



Cellulose Ethanol *is ready to go*

TEAM Tech Talk

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Who is Iogen?

- Headquartered in Ottawa, Canada, Iogen Corporation is a leading industrial biotechnology company specializing in cellulose-based enzyme technology
- Iogen operates the world's largest pre-commercial cellulose ethanol demonstration facility
- Production of cellulose ethanol started in April 2004



The leading firm in cellulose ethanol technology

- Pioneer in making ethanol from “biomass”
 - Active since late 1970s
 - \$140+ million spent in development
- A leading position
 - 178 employees focused in this area
 - \$40 million demonstration plant... the world’s first
 - Competitive commercial manufacturer of enzymes
- Alliances:



\$68m



\$25m

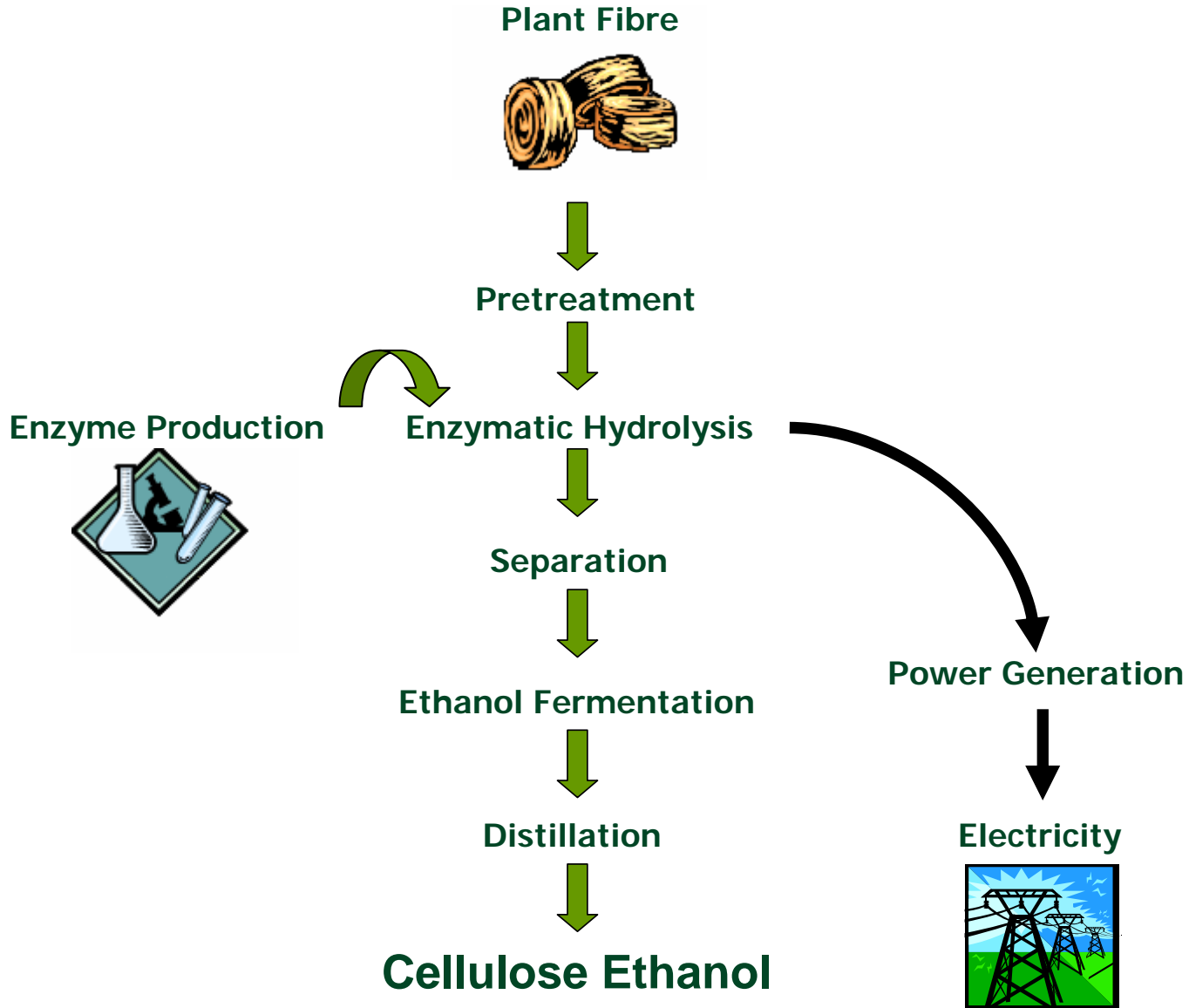
Canada

\$21m

Considerable media interest

- “No one has ever brewed biofuel from straw on a commercial scale. With Shell’s backing, **Iogen** is likely to be the first.”
 - Fortune, February 13, 2006
- “But **the biofuel to watch is cellulosic ethanol...** Royal Dutch Shell has a joint venture with **Canada’s Iogen** which plans to open a commercial plant by 2009.”
 - The Economist, Feb. 11, 2006
- “Private-sector investors - from Virgin mogul Richard Bransen to **Canada’s Iogen Corp** - are putting money into the concept in hopes of seeing an ethanol boom in the U.S.”
 - The Wall Street Journal, February 2, 2006

IOGEN's cellulose ethanol process



Process overview

- **Pretreatment**
 - Modified steam explosion process
 - Used to increase surface area (accessibility) of the fibre to enzymes
- **Enzyme production**
 - New, highly efficient cellulase enzyme systems tailored to specific pretreated feedstock
- **Hydrolysis**
 - A multi-stage hydrolysis process
 - Systems of high productivity and conversion of cellulose to glucose
- **Ethanol fermentation**
 - Uses advanced microorganisms and fermentation systems to convert both C5 & C6 sugars
 - The ‘beer’ produced by fermentation is then distilled using conventional technology to produce alcohol (ethanol)

Feedstock selection

- Main focus
 - Cereal straws
 - Wheat, barley, oat
 - Corn stover
 - Switch grass
- Criteria
 - Wide availability
 - Low cost, but win/win situation between plant & producers
 - Low risk
 - Ability to contract supply
 - Certainty of supply and price

Yields

- Based on wheat straw, Iogen's cellulose ethanol process yields:
 - ~340 litres of cellulose ethanol per tonne of fibre
 - ~250 kg of lignin per tonne of fibre
 - Lignin has ~80% btu content of thermal coal

Demonstration scale cellulose ethanol plant



Demonstration scale cellulose ethanol plant



Commercial plant rollout: What are the site evaluation criteria?

Assess commercial/country risk using factors such as:

Feedstocks

- Type, availability, cost, ease of collection

Infrastructure Issues

- Water availability/cost, road network, rail, power and natural gas price

Investment Climate

- Tax rates, industrial development incentives, financing options

Ethanol & Co-Product Sales

- Off-take customers, refinery locations, market proximity

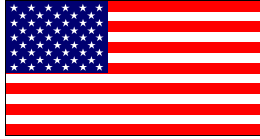
Government Policy

- Tax situation, fuel mandates, financial incentives

The world's first plant: Canada or the U.S.?



Cellulose ethanol commercialization: Site selection is about the best business case



- The Energy Policy Act of 2005
 - \$250 million loan guarantee on each of the first four qualifying cellulose ethanol plants
- 2006 Presidential State of the Union Address
 - “Producing ethanol from... stalks or switchgrass to replace oil imports from the Middle East”
- Energy Secretary Bodman Feb/'06 testimony
 - The loan guarantee program is “a very high priority”

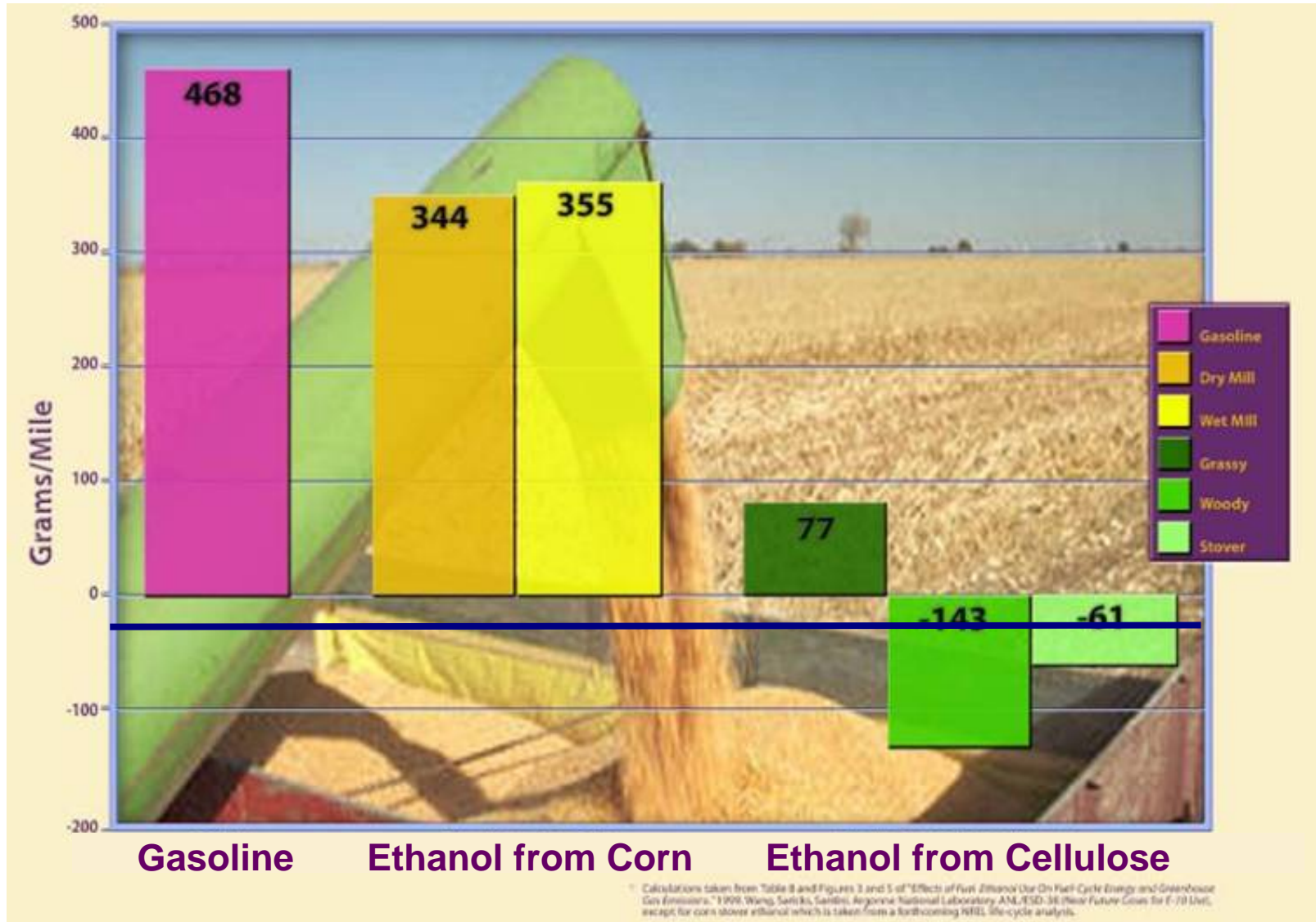


- Public/private partnership:
 - GoC [taxpayers] have contributed \$21 million towards the technology to date
- Industry Canada is the lead Ministry on the file
 - Working to deliver a success to GoC/ EC’s goal of reducing GHGs through made-in-Canada solutions
- Role for GoC
 - Overcoming market barriers to emerging tech. commercialization requires government risk sharing

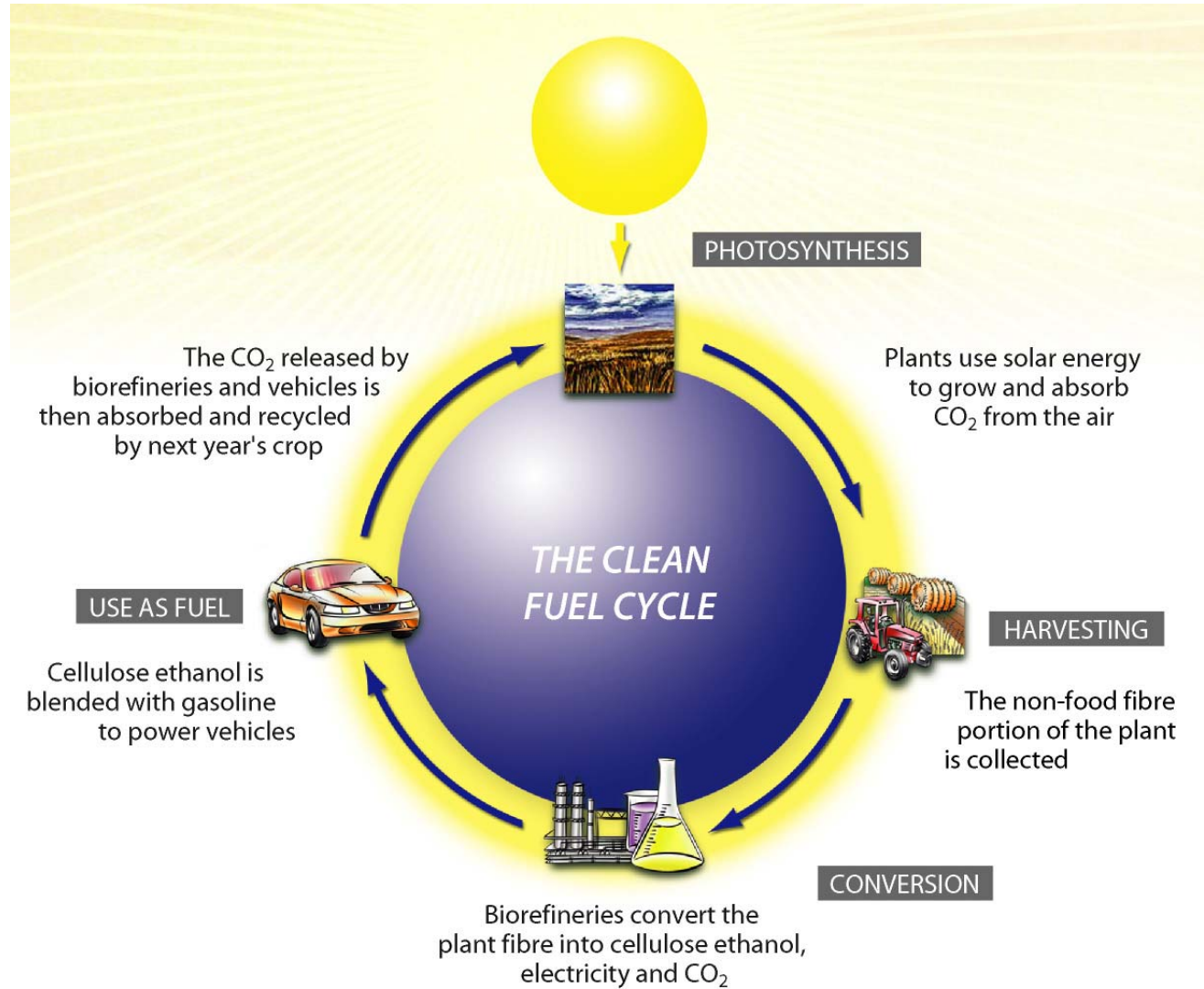
Benefits to agriculture

- Puts \$ in farmer's pockets
- Keeps jobs on the farm and in the community
- Represents a living example of sustainable development
- Eliminates the need for straw burning (certain soil zones)

Benefits to the environment – CO₂



The clean fuel cycle



Benefits for energy security

- Cellulose ethanol can have a significant impact
- Over 1 billion tons of agriculture and forestry residue plus dedicated crop material is available in the US, according to recent DOE/USDA estimates
- Using Iogen yields, 1 billion tons of cellulosic material:
 - = ~75 billion gallons of cellulose ethanol
 - On an energy basis = over 40% of current US gasoline consumption

A commercial biorefinery could look like...



- **Project Developer:**

- Iogen
- Shell Global Solutions

- **Lead Equity Investors:**

- Royal Dutch/Shell
- Iogen Energy

- **Project Data:**

- \$410 M project cost
- ~500,000 t/yr feedstock
- ~120 million L/yr production
- Associated power plant and enzyme plant

- **Lead Candidate Locations:**

- Idaho
- Saskatchewan
-
- Nebraska
- Alberta
- Manitoba



Questions?