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THE UNIVERSITY OF BRITISH COLUMBIA

UBC-BERI
Bio-Economy Research Innovations

Perspectives and Priorities for Bioenergy Research in the Pacific Northwest

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Perspective:

The future forest bio-economy is based on integrated production of energy, fuel, chemicals, materials

Forest bio-economy

- **The bio-economy is transforming our world and our vision of the forest**
  - Forests provide truly renewable, sustainable, recyclable, climate neutral energy, fuel, chemicals and materials
  - FPAC Bio-pathways analysis shows near future bio-economy is estimated to be $200 Billion by 2015*

- **Next generation industry is integration of**
  - Bio-energy / bio-fuel production
  - High value bio-chemicals and nutraceuticals
  - Advanced materials and composites
  - New fibre based products and building materials

Source: *FPAC – Bio Pathways

Current bio-energy in BC

- More than 800 MW of biomass electricity installed (mostly P&P cogeneration)
- Growing pellet industry with 2 Mt/y
- Several new ORC electricity generation installations
- 4 Nexterra gasification systems have been built
- 17 Million t/y forest biomass available for energy in BC with additional 11Mt/y for next 15 years
  - 30% of current fossil energy

http://www.energyplan.gov.bc.ca/bioenergy/PDF/BioEnergy_Plan_005_0130_web0000.pdf
http://www.biocap.ca/images/pdfs/BC%20Bioenergy%20Primer.pdf

http://www.bioenergypartnership.ca/resource_inventory.html

Product integration is key

- Forest based energy, fuel, chemicals, advanced materials are not economic as a stand alone industry
- Integration of advanced bio-products with existing industry is the near term key to success
- Pulp and paper companies will be the early adopters of forest bio-economy technologies
- Pre-existing, capital intensive systems:
  - Biomass collection and handling
  - Thermo-chemical conversion
  - Environmental (air and water)
- 'Bolt-on' technology for bio-energy, fuel, chemical and materials production is economic today

The University of British Columbia

$1.96B Revenue in 2010 / 2011 and provides $10B in economic impact to the Province

$549M in research grants from industry and government; 1000 industry partnership/y

54,125 students with over 250,000 alumni in 120 countries

3,694 Faculty and 9,727 staff throughout comprehensive faculties: Engineering, Science, Forestry …

We are strong partners with industry for sustainability through education and innovation

"The University explores and exemplifies all aspects of economic, environmental, and social sustainability"

Stephen Toope's and UBC strategy – Place and Promise: The UBC Plan

* 2012 Times Higher Education Reputation Rankings

UBC Bio-Economy Research Innovations

BERI: A Vertically Integrated Network of Bio-economy Expertise and Infrastructure

Michael Smith Laboratory

- Feed stock genomics
- Bio conversion
- Enzymatic conversion
- Nuraceutical

Clean Energy Research Centre

- Thermochemical conversion
- Pyrolysis
- Gasification
- Separation

Advanced Material Process Eng. Laboratory

- NCC/MFC products
- Carbon fibre
- Composites
- Bio-Polymers

Pulp and Paper Centre

- Competitiveness
- Bio-product development
- Fibre product development

Centre for Advanced Wood Processing

- Product design and development
- Wood science
- Forest economics management and policy

Sauder School of Business

- Bio-economy markets and policy

Fully Integrated Trans-Disciplinary "Seeds to Solutions" Network

Feedstock development → Bio-Conversion Discovery → Bio-Process Engineering → Product development → Technology Transfer → Market development

BERI's 50+ faculty hav leveraged more than $150M in research and infrastructure funding to publish more than 2000 journal papers, train 350 HQP, file more than 50 new patents and create 4 new companies since 2004

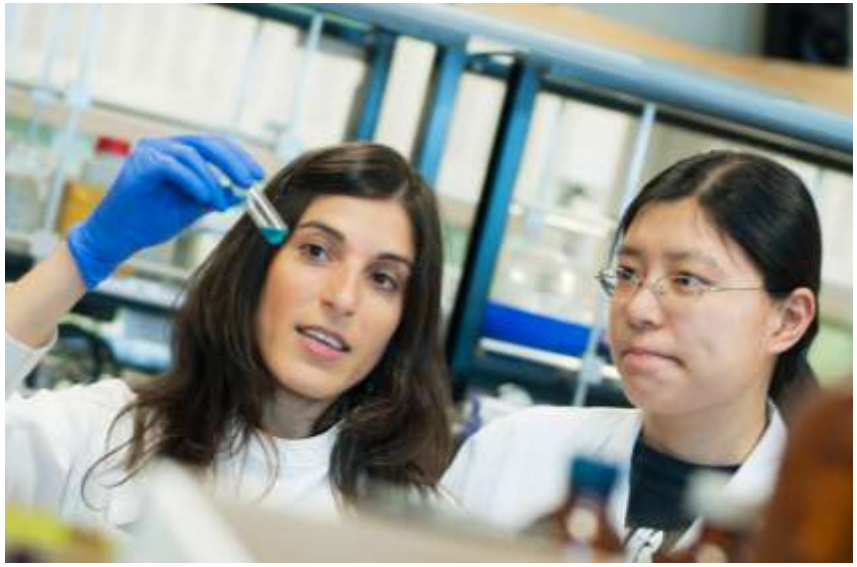
The Bio-Economy Research Innovation Strategy

A strategy for the province:

1. Identify near term bio-economy products and platforms best suited to BC's advantages

2. Develop product and platform roadmaps that identifies technical, and market barriers

3. Develop the expertise, infrastructure and partnerships to reduce the technical, capital and market risks of investment



The Bio-Economy Research Innovation

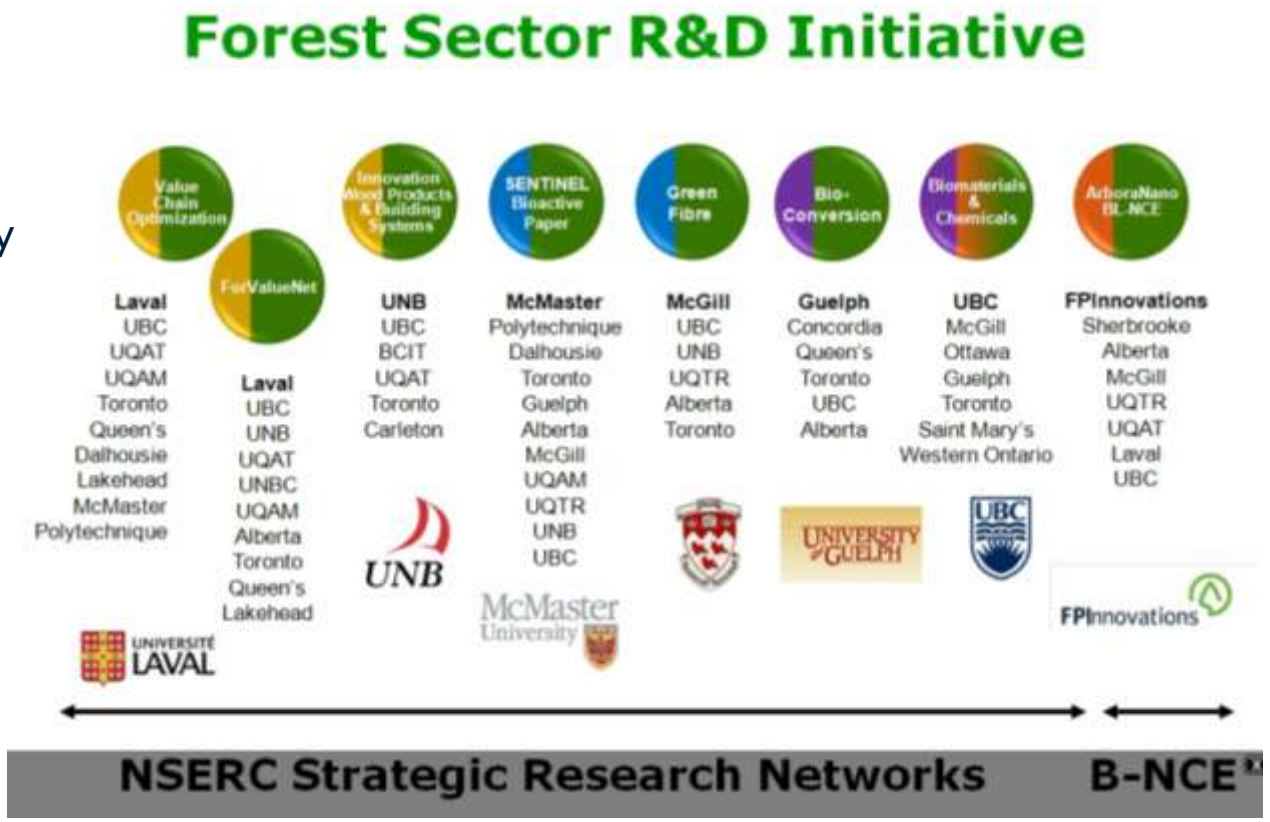
UBC BERI is working to:

1. Recruit the best and brightest to create a world class innovation cluster
   - NSERC-IRC Mercer Chair in the bio-economy
   - New hire in Chemical and Biological Engineering
   - 3 New hires in Michael Smith Laboratories
2. Build a Provincial bio-economy network that brings together industry, government and universities
3. Develop unique world class bio-economy demonstration infrastructure
4. Create an innovative bio-economy graduate education program

Creating a bio-economy technology incubation and demonstration environment

Pulp and Paper Centre & BERI Integration into NSERC Forest Sector R&D Initiative

- FIBRE – Represents 8 NSERC Strategic Networks
- $34M Federal investment in University research
- 100 Professors
- 400 Students and Post-Doctoral Fellows
- Largest forest bio-economy research network in the world
- Strong collaborations with FPInnovations



UBC Living Laboratory Initiative

- **UBC is a self-contained city home to more than 54,000 residents**
  - Operates, builds and maintains its own infrastructure and utilities
  - Effectively isolated and separated form the city of Vancouver
- **The UBC-City is the ideal test bed for the operational deployment of state-of-the-art sustainable technologies**
  - Provides opportunity to conduct leading research, development and demonstration on emerging operational technologies
  - Example, deploy next generation smart grid technologies throughout the city
    - Early operational access allows UBC engineers and scientists to develop, implement and test new sustainable technology
    - Attract and incubate technology partners to BC
    - Showcase new technologies to the world

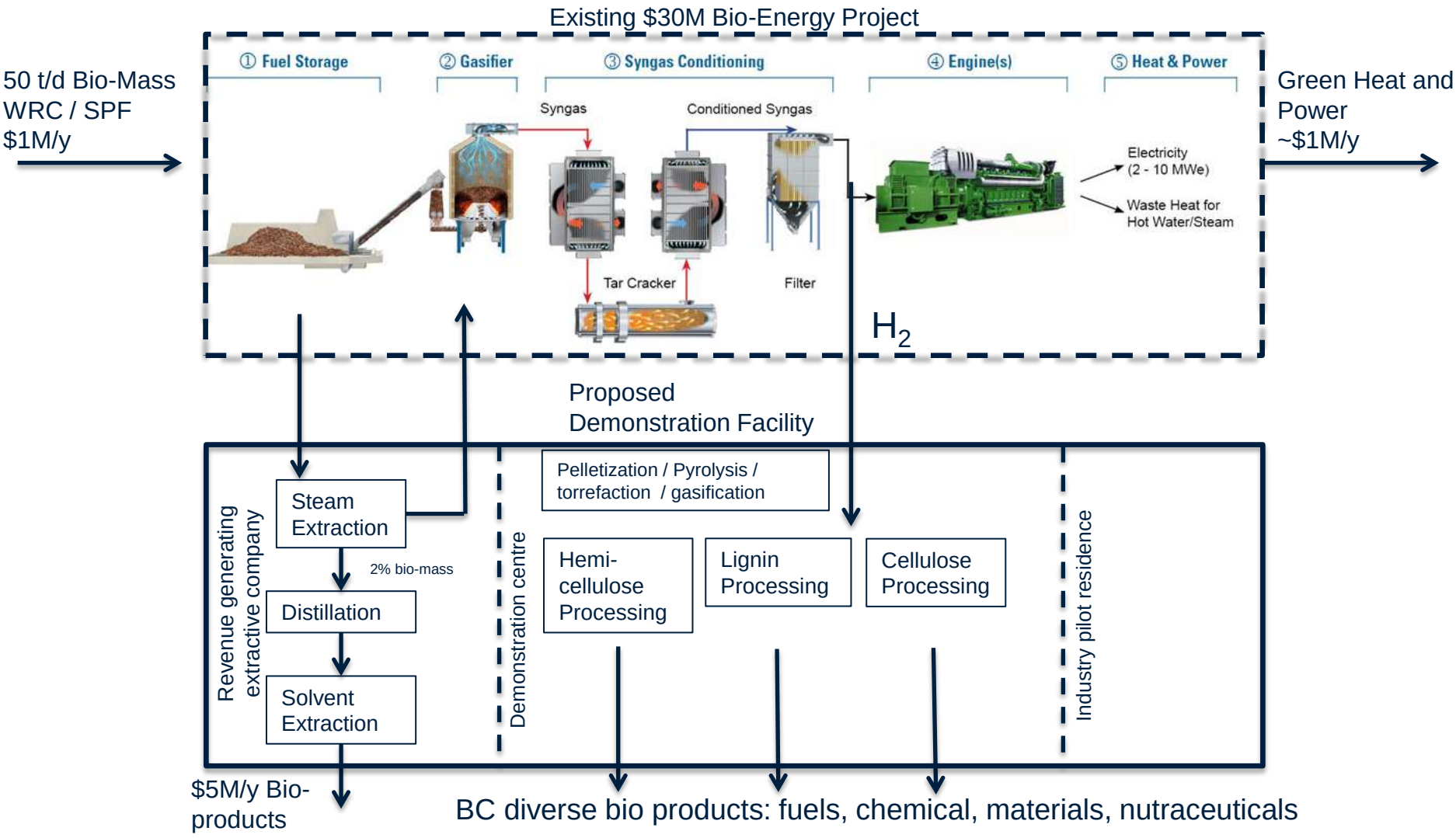
UBC-City is the Living Laboratory

UBC Living Laboratory – Bioenergy Research and Demonstration Facility

- **Strategic investment in bio energy**
- **$30M bio-mass combined heat and power facility on campus**
  - 50 t/d forest bio-mass gasification facility
  - Provides green heat and power offsetting fossil fuel consumption (2 MW electrical power)
  - Demonstrates and showcases green BC technology to the world
- **RD&D Opportunities**
  - Short term: Bio-mass handling, treatment, conversion, syngas upgrading, environmental technologies.
  - Long term: Develop and demonstrate next generation syngas upgrading, conversion, storage, new energy technologies
- **Develop, attract and showcase next generation bio-energy technologies**

Nexterra gasification system at UBC

UBC Living Laboratory – Bio Refinery



Living Laboratory – Bio Refinery

The worlds first *operational* bio-refinery to extract high value chemicals and materials from BC forest bio-mass prior to energy production

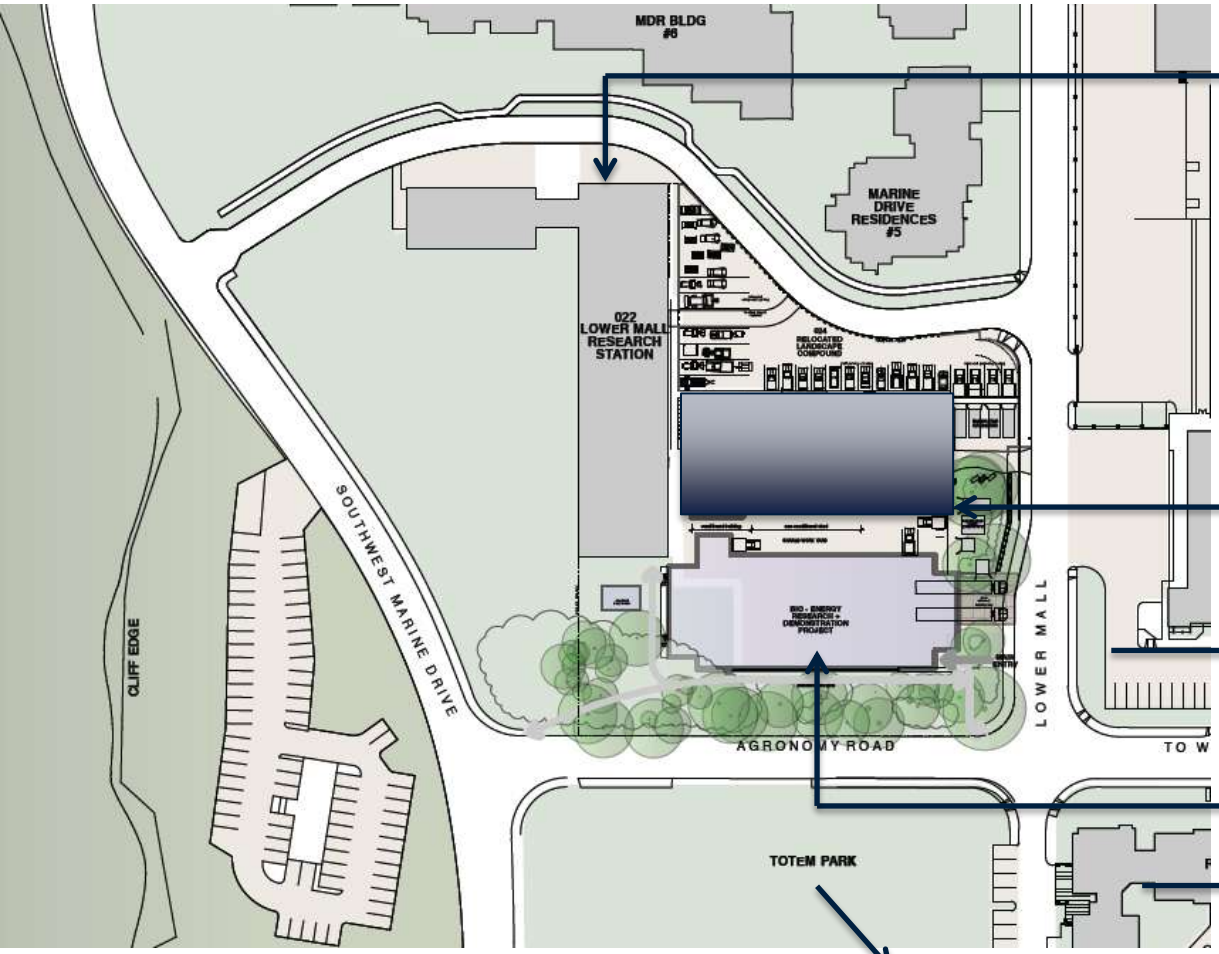
Three components to maximize revenue and drive innovation:

1. **Extractive business**
   - Initial bio-products estimated to provide $5M in revenue
2. **Demonstration pilot facilities**
   - Reduce the risk and cost of capital investment
   - Foster new bio-product markets
   - Flexible, transportable pilot systems
3. **Pilot incubator space**
   - Attract new technology partners and capital investment to BC
   - Foster start-ups, new technologies and new markets

http://en.wikipedia.org/wiki/File:Holzvergasung.jpg

Key infrastructure to demonstrate BC's bio-economy strategy

Bio-economy Innovation Cluster



BC Bio-Economy Inc.
1. Bio-economy incubator
   - Office / meeting resources
   - Bio-laboratory space
   - Access to R&D, mentoring, market and financial assistance
2. University education and labs
3. Corporate / industry labs

Bio-Refinery
Pilot scale demonstration

CERC, MSL, CAWP, AMPEL, …
UBC Strategic research centres in support of bio-economy research

Bio-energy research and demonstration centre

Pulp and Paper Centre
Renewed focus on product development and competitiveness

FP Innovations

Summary

- UBC is a strong innovation partner in the emerging forest bio-economy
- We recognize that bioenergy will be integrated with biofuel, biochemical and advanced biomaterial production
- Created UBC BERI, Bio-Economy Research Innovations: a vertically integrated network of faculty and specialized infrastructure
- $30 Million investment in bio-energy research and demonstration
- Developing the UBC Bio refinery, an operational bio products demonstration facility as key infrastructure the Provincial technology cluster

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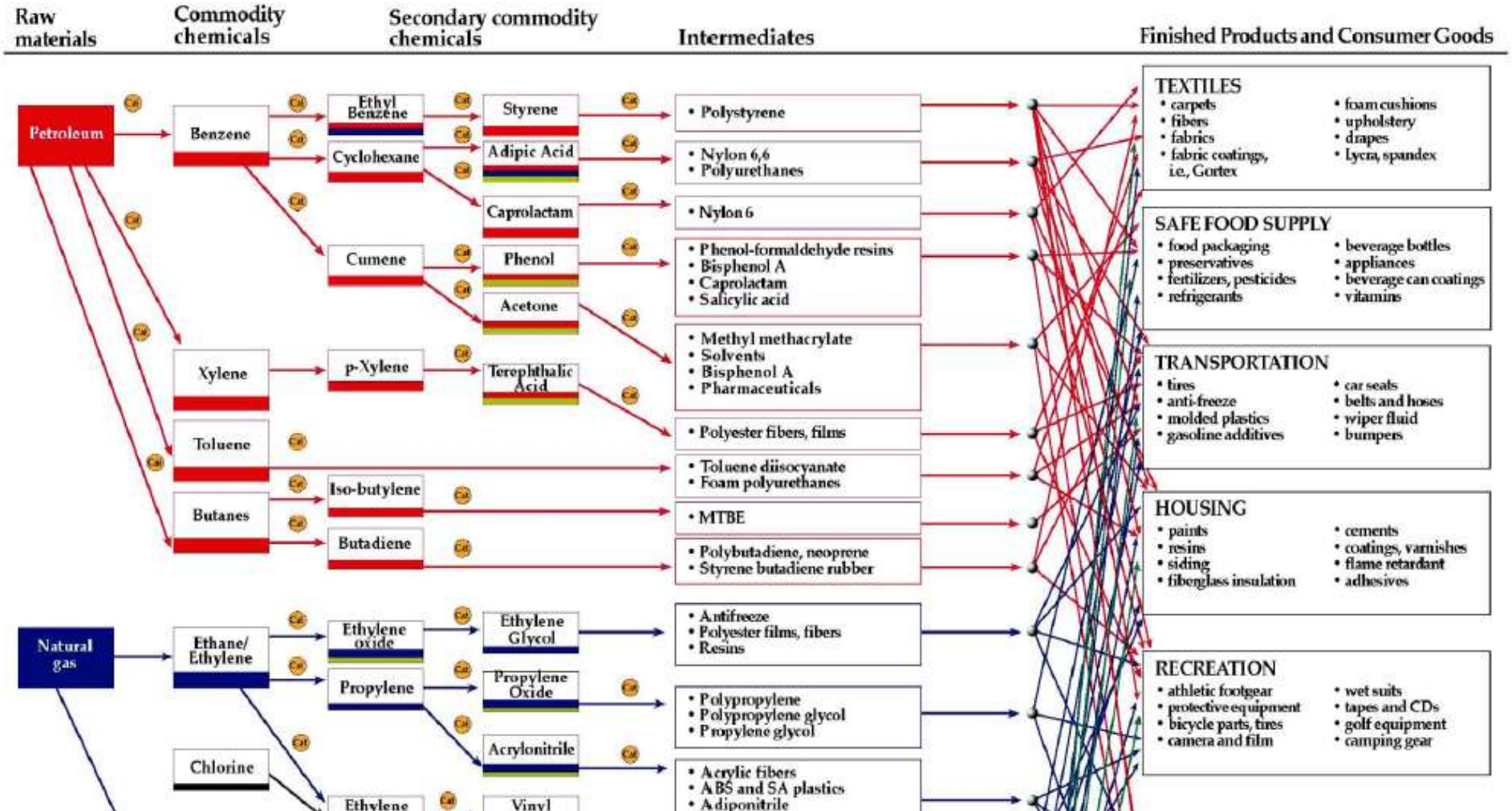
THE UNIVERSITY OF BRITISH COLUMBIA

Today's Fossil Economy

Source: DOE
http://www1.eere.energy.gov/biomass/pdfs/35523.pdf



Future Bio-Economy

Source: DOE
http://www1.eere.energy.gov/biomass/pdfs/35523.pdf