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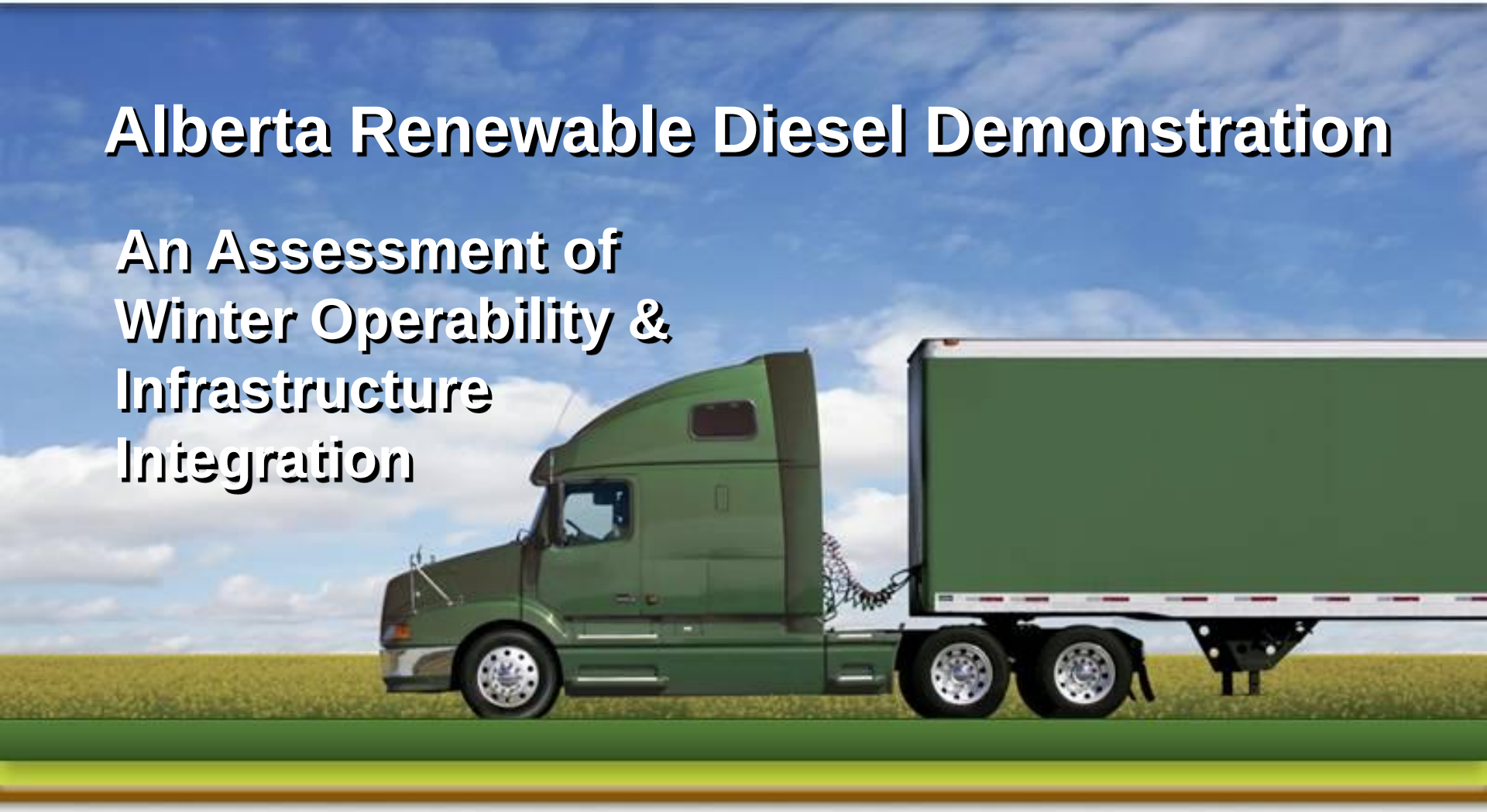
ALBERTA renewable DIESEL DEMONSTRATION

Alberta Renewable Diesel Demonstration

An Assessment of Winter Operability & Infrastructure Integration



Alberta Renewable Diesel Demonstration

Significance:

- **First Canadian on-road demonstration of cloud point adjusted renewable diesel blends using ultra low sulphur kerosene for cloud point adjustment.**
- **First demonstration of both biodiesel (fatty acid methyl ester, or FAME) and hydrogenation derived renewable diesel (HDRD) in range of Canadian climatic conditions**
- **First on-road demonstration involving participation of CPPI member petroleum refiner, Shell Canada, to blend and retail cloud point adjusted renewable diesel blends in business as usual model.**

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Project Overview

Background and Project Scope

Background

- Environment Canada issued Notice of Intent to Regulate a Renewable Fuel Standard for Canada contingent upon ‘successful demonstrations’ (December, 2006)
- Stakeholders proposed a one-year cold weather operability study to address industry concerns over commercial renewable diesel use in winter
- Partnership struck between fuel industry, trucking industry, federal and provincial governments, and managed by Climate Change Central (late 2006, Contribution Agreements signed April, 2007)

Sponsors

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Major Sponsors

Canada

Alberta

Supporting Sponsors

Canadian Renewable Fuels Association

Canadian Petroleum Products Institute / Institut canadien des produits pétroliers

CANADIAN BIOENERGY

NESTE OIL

canolacouncil

MILLIGAN BIO-TECH

"Experts in Our Field"

Participants

ROSENAU TRANSPORT LTD.

GIBSONS

GIBSON ENERGY LTD.

First Canada

HI-WAY 9 Express Ltd.

Canadian Freightways

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Purpose & Scope

- Demonstrate cold weather operability of cloud point adjusted 2% winter blends of biodiesel (FAME) and hydrogenation derived renewable diesel (HDRD) with ULSD after cloud point correction with ultra low sulphur kerosene (ULSK)
- Transition to 5% blends in spring/summer, and incorporation of mixed-feedstock FAME (75% canola methyl ester / 25% tallow methyl ester)
- Demonstrate viability of terminal-level injection blending and workable blend formulation to meet CGSB cloud point specs
- Deploy blended fuel in ‘business as usual’ application for commercial carriers

Focus: Operability

Evaluate Fuels

- Cold weather physical characteristics: cloud point, low-temperature filtration etc.
- Create suitable blend to meet CGSB cloud point targets
- Observe fuel through distribution chain and end use

Evaluate Operability

- Performance in cold Alberta winter
- Collect observations and hands-on experience for stakeholders

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Testing Protocols

Fuels

- Third party lab analysis by Alberta Research Council on retains throughout supply chain (clear & bright, density, ASTM and CGSB)
- Suppliers selected based on quality, reliable supply and environmental characteristics

Vehicles

- Commercial fleets recruited – consistent routes, fuel at designated locations
- Tracked for fuel efficiency and maintenance (failures, filter plugging, loss of service)
- Regular contact with fleets to identify areas of concern – otherwise business as usual

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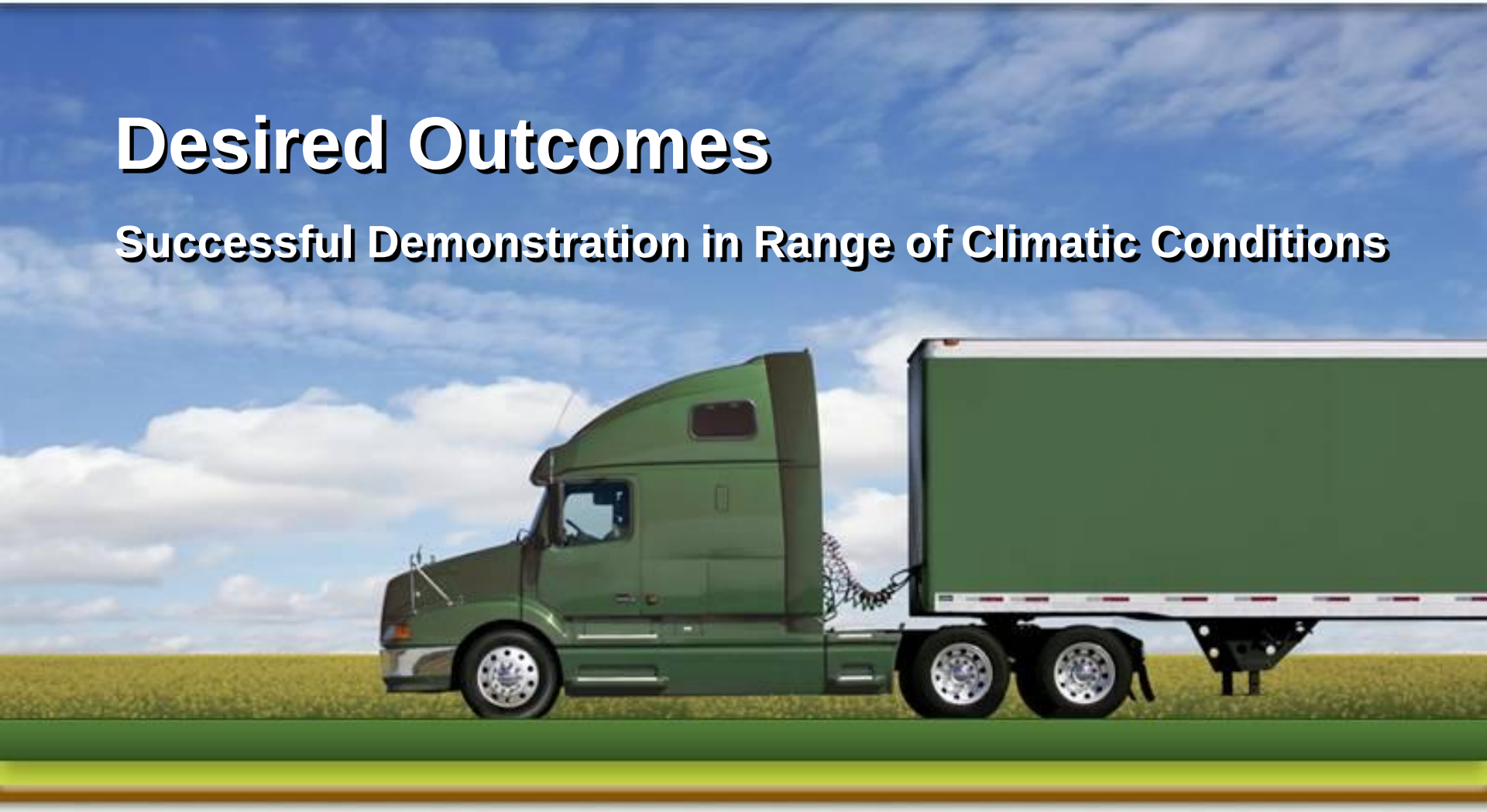
Desired Outcomes

Successful Demonstration in Range of Climatic Conditions



Value for Stakeholders

Desired Outcomes – Fuel Industry:

- Increase knowledge of blend formulation to meet cloud point specification in northern climates – both for FAME and HDRD
- Understand how renewable diesel fuels will fit into the Canadian Fuel Supply
    - •Confirm that project-specific blends can work in Canada
    - •Confirm fuel quality and performance can be maintained throughout supply chain
- Generate impartial, credible, multi-party observations for policy-makers to use in creating renewable fuel policy for Canada

Value for Stakeholders

Desired Outcomes - Fleets:

- Address concerns of commercial carriers regarding cold weather operability, fuel quality, blending and handling (distribution)
- Provide hands-on experience among commercial fleet operators
- No breakdowns or non-starts attributed to biofuels
- Knowledge and experience gained by fleets and fuel industry

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Summary Report:

Successful Demonstration

Industrial Scale Blending Facility

Temporary Blending Facility

- Shell's Sherwood Marketing Terminal

Cardlocks

- Three commercial Shell/Flying J sites
- One yard tank

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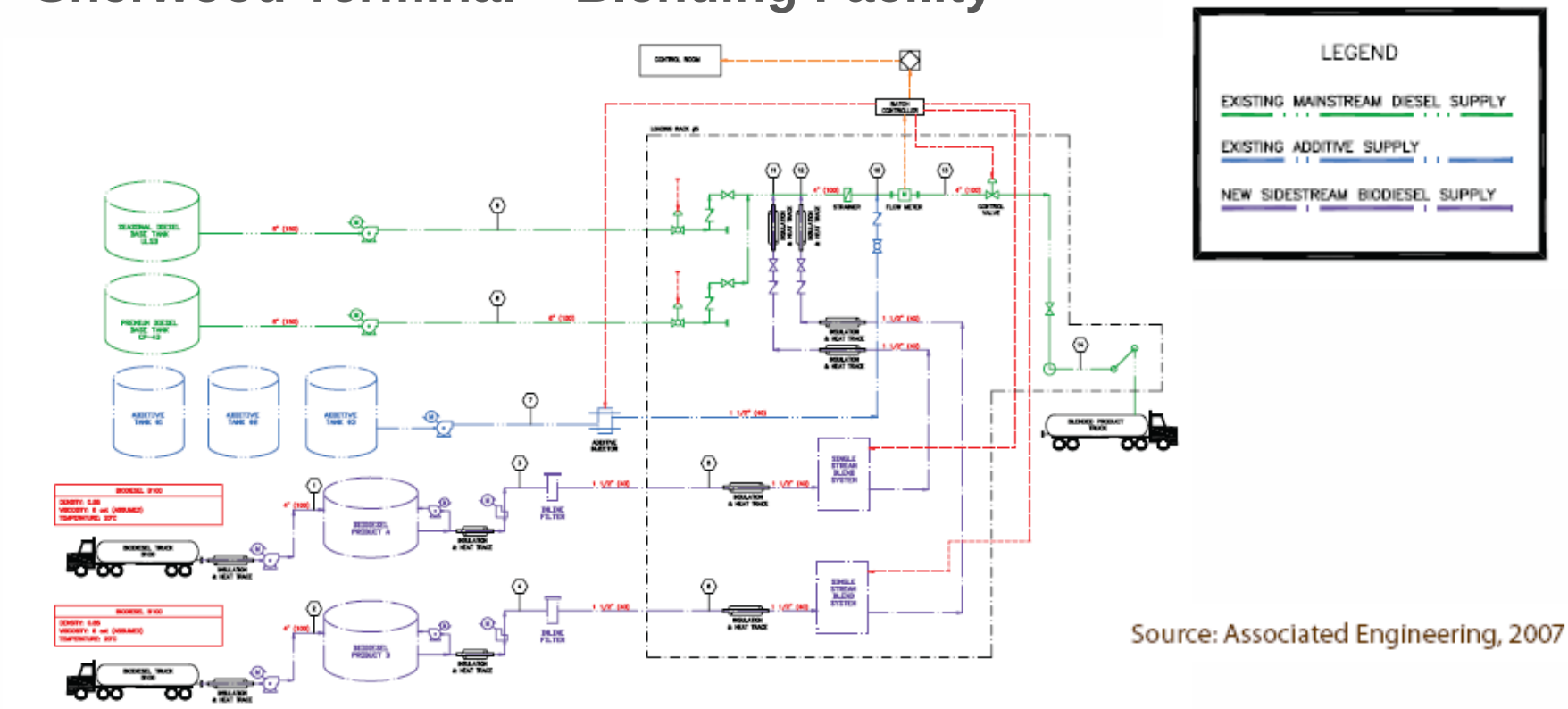
Blending Facility

Sherwood Terminal – Blending Facility



Source: Associated Engineering, 2007

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Sherwood Terminal – Blending Facility

Project Timeline

- Cardlocks ready late 2007
- Fuels acquired December, 2007
- Official launch January, 2008
- Duration of demonstration – (December 2007 to September 2008)
- Interim report in late spring, 2008
- Final results published February, 2009

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Key Points

- Five fleets recruited – 75 trucks: 16 control, 29 on FAME, 30 on HDRD
- Monitoring and testing protocols signed off by multi-stakeholder group
- Over 1.6 million litres of blended product dispensed
- Over 5.5 million km driven by fleet vehicles

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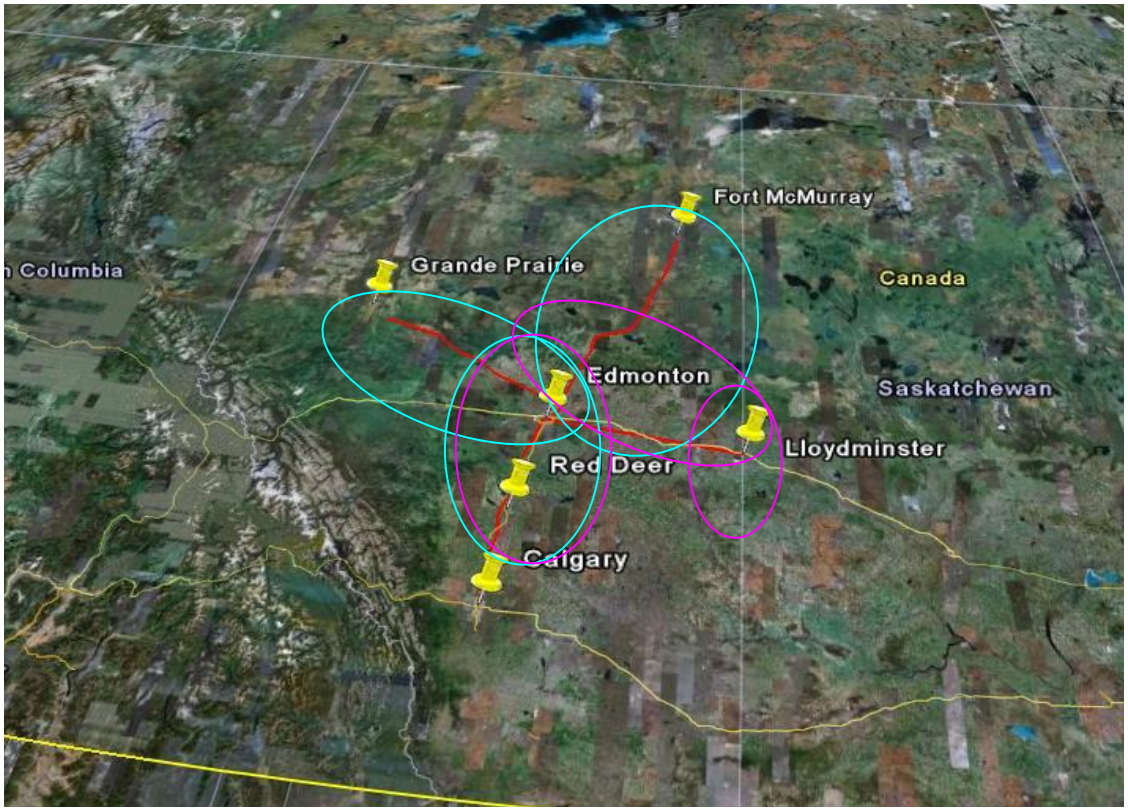
Study Parameters

Operating Area

FAME Operating Area	◯
HT Operating Area	◯



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Monitoring & Reporting

Protocols, Observations and Project Conclusions

Protocols for Data Gathering

Project Monitoring

- Overall fuel efficiency
- Fleet monitoring – budget for analyzing filters, parts, engine oil
- Neat biofuel quality testing
- Blended fuel quality testing
- Cloud point, blend level, density and lubricity on blended fuel

Protocols for Data Gathering

Fuel Quality

Tests Required Along Supply Chain	Full ASTM 6751 or CAN/CGSB 3.517	Clear & Bright and Density	Density, Cloud Point, Blend Level and Lubricity*	Additional testing
Neat Fuel – Producer	Each batch			Only if trouble
Neat Fuel – Delivery	Each batch	Upon delivery		Only if trouble
Blended Fuel – Delivery			Each batch	Only if trouble

*Lubricity only required on a subset of retained samples

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Product Quality

ARDD Fuel Quality Parameters

- FAME met ASTM D6751
- HDRD met CAN/CGSB 3.517
- FAME blends met CAN/CGSB 3.520
- HDRD blends met CAN/CGSB 3.517
- Neat biofuel deliveries accompanied by Certificate of Analysis and pass clear & bright test before offloading
- Additional: 200 second CSFT
- Additional: neat FAME delivered at 15^{o}C above cloud point; neat HDRD at 5^{o}C above cloud point

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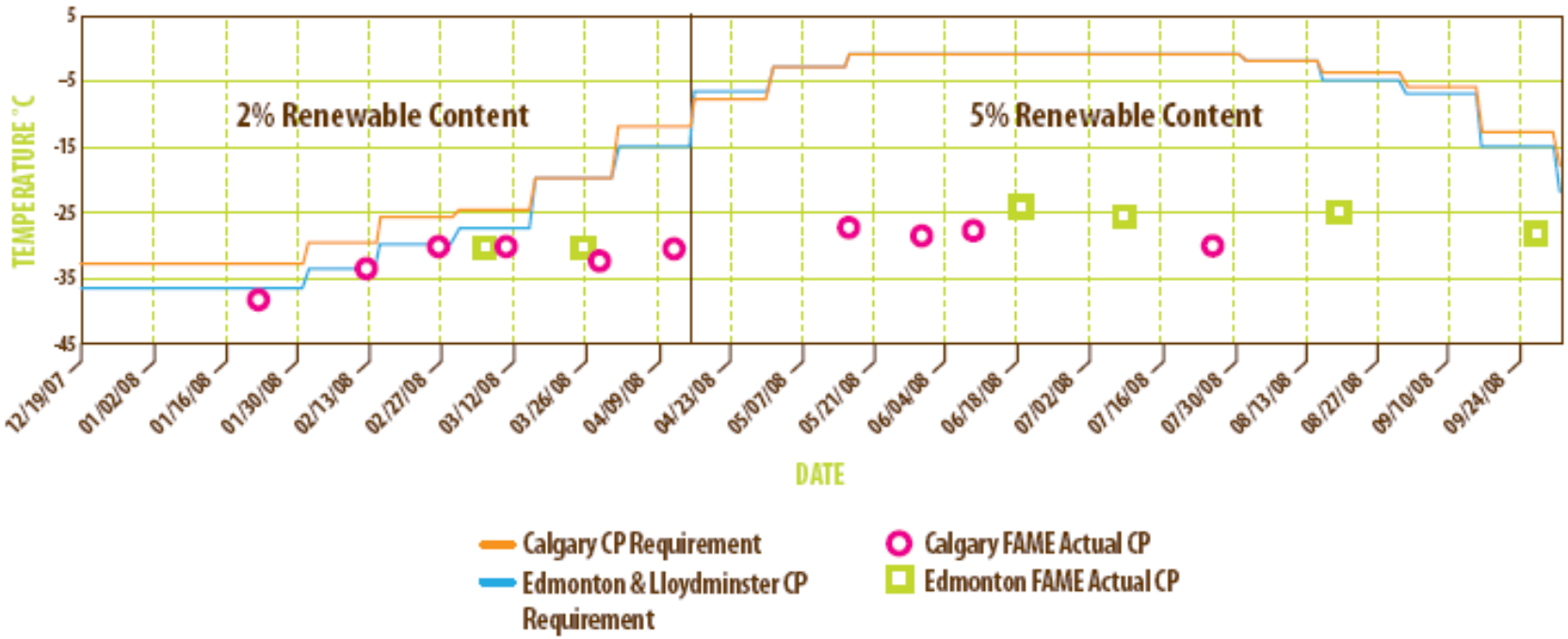
Fuel Volumes by Type and Location

Total Fuel Lifted	B2 FAME	2% HDRD	B5 FAME	5% HDRD	Total
Lloydminster		177,117		220,816	397,933
Calgary Barlow	100,440		163,941		264,381
Edmonton South		226,161		203,683	429,844
Rosenau Yard	145,132		376,126		521,258
Total	245,572	403,279	540,067	424,498	1,613,416

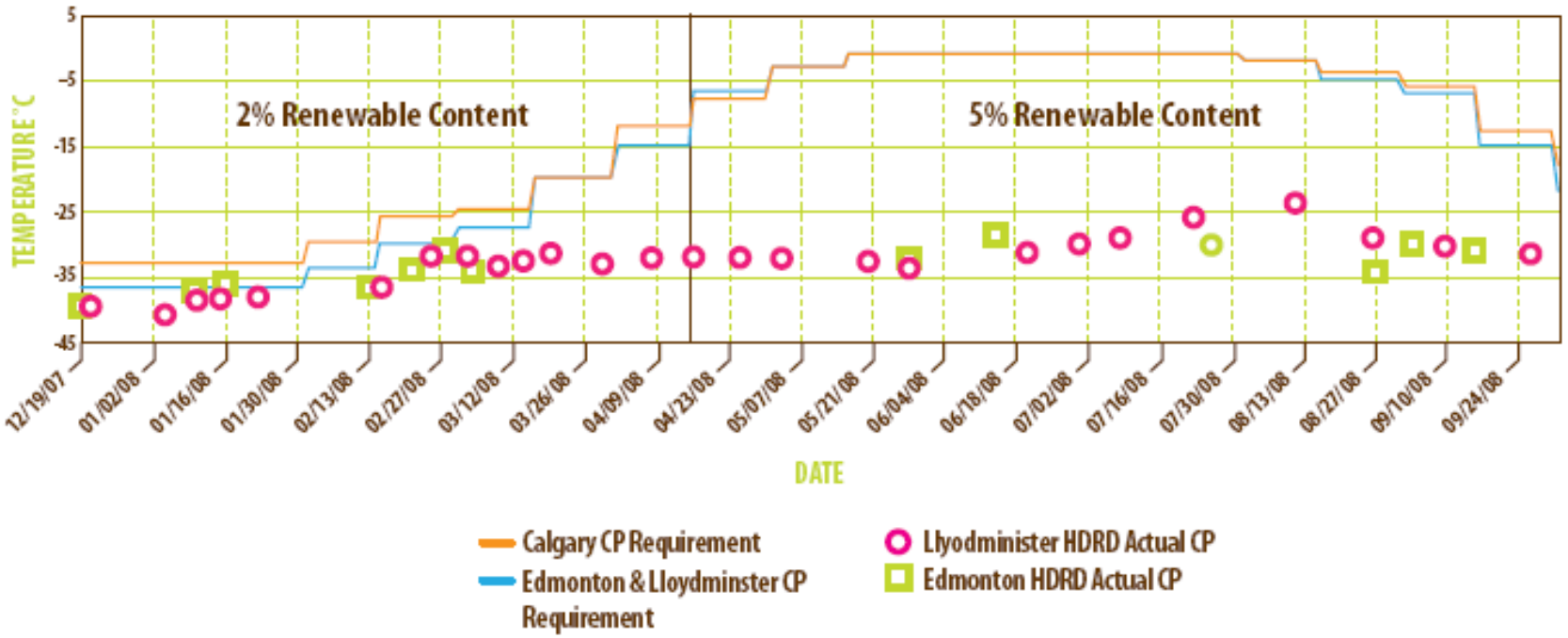
Cold Weather Performance

FAME Cloud Point Results



Cold Weather Performance

HDRD Cloud Point Results



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Cloud Point Adjustment

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Winter kerosene requirement for CAN/CGSB 3.520 compliance in ARDD conditions

	Required Cloud Point (°C)	FAME Results %			HDRD Results %		
		FAME	Seasonal ULSD	Kerosene (CP-45)	HDRD	Seasonal ULSD	Kerosene (CP-45)
AB-1 Zone (Calgary)							
Dec 1 – Jan 31*	-33	2	66	32	2	87	11
Feb 1 - 14	-30	2	70	28	2	88	10
Feb 15 - 28	-26	2	74	25	2	89	9**
Mar 1 - 15	-25	2	74	24	2	90	8**
Mar 16 - 31	-20	2	77	21	2	90	8**
AB-2 Zone (Edm & Lloyd)							
Dec 1 - 31	-36	2	55	43	2	84	14
Jan 1 - 31	-37	2	55	43	2	83	15
Feb 1 - 14	-34	2	64	34	2	86	12
Feb 15 - 28	-30	2	70	28	2	88	10
Mar 1 - 15	-28	2	72	26	2	89	9**
Mar 16 - 31	-20	2	77	21	2	90	8**

*Half-month periods have been aggregated where the cloud point is the same.

**Blending model was kept the same despite receipt of the HDRD with a -28oC cloud point.

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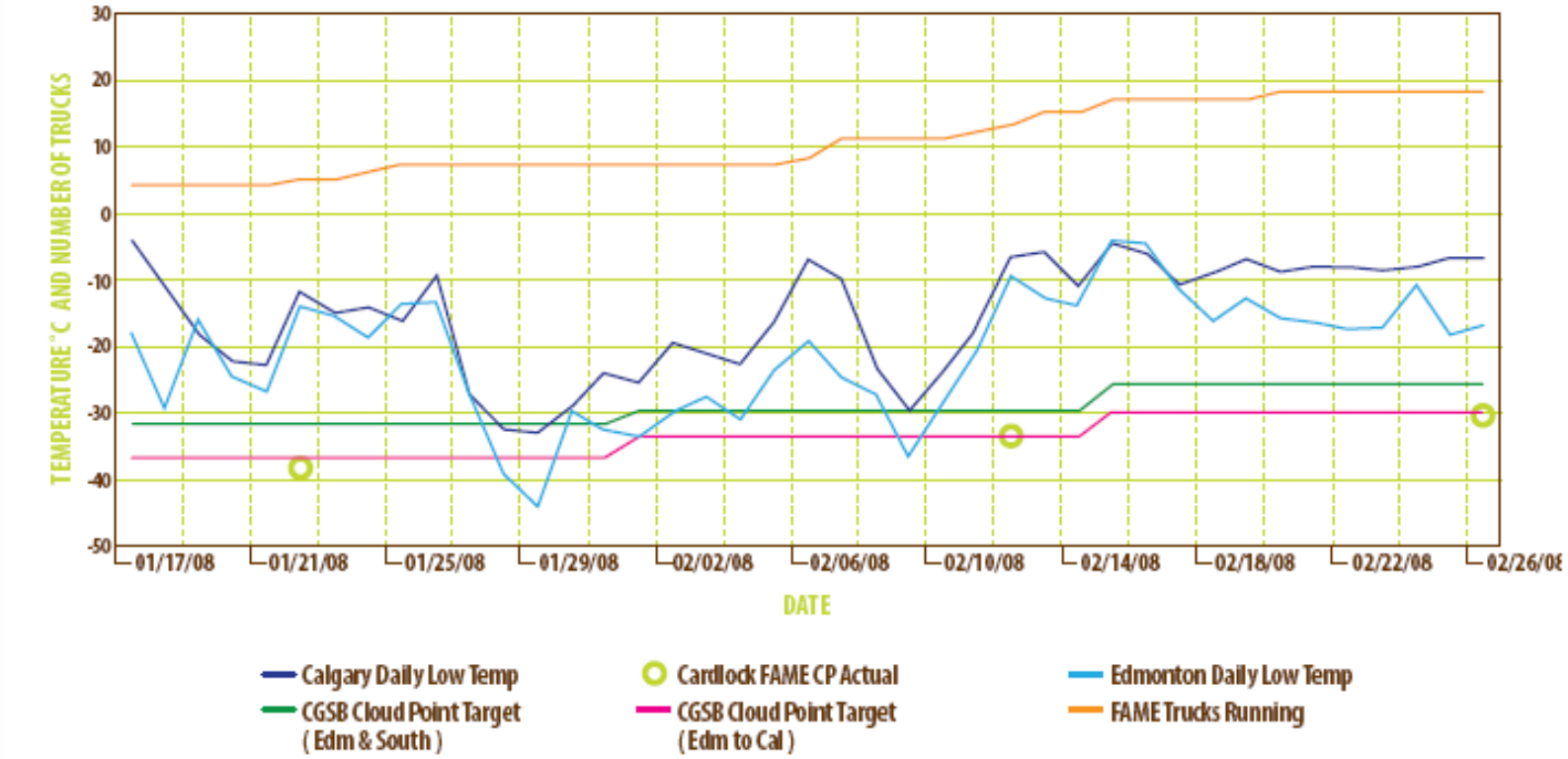
Winter Period Operation

FAME Fleet – Cold Snaps



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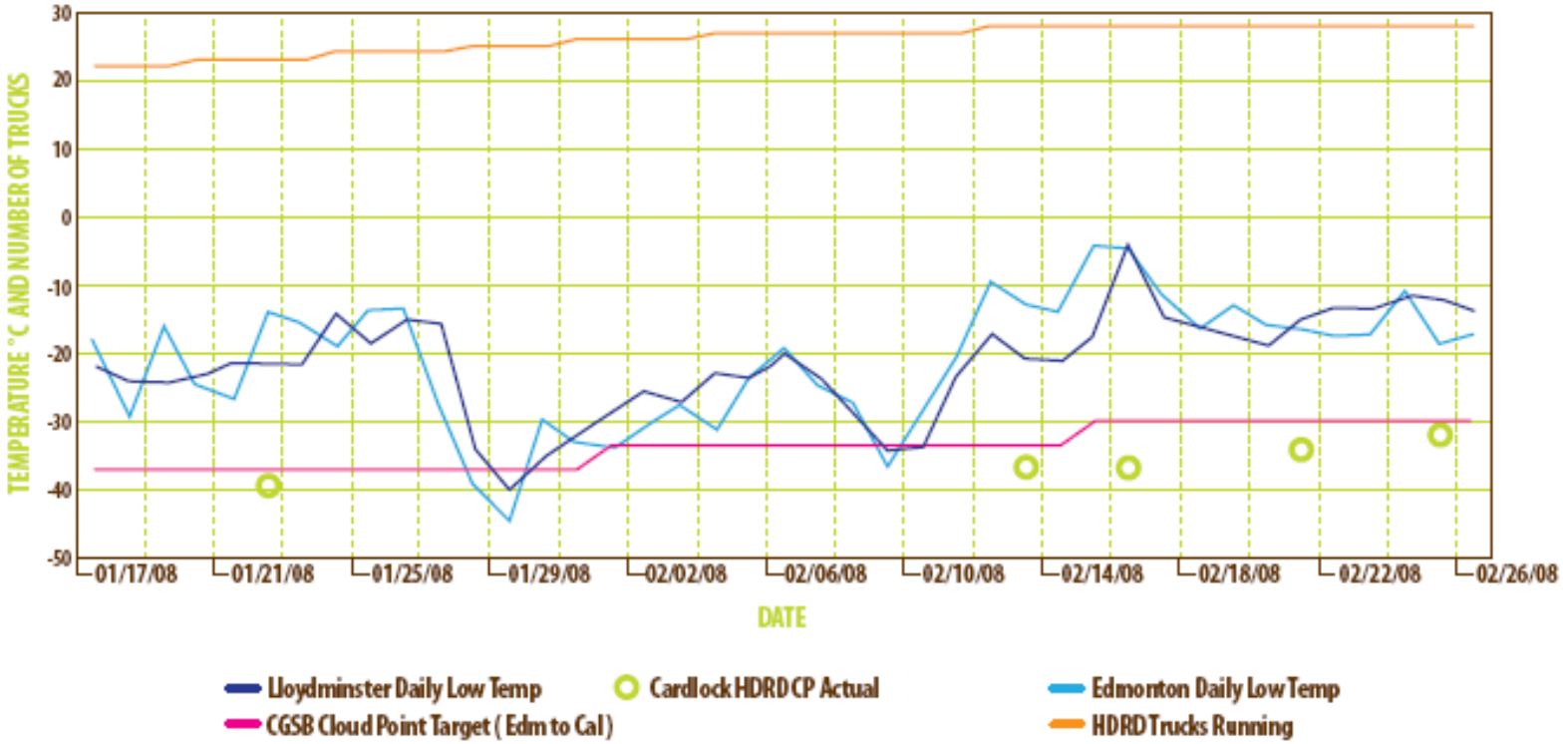
Winter Period Operation

HDRD Fleet – Cold Snaps



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Accomplishments

Observations

- Blended, delivered and operated B2 blends of FAME and HDRD in very cold temperatures
- No reports of non-starts, plugged filters or loss of power with long-haul trucks
- Successful blending, handling and retailing in commercial card locks
- ‘Seamless integration’ from end user point of view

Accomplishments

Conclusions

- No operational difficulties at B2 in cold weather in ARDD (except for one fuel filter for cold start on a school bus– insufficient data to determine cause)
- Fuel quality maintained throughout supply chain and infrastructure
- Handling practices met according to standard practices (with the addition of delivery temperature and 200 second CSFT)

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Conclusions

- It is possible to create CGSB 3.520 compliant blends at 2% in winter with CME or HDRD using ULSK for the cloud point schedules of the regions covered.
- CGSB compliant blends of 5% were made in spring/summer with mixed-feedstock FAME and HDRD without ULSK from April 1 to September 30 due to the cloud point of the seasonal diesel used.
- Effect of renewable content on cloud point was offset by ULSK addition for winter operation. For FAME the 3°C deflection from 2% canola methyl ester required 21 to 43% kerosene with -45°C cloud point. For 2% HDRD the 1°C cloud point deflection required 0-15% ULSK in the same conditions.

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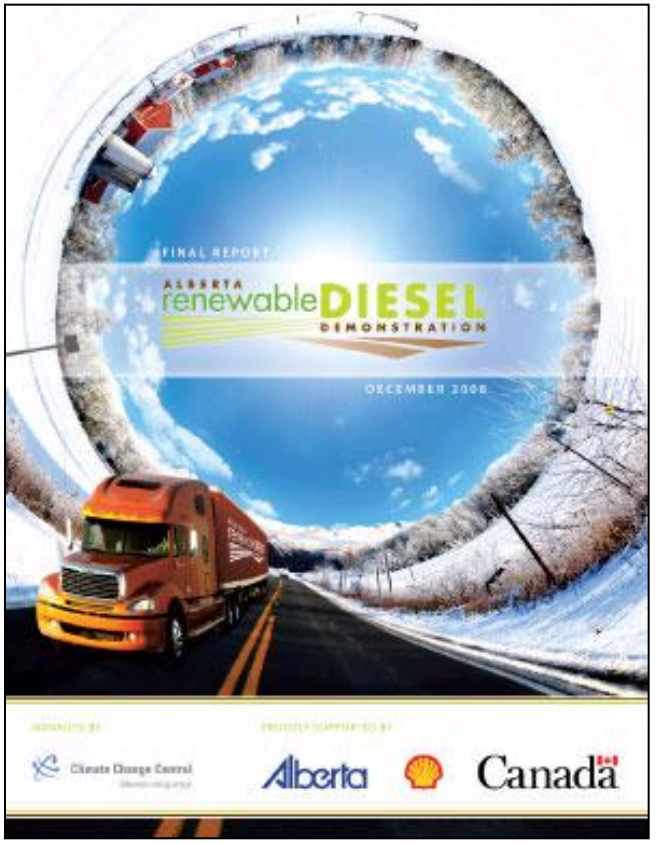
Final Report

www.renewablediesel.ca



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Comments or Questions?

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