Sustainable Concrete: Fact or Fiction

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Holcim

Today…

- Introduction (concrete, sustainability & Holcim)
- New Zealand Used Oil Recovery Programme
- Uptake of CO_2 in New Zealand Concrete
- Capture of Flue Gas CO_2 Using Algae

Concrete

- Aggregate
- Water
- 10% Cement
- New Zealand Made

Sustainable Attributes

- ✓ Thermal Comfort
- ✓ Durability & Longevity
- ✓ Fire Performance
- ✓ Safe, Robust and Secure
- ✓ Acoustic Performance

MYTH BUSTER

- **True or False?**
  One tonne of concrete produces one tonne of carbon dioxide…

- **<u>FALSE</u>**

NZ CEMENT INDUSTRY

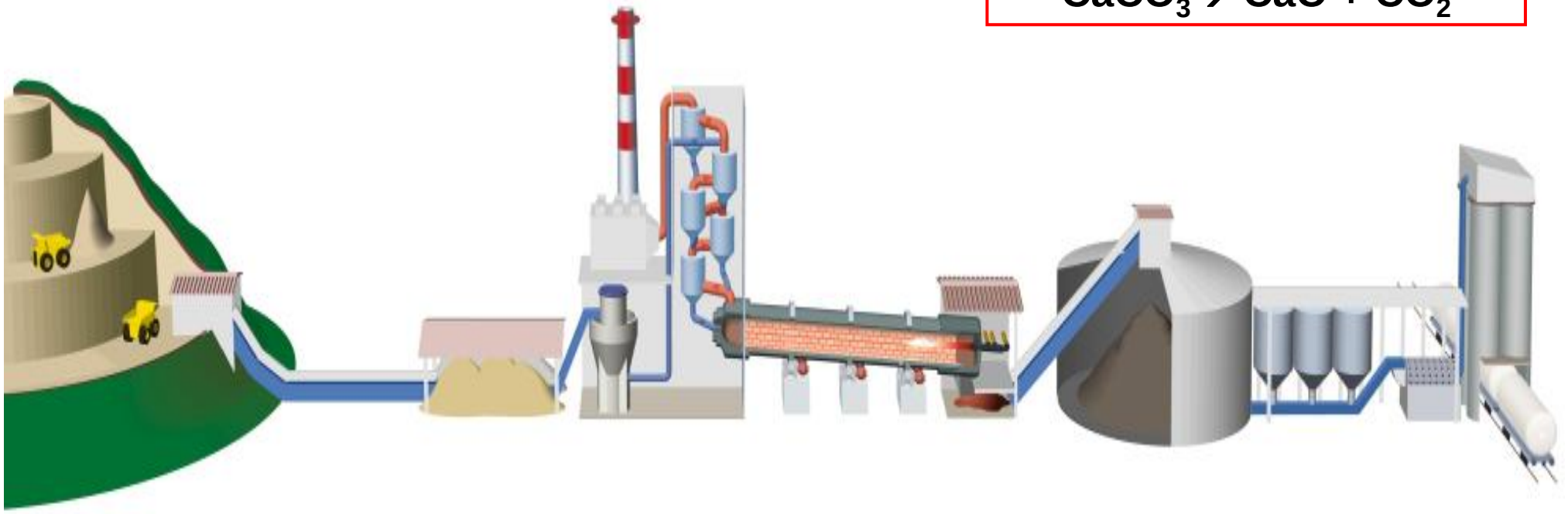
Specific CO_2 Emissions = 850kg/t

~50% Fuel CO_2

Carbon + $\Delta H \rightarrow CaO + CO_2$

~50% Process CO_2 limestone calcination:

$CaCO_3 \rightarrow CaO + CO_2$



Specific CO_2 in New Zealand

- Cement (CCANZ,2007) = 850kg/t
- Aggregate Production* = 4kg/t
- Ready Mix Production* = 3kg/t
- Concrete (MP30 standard mix) = 96kg/t

* Source: Holcim averaged data, excluding transportation

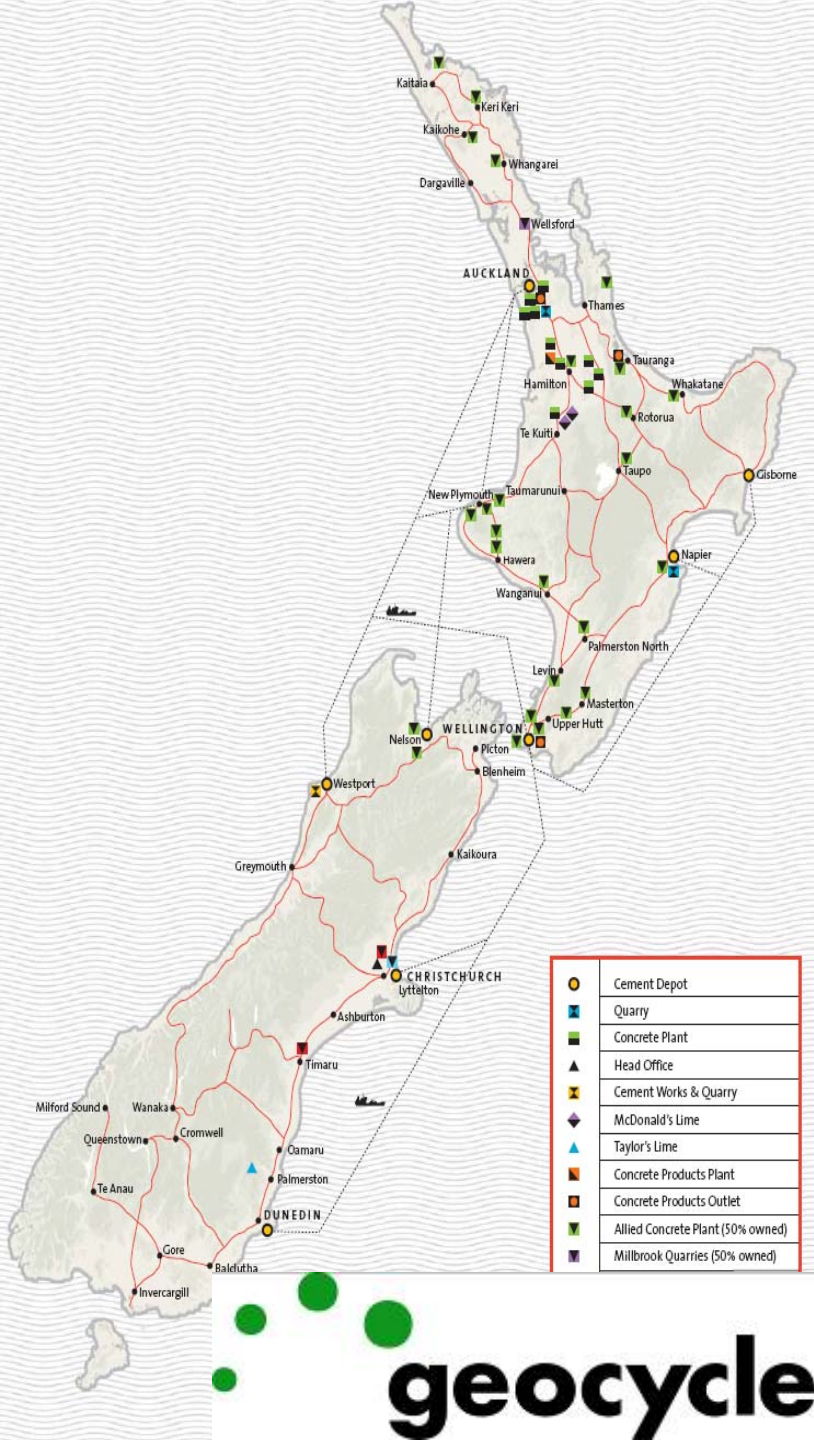
Holcim (New Zealand) Ltd Environmental Highlights:

- ISO14001 Certification Achieved for all 35 Sites
- 20.1% Reduction in specific CO_2 since 1990
- Biodiversity – Partnership with World Conservation Union
- Holcim Foundation for Sustainable Construction

Holcim GlassCrete:
The Brewery Made of Glass

NZ Used Oil Recovery Programme

- Established in 1995
- Cement ships back loads
- 40% of New Zealand used oil - 11 million litres
- Best Available Technology for the disposal of used oil in New Zealand



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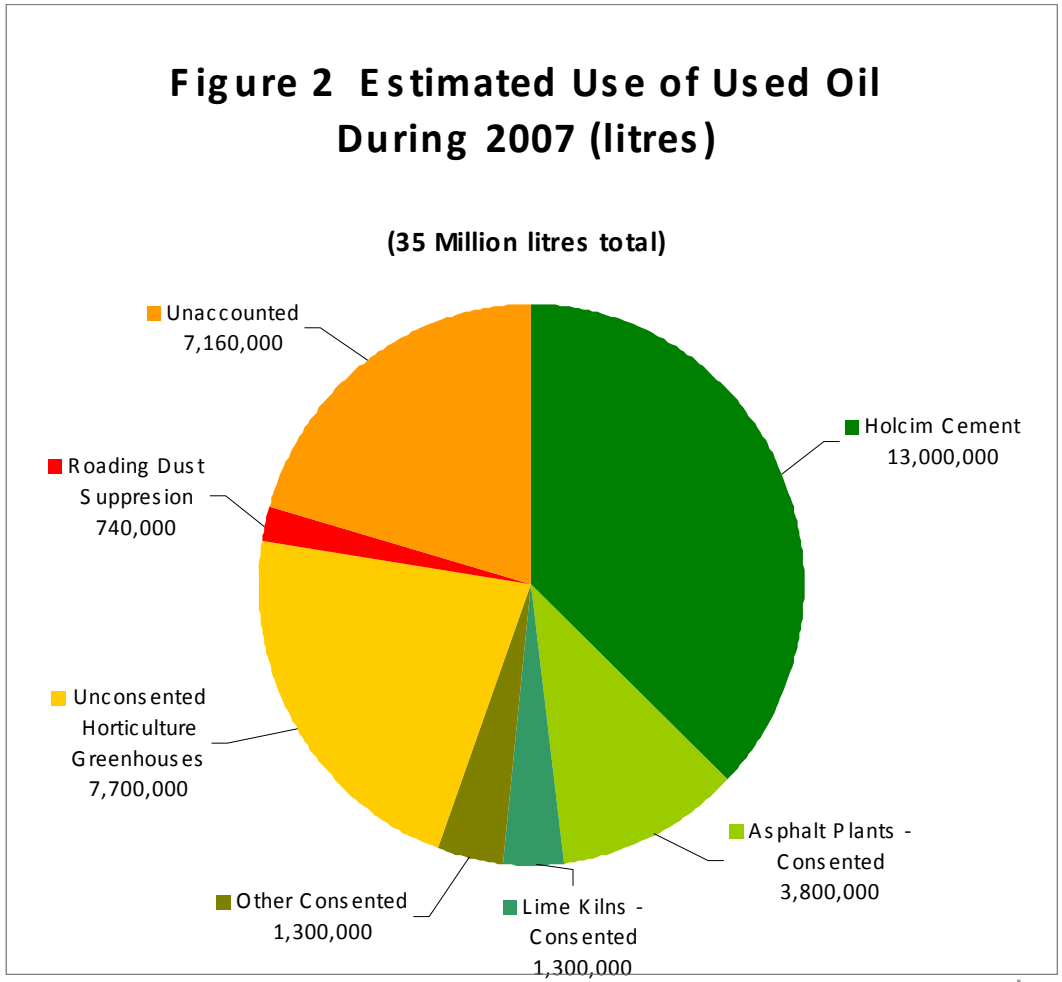
geocycle

Alternatives Disposal Methods

- Greenhouse Industry
- Industrial & Domestic Heating
- Road Dust Suppression
- Dumped



Benefits of the New Zealand UORP

- Transparent, environmental secure & fully monitored

- Cement manufacturing at approx. 1480ºC with gas temp up to 2000ºC

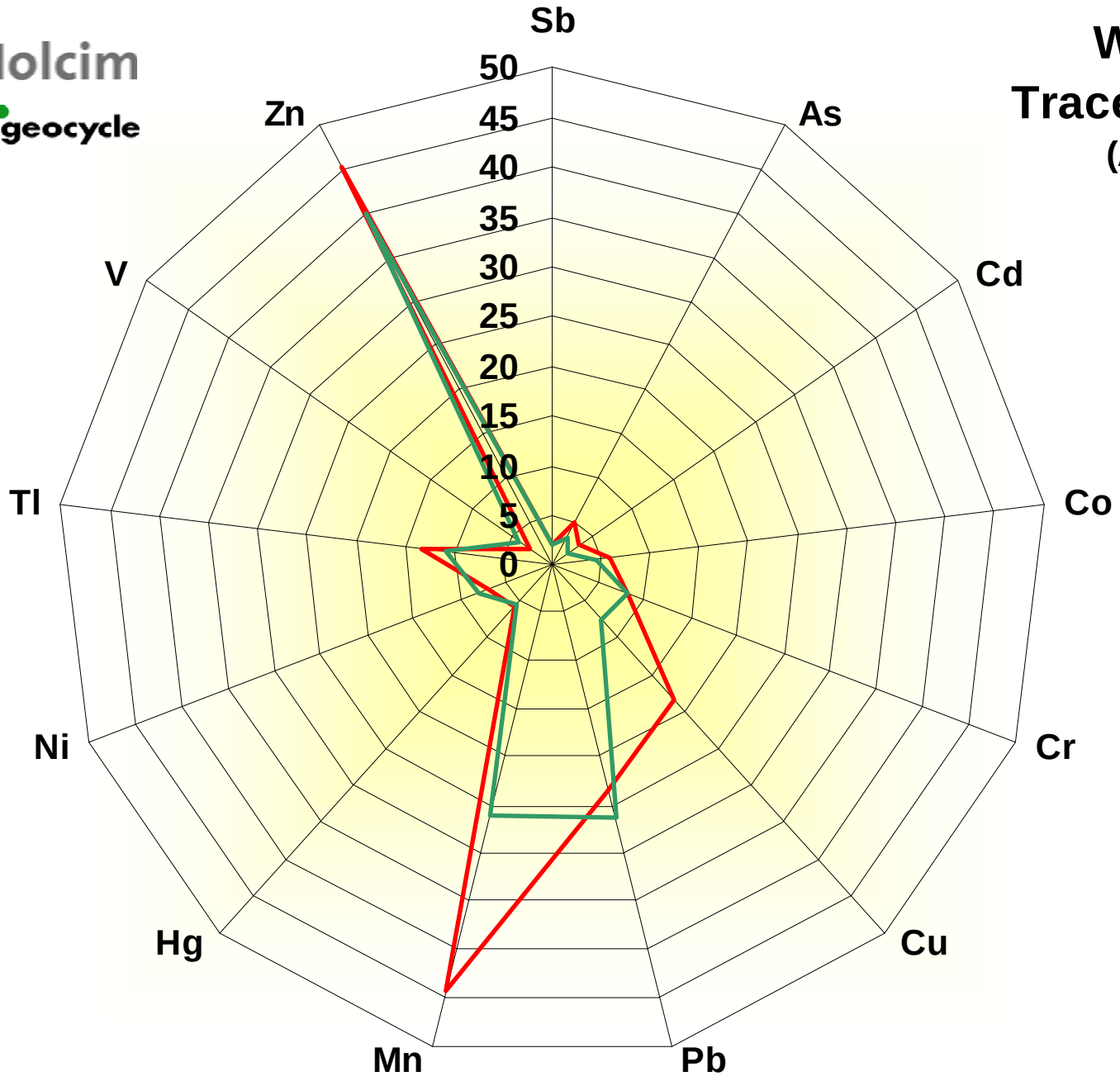
- Gas residence time 6 sec >1,000ºC

- Ash and contaminants are incorporated into the cement

Emissions Monitoring & Reporting

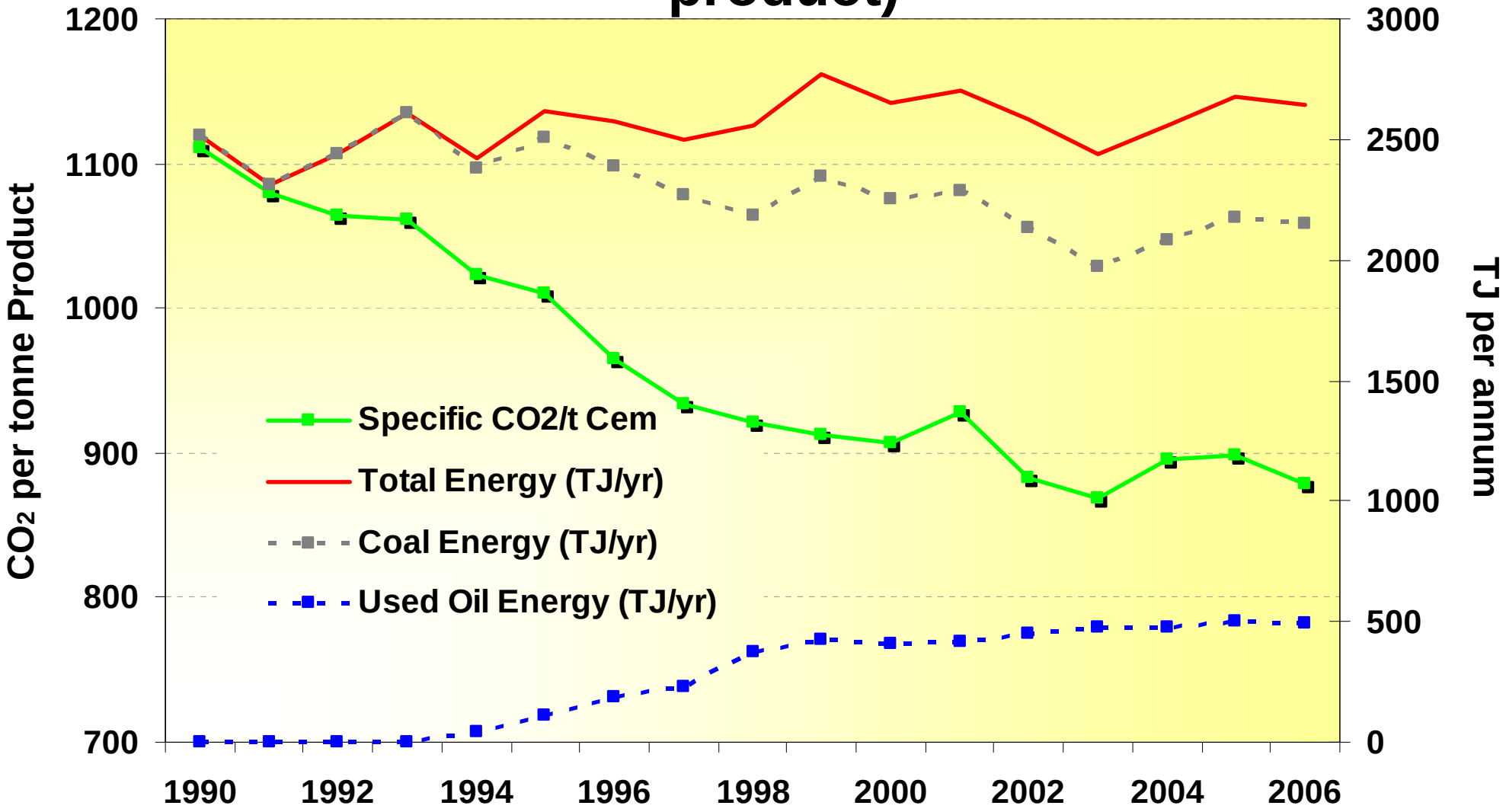
- Pre-Burn Oil Quality
- Continuous Emissions Monitoring SOx, NOx, CO, PM and VOC
- Independent Biannual Stack Tests - Gases, Metals, Benzene, NH_3, HCl, Dioxins & Furans

Westport Works
Trace Metals Emissions
(Average 1996-2006)



All units: μg/Sm^3

Westport Works CO_2 Emissions ($kgCO_2$/t product)



Duelling Billboards…

CONCRETE

THE RESPONSIBLE CHOICE

CONCRETE SOAKS UP CO_2

SUSTAINABLE BUILDING SOLUTIONS

www.sustainableconcrete.org.nz

Concrete^3

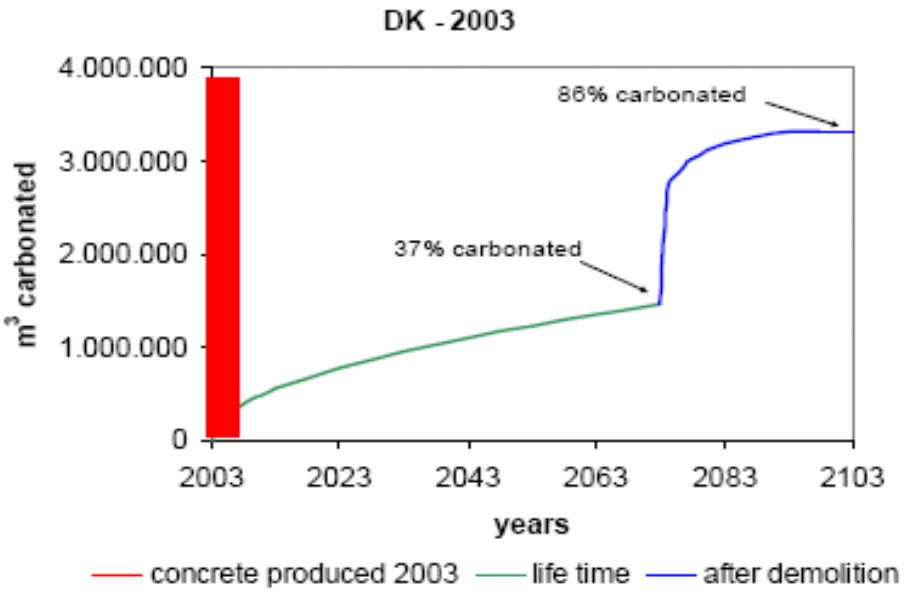
Recarbonation

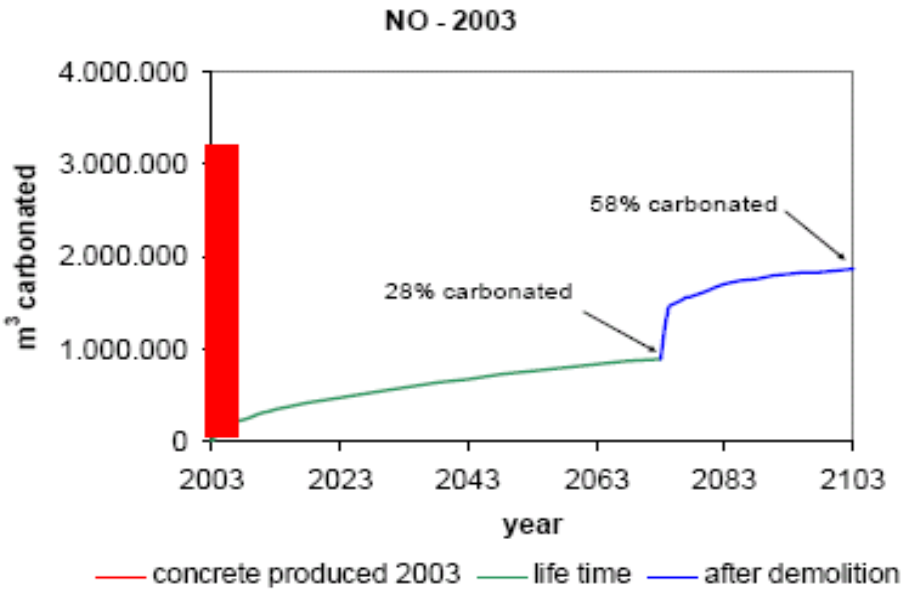
$$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$$

- Initial carbonation during service life
- Rapid recarbonation with demolition and crushing

(Pade and Guimaracs, 2007)

Nordic Research (Pade and Guimaracs, 2007)





The Project

- Investigate whether recarbonation was a measurable phenomenon in NZ concrete
- Collected real-world samples of concrete
- Assess the extent of the recarbonation in NZ & compare results with Nordic research
- Preliminary Investigation - Identify opportunities for further work

Test Methodology

- XRF
- Carbonation titration
- Phenolphthalein test

Results …

3 months

15 Years

84 Years

50 Years

57 Years

Ongoing Work

- Modern cement & concrete testing in a controlled environment
- Future estimates of recarbonation
- Optimum age and crushing sizes
- LCA of concrete v other building materials

Team Holcim Dragons - 2008

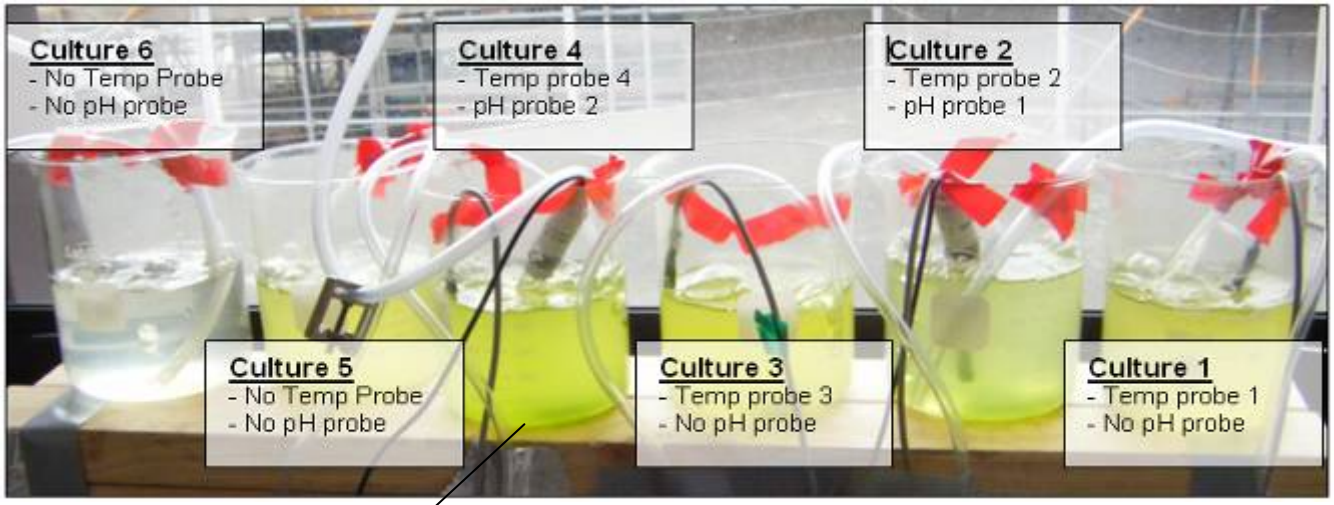
Mission:

"to investigate a technically feasible algae system concept to reduce the overall carbon dioxide emissions from the Westport cement kiln by 10%."

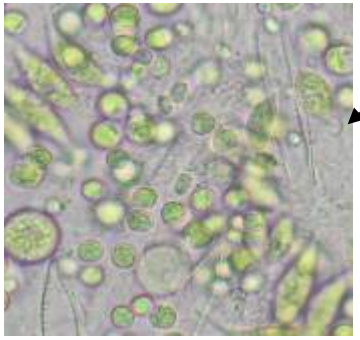
Research – Systems

- Open farming systems

- Closed bioreactor systems



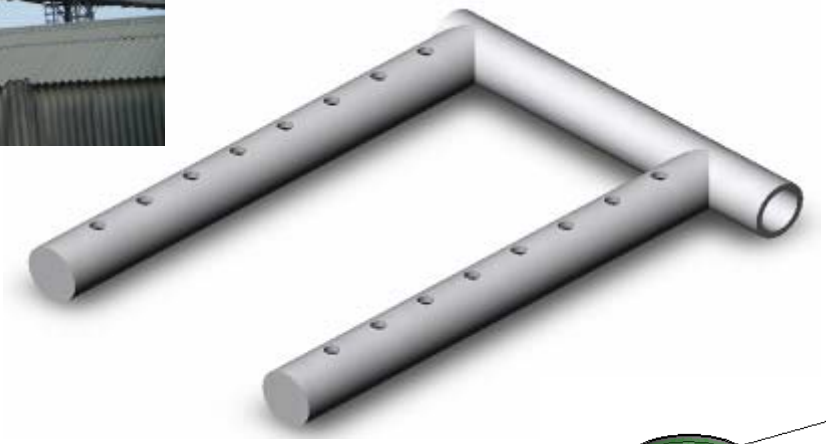
Experimental cultures as set up



Algae under the microscope

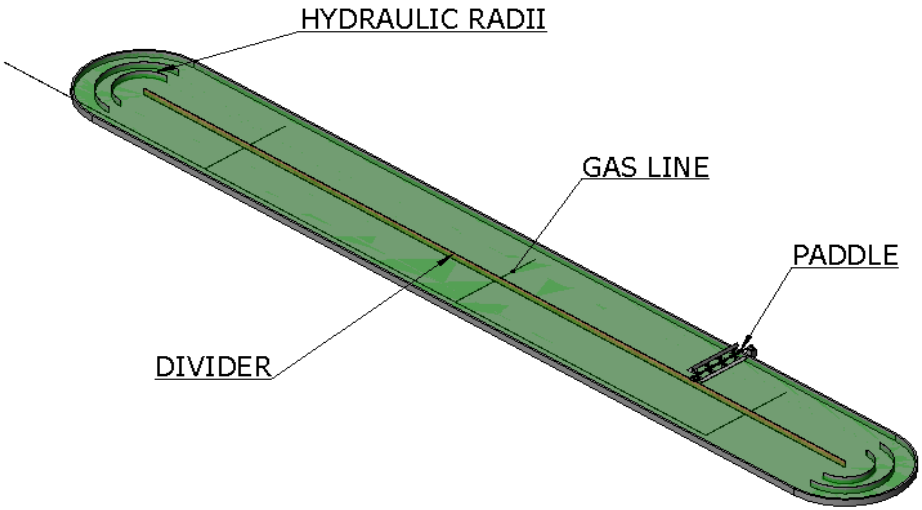
Experimental equipment

Design Components



- Technically feasible

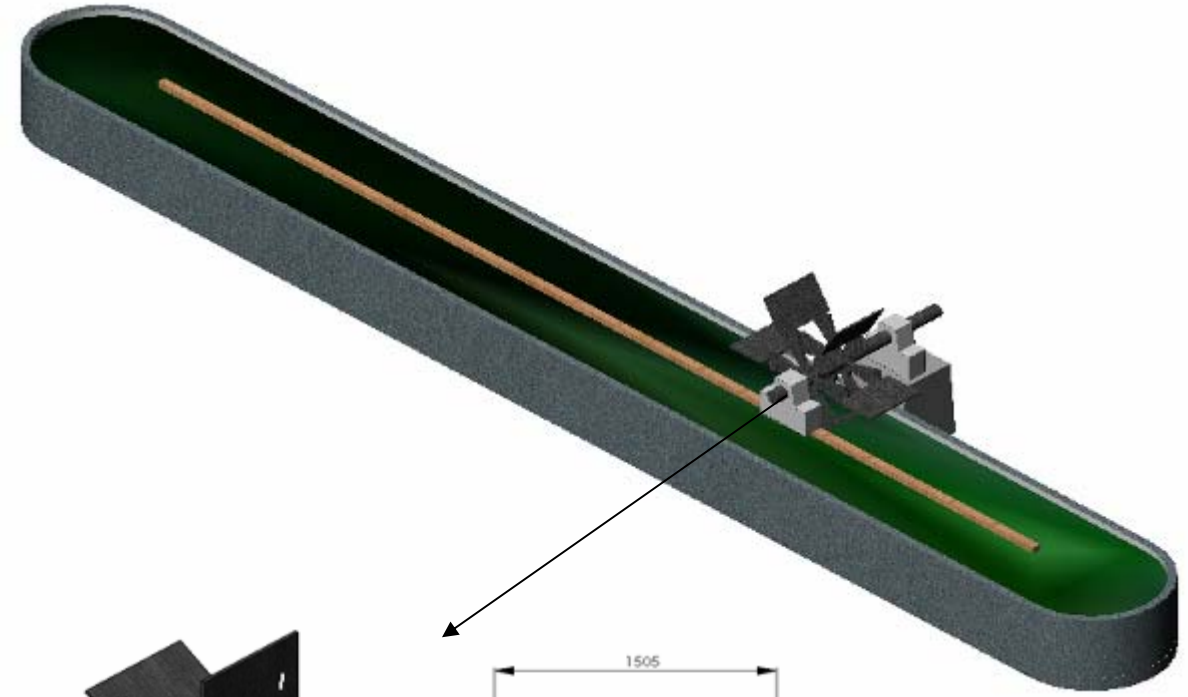
- Prohibitively expensive!

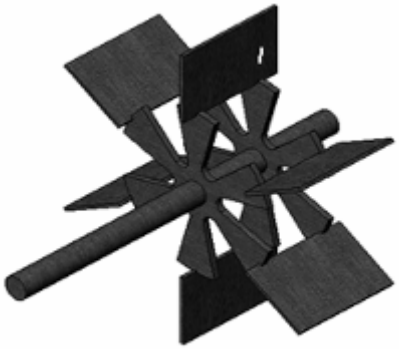


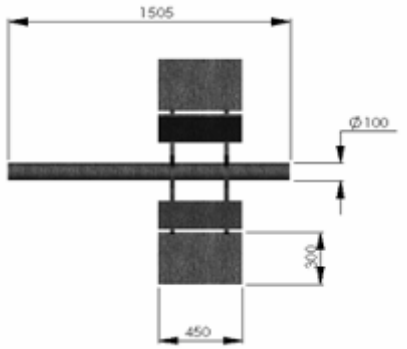
Pilot implementation plan

Three 10 m x 1 m ponds:

- One continuous feed flue gas
- One intermittent feed flue gas system based on pH level
- One control with no flue gas input







Conclusions

- Concrete as a building material has many sustainable attributes, particularly when a LCA approach is taken.

- Process efficiencies and the continued use of used oil by Holcim have significantly reduced the emissions of CO_2 from the manufacture of cement.

- Holcim's research into understanding and reducing CO_2 is aimed at providing sustainable solutions for New Zealand's built environment.

Thank You

Enjoy Your Conference

Acknowledgements:

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