



CRITICAL ISSUES FOR BIOFUEL'S USE IN DIESEL

Presented at
**Biodiesel: Powered by Canola, Fuelling our
Future**

July 17 – 18, 2006 Calgary

Presented by:
Shell Canada Ltd.
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Agenda

- Overview General/Biodiesel
- Shell and biofuels
- Shell Canada and biodiesel
- Economics and the business case – today
- Biofuels Options
- Quality of B100 and blends
- Timing and the introduction of ULSD
- Consumer acceptance and demand
- Sustainable development factors
- Distribution considerations
- Biodiesel has issues - So What?
- National Renewable Fuels Strategy (NRFS) policy development
- Summary



Setting the stage

- **When I refer to Shell I mean Shell Canada (SCL) unless I reference Shell Global which is the world wide Royal Dutch Shell Group. RDS owns 78% of Shell Canada.**
- **When I refer to :**
 - **Biodiesel I mean the methyl ester variety of biofuels.(not specific to canola)**
 - **Diesel Biofuels I mean other biofuels for use in diesel like hydrogenated seed oil, crude substitution in refineries, synthetic diesel, ethyl levulinate, etc.**



What I heard yesterday (paraphrased)

- **Stewart Campbell:** First are the bio-ester and second generation of biofuels for diesel are on the horizon.
- **Loren Hepburn:** We are all in this together and to go forward we must work together.
- **Mike Reaney:** We need Canadian specific data on biodiesel made from canola blended with Canadian diesel made from synthetic crude.
- **Doug Hooper:** We need to address the issues of costs/incentives, quality and getting the customer on board to advance future use of biodiesel.



Overview - General

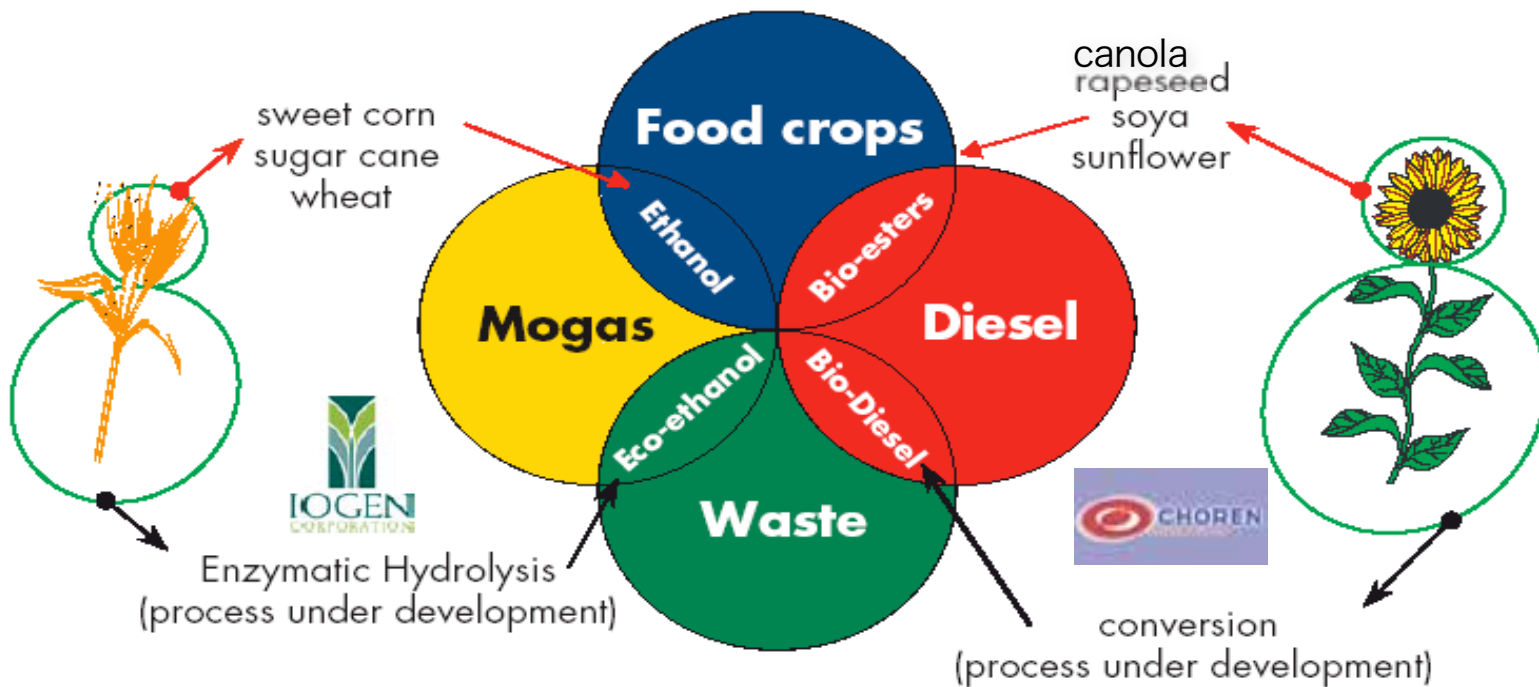
- Shell (Global) is the world leading distributor of biofuels today by volume.
- Shell Canada supports the use of biofuels and assesses the biofuels options using our SD criteria:
 - Environment (air, water, lifecycle ...)
 - Economic (cost, quality ...)
 - Social (community impacts, values ...)
- Biofuels from food crops (soy, canola, corn, wheat) dominate the commercially available biofuels today and in the near term. Shell will access and use these biofuels as needed in response to the market or regs.
- Biofuels derived from waste residues are well suited to meet Shell's long term SD objectives.
- The sustainability of biofuels derived from some food crops is limited by their cost and overall energy input requirements.

➔ SCL is seeking opportunities to expand biofuels use.



Shell is committed to advanced biofuels

that meet the needs of all stakeholders



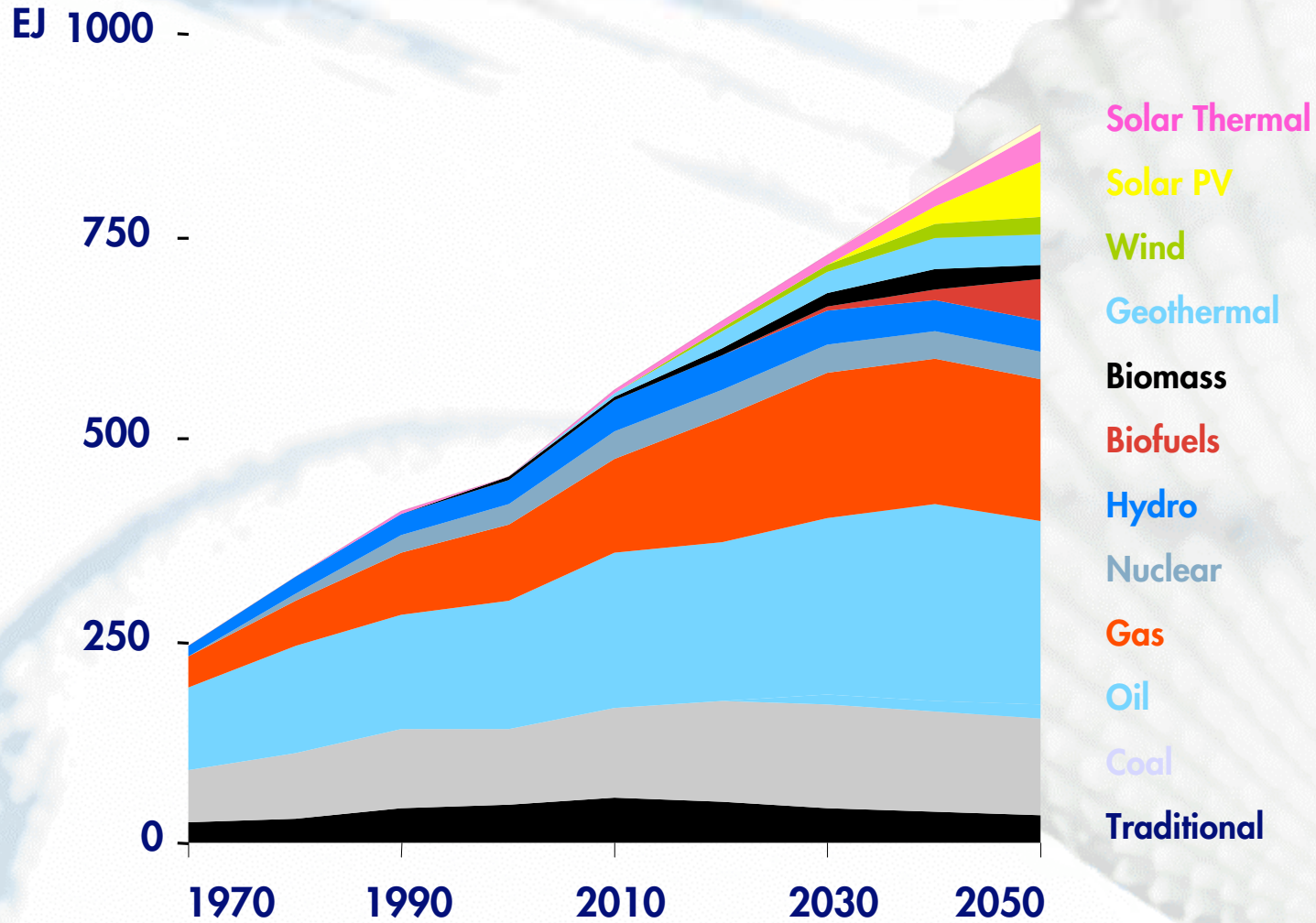
Addressing the sustainability challenge for biofuels:

- Economics - ultimately must be competitive with hydrocarbons
- Social - avoid food crops as a feedstock
- Environmental - lowest lifecycle impact



Global Energy mix (diversity)

It's a matter of timing



Overview – Biodiesel

- Biodiesel (methyl ester) will be a larger part of the Canadian diesel supply in the near future.
 - Shell will be a leader in the introduction of biofuels into the diesel supply pool in Canada.
 - Currently biodiesel (methyl ester) is the most advanced commercially available diesel biofuel today.
 - There are hurdles to biodiesel use in Canada related to quality, cost and customer acceptance. Stakeholders need to work cooperatively to ensure these issues are addressed.
 - Other biofuels potentially suitable for use in diesel are in development and will offer advantages over “biodiesel”.
- ➔ **Seed oil hydrogenation, refinery processing and BTL are examples of promising biofuels for use in diesel.**



Why is Shell Canada interested in biodiesel?

- Biodiesel gaining steam globally
- Government promotion of Kyoto
- High crude price enhances biodiesel economics
- Canadian production facilities in operation
- National biofuels strategy
- Some municipalities eager to try
- Shell is a fuel leader
- Supports Shell sustainable development approach



Ride the Rocket.



Economics & business case - today

- USA average price of B100; 100 cpl versus diesel at 65 cpl (pre tax, incentives and dist/blend) 35 cpl differential
- Incentives in Canada range from 4 to 25 cpl for B100 compared to 30-40 cpl in USA and 60-70 cpl in Europe
- Additional capital costs (storage, blending)
- Additional operating costs (additives, logistics, heating)
- Expect little or no cost recovery in market
- Business case based on < \$70/bbl crude
- Requires world scale biodiesel plants built near feedstock

➔ **Must compete long term against diesel production cost**



Biofuels Options

- Raw seed oil is unsuitable for use in diesel engines and must be modified.
- Technology exists to hydrogenate seed oils to produce high quality diesel components.(in refinery process stream or stand alone unit) (NExTL, Super Cetane, and others)
- Petrobras recently announced their intent to replace a percentage of crude oil (starting at 2% vol and increasing to 10% vol) with soy bean oil.
- Hydrogenation either in an existing refinery or in a dedicated process unit has advantages:
 - Quality issues addressed
 - Fungible diesel product easily distributed
 - Potentially lower cost and enhanced GHG reduction.

➔ **Shell (Global) is researching biofuel options for diesel & SCL is exploring potential Cdn applications.**



Biofuels and Biodiesel must offer....No compromise on quality

- Cold flow, thermal oxidation, oxidative stability, viscosity, micro growth most critical. Some issues remain unresolved, but progress is being made.
- BQ 9000, C of A per batch, and enforcement are needed measures (NBB) Must avoid Minnesota/Halifax incidents.
- B100 quality; enhanced ASTM D 6751 (merges with EN14214) and tailored to Canadian needs.
- B2 and B5 quality from seed oil feasible at a cost ????
- B20 not feasible on large scale. Waste animal renderings/yellow grease derived biodiesel has limited application using current technology.
- Quality failure means lost market share, reputation damage and costly class action suits.

Shell fuel quality is paramount. Must meet CGSB standards and customer's expectations.



Biodiesel quality attributes summary

- Cetane Quality (cold start, white smoke, noise)
- Lubricity (diesel fuel injector life)
- Flash Point (volatility/safe handling)
- Fuel Economy
- Viscosity (spray pattern, leakage)
- Cloud Point (cold operability)
- Bio/Oxidation Stability/Material Compatibility

<u>Biodiesel</u>
+
+
+
-
-
-
-

Spec	Biodiesel	ULSD Seasonal
Density kg/m ³	880	830 typical
Cetane Number	50 to 60	40 minimum
Flash Point oC	>130	40 minimum
Kinematic Viscosity cSt	>4.55	2.45
Cloud Point oC	-3 to 11	-1 to -43 typical range



Cloud point – major challenge in Canada

- A widely recognized issue in cold climate application
- Cloud point schedule
 - Seasonal and geographic specific
 - Statistic data already contains certain risk!
- Cloud point is extremely tight in winter season.
- Biodiesel blending and additives cannot be compromised
 - Impact to other specifications
 - Both Stove and additives have shown limited effectiveness

➔ **Biodiesel blends must meet current seasonal CGSB diesel specifications.**



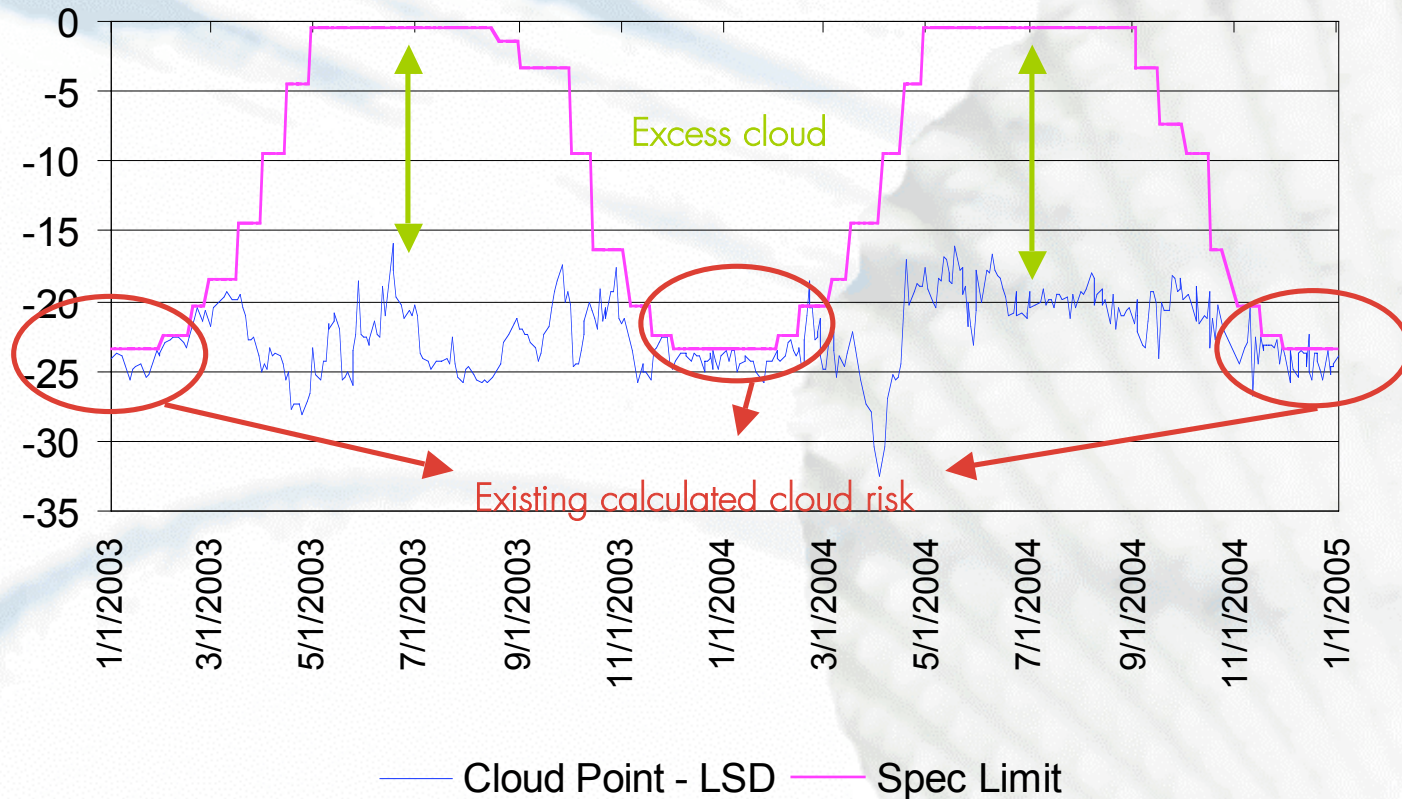
Cloud Point for Seasonal Diesel Supplied on Delivery (December – February)



➔ **Typical European Cloud Point is -15 C**



Cloud point log data – typical LSD

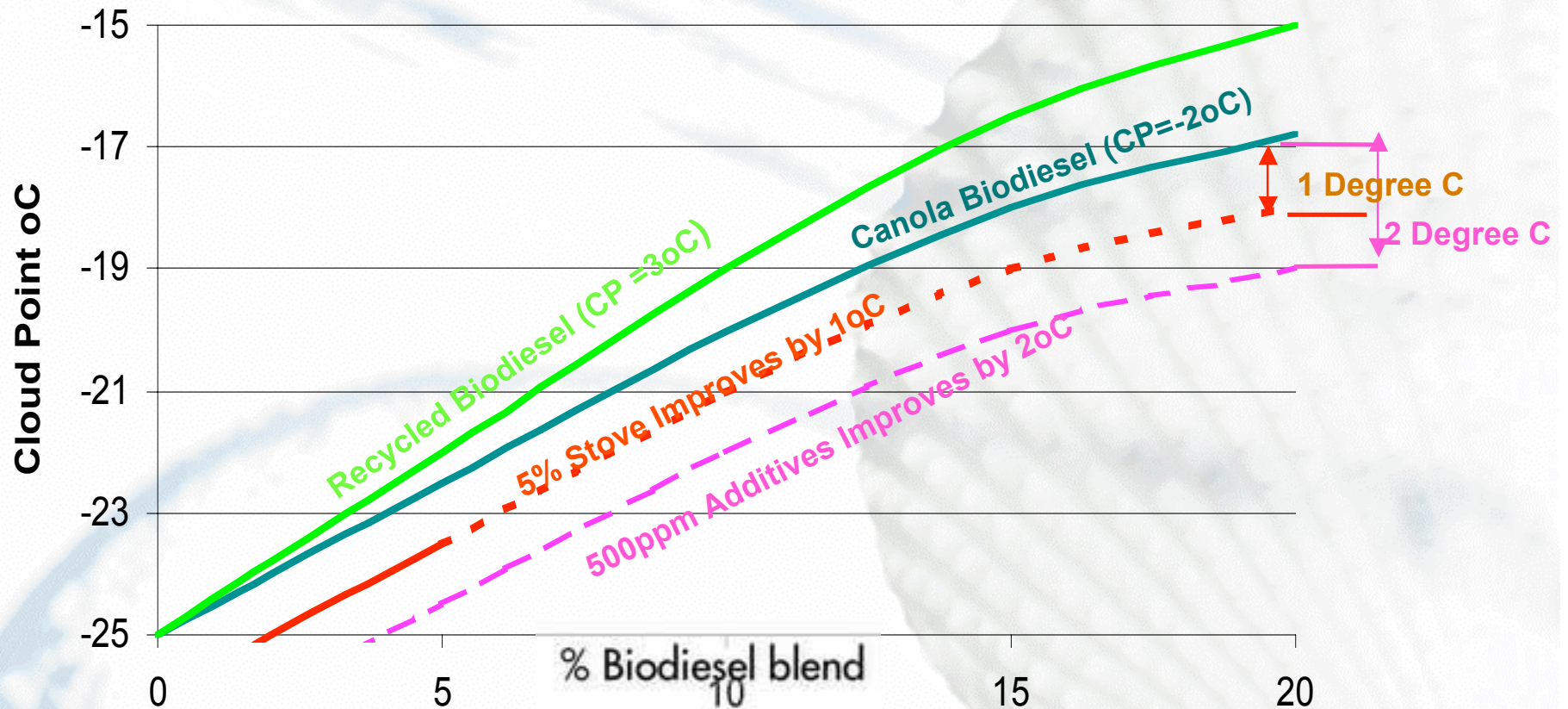


Summer blends have excess cloud

Winter blends are tight to cloud specification



Impact on cloud point of diesel fuel



Our primary premise: Biodiesel must meet existing Quality and fit for purpose specifications ...everyday



Timing and ULSD

- Shell has invested \$400M in ULSD, industry \$2.5B
- ULSD production in full swing effective June 1 2006. Sales spec Oct 16, 2006 at 15 ppm S max.
- ULSD different than LSD but will meet all CGSB specs
 - Variance between refiners still meeting CGSB
 - Contamination and quality issue critical
- Majority of engine manuf. currently do not recommend biodiesel in 2007 engine tech. due to be introduced October 2006.
 - Warranty issue
- Outstanding issues of biodiesel in LSD made more complex by unknowns of ULSD introduction.
- Expect fuel suppliers, engine manufacturers, and truckers to want to ensure ULSD is field proven before adding additional complexity of biodiesel.

Commercial biodiesel blends in ULSD unlikely for a year



ULSD – more than just low sulphur

- Sulphur leaving refinery - 7 to 10 ppm sulphur maximum
- Sulphur point of sale - 15 ppm sulphur maximum
- Cetane improvement of 1-2 numbers
- Reduction of aromatics (solvency of biodiesel)
- Slightly lower density and lower energy content
- Cloud point will be more difficult to meet
- Lubricity of ULSD can be lower, corrected using additives

➔ Need to monitor other properties (i.e. corrosion, stability, etc.)



Consumer acceptance & demand

- In 2005, 19 BL of on road LSD diesel consumed in Canada
 - 7.4 BL in Western Canada
- Limited potential for general B20 blend except captive municipal fleets.
- Municipal fleets represent only 3% of diesel market.
 - Early leaders but not a sustained business opportunity
 - Higher blend B20 focused.
- Canadian truckers are concerned about use of biodiesel due to quality and cost concerns impacting competitiveness.
- CTA “conduct pilot programs to ensure operational concerns are addressed with regard to existing and 2007-10 truck engines before any national biodiesel blend can be considered”
- Shell markets fuel that meet all customers requirements everywhere, everyday
 - Not realistic to market to the “knowledgeable consumer”

➔ **Market driven forces prevail**



Sustainable development factors

- Life cycle GHG reduction is biodiesel's most attractive sustainable feature. Need to verify with latest data.
- Reduction of CAC emissions minor impact on existing fleet and virtually no impact on 2007+ fleet.
- Sustainable development is enhanced if feedstock is waste not food
 - Hydrogenation, refinery feed stream near term for seed oil
 - Waste gasification, FT process most promising technology
- Biodiesel and other diesel biofuels should be differentiated from other biofuels based on verified GHG reduction potential.

➔ **Biodiesel fits with Shell sustainable development renewable fuels strategy**

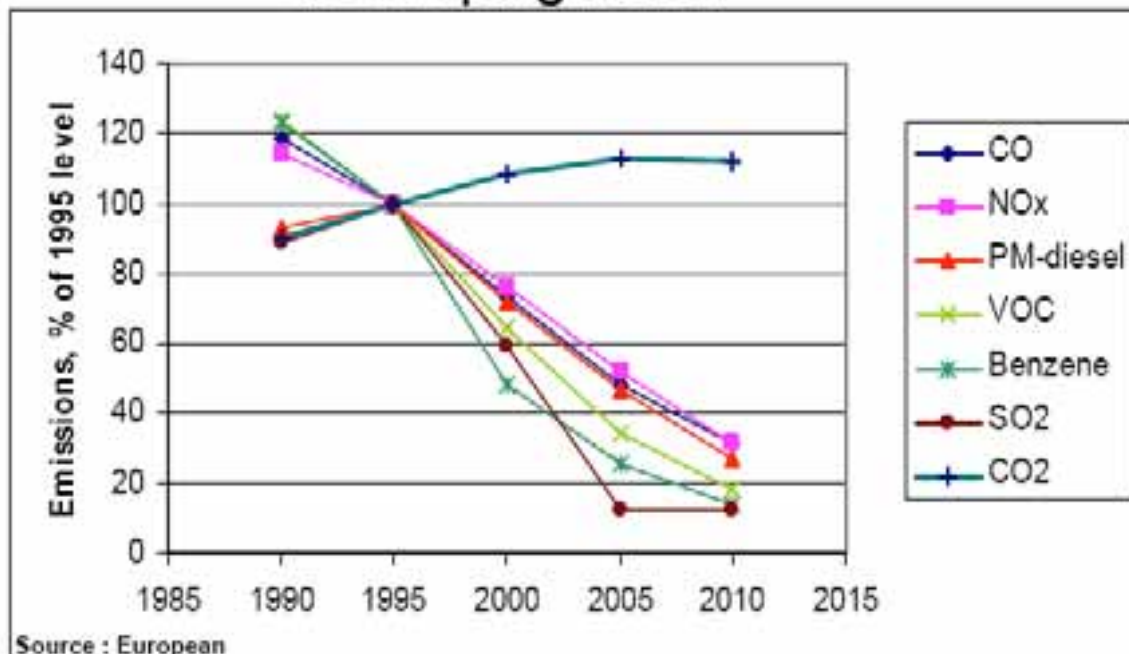


Global mobility



World Business Council for
Sustainable Development

Significant progress is already being made in reducing local emissions – the key issue is timing of improvements in the developing world

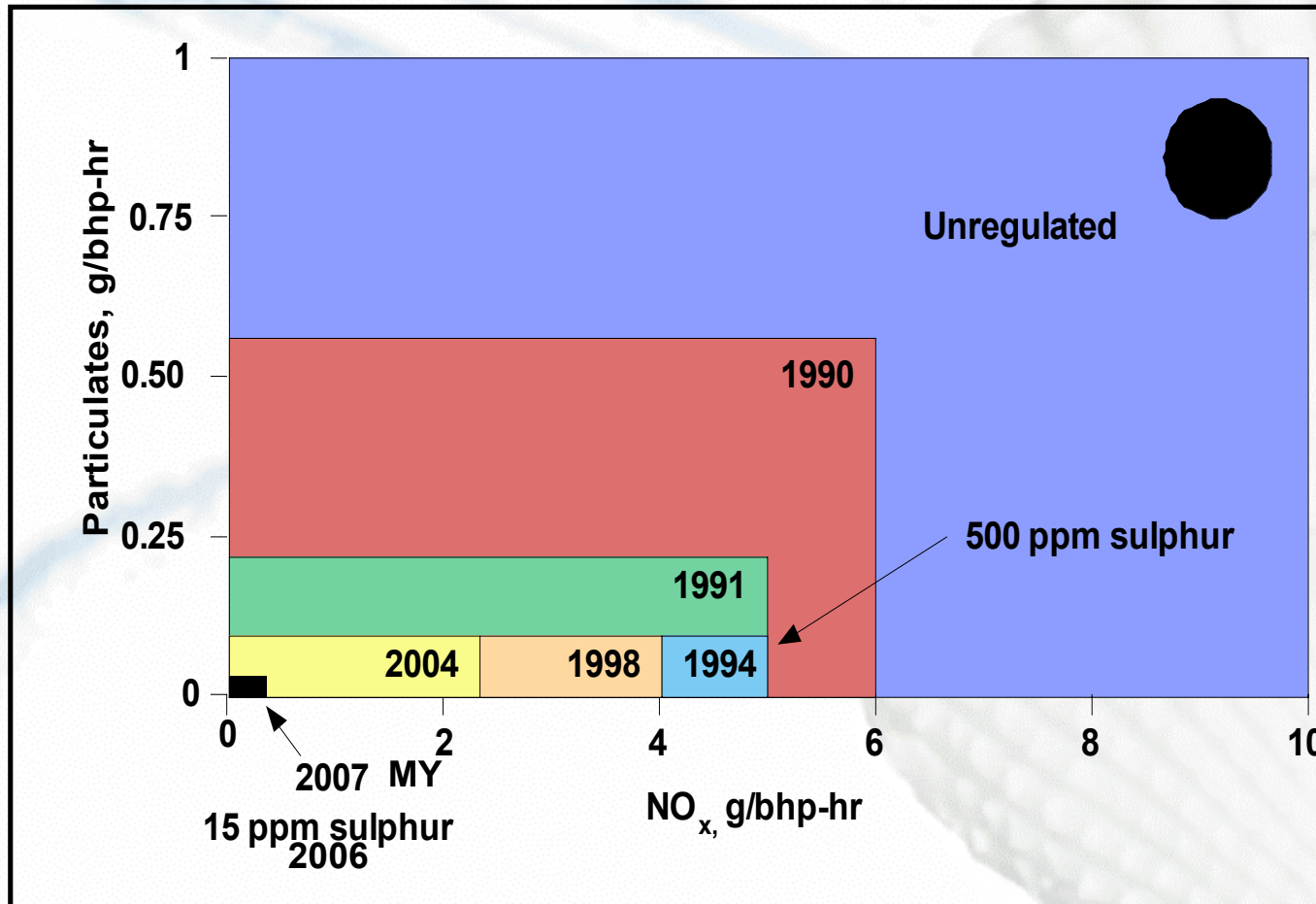


Source : European
Commission

Future challenge: Reduce CO₂ while maintaining low regulated emissions



Heavy duty vehicle emissions standards



➔ **2007 MY vehicles will achieve an ultra low emission level**



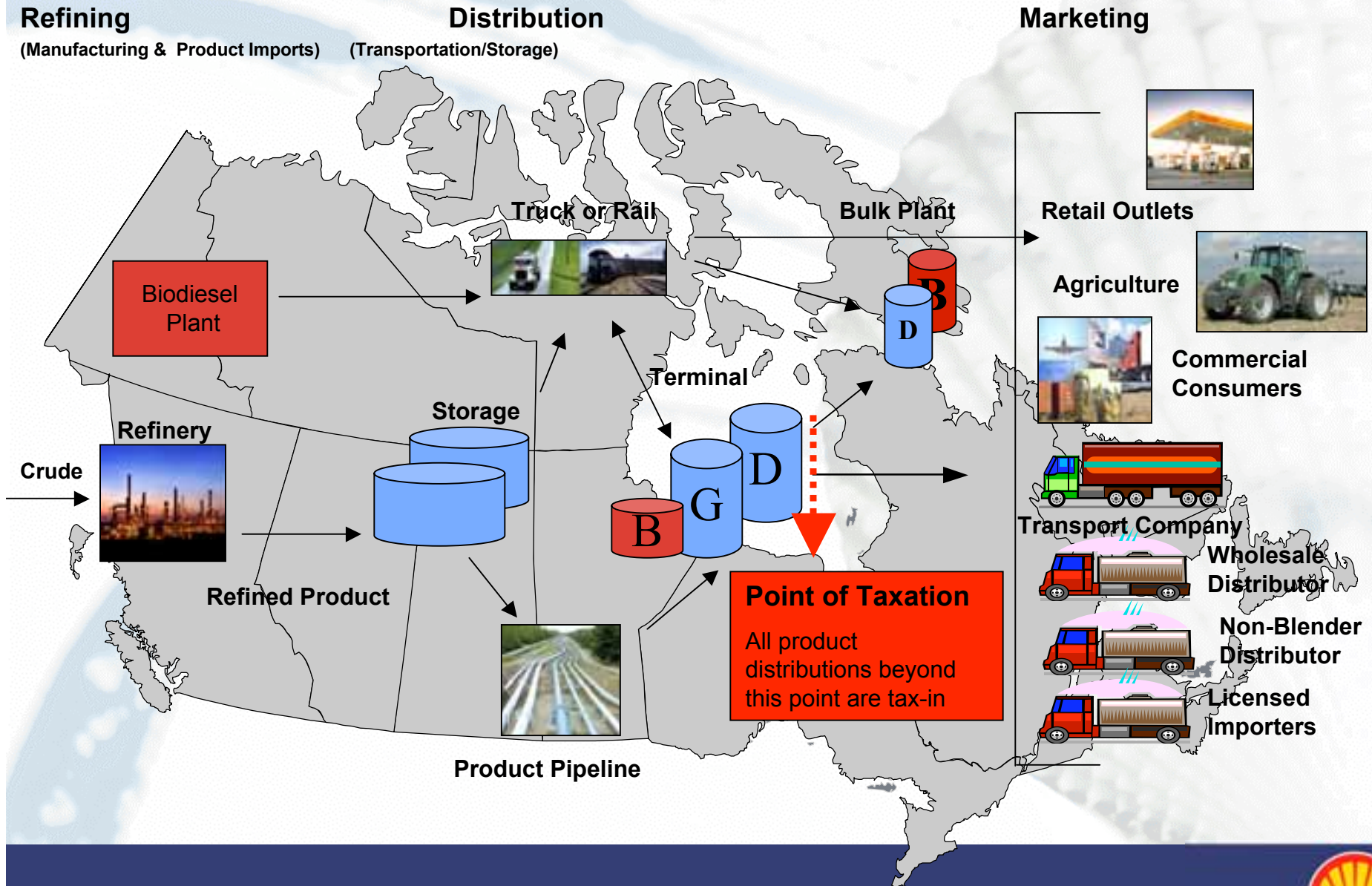
Distribution considerations

- Limited storage and ability to heat biodiesel or diesel
- Terminal sharing and co-mingling of diesel fuel is problematic
- Must be capable of blending with all diesel
- Splash blending not suitable
- Multiple end uses of diesel fuel could create issues
- Rail or truck biodiesel to terminals
- No pipeline shipment of biodiesel or blends feasible at this time

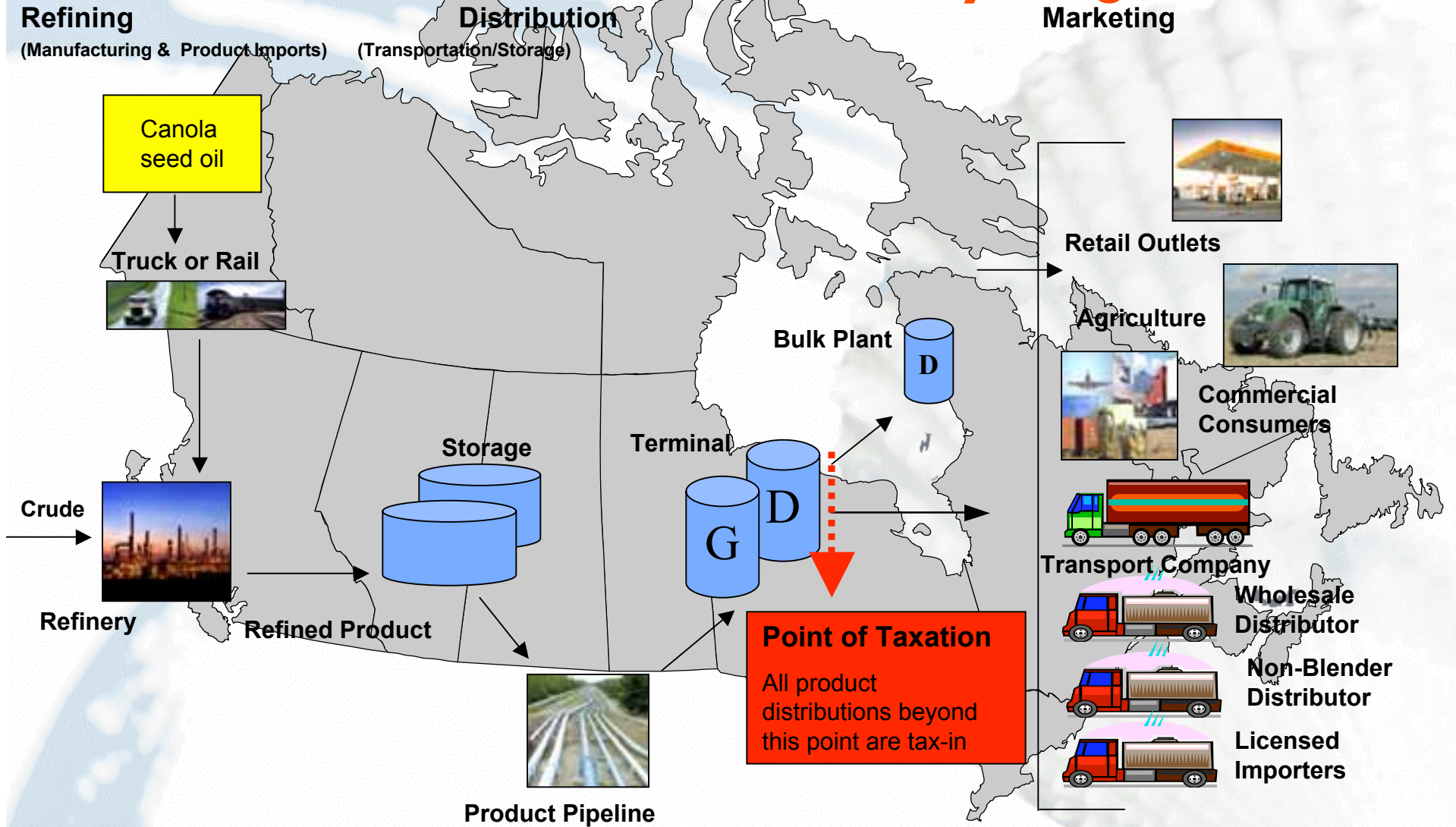
➔ Preserve efficiency of national fuel supply network essential



Downstream distribution - Methyl Ester



Downstream distribution - Hydrogenation



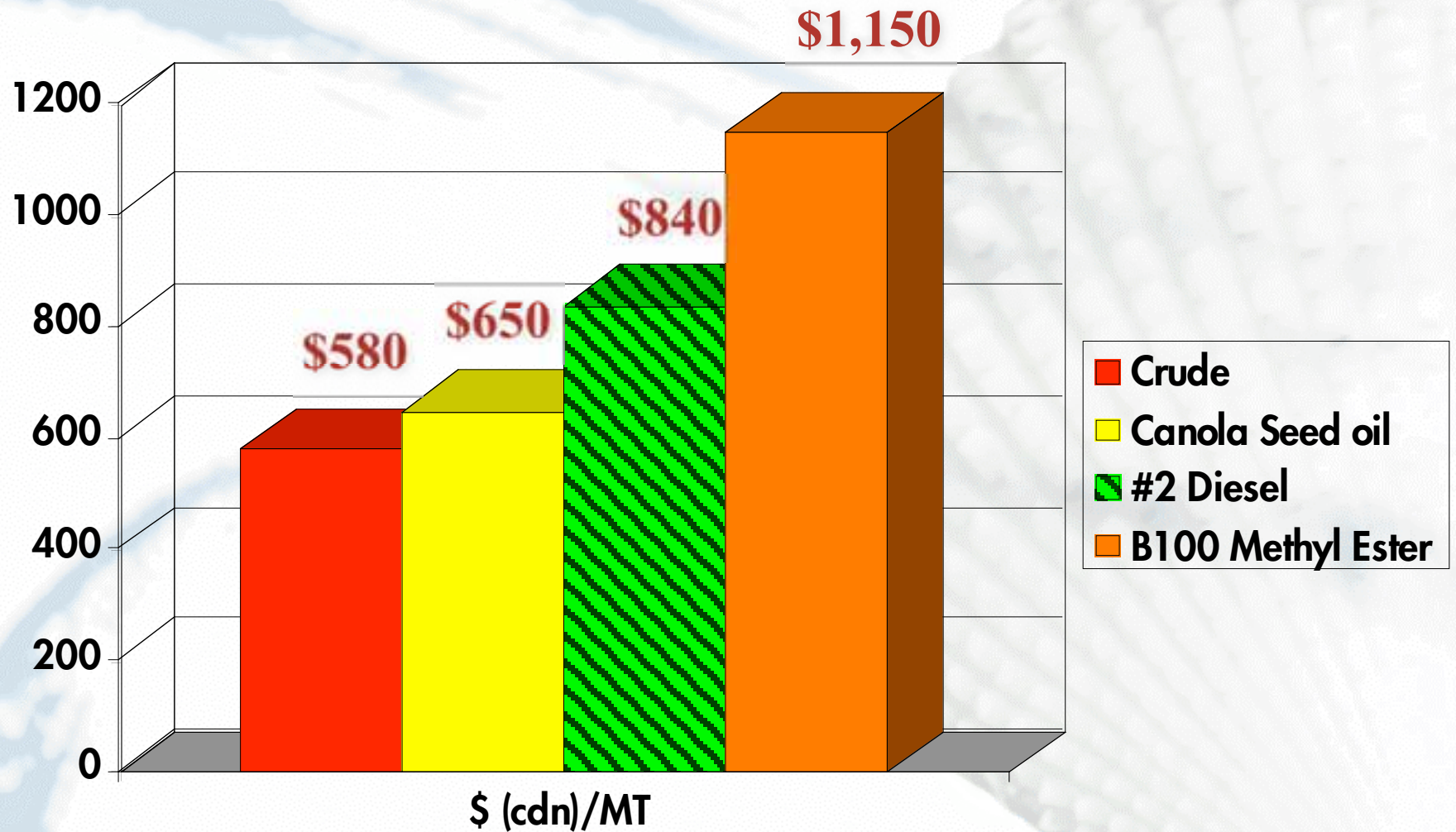
Biodiesel has issues – So What

- **COST - POSTED PRICING** (no tax or incentives)
 - Canola (2005) \$650 (cdn) /MT Crude(2006) \$ 580(cdn) /MT
 - #2 Diesel (2006) \$840(cdn)/MT B100 (2006) \$ 1,150 (2006)/MT
(spot prices are not reflective of offtake terms)
- 📁 Today's canola seed oil price is attractive to refiners compared to #2 diesel and biodiesel
- 📄👉 B100 more costly than # 2 diesel. Supply cost increase passed on to
- 📄👉 Truckers must compete in CDN across provinces and with USA.
- 📄👉 Need equal opportunity to blend biodiesel across Canada
- 📄👉 US/CDN fuel marketers need level playing field.
- 🕒👉 CDN diesel biofuel producers including biofuels must be competitive on a global basis.

➔ **To avoid market distortions Government must strike a delicate balance....**



Canadian Spot Posted Prices



Biodiesel has issues – So What


■ Quality


 Diesel fuel must be fit for all customer's use

 Quality issues can mean equipment damage and loss of business

 Who is liable? Engine OEM, fuel supplier, biodiesel supplier, gov't ?

 Biofuels reputation is damaged. (i. e. diesel LDV in early 1980s)

 Cloud point: additives still in development and only 450ML/yr of Stove Oil in CDN versus 20 BL of diesel. Inadequate supply. Higher cost.

 **Need a biodiesel/biofuel demo with long haul truckers in the West. Shell is working with partners to try to make this happen.**




Biodiesel has issues – So What

■ Customer Acceptance

 Municipal fleets are not representative of the bulk of the diesel business.

 Truckers will fuel where cost is lowest. It may be out of province or even out of country.

 If we don't have customers at least neutral on biodiesel is it reasonable to regulate use?

 **Need a biodiesel/biofuel demo with long haul truckers in the West. Shell is working with partners to try to make this happen.**



National Renewable Fuels Strategy (NRFS)

- Shell Canada supports federal discussion leading to a NRFS
 - including all biofuels including ethanol, biodiesel, and other biofuels

Core elements to consider:

- rescind provincial mandates
- open borders (provincial & international) for biofuels and blends
- pool average for all biofuels for flexibility with credit trading
- equal opportunity to market biofuels across Canada
- no compromise on quality (CGSB/ASTM/EN/BQ-9000)
- maximize benefits for Canadians
- recognition of GHG reduction potential
- level playing field for fuel/biofuel producers, blenders and importers
- seamless and transparent to consumers
- encourages new and emerging technologies

➔ **Suitable target for Canada requires assessment.
Start process asap.**



Biofuels and Biodiesel Summary

- Biodiesel is costly and currently has quality hurdles especially in cold climates and has not achieved broad customer acceptance with Canadian long haul truckers.
 - Biofuels from canola seed oil, other seed crops and waste have the potential of being more cost competitive and achieving the same quality standards as current diesel fuel.
- ➔ **The NRFS should allow biofuels and biodiesel to compete on the basis of quality and cost .**



Summary

- Biodiesel should be part of NRFS overall biofuels requirement. Not a separate biodiesel mandate.
- Biodiesel use must be seamless to all customers every day . Meets CGSB standards
- Maximize environmental benefits
- Must be cost competitive with diesel production long term
- Customers base must willing to use diesel biofuels.
- Window of opportunity is after ULSD has a proven track record.
- Must preserve efficiency of national fuel supply network
- Encourage optimization of biofuels through R&D. Avoid setting up barriers and picking winners.

➔ **Biodiesel will find a place in Canadian fuel supply along with other diesel biofuel options**





➔ If we work together we can wrestle this issue to the ground.





➔ **And that ain't no bull. YAHOOooo....**



Questions



Canadian Trucking Alliance – June 2006

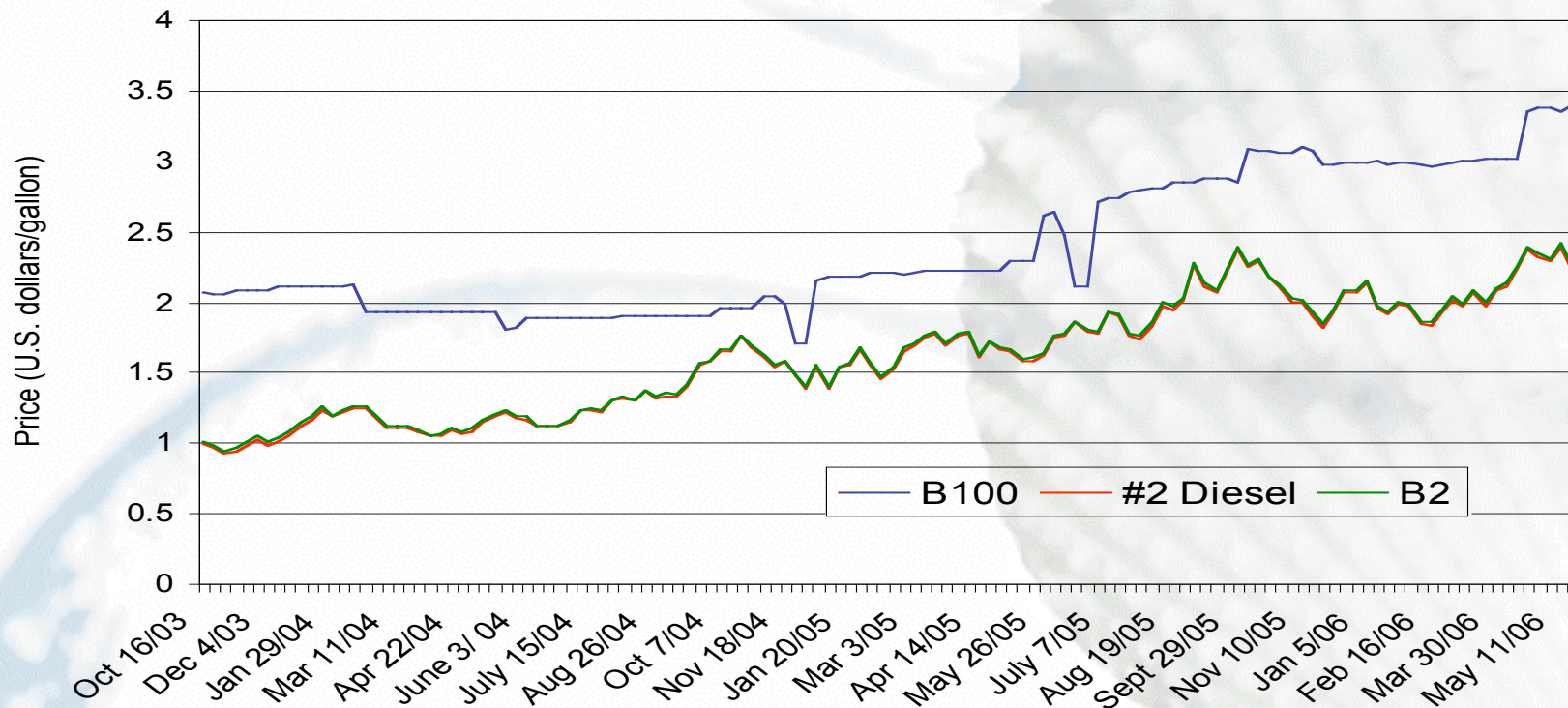
- “The trucking industry supports the exploration and eventual use of alternative fuels that are efficient, effective and practical from an operating and environmental perspective. In other words, alternative fuels that:
 - 📁 Contain the energy content needed to propel the high horsepower engines required to move heavy manufactured goods and raw materials;
 - 📄 Is readily available in all markets;
 - 📄 Do not void engine warranties;
 - 📄 Fit within the economics of the established fuel market; and
 - 📄 Meet all emissions reduction requirements.

The trucking industry has no problem with reducing its dependence on oil based product, if these conditions can be met.”



Biodiesel vs # 2 Diesel

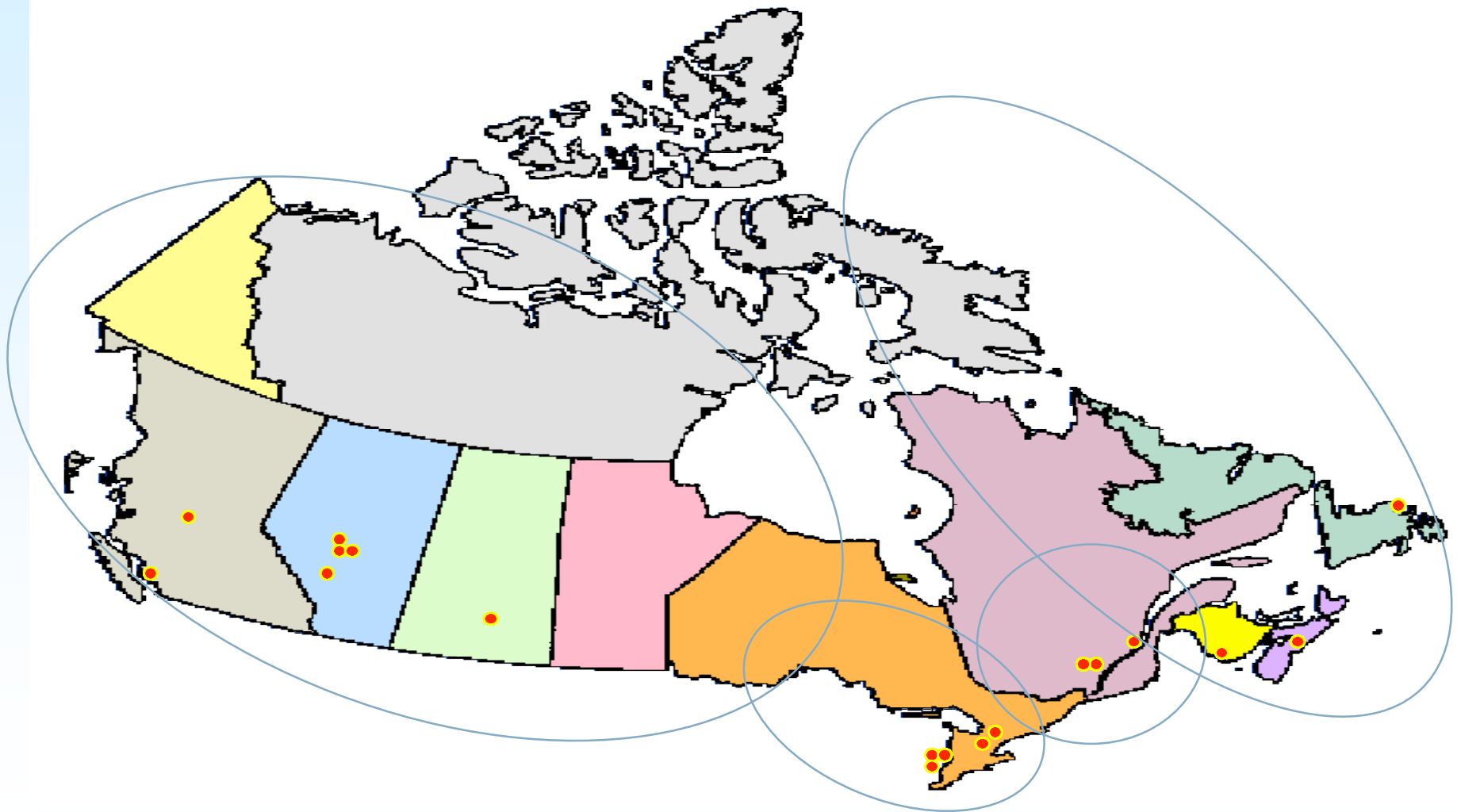
(2003 - 2006)



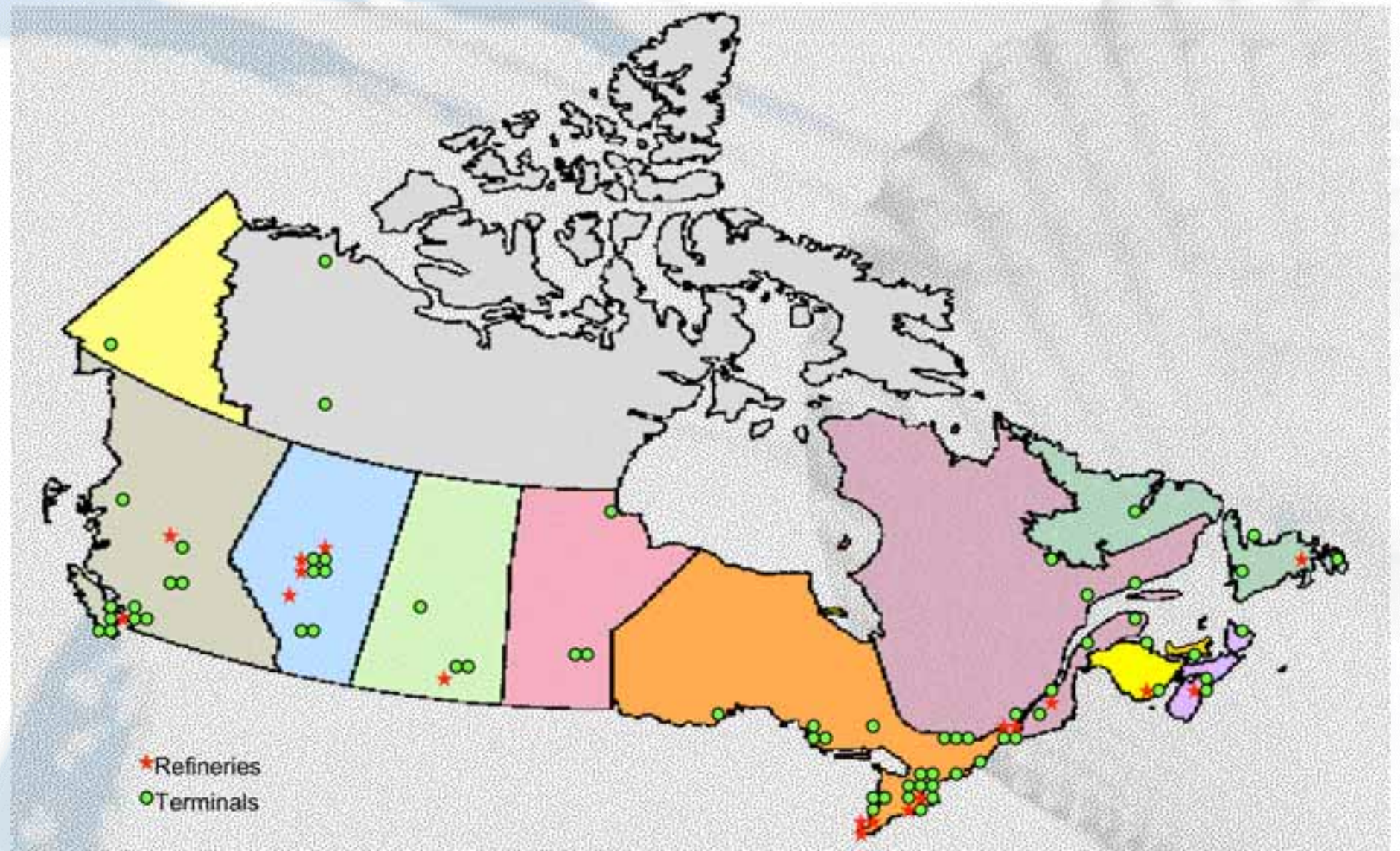
Note: Prices are weekly averages and do not include taxes and may be net of certain subsidies.
Source: energy's Alternative Fuels Index



Supply orbits regional in nature



Product terminals



Source: Natural Resources Canada



Western Canada product movements

