Measuring Success in the 1st Year of Operation and Setting a Roadmap for the future

Presented to: SWANA Northern Lights Chapter AGM
By: Nathan Ziegler, P.Eng
Date: 2014-05-14
Saskatoon Light & Power

- Branch of the City of Saskatoon founded in 1906
- Peak Demand for Power 225 MW
- Annual Energy Sales 1,100 GWH
- Annual Revenue $130 M
Presentation Overview

1. Project Background
2. Measuring Success
3. Benefits
Project Presentations to SWANA

This is the third time the Saskatoon Landfill Gas Project has been presented to SWANA:
1. 2011 – in Saskatoon
2. 2014 – in Regina
Project Overview

• Project Overview
  – Design started in 2010.
  – Clay Cap installed in 2011.
  – Construction started spring 2012.
  – Operations started March 2014.

• Project cost $15 million.
  – $6.3 million funded by the Canada-Saskatchewan Provincial-Territory Base Fund (PT Base Fund).
  – Balance funded by the City from the Electrical Distribution Replacement Reserve (EDRR) and the Landfill Replacement Reserve (LRR).
Saskatoon Landfill

- Saskatoon Landfill is located south-west corner of Saskatoon.
Clay Cover

- 450mm (18”) of compacted clay-like soil covering 12-hectares was installed in 2011.
- Approx. 53,000 m³ (69,300 cubic yards) of soil was brought in.

Photos by Saskatoon Light & Power
Well Drilling

- 29 vertical well installed in the garbage (summer 2012).
- Deepest well was 30.8m (101 feet).

Photos by Saskatoon Light & Power
Media Day

- Media were given a tour and explained the well drilling process on July 17, 2012.

Photos by Saskatoon Light & Power
Trenching & Unground Piping

- Each well connects to Gas Collection pipe through underground piping. The gas from the wells drawn by a vacuum compressor to the Gas Collection Facility.
Landfill Gas Collection Facility

• Vacuum Compressor, Cooling/Dehydration Equipment, and Flare.

Photos by Saskatoon Light & Power
Commissioning

- Commissioning occurred October/November 2013.

Photos by Saskatoon Light & Power
Power Generation Facility

- There are two 815kW engine-generator sets.
- Each consumes approximately 230 cfm of Landfill Gas when running full speed.
Utilization Pipe

- Part of the Utilization pipeline was directional drilled under a roadway.
- A Pig Launcher and Receiver were installed at either end.
Power Generation Facility

- There are two 815kW engine-generator sets.
- Electricity is sold to SaskPower as part of the Green Energy Options Program

Photos by Saskatoon Light & Power
Gas Collection Facility

- The Gas Collection Facility draws gas from the wellfield, and flares the gas or removes moisture and particulates from the gas and sends the gas to the Power Generation Facility.

Photos by Saskatoon Light & Power
Power Generation Facility

- The Power Generation Facility combuts the landfill gas in two 815kW Landfill Gas Engine-Generator sets, generating electricity sent to the electrical grid.
Measuring Success

**Collection System**
- The Collection System is operated and maintained by Public Works

**Power Generation System**
- The Power Generation System is operated and maintained by Saskatoon Light & Power.
Collection System Measurements

**Wellhead**
- Gas Quality (methane, carbon dioxide, oxygen, carbon monoxide, hydrogen, balance gasses)
- Gas temperature
- Gas Flow
- System Vacuum (downstream of wellhead valve)
- Applied Vacuum (upstream of wellhead valve)

**Wellfield**
- Condensate trap pump counts

**Plant**
- Gas Quality (methane, oxygen)
- Gas Flow
- Sales / Flare Gas daily volumes
- Pitbull pump counts
- Drip leg / Moisture separator drain counts
- Flare Runtime
Power Generation System Measurements

Production
• Electricity Production
• Utilization Factor
• Load Factor
• Capacity Factor
• Outage Events

Engines
• Engine Hours
• Valve Stem Recession
• Emissions Levels
• Oil Sampling
• Glycol Analysis

Financial
• Revenue
• Expenses
• Profit
Monthly Report

- A monthly report is sent to the entire team.
Monthly Report

- A monthly report is sent to the entire team.
## LFG GENERATION UPDATE

### Quick Statistics:

<table>
<thead>
<tr>
<th></th>
<th>Electricity Production (MWh)</th>
<th>Sales ($)</th>
<th>Utilization Factor</th>
<th>Load Factor</th>
<th>Capacity Factor</th>
<th>Shutdowns/Trips (# of events)</th>
<th>Maintenance/Other (# of events)</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>1004.16</td>
<td>103,951</td>
<td>98.4%</td>
<td>98.4%</td>
<td>85.6%</td>
<td>4</td>
<td>7</td>
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<tr>
<td>Month Goal</td>
<td>1212.72</td>
<td>119,264</td>
<td>95%</td>
<td>100%</td>
<td>95%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2014 Avg.</td>
<td>924</td>
<td>94,200</td>
<td>87.9%</td>
<td>89.6%</td>
<td>76.5%</td>
<td>11.0</td>
<td>2.9</td>
</tr>
</tbody>
</table>

### Monthly Report

- A quick view of Monthly Statistics
Highlights:

- 94.3%!
  94.3% Capacity Factor, which is only 0.7% off our overall goal. This level of production rivals all other power plants in Saskatchewan.
- In March, we sold $118,380 of a possible $119,264. Crushing our old record.
- We have officially been running for one full year. Congratulations to all for an impressive first year. In our first year we:
  - Attended 142 outages.
  - 15,536 engine runtime hours.
  - 11,502 MWh generated.
  - $1,178,000 sales of electricity.
  - 253,000,000 Cubic Feet of LFG Gas Combusted.

<table>
<thead>
<tr>
<th></th>
<th>Revenue</th>
<th>Expenses</th>
<th>Profit</th>
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<tbody>
<tr>
<td>Proforma Budget</td>
<td>$1,385,036</td>
<td>$424,360</td>
<td>$960,676</td>
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<tr>
<td>Operating Budget</td>
<td>$1,100,000</td>
<td>$666,632</td>
<td>$433,368</td>
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<tr>
<td>Actual to Date*</td>
<td>$211,459</td>
<td>$68,293</td>
<td>$143,166</td>
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<tr>
<td>Forecasted</td>
<td>$1,211,500</td>
<td>$702,100</td>
<td>$509,400</td>
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</tbody>
</table>

*Actuals to Date are as of Feb 28, 2015

Monthly Report

- Monthly Highlights & Financial Review
Production Performance:

Utilization Factor = Runtime Hours / Available Hours
Capacity Factor = Actual Generation in MWh / (1.63MW x 24 hours per day x Days in Month)
Load Factor = Actual Generation in MWh / (1.63MW x Runtime Hours)

Updated to Mar 31, 2015

Monthly Report
• Production Performance
Monthly Performance:

Generation Production (MWhs)

<table>
<thead>
<tr>
<th></th>
<th>2014 Avg</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
<tbody>
<tr>
<td>MWhs</td>
<td>923.9</td>
<td>1052.0</td>
<td>991.3</td>
<td>1143.6</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>1062.3</td>
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</table>

Monthly Report

- Generation Production
### Monthly Report

- Monthly Comparison

<table>
<thead>
<tr>
<th></th>
<th>2014 Avg</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>2015 Avg</th>
<th>2015 Total</th>
<th>2014 Total</th>
<th>Total Total</th>
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</thead>
<tbody>
<tr>
<td>Shutdown/Trips (# of events)</td>
<td>11</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>12</td>
<td>99</td>
<td>111</td>
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<tr>
<td>Maint/Other Stops (# of events)</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>2</td>
<td>5</td>
<td>28</td>
<td>31</td>
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<td>Flare Runtime (Hours)</td>
<td>35</td>
<td>21</td>
<td>23</td>
<td>0</td>
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<td></td>
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<td></td>
<td></td>
<td>15</td>
<td>44</td>
<td>316</td>
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<td>Sales Gas Volume (1000 x SCF)</td>
<td>16296</td>
<td>17920</td>
<td>16748</td>
<td>17334</td>
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<td></td>
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<td></td>
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<td></td>
<td>17334</td>
<td>52002</td>
<td>149592</td>
<td>201594</td>
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<tr>
<td>Flare Gas Volume (1000 x SCF)</td>
<td>1190</td>
<td>618</td>
<td>622</td>
<td>0</td>
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<td></td>
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<td></td>
<td>413</td>
<td>1240</td>
<td>50459</td>
<td>51699</td>
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<tr>
<td>Runtime Hours (Hours)</td>
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<td>1349</td>
<td>1278</td>
<td>1447</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>1358</td>
<td>4074</td>
<td>11462</td>
<td>15536</td>
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<tr>
<td>Power Sales (MWh)</td>
<td>923.9</td>
<td>1052.0</td>
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<td>1143.6</td>
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<td>1062.3</td>
<td>3187</td>
<td>8315</td>
<td>11502</td>
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<tr>
<td>Sales (1000 x $)</td>
<td>94.2</td>
<td>109.0</td>
<td>102.6</td>
<td>118.3</td>
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<td></td>
<td>110.0</td>
<td>330</td>
<td>848</td>
<td>1178</td>
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<tr>
<td>Load Factor (%)</td>
<td>89.6</td>
<td>95.6</td>
<td>95.2</td>
<td>97.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td>95.9</td>
<td>288</td>
<td>806</td>
<td>1094</td>
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<tr>
<td>Utilization Factor (%)</td>
<td>87.9</td>
<td>98.3</td>
<td>99.8</td>
<td>97.7</td>
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<td></td>
<td></td>
<td></td>
<td>98.6</td>
<td>296</td>
<td>791</td>
<td>1087</td>
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<tr>
<td>Capacity Factor (%)</td>
<td>76.5</td>
<td>86.7</td>
<td>90.5</td>
<td>94.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>90.5</td>
<td>272</td>
<td>688</td>
<td>960</td>
</tr>
</tbody>
</table>
2015 Outage Report

- Shutdown/Trips: 56%
- Maintenance: 25%
- SPC Line Issues: 13%
- Other: 6%

Monthly Report

- Outage Report

Updated to Mar 31, 2015
First Year Results

The Landfill Gas project has now been running for one full year, and has:

- Generated 11,500 megawatt-hours of electricity, enough for 1,150 homes.
- Combusted 7,164,000 cubic metres (253 million cubic feet) of landfill gas.
- Operated for 15,500 runtime hours.
- Sold $1,178,000 of electricity to SaskPower.
First Year Results

During the first 3 months of operation, the facility experienced an average of:

- 17 shutdown events per month
- Average runtime of 85%
- An overall capacity factor of 74.9%

During the last 3 months of operation, the facility experienced an average of:

- 4 shutdown events per month
- Average runtime of 95%
- An overall capacity factor of 90.5%
Economic Benefits

- Electricity generated from this project is sold to SaskPower under the Green Options Partners Program (GOPP), at a value of about $1.3 million per year.
- The project will generate enough electricity annually to power 1,300 homes.
Environmental Benefits

• The project will reduce greenhouse gas emissions by over 45,000 tonnes per year – the equivalent to removing over 9,000 vehicles from our roads each year.
• The collection process of the methane-rich gas will also have a positive impact on air quality/odours within the Landfill area.

Saskatoon Landfill
• The Landfill has been operating at this site since 1955
• There are over 5 million tonnes of waste currently in place
• Over 130,000 tonnes are added annually
Other benefits

VIEW OF ENERGY

PRODUCTION OF ENERGY

USE OF ENERGY

Making a difference
Create new sources of green energy where feasible.

VISION & GOALS
City Vision and Mission

Energy & GHG Management Plan
The Saskatoon Energy and Greenhouse Gas Management Plan was a collaborative initiative of the City of Saskatoon and Road Map 2020 and provides a framework to manage greenhouse gas emissions and reduce energy consumption.

Community Vision
A visioning project to engage the community in conversation about what we aspire to achieve as Saskatoon grows over the next 50-70 years. Over 7,000 citizens involved over an 8-month period (Sept, 2010 to April, 2011).

Strategic Plan
Developed with input from the Community Vision, the City’s 10 Year Strategic Plan outlines what is important in the near term and where we need to focus our energies. It includes an overarching mission, values and leadership commitments.

- Strategies for the Long Term: Create new sources of green energy where feasible.
SL&P Vision & Goals

Vision
Saskatoon Light & Power's priority focus will be to continue our record of innovation through a pattern of disciplined and cost-conscious investments in our infrastructure. **We will continue to develop green energy projects in order to meet our commitment to the environment while maximizing our return on investment to the City of Saskatoon.**

Objectives

- **One of the Utility's strategic directions is to harness and promote the use of renewable energy sources thereby reducing our reliance on fossil fuels for energy generation.**
- Provide staff training and continued promotion of a safe workplace by personal commitment by all staff.
- Implementation of an Asset Management System in order to improve maintenance efficiencies and effectiveness.
- Succession planning through our continued focus on the apprenticeship program.
Generation Vision & Goals

Generation Vision
Saskatoon Light & Power will begin development of a new Green Energy Park. The vision for this park is to showcase our alternative energy projects in a way that provides educational opportunities for the public and to promote energy conservation and renewable energy solutions.

Goals
Saskatoon Light & Power, through the priorities set our by the City Of Saskatoon in the Strategic Plan, has created strategic business goals for our generation portfolio:

- Generate 10% of our electricity requirements;
- Provide electricity from sustainable sources; and
- Provide additional revenue for the City of Saskatoon.
Questions?

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