



Creating forest sector solutions

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Truck & Logging Energy Efficiency Workshop

October 20, 2011

Terrace, BC

Cameron Rittich – Researcher

Session Plan – Fuel Efficiency in the Woods

1. Fuel Efficiency – What is it? And why does it matter?
2. Fuel Management – tracking fuel use
3. Developing a Plan to reduce fuel consumption
4. 10 Steps closer to a smaller fuel bill
5. Improving the machine performance and new equipment purchases
6. New technologies and FPInnovation's R&D efforts in energy efficiency

How much fuel? Fuel Consumption Benchmarking Studies provide the answer...

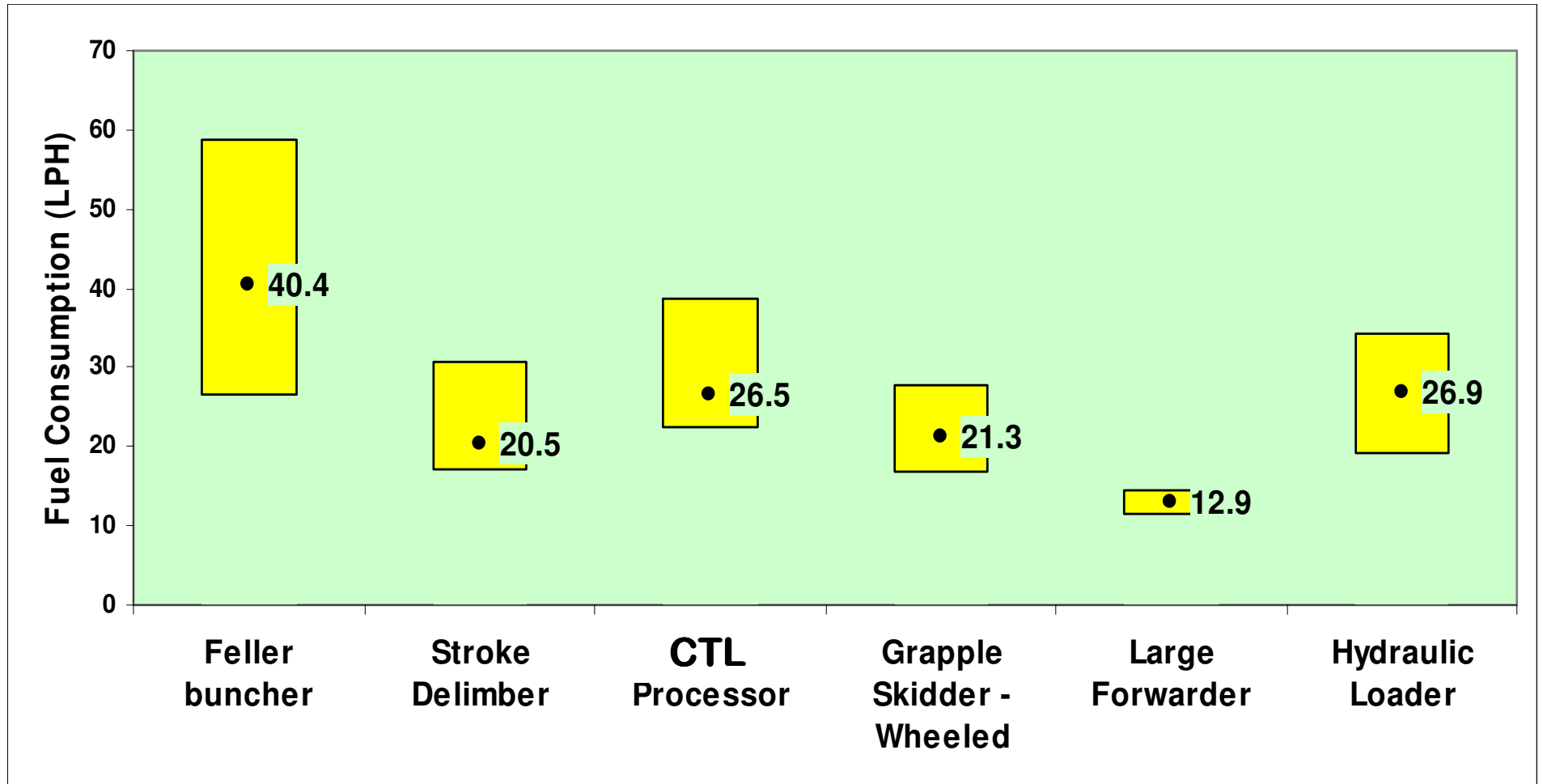


Fuel Consumption Benchmarking Studies Cont.

- Over 100 machines have been studied to date
- Some of the parameters we are tracking include:

- Machine specs
- Logging & Site conditions
- Fuel Density

Fuel Consumption - Typical Machines in Western Canada



How do we compare to the Swedes?

	Sweden 	Western Canada 
Felling	1.2 (Double Grip Harvesters)	0.46 (Bunchers)
Processing		0.64 (Strokers and CTL)
Extraction	0.5 (Forwarders)	0.33 (Skidders, some Forwarders)
Totals	1.7 L/m ³	1.43 L/m ³



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**Fuel Efficiency –
What is fuel efficiency?
Why Does it Matter?**

What is Energy Efficiency?.....

- “The consumption of minimum amount of energy required to produce a desired output.”



- 0 litres/ PHH or m^3



30-40 litres/PMH or ? M^3

Cutting to the issue.....

- How many liters of diesel does it take to produce a m³ of wood.

Important: lower fuel intensity can be obtained either by reducing the hourly fuel consumption OR by increasing the amount of wood produced during that same hour

Why is fuel efficiency important? History has some lessons...

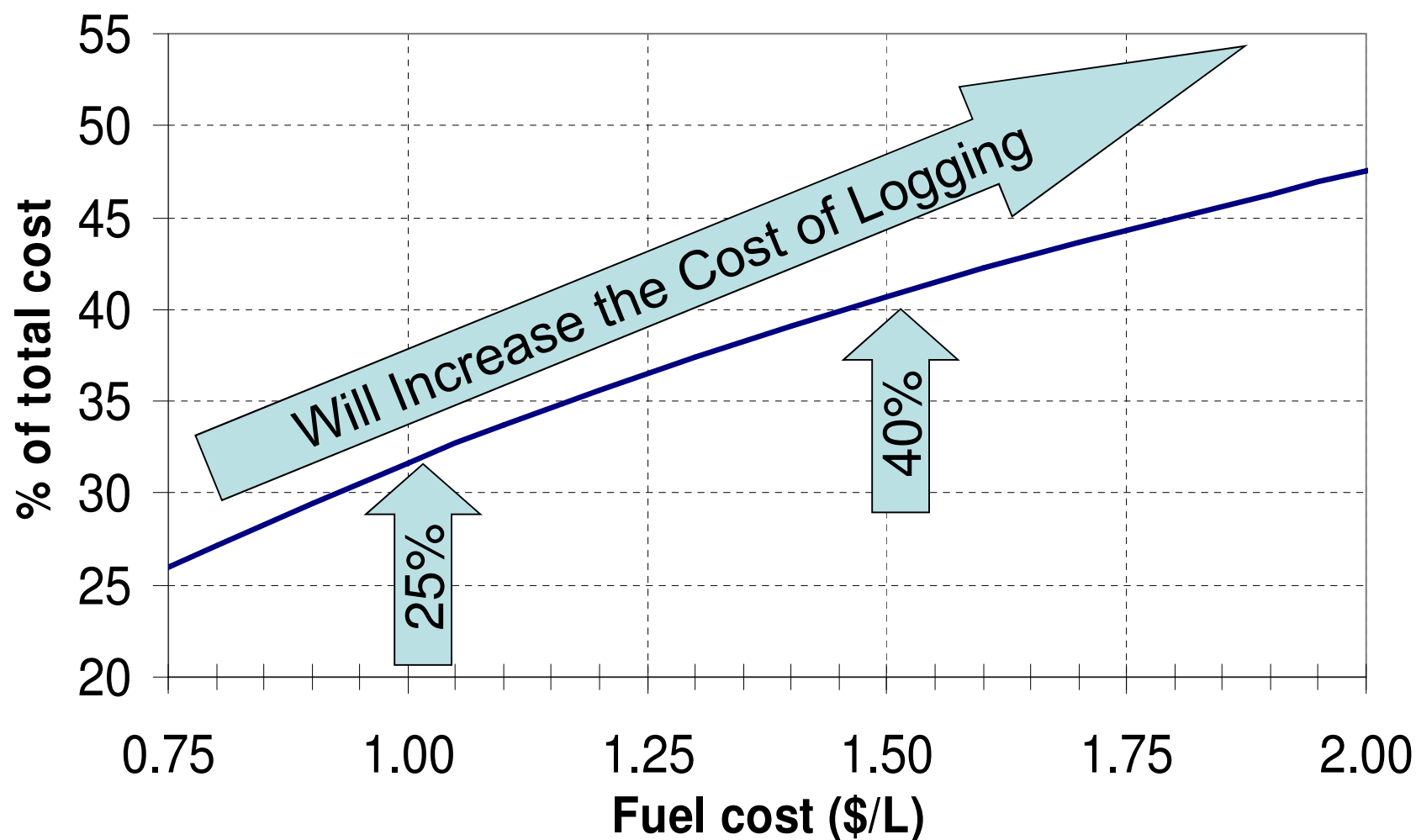
Average Retail Prices (cents/L) for Diesel in Prince George



Source NRCan:

http://www2.nrcan.gc.ca/eneene/sources/pripri/prices_bycity_e.cfm?PriceYear=0&ProductID=5&LocationID=66,8,39,17

% of fuel costs in total costs vs. Price of Fuel



Impact of fuel cost

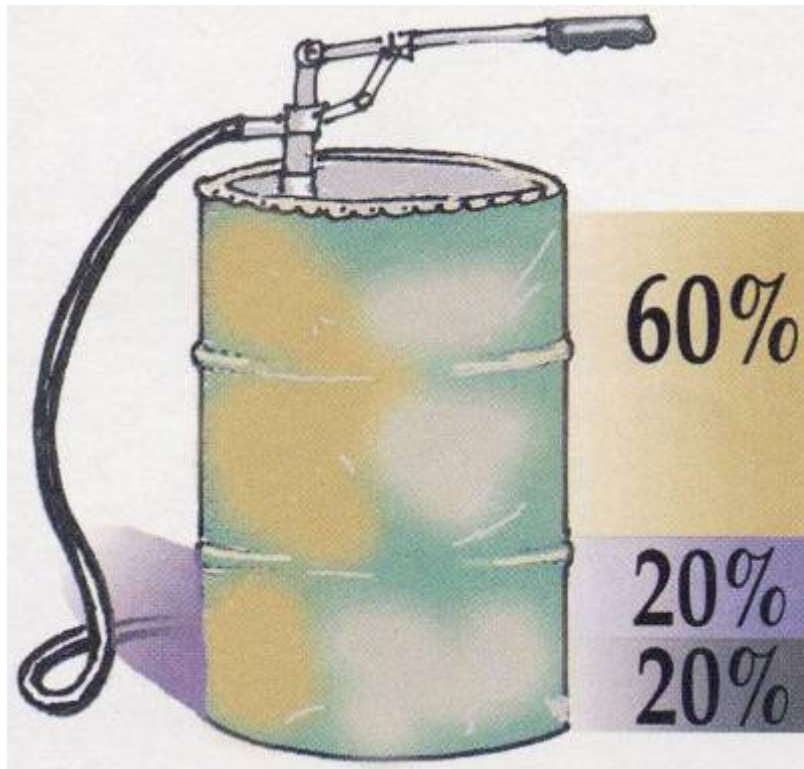
- \$1.00 /L
 - Harvester 13% hourly cost
 - Feller-buncher 24% hourly cost
- \$1.40 /L
 - Harvester 17% hourly cost
 - Feller-buncher 30% hourly cost

Impact of Variables – Feller Buncher example

- Fuel (up to 25 % + of total costs):
 - Reduce overall consumption 1 % **2,400 \$/year**
 - Reduce idling by 1 hour per day **600 \$/year**
- Machine Uptime....Utilization:
 - Increase by 1 % **6,500 \$/year**
- Productivity:
 - Increase by 1 % **38,000 \$/year**

This example is for ONE machine – how many machine\$ do you have ?

What Factors Influence Fuel Consumption?



60% The design of the machine

20% The engine technology

20% The operator's work methods



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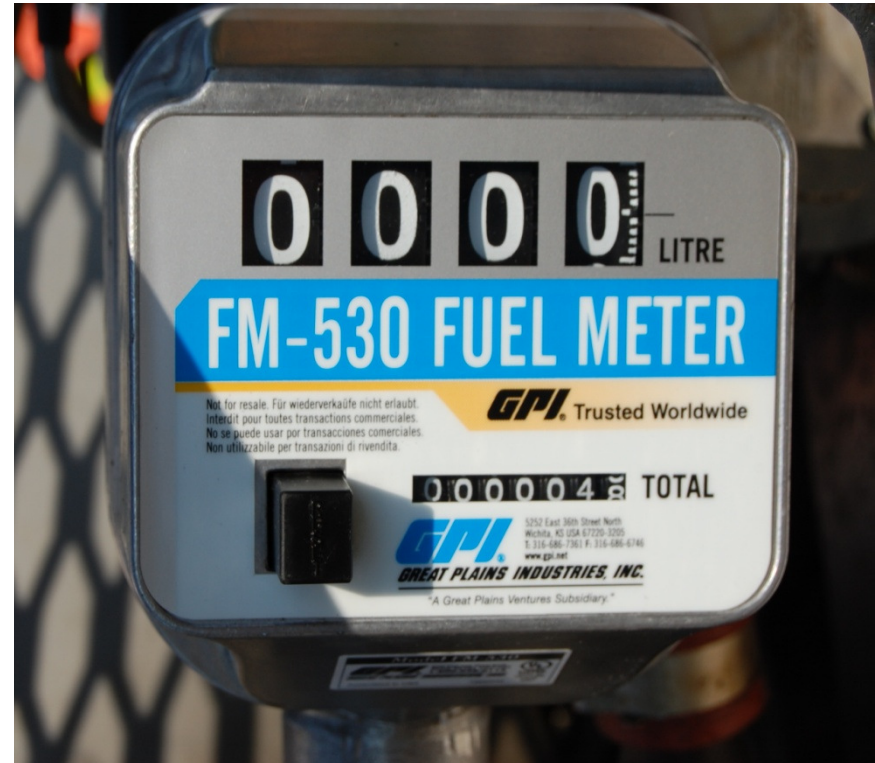
Fuel Management –the Basics of Tracking Fuel Consumption

Why Measure Fuel Consumption ?

- You can't manage what you can't measure!
- Changing conditions can make a profitable operation unprofitable in a short amount of time
- If your machine's fuel consumption increased 20% in a month's time – wouldn't you want to know?

How Do I Measure Fuel Consumption ?

- 1. Install fuel meters on all tanks
- 2. Ask operators to fill their tanks & record the amount
- 3. Track the numbers in a simple ledger



Tracking Fuel Consumption – Record Keeping

SHIFT DIARY					Machine No.	Skidder 9701	
Date	Time	Op. Initials	Hour Meter	Litres of Fuel	Block ID	Activity / Cutting Spec	Comments
Mar 1	5:30 pm	CGR	5890	145.6	580A	Skid to spur A	1 hour spent fixing hose
Mar 2	5:25 pm	BDB	5901	155.8	580A	Skid to mainline	Oil on pedals!

Tracking Productivity - Recorders, MultiDATs & FPDats



What can I learn from Fuel Consumption & Productivity Figures?

- Litres per hour by machine type
- Mechanical defect in the machine
- Litres per shift / month / hectare
- Litres per cubic metre
- Fuel consumption by terrain type
- Fuel consumption by species / cutting spec.

Costs change when operating
conditions change!

BID ACCORDINGLY!

Example of tracking fuel use in a 40,000m³ cutblock

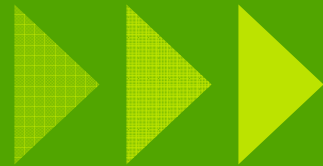
Operator	Machine	Litres	Production	L/m ³
Bob	Skidder 1	6,000	20,000	0.30
Chris	Skidder 2	5,600	20,000	0.28
Lee	Buncher 1	9,200	20,000	0.46
Don	Buncher 2	10,400	20,000	0.52
Mike	Processor 1	10,933	20,000	0.82
Sue	Processor 2	10,400	20,000	0.78

Assumes each machine produces equal volume.
Better to use actual data from OBCs i.e. processor head computer or by other means.

Conclusions – Tracking Fuel Consumption

- **YOU** can do something about it!
- Fuel costs **CAN** be reduced!
- **Measure** it
- **React** to it!
- **Benefit** from it!





Developing a Plan to Reduce Fuel Consumption



An Energy Efficiency Program Consists of:

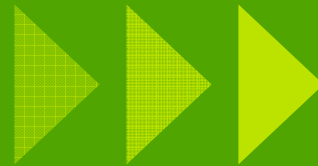
1. A commitment from management
2. Clearly defined objectives (i.e. measuring fuel consumption and productivity)
3. A program coordinator
4. A team approach
5. Follow up on results (train and coach operators)
6. Performance incentive program

Potential Incentive Methods

- Regular posting of operator fuel consumption – attach production and fuel consumption figures to paystub to raise awareness
- Award gift cards or ? for the most improved performer in the crew
- Reward each operator based on their own performance

Example of goal setting – 3 month period

Operator	Machine	LPH	LPH next quarter	Percent Change
Bob	Skidder 1	21.3	21.4	0.5%
Chris	Skidder 2	23.5	25.0	16.4%
Lee	Buncher 1	40.4	42.0	4.1%
Don	Buncher 2	44.9	44.2	-1.6%
Mike	Processor 1	20.2	20.5	1.5%
Sue	Processor 2	24.2	24.3	0.4%



10 Steps closer to a smaller fuel bill



10 steps closer to a smaller fuel bill



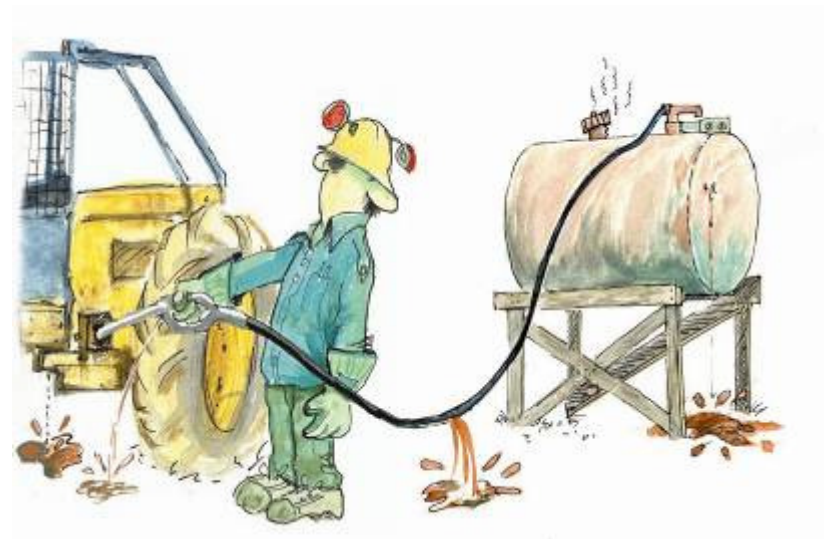
- *Maximize equipment productivity*
- More m³/PMH means less L/m³
- Implement best working techniques
- Train operators
- Avoid wasted operating time



10 steps closer to a smaller fuel bill



- *Promote a fuel efficiency philosophy in your company*
- Monitor individual machine consumption
- Keep all fuelling infrastructure in top notch condition
- Operate the smallest possible machine capable to perform the required task



10 steps closer to a smaller fuel bill



- *Maintain equipment as per manufacturer's specs*
- Keep engines tuned and in good condition
- Keep tires properly inflated, chains properly tensioned
- Ensure repairs do not compromise performance.



10 steps closer to a smaller fuel bill

4

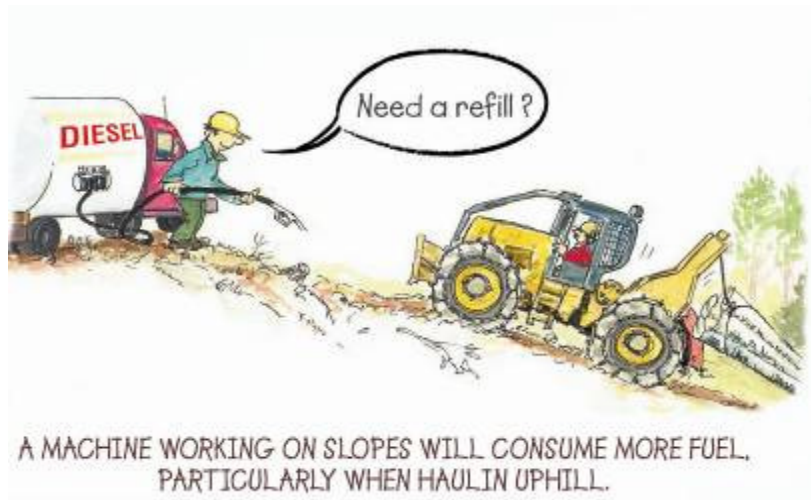
- *Reduce heat build-up in engines and hydraulic systems*
- Thermostat controls on fans and oil coolers
- Reversible fans helps clean out debris
- Proper viscosity oil and hydraulic fluid
- Grease moving parts regularly to reduce friction



10 steps closer to a smaller fuel bill



- *Plan work to minimize unnecessary machine travel*
- Plan fuelling so machines never travel back to the tank without working
- Mobile fuel tanks close to machines
- Locate landings so loaded equipment travels downhill



10 steps closer to a smaller fuel bill



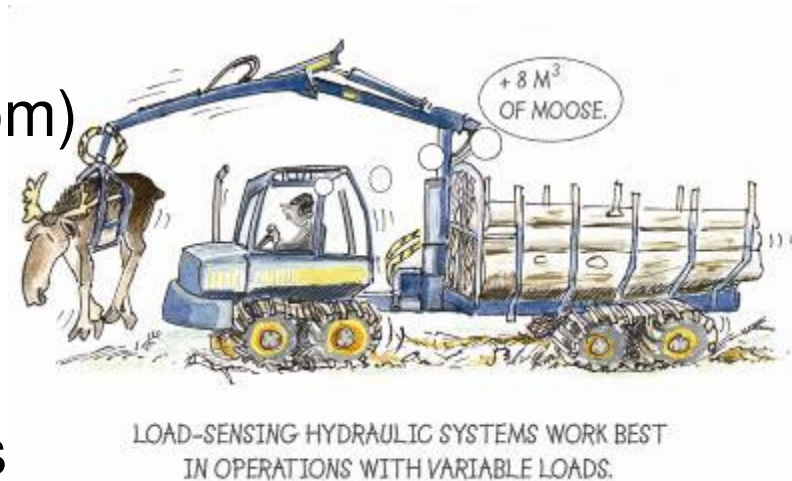
- *Use electrical accessories only when necessary*
- Shut off engine compartment and work lights as soon as practical (up to 0.5 L/Hr more fuel)



10 steps closer to a smaller fuel bill



- *Work smoothly and avoid jerky movements*
- Avoid sudden changes in directions (travel, swing or boom)
- On modern machines, adjust hydraulic settings to your operating style
- If you have a cab levelling feature, keep your cab level as this reduces the energy to rotate the upper structure



10 steps closer to a smaller fuel bill

8

- *Adopt energy-saving techniques*
- Avoid working/lifting at boom full extension *
- Do not lift boom higher than required during loading and unloading
- Reduced pressure on knives during delimbing to reduce friction (maintain quality however)



10 steps closer to a smaller fuel bill



- *Maintain equipment to minimize energy requirements*
- Keep delimbing knives extra sharp (small counter edge)
- Keep saw teeth and saw chains in perfect conditions
- Do not extend saw beyond the stem being bucked



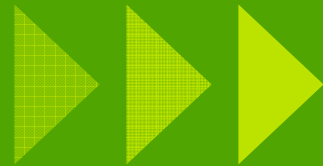
10 steps closer to a smaller fuel bill

10

- *Avoid excessive idling*
- Feller-buncher – 3.0 LPH
- Chipper – 8.0 LPH !
- Shut-off engines while refuelling or lunch breaks
- Follow cold weather start-up procedures as suggested by the manufacturer



Energy Efficiency in the Woods



**Improving the machine
performance and new
equipment purchases**



Time for a new machine ?



Steps to Achieve Efficient Specs

- Comparison shop 3 manufacturers products – minimum! Not all machines are the same.
- Buy the newest machine you can afford. In general, the newer a machine, the more productive it is. Studies have show that newer machines may consume more fuel, but they get more wood.

See Beyond the Purchase Price

- Payload
- Fuel Consumption
- Maintenance
- Downtime
- Purchase price
- Resale value



New vs. Old – Skidder Case Study

	Model Year	Litres per hour	Cubic metres per hour	Litres per cubic metre
JD748H Tier 3 emissions	2008	21.4	103.6	0.21
JD748G3 Tier 2 emissions	2004	18.3	72.7	0.25

Steps to Achieve Efficient Specs

- Load sensing hydraulics offers significant reduction in engine speed, noise levels, and fuel consumption
- Variable Speed Hydraulic and Reversible fans save fuel.
- Look at manufacturer's fuel consumption figures with skepticism – what do people using the product have to say?

Return on Investment – Cab Heater Example

- Loader waiting for trucks wastes fuel idling.
- Solution, shut it down and keep operator warm with a heater.
- But, does it pay?



Return on investment – Cab Heater example

Idling Time Reduction: 1.5 hrs

Payback period :

\$1,400

÷ 1,125 \$/year

1.5 hrs x 3.0L/hr = 4.5 L/day

4.5 L/day x 250 days/year

= 1,125 L/year

\$1/L, the saving is \$1,125/year

1.25 years

Cost of Heater \$1400



Excessive Idling is harmful to the environment

- Increases fuel costs:
 - Every hour of idling wastes up to 4 litres of fuel
- Increases harmful emissions
 - NO_x , CO, PM, VOC
- 1 litre of diesel produces about 2.7 kg of CO_2

Excessive Idling is harmful to your wallet



- Increases maintenance costs:
 - Extended idling can reduce the life of engine oil by up to 75%
 - Increases wear & tear of certain components (ex: filters, valve seats, piston heads, etc.)
 - 1 hour of idling = 2 hours of running time
 - **Depreciation and resale are directly related to hour meter !**

Techniques to Reduce Fuel Consumption

- Install reversible electric fans – a fixed fan can consume 1 to 2 litres per hour (reversing electric fans can clean out radiators plugged with debris and reduce fuel consumption)
- Are your lubes the right type for the time of year and/or anticipated temperatures?
- Synthetic engine, gear, and hydraulic fluids are proven performers.
- Install engine idle shutdown timers

Spotlight on Technologies that Save Fuel

- Electronic control on lock up torque converters.
- Brake declutch switch directs power to grapple function automatically.





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**New technologies and
R&D efforts in energy
efficiency**

What is in the works ?

- Engine technologies & emissions
- Fuel additives
- FPDat linked to Electronic Control Modules
- FPFuel a smart fuel meter

Engines - Tier 4 Emission Packages

- Selective Catalytic Reduction (SCR) requires a catalytic converter into which is injected Diesel Exhaust Fluid (DEF) – composed of water and urea.
- Urea reacts with the NO_x to form nitrogen and water vapor.
- Because NO_x gases are effectively eliminated in the downstream after treatment chamber, the level of NO_x produced by the engine can be significantly higher and therefore the engine can be retuned for maximum fuel efficiency.

Diesel Additives – Fuel Savings or Preventative Maintenance Measure?

- EPA certification does not guarantee fuel savings
- Component lubrication may be enhanced or required with older engines designed for high sulphur content fuel.
- Be critical of fuel saving claims from manufacturer's*

What is the payback period? Use caution!

FPInnovations – FPDat



- Automated data collection
- Customizable reports
- “Dashboard Display” will show operator how he is doing

FPInnovations – Research Developments

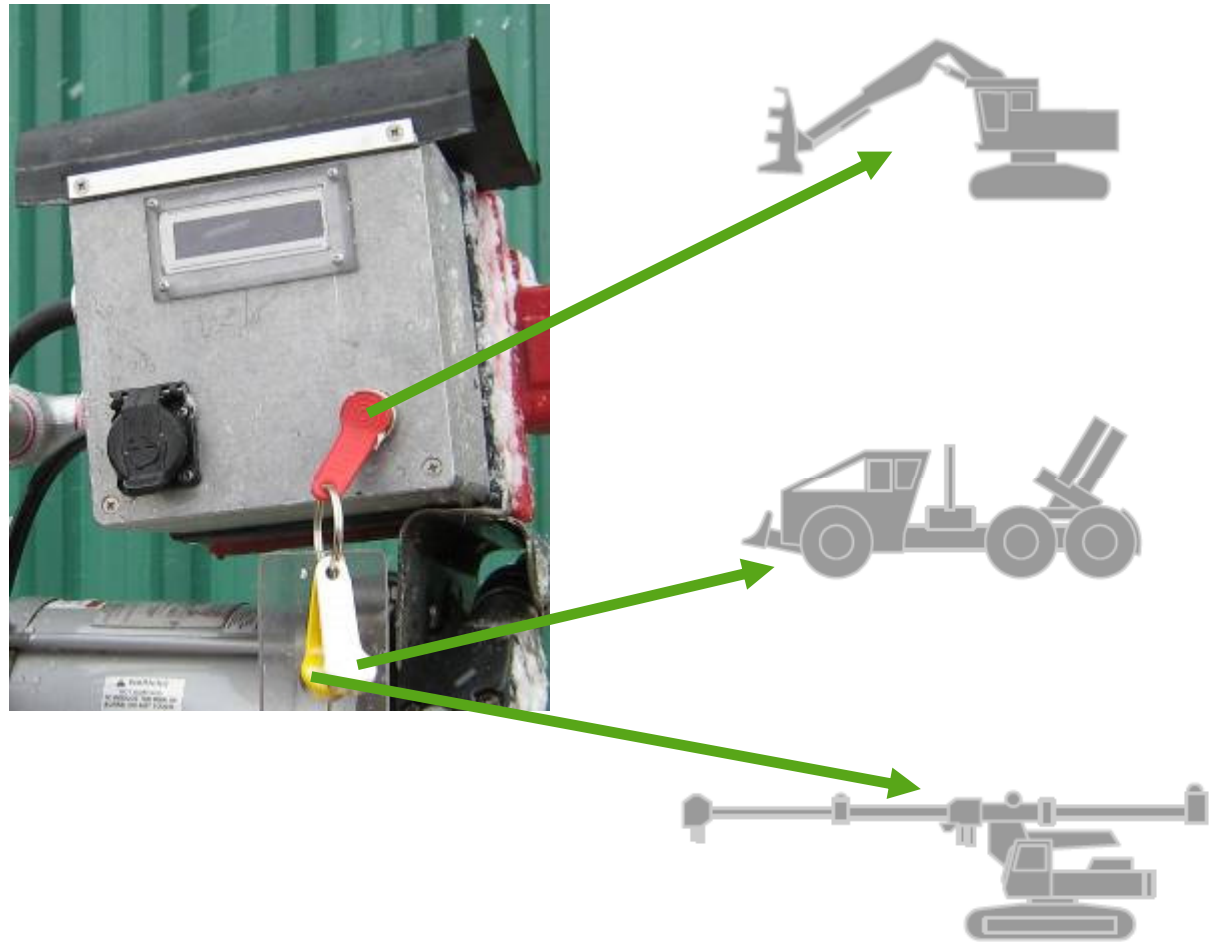


- ECM data transferred to FPDAT.
- FPDAT data transferred wirelessly to download suitcase in supervisors pickup
-



FPInnovations – a smarter fuel meter = FPFuel

- How does it work?
- Individual key per machine (ID)
- Must put the key to start
- Records date and time, ID and amount of fuel
- Download with a PDA or laptop



Conclusions

- Fuel economy can be improved – use a systems approach and involve all employees
- Tracking fuel consumption is not as hard as it looks – why not get started tomorrow?
- Plan the work and work the plan!
- Stay on top of maintenance – the small stuff can have a cumulative affect.
- Keep an eye on new technologies.

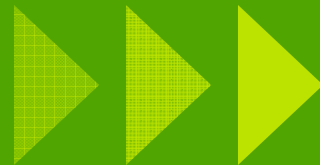


BREAK



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Improving the Efficiency of Your Trucks

Cameron Rittich – Researcher

This presentation made possible due to the financial support of Natural Resources Canada

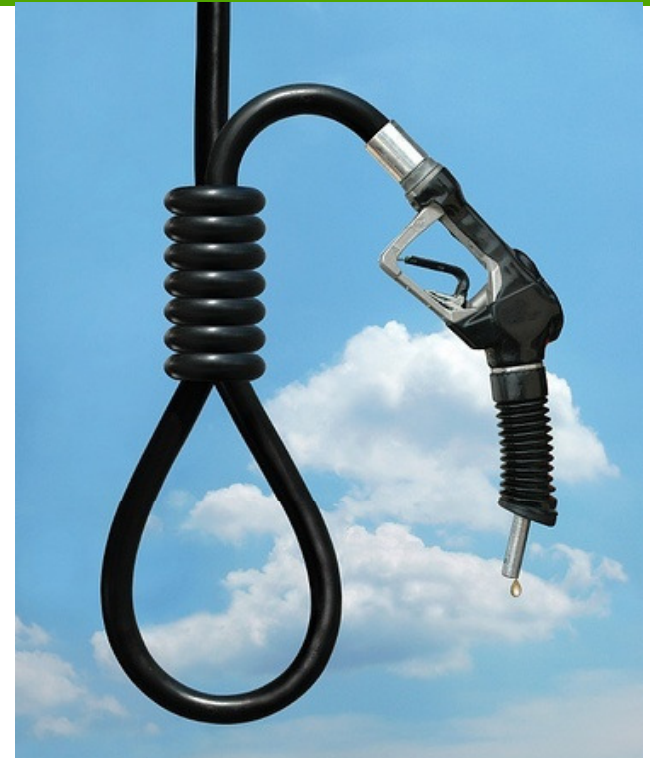
Session Plan

1. [Your Challenges](#)
2. [Energy efficiency in transportation](#)
3. [Spec'ing options](#)
4. [Energy Efficiency R&D](#)



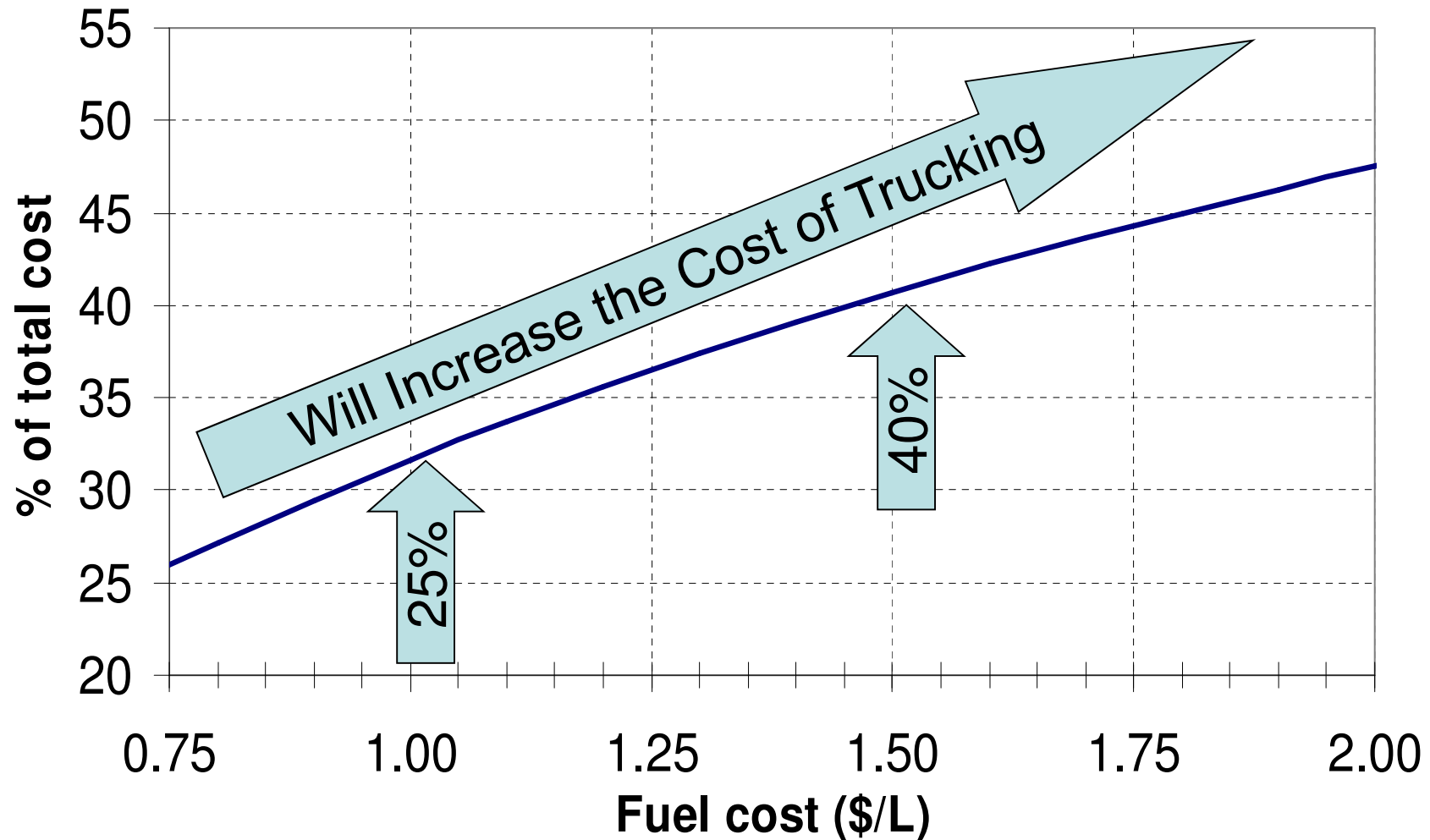
Your Challenges...

- Reducing costs
- Energy efficiency
- Payload optimization
- Preventive maintenance – minimize downtime
- Maximize vehicle use



Increase Profits

% of fuel costs in total costs vs. Price of Fuel

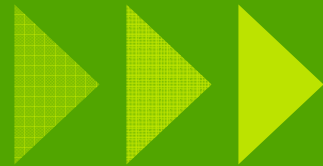


Impact of Variables

- Fuel (35 % + of total costs):
 - Reduced by 1 % **1100 \$/year**
- Payload :
 - Increase of 1000 kg **7000 \$/year**
- Vehicle availability/uptime:
 - Increase of 1 % **3000 \$/year**
- Lost time (waiting time):
 - Reduced by 1 % **1500 \$/year**

Energy Efficiency Session Plan

- Energy Efficiency Program
- SmartDriver for Forestry Trucks
- Driving techniques to reduce fuel consumption
- On-board Computers
- Performance Incentive Programs



Energy Efficiency Program

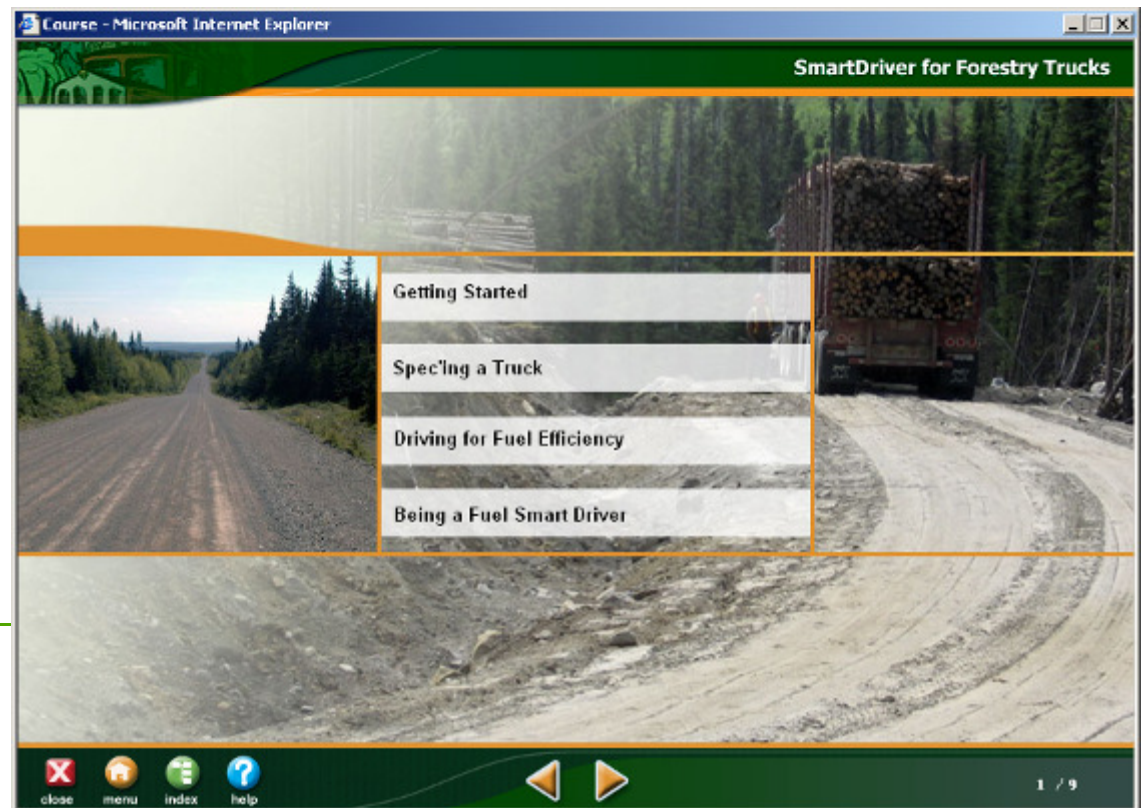


An Energy Efficiency Program Consists of:

1. A commitment from management
2. Clearly defined objectives (i.e. measuring fuel consumption and productivity)
3. A program coordinator
4. A team approach
5. Follow up on results (train and coach operators)
6. Performance incentive program

Smart Driver For Forestry Trucks

- Training program conceived by FPInnovations for NRCan
- Designed for trainers and for self teaching
- Updated in 2007

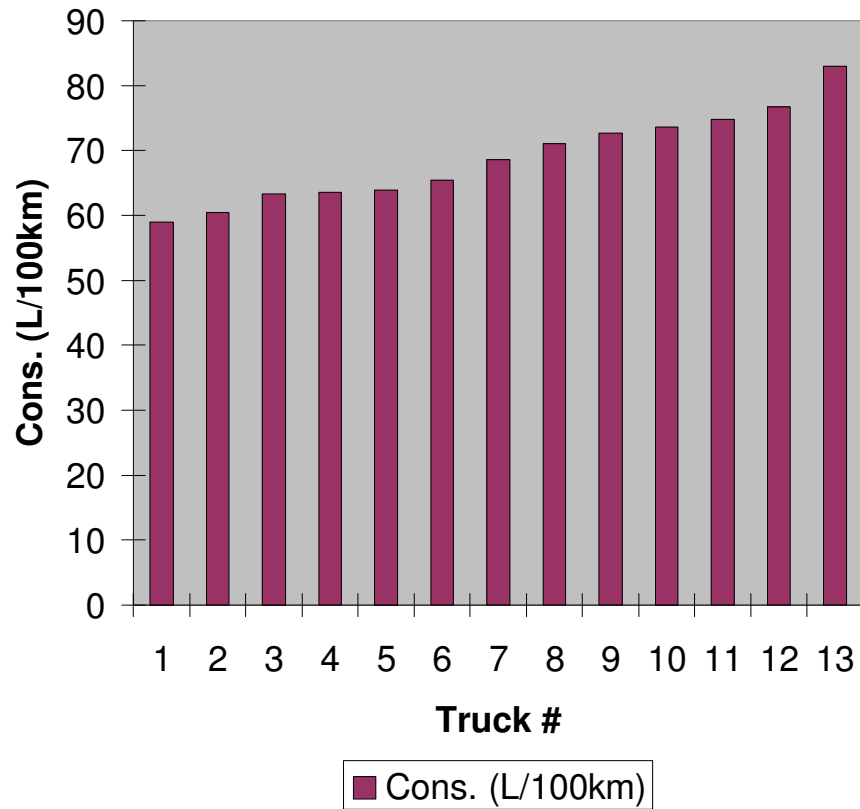


Results from Energy Efficiency Programs using SmartDriver for Forestry Trucks training

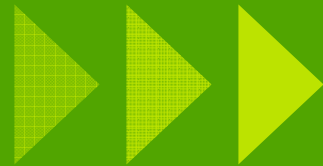


Participant	Savings
Bowater	9%
Coop St-Félicien	12%
Claude Guérin	10%
CBPP	6%

Truck Fuel Consumption Study



- Cons: 59 to 83 L/100km
 - A 41% difference from high to low!
- 3000 km/week
 - High cons: 2,490 L/week
 - Low cons: 1,770 L/week
 - Difference: 720 L/week
- 38 weeks = \$ 27360
- 100 t of GHG



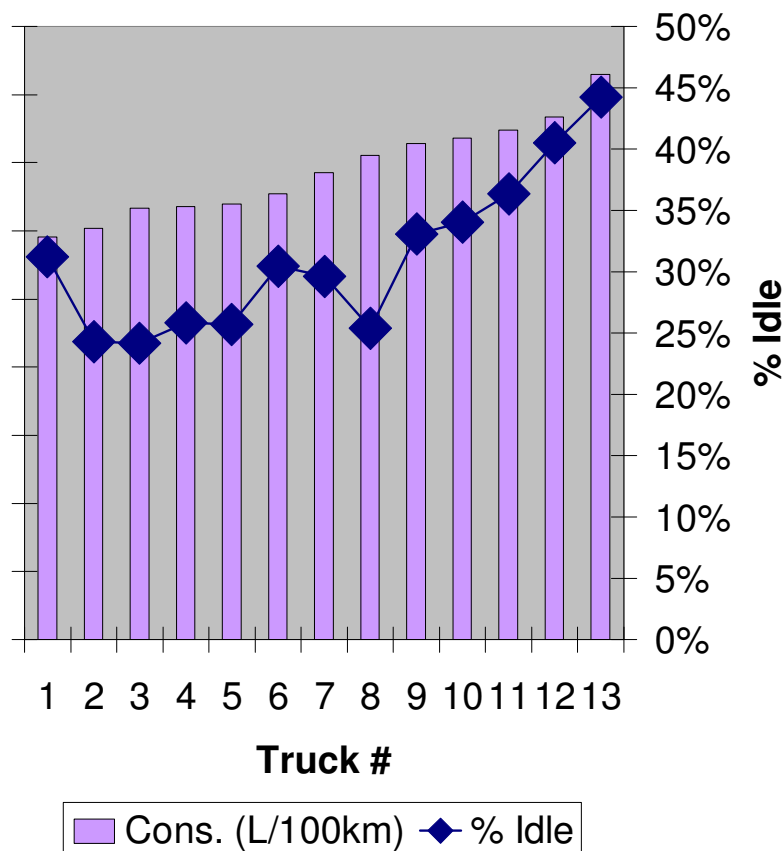
Driving techniques to reduce fuel consumption



The Key Driving Techniques

- Reduced Idling
- Proper RPM range – sweet spot
- Progressive gear shifting
- Reduced Cruising Speed
- Anticipate and reduce speed by decelerating, not breaking

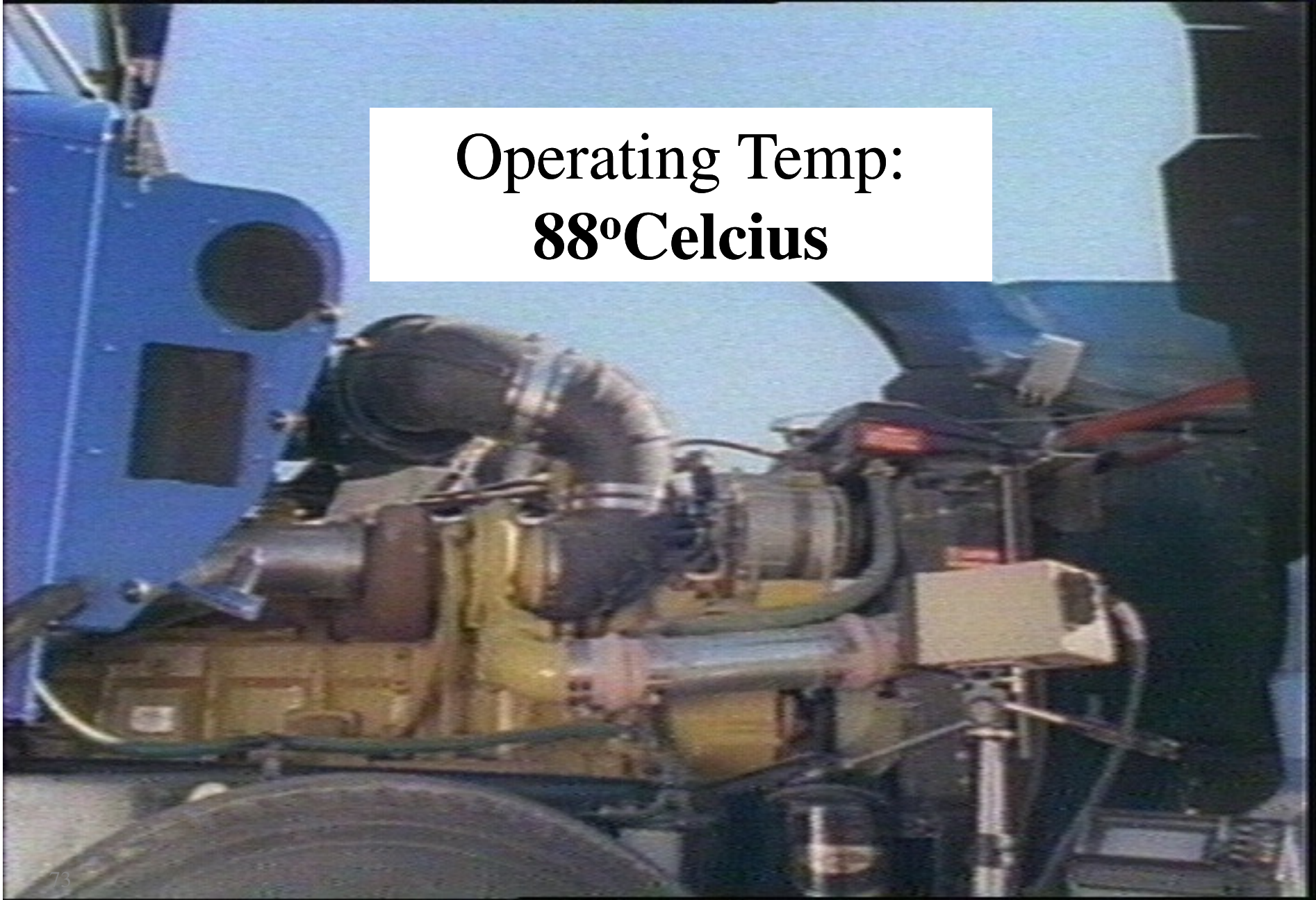
Fuel Consumption and Idling Study

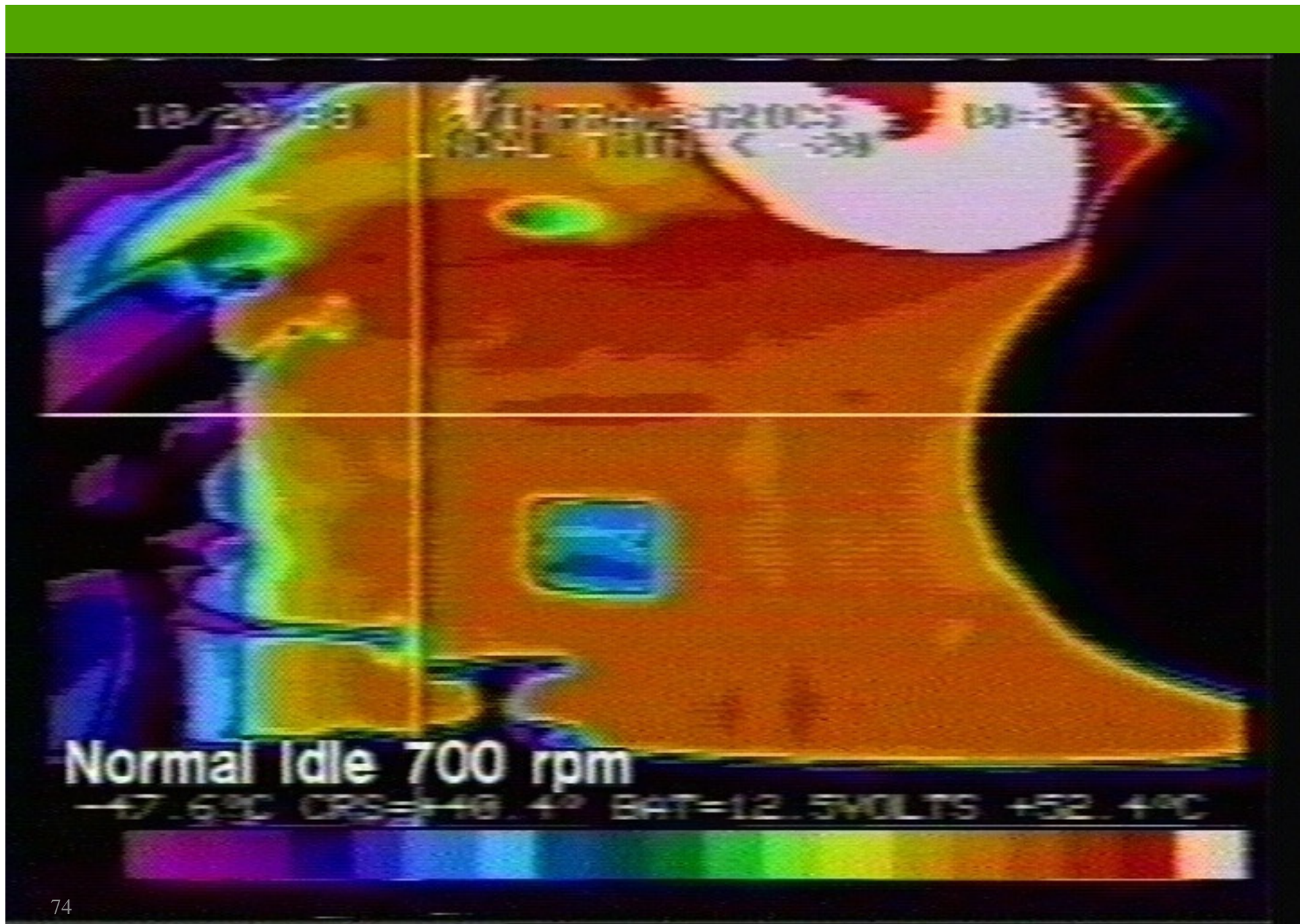


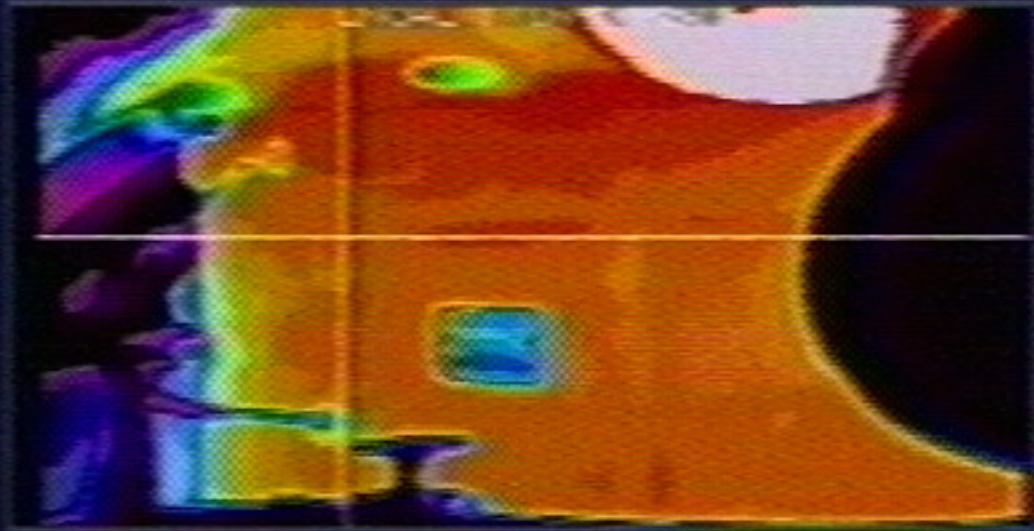
- Idling: 24% to 46%
- 15 - 27 hours (out of 60) per week
- Reduction from 35% to 17.5% = 800h to 400 h = **1600 L**

1600 \$/year

Operating Temp:
88°Celcius

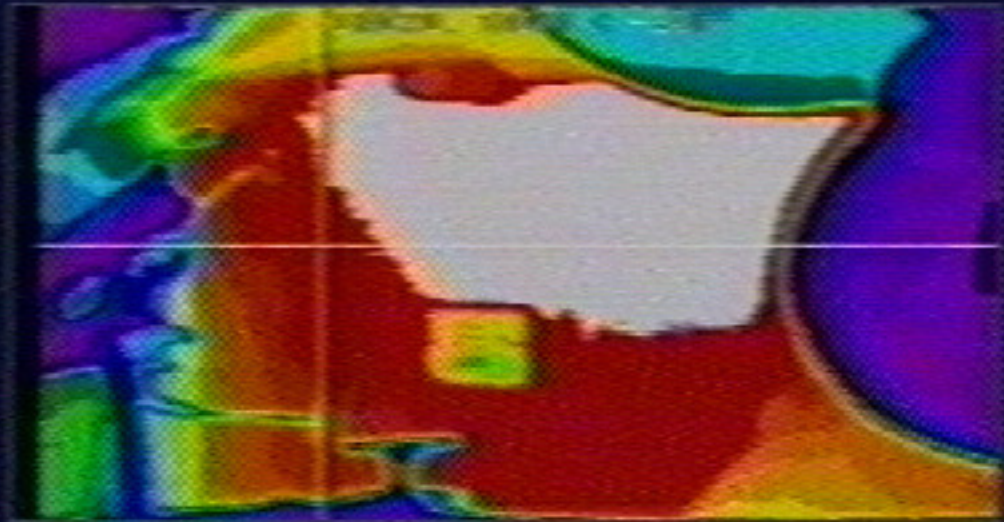




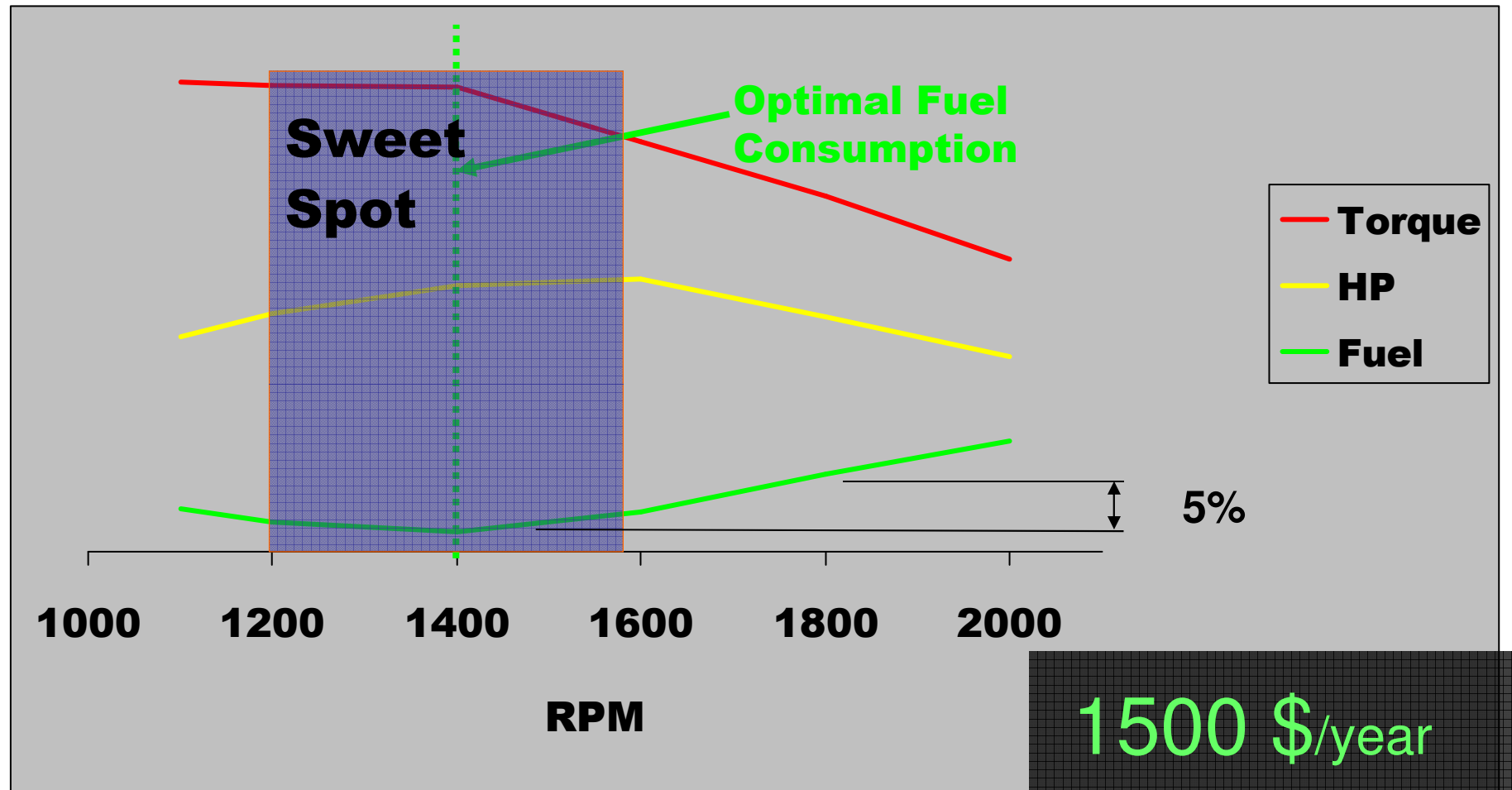


Normal idle:
700 rpm

60 minutes
after engine
shutdown



Engine Performance Curves



Driving at the “Sweet Spot”



At the track

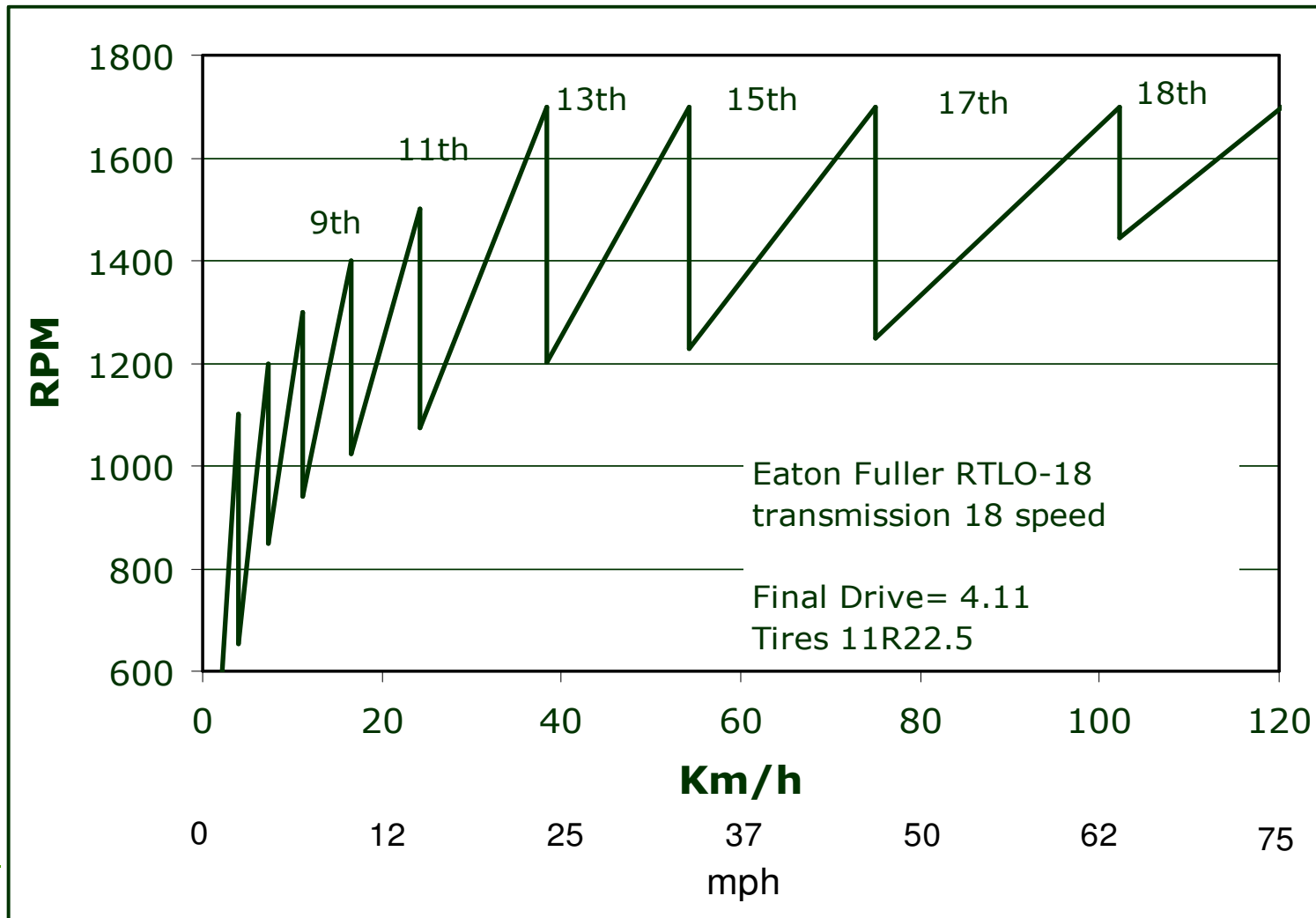
100 km @ 98 km/h

18th gear, 1400 rpm

17th gear, 1610 rpm

**+3.1% increase in
fuel use**

Progressive & Skip Shifting

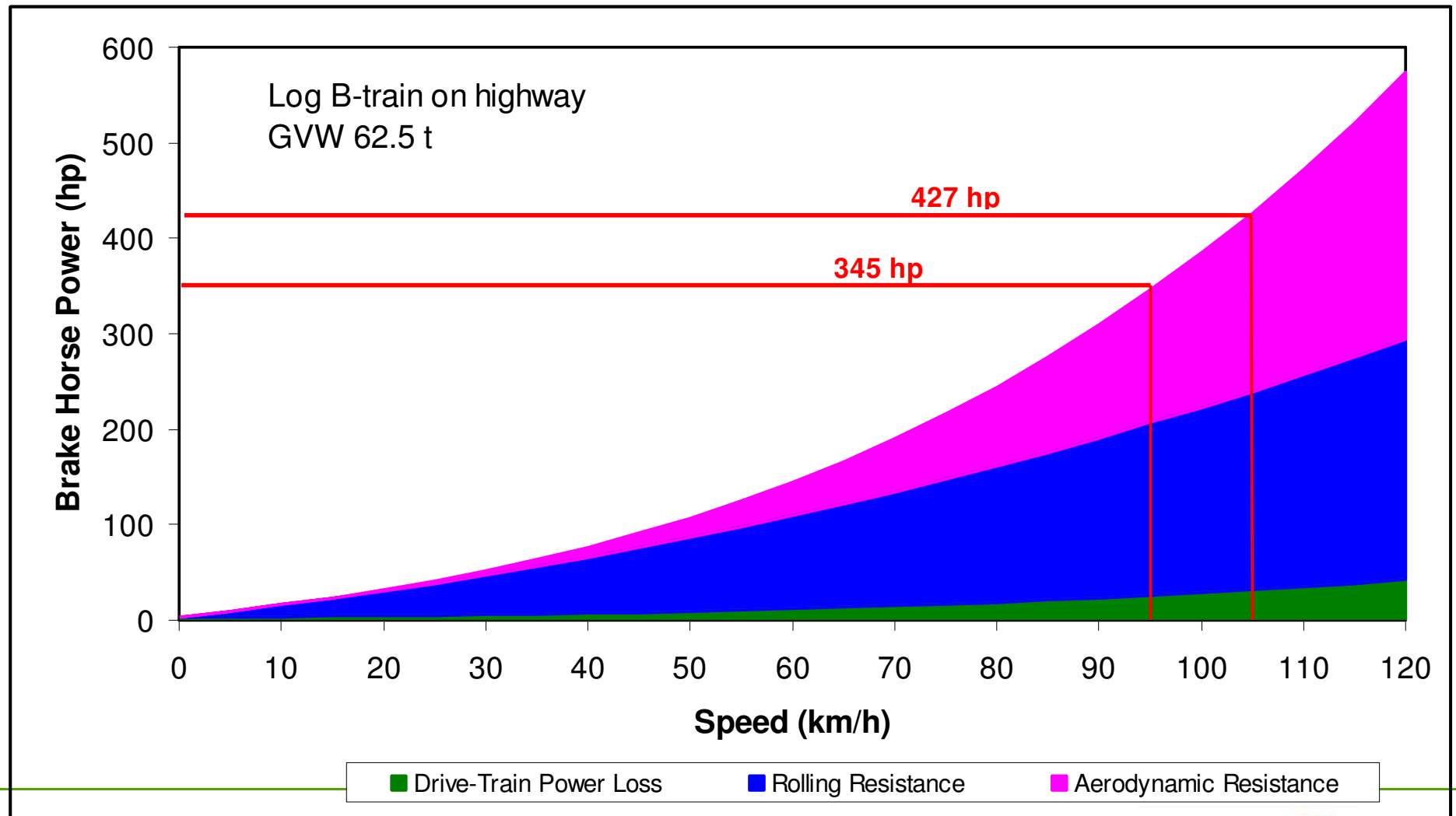


Speed

- Aerodynamic resistance increases dramatically at speeds above 90 km/h
- For each 10 km/h increase over 90 km/h, fuel consumption increases by 10%
- For one year, a truck that drives 90 km/h could save 6,000L in fuel versus a truck driven at 100 km/h. (annual distance of 100,000 km)

6000 \$/year

Speed vs. Power



Impact of Reducing Speed

- Example :
 - Reduce highway cruising speeds from 105 to 95 km/h
 - 150 km long trips
 - 100 km highway
 - 50 km gravel
 - majority of time spent cruising on highway

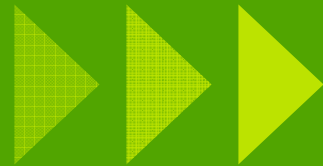
Impact of Reducing Speed

Additional cycle time (minutes)	13.0 min
Additional labour costs	\$ 5.42
Reduced fuel consumption (L)	12.0 L
Reduced fuel costs	\$ 12.00
Labour & fuel cost SAVINGS for 1 trip	\$ 6.58
Labour & fuel cost SAVINGS for 1 year	\$ 3,290

Conclusions – Driver Training

- Drivers have a major impact on fuel consumption
- For a truck on one shift (2,400 h/year and 100,000 km):

Idle time reduction	2,400 \$/yr
Green band (Sweet Spot)	1,500 \$/yr
Progressive shifting	1,000 \$/yr
Speed reduction	6,000 \$/yr
<hr/>	
Total	10,900 \$/yr



On-Board Computers



Benefits of Implementing On-Board Computers

- Precise and reliable measurement tool
- Doesn't disturb regular operations
- Creates awareness of energy efficiency issues

Benefits of Implementing On-Board Computers

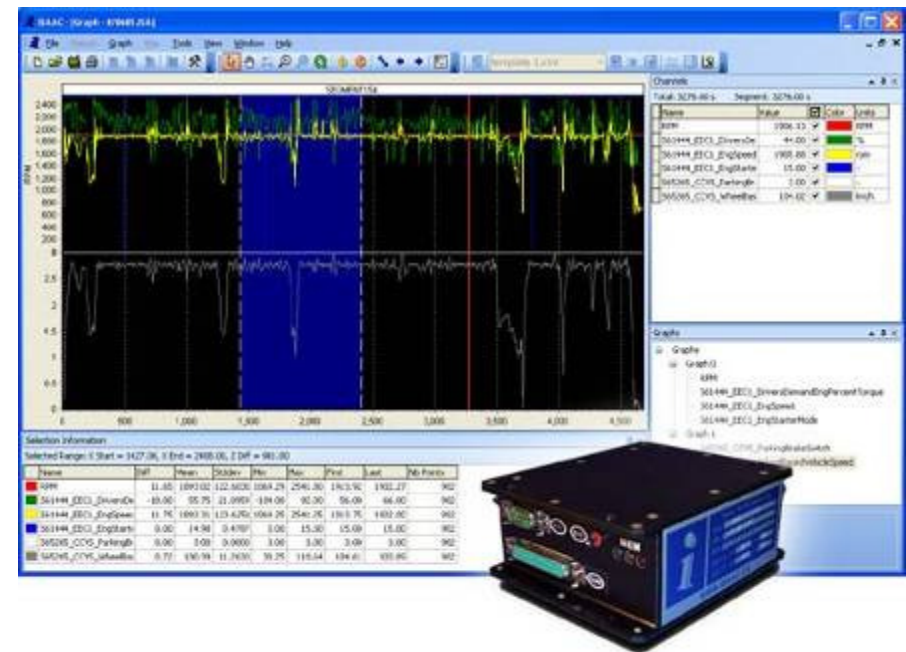
- Energy efficiency programs
- Analysis of cycle times
- Evaluation of new technologies
- Safety Program



**Increases in Performance,
Productivity & Safety**

On-Board Computer

- Linked to the ECU
- Tracks engine performance
- Driver entries
- Can track truck using GPS
- Management tool, not just a data recorder



CAUTION ! Make sure the system you buy is easy to use and that automated reports meet your needs!

DDEC® Reports - Trip Activity

Print Date: Nov 03, 2008 10:39 AM (EST)

Clark Freightways
2864 Norland Ave
Burnaby, BC V3B
604-298-7804

Trip: 03/12/07 12:48 PM (EST) to 11/03/2008 (EST)
Vehicle ID: 1163
Driver ID:
Odometer: 228591.0 mi

Trip Distance 160342.3 mi
Trip Fuel 38046.30 gal
Fuel Economy 4.24 mpg
Avg Drive Load 56 %
Avg Vehicle Speed 54.4 mph

Trip Time 3591:10:12
Fuel Consumption 70.62 gal/h
Idle Time 263:45:37
Idle Percent 7.37 %
Idle Fuel 242.63 gal

Driving Time 3317:24:35
Driving Percent 92.63 %
Driving Fuel 37503.66 gal
Driving Economy 4.76 mpg

VSG(P70) Total Time 159:30:09
VSG(P70) Percent 4.43 %
VSG(P70) Total Fuel 147.00 gal

Vehicle Speed Limiting
Time 22:00:37
Percent 0.67 %
Distance 1501.9 mi
Fuel 347.65 gal

Stop Idle Time 133:47:25
Stop Idle Percent 2.90 %
Stop Idle Fuel 156.63 gal

Top Gear
Time 2437:00:55
Percent 75.12 %
Distance 152315.4 mi
Fuel 27031.98 gal
Time 311:42:59

Over Rev Limit 1000 rpm
Count 2708
Time 2:19:27
Percent 0.36 %

Highest RPM 2192 rpm
Occurred 09/21/08 04:09:17 (RSP)

Top Gear - 1
Percent 10.22 %
Distance 15301.1 mi
Fuel 4780.13 gal

Diag. Records 11
Load Brake Count 15
Brake Count 42361
Eng. Brake Time 387:44:44

Cruise
Time 2204:01:03
Percent 65.44 %
Distance 130237.3 mi
Fuel 23289.03 gal

Optimized Idle Time
Active 0:00:00
Run 0:00:00
Battery 0:00:00
Engine Temp. 0:00:00
Thermostat 0:00:00
Extended Idle 0:00:00

Top Gear Cruise
Time 1925:35:11
Percent 58.04 %
Distance 118642.9 mi
Fuel 22946.12 gal

Continuous 0:00:00
Optimized Idle Battery Charging Events
Normal Count 0
Alternate Count 0
Continuous Run 0

Speeding A1>66 mph and <71 mph:
Count 57863
Time 1:00:48:36
Percent 4.69 %

Run Or Time
Total Time 192:22:16
Engine System 21:15:41
Manual 66:53:19
A/C 32:13:16

Speeding B1>71 mph:
Count 6527
Time 19:01:51
Percent 0.54 %

Pump On Time
Time 0:00:00
Distance 0.0 mi
Fuel 0.00 gal

Highest Speed 83.0 mph
Occurred 08/19/08 22:05:10 (EST)

Coasting Time 0:00:00
Coasting Percent 0.00 %

Engine Utilization 24.79 %
Vehicle Utilization 22.96 %

LEP Regeneration
Exhaust Regen Count 0
Driving Regen Count 0

ECM Download Data

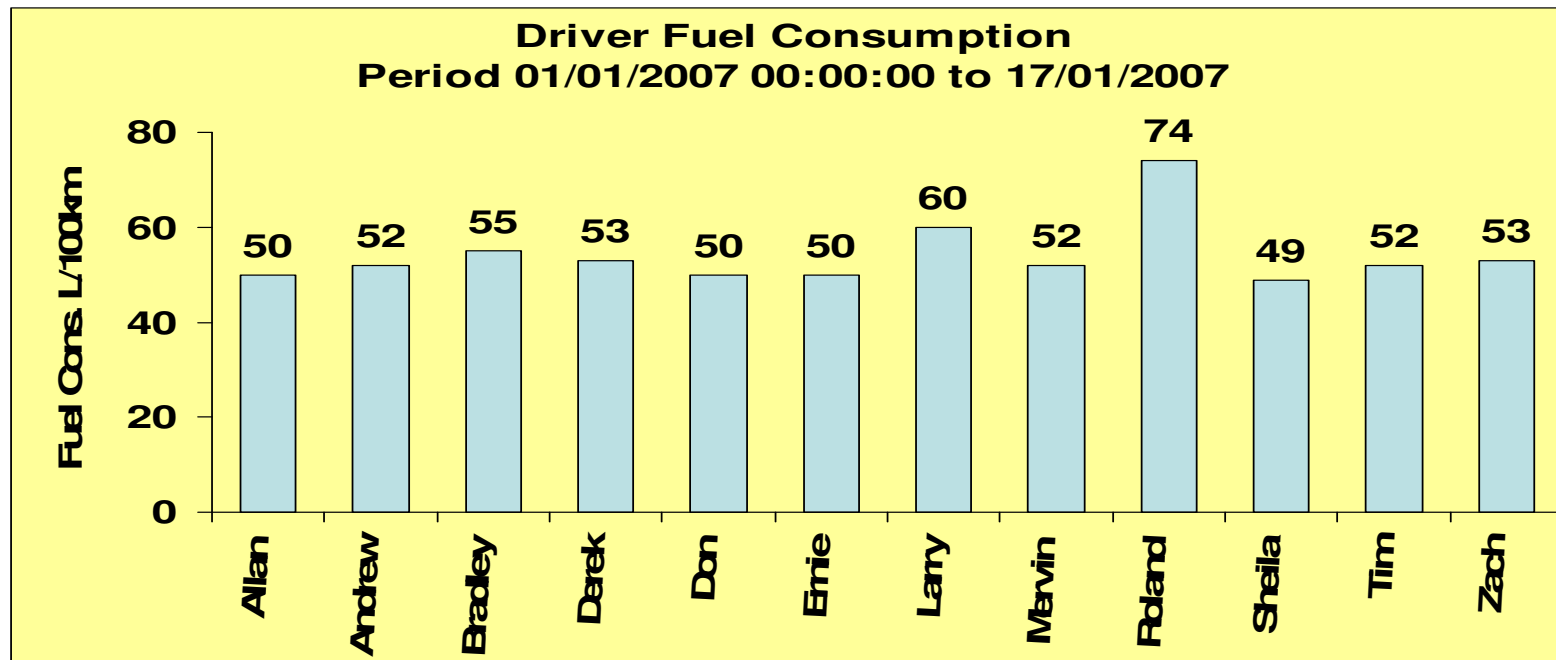
- ## DDEC Reports
- 2 Identical highway trucks
 - Working on the same haul

Driving Comparison Case Study

Fuel economy (L/100 km)	52.2	49.6
	Truck A	Truck B
Idle time (%)	17.6	7.4
Vehicle speed limiting (%)	1.55	0.67
Top gear (%)	62.8	75.1
Cruise (%)	9.5	66.4
Top gear cruise (%)	8.4	58.0

+5.1% or – \$5,000 / year

Using Reports to set goals

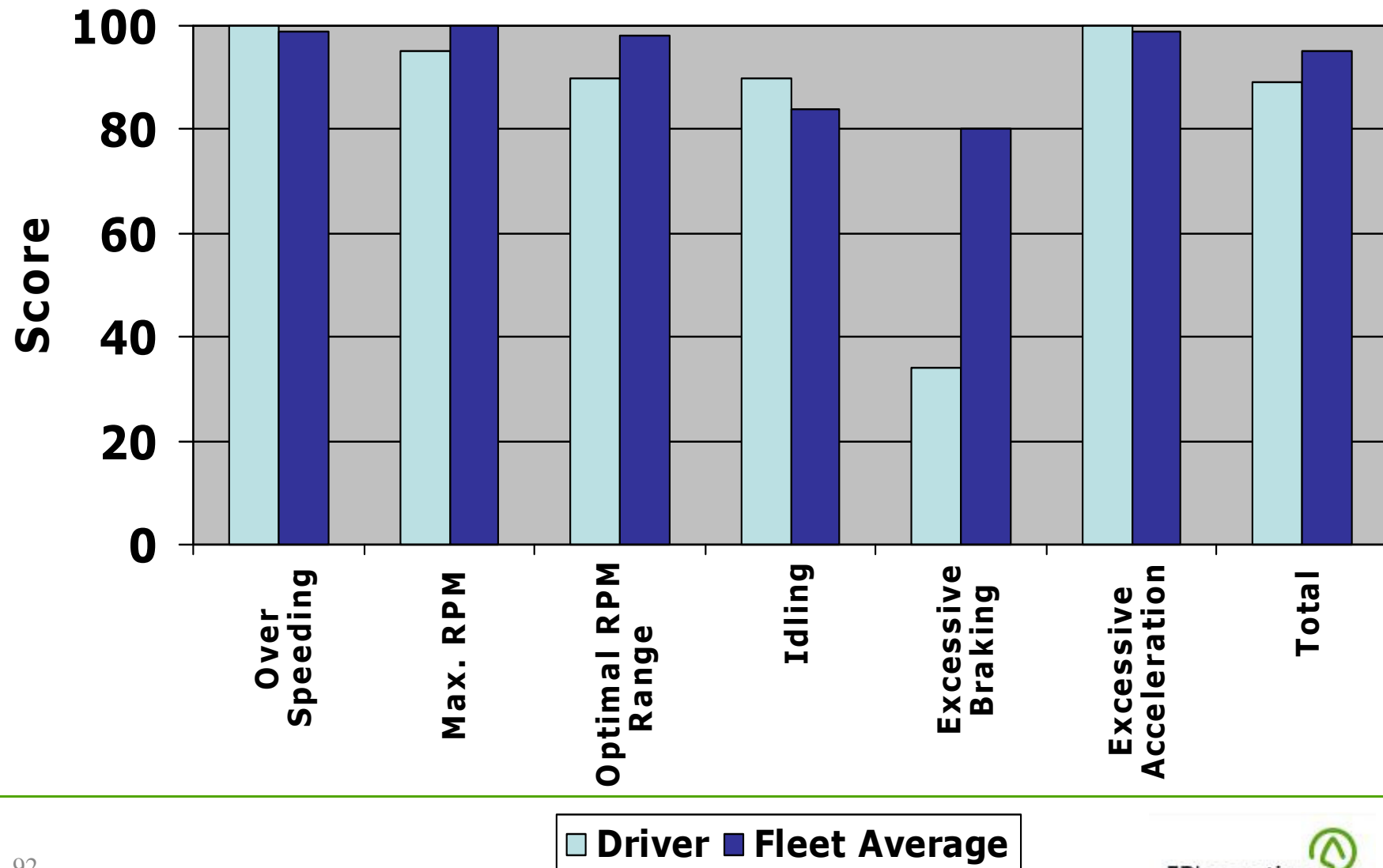


Current fleet average is 54 L/100km, set goal as 50 L/100km. Potential fuel saving of 48,000 Litres or \$60,000.

Performance Indicators and Limits

- The 6 performance indicators with limitations
 - Maximum Speed : 105 km/h
 - Maximum RPM : 1800 RPM
 - Idling : 5 minutes
 - Braking : 5 kph/s
 - Acceleration : 3 kph/s
 - Sweet Spot RPM : 1200 - 1600 RPM
- A score out of 100 for each parameter
- Each parameter is given a different weight to calculate the total

Driver Performance Score - Techniques



Potential Incentive Methods

- Regular posting of driver scoring results
- Award cash for the best performer of the fleet
- Reward each driver based on their own performance



Compare the results



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Spec'ing Options

Lesson Plan

- Steps to achieve efficient specs
- Examples of improved specifications
- Spotlight on truck technologies

The Keys of Spec'ing

- High payload (Low Tare)
- Low fuel consumption
- Low maintenance cost



See Beyond the Purchase Price

- Payload
- Fuel consumption
- Maintenance
- Downtime
- Purchase price
- Resale value



Light-weight Components

- Engine
- Suspension
- Cab protector
- Axles
- Frame
- Fuel tanks
- Bumpers
- Wheels & tires
- Trailers
- No sleeper



Steps for Efficient Spec'ing

- Build a truck suited to your needs
 - Determine specs of existing fleet
 - Spec with what you know
- Identify available alternatives adapted to your needs
 - Talk with your dealer and suppliers
 - Talk with fellow truck owners
 - Talk with FPInnovations

Impact of Component Choices

- Analyse the cost benefits:
 - Return on Investment
 - Additional revenue
 - Energy efficiency
- Assign value to things that make more money, conversely....



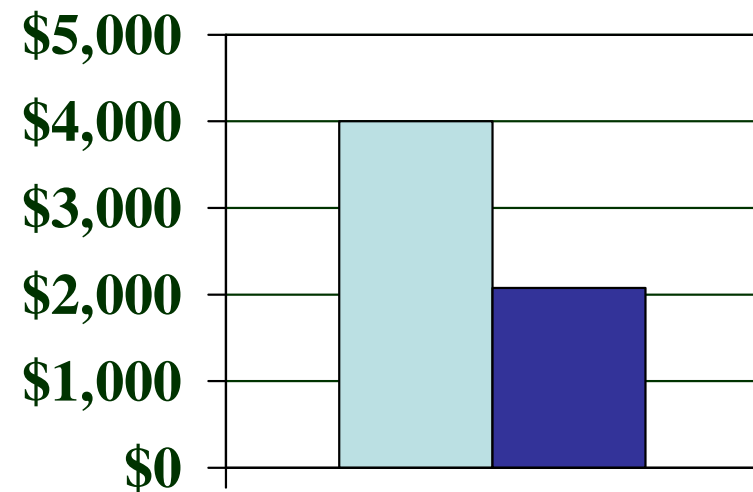
Return on investment – Al rims

10 rims:

150 kg Weight Savings
× 15 \$/t (Rate)
× 500 trips

1125 \$ / year

Purchase Price



Rims

Aluminum Steel

Return on investment – AI rims

Over 5 years:

$$\begin{array}{r} 1125 \text{ \$/year} \\ \times \quad 5 \text{ years} \\ \hline 5625 \text{ \$} \\ - 2000 \text{ \$ Additional cost} \\ \hline \end{array}$$

3625 \$ Net

Payback period :

$$\begin{array}{r} 2000 \text{ \$} \\ \div 1125 \text{ \$/year} \\ \hline \end{array}$$

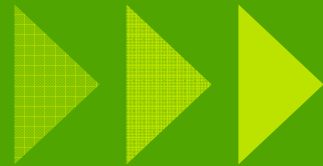
1.8 years



Example of improved specifications

Components	Base	Modified	Weight reduction (kg)
Engine	Cat C15 – 475 hp	Cat C13 – 470hp	220
Frame	1/4 full frame insert	No insert	165
Wheels (10)	Steel	Aluminium	150
Front axle	16000 lb	14600 lb	30
Suspension	Leaf	Air	115
Fuel tanks	2 - 120 gal	2 - 90 gal	70
Sleeper	Yes	No	225
Cab protector	Steel	Aluminium	225
Total			1200

Spec'ing Options



Examples of improved specifications



Does it Work in the Real World ?



Tembec Inc. Star Truck 1

- Reduced Tare weight by 3000 Kg
- Increased payload by over 1700 t/yr
- No change in maintenance observed
- TPCS = 40% reduction in summer tire wear
- 13% less idling (cab heater)

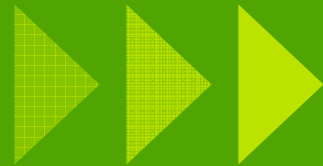
Fleet reduced tare weight by 8%
due to project awareness

J.D.Irving Ltd. Star Truck

- Reduced average tare weight by 1600 Kg
- Increased average payload by 900 Kg

- Maintenance costs 8% lower
- Fuel consumption and CO₂ emissions 9.4% lower

Spec'ing options



Spotlight on trucking technologies



Benefits of Tire Pressure Control Systems

- Improved traction – better mobility
- Extended haul season
- Reduced vibrations – reduced repairs, better comfort
- Reduced tire wear – 25% +
- Improved fuel consumption on forest roads

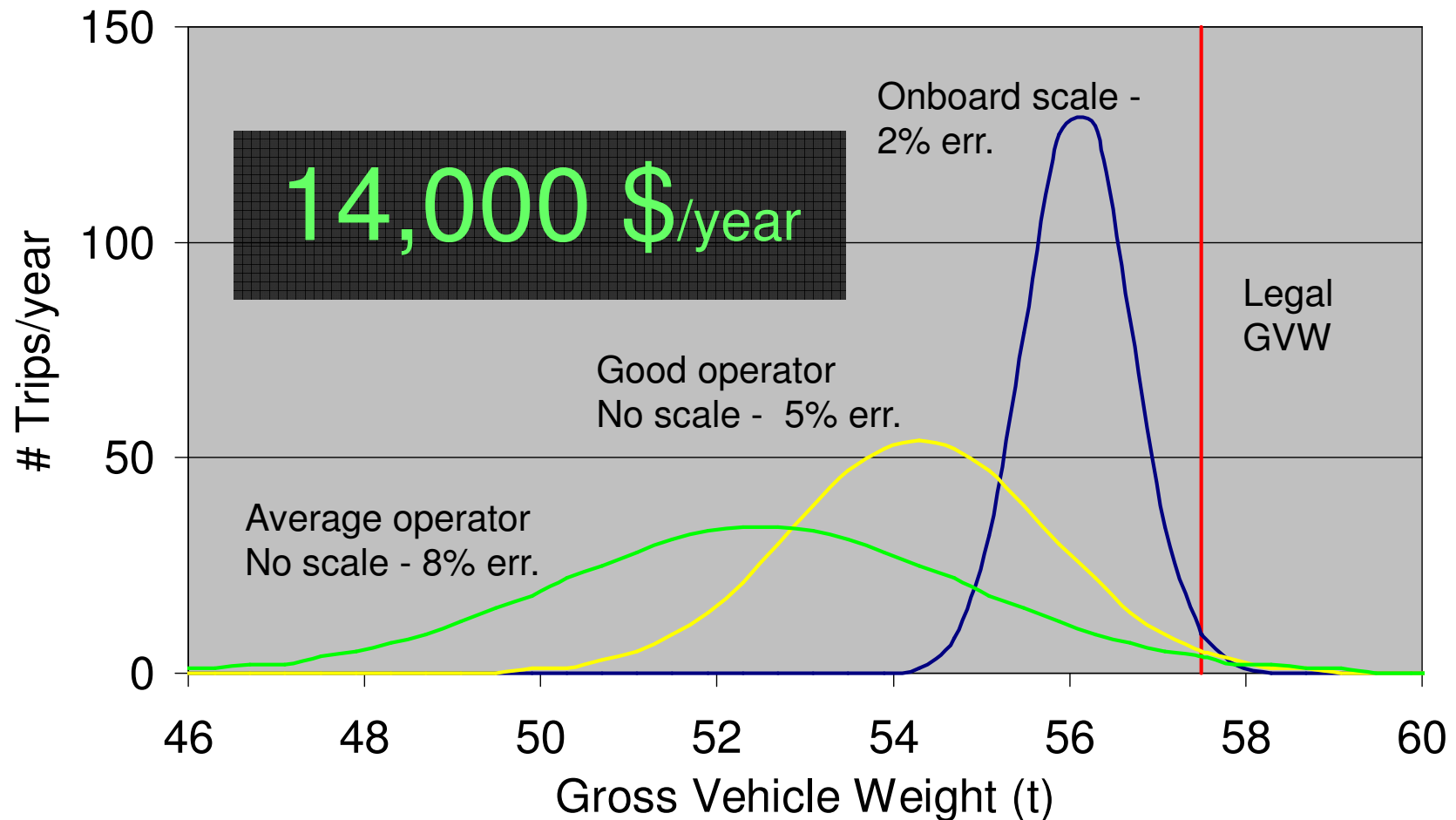


Tire Pressure Control Systems (TPCS)

- Modify tire pressure depending on road conditions
- Long Haul Test :
 - Highway = no difference
 - Muddy road
 - **Empty: 14% (Fuel Economy)**
 - **Loaded: 30% Improvements)**
 - Gravel Road:
 - **Empty: 6%**
 - **Loaded : 2%**



Advantage - Onboard Weigh Scale (2% overweight permitted)



- 500 trips per year
- Scale cost 2 500\$
- Average rate 15 \$/t

Conclusions – Spec'ing Options

- A good vehicle specification has major impacts on productivity, efficiency and profitability
- Return on investment, additional revenues and energy efficiency must all be taken into account
- Examples (Net revenues/year):
 - Aluminum rims = 725 \$
 - Smaller engine = 6 900 \$
 - Onboard weigh scale = 14 000 \$



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FPInnovations R&D in Energy Efficiency

Plan

- Technology evaluation
 - Biodiesel mandate
 - EPA 2010 emissions engines
- Energotest 2007, 2008, 2009, 2010, 2011...
- Composite components

Biodiesel

- A renewable fuel manufactured from vegetable oils, animal fats, and recycled cooking oils.
- Engines can burn 100% Biodiesel, but blends in the B2 to B20 percent ratio are most common.
- Reduces GHG emissions and has improved lubricity and cetane value.
- BC Government 5% biodiesel content in effect now.

Biodiesel – Available now – what to do ?

- In blends of B20 and lower, it can be used like regular petro-diesel.
- Biodiesel has a solvent effect – changing out fuel filter is recommend after the first week of use.
- Ask the vendor to ensure the fuel meets ASTM D6751 and CGSB specifications.

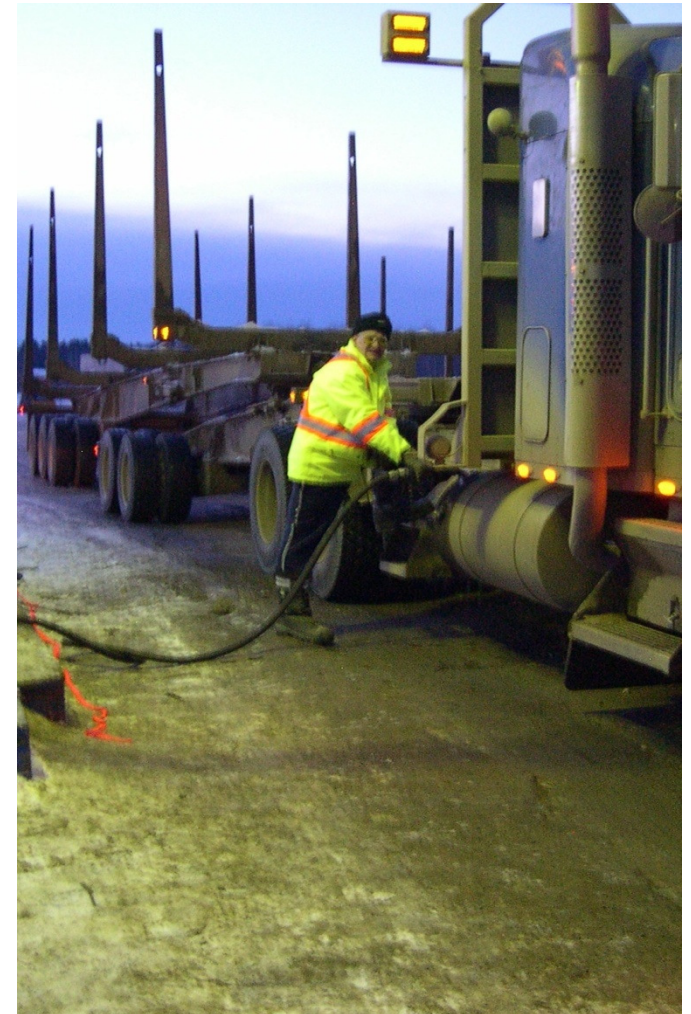
Engine Warranties and Biodiesel – A Brief Summary

Caterpillar	B30 and lower blends & oil analysis recommended.	No restrictions
Cummins	up to B20 in some models, oil analysis recommended.	No restrictions
Detroit Diesel	B5 and lower approved	No restrictions
International	B5 approved and higher blends have disclaimer.	No restrictions
Mack	B5	Soy base only
Volvo	B5	Soy base only

EPA 2010 Emissions Engines w/SCR

CASE STUDY: 2011 Western Star w/560 hp DD15

- Consumed 11.3% less fuel than fleet average
- Consumed 1.55 L/100km of Urea DEF
- Including DEF, consumed 8.8% less fuel than fleet



PIT - Energotest

- Objective: Evaluate potential energy saving technologies in an accelerated manner.
- Tests conducted at Transport Canada's motor vehicle test centre in Blainville QC



Methodology

- Tests based on established TMC/SAE testing procedures
- Track layout: 6.4 km oval
- Test circuit = 15 laps (~100 km) @ 100 km/h





Trailer skirts



Boat tails



Drive axle fenders



Tractor-trailer gap fairings



Wide tires



Tractor-trailer gap deflector



Liberator Muffler



Tree length vs Short wood



**Decreased
following
distances**



**85 psi vs
100 psi**



**Uncoupled
rear
differential**

123



Open chip trailer door

Results – Aerodynamic Devices

Supplier	Technology	Economy (%)
Freight Wing	Trailer skirts	7.2
Advanced Transit Dynamics	TrailerTails™, rear drag reduction device	5.1
Meka Form	Road tractor fenders	1.4
Cascades Transport	Tank shield	1.0
Cascades Transport	Cab space deflector MANAC trailer	1.0

Results – Engine Technologies

Supplier	Technology	Economy (%)
Passing Lane	Liberator muffler, trailer w/48000kg load, Cummins ISX	-0.7
Various	Fuel & Oil Additives	< 2.0
Dynamic Fuel Systems	Jetstar, hydrogen injection	-0.2
Doggett Enterprises	XADO, engine oil additive	-4.2

Results – Rolling Resistance

Supplier	Technology	Economy (%)
Michelin North America (Canada)	Wide Based Tires – X One	9.7
FPIinnovations	B-Train axles up vs. axles down	4.8
Continental	Continental HDL Eco Plus Tires	2.4
MTQ	Impact of tire pressure (85 vs. 100 psi)	-3.1

Results - Various

Supplier	Technology	Economy (%)
El Cargo	Automatic Tarp system	14.93
FPIinnovations	Speed, 98 to 92 km/h reduction	5.12
FPIinnovations	Chip trailer, Impact of opened doors	1.6
FPIinnovations	Tree length vs Short wood	1.3
Cascades Transport	Uncoupled differential	0.1

Conclusions

- Most promising results:
 - Aerodynamic technologies showed a 7% reduction
 - Wide tires showed a 10% reduction
- Emissions tests showed little to no improvement in emissions

Composite Components - Trailer Stakes and Bunks

- **Stakes in fibreglass / polyurethane resin**
 - Uninterrupted process, low production costs
 - Very strong mechanical resistance (on par with steel!)
- **Design objectives**
 - Same strength as steel
 - Must last 7-8 years & maintenance free
 - Competitive pricing
- **Lightest steel stake (on the market) : 76 lb**
- **FPInnovations composite stake: 48 lb**
 - 28 lb less, 37% lighter!
 - 20 stakes = 560 lb (255 kg)

Structural Tests – Testing of Assembly



Structural Tests – Testing of Assembly



FPIinnovations – Energy Efficiency Workshop

Thank You!