



Low Carbon Fuels in the Cement Industry



About Lafarge Canada Inc - A member of LafargeHolcim

- **Lafarge Canada Inc. consists of two separate business units: Western Canada and Eastern Canada. Separated by the Manitoba border**
- **We provide building materials solutions for the construction sector using cement, ready mix concrete, and aggregates.**
- **Lafarge is not just a material supplier**
 - buildings and bridges,
 - brownfield soil remediation,
 - energy,
 - mining and
 - pavement infrastructures.
- **R&D network of more than 1,000 experts, the world's largest building materials research centre in Lyon, France.**

Cement Manufacturing in Ontario

- **Cement manufacturing operations at 7 locations across the Province:**
 - **Essroc Italcementi Group** – Picton
 - **Federal White Cement Ltd.** – Woodstock
 - **Holcim (St. Lawrence Cement)** – Mississauga
 - **Lafarge Canada Inc.** – Bath and Woodstock (*in care and maintenance mode*)
 - **St Marys Cement Group** – Bowmanville and St Marys

- **Sector makes important direct contributions to the Ontario economy (jobs, taxes, community donations)**
 - **Produced:** 7.3 MT of cement in 2007 -- **45% of national production**
 - **Exported:** 3.1 MT of cement to USA in 2007 -- **over 42% of provincial production**

- **Cement makes an important contribution to the Provincial and regional economy (direct \$1 billion and 1,000 jobs; indirect \$5 billion/15,000 jobs), allowing the province to be fully self-sufficient in meeting demand:**
 - Infrastructure renewal and expansion
 - Cement and concrete products play an important role in making Ontario's infrastructure more sustainable and energy efficient

A Quick Carbon Quiz

What percentage of the world's CO₂ emissions are generated by the cement industry?

5%

If the worldwide cement industry was a country, what would our rank be in terms of CO₂ emissions?

5th

More concrete sold than all other building materials combined? (True/False)

True

Can smart concrete design lead to net-zero homes and buildings?

Yes

Can we cure “concrete” with CO₂ instead of water?

Yes

Project background

cement 2020

- **What is Cement 2020**
 - To move the Canadian Cement Industry to a world leading position in terms of sustainability
 - Lafarge Bath plant as a demonstration site
 - Energy, water, social, economic, carbon, biodiversity, etc
- **What are low carbon fuels?**
 - A combination of virgin and non-virgin biomass materials and other materials that result in lower carbon emissions than the reference fuel (coal/coke), on a GJ to GJ basis
 - Materials selected for testing arose from a Request for Proposal process to local businesses
 - Two main categories:
 - Fuel derived from “waste” sources
 - Fuel derived from “virgin” sources
 - Bath plant uses imported coal and petcoke today
- **Demonstration Pilot**
 - 75 tonnes per day, 3 years (75 tpd = approx. 10% co-fire)
 - Partners include: Queens, Pollution Probe, and the Cement Association
 - All fuels are expected to lower emissions

LCF Demonstration Pilot

Phase 1 Underway

Simplified Approved Fuel Types for Testing

- **Treated wood (Railway Ties, Telephone poles, etc)**
- **Asphalt shingles**
- **Construction & Demolition waste**
 - C&D; floor laminates; wood treated with organics; non-recyclable packaging
- **Pre-Consumer, Post-Diversion**
 - Coffee roasting chaff; materials made predominantly from biomass (excluding biomass from animals, biomass from food processing and preparation operations, and odourous biomass); manufacturing end rolls and cores; carpet cuttings; textiles; paper fibre/wood/plastic composite materials; sawdust; woodchips
- **Post-Consumer, Post-Diversion**
 - cardboard; banknotes; disposable beverage cups and lids; non-recyclable paper, fibre packaging and related similar products; printed paper; paper towels; materials made predominantly from biomass (per above)

Suggested for Phase 2

Low Carbon Fuels: Chemistry

Biogenic carbon is deemed carbon neutral

- **Combustion is a chemical reaction that oxidizes carbon based fuels into water and carbon dioxide.**
- **Some fuels produce less CO₂ per Gigajoule of heat release**



Ultimate analysis gives you x, y, and z

This can be calculated and lead to kg of CO₂ produced

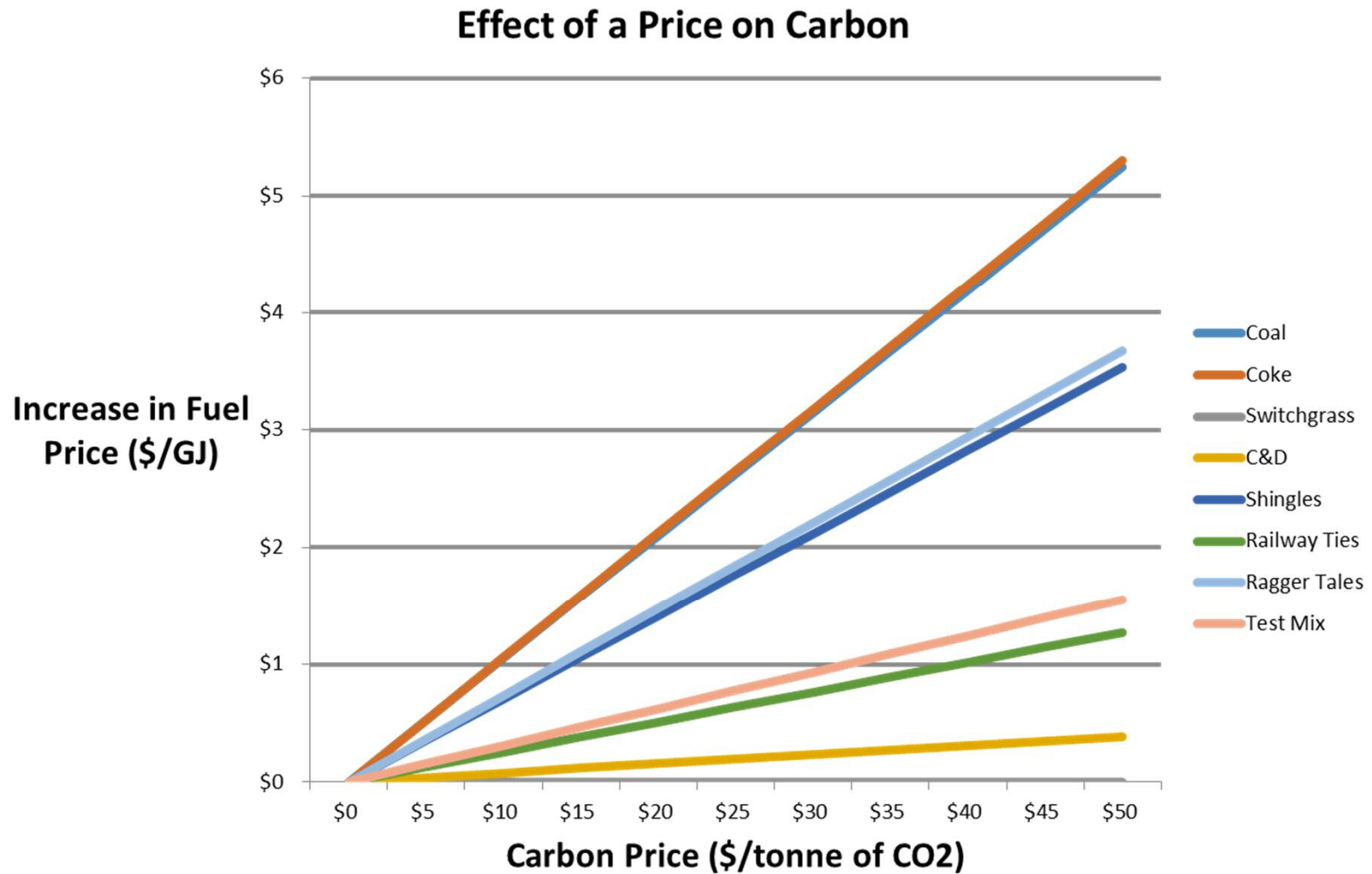
You need this to correct from “High Heat Value” to “Low Heat Value”

Proximate analysis gives you this (but correct to lower heating value on an “as received basis”)

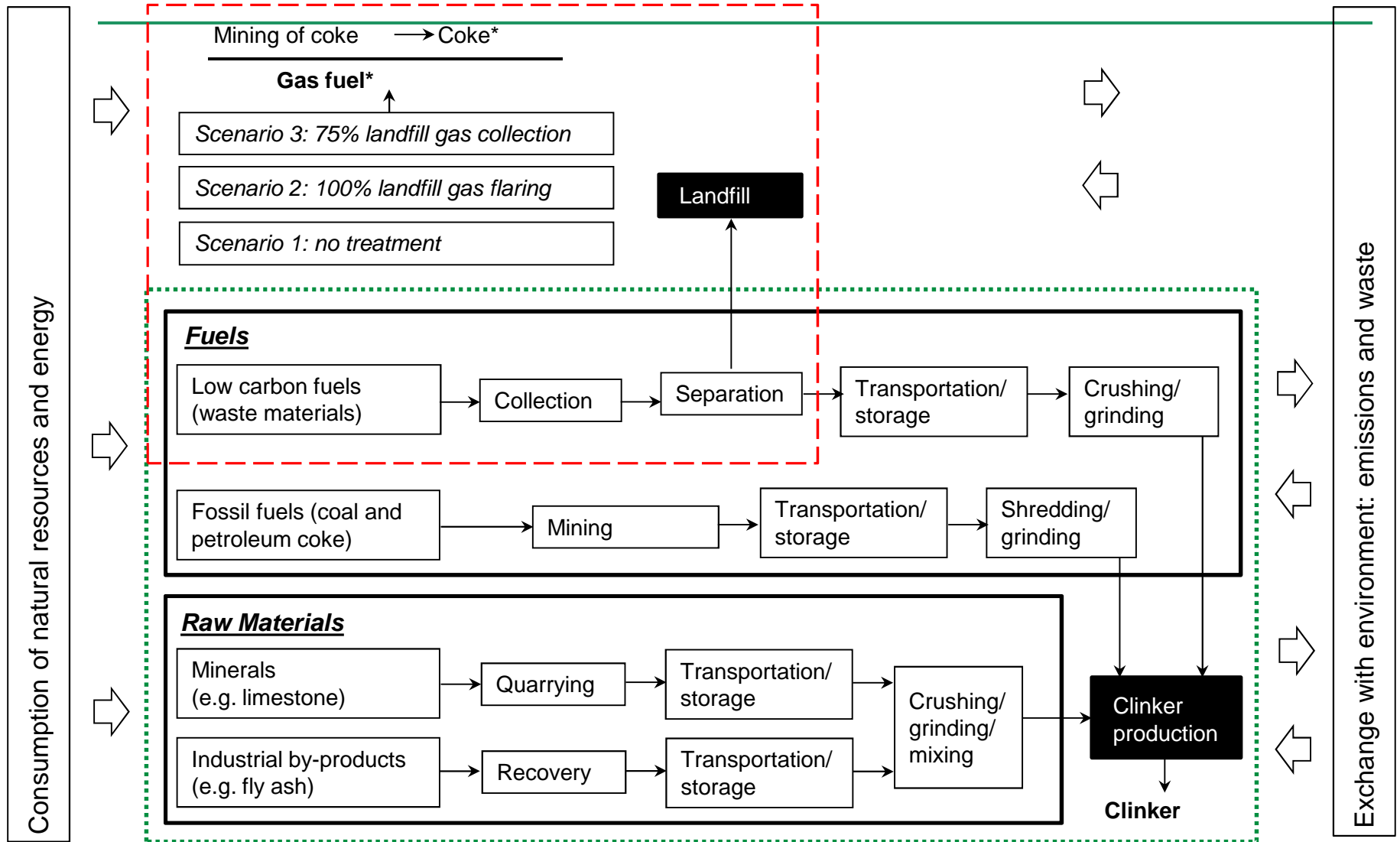
So what does all of this mean to the cost of fuel purchases with a Price on Carbon added in?




Putting it all together



LCA system boundary



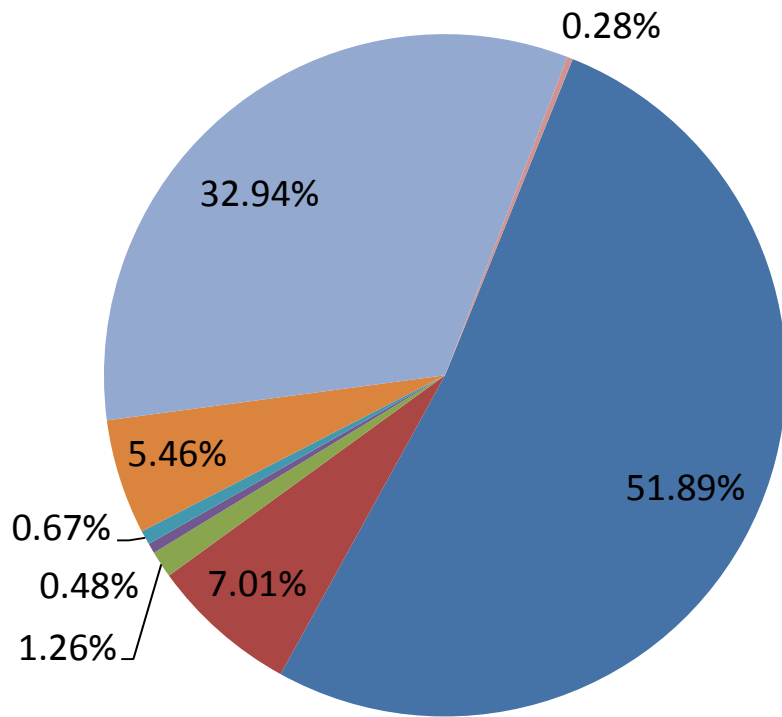
 System boundary for landfill pathway

 **LAFARGE** A member of  System boundary for clinker production pathway

Global warming potential composition

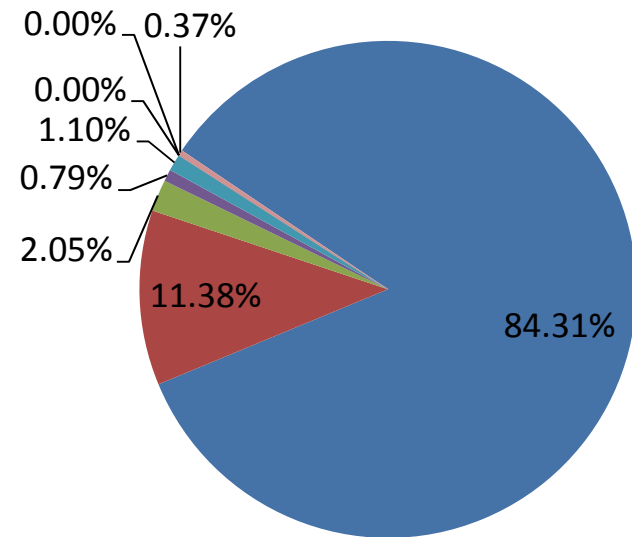
☐ GHG emission decreases by 39% as all fossil fuels are substituted by LCFs.

Baseline: 99% coke + 1% coal
1.01 t CO₂-e/t clinker



- Calcination
- Natural gas
- Electricity
- Fuel combustion

LCF: 100% C&D wood
0.62 t CO₂-e/t clinker



- Raw material production
- Transport (raw material)
- Fossil fuel production
- Transport (fuel)

LCF Emissions Analysis

Example: Lead

- Mean values:
 - 2014 LCF: 2.616 $\mu\text{g}/\text{m}^3$ @ 11% O_2
 - 2014 Baseline: 3.605 $\mu\text{g}/\text{n}$ @ 11% O_2
 - 2012: 1.557 $\mu\text{g}/\text{m}^3$ @ 11% O_2
 - 2010: 25.57 $\mu\text{g}/\text{m}^3$ @ 11% O_2

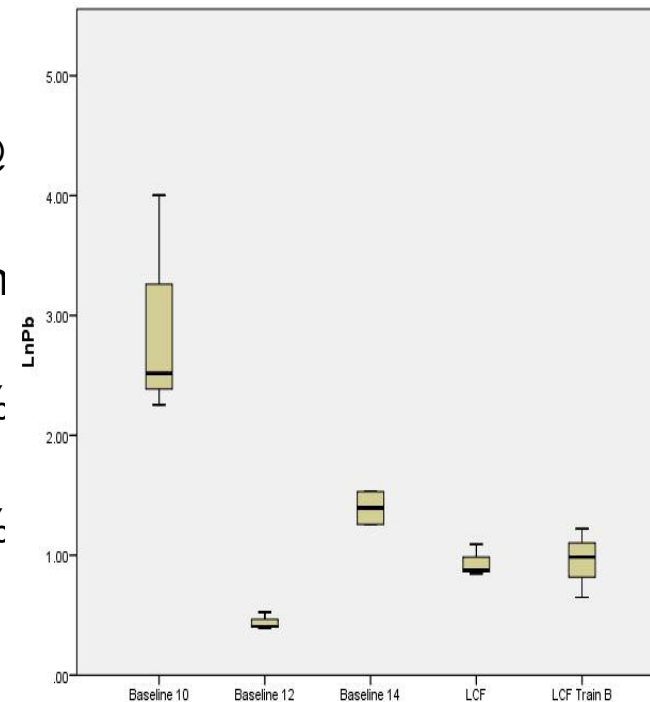


Figure 4: Lognormalized Lead Box and Whisker Plot

PARTITIONING FACTOR

Definition: the proportion of metals from the raw materials or fuel that becomes part of the product AND ARE NOT RELEASED INTO THE ATMOSPHERE

	Inputs		Outputs		
	(Coal/Coke)/biomass (90:10)	Raw mix	Stack Emissions	Clinker by difference	Partitioning Factors
Cobalt	26.0	506.8	0.126	533	99.976%

Low Carbon Fuel Specifications

- **Heating value**
 - > 14 GJ/tne (Lower HV)
- **Size**
 - 90% passing 10 mm (3D)
 - 90% passing 25 mm (2D)
- **Water content**
 - < 15%
- **Other**
 - Homogeneous
 - Low carbon (net)
 - Low heavy metals
 - Low or good ash
 - Low chlorine (< 500 ppm)
 - Tramp non-combustibles removed



The new Alternative Low Carbon Fuels Regulation – what does it mean in practice?

What it means

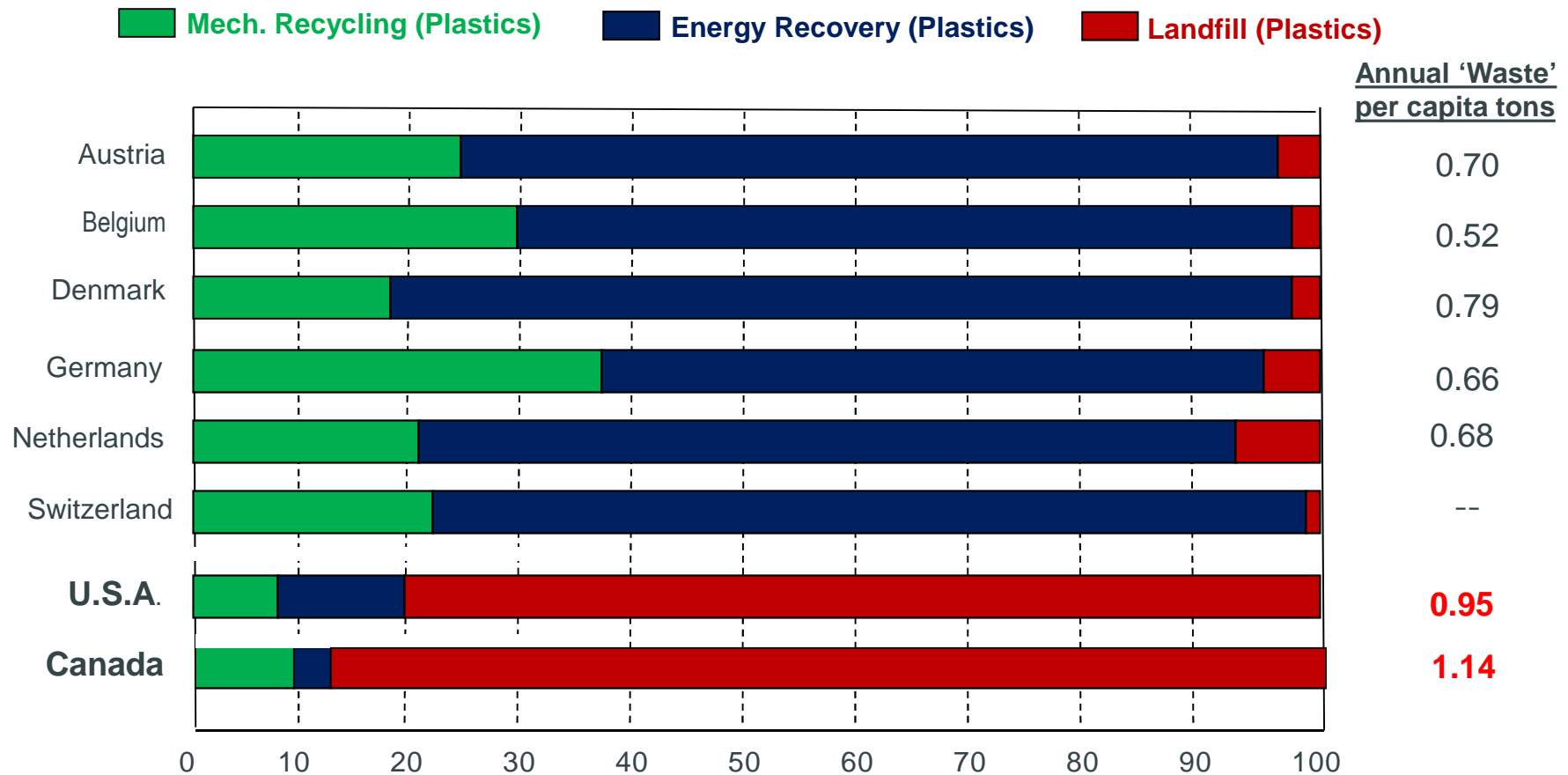
- **Fuel Replacement now has a home in the complex Ontario waste regulatory world**
- **Low carbon fuels recognized as a much needed tool to reduce Ontario's GHG emissions from Cement, Steel, Lime sectors**
- **Recognizes it as fuel use, not waste disposal**
 - No scary language needed when communicating
 - A long overdue PARTIAL shift in mindset
- **A slightly more streamlined Approval process**
 - Builds in reliable 30-day test Approval process
 - Approval with test results in a second step

What it does not mean

- **Danger to recycling**
 - More to come on this
- **No environmental consultation**
- **No environmental requirements**
- **Free pass to become a Material Resource Recovery Facility (MRRF)**

Does Fuel Replacement endanger recycling?

Energy Recovery Improves Diversion from Landfills



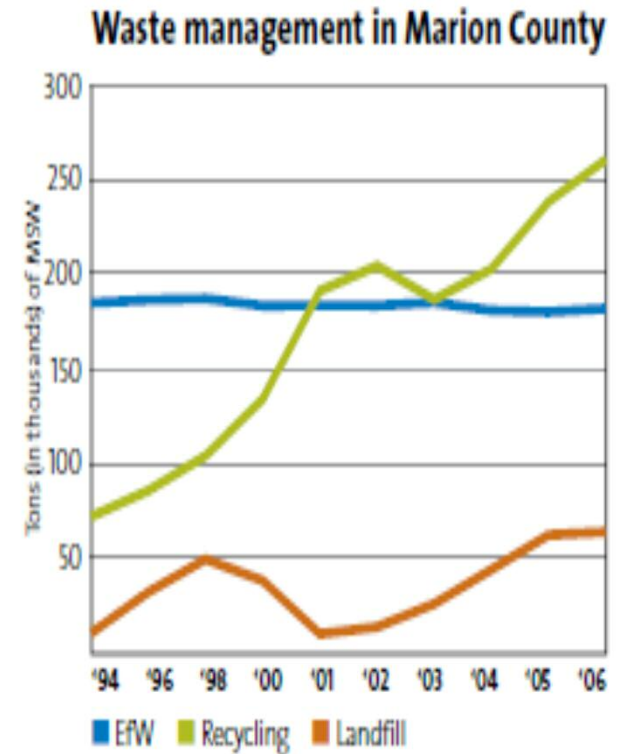
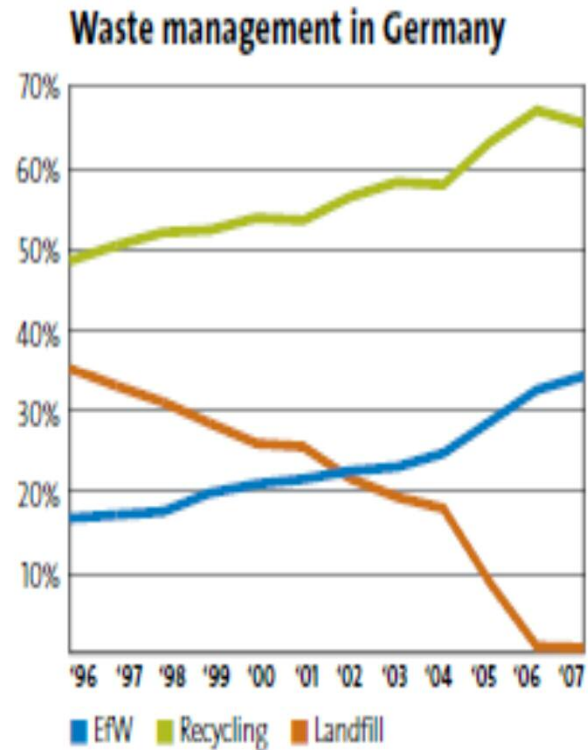
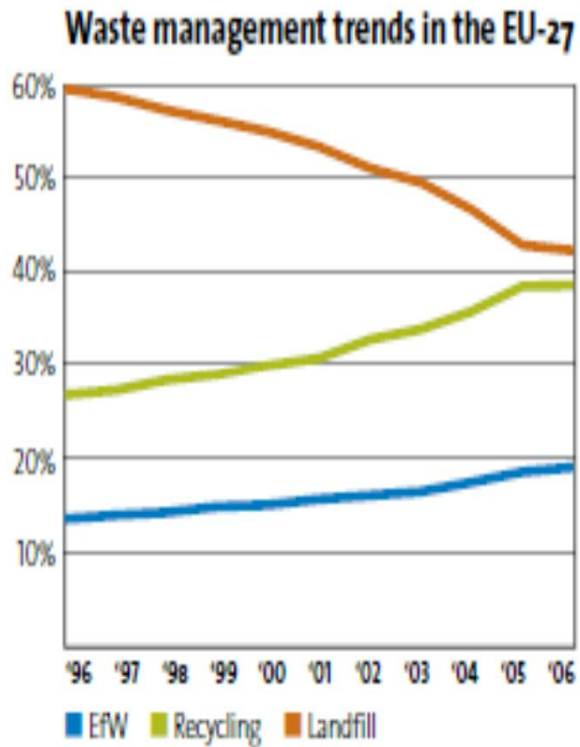
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Sources: European Environmental Agency / Plastics Europe / U.S. EPA / CPIA / Covanta Energy

* USA & Canada includes composting



Recycling Increases In The Presence Of Energy Recovery



Source: Covanta EFW Report 2009/2010

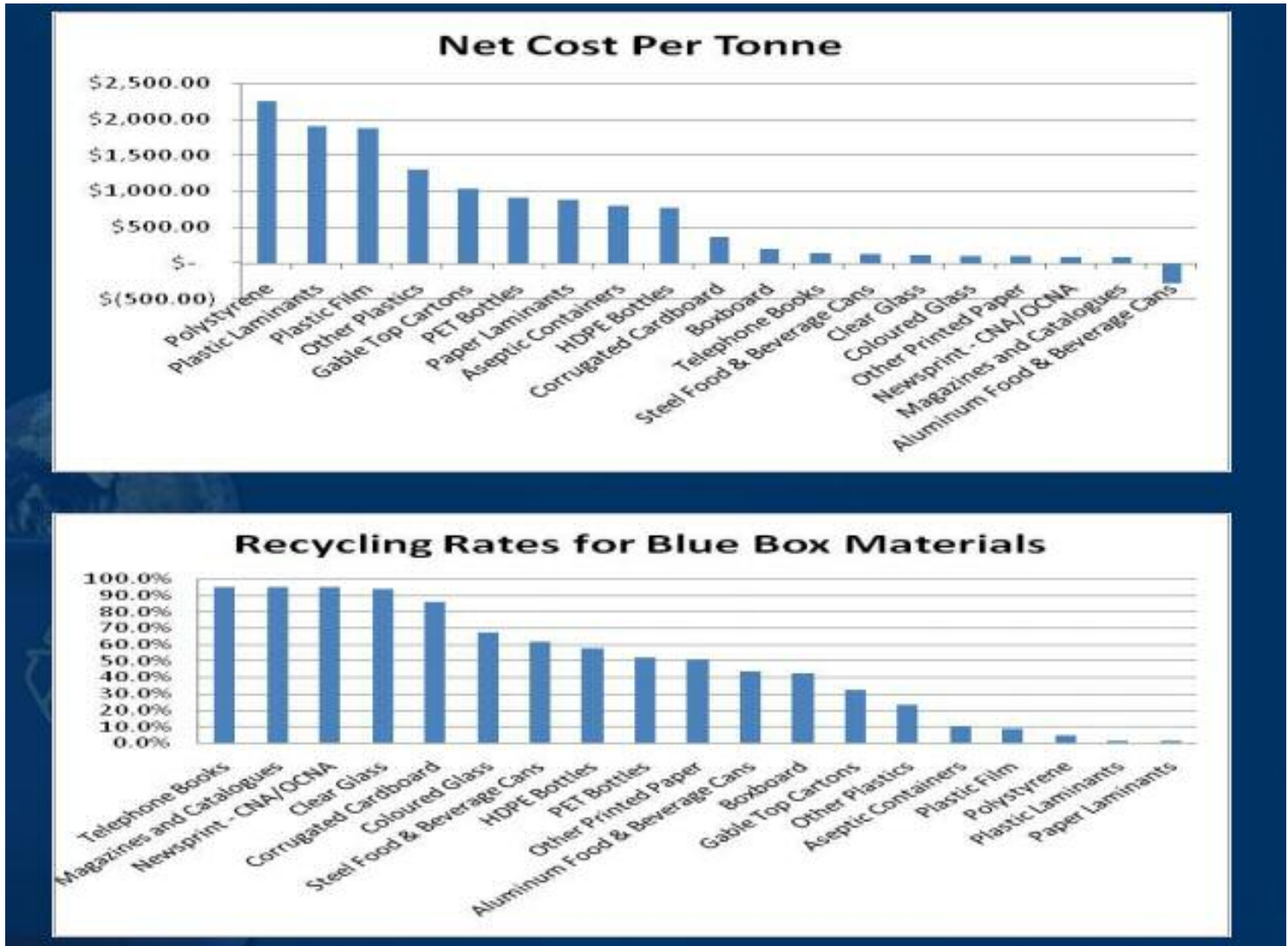
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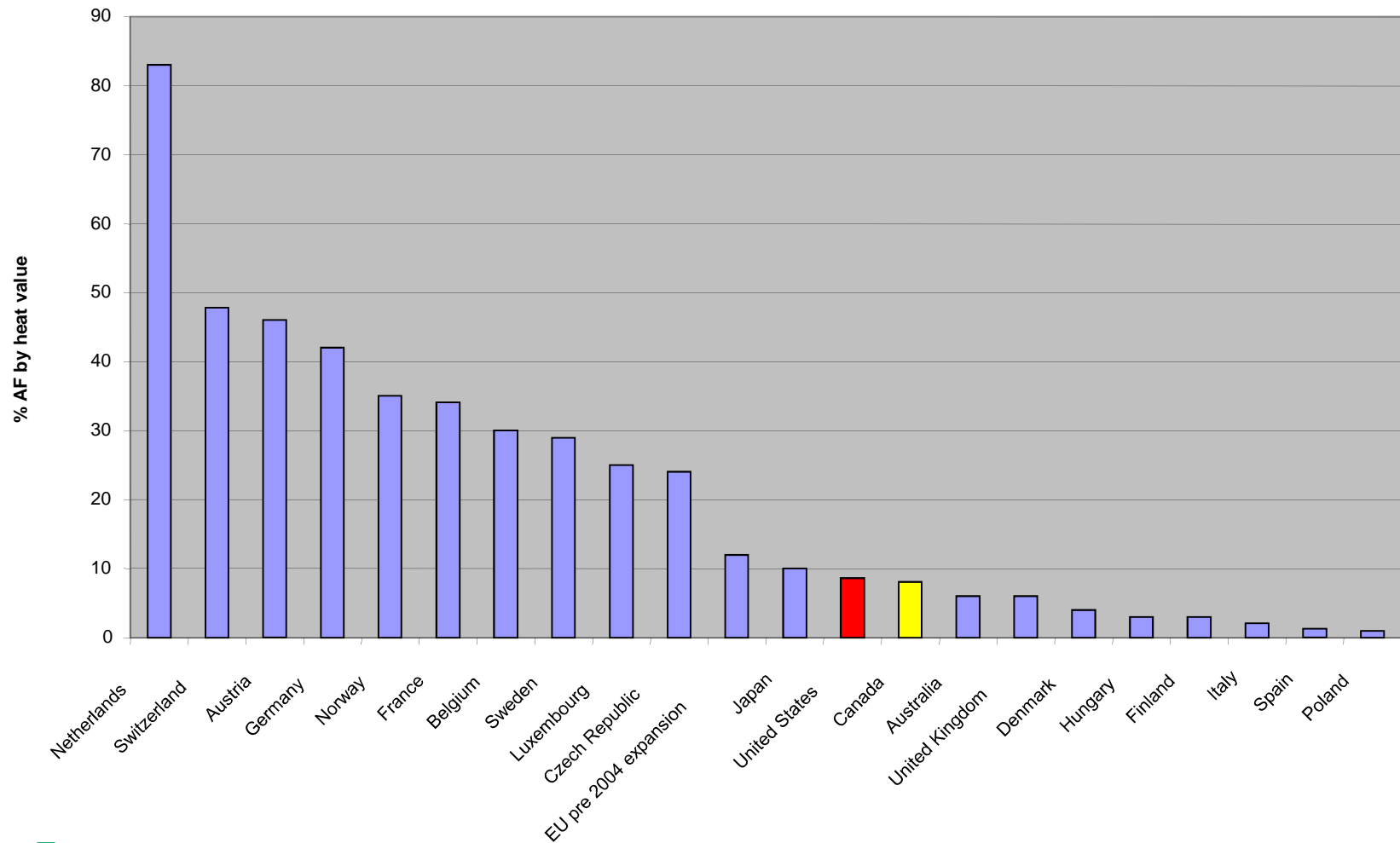
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Limits to Recycling

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Non-Fossil Fuel Use in Cement Plants (2002)



One Last Thought.....

Cement kilns don't "dispose" of "waste" fuels for the same reason your car isn't a gasoline disposal system.

Low Carbon Fuel is an engineered product arising from the circular economy.



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