

Building a Modern
Bio-based Economy
BIOL315 Summer
Lecture 5

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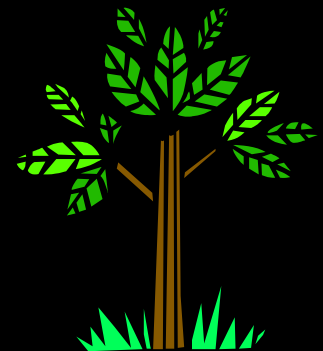
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What is a bio-economy?

- Economic framework based on biological commodities
- As auxotrophs, plants form the base of every food chain and are the ultimate baseline for a bio-based economy
- Bio-based includes naturally-occurring resources and agricultural commodities and what else?....

The traditional bio-economy...

- Settlement of Canada - resource-based economy
- First industries = forestry, agriculture, hunting/trapping - all primary resource based
- Down-sides of traditional bio-economy - dirty, inefficient use of resources, unsustainable

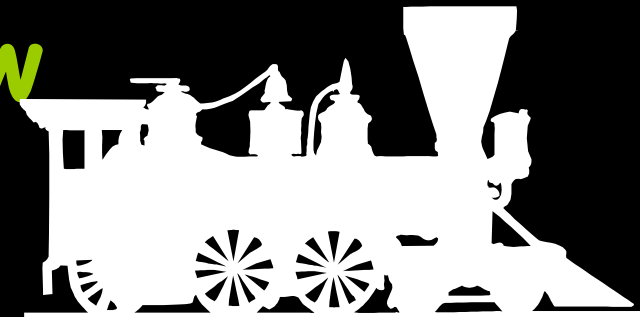
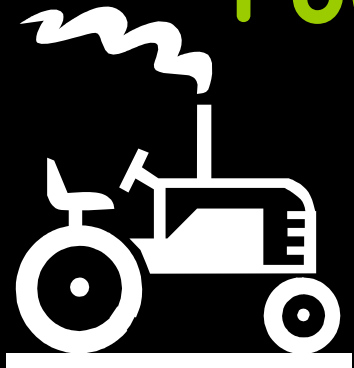


Movement away from the traditional bio-based economy

- Why did we move away from those traditional homesteading farms and forestry operations?

Petroleum-based economy

- Carbon dense energy source
- Tremendous spin-off industries, and variability in consumer products
- Power and financial base in hands of few

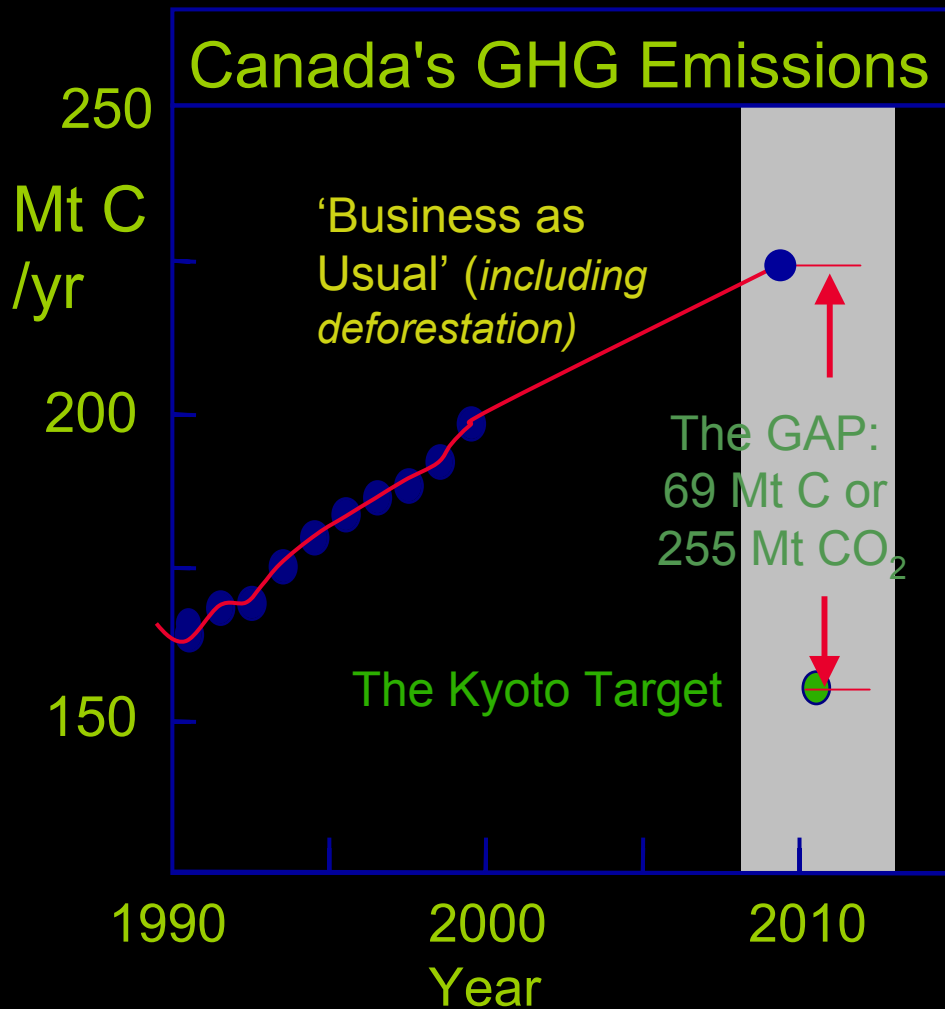


Drivers for the development of a modern bio-economy...

- Isn't this moving *backwards*?
- Need to address negative aspects of fossil fuel consumption
 - diminishing supply
 - national security issues
 - greenhouse gas (GHG) emissions

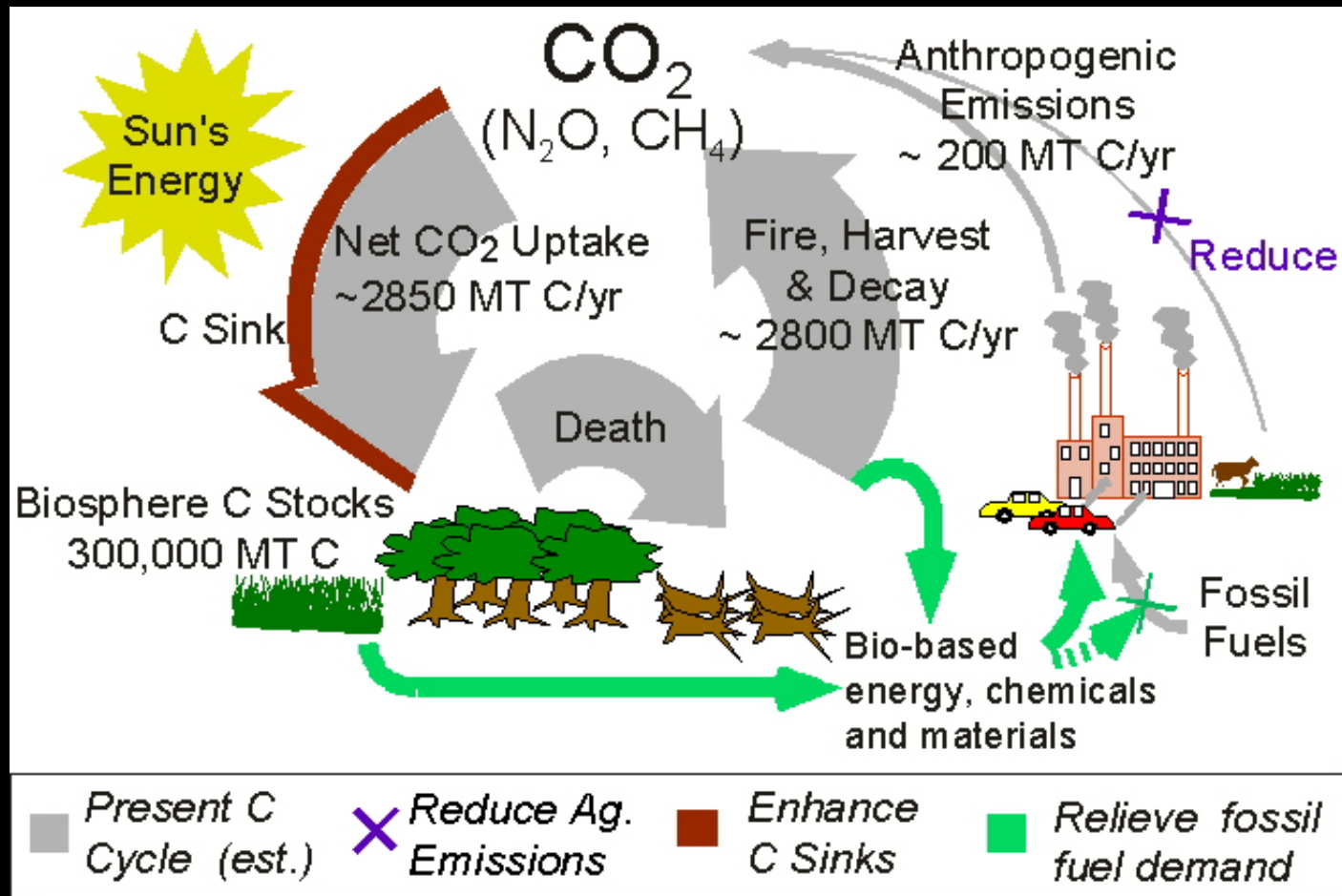


Addressing GHG Emissions - Kyoto Commitments



- 'Business as usual' will be +36%, not -6% of 1990.
- There will probably be other reduction targets after 2012.

How do we address GHG emissions?



*C sinks without additional GHG emissions
C stocks coupled to bio-based products*

Other advantages of a Bio-based Economy

- Opportunity to develop emerging technologies (Innovation Agenda)
 - Improve rural economies
 - Improved sustainability

So where does the biomass for
a “bio-based” economy come
from?

**primary production of forest
and agriculture industries**

agricultural wastes

forest waste biomass

municipal waste streams

(MSW, biosolids)

What economic sectors are involved?

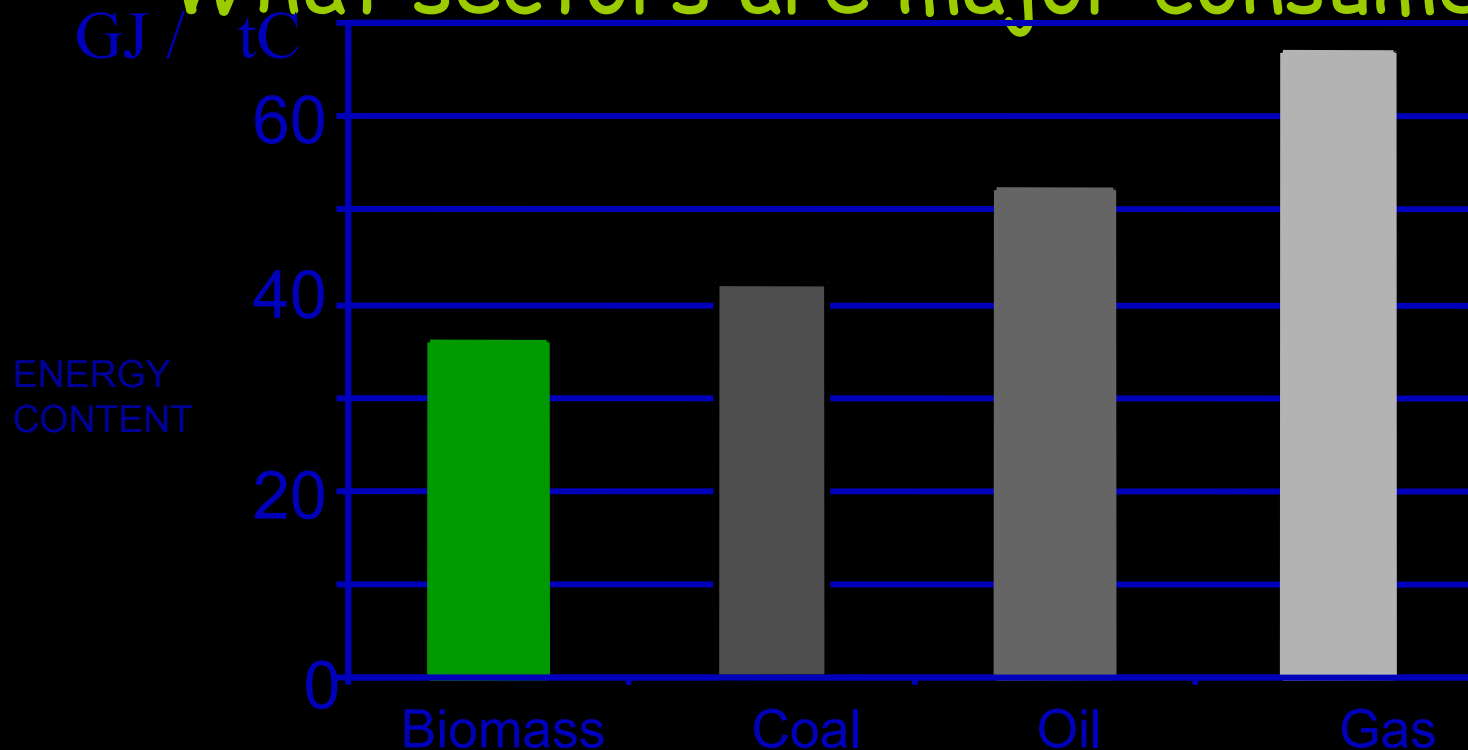
- Primary resource economies
 - Forestry
 - Agriculture
 - Energy
- Transportation
- Manufacturing and high tech
 - Pharmacology
- Phytoremediation/urban planning

Biofuels and Energy

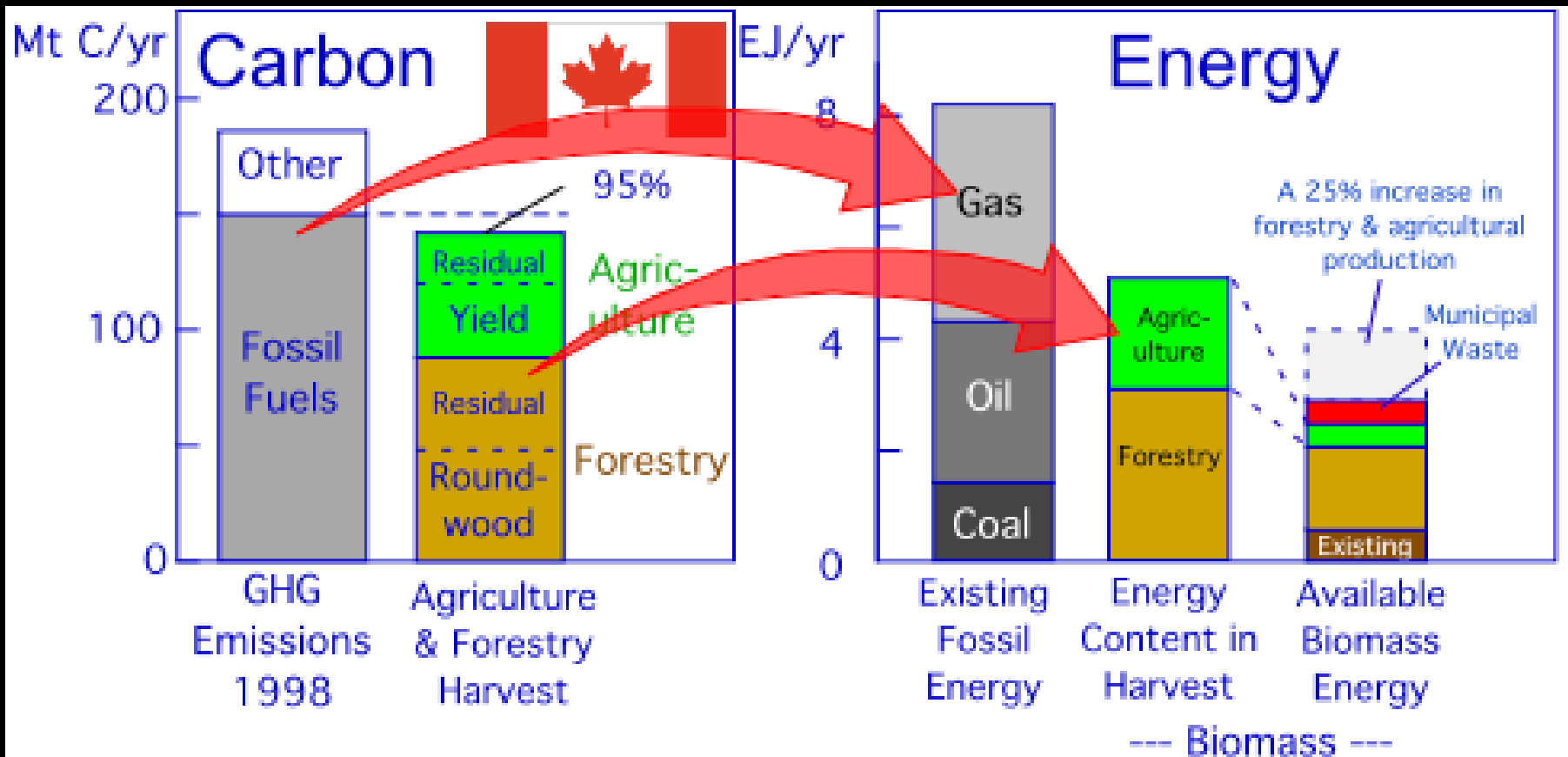
- Search for alternate fuels for typical combustion engines
- Replacement for fossil fuel-based energy sources (coal, gas, diesel, natural gas)
 - Ethanol
 - Bio-diesel

Canada's Energy Requirements

- What is our fossil fuel consumption? today, tomorrow?
- What proportions are gas, diesel?
- What sectors are major consumers?



Energy Potential from Bio-mass



Redrawn from Wood and Layzell, 2002, with permission

Does Canada have enough biomass to produce what we need?

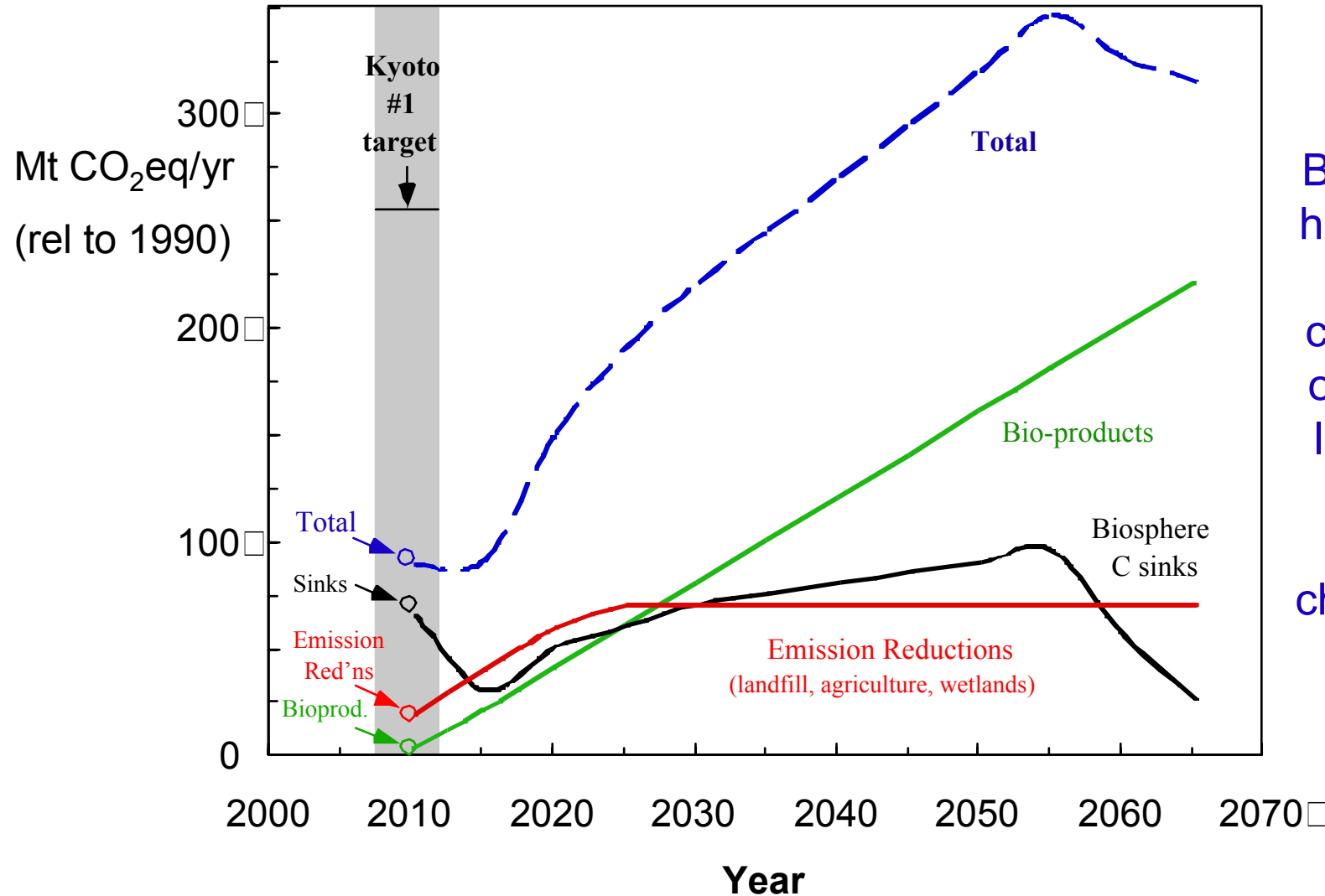
Wood, S.M. and Layzell, D.B. 2003.

*A Canadian Biomass Inventory:
Feedstocks for the Bio-based Economy.*

*An Industry Canada Contract with the
BIOCAP Canada Foundation.*



Biosphere Strategies for GHG Management (predicted)



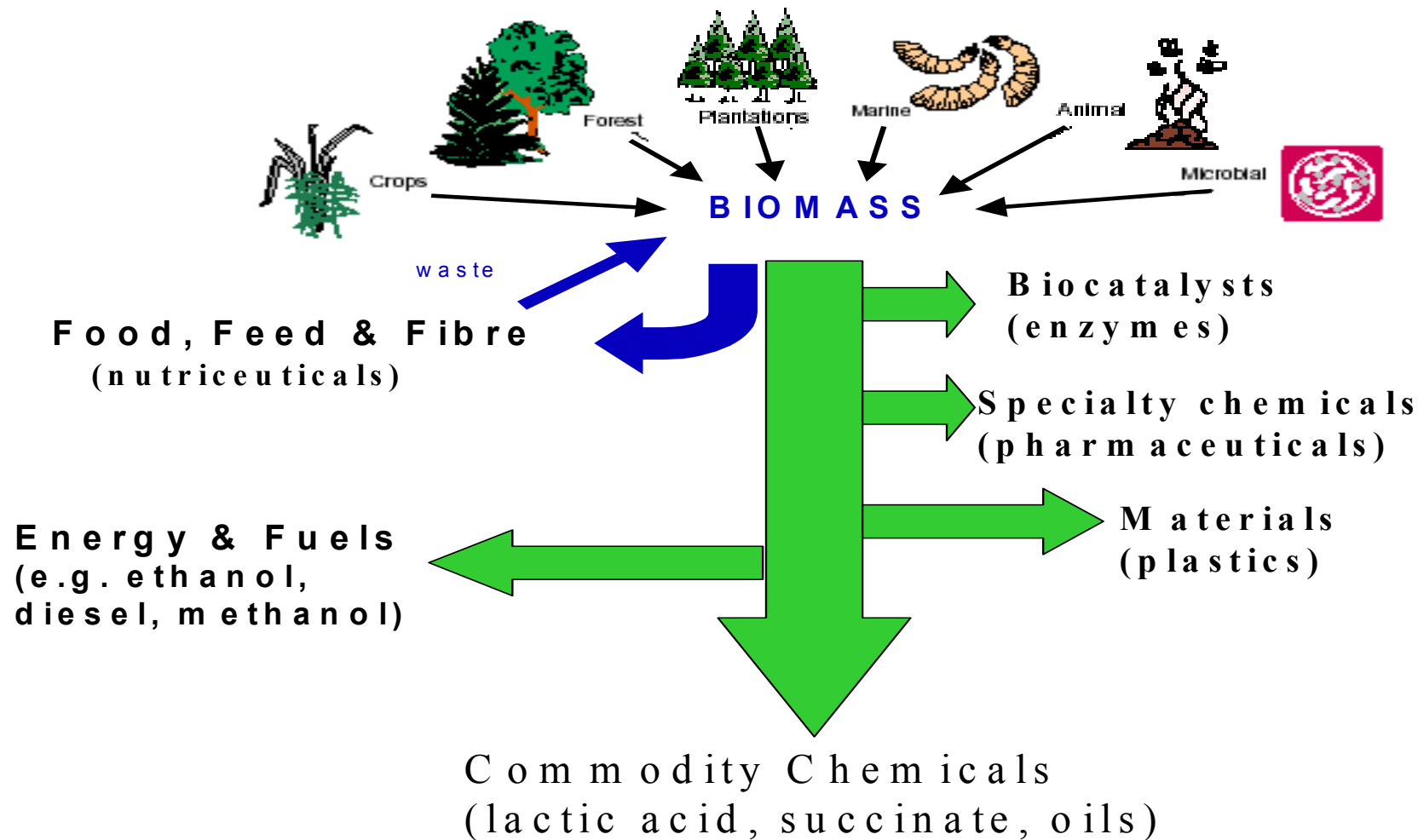
Bio-products hold promise as key components of Canada's longer term solution to the challenges of climate change.

What are the major fuel technologies, and how do these work?

- Ethanol – fermentation of cellulosic sources
- Production of bio-diesel from vegetable oil, or animal tallow based wastes – BIOX (www.bioxcorp.com)
- Pyrolysis of lignocellulosic (wood waste) sources to produce pyrolysis oil

What are bio-products?

- Products, materials and processes which are produced from biomass
- Includes traditional products such as foods, feed, fibre
- NOW also includes new bio-products which replace those from the petroleum-based economy
 - *Materials derived from a bio-refinery*



Schematic representation of a bio-refinery

Redrawn from D. Layzell, E. Chornet, with permission

Commodity chemicals

- The 'bio-refinery' has the ability to produce high grade commodity chemicals from non-petroleum sources at competitive costs
- These include lactic acid, succinate, oleosins

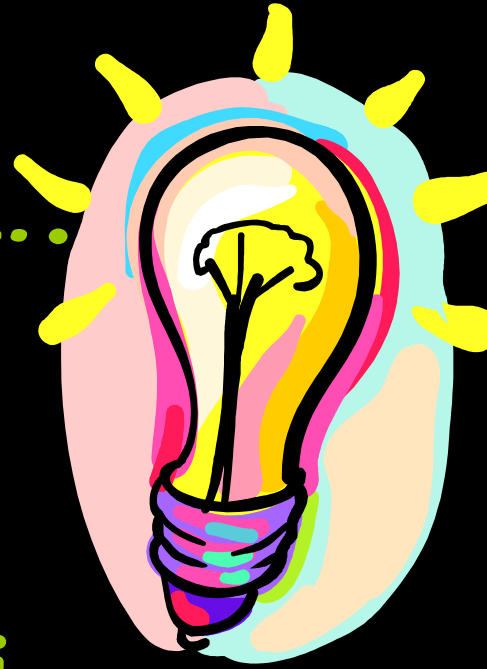
Specialty chemicals

- Derivation of high-value compounds from bio-sources
- Production of pharmaceuticals from plant sources, eg. Taxol from Pacific yew; edible vaccines
- Production of by-products from pyrolysis technology (see www.ensyn.com for typical example)

Bio-catalysts and enzymes

- Using plant or microbial enzymes to perform industrial service
- Degradation of complex molecules (lignin) using naturally occurring molecules
- Biotech applications

A new way of thinking....



Petroleum based industries
produced chemicals as a bi-
product of fuel refinement

Bio-based industries produce fuel
as a bi-product of high value
commodity manufacture