

IDEA – Evolving Energy-



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Presentation overview

- Background:
How a waste manager and a biomass grower got together.
- The Calgary Demonstration project:
First large scale project of its kind in Canada.
- The SRIC willow crop cycle overview:
Some key numbers
- Conclusion

Background

SYLVIS is a Canadian residuals management consulting and contracting firm with the sole focus of researching, recommending and implementing beneficial residuals management.

Bionera Resources provides project management services and feedstock solutions to heat and power plant managers who want to use purpose-grown woody biomass to stabilize their energy supply and costs, reduce their greenhouse gas emissions and shrink their carbon footprint.

In light of low fossil fuel costs combined with the need to effectively manage wastewater and biosolids, **SYLVIS** and **Bionera** have joined forces to offer municipalities and districts a unique concept for beneficially using biosolids or wastewater in an environmentally protective manner while generating biomass at a reliable and competitive cost.

- Biosolids and wastewater from municipalities can be beneficially used as a fertilizing soil amendment and conditioner for willow plantations established on marginal agricultural lands.
- The rapid uptake and evaporative power of willows enables the quick depletion of minerals and water in the soil. This supports the re-application of biosolids after each harvest (2-3years) for the duration of the plantation (20 years).

Calgary Demonstration Program

A research and monitoring project designed to:

- Improve marginal agricultural soils through the beneficial use of biosolids
- Diversify the City of Calgary's biosolids management program
- Assess willow biomass production capability in Southern Alberta
- Provide data to ESRD as a reference for future regulatory policy updates



September 4, 2014

Land Improvement Using Biosolids

- Biosolids are produced from municipal wastewater treatment
- Stabilized nutrients and organic matter
- Beneficially used as a fertilizing amendment
- Managed and applied in an environmentally protective manner



Transportation Overview

- Biosolids transport from July - October
- Road use agreement obtained prior to transport
- Cleaning and inspections of county roads conducted regularly
- Stockpiles constructed with berms to delineate biosolids
- Road status updates provided to County representatives
- All trucks washed before returning to public roadways



Application Overview

Biosolids Applications and Incorporation

- 1100 hectares of marginal ag land and willow biomass fertilized to date; ~360 ha in each of 2013, 2014 and 2015
- Applied at target agronomic rate of 25 dt/ha
- Incorporated within 24 hours of application
- Tillage trial and new equipment acquired to improve incorporation



Environmental Monitoring

- Soil quality
 - Spring sampling year following application (fertility)
 - Fall sampling year following application (fertility and metals)
- Water quality
 - Spring meltwater
 - AWS stormwater catchment, willow irrigation
 - Voluntary well monitoring (spring & fall)
- Biosolids quality
- Vegetation growth and yield



Why a Woody Energy Crop?

- Proven technology
- Suited for under-utilized land
- Compatible with dominant biomass fuel
 - forest and sawmill residues, chips, construction debris
- Single pass harvesting

Growth Cycle



Planting



Egedal Energy Planter 40
acres per day



Weed control



Growth: 5, 10 and
15 weeks old



June 1st during 2nd year



2nd year after planting — Strathmore, Sept 2015



Three year's growth northeast USA



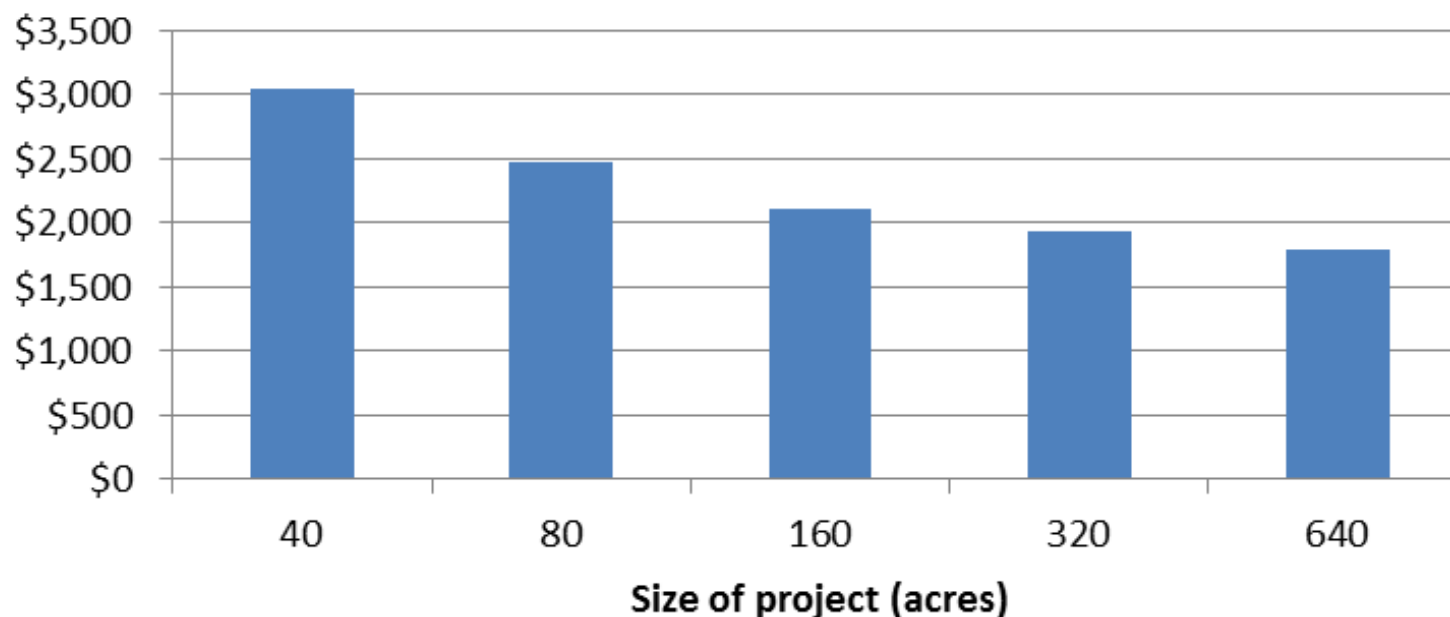
Harvest (40 tonnes per hour)



Result



Typical establishment cost high density willow



Inclusive of : Management, site preparation, cuttings, planting, weed control and coppicing. Indicative numbers only.

Sample Economics

CA\$ per bone-dry tonne, 11% CoC

your results may vary!



Example Costs for a 200 ha biomass farm		Example Offsets	
Crop establishment and removal	\$45	Biosolids management	(\$14 - \$41)
Land lease and tending	\$20	Carbon offset at \$10 per tCO ₂ e	(\$9 - \$18) (Gas – Coal)
Harvest & transport	\$19	Carbon tax at \$10 - \$30 / tCO ₂ e	(\$9 - \$27)
Overhead	\$17	Administration to achieve offsets	\$9
Total	\$101		\$23 - \$77
Net Feedstock Cost		\$1.33 - \$4.33 per GJ (HHV)	\$20 - \$65 per MWh _e
		\$24 - \$78 per BDT	

Feedstock attributes:

Willow Biomass Energy Crop

Bionera - average numbers

Heat energy (HHV)		16.6 million Btu per dry ton 8,300 Btu / lb	19.3 GJ per dry tonne 5.4 MWh per dry tonne
Heat energy (LHV - without flue gas heat recovery) at moisture content: 40% year-round average - 45% when harvested			
		8.4 million Btu per wet ton	9.8 GJ per wet tonne
		14.1 million Btu per dry ton	16.4 GJ per dry tonne
Farm	High:	6.7 oven-dry-tons / acre / yr	15 bone-dry-tonnes / hectare / year
Yield	Likely:	4.5 ODT / acre / yr	10 BDT / ha / yr



conclusion

- The willow coppice system works on under-utilized farmland in temperate areas.
- Great opportunity to provide a win-win situation to generate District Heat and beneficially use residual resources
- Long term crop.

Thank you !!!