

# - Back to the Future - Products from the Bioeconomy

**Presentation on,  
Bioproducts, Biorefineries  
and Industrial Biotechnology  
to the  
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# Overview of this Presentation

- We have a hybrid petro/bio-economy
- Bioproducts and the benefits of new value chains
- Major corporations are positioning themselves
- Canadian initiatives / new programs
- Biorefining: the bioeconomy is about more than biofuels

# Quote from OECD 2002

The Application of Biotechnology to Industrial Sustainability - A Primer

“The world was not always dependent on petroleum. A traditional bio-based economy provided and continues to provide us with food, feed, fibre and wood. Before the 1920s, many of our industrial products were also bioproducts, such as fuels, chemicals and materials derived from biomass, primarily wood, and various agricultural crops. Cheap and abundant oil changed that.

However, advances in technology, and biotechnology in particular, are making it economically viable and environmentally attractive to "go back to the future" and begin supplementing, and eventually perhaps, replacing petroleum with biomass, a renewable feedstock derived from plants.”

# Context

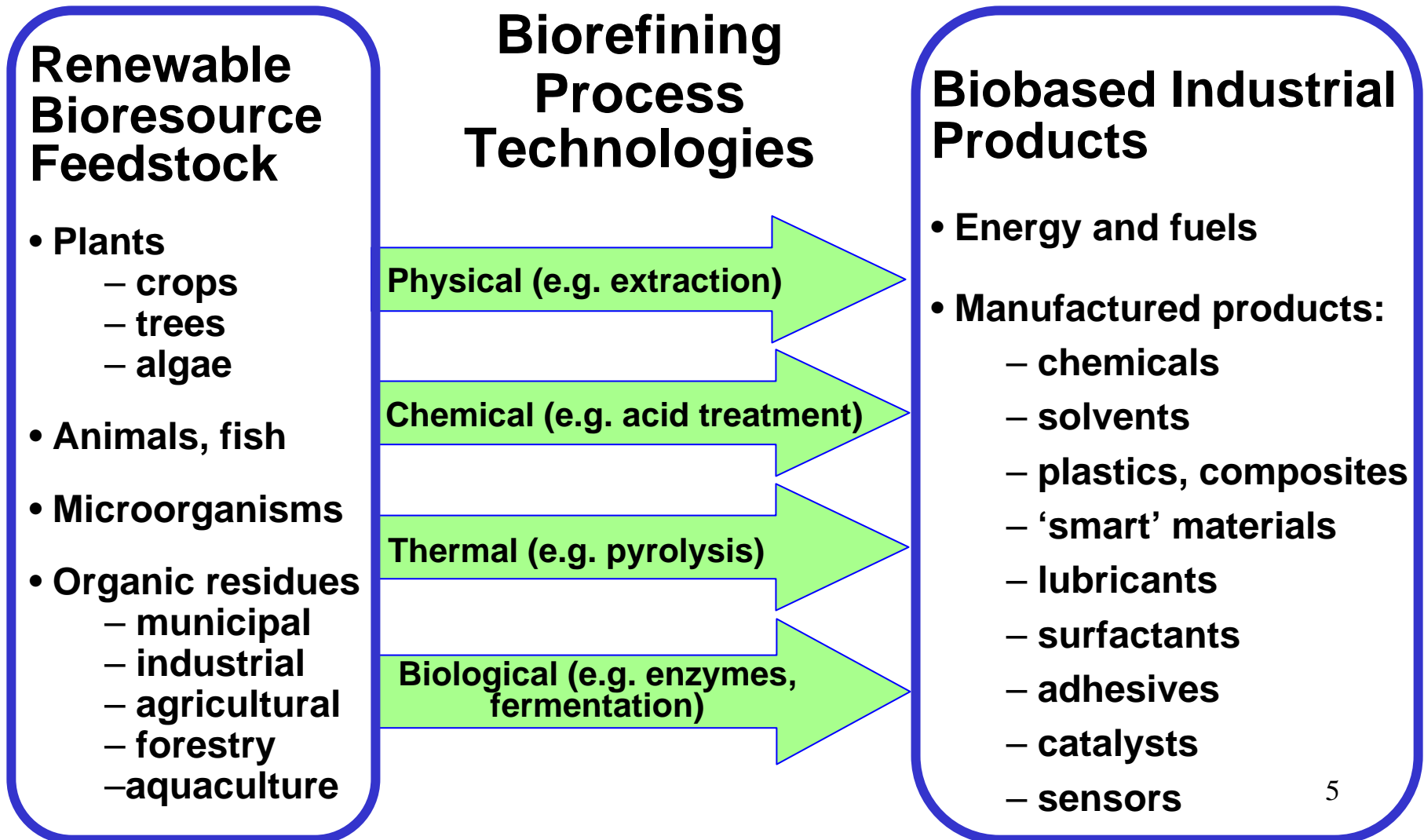
## **The global economy relies on fossil and renewable carbon**

- **Biobased energy, products and processes are beginning to transform key sectors of the global economy**
- **Renewable carbon products can complement or replace those from fossil carbon**
- **Renewable carbon also complements wind and solar energy because it can supply liquid transportation fuels, chemicals and materials, such as plastics**

## **New cross-sector value chains are being established**

- **Creating new, more sustainable business opportunities**
- **Resulting in mutual competitive advantages for the manufacturing, chemicals, plastics, energy, forest and agriculture sectors**

# A wide range of products can be manufactured from renewable carbon



# Examples of unconventional biobased value chains

Raw Material	Intermediate	End Product
Vegetable oil	Poly-urethane	Automotive foam seating
Natural fibre from e.g. flax, hemp	High strength light weight composites	Automotive panels
Sugar in pulp-and-paper process water	Ethanol	Vinegar in pickles and salad dressings
Dextrose from corn	Lactic acid	Recyclable and biodegradable plastic for containers, textiles
Starch from grain	Modified starch superabsorbents	Biodegradable disposable diapers

## Existing bioproducts



# Driving Forces for the Bioeconomy

- High cost and cost spikes of oil, natural gas and electricity
- Energy security
- Increasing global competition and global redistribution of manufacturing jobs
- Depressed forest and agriculture sectors and rural economic hardship
- Environmental and climate change concerns
- Integration of advances in biotechnology with chemistry, materials science and nanotechnology
- New cross-sector opportunities for new value creation and capture

## **Bioproducts are a growing activity in Canada's resource processing and manufacturing industries.**

**In 2003 Statistics Canada identified 232 firms with bioproducts related activities.**

	Total	Bioproducts portion	Bioproducts as % of total
Employment	24,400	7,900	32%
Revenue	\$ 12 B	\$ 3.2 B	27%
Exports	\$ 5.8 B	\$ 1.5 B	25%
R&D	\$ 232 M	\$ 94 M	41%

**[Note: Data is from a Statistics Canada special survey of the resource processing and manufacturing sectors for the year 2003 where 232 firms reported bioproducts-related activity]**

# Major corporations are positioning themselves

- **Energy sector:**

- **Shell:** invested \$46M in **Iogen**; predicts that by 2050, 30% of total global energy and chemicals will be derived from biomass
- **BP:** alliance with **DuPont** in UK to produce bio-butanol as a fuel
- **Suncor:** strategic alliance with **Lignol** on ethanol and chemicals from forest residues

- **Chemical sector:**

- **Dupont** target doubling revenues based on renewable sources from \$4B in 2006 to \$8B by 2015; now producing Sorona plastic commercially from biobased feedstock
- Consortium (**Degussa, BASF, Bayer, Henkel, Lanxess**) formed to advance a hybrid petro/bio-chemical industry in Germany

- **Automotive sector:**

- **Woodbridge** has market-ready biobased technology to produce polyurethane foam for automotive components
- **Magna** is working with researchers at the University of Toronto to develop high-performance low-cost composites from cellulose fiber in pulp & paper byproducts
- **Honda** is developing bioplastic and biofuel technologies for next generation green automobiles that are easier to recycle and less polluting to run
- **Auto 21** Canadian research network is developing a “Bio-Auto” initiative

# Major corporations are positioning themselves

- **Forest sector:**

- **Tembec** has \$200M/y in sales of industrial chemicals which account for 6% of total revenue; will be a net energy producer in 5 years
- **Canadian Forest Innovation Council** identified energy, chemicals and advanced composite materials as large new unconventional market opportunities for the forest sector bioproducts (\$ potential in tens of billions)

- **Agri-business sector:**

- **Cargill-NatureWorks** is now a leading producer of biobased plastic and is developing biorefineries to become a major supplier of intermediate chemicals from renewable raw materials
- **Archer Daniels Midland** is the largest US producer of fuel ethanol and has acquired Canadian company Group Lysac a producer of biobased and biodegradable super absorbents used in disposable diapers
- **Maple Leaf (Rothsay)** produces 35 M litres per year of biodiesel from rendered animal fat at its plant near Montreal; business strategy is to increase value capture and reduce environmental liability from waste animal fat

# Opportunities from Industrial Bioproducts

## Importance for national and global economies:

- Resource-based manufacturing industries: increased value creation and capture, improved competitiveness, more sustainable feedstock, new materials creating high-growth markets
- Energy/Transportation and Chemical industries: next generation biobased fuels, chemicals and materials that perform better and cost less when economies of scale are achieved
- Environment: new technologies and products that prevent pollution, reduce greenhouse gas emissions and save costs

A few mature industry sectors account for a majority of exports in many countries

**MANUFACTURING**  
Automotive, Aerospace,  
Building Materials

**RESOURCE PROCESSING**

Chemicals & Plastics

Energy & Transport Fuel

**BIO-RESOURCE**

Agriculture

Forest

# However, these sectors now face major competitiveness challenges

## MANUFACTURING

- Lower-cost competition
- Supply chain sustainability

Need to become more competitive

Need more sustainable feedstock, low-carbon energy / transport fuels

## RESOURCE PROCESSING

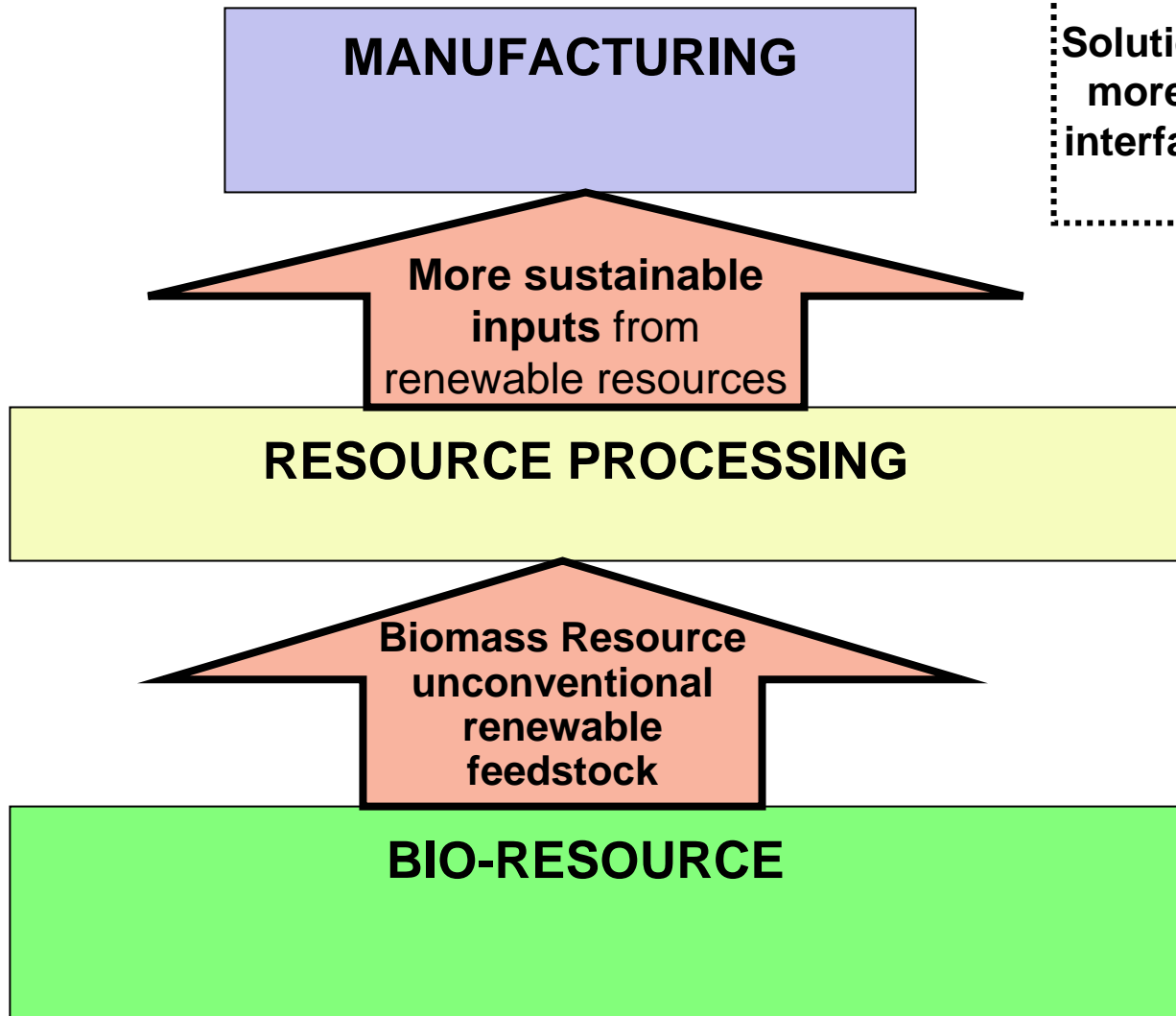
- Feedstock supply/cost; long-term sustainability
- Climate change/environmental pressures

Need new markets and to add more value

## BIO-RESOURCE

- Increasing global competition
- Depressed commodity prices / increasing input costs

# New bio-based value chains can provide new cross-sector solutions



Solutions are found more often at the interface with other sectors

# Leading to cumulative economic and environmental benefits

## Advantages

Increased sector competitiveness & sustainability

More sustainable inputs

New feedstock, processes

New value capture

Increased resource productivity

### MANUFACTURING

- Domestic supply chain advantage
- Greener products & greater efficiency

### More sustainable

- Energy for processes
- Fuels for transport
- Chemicals, plastics

### RESOURCE PROCESSING

- More sustainable feedstock
- GHG-neutral fuels
- Green intermediates/products
- Pathway to sustainable hydrogen

Biomass Resource  
Unconventional  
Renewable Feedstock

### BIO-RESOURCE

- New large markets
- New value from “waste” and residues

# Role of Government

## **Help industry and producers capture the benefits:**

- Promote development of new cross-sector opportunities
- Stimulate innovation, improved linkages with research community
- Engage industry via technology roadmaps and R&D project development
- Influence priorities for publicly funded research and research networks
- Promote more sustainable development - build innovation networks, identify commercialization barriers, implement relevant policies

## **Policy coordination:**

- Economic Development, Fiscal/Tax
- S&T, Education
- Environmental and health regulation
- Agricultural
- Natural Resources

# Canadian Biomass Innovation Network

([www.cbin.gc.ca](http://www.cbin.gc.ca))

- Partnership of federal departments and agencies:
  - Natural Sciences and Engineering Research Council
  - National Research Council
  - Industry Canada
  - Agriculture and Agri-Food Canada
  - Natural Resources Canada (energy & forestry)
  - Environment Canada
- Objective: capture economic & environmental benefits from biomass, biofuels, bioproducts, and industrial biotechnology
- Delivers an applied R&D program ~ \$ 10 million/year
- Building links with other federal programs and with provinces
- Building linkages with similar groups internationally

# Progress on the Bioeconomy

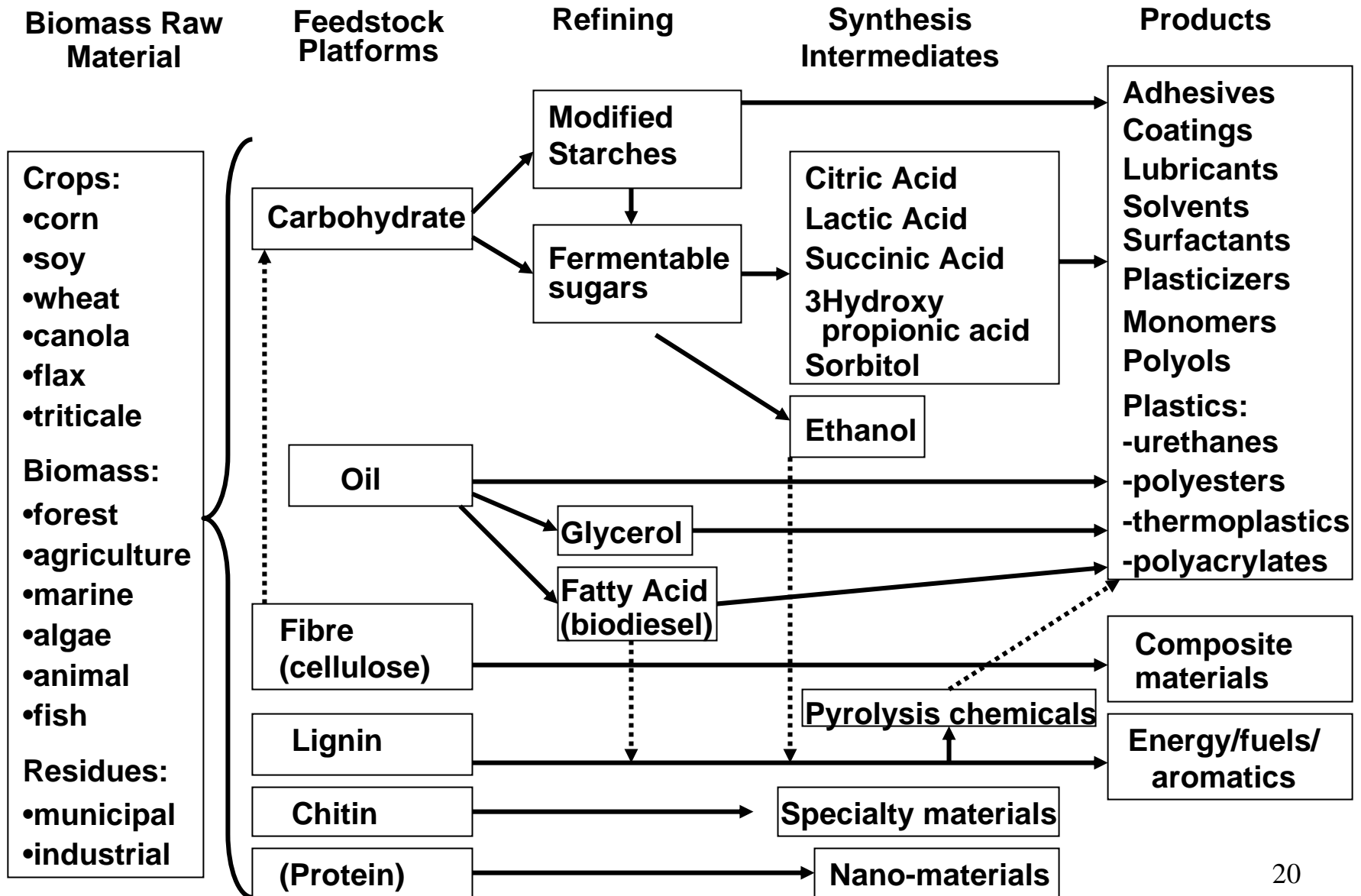
- In 1996, the OECD identified industrial biotechnology as a key technology for sustainable economic development
- Awareness is now increasing of bioproducts/bioenergy opportunities in a number of key sectors and organizations on a global basis
- Linkages are forming across sectors (ag, forest, chemical, energy, manufacturing) and disciplines (biology, chemistry, engineering)
- National communities of practice are emerging for bioproducts that include industry, researchers, government program/project managers, and non-government organizations
- **But** not all the required technologies and production systems are available “off the shelf” - there is need for large new investments in R&D, technology integration, systems engineering, demonstration and deployment

# New Canadian Government Initiatives Totaling over \$1 Billion

- **Agriculture innovation:**
  - \$479 million for bioproducts, biofuels and new uses for crops
- **Forest innovation:**
  - \$127 million to address unconventional markets (energy, chemicals)
- **ecoEnergy Technology:**
  - \$230 million for R&D on renewable energy, carbon capture
- **Sustainable Development Technology Canada (SDTC)**
  - \$500 million for “next generation” renewable fuels and biorefineries
- **National Research Council - new National Program on Bioproducts**

*There is growing recognition of a need for a consensus process  
- a Technology Roadmap on Biorefining -  
to help identify opportunities for investments in  
S&T, R&D and demonstration*

# Biorefining is about more than biofuels



# Opportunities for International Linkages on Biorefining

- International Energy Agency Task 42 on Biorefineries  
<http://www.biorefinery.nl/iea-task/>
- EPO BIO (industrial crops) <http://www.epobio.net/epobio.htm>
- NAFTA (Canada, USA, Mexico)
- APEC (Australia, ASEAN, Canada, China, Japan ... Mexico ...)

# Some Points to Consider

- The bioeconomy is about much more than biofuels
- Biofuels require value capture from co-products to be profitable
- Biobased does not automatically mean environment friendly or sustainable – need to measure performance
- Developing the bioeconomy requires innovation networks linking:
  - sectors (agriculture, forestry, chemicals, energy, manufacturing)
  - and disciplines (biology, chemistry and engineering)
- The bioeconomy is a long term project - need for long term strategic planning to capture the benefits and avoid the risks

Thank You