Opportunities
in Integrated BioRefining

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Growing Power Group

Growing Power™

Presentation Overview

- Technology Introduction
- Current Environment & Drivers for Change
- Impacts related to Biofuels
- Wheat, Barley and DDGS dynamics
- Advantages of the Integrated BioRefinery™
- Conclusion
- Questions

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Anaerobic digestion
What is it?

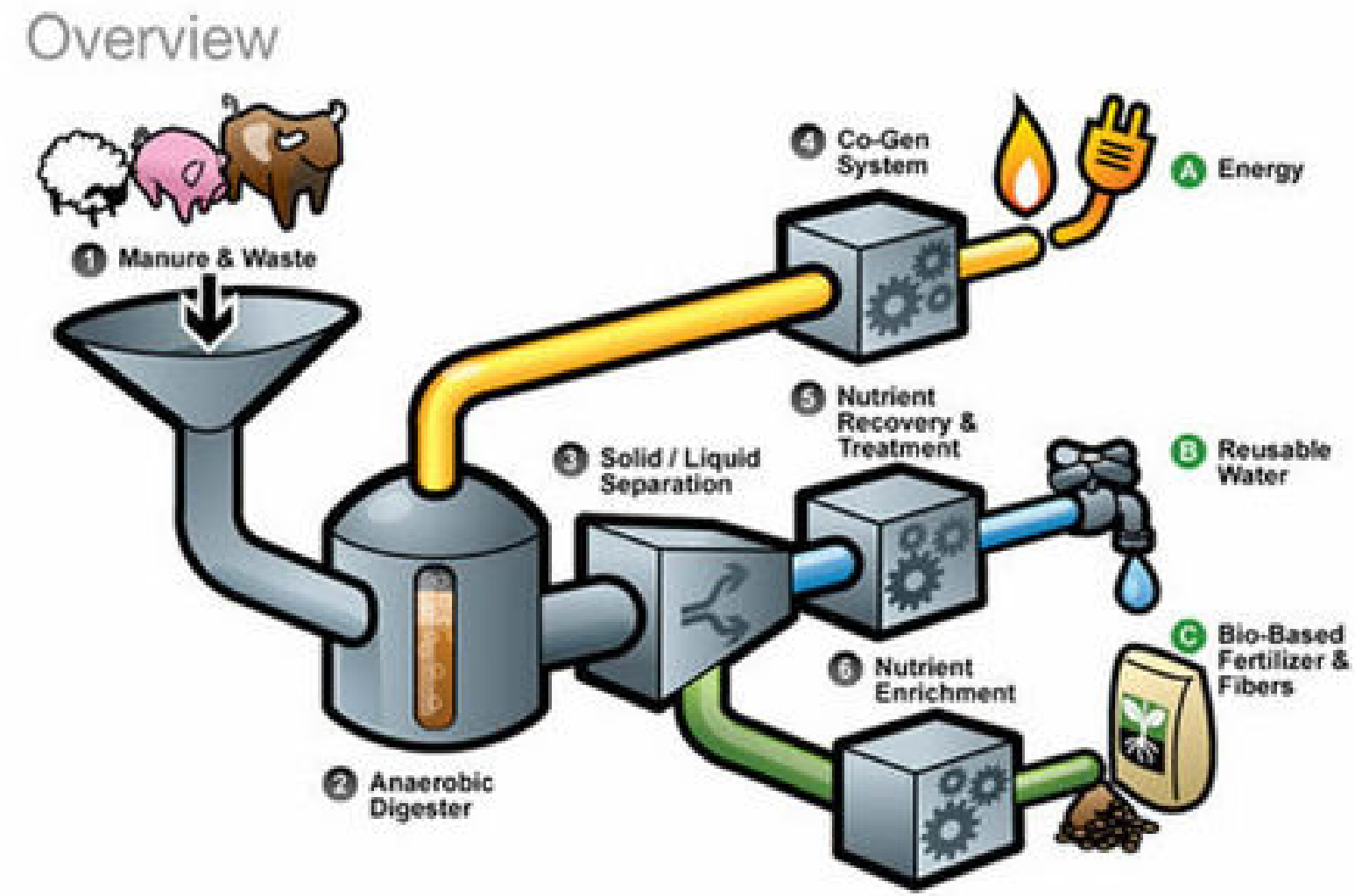
- Anaerobic digestion is a biochemical reaction carried out in a number of steps by several types of bacteria and bacteria-like organisms.
- There is no oxygen present and methane gas (a fuel) is produced.
- The amount of gas produced varies with the amount of organic waste fed to the digester.
- The rate of decomposition (and gas production) is influenced by several critical factors.

Component		**Percentage**
Methane	CH_4	40-70
Carbonic gas	CO_2	30-60
Hydrogen	H_2	1.0
Nitrogen	N_2	0.5
Ammonia	NH_3	<0.1
Oxygen	O_2	0.1
Hydrogen sulphide	H_2S	0.1

Growing Power Anaerobic Digestion System
Cracking the code to high-solids feedstock

- AD systems have significant returns to scale
  - Source of digestion feedstock limits scale in typical applications
  - Largest sources of feedstock are “difficult”; high in solids and fibre, contaminated with stones and sand, and highly variable (examples: Feedlot Manure, MSW, packing plant waste)
  - Highmark Renewables technology cracked the code
- Unlocking higher returns requires both scale, productivity and capture of the full value of energy produced

Growing Power Anaerobic Digestion System
World-Leading High-Solids Technology



Operating Biogas Plant at Hairy Hill
Commissioned in February 2005

- Processes 95 MT of high solids feedlot manure from Highland Feeders Ltd. daily
- Produces up to 1mW of continuous electrical output, biofertilizers, heat and reusable water.

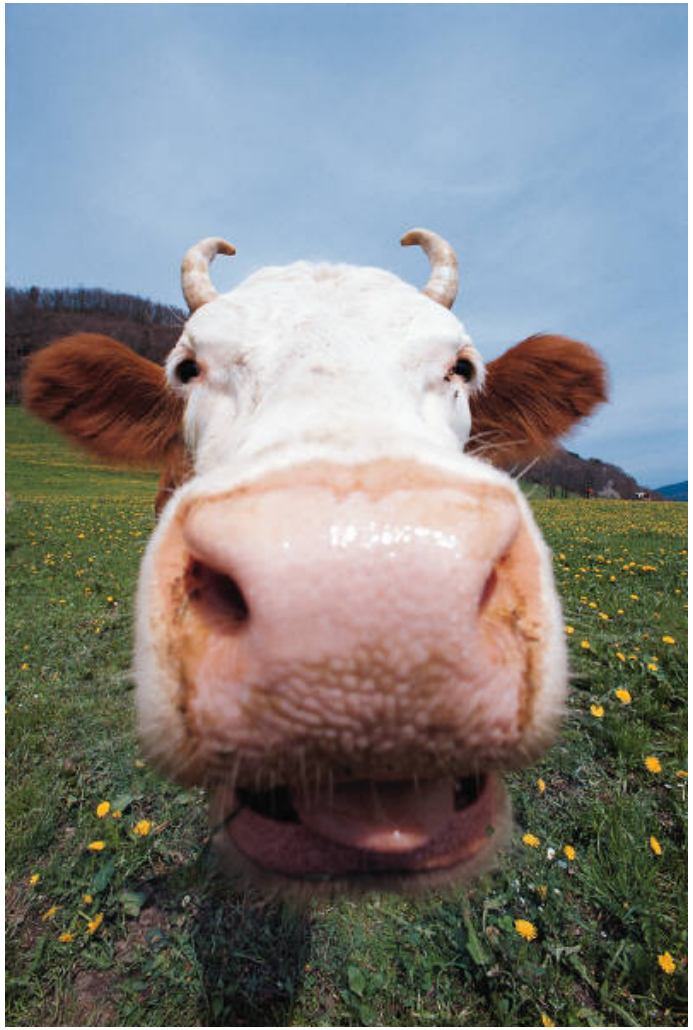
Operating Biogas Plant at Hairy Hill
Real returns

- Operating continuously for more than three years
- GE-Jenbacher engine problem free for more than 22,000 hrs
- The right technology for this application, enabling our current success

New Growing Power Anaerobic Digestion Facilities
Hurdles

- ~3MW of biogas produced to make 1MW of electrical power
- Cogeneration allows capture of large amounts of energy in the form of heat, in excess of needs of the biogas plant
- Heat has a very low value, and is challenging to transport
- Getting to the next level of ROI - competitive with O&G, requires capturing full value for the energy produced
- AD facilities will be built where the value proposition is clear

New Growing Power Anaerobic Digestion Facilities
Key Success Factors



- High prices for electrical energy
  - Gov't support helpful
  - Some jurisdictions better than others
- Resource material (feedstock) supply abundance
- Co-product markets
- **A home for the heat!**

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Current Environment
Energy (Oil, Gas, Coal, Power, Oilsands)

Strong growth in demand for all forms of energy

- Record high oil and gasoline prices
- Energy rich provinces booming (sector specific)

Public backlash

- High prices and profits in O&G industry
- Environmental impacts
  - human health
  - land use
  - nature and wildlife
  - water resources
- CO2 and Global Warming

Key Considerations:

- No foreseen reduction in demand growth (world depends on the utility of oil)
- CO2-intensity increasing (i.e. Oilsands, Coal-based electricity)

Current Environment
Renewable Energy and CleanTech

Incredible interest in Renewable Energy and CleanTech

- Wind
- Solar
- Tidal and Hydro
- Geothermal
- Hydrogen
- Nuclear
- Energy Efficiency
- Biofuels – Ethanol, Biodiesel, and Biogas

Issues

- Not immune to scrutiny
- New and often unproven technologies
- Skeptics want to wait for the perfect solution

Key Considerations

- Commercially-available and economically-viable (with some level of support)
- Each individual technology has limitations and issues
  - Wind – aesthetics, bird deaths, grid-connection & stability
  - Hydrogen – source of the hydrogen
  - Biofuels - ? Scapegoat or true culprit

Current Environment
Agriculture

Nervous times

- High prices in grains (Benefit for the grain sector – opposite for livestock)
  - Driven by
    - New demand? (policies outside our border always impacted values)
    - Biofuels? (impacts need to be assessed by region/jurisdiction)
    - High energy costs?
- New marketing initiatives

Issues

- Shortages of inputs, equipment, shipping capacity
- Livestock sector reeling

Key Considerations

- Will high grain prices continue?
- Will the livestock sector recover?
- Continued advances in technology (equipment, inputs, genetics)

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Canadian Ethanol Mandates
Overview

Mandates

- Federal Mandate – 5% in 2010 Required production 2,100 MM lt

- Various Provincial Mandates
  - SK – 7.5% in 2007
  - MB – 8.5% in 2008
  - ON – 5.0% in 2007, 10% in 2010
  - QC – 5.0% in 2012
  - BC – 5.0% in 2010

Western Canada	Litres (millions)	MT of Wheat (millions)
Ethanol Mandate – Federal	645	1.74
Ethanol Mandate - Federal & Provincial	730	1.97

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Western Canadian Feedstock Assessment
Wheat supply and requirement for Ethanol production

2001/2002 to 2005/2006 average		
	All Wheat	Wheat ex Durum
Canadian Acres (millions)	23.882	18.433
Canadian Production (millions of MT)	22.084	17.713
Total Exports (millions of MT)	14.346	10.843
Exports as a percentage of total production	60%	59%
Prairie Acres (millions)	22.787	17.338
Prairie Production (millions of MT)	20.116	15.745
Wheat acres required for ethanol mandate (millions)	2.2	
Acres as a percentage of Prairie acres	9.7%	12.7%
Wheat tonnage required for ethanol mandate (millions of MT)	1.97	
Tonnage as a percentage of total Canadian exports	13.7%	18.2%
Tonnage as a percentage of total Western ethanol production	9.8%	12.5%

source: Statscan, Cereals and Oilseeds Review, January 2008

Western Canadian Feedstock Assessment
Byproduct impact on Barley Supply Demand

2001/2002 to 2005/2006 average	
	Million MT
Wheat required for ethanol production (western Canada)	1.97
DDGS produced	0.65
Feed Barley Production*	5.41
DDGS produced as percentage of Feed Barley Production	12%
	Million Acres
Total Barley Acres*	8.74
Feed Barley Acres	5.24
Released Wheat acres (shown below) as a percentage of Feed Barley Acres	8.4%
Wheat acres required for feedstock (0.9 MT / acre)	2.2
Yield advantage of high starch wheats (%)	20%
Wheat acres required for feedstock (based on starch varieties)	1.76
Difference / Acres released Difference	0.44
*Prairie Barley Production - average 01/02 to 05/06	

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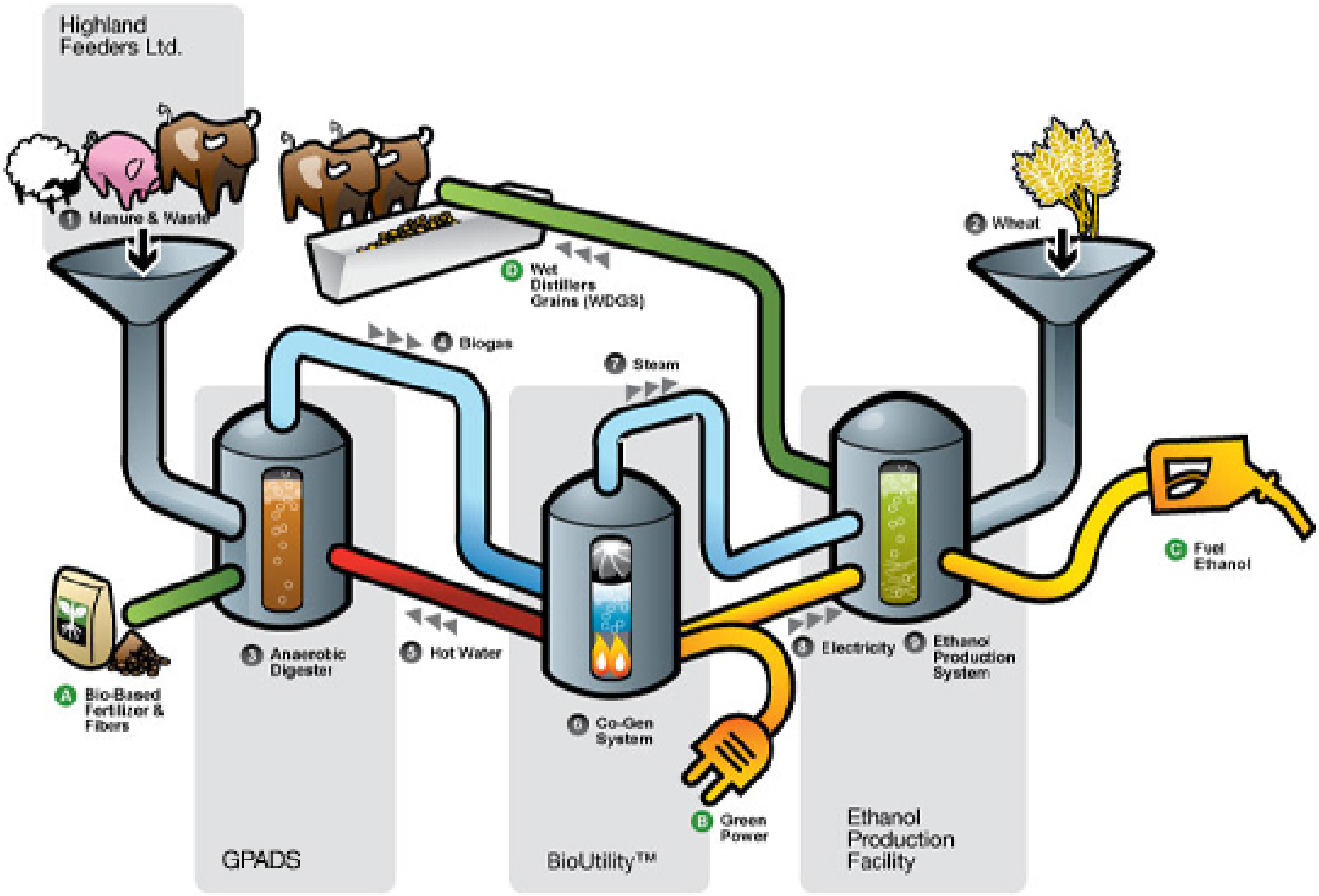
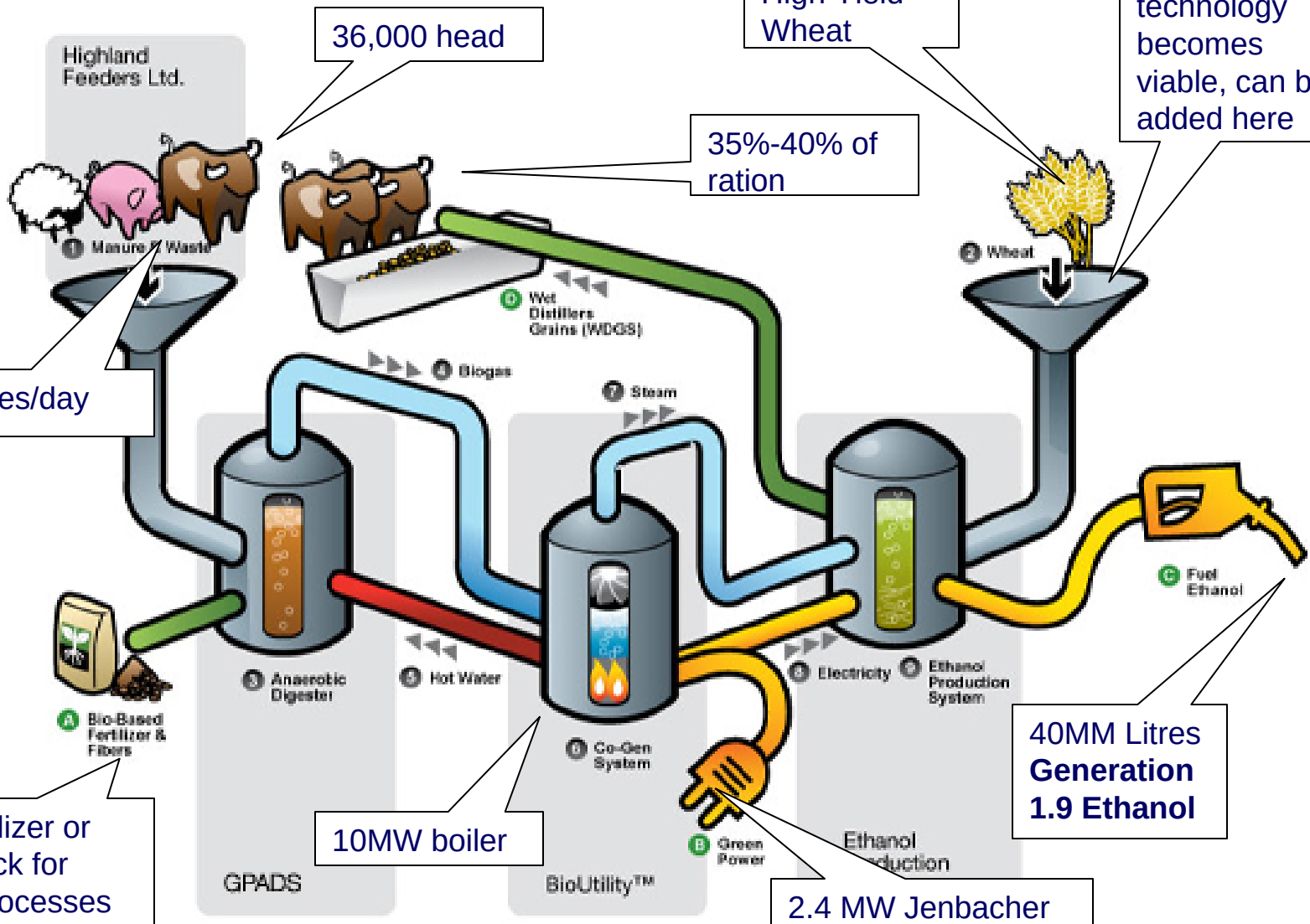
The Integrated BioRefinery™
Generation 1.9 Biofuels Production



Integrated BioRefinery™ Overview

The Integrated BioRefinery™
Selected Features



36,000 head

High Starch, High Yield Wheat

As cellulosic technology becomes viable, can be added here

35%-40% of ration

500 tonnes/day

40MM Litres **Generation 1.9 Ethanol**

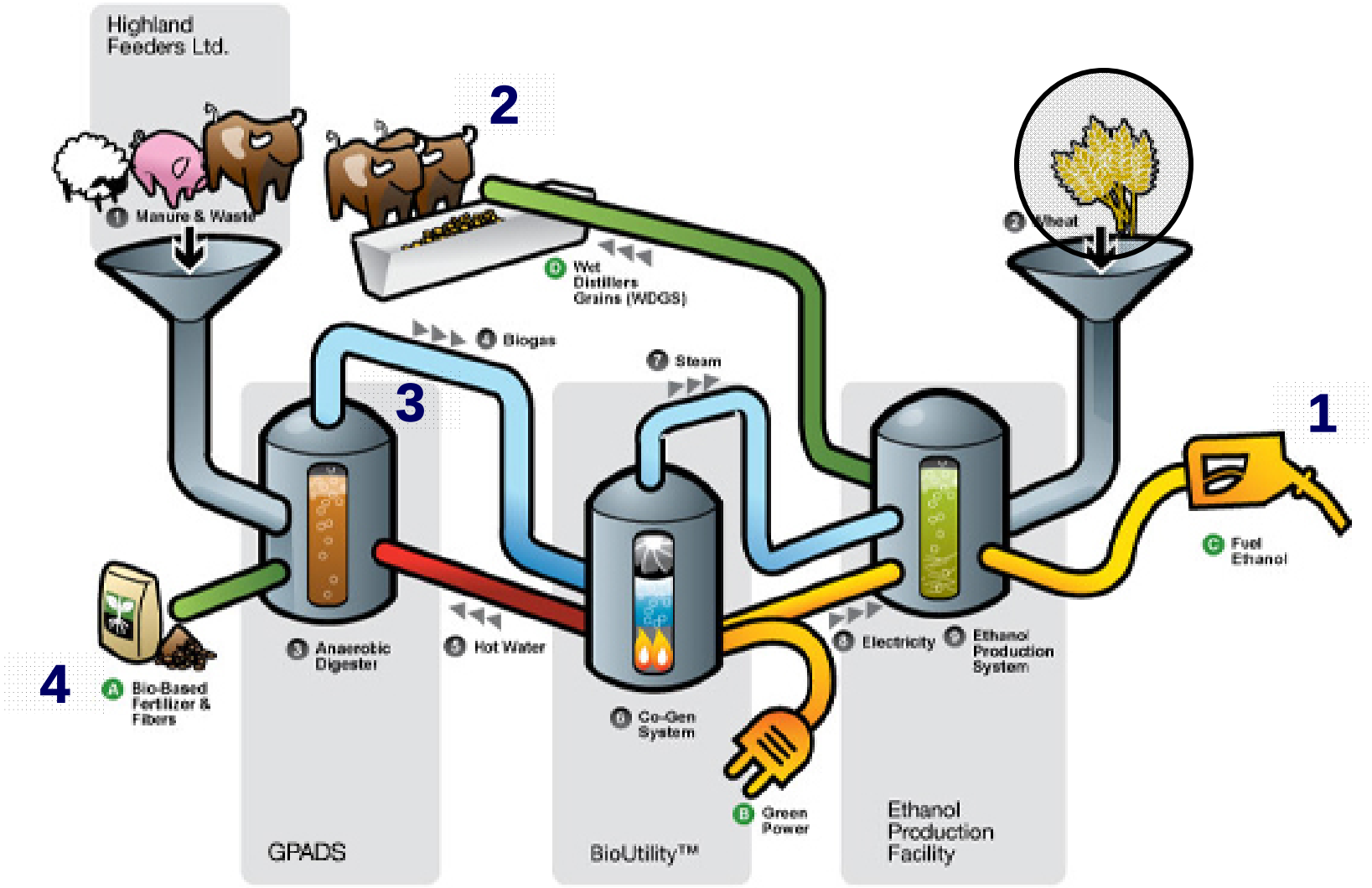
BioFertilizer or feedstock for other processes

10MW boiler

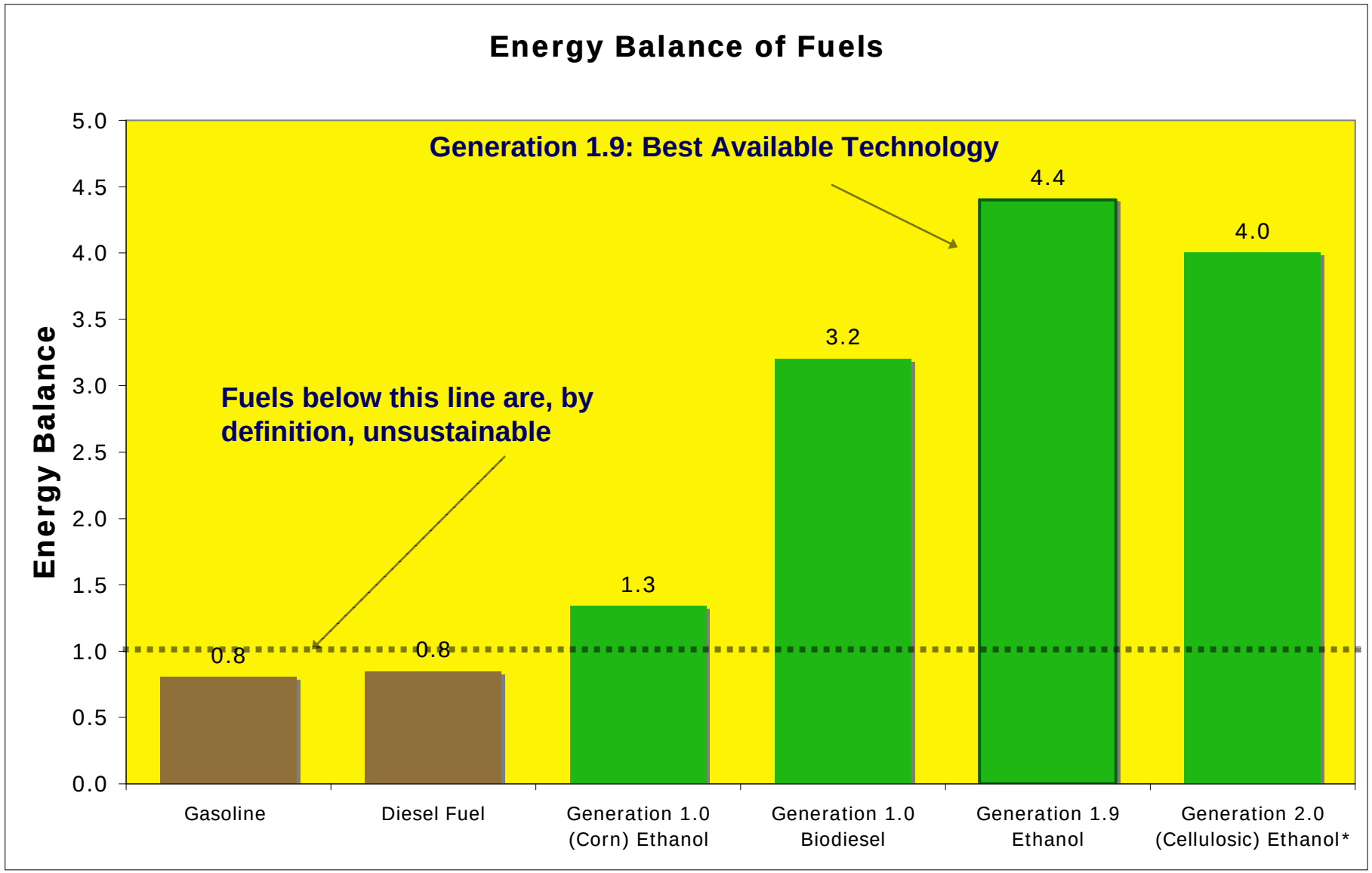
2.4 MW Jenbacher

Integrated BioRefinery™ Overview

The Integrated BioRefinery™
Use of Grain



Integrated BioRefinery™ Overview


Energy Balance of Fuels
Generation 1.9: Best Available Technology
Fuels below this line are, by definition, unsustainable
Energy Balance
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.8
0.8
1.3
3.2
4.4
4.0
Gasoline
Diesel Fuel
Generation 1.0 (Corn) Ethanol
Generation 1.0 Biodiesel
Generation 1.9 Ethanol
Generation 2.0 (Cellulosic) Ethanol*

Issues with Biofuels
Criticisms of Grain-based Ethanol

Concerns:	Integrated BioRefinery™ addresses these concerns
Food versus Fuel	Feedstock is utilized three+ times •as ethanol feedstock, as WDGS, as biogas
Net energy gain	4.4 : 1.0 versus 1.24 : 1.0 for traditional plants
Water consumption	3.1 : 1.0 versus 6.2 : 1.0 for traditional plants and 4.5 : 1.0 for oilsands production, no water is permanently removed from ecosystm
Impact on feedgrain markets	Supply & Demand imbalance offset by WDGS availability
Greenhouse Gas Emissions	Producer of credits (75,000 MT/annum) versus traditional plants which are net emitters

Benefits of Integrated BioRefinery™
Ethanol Plant, Biogas Plant, Power Generation & Feedlot

- VASTLY IMPROVED net energy balance for ethanol production
- Highly efficient use of H20
- Production of GHG offsets (75,000 MT per annum)
  - A traditional ethanol plant is a net producer of GHG's
- Enables production of WDGS
  - Reducing capital requirements – no need for drying equipment
  - Reducing energy requirements – both gas and power
- Secure and adjacent market for WDGS
- Enables high-value utilization of feedlot manure
- Self-generating 135% of electricity requirements
- Self-generating 80% of gas requirements
- Reduced exposure to energy markets
- Shared overhead and infrastructure

Resulting in an economic and environmental competitive advantage

Integrated BioRefinery™
Opportunities in a tightening biofuels world

- Competitiveness driven by technological advantages
  - Full capture of renewable energy value!
  - Energy savings = cost savings
  - More than offsets increased capital costs
  - Barriers to entry for other attemptees
- Significant global opportunity to place Integrated BioRefineries of this, or similar designs
  - Upwards of 400 possible sites
- Strong market also in redevelopment of existing biofuels plants with Growing Power technology improvements

Our Sustainable competitive advantage comes from our core technology, the Growing Power Anaerobic Digestion System

Integrated BioRefinery™
Opportunities in a tightening biofuels world

- Opportunities for “Right-Sized” plants, where large biogas meets small liquid fuels plants
  - Risks dramatically lower in commodities
  - Returns competitive with other ‘energy industry’ plays, not just Renewables

Resulting in an economic and environmental competitive advantage in a commodity business.

Integrated BioRefinery™
Opportunities in a tightening biofuels world

- Public Sentiment / Government Policy favors a better biofuel
  - Energy balance and Water balance matters
  - Gov't programs favor agricultural producer investment, only possible in regional scale plants
  - A better biofuel, Generation 1.9, has the greatest potential to be the low cost fuel supplier in the face of ever-increasing energy demand

Better Biofuels Generate Better Economic, Environmental and Social Returns

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Conclusion

- Demand for all sources of energy will continue to increase rapidly
  – Renewable Energy and CleanTech will be particularly in demand

- Ethanol demand in the US and Canada will continue to grow
- The carbon footprint of all energy sources will be highly scrutinized

- Ethanol production can be cost-effective and socially-responsible and achieve better than second generation net energy balance today.
- Total tonnage of feed for livestock in Canada should actually increase.
- Feedlots can be world class producers of renewable energy through the co-location of existing and commercially-viable technology.

Questions