. 28.201, Rev. 07-01-12 - 6" meter*
Total Water Cost (w/ min charge)	$24,323	$24,323	$0.0215 $ per cf	*City's Sup #2012-3, Sec. 28.201, Rev. 07-01-12 - avg com'l rate*
Wastewater/Sewer (cf/yr)	63100	63100		*Assume 10% of water usage*
Stormwater Drainage Charge	$41	$41	$3.45 per month	*City's Sup #2011-3, Sec.28.802, Rev.07-01-11*
Total Sewer Cost (w/ charge)	$1,436	$1,436	$2.21 $ per 100cf	*City's Sup #2012-3, Sec.28.304, Rev.07-01-12*
Telephone	$5,000	$5,000		*based on RRP's phone operation FY2011-2012 from City budget*
Total Utility Costs	**$87,221**	**$87,221**		

Scenario 6a - Mass Burn of Raw MSW, Electrical Generation System

BASE CASE	2012	2019	2020	2021	2022	2023	2024
OPERATIONS							
Mass Burn Processing Days/Year	0	310	310	310	310	310	310
Mass Burn Hours Operation/Year[1]	0	7,446	7,446	7,446	7,446	7,446	7,446
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW Delivered	56,000	60,040	60,640	61,250	61,860	62,480	63,100
Yard Waste Tonnages Delivered	5,000	5,350	5,400	5,450	5,500	5,560	5,620
Supplemental MSW	0	0	0	0	0	0	0
Less: Bypass & Non-Processible Waste	2,200	2,400	2,430	2,450	2,470	2,500	2,520
Less: Additional Bypass Waste		0	0	0	0	0	0
Process Outputs (tons)							
MSW Combusted		62,990	63,610	64,250	64,890	65,540	66,200
Combustion Ash Residue		17,640	17,810	17,990	18,170	18,350	18,540
Ferrous & Non-Ferrous Recovery[2]		2,420	2,440	2,470	2,490	2,520	2,540
Energy Outputs							
Electrical Generation - Net kWh/year		37,794,000	38,166,000	38,550,000	38,934,000	39,324,000	39,720,000
Carbon Offsets (tonnes CO2e)		0	0	0	0	0	0
SYSTEM REVENUES							
Tipping Fee Revenue[3]		$3,449,300	$3,483,600	$3,518,400	$3,553,200	$3,589,100	$3,625,000
Per Capita Revenue[3]		$819,000	$819,000	$819,000	$819,000	$819,000	$819,000
Energy Revenues[4]		$1,889,700	$1,908,300	$1,927,500	$1,946,700	$1,966,200	$1,986,000
Carbon Credits		$0	$0	$0	$0	$0	$0
Ferrous & Non-Ferrous Revenues[2]		$492,000	$506,800	$522,100	$537,900	$554,100	$570,900
Subtotal Revenues		**$6,650,000**	**$6,717,700**	**$6,787,000**	**$6,856,800**	**$6,928,400**	**$7,000,900**
Avoided Yard Waste Management Costs		$31,800	$31,800	$31,800	$31,800	$31,800	$31,800
EPG: Avoided RDF Ash Removal & Disposal Costs		$138,100	$140,800	$143,700	$146,500	$149,500	$152,400
EPG: Avoided RDF Storage Bins O&M		$184,900	$188,600	$192,400	$196,300	$200,200	$204,200
EPG: Avoided Boiler Maintenance Costs		$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
EPG: Avoided Extra Cost of Power to Burn RDF		$4,061,100	$6,879,100	$7,090,800	$7,309,000	$7,533,900	$7,765,700
Subtotal Revenues w/ Avoided Costs		**$12,099,900**	**$14,992,000**	**$15,279,700**	**$15,574,400**	**$15,877,800**	**$16,189,000**
SYSTEM EXPENSES							
Labor[5]		$3,649,000	$3,722,000	$3,797,000	$3,873,000	$3,950,000	$4,029,000
Facilities Maintenance		$104,500	$106,600	$108,800	$110,900	$113,100	$115,400
Stationary Equipment Maintenance/Replace		$1,191,200	$1,215,000	$1,239,300	$1,264,100	$1,289,400	$1,315,200
Rolling Stock Maintenance		$113,700	$116,000	$118,300	$120,700	$123,100	$125,600
Rolling Stock Equip Replacement Costs		$87,300	$89,000	$90,800	$92,600	$94,500	$96,400
Fuel Costs		$210,200	$214,400	$218,700	$223,100	$227,500	$232,100
Utilities - Electricity, Natural Gas, Water, Sewer & Telephone		$100,200	$102,200	$104,200	$106,300	$108,400	$110,600
Reagents/Chemicals Consumption - Ammonia, Lime & Activated Carbon		$193,600	$199,400	$205,500	$211,700	$218,100	$224,700
Ash Residue Disposal		$1,114,500	$1,147,700	$1,182,500	$1,218,200	$1,254,900	$1,293,200
Bypass/Non-Processible Waste Disposal		$162,000	$167,400	$172,100	$177,000	$182,700	$187,900
Annual Stack Testing		$172,300	$175,700	$179,300	$182,800	$186,500	$190,200
General & Admin, Legal, Accounting, Supplies, Tools, Expendables[6]		$182,500	$186,100	$189,900	$193,700	$197,500	$201,500
Insurance		$138,700	$141,500	$144,300	$147,200	$150,100	$153,100
Property Taxes		$0	$0	$0	$0	$0	$0
Contingency (10%)		$742,000	$758,300	$775,100	$792,100	$809,600	$827,500
Subtotal Expenses		**$8,161,700**	**$8,341,300**	**$8,525,800**	**$8,713,400**	**$8,905,400**	**$9,102,400**
CAPITAL COSTS/DEBT SERVICE							
Mass Burn Project Net Debt Service[7]		$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000
Subtotal Debt Service		**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**
NET REVENUES (EXPENSES)[8]		**($10,892,700)**	**($11,004,600)**	**($11,119,800)**	**($11,237,600)**	**($11,358,000)**	**($11,482,500)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]		**$167**	**$167**	**$167**	**$167**	**$167**	**$167**
NET REVENUES (EXPENSES) w/ Avoided Costs[9]		**($5,442,800)**	**($2,730,300)**	**($2,627,100)**	**($2,520,000)**	**($2,408,600)**	**($2,294,400)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]		**$83**	**$41**	**$39**	**$37**	**$35**	**$33**

Notes:

[1] Mass Burn operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery part of mass burn operations.

[3] Tipping fee ($52.75/ton) and $9.10 per capita revenues currently received at RRP with no escalation.

[4] Energy revenues at $0.05/kWh with no escalation.

[5] Estimated labor requirement for mass burn facility operation based on City labor rates.
Labor allocation from power plant operations should be deducted from such operations budget.

[6] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, legal & accounting, etc.

[7] Includes capital costs for mass burn facility equipment, buildings, site work, permitting, engineering services (design & construction period services), start-up, and contingency at 20%.

[8] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[9] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

[10] Additional revenues required divided by MSW and yard waste received at the facility.

Scenario 6a - Mass Burn of Raw MSW, Electrical Generation System

BASE CASE	2025	2026	2027	2028	2029	2030	2031
OPERATIONS							
Mass Burn Processing Days/Year	310	310	310	310	310	310	310
Mass Burn Hours Operation/Year[1]	7,446	7,446	7,446	7,446	7,446	7,446	7,446
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW Delivered	63,730	64,370	65,010	65,660	66,320	66,980	67,650
Yard Waste Tonnages Delivered	5,680	5,740	5,800	5,860	5,920	5,980	6,040
Supplemental MSW	0	0	0	0	0	0	0
Less: Bypass & Non-Processible Waste	2,550	2,570	2,600	2,630	2,650	2,680	2,710
Less: Additional Bypass Waste	0	0	0	0	0	0	0
Process Outputs (tons)							
MSW Combusted	66,860	67,540	68,210	68,890	69,590	70,280	70,980
Combustion Ash Residue	18,720	18,910	19,100	19,290	19,490	19,680	19,870
Ferrous & Non-Ferrous Recovery[2]	2,570	2,600	2,620	2,650	2,670	2,700	2,730
Energy Outputs							
Electrical Generation - Net kWh/year	40,116,000	40,524,000	40,926,000	41,334,000	41,754,000	42,168,000	42,588,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Tipping Fee Revenue[3]	$3,661,400	$3,698,300	$3,735,200	$3,772,700	$3,810,700	$3,848,600	$3,887,100
Per Capita Revenue[3]	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000
Energy Revenues[4]	$2,005,800	$2,026,200	$2,046,300	$2,066,700	$2,087,700	$2,108,400	$2,129,400
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ferrous & Non-Ferrous Revenues[2]	$588,100	$606,000	$624,300	$643,100	$662,600	$682,600	$703,200
Subtotal Revenues	**$7,074,300**	**$7,149,500**	**$7,224,800**	**$7,301,500**	**$7,380,000**	**$7,458,600**	**$7,538,700**
Avoided Yard Waste Management Costs	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800
EPG: Avoided RDF Ash Removal & Disposal Costs	$155,500	$158,600	$161,800	$165,000	$168,300	$171,700	$175,100
EPG: Avoided RDF Storage Bins O&M	$208,300	$212,400	$216,700	$221,000	$225,400	$229,900	$234,500
EPG: Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
EPG: Avoided Extra Cost of Power to Burn RDF	$8,004,700	$8,251,000	$8,504,900	$8,766,600	$9,036,300	$9,314,400	$9,601,000
Subtotal Revenues w/ Avoided Costs	**$16,508,600**	**$16,837,300**	**$17,174,000**	**$17,519,900**	**$17,875,800**	**$18,240,400**	**$18,615,100**
SYSTEM EXPENSES							
Labor[5]	$4,110,000	$4,192,000	$4,276,000	$4,361,000	$4,449,000	$4,538,000	$4,628,000
Facilities Maintenance	$117,700	$120,100	$122,500	$124,900	$127,400	$130,000	$132,600
Stationary Equipment Maintenance/Replace	$1,341,500	$1,368,300	$1,395,700	$1,423,600	$1,452,100	$1,481,100	$1,510,700
Rolling Stock Maintenance	$128,100	$130,600	$133,200	$135,900	$138,600	$141,400	$144,200
Rolling Stock Equip Replacement Costs	$98,300	$100,300	$102,300	$104,300	$106,400	$108,500	$110,700
Fuel Costs	$236,700	$241,500	$246,300	$251,200	$256,200	$261,400	$266,600
Utilities - Electricity, Natural Gas, Water, Sewer & Telephone	$112,800	$115,100	$117,400	$119,700	$122,100	$124,500	$127,000
Reagents/Chemicals Consumption - Ammonia, Lime & Activated Carbon	$231,400	$238,500	$245,700	$253,100	$260,800	$268,600	$276,700
Ash Residue Disposal	$1,331,900	$1,372,300	$1,413,800	$1,456,500	$1,501,000	$1,545,900	$1,592,100
Bypass/Non-Processible Waste Disposal	$193,900	$199,300	$205,700	$212,200	$218,100	$225,000	$232,100
Annual Stack Testing	$194,000	$197,900	$201,900	$205,900	$210,000	$214,200	$218,500
General & Admin, Legal, Accounting, Supplies, Tools, Expendables[6]	$205,500	$209,600	$213,800	$218,100	$222,500	$226,900	$231,400
Insurance	$156,200	$159,300	$162,500	$165,800	$169,100	$172,500	$175,900
Property Taxes	$0	$0	$0	$0	$0	$0	$0
Contingency (10%)	$845,800	$864,500	$883,700	$903,200	$923,300	$943,800	$964,700
Subtotal Expenses	**$9,303,800**	**$9,509,300**	**$9,720,500**	**$9,935,400**	**$10,156,600**	**$10,381,800**	**$10,611,200**
CAPITAL COSTS/DEBT SERVICE							
Mass Burn Project Net Debt Service[7]	$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000
Subtotal Debt Service	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**
NET REVENUES (EXPENSES)[8]	**($11,610,500)**	**($11,740,800)**	**($11,876,700)**	**($12,014,900)**	**($12,157,600)**	**($12,304,200)**	**($12,453,500)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$167**	**$167**	**$168**	**$168**	**$168**	**$169**	**$169**
NET REVENUES (EXPENSES) w/ Avoided Costs[9]	**($2,176,200)**	**($2,053,000)**	**($1,927,500)**	**($1,796,500)**	**($1,661,800)**	**($1,522,400)**	**($1,377,100)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$31**	**$29**	**$27**	**$25**	**$23**	**$21**	**$19**

Notes:

[1] Mass Burn operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery part of mass burn operations.

[3] Tipping fee ($52.75/ton) and $9.10 per capita revenues currently received at RRP with no escalation.

[4] Energy revenues at $0.05/kWh with no escalation.

[5] Estimated labor requirement for mass burn facility operation based on City labor rates.
Labor allocation from RDF and power plant operations should be deducted from such operations budget.

[6] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, legal & accounting, etc.

[7] Includes capital costs for mass burn facility equipment, buildings, site work, permitting, engineering services (design & construction period services), start-up, and contingency at 20%.

[8] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[9] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

[10] Additional revenues required divided by MSW and yard waste received at the facility.

Scenario 6a - Mass Burn of Raw MSW, Electrical Generation System

BASE CASE	2032	2033	2034	2035	2036	2037	2038
OPERATIONS							
Mass Burn Processing Days/Year	310	310	310	310	310	310	310
Mass Burn Hours Operation/Year[1]	7,446	7,446	7,446	7,446	7,446	7,446	7,446
MATERIAL QUANTITIES							
Waste Deliveries (tons)							
MSW Delivered	68,330	69,010	69,700	70,400	71,100	71,810	72,530
Yard Waste Tonnages Delivered	6,100	6,160	6,220	6,280	6,340	6,400	6,460
Supplemental MSW	0	0	0	0	0	0	0
Less: Bypass & Non-Processible Waste	2,730	2,760	2,790	2,820	2,840	2,870	2,900
Less: Additional Bypass Waste	0	0	0	0	0	0	0
Process Outputs (tons)							
MSW Combusted	71,700	72,410	73,130	73,860	74,600	75,340	76,090
Combustion Ash Residue	20,080	20,270	20,480	20,680	20,890	21,100	21,310
Ferrous & Non-Ferrous Recovery[2]	2,760	2,780	2,810	2,840	2,870	2,900	2,920
Energy Outputs							
Electrical Generation - Net kWh/year	43,020,000	43,446,000	43,878,000	44,316,000	44,760,000	45,204,000	45,654,000
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Tipping Fee Revenue[3]	$3,926,200	$3,965,200	$4,004,800	$4,044,900	$4,085,000	$4,125,600	$4,166,700
Per Capita Revenue[3]	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000
Energy Revenues[4]	$2,151,000	$2,172,300	$2,193,900	$2,215,800	$2,238,000	$2,260,200	$2,282,700
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ferrous & Non-Ferrous Revenues[2]	$724,500	$746,300	$768,800	$792,000	$815,900	$840,500	$865,800
Subtotal Revenues	**$7,620,700**	**$7,702,800**	**$7,786,500**	**$7,871,700**	**$7,957,900**	**$8,045,300**	**$8,134,200**
Avoided Yard Waste Management Costs	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800
EPG: Avoided RDF Ash Removal & Disposal Costs	$178,600	$182,200	$185,800	$189,500	$193,300	$197,200	$201,100
EPG: Avoided RDF Storage Bins O&M	$239,200	$244,000	$248,900	$253,900	$259,000	$264,100	$269,400
EPG: Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
EPG: Avoided Extra Cost of Power to Burn RDF	$9,896,400	$10,201,000	$10,514,800	$10,838,400	$11,171,900	$11,515,700	$11,870,000
Subtotal Revenues w/ Avoided Costs	**$19,000,700**	**$19,395,800**	**$19,801,800**	**$20,219,300**	**$20,647,900**	**$21,088,100**	**$21,540,500**
SYSTEM EXPENSES							
Labor[5]	$4,721,000	$4,815,000	$4,912,000	$5,010,000	$5,110,000	$5,212,000	$5,316,000
Facilities Maintenance	$135,200	$137,900	$140,700	$143,500	$146,400	$149,300	$152,300
Stationary Equipment Maintenance/Replace	$1,540,900	$1,571,700	$1,603,200	$1,635,200	$1,667,900	$1,701,300	$1,735,300
Rolling Stock Maintenance	$147,100	$150,100	$153,100	$156,100	$159,200	$162,400	$165,700
Rolling Stock Equip Replacement Costs	$112,900	$115,200	$117,500	$119,800	$122,200	$124,700	$127,200
Fuel Costs	$271,900	$277,400	$282,900	$288,600	$294,300	$300,200	$306,200
Utilities - Electricity, Natural Gas, Water, Sewer & Telephone	$129,600	$132,200	$134,800	$137,500	$140,300	$143,100	$145,900
Reagents/Chemicals Consumption - Ammonia, Lime & Activated Carbon	$285,100	$293,700	$302,500	$311,700	$321,100	$330,800	$340,700
Ash Residue Disposal	$1,641,100	$1,689,700	$1,741,400	$1,793,600	$1,848,000	$1,903,900	$1,961,300
Bypass/Non-Processible Waste Disposal	$238,400	$245,900	$253,500	$261,400	$268,500	$276,800	$285,300
Annual Stack Testing	$222,900	$227,300	$231,900	$236,500	$241,300	$246,100	$251,000
General & Admin, Legal, Accounting, Supplies, Tools, Expendables[6]	$236,100	$240,800	$245,600	$250,500	$255,500	$260,600	$265,800
Insurance	$179,400	$183,000	$186,700	$190,400	$194,200	$198,100	$202,100
Property Taxes	$0	$0	$0	$0	$0	$0	$0
Contingency (10%)	$986,200	$1,008,000	$1,030,600	$1,053,500	$1,076,900	$1,100,900	$1,125,500
Subtotal Expenses	**$10,847,800**	**$11,087,900**	**$11,336,400**	**$11,588,300**	**$11,845,800**	**$12,110,200**	**$12,380,300**
CAPITAL COSTS/DEBT SERVICE							
Mass Burn Project Net Debt Service[7]	$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000	$9,381,000
Subtotal Debt Service	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**	**$9,381,000**
NET REVENUES (EXPENSES)[8]	**($12,608,100)**	**($12,766,100)**	**($12,930,900)**	**($13,097,600)**	**($13,268,900)**	**($13,445,900)**	**($13,627,100)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$169**	**$170**	**$170**	**$171**	**$171**	**$172**	**$173**
NET REVENUES (EXPENSES) w/ Avoided Costs[9]	**($1,228,100)**	**($1,073,100)**	**($915,600)**	**($750,000)**	**($578,900)**	**($403,100)**	**($220,800)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$17**	**$14**	**$12**	**$10**	**$7**	**$5**	**$3**

Notes:

[1] Mass Burn operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery part of mass burn operations.

[3] Tipping fee ($52.75/ton) and $9.10 per capita revenues currently received at RRP with no escalation.

[4] Energy revenues at $0.05/kWh with no escalation.

[5] Estimated labor requirement for mass burn facility operation based on City labor rates.
Labor allocation from RDF and power plant operations should be deducted from such operations budget.

[6] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, legal & accounting, etc.

[7] Includes capital costs for mass burn facility equipment, buildings, site work, permitting, engineering services (design & construction period services), start-up, and contingency at 20%.

[8] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[9] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

[10] Additional revenues required divided by MSW and yard waste received at the facility.

Scenario 6b - Mass Burn of Shredded MSW, Electrical Generation System

BASE CASE	2012	2019	2020	2021	2022	2023	2024
OPERATIONS							
Mass Burn Processing Days/Year	0	310	310	310	310	310	310
Mass Burn Hours Operation/Year[1]	0	7,446	7,446	7,446	7,446	7,446	7,446
MATERIAL QUANTITIES (tons)							
Waste Deliveries							
MSW Delivered	56,000	60,040	60,640	61,250	61,860	62,480	63,100
Yard Waste Tonnages Delivered	5,000	5,350	5,400	5,450	5,500	5,560	5,620
Supplemental MSW	0	0	0	0	0	0	0
Less: Bypass & Non-Processible Waste	2,200	2,400	2,430	2,450	2,470	2,500	2,520
Less: Additional Bypass Waste		0	0	0	0	0	0
Process Outputs							
MSW Combusted		62,990	63,610	64,250	64,890	65,540	66,200
Combustion Ash Residue		17,640	17,810	17,990	18,170	18,350	18,540
Ferrous & Non-Ferrous Recovery[2]		2,420	2,440	2,470	2,490	2,520	2,540
Energy Outputs							
Electrical Generation - Net kWh/year		37,164,100	37,529,900	37,907,500	38,285,100	38,668,600	39,058,000
Carbon Offsets (tonnes CO2e)		0	0	0	0	0	0
SYSTEM REVENUES							
Tipping Fee Revenue[3]		$3,449,300	$3,483,600	$3,518,400	$3,553,200	$3,589,100	$3,625,000
Per Capita Revenue[3]		$819,000	$819,000	$819,000	$819,000	$819,000	$819,000
Energy Revenues[4]		$1,858,200	$1,876,500	$1,895,400	$1,914,300	$1,933,400	$1,952,900
Carbon Credits		$0	$0	$0	$0	$0	$0
Ferrous & Non-Ferrous Revenues		$492,000	$506,800	$522,100	$537,900	$554,100	$570,900
Subtotal Revenues		**$6,618,500**	**$6,685,900**	**$6,754,900**	**$6,824,400**	**$6,895,600**	**$6,967,800**
Avoided Yard Waste Management Costs		$31,800	$31,800	$31,800	$31,800	$31,800	$31,800
EPG: Avoided RDF Ash Removal & Disposal Costs		$138,100	$140,800	$143,700	$146,500	$149,500	$152,400
EPG: Avoided RDF Storage Bins O&M		$184,900	$188,600	$192,400	$196,300	$200,200	$204,200
EPG: Avoided Boiler Maintenance Costs		$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
EPG: Avoided Extra Cost of Power to Burn RDF		$4,061,100	$6,879,100	$7,090,800	$7,309,000	$7,533,900	$7,765,700
Subtotal Revenues w/ Avoided Costs		**$12,068,400**	**$14,960,200**	**$15,247,600**	**$15,542,000**	**$15,845,000**	**$16,155,900**
SYSTEM EXPENSES							
Labor[5]		$3,787,000	$3,862,000	$3,939,000	$4,018,000	$4,099,000	$4,181,000
Facilities Maintenance		$109,100	$111,300	$113,500	$115,800	$118,100	$120,500
Stationary Equipment Maintenance/Replace		$1,273,900	$1,299,400	$1,325,400	$1,351,900	$1,378,900	$1,406,500
Rolling Stock Maintenance		$113,700	$116,000	$118,300	$120,700	$123,100	$125,600
Rolling Stock Equip Replacement Costs		$87,300	$89,000	$90,800	$92,600	$94,500	$96,400
Fuel Costs		$210,200	$214,400	$218,700	$223,100	$227,500	$232,100
Utilities - Electricity, Natural Gas, Water, Sewer & Telephone		$100,200	$102,200	$104,200	$106,300	$108,400	$110,600
Reagents/Chemicals Consumption - Ammonia, Lime & Activated Carbon		$193,600	$199,400	$205,500	$211,700	$218,100	$224,700
Ash Residue Disposal		$1,114,500	$1,147,700	$1,182,500	$1,218,200	$1,254,900	$1,293,200
Bypass/Non-Processible Waste Disposal		$162,000	$167,400	$172,100	$177,000	$182,700	$187,900
Annual Stack Testing		$172,300	$175,700	$179,300	$182,800	$186,500	$190,200
General & Admin, Legal, Accounting, Supplies, Tools, Expendables[6]		$189,400	$193,100	$197,000	$200,900	$205,000	$209,100
Insurance		$147,000	$149,900	$152,900	$156,000	$159,100	$162,300
Property Taxes		$0	$0	$0	$0	$0	$0
Contingency (10%)		$766,000	$782,800	$799,900	$817,500	$835,600	$854,000
Subtotal Expenses		**$8,426,200**	**$8,610,300**	**$8,799,100**	**$8,992,500**	**$9,191,400**	**$9,394,100**
CAPITAL COSTS/DEBT SERVICE							
Mass Burn Project Net Debt Service[7]		$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000
Subtotal Debt Service		**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**
NET REVENUES (EXPENSES)[8]		**($11,747,700)**	**($11,864,400)**	**($11,984,200)**	**($12,108,100)**	**($12,235,800)**	**($12,366,300)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]		**$180**	**$180**	**$180**	**$180**	**$180**	**$180**
NET REVENUES (EXPENSES) w/ Avoided Costs[9]		**($6,297,800)**	**($3,590,100)**	**($3,491,500)**	**($3,390,500)**	**($3,286,400)**	**($3,178,200)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]		**$96**	**$54**	**$52**	**$50**	**$48**	**$46**

Notes:

[1] Mass Burn operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery part of mass burn operations.

[3] Tipping fee ($52.75/ton) and $9.10 per capita revenues currently received at RRP with no escalation.

[4] Energy revenues at $0.05/kWh with no escalation.

[5] Estimated labor requirement for mass burn facility operation based on City labor rates.
Labor allocation from RDF and power plant operations should be deducted from such operations budget.

[6] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, legal & accounting, etc.

[7] Includes capital costs for mass burn facility equipment, buildings, site work, permitting, engineering services (design & construction period services), start-up, and contingency at 20%.

[8] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[9] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

[10] Additional revenues required divided by MSW and yard waste received at the facility.

Scenario 6b - Mass Burn of Shredded MSW, Electrical Generation System

BASE CASE	2025	2026	2027	2028	2029	2030	2031
OPERATIONS							
Mass Burn Processing Days/Year	310	310	310	310	310	310	310
Mass Burn Hours Operation/Year[1]	7,446	7,446	7,446	7,446	7,446	7,446	7,446
MATERIAL QUANTITIES (tons)							
Waste Deliveries							
MSW Delivered	63,730	64,370	65,010	65,660	66,320	66,980	67,650
Yard Waste Tonnages Delivered	5,680	5,740	5,800	5,860	5,920	5,980	6,040
Supplemental MSW	0	0	0	0	0	0	0
Less: Bypass & Non-Processible Waste	2,550	2,570	2,600	2,630	2,650	2,680	2,710
Less: Additional Bypass Waste	0	0	0	0	0	0	0
Process Outputs							
MSW Combusted	66,860	67,540	68,210	68,890	69,590	70,280	70,980
Combustion Ash Residue	18,720	18,910	19,100	19,290	19,490	19,680	19,870
Ferrous & Non-Ferrous Recovery[2]	2,570	2,600	2,620	2,650	2,670	2,700	2,730
Energy Outputs							
Electrical Generation - Net kWh/year	39,447,400	39,848,600	40,243,900	40,645,100	41,058,100	41,465,200	41,878,200
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Tipping Fee Revenue[3]	$3,661,400	$3,698,300	$3,735,200	$3,772,700	$3,810,700	$3,848,600	$3,887,100
Per Capita Revenue[3]	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000
Energy Revenues[4]	$1,972,400	$1,992,400	$2,012,200	$2,032,300	$2,052,900	$2,073,300	$2,093,900
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ferrous & Non-Ferrous Revenues	$588,100	$606,000	$624,300	$643,100	$662,600	$682,600	$703,200
Subtotal Revenues	**$7,040,900**	**$7,115,700**	**$7,190,700**	**$7,267,100**	**$7,345,200**	**$7,423,500**	**$7,503,200**
Avoided Yard Waste Management Costs	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800
EPG: Avoided RDF Ash Removal & Disposal Costs	$155,500	$158,600	$161,800	$165,000	$168,300	$171,700	$175,100
EPG: Avoided RDF Storage Bins O&M	$208,300	$212,400	$216,700	$221,000	$225,400	$229,900	$234,500
EPG: Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
EPG: Avoided Extra Cost of Power to Burn RDF	$8,004,700	$8,251,000	$8,504,900	$8,766,600	$9,036,300	$9,314,400	$9,601,000
Subtotal Revenues w/ Avoided Costs	**$16,475,200**	**$16,803,500**	**$17,139,900**	**$17,485,500**	**$17,841,000**	**$18,205,300**	**$18,579,600**
SYSTEM EXPENSES							
Labor[5]	$4,264,000	$4,350,000	$4,437,000	$4,525,000	$4,616,000	$4,708,000	$4,802,000
Facilities Maintenance	$122,900	$125,400	$127,900	$130,400	$133,000	$135,700	$138,400
Stationary Equipment Maintenance/Replace	$1,434,600	$1,463,300	$1,492,600	$1,522,400	$1,552,900	$1,583,900	$1,615,600
Rolling Stock Maintenance	$128,100	$130,600	$133,200	$135,900	$138,600	$141,400	$144,200
Rolling Stock Equip Replacement Costs	$98,300	$100,300	$102,300	$104,300	$106,400	$108,500	$110,700
Fuel Costs	$236,700	$241,500	$246,300	$251,200	$256,200	$261,400	$266,600
Utilities - Electricity, Natural Gas, Water, Sewer & Telephone	$112,800	$115,100	$117,400	$119,700	$122,100	$124,500	$127,000
Reagents/Chemicals Consumption - Ammonia, Lime & Activated Carbon	$231,400	$238,500	$245,700	$253,100	$260,800	$268,600	$276,700
Ash Residue Disposal	$1,331,900	$1,372,300	$1,413,800	$1,456,500	$1,501,000	$1,545,900	$1,592,100
Bypass/Non-Processible Waste Disposal	$193,900	$199,300	$205,700	$212,200	$218,100	$225,000	$232,100
Annual Stack Testing	$194,000	$197,900	$201,900	$205,900	$210,000	$214,200	$218,500
General & Admin, Legal, Accounting, Supplies, Tools, Expendables[6]	$213,200	$217,500	$221,900	$226,300	$230,800	$235,400	$240,100
Insurance	$165,500	$168,800	$172,200	$175,600	$179,200	$182,700	$186,400
Property Taxes	$0	$0	$0	$0	$0	$0	$0
Contingency (10%)	$872,700	$892,100	$911,800	$931,900	$952,500	$973,500	$995,000
Subtotal Expenses	**$9,600,000**	**$9,812,600**	**$10,029,700**	**$10,250,400**	**$10,477,600**	**$10,708,700**	**$10,945,400**
CAPITAL COSTS/DEBT SERVICE							
Mass Burn Project Net Debt Service[7]	$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000
Subtotal Debt Service	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**
NET REVENUES (EXPENSES)[8]	**($12,499,100)**	**($12,636,900)**	**($12,779,000)**	**($12,923,300)**	**($13,072,400)**	**($13,225,200)**	**($13,382,200)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$180**	**$180**	**$180**	**$181**	**$181**	**$181**	**$182**
NET REVENUES (EXPENSES) w/ Avoided Costs[9]	**($3,064,800)**	**($2,949,100)**	**($2,829,800)**	**($2,704,900)**	**($2,576,600)**	**($2,443,400)**	**($2,305,800)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$44**	**$42**	**$40**	**$38**	**$36**	**$33**	**$31**

Notes:

[1] Mass Burn operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery part of mass burn operations.

[3] Tipping fee ($52.75/ton) and $9.10 per capita revenues currently received at RRP with no escalation.

[4] Energy revenues at $0.05/kWh with no escalation.

[5] Estimated labor requirement for mass burn facility operation based on City labor rates.
Labor allocation from RDF and power plant operations should be deducted from such operations budget.

[6] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, legal & accounting, etc.

[7] Includes capital costs for mass burn facility equipment, buildings, site work, permitting, engineering services (design & construction period services), start-up, and contingency at 20%.

[8] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[9] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

[10] Additional revenues required divided by MSW and yard waste received at the facility.

Scenario 6b - Mass Burn of Shredded MSW, Electrical Generation System

BASE CASE	2032	2033	2034	2035	2036	2037	2038
OPERATIONS							
Mass Burn Processing Days/Year	310	310	310	310	310	310	310
Mass Burn Hours Operation/Year[1]	7,446	7,446	7,446	7,446	7,446	7,446	7,446
MATERIAL QUANTITIES (tons)							
Waste Deliveries							
MSW Delivered	68,330	69,010	69,700	70,400	71,100	71,810	72,530
Yard Waste Tonnages Delivered	6,100	6,160	6,220	6,280	6,340	6,400	6,460
Supplemental MSW	0	0	0	0	0	0	0
Less: Bypass & Non-Processible Waste	2,730	2,760	2,790	2,820	2,840	2,870	2,900
Less: Additional Bypass Waste	0	0	0	0	0	0	0
Process Outputs							
MSW Combusted	71,700	72,410	73,130	73,860	74,600	75,340	76,090
Combustion Ash Residue	20,080	20,270	20,480	20,680	20,890	21,100	21,310
Ferrous & Non-Ferrous Recovery[2]	2,760	2,780	2,810	2,840	2,870	2,900	2,920
Energy Outputs							
Electrical Generation - Net kWh/year	42,303,000	42,721,900	43,146,700	43,577,400	44,014,000	44,450,600	44,893,100
Carbon Offsets (tonnes CO2e)	0	0	0	0	0	0	0
SYSTEM REVENUES							
Tipping Fee Revenue[3]	$3,926,200	$3,965,200	$4,004,800	$4,044,900	$4,085,000	$4,125,600	$4,166,700
Per Capita Revenue[3]	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000	$819,000
Energy Revenues[4]	$2,115,200	$2,136,100	$2,157,300	$2,178,900	$2,200,700	$2,222,500	$2,244,700
Carbon Credits	$0	$0	$0	$0	$0	$0	$0
Ferrous & Non-Ferrous Revenues	$724,500	$746,300	$768,800	$792,000	$815,900	$840,500	$865,800
Subtotal Revenues	**$7,584,900**	**$7,666,600**	**$7,749,900**	**$7,834,800**	**$7,920,600**	**$8,007,600**	**$8,096,200**
Avoided Yard Waste Management Costs	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800	$31,800
EPG: Avoided RDF Ash Removal & Disposal Costs	$178,600	$182,200	$185,800	$189,500	$193,300	$197,200	$201,100
EPG: Avoided RDF Storage Bins O&M	$239,200	$244,000	$248,900	$253,900	$259,000	$264,100	$269,400
EPG: Avoided Boiler Maintenance Costs	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000	$1,034,000
EPG: Avoided Extra Cost of Power to Burn RDF	$9,896,400	$10,201,000	$10,514,800	$10,838,400	$11,171,900	$11,515,700	$11,870,000
Subtotal Revenues w/ Avoided Costs	**$18,964,900**	**$19,359,600**	**$19,765,200**	**$20,182,400**	**$20,610,600**	**$21,050,400**	**$21,502,500**
SYSTEM EXPENSES							
Labor[5]	$4,898,000	$4,996,000	$5,096,000	$5,198,000	$5,302,000	$5,408,000	$5,516,000
Facilities Maintenance	$141,200	$144,000	$146,900	$149,800	$152,800	$155,900	$159,000
Stationary Equipment Maintenance/Replace	$1,647,900	$1,680,900	$1,714,500	$1,748,800	$1,783,800	$1,819,400	$1,855,800
Rolling Stock Maintenance	$147,100	$150,100	$153,100	$156,100	$159,200	$162,400	$165,700
Rolling Stock Equip Replacement Costs	$112,900	$115,200	$117,500	$119,800	$122,200	$124,700	$127,200
Fuel Costs	$271,900	$277,400	$282,900	$288,600	$294,300	$300,200	$306,200
Utilities - Electricity, Natural Gas, Water, Sewer & Telephone	$129,600	$132,200	$134,800	$137,500	$140,300	$143,100	$145,900
Reagents/Chemicals Consumption - Ammonia, Lime & Activated Carbon	$285,100	$293,700	$302,500	$311,700	$321,100	$330,800	$340,700
Ash Residue Disposal	$1,641,100	$1,689,700	$1,741,400	$1,793,600	$1,848,000	$1,903,900	$1,961,300
Bypass/Non-Processible Waste Disposal	$238,400	$245,900	$253,500	$261,400	$268,500	$276,800	$285,300
Annual Stack Testing	$222,900	$227,300	$231,900	$236,500	$241,300	$246,100	$251,000
General & Admin, Legal, Accounting, Supplies, Tools, Expendables[6]	$244,900	$249,800	$254,800	$259,900	$265,100	$270,400	$275,800
Insurance	$190,100	$193,900	$197,800	$201,800	$205,800	$209,900	$214,100
Property Taxes	$0	$0	$0	$0	$0	$0	$0
Contingency (10%)	$1,017,100	$1,039,600	$1,062,800	$1,086,400	$1,110,400	$1,135,200	$1,160,400
Subtotal Expenses	**$11,188,200**	**$11,435,700**	**$11,690,400**	**$11,949,900**	**$12,214,800**	**$12,486,800**	**$12,764,400**
CAPITAL COSTS/DEBT SERVICE							
Mass Burn Project Net Debt Service[7]	$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000	$9,940,000
Subtotal Debt Service	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**	**$9,940,000**
NET REVENUES (EXPENSES)[8]	**($13,543,300)**	**($13,709,100)**	**($13,880,500)**	**($14,055,100)**	**($14,234,200)**	**($14,419,200)**	**($14,608,200)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$182**	**$182**	**$183**	**$183**	**$184**	**$184**	**$185**
NET REVENUES (EXPENSES) w/ Avoided Costs[9]	**($2,163,300)**	**($2,016,100)**	**($1,865,200)**	**($1,707,500)**	**($1,544,200)**	**($1,376,400)**	**($1,201,900)**
ADD'L REQUIRED MSW TIP FEES ($/ton)[10]	**$29**	**$27**	**$25**	**$22**	**$20**	**$18**	**$15**

Notes:

[1] Mass Burn operating hours correspond to annual capacity factor and 24 hours operation.

[2] Revenues from ferrous and non-ferrous metals recovery part of mass burn operations.

[3] Tipping fee ($52.75/ton) and $9.10 per capita revenues currently received at RRP with no escalation.

[4] Energy revenues at $0.05/kWh with no escalation.

[5] Estimated labor requirement for mass burn facility operation based on City labor rates.
Labor allocation from RDF and power plant operations should be deducted from such operations budget.

[6] Includes general administration, health & safety, supplies, PPE, training, wearing apparel, misc. tools, legal & accounting, etc.

[7] Includes capital costs for mass burn facility equipment, buildings, site work, permitting, engineering services (design & construction period services), start-up, and contingency at 20%.

[8] Equals the "Subtotal Revenues" less the Expenses and Debt Service.

[9] Equals the "Subtotal Revenues w/ Avoided Costs" less the Expenses and Debt Service.

[10] Additional revenues required divided by MSW and yard waste received at the facility.

APPENDIX D
BOND SIZING RUNS

Bond Sizing Calculation Methodology - Scenario 1

ASSUMPTIONS		Values
Construction Assumptions:		
Construction Cost Annual Escalation Rate		4.0%
Escalation Months from 1-1-2013 to NTP		0
Planning, Permitting & Design (months)		18
Months for Construction (Months):	1.50	18
Debt Assumptions		
Amortization period (Years):		20
Availability of Reserves (%):		100%
Taxable Debt Portion (%)		
Equity Portion (%) excl. tax benefits		
Construction Price Financed ($):		$36,591,000
Draw Down Availablity of Funds (%):		30%
Underwriter's Discount & Expenses (%):		4.0%
Interest Rate Assumptions		
Blended Bond Interest Rate (%)		6.0%
Tax Exempt Rate (%)		
Taxable Rate (%)		
Equity Rate (%)		
Reinvestment Rates		
Long Term Reinvestment Rate (%):		2.0%
Short Term Reinvestment Rate (%):		2.0%
CALCULATIONS:		
Number of Const. Payment Periods		3
Interest During Construction Availability:		0.67
Blend Capital Recovery Factor		
Bond Capital Recovery Factor		8.7%
Debt Service Reserve Cap		8.7%
Bond Issue Size (Round up to nearest $5000)		**$46,065,000**
Capital Cost		$36,591,000
Bond Discount		$1,842,600
Debt Service Reserve		$4,016,200
Interest During Construction		$4,145,850
Subtotal		$46,595,650
Interest on:		
Capital		$329,320
Debt Service Reserve		$120,490
Interest During Construction		$82,920
Subtotal		$532,730
Bond Issue Size		$46,063,000
Annual Interest Earned on Debt Service Reserves		$80,000
Net Annual Debt Service		**$3,936,000**

Ames Gasifier Project Capital Requirements

Scenario 1 (2012$)	$34,500,000
Esc. (To const.)	$2,091,000
Projected Costs	$36,591,000
Grant Funding	$0
Other Funding	$0
Financed Capital	$36,591,000

Bond Sizing Calculation Methodology - Scenario 2

ASSUMPTIONS		Values
Construction Assumptions:		
Construction Cost Annual Escalation Rate		4.0%
Escalation Months from 1-1-2013 to NTP		0
Planning, Permitting & Design (months)		18
Months for Construction (Months):	1.50	18
Debt Assumptions		
Amortization period (Years):		20
Availability of Reserves (%):		100%
Taxable Debt Portion (%)		
Equity Portion (%) excl. tax benefits		
Construction Price Financed ($):		$35,848,000
Draw Down Availablity of Funds (%):		30%
Underwriter's Discount & Expenses (%):		4.0%
Interest Rate Assumptions		
Blended Bond Interest Rate (%)		6.00%
Tax Exempt Rate (%)		
Taxable Rate (%)		
Equity Rate (%)		
Reinvestment Rates		
Long Term Reinvestment Rate (%):		2.0%
Short Term Reinvestment Rate (%):		2.0%
CALCULATIONS:		
Number of Const. Payment Periods		3
Interest During Construction Availability:		0.67
Blend Capital Recovery Factor		
Bond Capital Recovery Factor		8.7%
Debt Service Reserve Cap		8.7%
Bond Issue Size (Round up to nearest $5000)		**$45,130,000**
Capital Cost		$35,848,000
Bond Discount		$1,805,200
Debt Service Reserve		$3,934,600
Interest During Construction		$4,061,700
Subtotal		$45,649,500
Interest on:		
Capital		$322,630
Debt Service Reserve		$118,040
Interest During Construction		$81,230
Subtotal		$521,900
Bond Issue Size		$45,128,000
Annual Interest Earned on Debt Service Reserves		$79,000
Net Annual Debt Service		**$3,855,000**

Ames Gasifier Project Capital Requirements

Scenario 2 (2012$)	$33,800,000
Esc. (To const.)	$2,048,000
Projected Costs	$35,848,000
Grant Funding	$0
Other Funding	$0
Financed Capital	$35,848,000

Bond Sizing Calculation Methodology - Scenario 3

ASSUMPTIONS		Values
Construction Assumptions:		
Construction Cost Annual Escalation Rate		4.0%
Escalation Months from 1-1-2013 to NTP		0
Planning, Permitting & Design (months)		18
Months for Construction (Months):	2.00	24
Debt Assumptions		
Amortization period (Years):		20
Availability of Reserves (%):		100%
Taxable Debt Portion (%)		
Equity Portion (%) excl. tax benefits		
Construction Price Financed ($):		$62,787,000
Draw Down Availablity of Funds (%):		30%
Underwriter's Discount & Expenses (%):		4.0%
Interest Rate Assumptions		
Blended Bond Interest Rate (%)		6.00%
Tax Exempt Rate (%)		
Taxable Rate (%)		
Equity Rate (%)		
Reinvestment Rates		
Long Term Reinvestment Rate (%):		2.0%
Short Term Reinvestment Rate (%):		2.0%
CALCULATIONS:		
Number of Const. Payment Periods		4
Interest During Construction Availability:		0.63
Blend Capital Recovery Factor		
Bond Capital Recovery Factor		8.7%
Debt Service Reserve Cap		8.7%
Bond Issue Size (Round up to nearest $5000)		**$81,700,000**
Capital Cost		$62,787,000
Bond Discount		$3,268,000
Debt Service Reserve		$7,123,000
Interest During Construction		$9,804,000
Subtotal		$82,982,000
Interest on:		
Capital		$753,440
Debt Service Reserve		$284,920
Interest During Construction		$245,100
Subtotal		$1,283,460
Bond Issue Size		$81,699,000
Annual Interest Earned on Debt Service Reserves		$142,000
Net Annual Debt Service		**$6,981,000**

Ames Gasifier Project Capital Requirements	
Scenario 3 (2012$)	$59,200,000
Esc. (To const.)	$3,587,000
Projected Costs	$62,787,000
Grant Funding	$0
Other Funding	$0
Financed Capital	$62,787,000

Bond Sizing Calculation Methodology - Scenario 4

ASSUMPTIONS		Values
Construction Assumptions:		
Construction Cost Annual Escalation Rate		4.0%
Escalation Months from 1-1-2013 to NTP		0
Planning, Permitting & Design (months)		18
Months for Construction (Months):	2.00	24
Debt Assumptions		
Amortization period (Years):		20
Availability of Reserves (%):		100%
Taxable Debt Portion (%)		
Equity Portion (%) excl. tax benefits		
Construction Price Financed ($):		$81,984,000
Draw Down Availablity of Funds (%):		30%
Underwriter's Discount & Expenses (%):		4.0%
Interest Rate Assumptions		
Blended Bond Interest Rate (%)		6.00%
Tax Exempt Rate (%)		
Taxable Rate (%)		
Equity Rate (%)		
Reinvestment Rates		
Long Term Reinvestment Rate (%):		2.0%
Short Term Reinvestment Rate (%):		2.0%
CALCULATIONS:		
Number of Const. Payment Periods		4
Interest During Construction Availability:		0.63
Blend Capital Recovery Factor		
Bond Capital Recovery Factor		8.7%
Debt Service Reserve Cap		8.7%
Bond Issue Size (Round up to nearest $5000)		**$106,680,000**
Capital Cost		$81,984,000
Bond Discount		$4,267,200
Debt Service Reserve		$9,300,800
Interest During Construction		$12,801,600
Subtotal		$108,353,600
Interest on:		
Capital		$983,810
Debt Service Reserve		$372,030
Interest During Construction		$320,040
Subtotal		$1,675,880
Bond Issue Size		$106,678,000
Annual Interest Earned on Debt Service Reserves		$186,000
Net Annual Debt Service		**$9,115,000**

Ames Gasifier Project Capital Requirements	
Scenario 4 (2012$)	$77,300,000
Esc. (To const.)	$4,684,000
Projected Costs	$81,984,000
Grant Funding	$0
Other Funding	$0
Financed Capital	$81,984,000

Bond Sizing Calculation Methodology - Scenario 5

ASSUMPTIONS		Values
Construction Assumptions:		
Construction Cost Annual Escalation Rate		4.0%
Escalation Months from 1-1-2013 to NTP		0
Planning, Permitting & Design (months)		18
Months for Construction (Months):	2.50	30
Debt Assumptions		
Amortization period (Years):		20
Availability of Reserves (%):		100%
Taxable Debt Portion (%)		
Equity Portion (%) excl. tax benefits		
Construction Price Financed ($):		$83,893,000
Draw Down Availablity of Funds (%):		30%
Underwriter's Discount & Expenses (%):		4.0%
Interest Rate Assumptions		
Blended Bond Interest Rate (%)		6.00%
Tax Exempt Rate (%)		
Taxable Rate (%)		
Equity Rate (%)		
Reinvestment Rates		
Long Term Reinvestment Rate (%):		2.0%
Short Term Reinvestment Rate (%):		2.0%
CALCULATIONS:		
Number of Const. Payment Periods		5
Interest During Construction Availability:		0.60
Blend Capital Recovery Factor		
Bond Capital Recovery Factor		8.7%
Debt Service Reserve Cap		8.7%
Bond Issue Size (Round up to nearest $5000)		**$112,940,000**
Capital Cost		$83,893,000
Bond Discount		$4,517,600
Debt Service Reserve		$9,846,600
Interest During Construction		$16,941,000
Subtotal		$115,198,200
Interest on:		
Capital		$1,258,400
Debt Service Reserve		$492,330
Interest During Construction		$508,230
Subtotal		$2,258,960
Bond Issue Size		$112,939,000
Annual Interest Earned on Debt Service Reserves		$197,000
Net Annual Debt Service		**$9,650,000**

Ames Gasifier Project Capital Requirements	
Scenario 5 (2012$)	$79,100,000
Esc. (To const.)	$4,793,000
Projected Costs	$83,893,000
Grant Funding	$0
Other Funding	$0
Financed Capital	$83,893,000

Bond Sizing Calculation Methodology - Scenario 6a

ASSUMPTIONS		Values
Construction Assumptions:		
Construction Cost Annual Escalation Rate		4.0%
Escalation Months from 1-1-2013 to NTP		0
Siting, Planning, Permitting & Design (months)		42
Months for Construction (Months):	2.5 yrs	30
Debt Assumptions		
Amortization period (Years):		20
Availability of Reserves (%):		100%
Taxable Debt Portion (%)		
Equity Portion (%)	excl. tax benefits	
Construction Price Financed ($):		$92,345,000
Draw Down Availablity of Funds (%):		30%
Bond Issuance Fees (%):		4.0%
Interest Rate Assumptions		
Blended Bond Interest Rate (%)		5.0%
Tax Exempt Rate (%)		
Taxable Rate (%)		
Equity Rate (%)		
Reinvestment Rates		
Long Term Reinvestment Rate (%):		2.0%
Short Term Reinvestment Rate (%):		2.0%

CALCULATIONS:	
Number of Const. Payment Periods	5
Interest During Construction Availability:	0.60
Blend Capital Recovery Factor	
Bond Capital Recovery Factor	8.0%
Debt Service Reserve Cap	8.0%
Bond Issue Size (Round up to nearest $5000)	**$119,290,000**
Capital Cost	$92,345,000
Bond Discount	$4,771,600
Debt Service Reserve	$9,572,100
Interest During Construction	$14,911,250
Subtotal	$121,599,950
Interest on:	
Capital	$1,385,180
Debt Service Reserve	$478,610
Interest During Construction	$447,340
Subtotal	$2,311,130
Bond Issue Size	$119,289,000
Annual Interest Earned on Debt Service Reserves	$191,000
Net Annual Debt Service	**$9,381,000**

Ames Mass Burn Project Capital Requirements

Scenario 6a (2012$)	$80,500,000
Esc. (To const.)	$11,845,000
Projected Costs	$92,345,000
Grant Funding	$0
Other Funding	$0
Financed Capital	$92,345,000

Bond Sizing Calculation Methodology - Scenario 6b

ASSUMPTIONS		Values
Construction Assumptions:		
Construction Cost Annual Escalation Rate		4.0%
Escalation Months from 1-1-2013 to NTP		0
Siting, Planning, Permitting & Design (months)		42
Months for Construction (Months):	2.5 yrs	30
Debt Assumptions		
Amortization period (Years):		20
Availability of Reserves (%):		100%
Taxable Debt Portion (%)		
Equity Portion (%)	excl. tax benefits	
Construction Price Financed ($):		$97,851,000
Draw Down Availablity of Funds (%):		30%
Bond Issuance Fees (%):		4.0%
Interest Rate Assumptions		
Blended Bond Interest Rate (%)		5.0%
Tax Exempt Rate (%)		
Taxable Rate (%)		
Equity Rate (%)		
Reinvestment Rates		
Long Term Reinvestment Rate (%):		2.0%
Short Term Reinvestment Rate (%):		2.0%
CALCULATIONS:		
Number of Const. Payment Periods		5
Interest During Construction Availability:		0.60
Blend Capital Recovery Factor		
Bond Capital Recovery Factor		8.0%
Debt Service Reserve Cap		8.0%
Bond Issue Size (Round up to nearest $5000)		**$126,405,000**
Capital Cost		$97,851,000
Bond Discount		$5,056,200
Debt Service Reserve		$10,143,100
Interest During Construction		$15,800,625
Subtotal		$128,850,925
Interest on:		
Capital		$1,467,770
Debt Service Reserve		$507,160
Interest During Construction		$474,020
Subtotal		$2,448,950
Bond Issue Size		$126,402,000
Annual Interest Earned on Debt Service Reserves		$203,000
Net Annual Debt Service		**$9,940,000**

Ames Mass Burn Project Capital Requirements	
Scenario 6b (2012$)	$85,300,000
Esc. (To const.)	$12,551,000
Projected Costs	$97,851,000
Grant Funding	$0
Other Funding	$0
Financed Capital	$97,851,000