

The Forest Biorefinery: North American drivers



Tom Browne

Location: Pacific Bio

Date: 9-12 October 2012

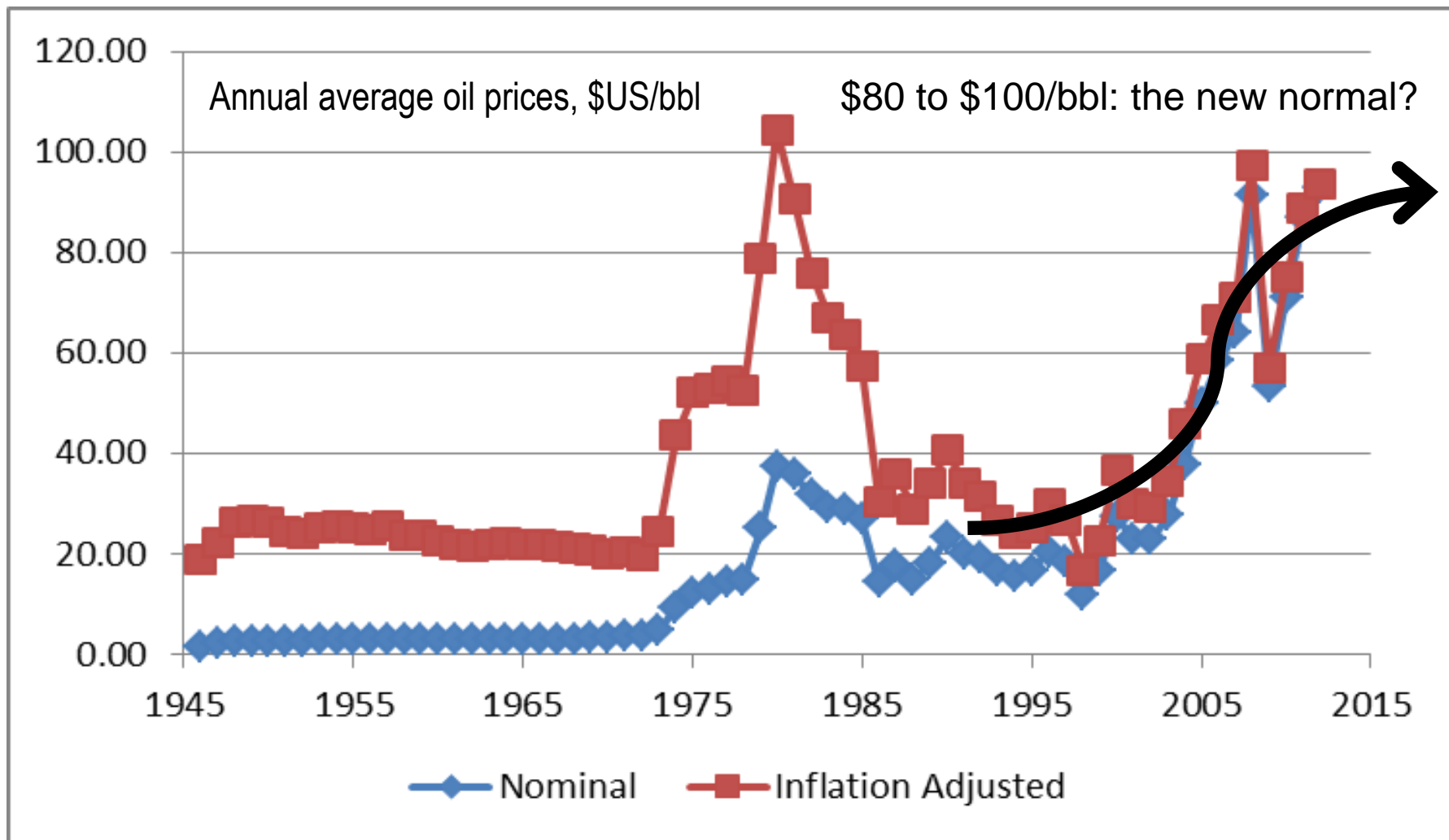
Wood is expensive

If wood costs \$100/odt, what should you make with it?

End use	Gross revenues, \$/odt of wood consumed
Pellets for heat at \$6/GJ	\$86
Power at \$0.09/kWh	\$124
Syngas at \$10/GJ	\$143
Ethanol at \$0.75/litre	\$150
CHP at 80% efficiency	\$181
Pulp at \$700/t and 45% yield	\$315
Chemical X at \$1.00/lb, 20% yield	\$440

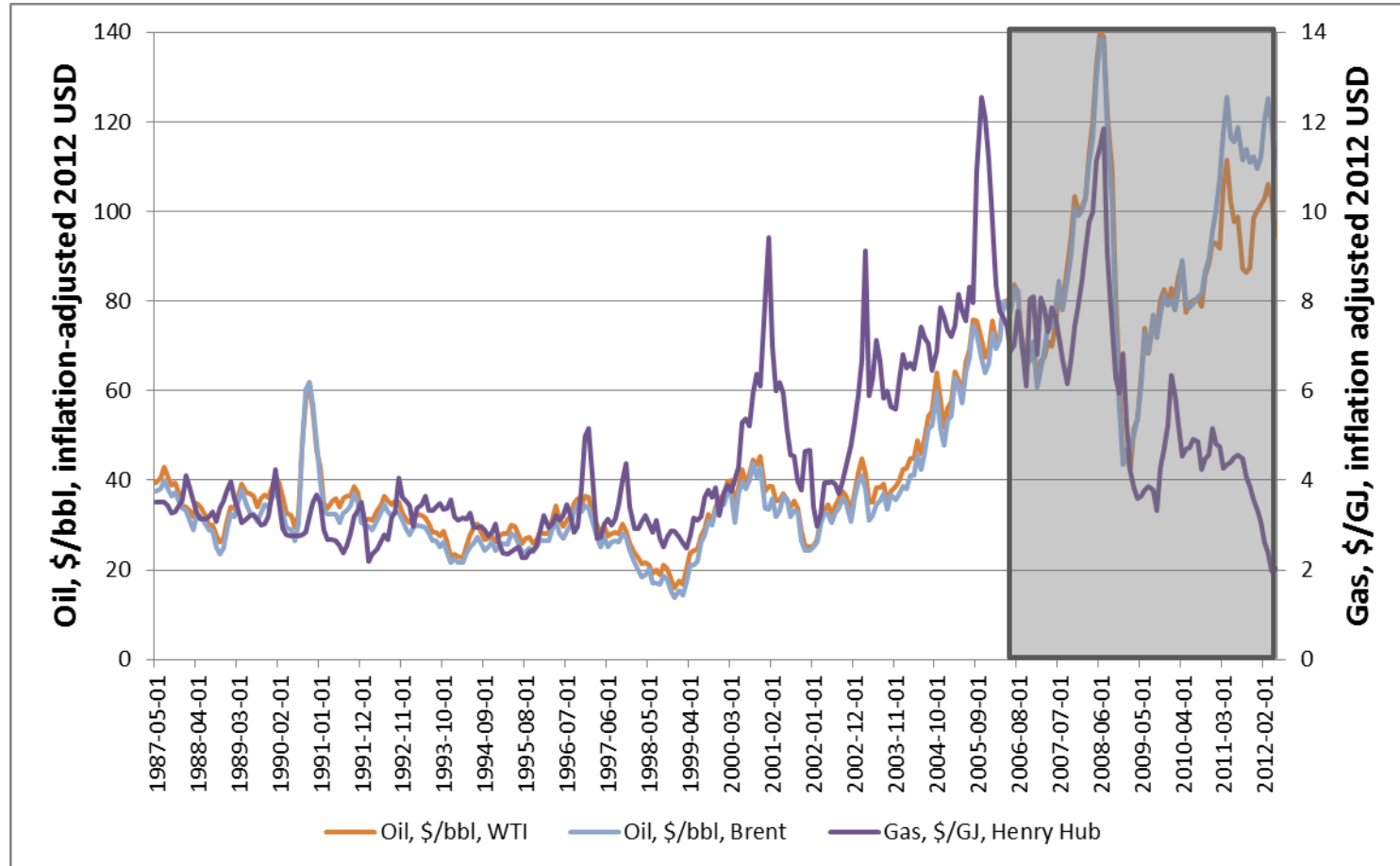
So what is Chemical X? A lot of chemical intermediates retail for \$1.00/lb

Bio-products make sense when oil is expensive



http://www.inflationdata.com/Inflation/Inflation_Rate/Historical_Oil_Prices_Table.asp

However, there are regional differences

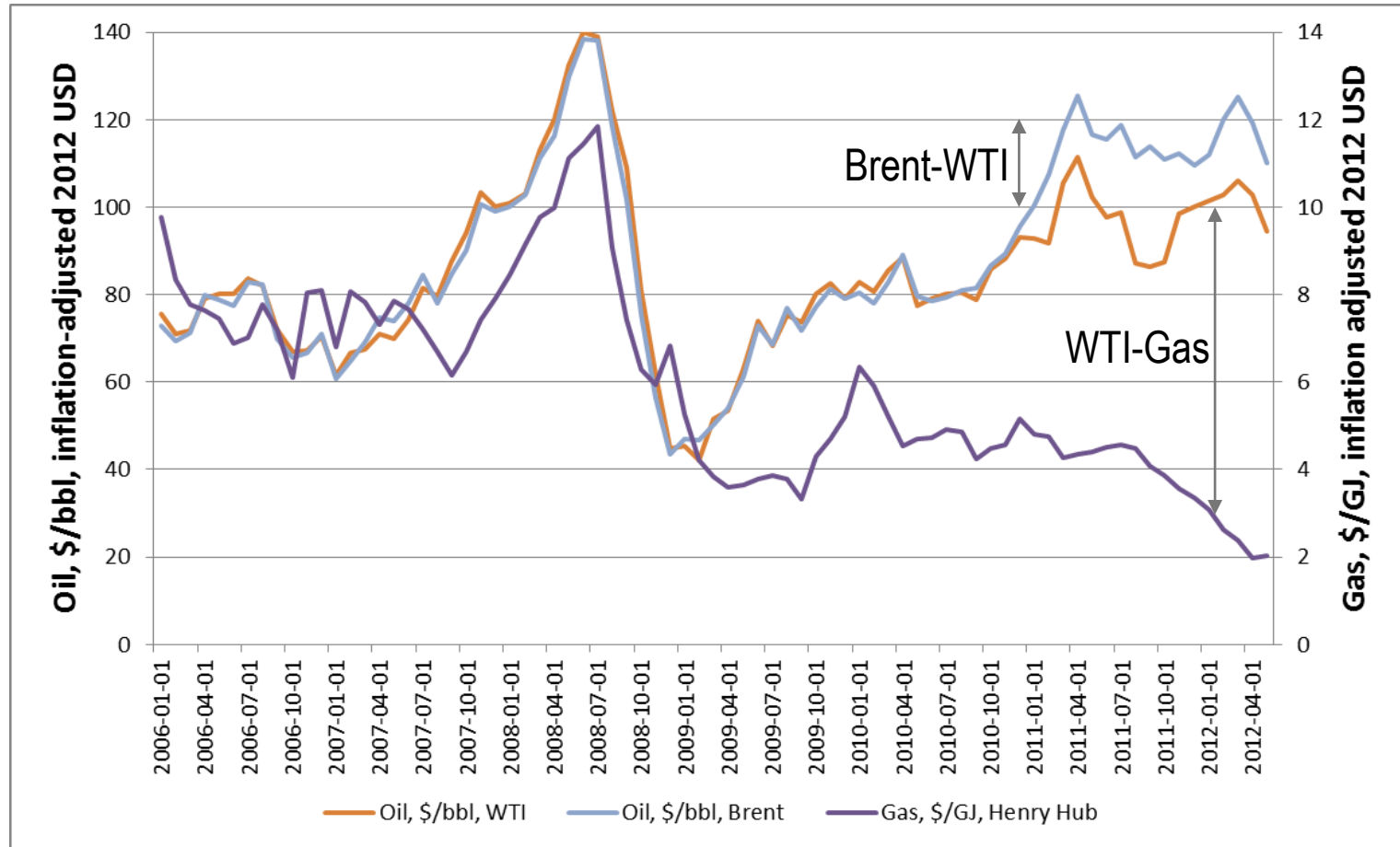


Gas: <http://tonto.eia.gov/dnav/ng/hist/n9190us3m.htm>

Brent: <http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RBRT&f=M>

WTI: <http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWT&f=D>

Increasing spreads: Brent-WTI, WTI-Gas



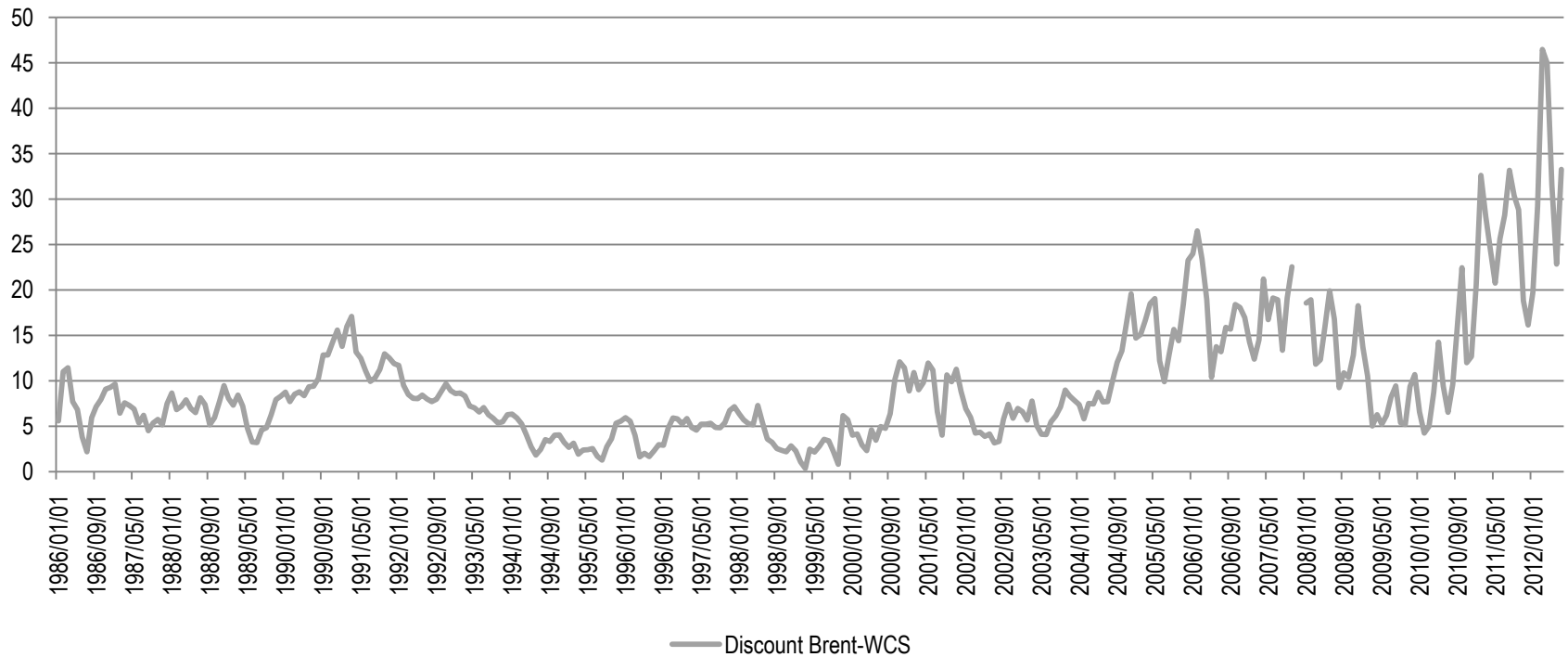
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Increasing spread: Brent-CDN Heavy

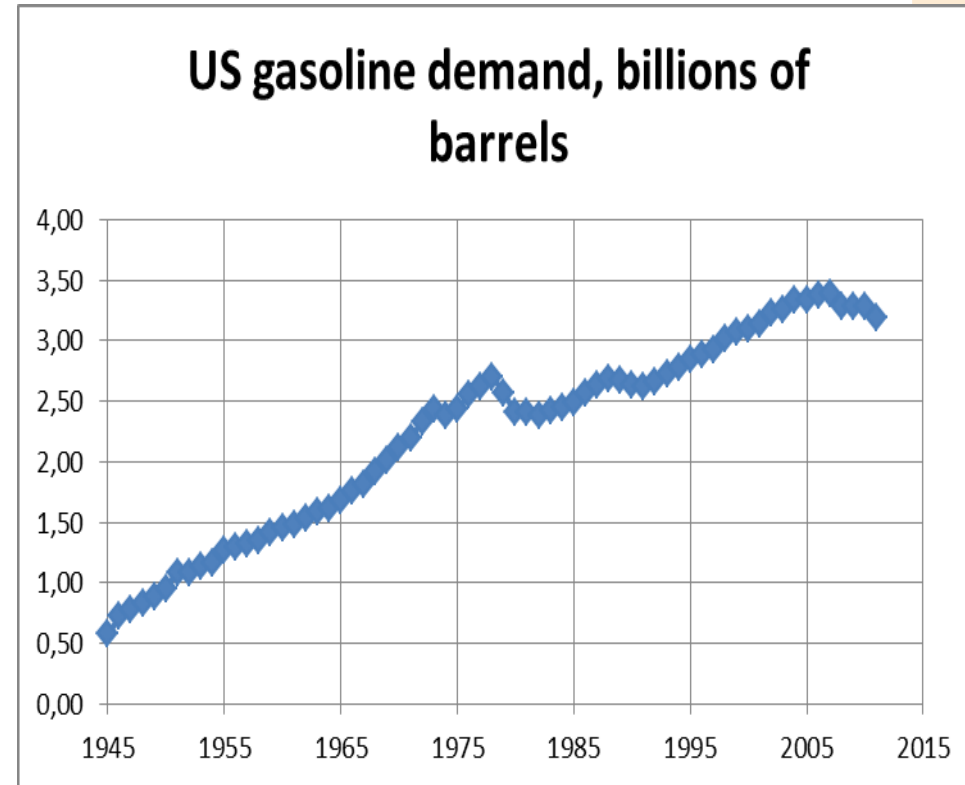
Discount Brent-WCS



<http://www.nrcan.gc.ca/energy/sources/petroleum-crude-prices/crude/1632>

Fossil fuels are cheap(er) in NAFTA:

- US gasoline demand has not recovered after the recession
- Glut of heavy oil from oil sands
- Lack of NAFTA refining capacity for heavy crude grades
- Lack of pipeline capacity to move landlocked crude to ports
- Potential glut of new oil from shale beds
- Glut of cheap natural gas from shale beds



→ It is difficult to convert expensive wood into cheap fuels

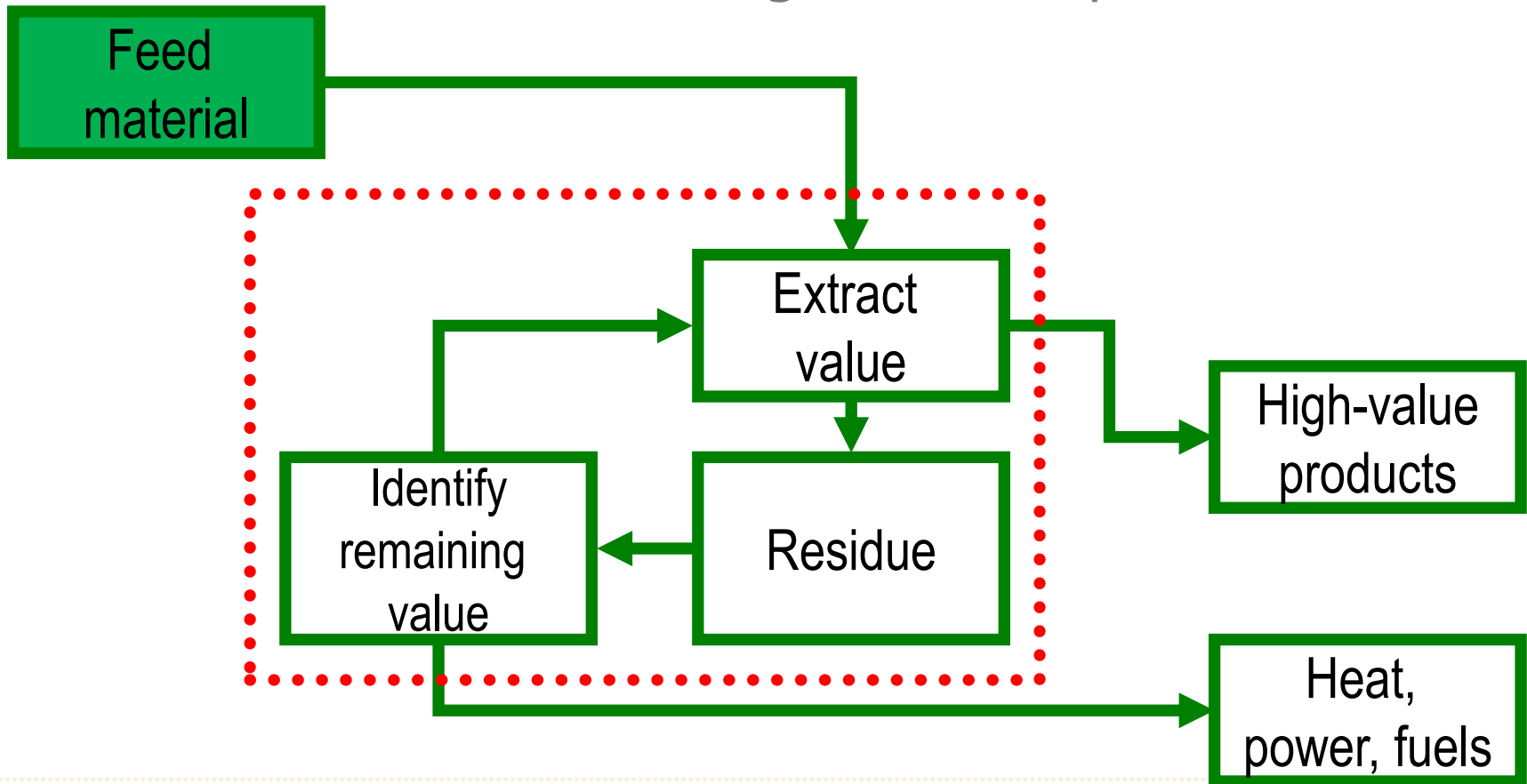
<http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MGFUPUS1&f=A>

Canadian & U.S. Crude Oil Pipelines - All Proposals



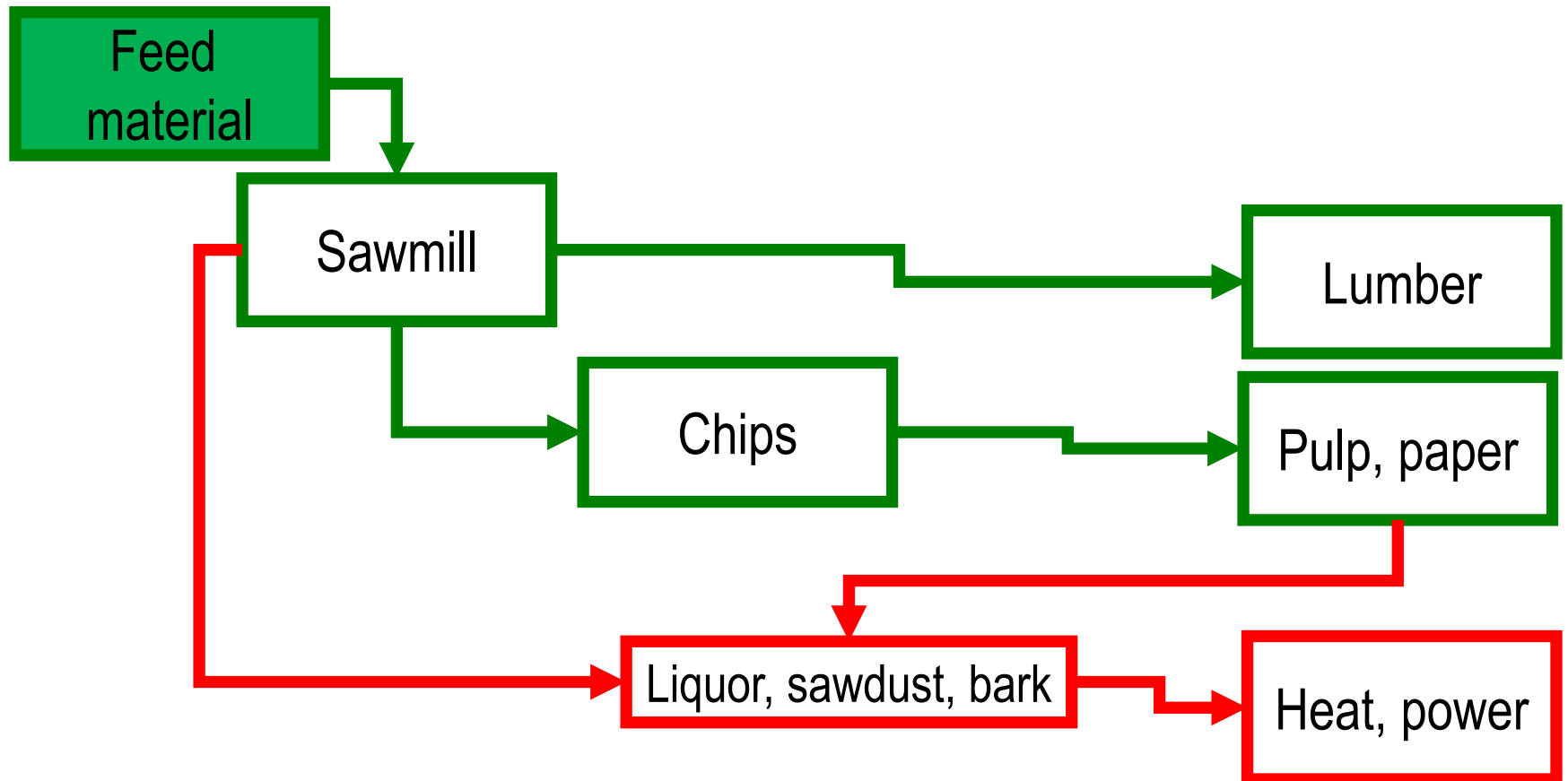
So what does this mean for the NAFTA-zone biorefinery?

Energy products will come from residues... and residues will come from higher value products:

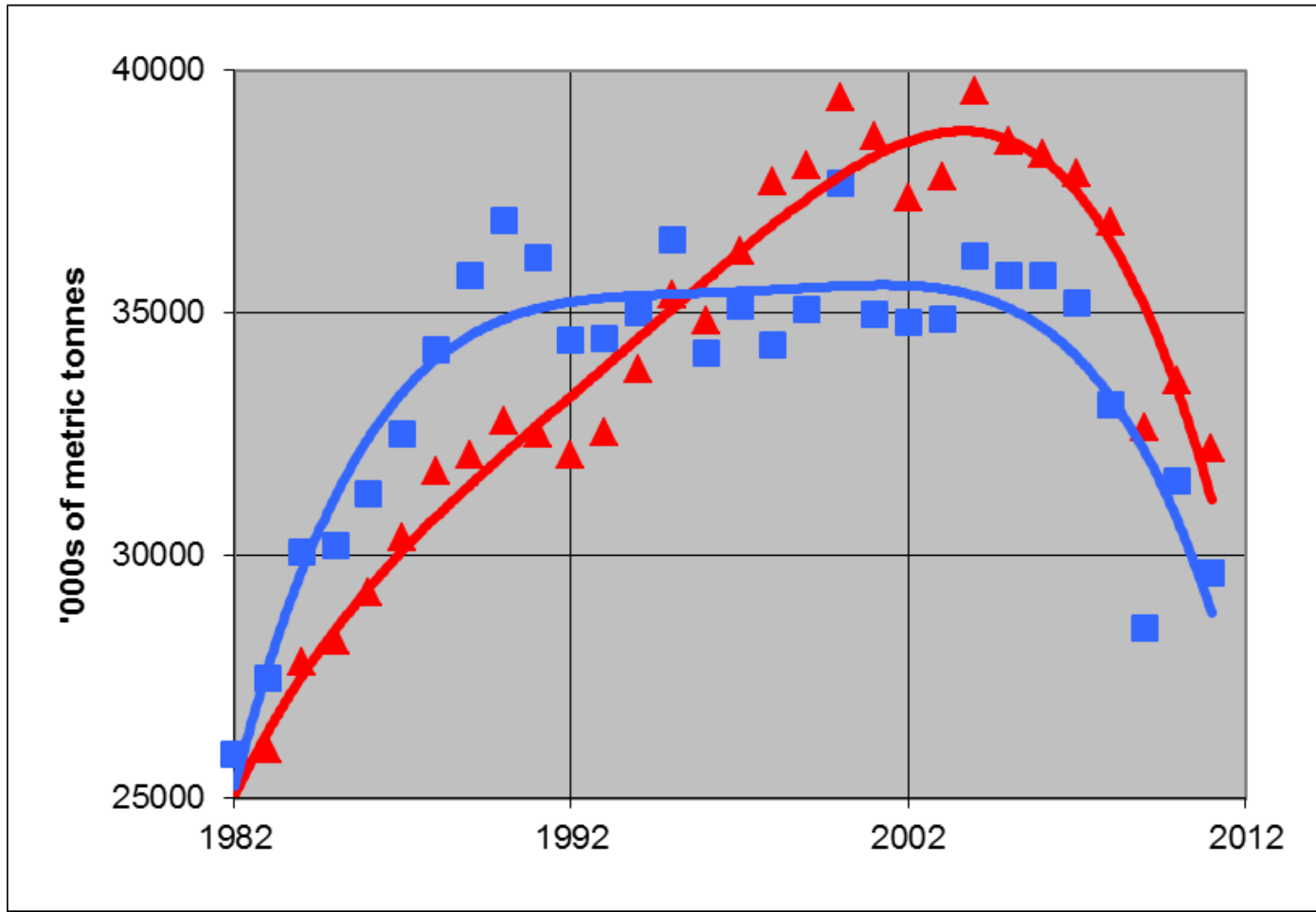


Current forestry model is a “bio-refinery”...

... but not all traditional products are still profitable



World newsprint demand is declining



Source: FAO

▲ Newsprint ■ Mechanical pulp

Forests are highly variable

- Large variations in wood species from location to location
 - Large variations within wood species
 - Large variations in forest management rules (a provincial responsibility in Canada)
 - Large variations in existing mill asset type and age
- Biomass is local, and so are the assets
- Solutions will also be local

Use existing assets

Don't ship wood long distances;
modify it onsite first

- Wood is expensive; primary transformation near forests is key
 - What a coincidence – logging roads tend to lead to sawmills or pulpmills!
- Look at synergies available at existing forest installations:
 - Utilities (heat, power, water and wastewater treatment facilities)
 - Transportation infrastructure
 - Wood handling equipment



Use existing assets

Look at synergies with chemical industry infrastructure

- Ship only what needs to be shipped
 - Minimize shipping of water (wood is 50% moisture)
 - Let the forest sector do something smart with the residues
- Minimize capital costs and plant disruptions at both ends of the supply chain
- Minimize transportation costs



An example: CelluForce

Commercial-scale nano-crystalline cellulose plant

- Academic beginnings: Patents awarded to Derek Grey, McGill University
- Initial scale-up: from gram scale to kilogram scale at FPIinnovations
 - Partnership between FPIinnovations and McGill University
- Commercial, tonne-scale plant:
 - Joint Venture between FPIinnovations and Domtar
 - Well-integrated with host mill
 - Waste stream currently integrated with a bio-methane plant

Biorefinery implementation:

1. Profitable energy products from residues necessarily imply the existence of a healthy primary industry to generate those residues
2. We can't compete with natural gas, but we can probably compete with oil

Thank you!

Contact

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