Anna Maria Workshop IX

How the sustainability challenge IS reshaping our cement and construction industry

Waltter Lopez

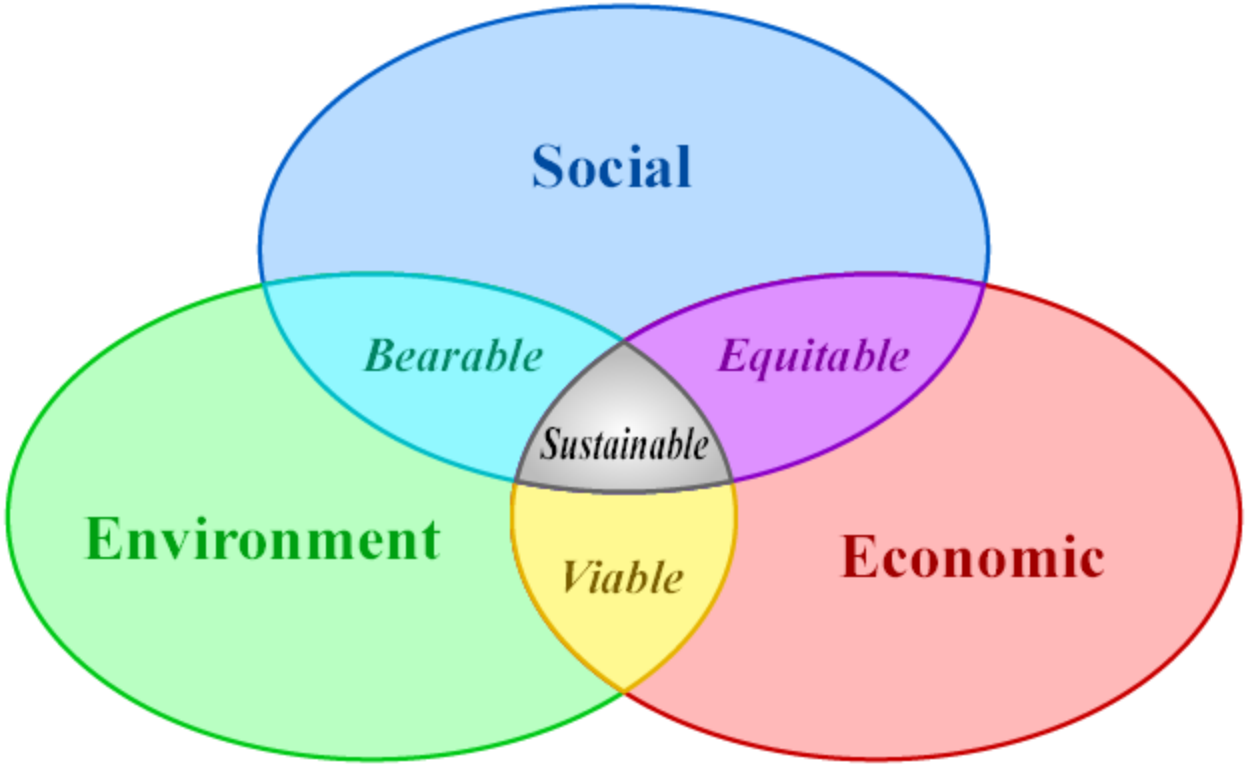
Anna Maria Island, FL
November 11-14, 2008

Sustainability Definition (1987)

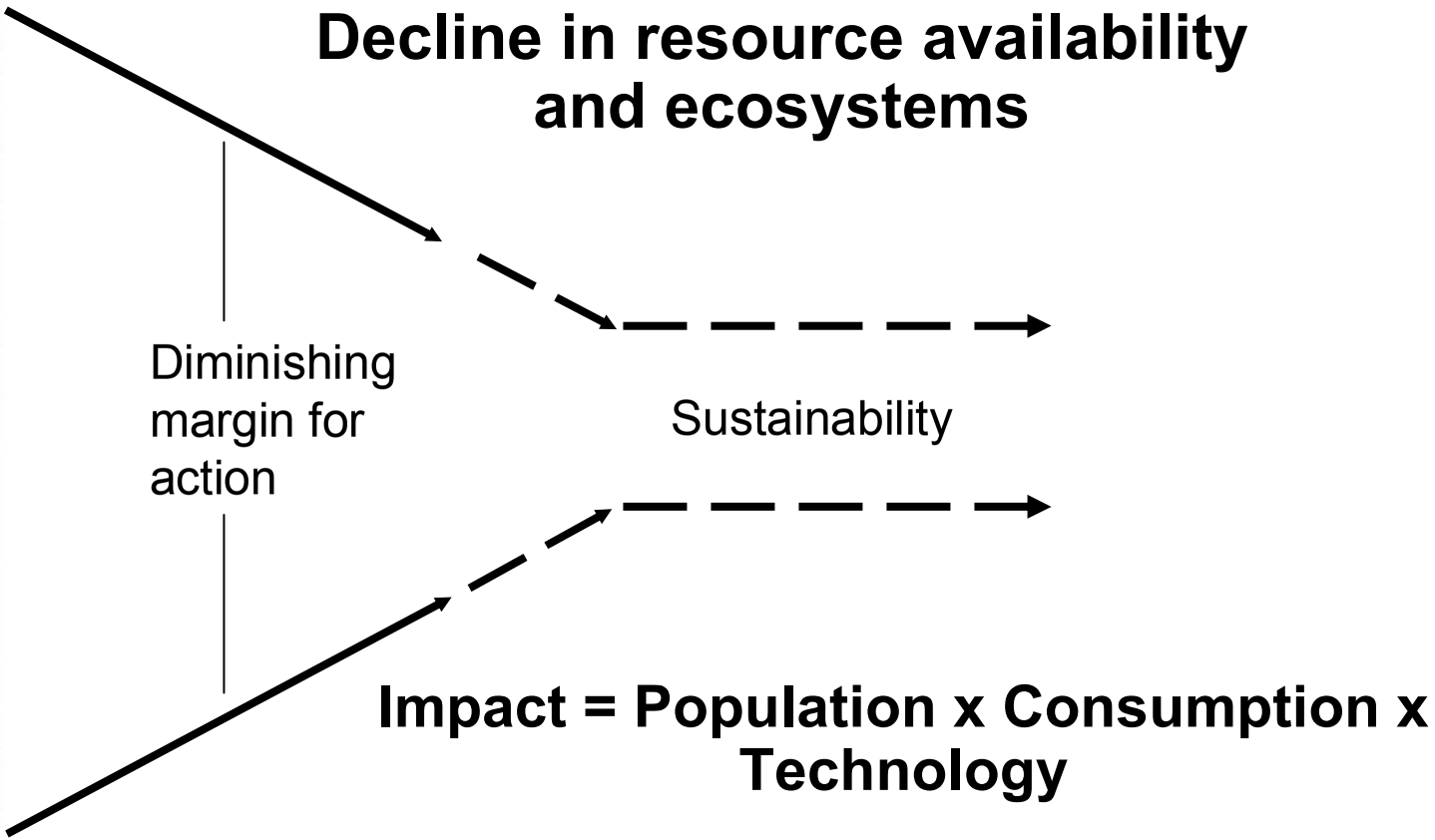
Created at the World Commission on Environmental and Development

"Meeting the needs of the present without compromising the ability of future generations to meet their own needs"

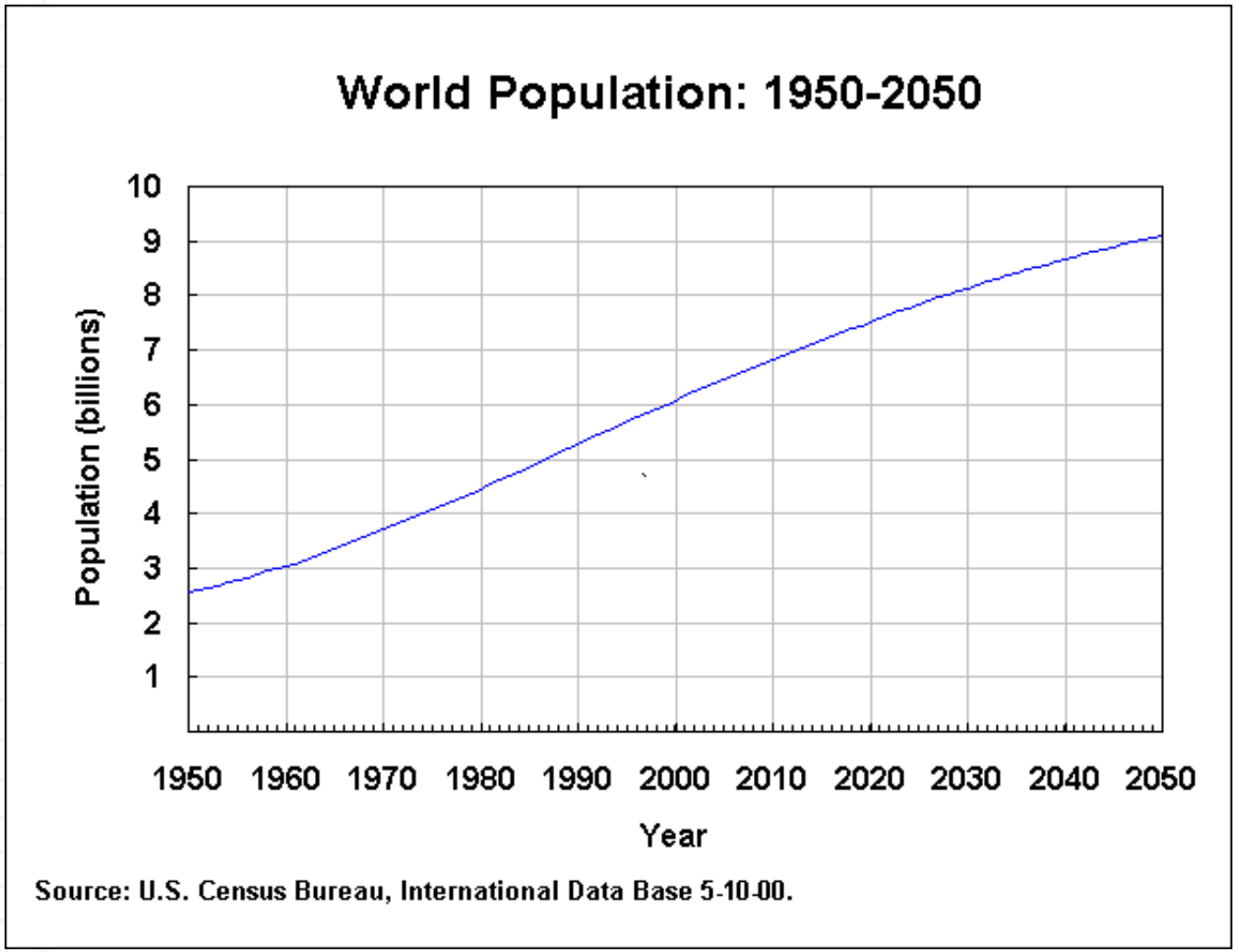
The three pillars of Sustainability



The challenge of sustainable development arises from these two major converging trends



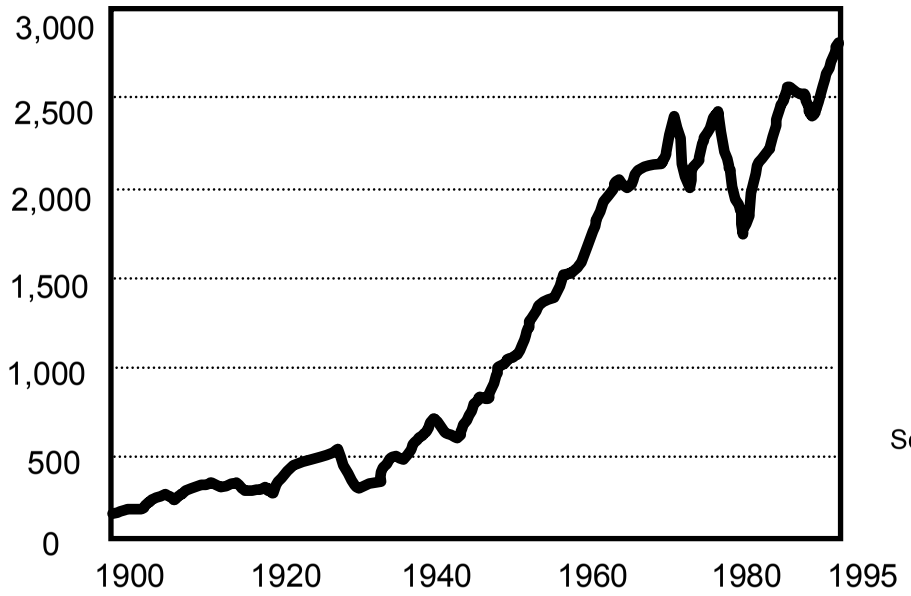
Demography: World population is increasing to unprecedented levels



Source: U.S. Census Bureau, International Data Base 5-10-00.

Massive flows of material and energy are used to meet the needs of this expanding population

Raw Materials Consumed in the US -More than all previous societies combined

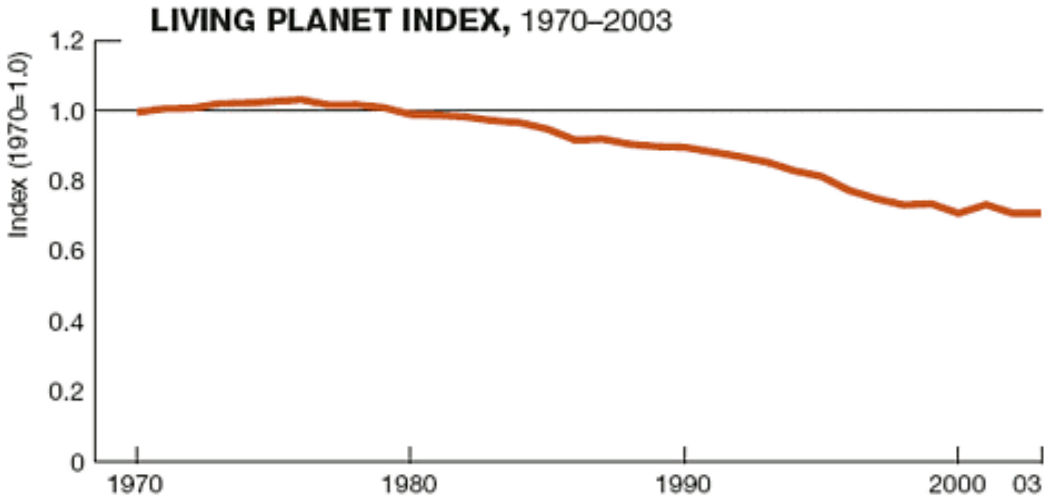


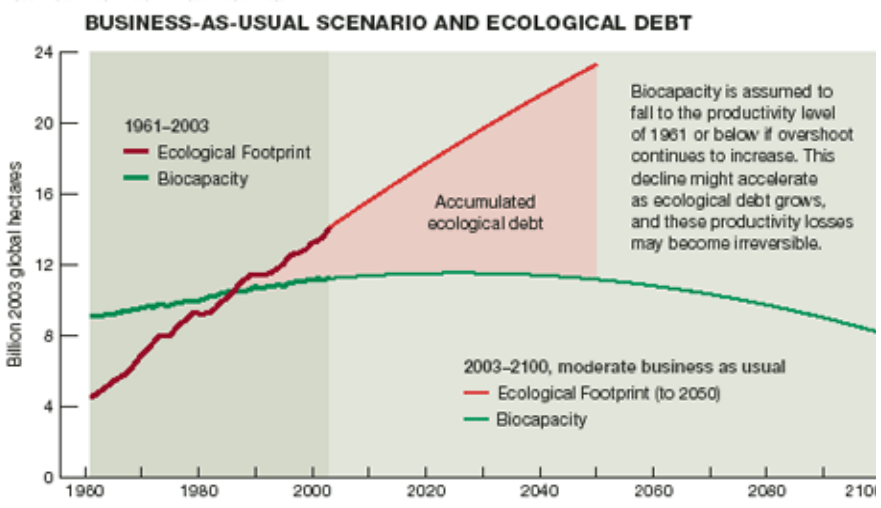
Source: USGS

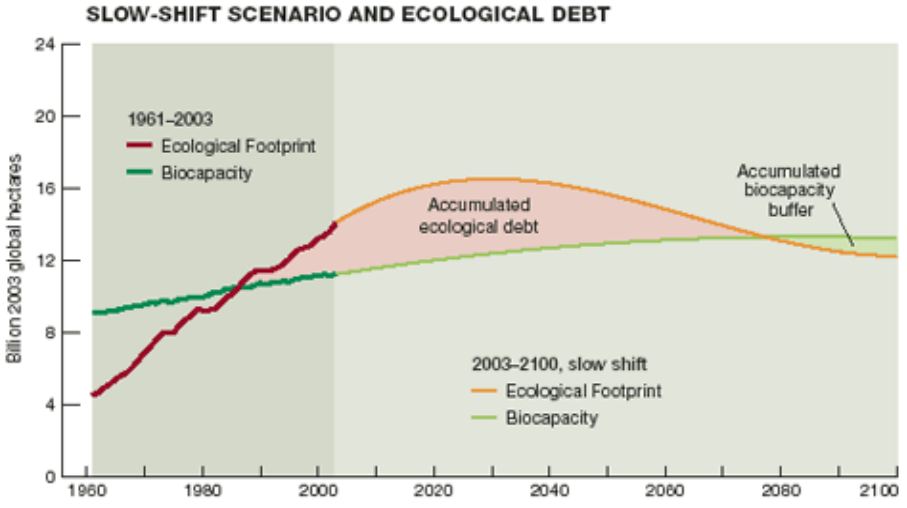
These trends are leading to a decline in the health and capacity of natural ecosystems worldwide

- Biologists: greatest extinction rate in 63 million years
- Global 50% drop in freshwater available per person
- 13 out of 17 fisheries collapsed or endangered
- Forest losses equal to area of UK/year, plus reduced diversity, acid rain etc.
- 30-80% topsoil losses significantly reduce diversity, absorptive capacity, and agricultural productivity

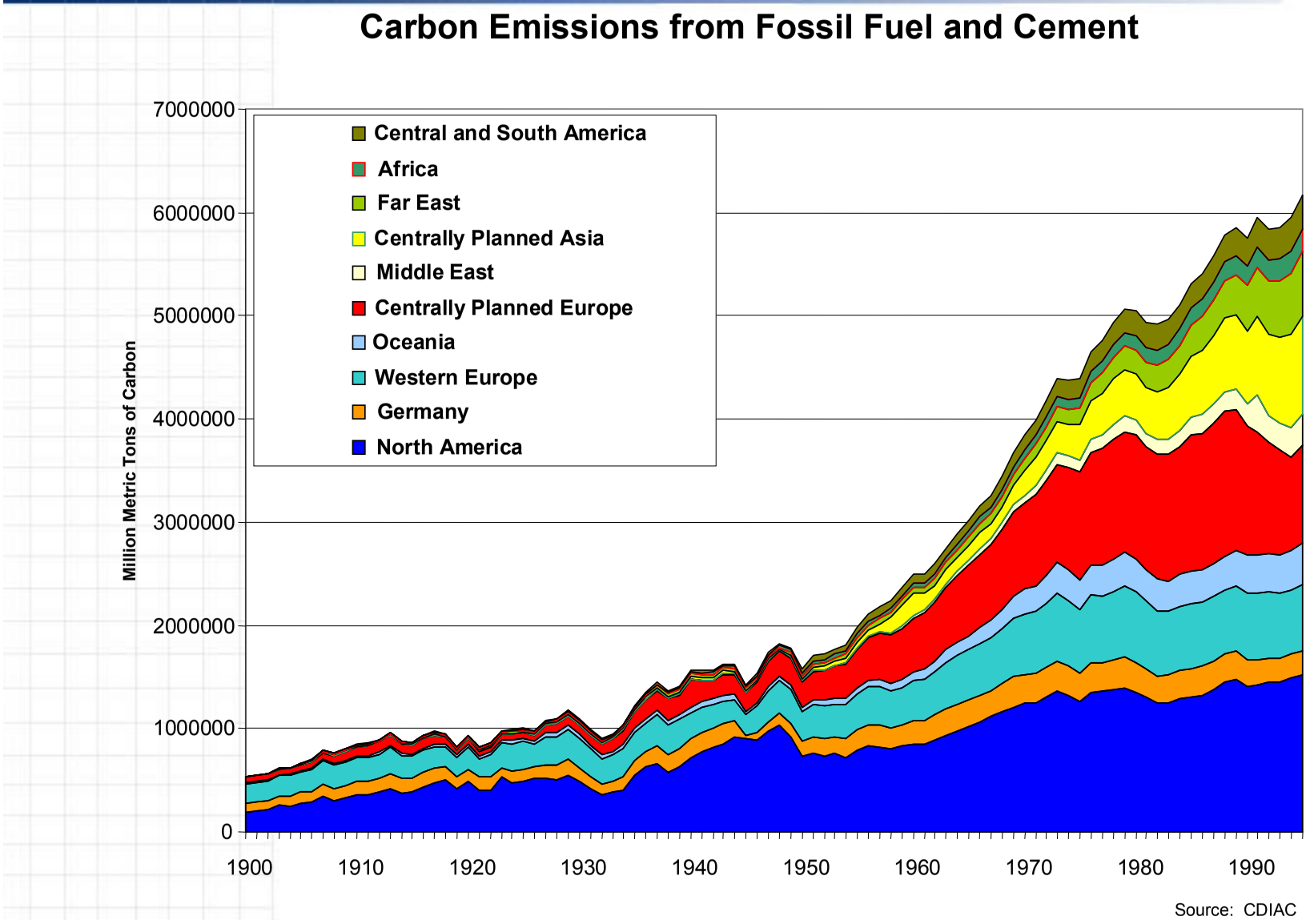
The living Plant Index





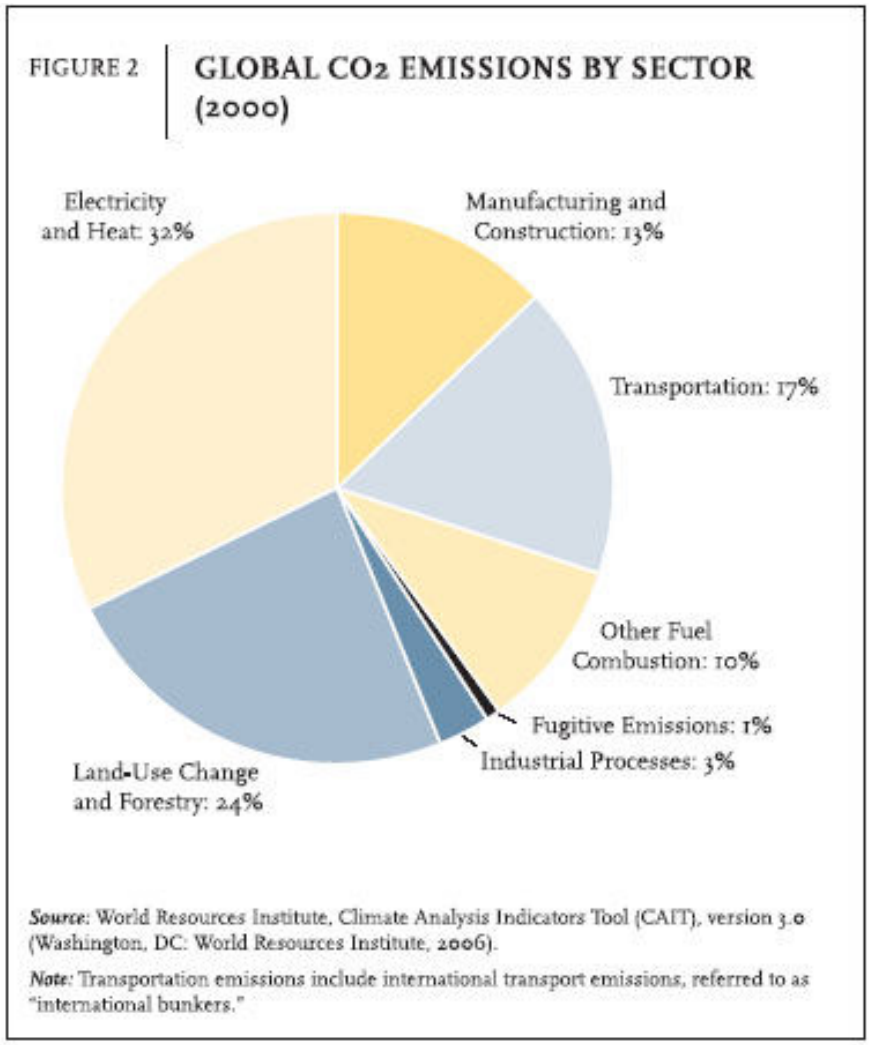


Global Trends: Atmospheric CO_2 emissions are rising

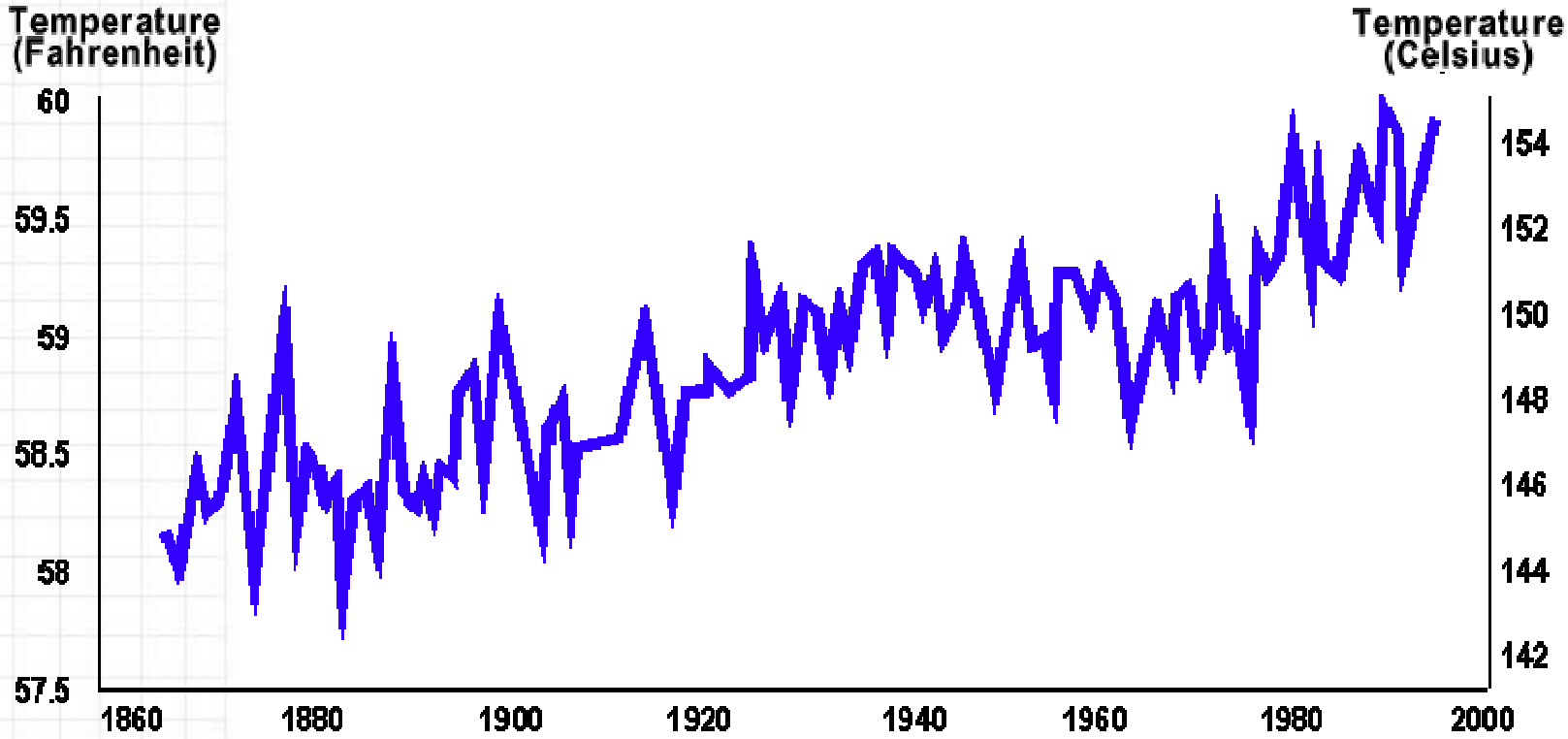


Source: CDIAC

Global Trends: Atmospheric CO_2 emissions are rising



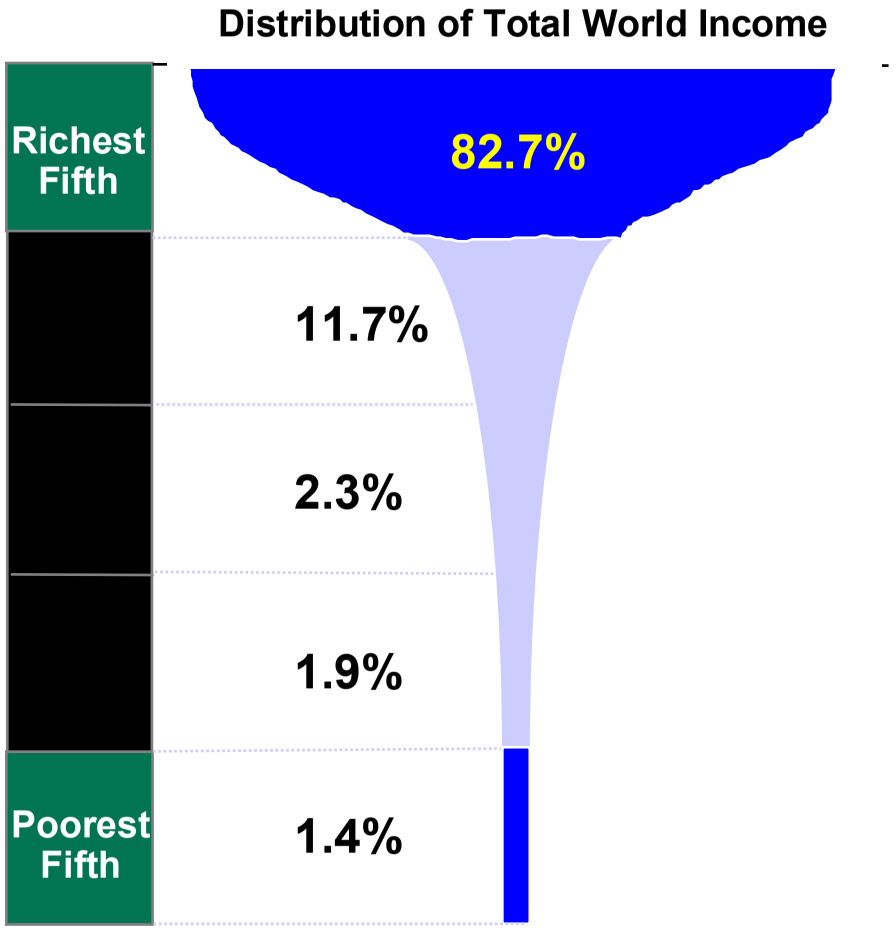
Surface temperatures have warmed over the past century



WORLD RESOURCES INSTITUTE

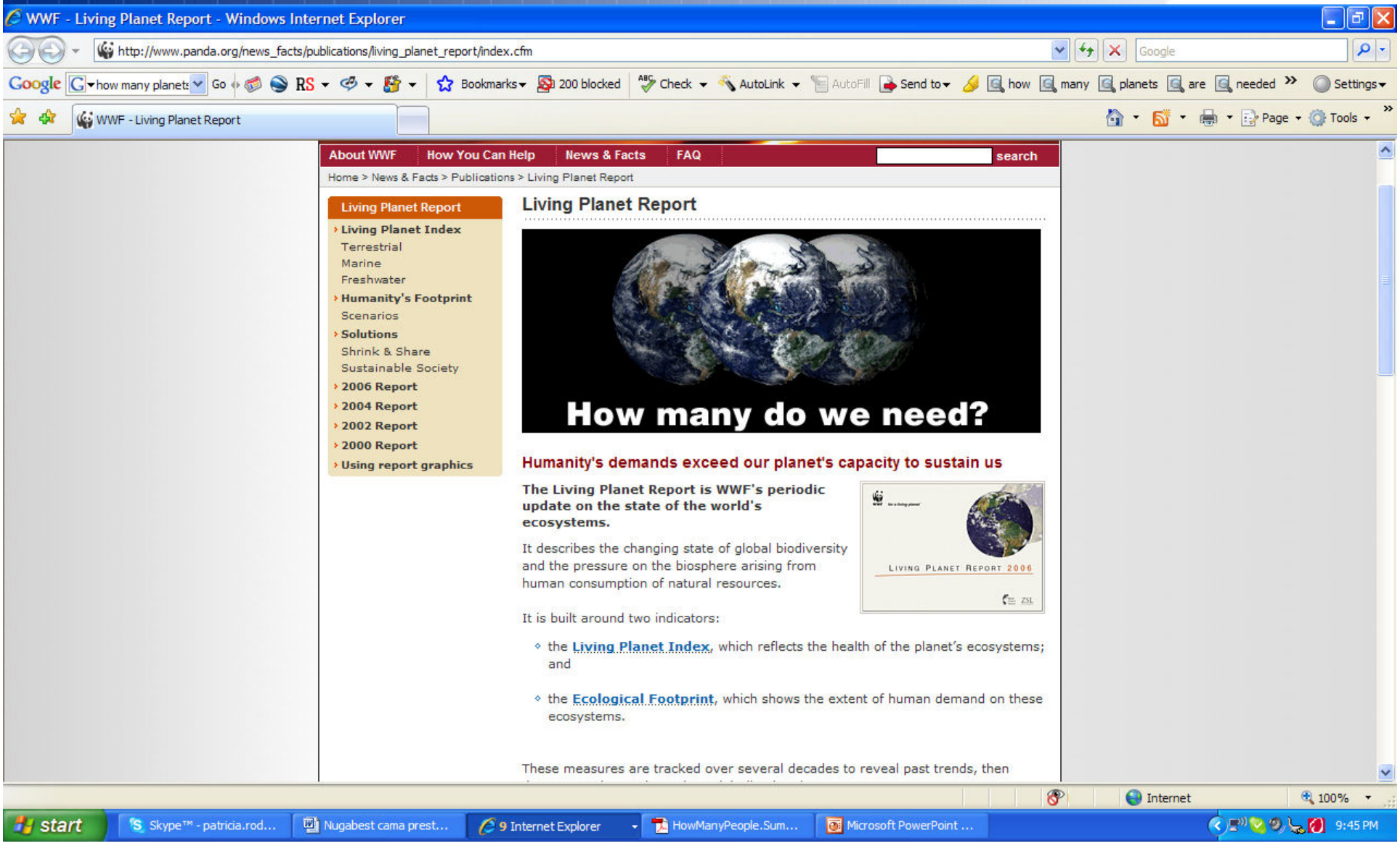
Inequity: At the same time, millions of people worldwide are struggling to meet their basic needs

- 1.3 billion people live in absolute poverty, with incomes less than $1/day (World Bank)
- 841 million people in developing countries suffer from basic protein-energy malnutrition (UN Food and Agriculture Organization)
- Nearly 1 billion people either cannot work or are employed in jobs where they cannot support their family (International Labor Organization)



(UNDP, Human Development Report 1992)

How many planets would we need if all the world's population lived like an average North-American?

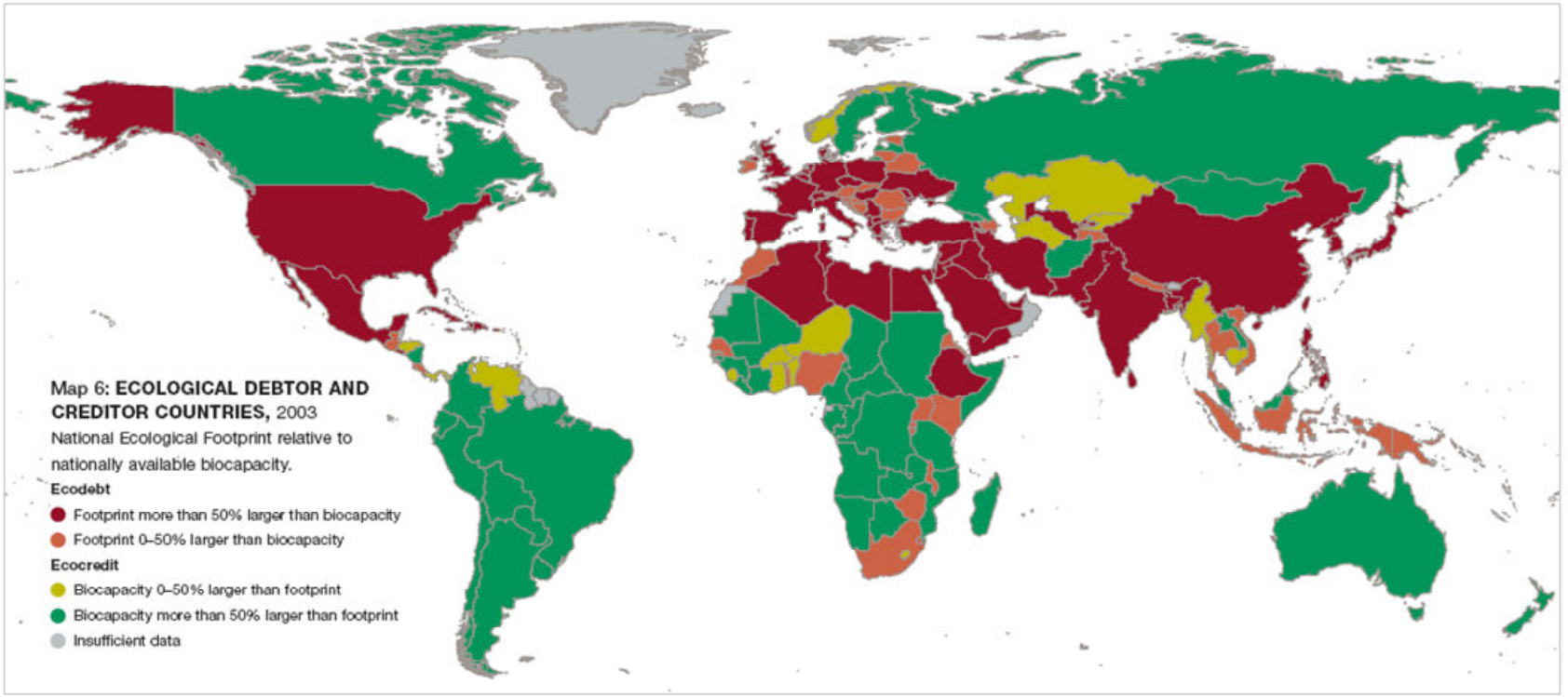


How many planets would we need if all the world's population lived like an average North-American?

5 Planets!!!

World's Ecological Footprint

Sustainability Dilemma



ECOLOGICAL FOOTPRINT

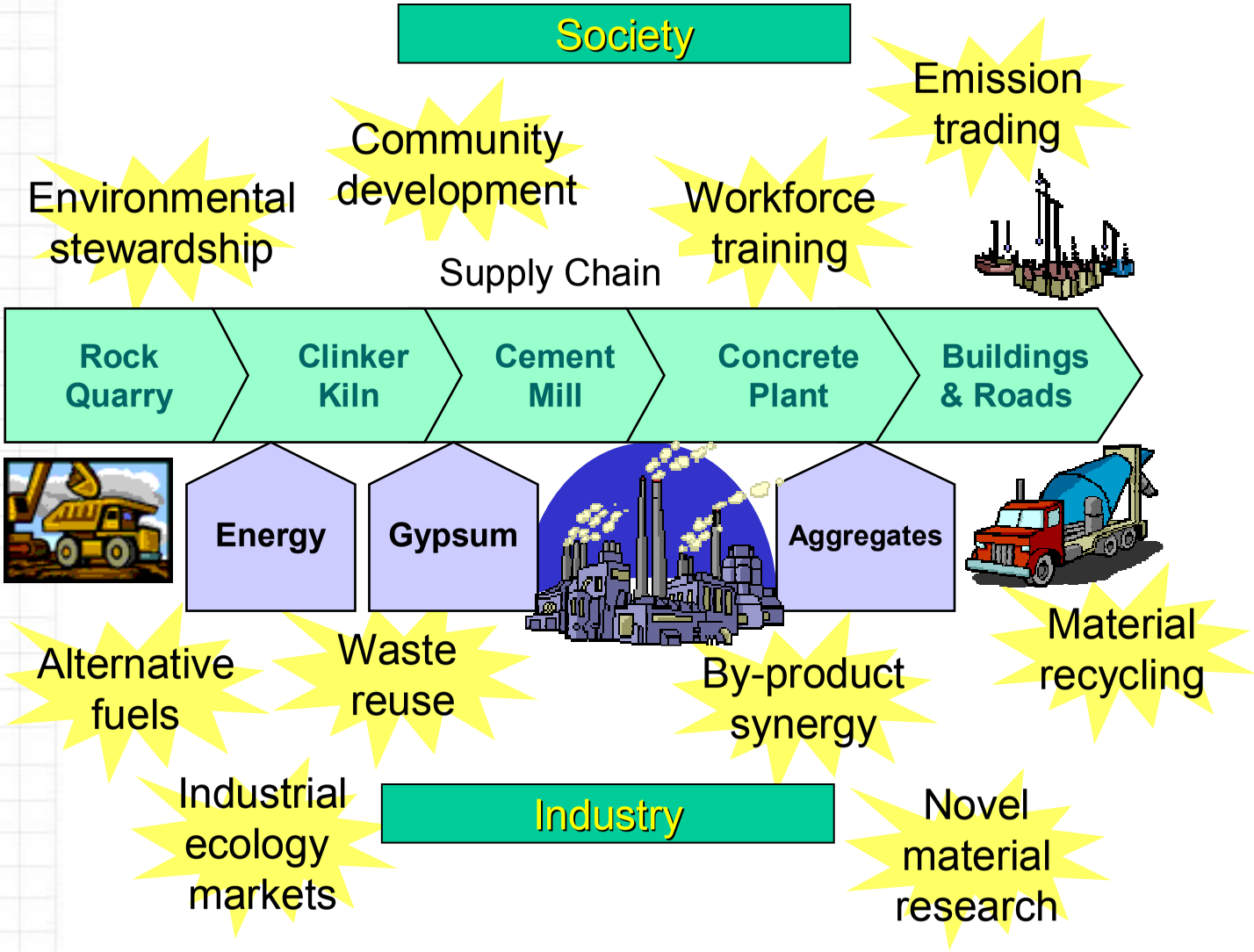
World's Ecological Footprint

Table 1: **ECOLOGICAL DEMAND AND SUPPLY IN SELECTED COUNTRIES**, 2003

	Total Ecological Footprint (million 2003 gha)	Per capita Ecological Footprint (gha/person)	Biocapacity (gha/ person)	Ecological reserve/deficit (-) (gha/person)
World	*14 073*	*2.2*	*1.8*	*-0.4*
United States of America	2 819	9.6	4.7	-4.8
China	2 152	1.6	0.8	-0.9
India	802	0.8	0.4	-0.4
Russian Federation	631	4.4	6.9	2.5
Japan	556	4.4	0.7	-3.6
Brazil	383	2.1	9.9	7.8
Germany	375	4.5	1.7	-2.8
France	339	5.6	3.0	-2.6
United Kingdom	333	5.6	1.6	-4.0
Mexico	265	2.6	1.7	-0.9
Canada	240	7.6	14.5	6.9
Italy	239	4.2	1.0	-3.1

Notes: Totals may not add up due to rounding. For an explanation of global hectares (gha) see page 38.

These trends can create strategic business opportunities (Sustainable Development)



But these trends can also create business constraints

Environmental & Social Impacts

- Water shortages
- Increasing toxicity
- Deforestation
- Water contamination
- Landfill shortage
- Lack of employment
- Lack of housing
- Income disparity

Legal/Market Constraints

- Regulation
- Insurance/banks
- Consumer/NGO pressure

Actual Constraints

- Water shortages
- Waste disposal overloaded
- Political unrest
- Economic recession

Business Implications

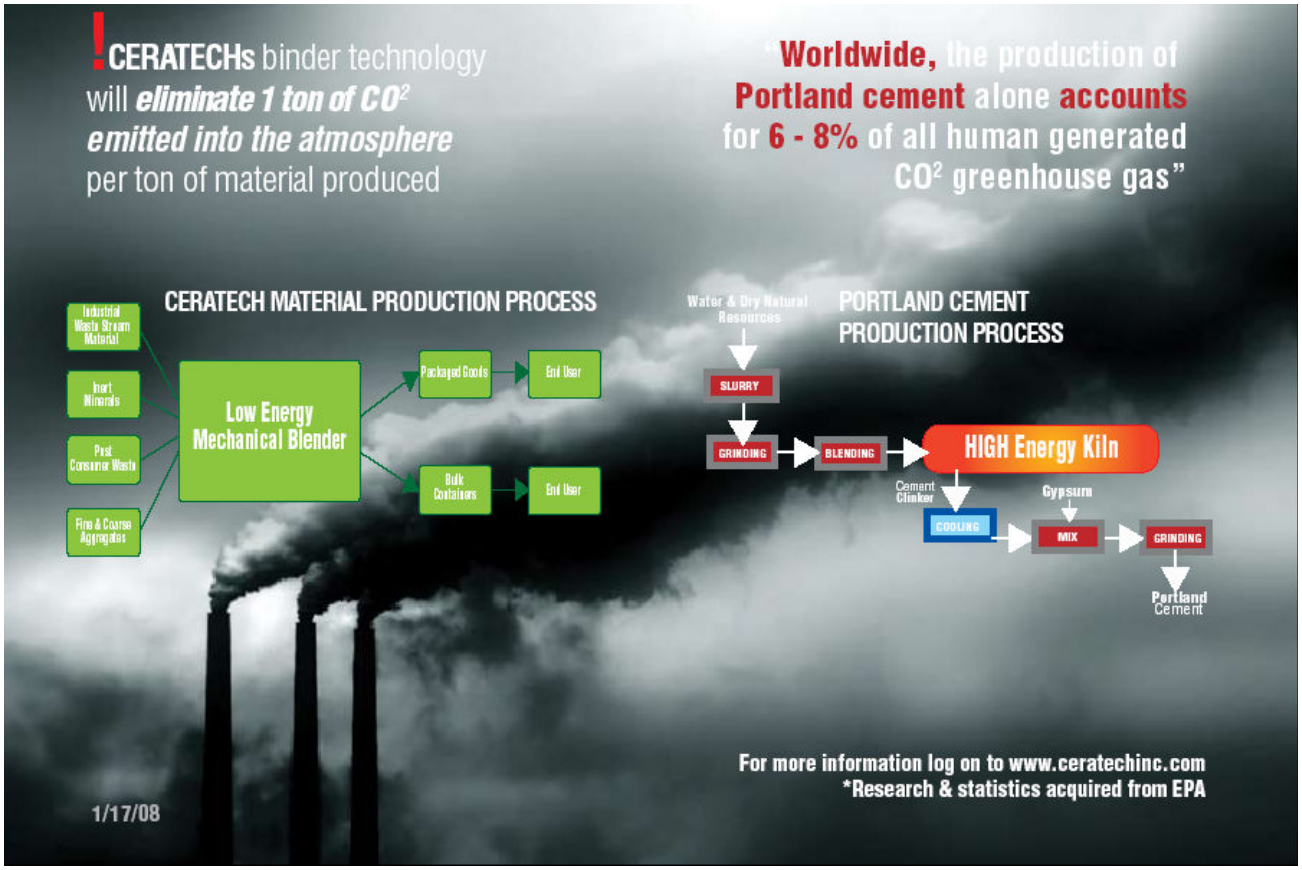
- Cost increases
- New compliance requirements
- Unpredictable energy/ raw material supply
- Reduced consumer demand
- Volatile markets

Like other extractive, energy-intensive industries, the cement industry is not on a sustainable path

- Major industry aspects are arguably unsustainable:
  - Quarrying impacts
  - Depletion of minerals
  - Energy use (quarrying and production)
  - Carbon dioxide emissions
- The market for cement could be influenced by emergence of "preferred" alternative construction methods and materials.
- The large energy requirements of cement production will become untenable in the face of rising costs and global warming concerns.
- Vast emerging markets in Asia may not follow the same consumption patterns as the developed nations.
- Cement plant expansion initiatives face increasing resistance from local communities as well as NGOs and other stakeholders, so that maintaining "right to operate" is more costly and time-consuming.

Sustainability is driving a new wave of binders with less than 10% clinker in the US market

This is the new message: Binders vs Portland cement



Societal expectations are changing regarding how global business affects these trends and its responsibilities to address them

Poll of 25,000 adults in 23 countries in 1999 found:

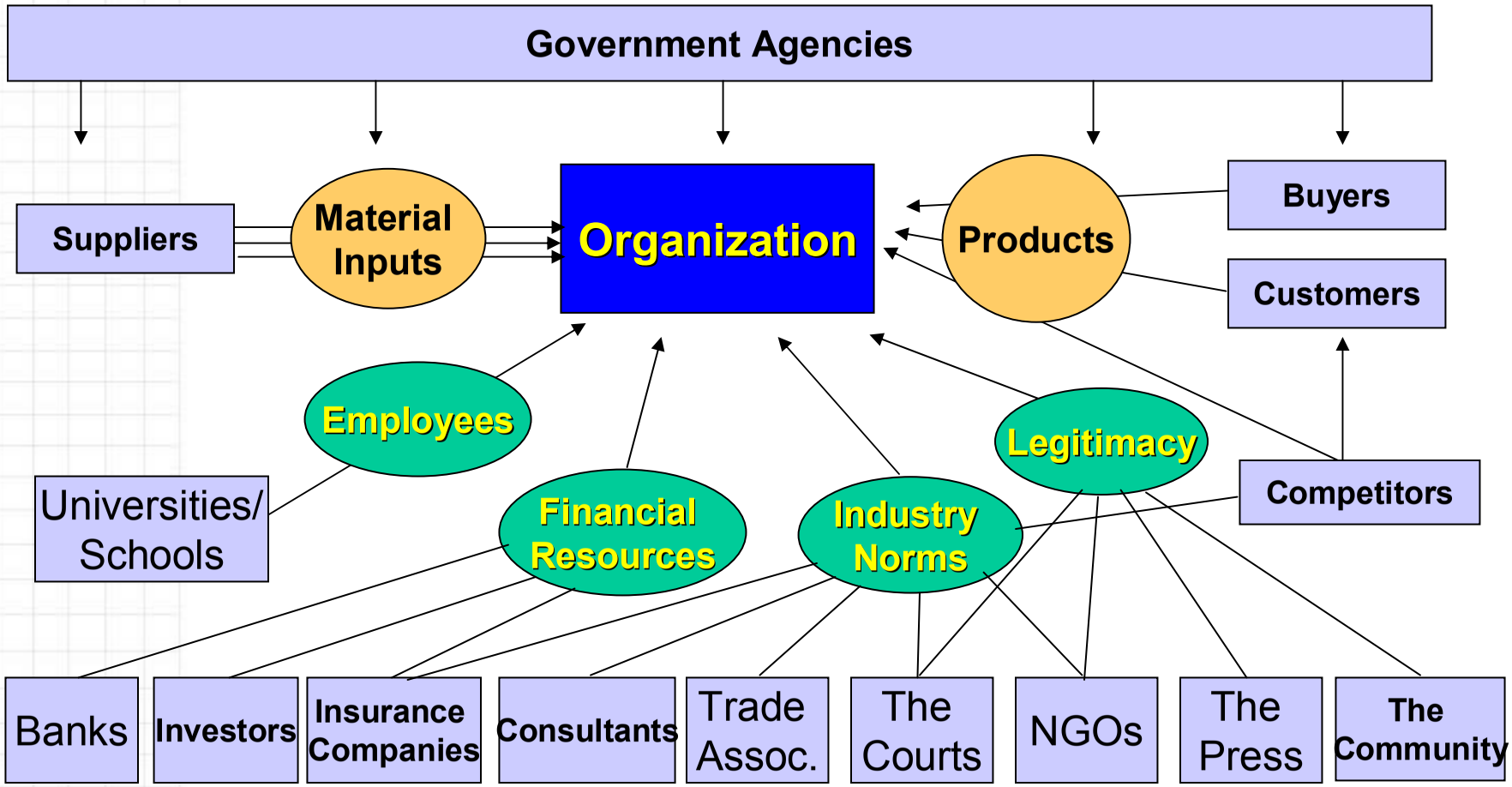
- ✓ 90% want companies to focus on more than profitability
- ✓ 73% say companies should be responsible for protecting the environment
- ✓ 56% judge companies on 'social responsibilities'
- ✓ Over 60% in Europe and America consider punishing companies who are not socially responsible

Poll conducted by Environics

We cannot wait for governments to do it all...you, in business, labor and civil society organizations, have skills and resources that are vital in helping to build a more robust global community.

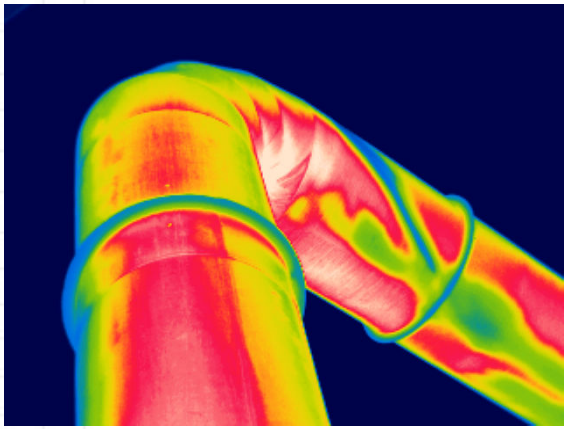
Kofi Annan, former UN Secretary General

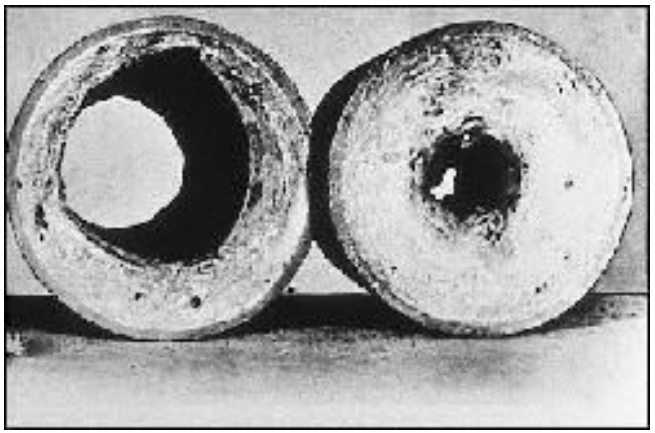
Each company is embedded in a web of relationships that can create pressure for action

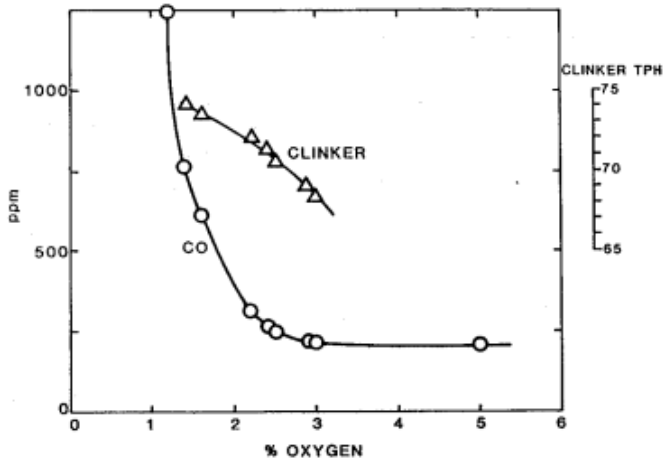


Source: Hoffman, Competitive Environmental Strategy

The sulfur challenge: build-ups, plugs & production loss







Kiln Production vs. Excess Oxygen[2]

The sulfur paradigms in the cement industry

Old sulfur paradigm (XIX-XX centuries)

- ✓ Minimize sulfur in the process to avoid build-ups and plugs in the kiln
- ✓ Strict control of sulfur in the process to keep it at the minimum possible (raw materials and fuels).
- ✓ Balance SO3/Na2Oeq ratio ~ 1.0
- ✓ SO3 clinker < 1.0
- ✓ SO3 cement < 3.5%

New sulfur paradigm (XXI century)

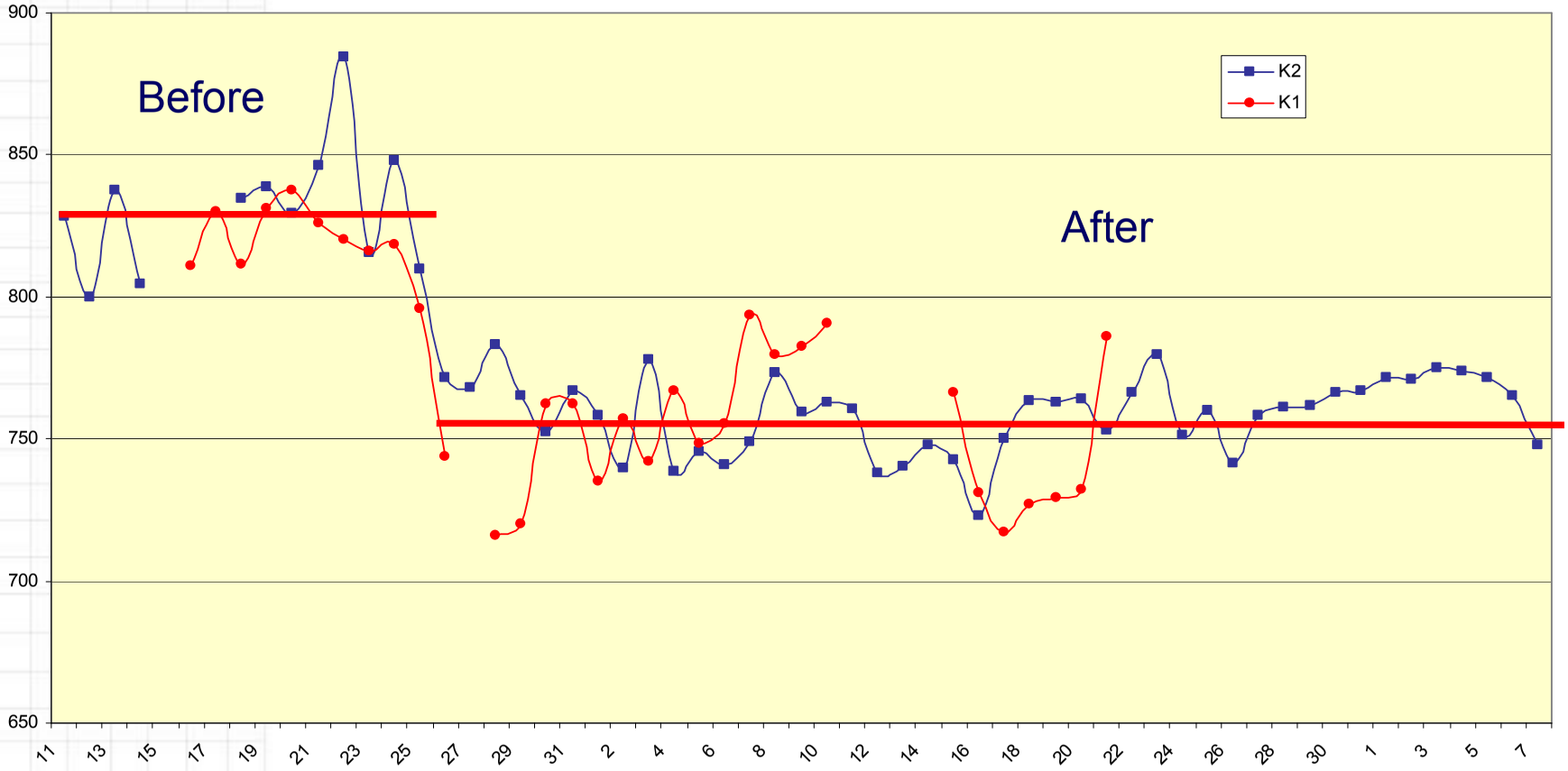
- ✓ Optimize sulfur in the process to be flexible and to minimize variable cost of cement
- ✓ Strict control of sulfur in the process to assure desired sulfur phases in clinker
- ✓ SO3/Na2Oeq ratio >> 1.0
- ✓ SO3 clinker >> 1.0
- ✓ SO3 cement >> 3.5%

CX's response to the Sulfur challenge: Calcium sulfoaluminate cement ($C_4A_3\underline{S}$)

	Calcium Sulfoaluminate Cement	Calcium Aluminate Cement	Calcium Silicate Cement (Portland type I)
Chemical Composition		% weight	
SiO_2	13.3	5.0	20.2
Al_2O_3	14.6	40.5	5.5
Fe_2O_3	1.8	16.0	2.2
CaO	52.0	38.0	63.9
MgO	2.1	0.3	2.0
SO_3	14.0	0.0	3.4
Na_2O	0.29	0.13	0.27
K_2O	0.64	0.05	0.79
LOI	1.2	0.3	2.8
NaO eq	0.71	0.16	0.79
Insoluble residue	0.45	4.62	0.24
Free-lime	0.37	0.11	0.73
Mineralogical composition by XRD			
Main phases	$C_4A_3\underline{S}$, C_2S, $C\underline{S}$	CA, C_2F	C_3S, C_2S
Secondary phases	C_4AF, C_3S	Fe_3O_4, C4AF	C_3A, C_4AF

CX's response to Sulfur challenge: Low Temperature Clinker

Reduction of specific thermal consumption at the kiln (Kcal/Kg clinker)

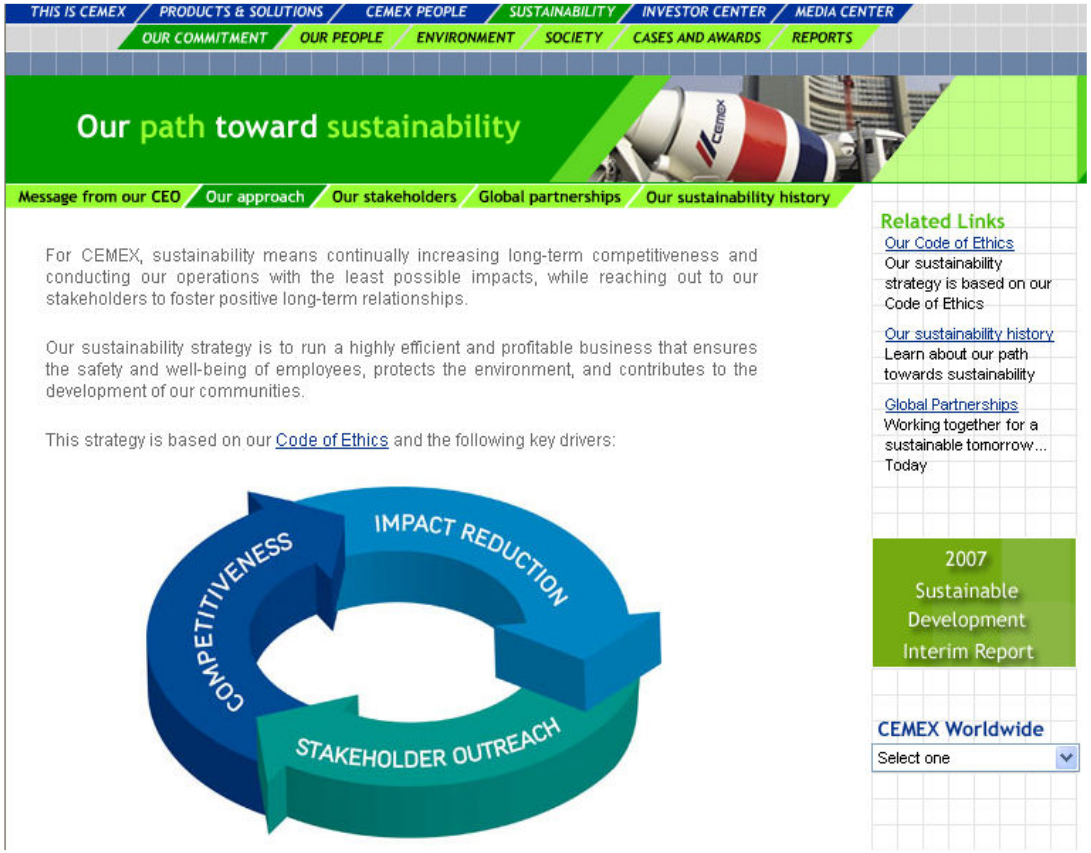


CX's response to Sulfur challenge: CREA™ Cement

Mineral Phase composition	Clinker phases (%)						SO3 in clinker	Calcination Temperature	SO3 in cement	Compressive strength (Mpa)			
	C_3S	C_2S	C_3A	$C_4A_3\underline{S}$	$C_{11}A_7.CaF_2$	$C\underline{S}$	(%)	°F (°C)	(%)	1 day	3 days	7 days	28 days
1	61	24	0	9	4	2	3	2282 (1250)	6	16	32	44	50
2	61	24	0	12	0	3	3	2282 (1250)	6	22	34	51	65
3	61	24	7	3	0	5	3	2462 (1350)	4	15	29	43	57
Typical calcium silicate cement	63	23	14	0	0	0	0.2	2642 (1450)	3	20	27	39	52

CX's Sustainability Strategy:

"To run highly efficient and profitable business that ensures the well being of employees, protects the environment and contributes to the development of communities"



Innovate the Construction Business

Cemex: Patrimonio Hoy

A Case Study Discussion prompted by

"Cemex: Innovation in Housing for the Poor"
Research directed by C.K Prahalad

Patrimonio Hoy

Modify the Tanda Savings Model

- Pool money as a group savings club
- Savings are distributed by lottery
- Cemex modified Grameen Bank's model
- 3 changes for Patrimonio Hoy
  1. Build brand trust among low-income consumers
  2. Extend credit and skills where there were none
  3. Shift managers' focus from sales to solutions

CX's Sustainable Initiative

Patrimonio Hoy = Inheritance Today

Lesson Learned from Mexico's 1994 Economical Crisis

Patrimonio Hoy is a micro financing program for low income families that wish to build or improve their homes

Micro-Credit	• CEMEX finances 80% of the cost of materials • Commits groups of 3 participants
Building Materials*	• Supply and delivery • Fixed prices during the project cycle • Storage service
Technical Support	• Technical assistance and project
Fast and Safe	• Reduces time by 65% and costs by 35% • Increases quality functionality
Accessible	• Weekly payments of US$14.8, with service centers in their communities

By improving life conditions through housing, Patrimonio Hoy supports a healthier development and family integration.

* Cement, reinforcing steel, blocks, bricks, aggregates

Cement Sustainability Initiative (CSI) Goals and Progress of the "Agenda for Action"

CEMEX

2007 SUSTAINABLE DEVELOPMENT INTERIM REPORT

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sustainability targets and performance

SUSTAINABILITY

targets and performance

This table gives an overview of our sustainability progress[1]. We are committed to improving our performance in all areas and will continue to disclose our achievements and challenges. Some targets may be revised in the future to reflect the continued growth of our company.

Area	Indicator	Targets	2007 Progress	Page #
Employee Health and Safety	Participation in our employee health program[2]	100% by 2010	▲	6-7
	Drivers certified by our training programs	100% by 2010	◆	6-7
	Lost Time Injury frequency rate for direct employees[3]	5.0 by 2010	▲	6-7
Local Impact on Land and Communities	Active sites with quarry rehabilitation plans	82% by 2010 100% by 2015	✔ ▲	8-9
CO_2 and ClimateChange	Reduction in CO_2 emissions per metric ton of cementitious product from 1990 baseline	25% by 2015	▲	8-9
Use of Alternative Fuels and Raw Materials	Alternative fossil fuels substitution	10% by 2015 15% by 2020	▲	8-9
	Biomass fuels substitution	5% by 2015 8% by 2020	▲	8-9
	Alternative raw materials substitution	12% by 2015 15% by 2020	✔ ▲	8-9
Other Emissions	% of clinker produced with continuous monitoring of major emissions (dust, NOx and SOx)	50% by 2010 100% by 2020	▲	8-9
	Reduction in specific emissions per ton of clinker from 2005 baseline	50% for dust by 2015 15% for NOx by 2015 10% for SOx by 2015	▼ ▲ ▼	8-9

▲ Positive progress ▼ Negative progress ◆ Measurement in progress ✔ Target achieved, we keep working towards our longer-term objectives

1. Except for health and safety, and for the reasons stated in 'About this report', indicators cover our cement operations only. We are working on upgrading our data systems to report the sustainability performance of all our business segments.
2. The participation in our employee health program is reported for the first time, this figure excludes our US operations as health services there are managed externally.
3. Our lost time injury frequency rate was previously reported as 'accident rate.' In contrast with past years, we adopted the industry standard to report the number of LTIs per 1,000,000 -rather than 200,000- hours worked.

The CO2 challenge:
Reduce 92 kg CO_2/metric ton of cementitous product by 2015

Cement Sustainability Initiative (CSI) CO_2 reduction Goal

CEMEX

2007
SUSTAINABLE DEVELOPMENT
INTERIM REPORT

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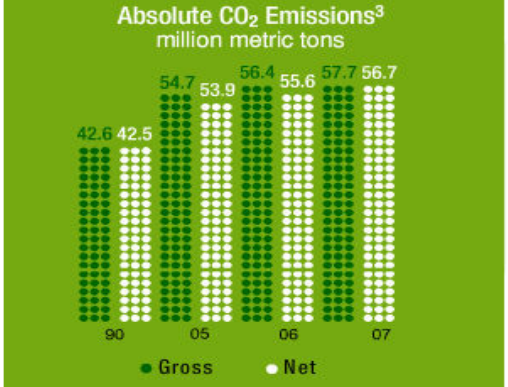
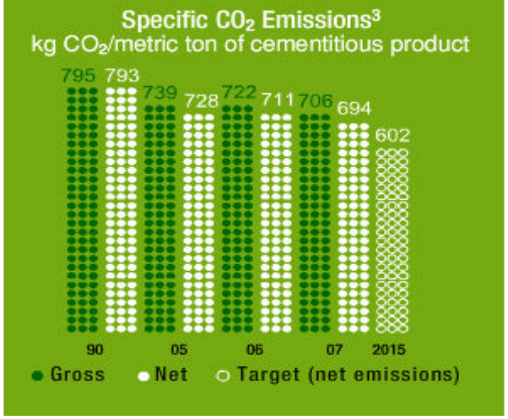
environmental commitment





We work in partnership with conservation groups to share expertise and improve the way we manage biodiversity. In December, we signed a ten-year agreement with BirdLife International, the largest global network of independent conservation organizations and a leading expert on protecting bird species. The agreement is based on previous work carried out with RMC before it was acquired by CEMEX. It commits us to prioritizing conservation in our quarries, and supporting wider conservation initiatives and awareness-raising among employees and communities.

CLIMATE CHANGE

Cement manufacturing is energy intensive, accounting for about 5% of carbon dioxide (CO_2) emissions globally. Energy is needed at all stages of production, from mining raw materials, crushing and milling, heating kilns, to packing and shipping the finished product.

Our emissions reduction strategy continues to be based on:

- Reducing our energy use. We use technology to improve energy efficiency, and use by-products from iron and steel making and coal-fired power stations as substitute materials in our cement. This allows us to save energy per ton of cement clinker we produce. Our use of alternative materials rose 50% to 12.8% of total material use–beating our 2015 target. We continue working to reach our 15% target by 2020
- Using alternative fuels with lower CO_2 emissions. Alternative fuels such as chipped tires, household waste, sewage sludge, animal meal, and secondary liquid fuels accounted for 7.0% of total energy use in 2007 up from 6.1% in 2006. Our target is to achieve 15% of alternative fuel substitution by 2015
- Investing in renewable energy generation. We continue developing projects under the UN Framework Convention on Climate Change. Among them, is the largest wind farm in Mexico with a capacity of 250 Megawatts, whose first stage will begin production in 2008. Once fully operational, it will supply 25% of our annual electricity needs in Mexico. Under the Kyoto Protocol's Clean Development Mechanism, we will be able to use the resulting carbon savings to offset emissions from operations located within regulated frameworks such as the European Union Emissions Trading Scheme (ETS).

3. The CO_2 emissions inventory was calculated according to the Cement CO_2 Protocol version 2.0 released in June 2005. The reporting perimeter includes our cement division: 63 cement plants and 20 cement grinding plants; 100% of the emissions of those operations over which there is operational control have been consolidated; recent acquisitions from Rinker are excluded. Net emissions are the result of gross emissions minus emissions from waste combustion (alternative fuels). The historical information was recalculated according with the results from the CO_2 verification process conducted in 2007.

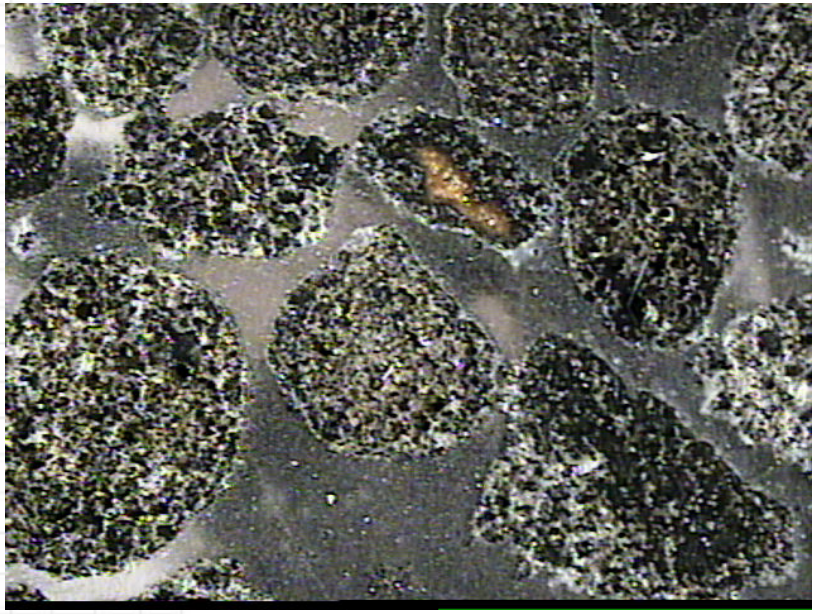
Another trends in the Industry impacting the Quality and performance of the cement

- **Emissions Reduction Battle:** As a result of the battle to reduce NOx, some Plants have been “lengthen their flames”, and the impact in clinker microscopy has been a reduction in alite birefringence (alite reactivity), slower cooling and in some cases the production of reducing conditions.

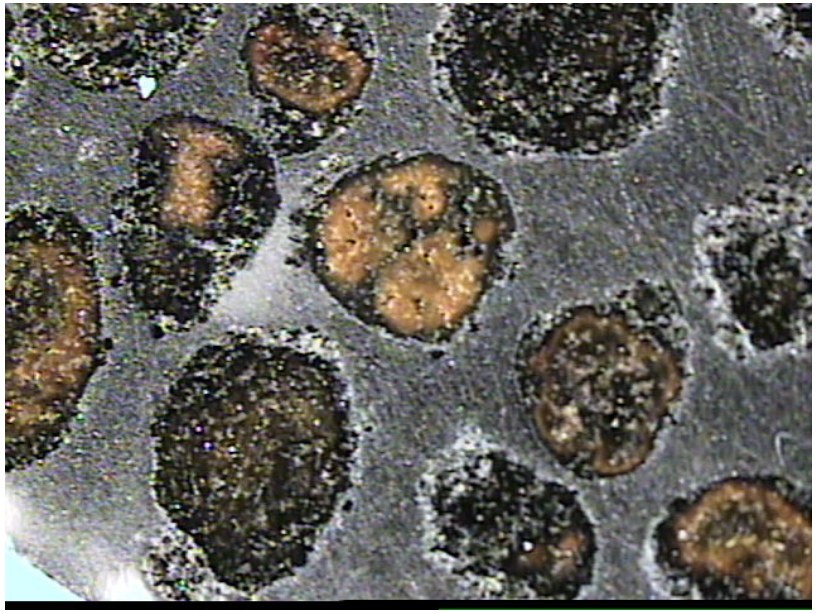
- **The use of multiple fuels** has presented a challenge to the steady state of the kilns, impacting the clinker quality.

The Alternative fuels challenge: Kiln instability and potential reducing conditions

Kiln instability and significantly drop in cement strengths when they increase the amount of tires burned

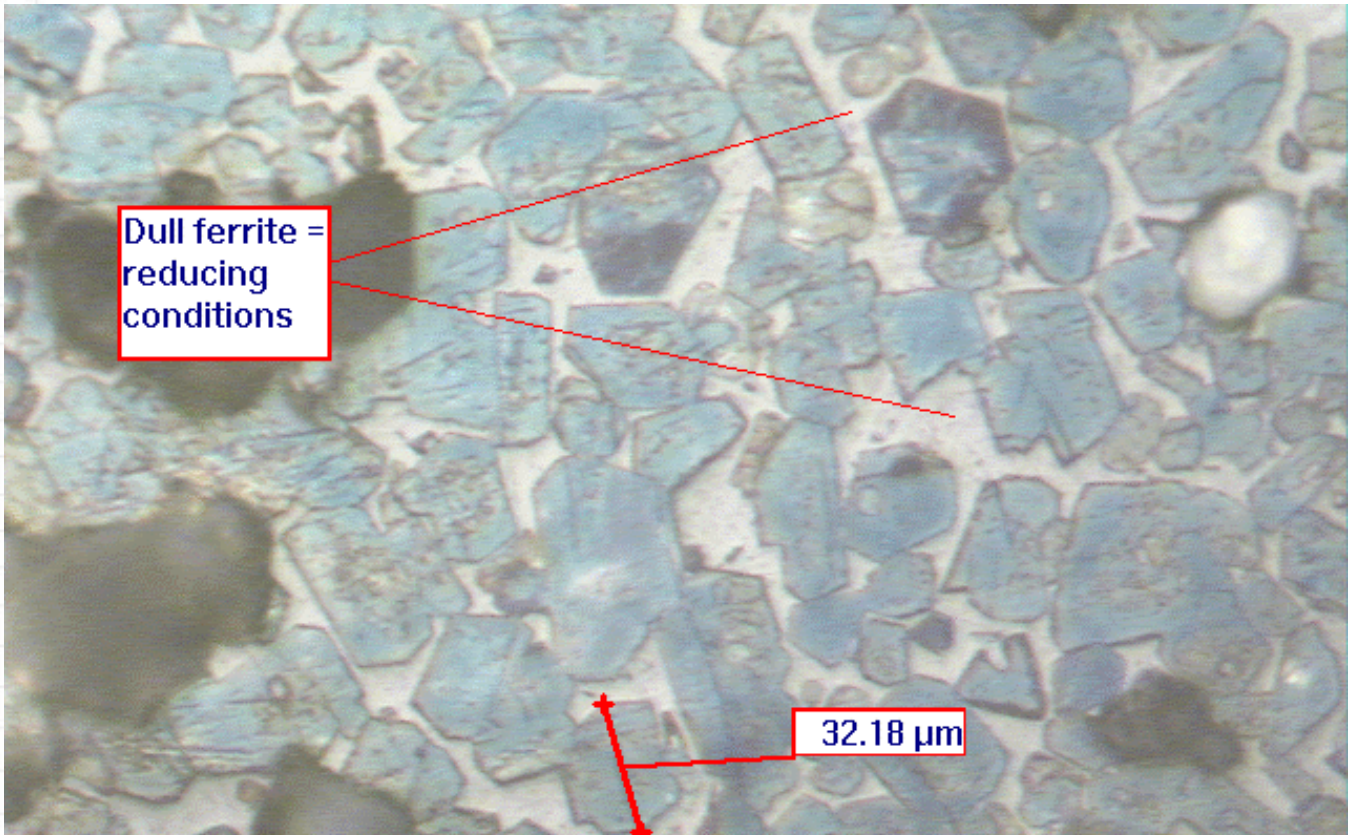


Clinker July 22

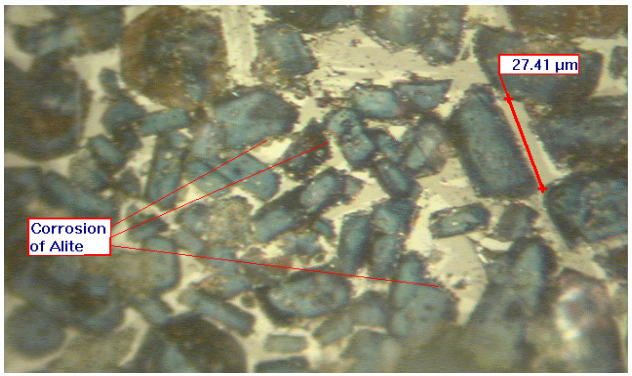


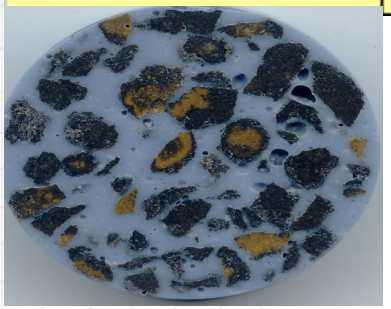
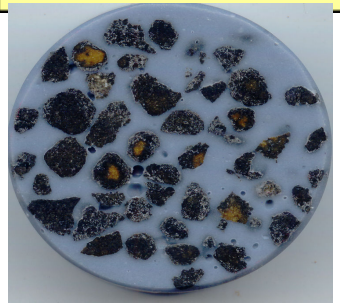
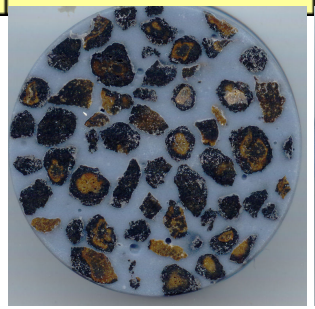
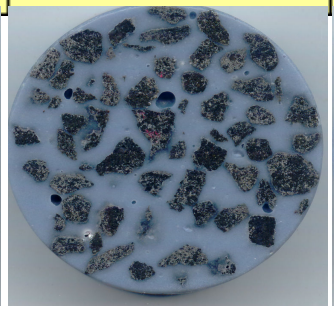
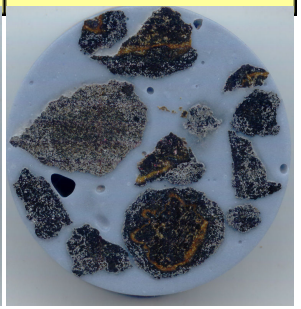
Clinker July 28

Dull ferrite, confirming reducing conditions in clinker

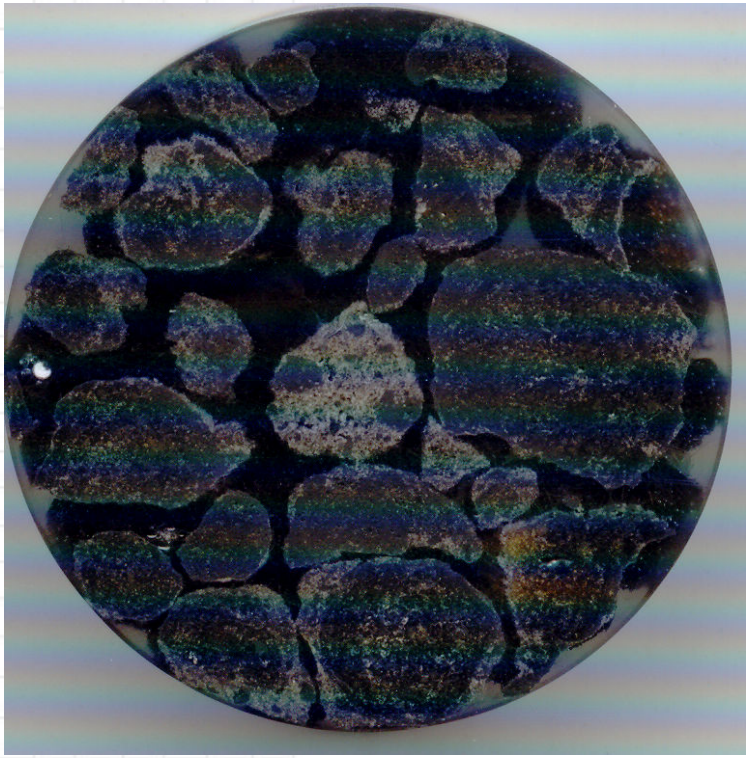


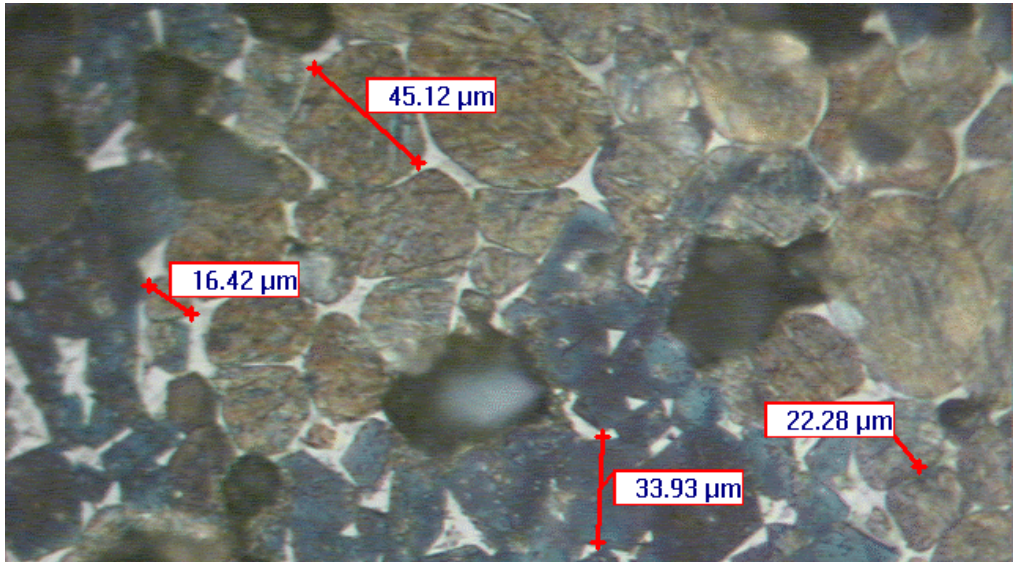
Impact of changes in process on clinker microscopy



Brown centers in clinker	Brown centers in clinker	Brown centers in clinker	Clinker completely black brown color is gone	Some brown lines in clinker still observed
++	+	+++	none	+
				

After process adjustments reducing conditions are gone

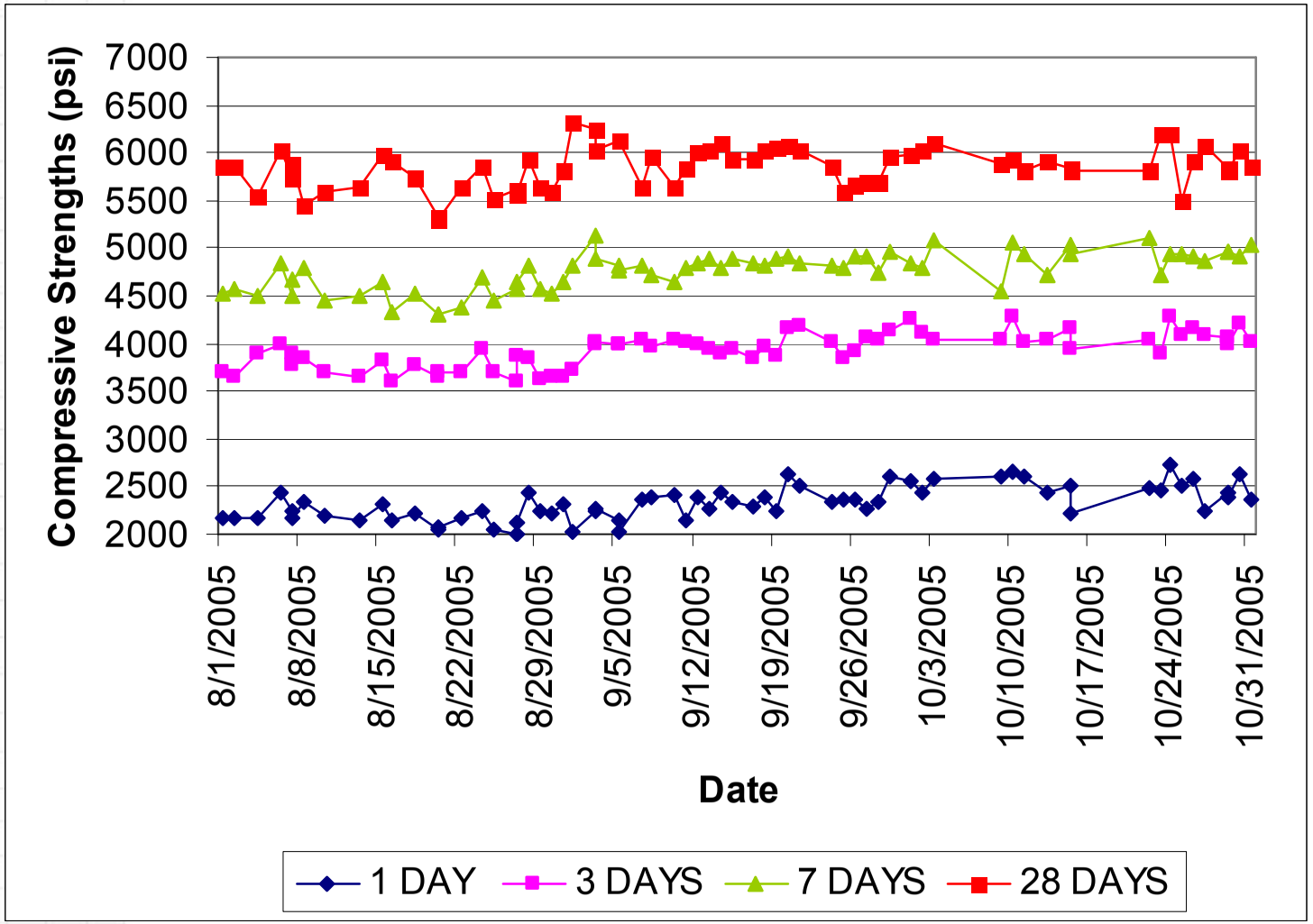




September 29 clinker

Alite corrosion and dull ferrite are gone

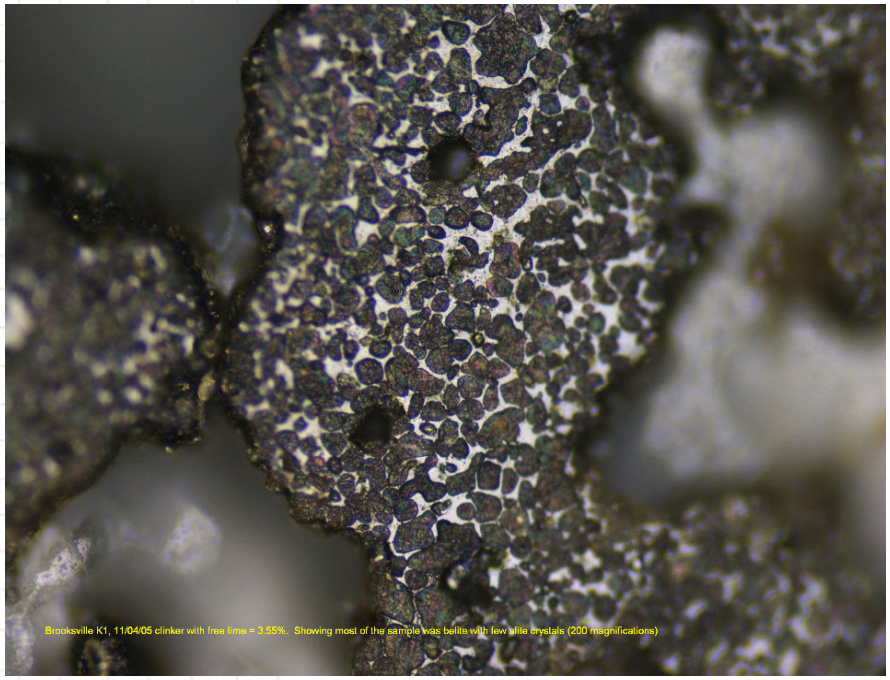
An compressive strengths improved



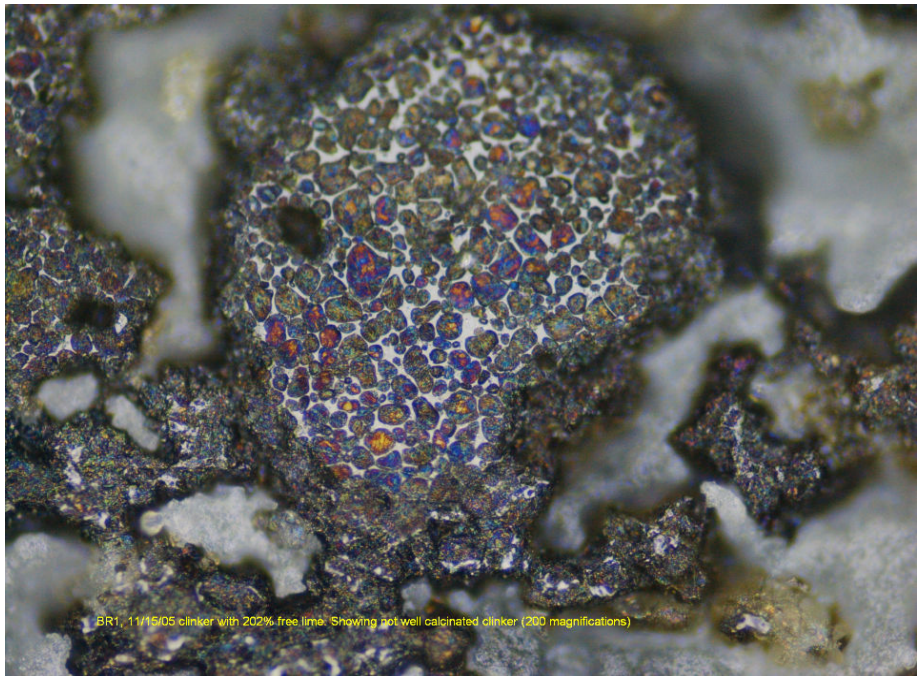
The cost of kiln instability: Effect of free lime in clinker microscopy

Sample	K1 clinker, 11-14 @ 10:00 hrs	K1 clinker, 11-15 @ 14:00 hrs	clinker, 11-15 @ 10:00 hrs	clinker, 11-18 @ 10:00 hrs
SiO2	21.93	22.67	22.91	20.63
Al2O3	5.92	5.40	5.37	5.87
Fe2O3	3.79	3.95	3.95	4.57
CaO	65.22	64.77	64.97	67.33
MgO	0.69	0.82	0.83	0.59
SO3	0.97	0.63	0.56	0.79
Na2O	0.10	0.08	0.08	0.10
K2O	0.49	0.41	0.39	0.12
Total alkali	0.42	0.35	0.34	0.18
Free-lime	**3.55**	**2.02**	**0.97**	**0.31**
C3S	50.82	47.61	47.03	68.99
C2S	24.51	29.04	30.17	7.08
C3A	9.28	7.63	7.54	7.82
C4AF	11.53	12.02	12.02	13.91
Liquid Phase	27.56	26.40	26.29	28.71

The cost of kiln instability: Effect of free lime in clinker microscopy

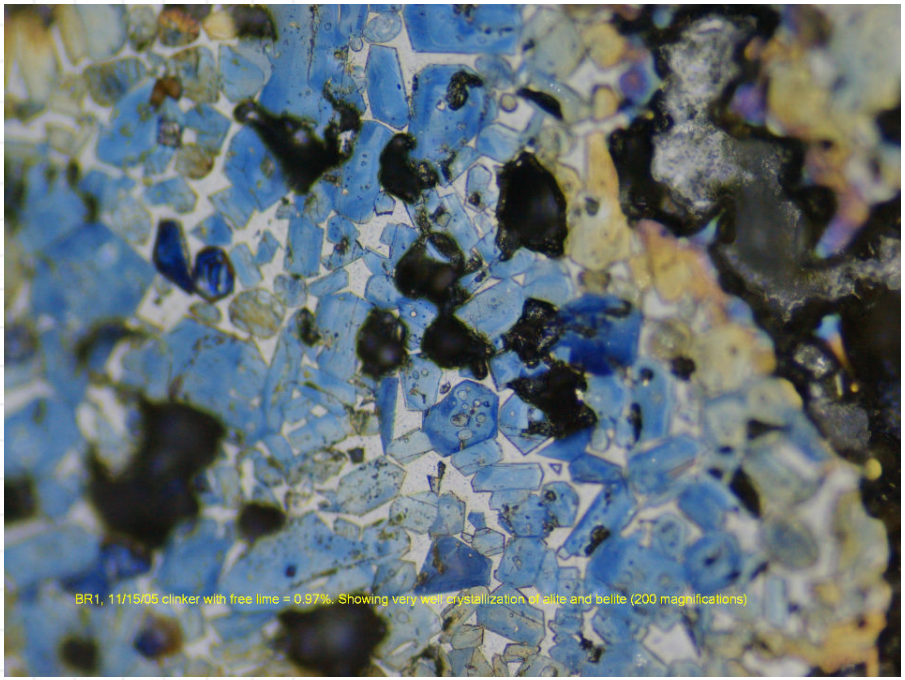


Clinker K1, 11-14 @ 10:00, **FL = 3.55%**

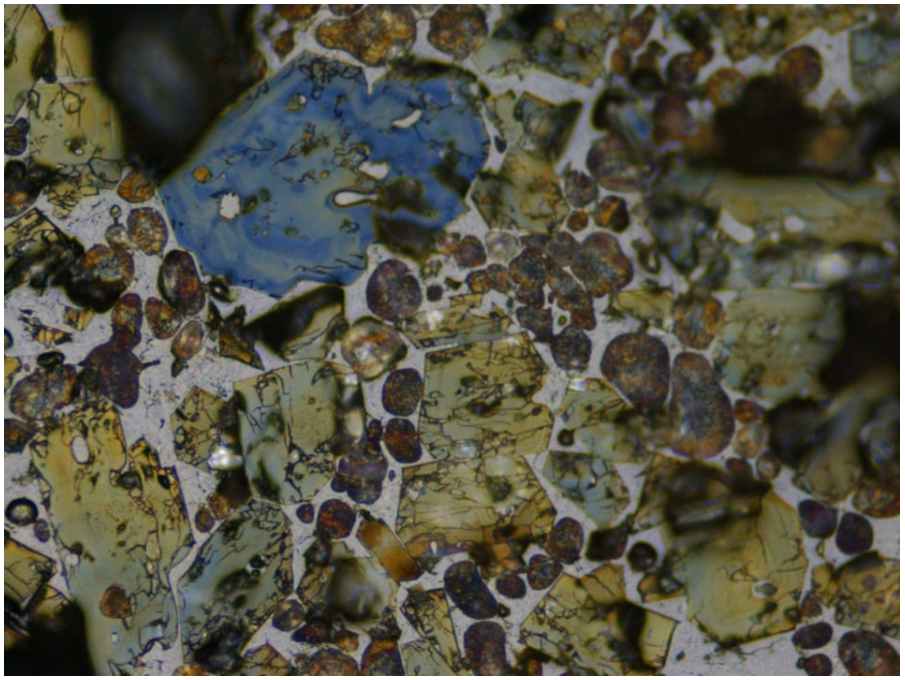


Clinker K1, 11-15 @ 14:00, **FL = 2.02%**

The cost of kiln instability: Effect of free lime in clinker microscopy

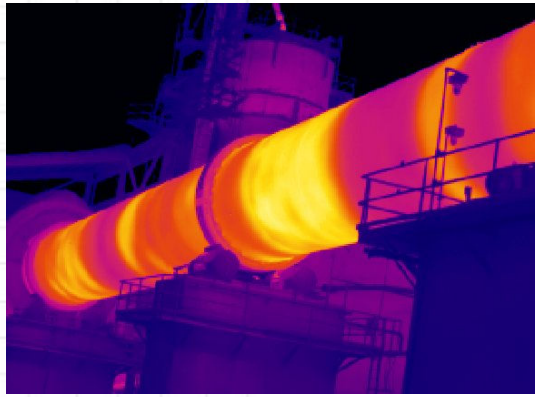


Clinker K1, 11-15 @ 10:00, **FL = 0.97%**



Clinker K1, 11-18 @ 10:00, **FL = 0.31%**

Sustainability Challenge for the Construction Industry:
≥ Performance and ↑ Sustainability:



Cement technology
already proven in other CX markets

+

Concrete Expertise

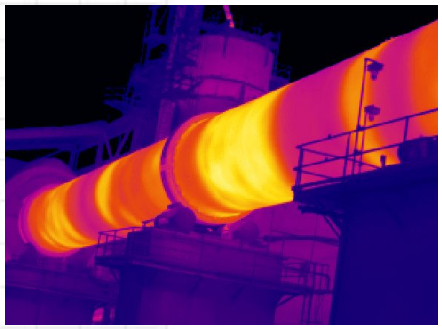
=

≥ Performance and
+ Sustainability

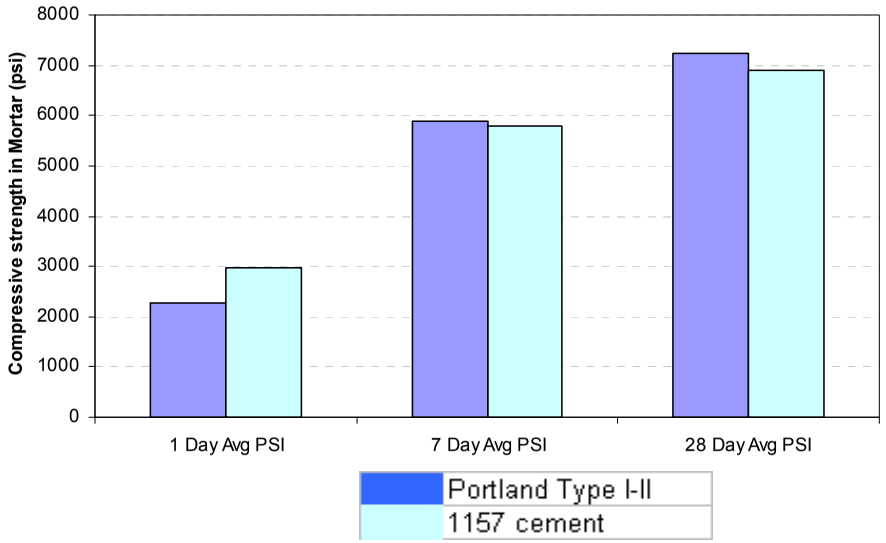
1157 cements with limestone

Cement Characteristics:

- Strength development in the typical range of a type I-II cement
- Certify as a 1157 cement
- . Blaine in the 5000 range with no negative impact on the water demand
- Initial Vicat in the 80-100 minutes range.
- Color is lighter compared to type I-II cement
- Reduces the CO2 footprint compared to type I-II cement
- Complies with ASTM C-1038



Cement technology
already proven in other CX markets

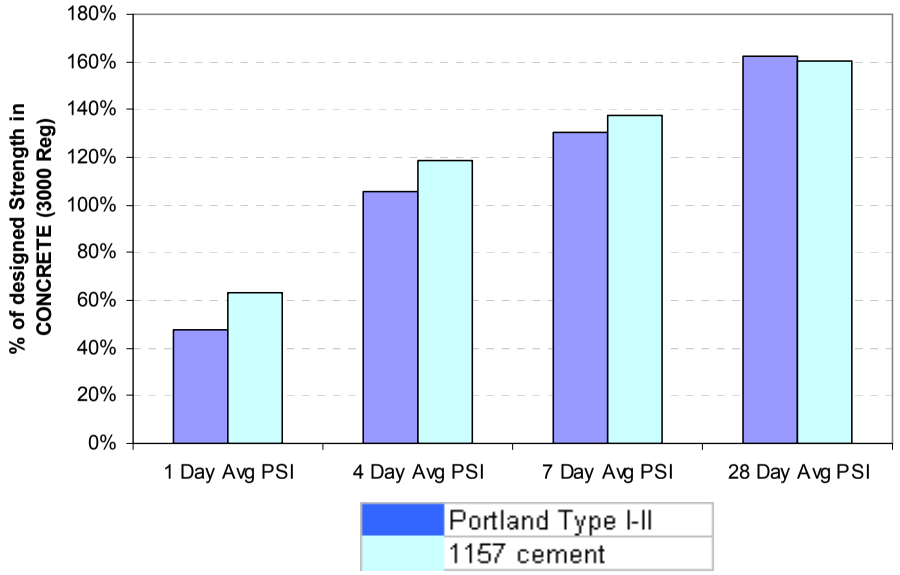


Concrete Performance using 1157 cement

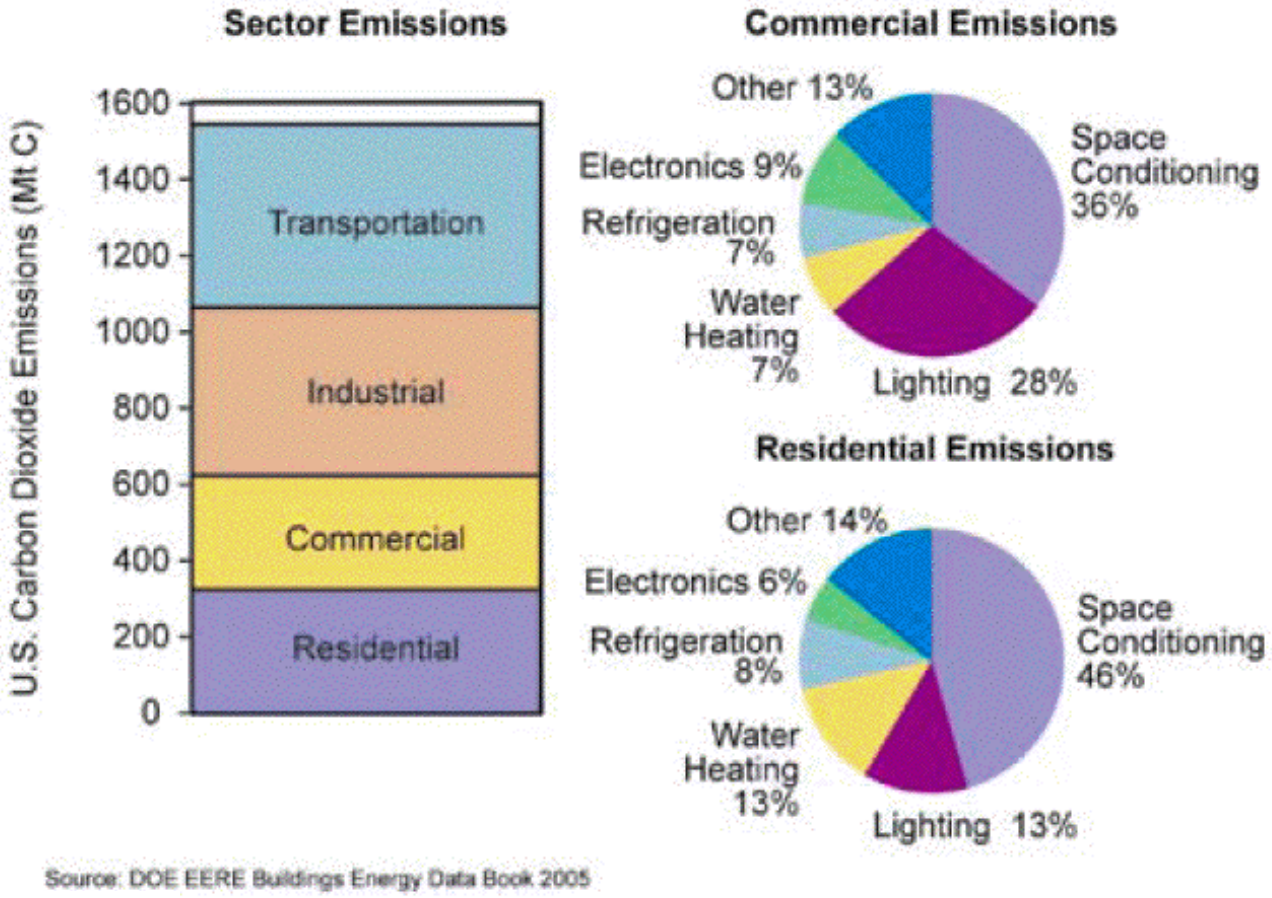
Concrete Characteristics:

- Strength development, water demand, bleed, and initial setting are comparable to a concrete made using a typical I-II cement
- Better workability than a typical type I-II concrete

Concrete Expertise



Most of the CO2 emissions of buildings are related to the space conditioning.

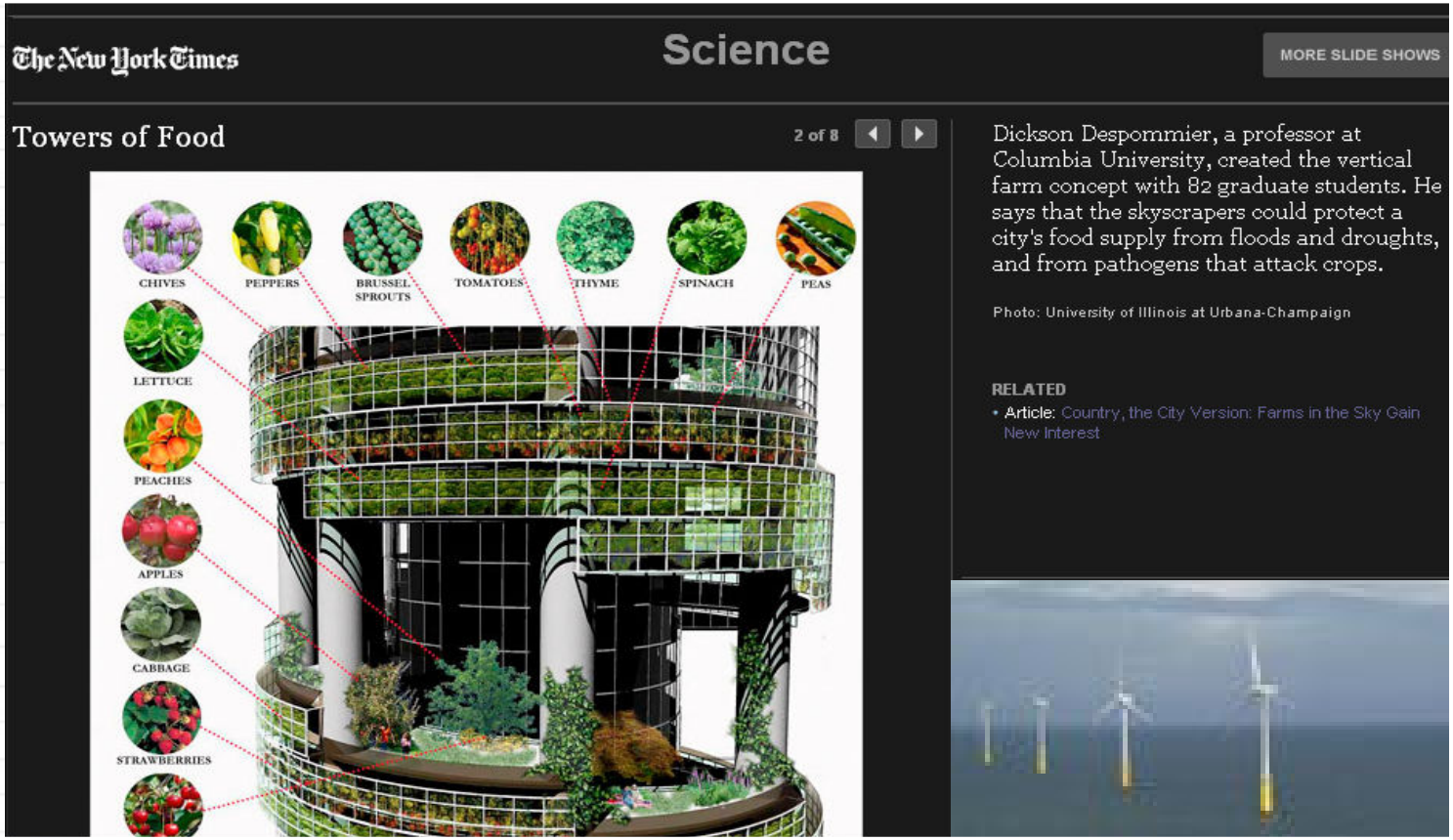


Source: DOE EERE Buildings Energy Data Book 2005

United States' carbon emissions by sector and (for commercial and residential buildings) by end use.

Another trend:
Architects are thinking outside the box…

Architects are creating virtually the new buildings and factories of the future



…..and acting Globally (Generation Green) With whom they are going to partner with?

The green building movement is showcasing their 10 creations in the FUTURE HOUSE Competence hosted by the Chinese Housing and Construction Ministry during the 2008 Olympics in Beijing

…..and acting Globally (Generation Green) With whom they are going to partner with?

This is the team representing the USA in FUTURE HOUSE during the 2008 Olympics in Beijing

Their idea is not offering only products or services but a whole practical and beautiful SOLUTION

Where we stand in Sustainable Technologies Know How? Green-Mix for Caltrans

- "Caltrans learned that 'green' concrete might be tough for this type of project, but they also felt that this was the way things were going into the future".
- **"For ready mixed companies with large enough technical and service departments, the prospects are great".**

Where we stand in Sustainable Technologies Know How?
CX's Orange Wanne® Constructive Solution in Germany

orange wanne®

Das Betonabdichtungssystem für Keller

orange wanne® – das Optimum für Wohnbaukeller

Planung

Grundlagen für die gesamte Planung sind die objektbezogenen Ausgangsdaten des Auftraggebers:

- Boden- und Wasserverhältnisse (Bodengutachten) bilden die Basis für die Bestimmung des Bemessungswasserstands und der Beanspruchungsklasse
- Geplante Nutzung bestimmt die Nutzungsklasse
- Grundriss, Aufriss und Statik des Gebäudes sind Grundlage für die Abdichtungsplanung und Umbemessung

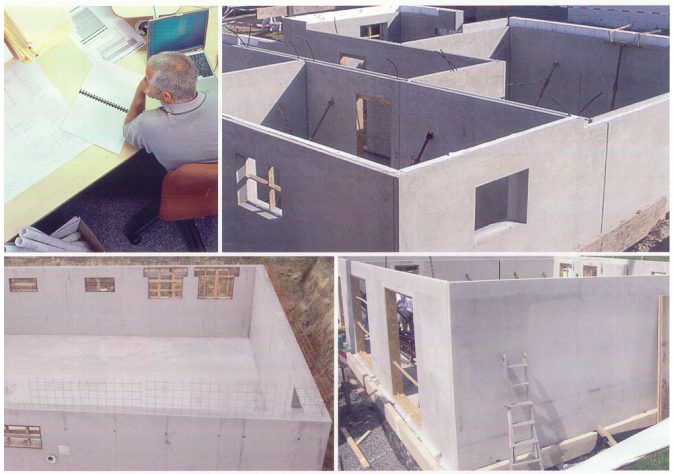
Unter Berücksichtigung dieser Daten wird die orange wanne® exakt geplant. Das hierfür von CEMEX speziell entwickelte Bemessungskonzept wurde vom iBMB der TU Braunschweig begutachtet und die Konformität mit der WU-Richtlinie bestätigt.

Ein weiteres Gutachten von Prof. Hegger (RWTH Aachen) weist nach, dass die orange wanne® unter praxisüblichen Randbedingungen mit Stahlfaserbetonwänden ohne zusätzliche Bewehrung zur Begrenzung der Rissbreite aus frühem Zwang hergestellt werden kann – und das für Wandlängen von bis zu 10 m!

Gemäß der DAfStb-WU-Richtlinie sind bei jedem Bauvorhaben unbedingt zu beachten:

- der Bemessungswasserstand
- die Beanspruchungsklasse und
- die Nutzungsklasse

Es werden die Beanspruchungsklassen 1 und 2 und die Nutzungsklassen A und B unterschieden.



CX is offering Innovative Constructive Solutions in Europe

Where we stand in Sustainable Technologies Know How? CX's success with SCC in the UK market

CEMEX Building the future™

2007 annual report

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teamwork and continuous improvement

ONGOING teamwork

CONTINUAL knowledge-sharing

CONTINUOUS improvement

Our post-merger integration (PMI) of Rinker exemplifies our teamwork and knowledge-sharing. The success of the process depends on the combined effort of everyone in both organizations; not only the joint PMI teams – 390 people, working full time and part time, from both companies and 20 different nationalities – but also those who continue to work full-time to run the business and maintain our high level of performance. Through our teams' and our companies' collaboration and shared learning, we identify and capitalize on best practices and synergies, retain talented people, ensure business continuity, and ultimately build one CEMEX.

Likewise, in Europe, our regional coordination teams facilitate communication, knowledge-sharing, and new initiatives among our operations. For example, our special projects team shares expertise about new specialty products such as self-compacting concrete. This product is easier to work with than other types of concrete because it requires no labor to compress the concrete, increases efficiency, and cuts the cost of construction. Until we introduced self-compacting concrete in the UK, there was almost no market for that product; it now accounts for approximately 1.2 percent of our ready-mix concrete volumes in the UK.

The British Ready Mix Concrete Association (BRMCA) has indicated some positive market trends:

- 10% year on year growth in SCC inquires
- Growth in volume from near zero in 2000 to a projected 523,000 cy in 2008
- Further grow potential for SCC is said to be massive for concrete frame applications

Thank you / Questions?