ACI AND CRITICAL INDUSTRY CHALLENGES – NUCLEAR POWER CONSORTUIM & EPA/FLY ASH UPDATE

SDC
Kansas City, Missouri
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Concrete and Reinforced Concrete Standards for Nuclear Power Plants

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US Nuclear Energy– Background Information

•US has 104 operating nuclear reactors. It is currently finishing the construction of a TVA's Watts Bar II reactor, number 105. NRC has NOT approved a new reactor construction since 1977. Construction permit for Watts Bar II reactor approved in 1973.

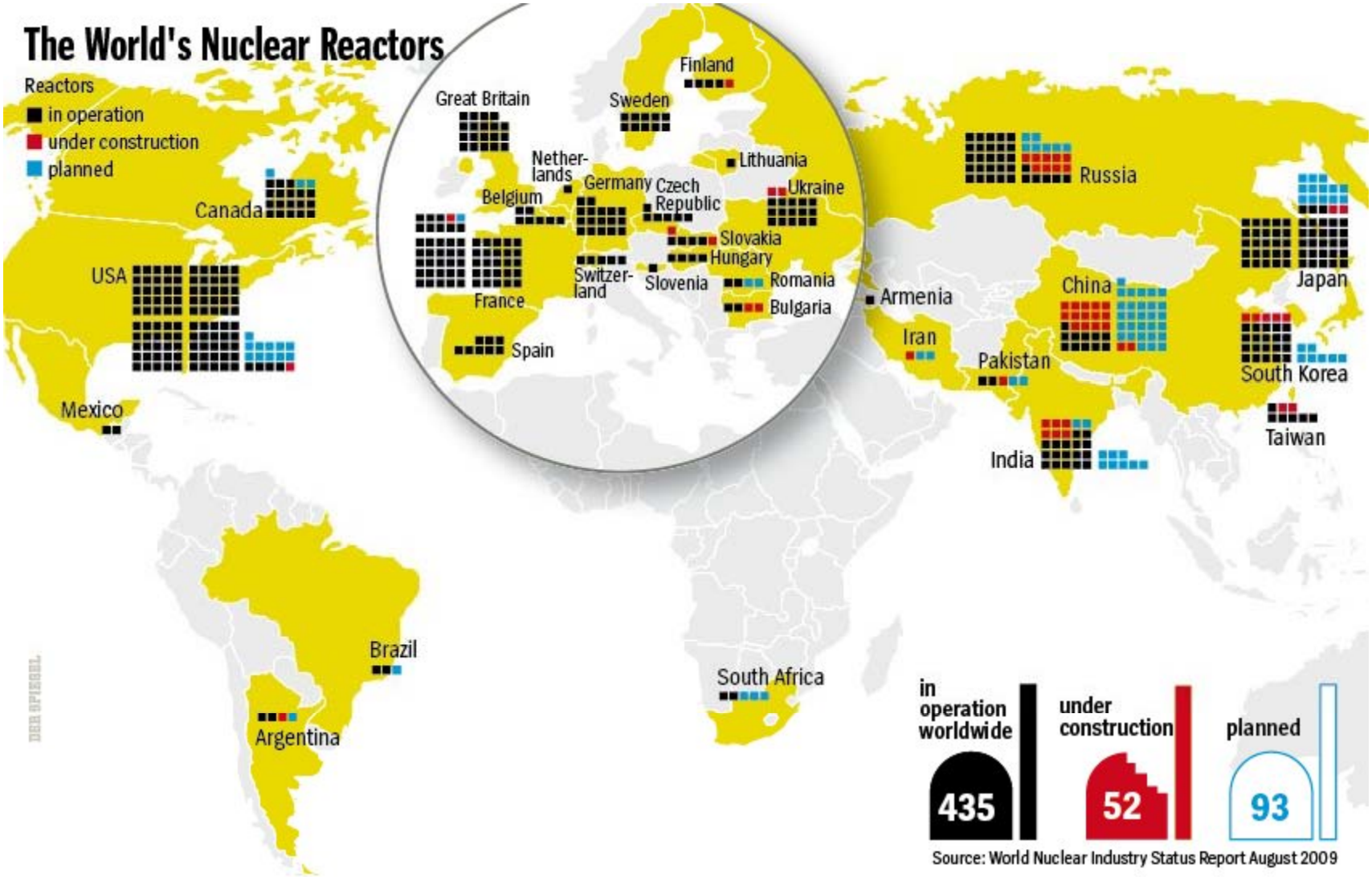
•Disasters
- –Three Mile Island – March 1979
- –Chernobyl – April 1986

•Since 2007, construction of new reactors has become more acceptable
- –increased energy demand
- –climate change issues
- –increased price of oil
- –geopolitical conflicts in fuel rich regions
- –inability to generate clean energy from coal

–Demand for energy within the US is expected to double by 2050

–Need for a new fleet of nuclear reactors

TREMENDOUS OPPORTUNITY !!!



Materials Consumption – A single Gen III Reactor offers

Tremendous Opportunity!

- concrete = 460K cubic yards (not including concrete for site preparation) = 0.9 M tons
- Reinforcing steel and embedded parts = 46K tons
- structural steel, = 25 tons
- Current projected construction costs for a Gen III reactor ≈ $10B/reactor

What is the Problem

- NRC has received applications for building 27 Gen III reactors. Four applications are expected to be approved soon and these reactors are projected to come on line sometime after 2018.
- Construction of any nuclear facility is a complicated process predicated on availability of up-to-date standards and codes cited in NRC regulatory documents.
- A large fraction of the codes and standards cited by NRC regulations have not been updated since the 1980's. These standards need to be updated prior to the construction of new nuclear reactors.
- Since the mid-1990's, the federal government has made extensive efforts to encourage industry to initiate construction of Gen III reactors by reducing the risk associated with their construction.
- Nuclear Energy Standards Coordination Collaboration (NESCC) established in June 2009 to upgrade standards and codes for constructing Gen III reactors.
- DOE and NRC have indicated willingness to provide financial support for these activities.

Construction of Gen III Olkiluoto, Finland and Flamanville, France Reactors

Tremendous Risk!!

Olkiluoto, Finland has 100% cost overrun and its completion date is two times longer than expected. Flamanville, France cost overruns are approximately 70%. Early defects the same at both locations and include

1. "concrete is porous", "water to cement ratio too high", "cracked concrete"
2. "the steel is brittle"
3. "poor workmanship"
4. "flawed construction plans"

Updating of Nuclear Energy Standards

- Mission of NESCC
  - **Facilitate and coordinate ANSI-accredited SDOs [including ACI] to prioritize, coordinate, create, and publish nuclear energy consensus standards that are under their cognizance;**
  - **Advance the U.S. Department of Energy (DOE) and NIST programs and activities that are established to expand the development, construction and deployment of new nuclear power plants and other nuclear energy facility technologies, including advanced reactor concepts and processing plants;**
  - **Interface with the U.S. Nuclear Regulatory Commission (NRC) to ensure its needs and priorities for nuclear energy-related standards supporting new licensing and regulatory activities are understood and coordinated.**

Need For Updating Standards

- Domenici-Barton Energy Policy Act of 2005 has made construction of new GEN III+ reactors highly favorable through
  - **Extension of Price-Anderson Act – minimizes public liability assigned to a utility due to nuclear reactor accident**
  - **Fast Track Licensing – standardization of Gen III reactor designs—three designs approved—GE, Westinghouse, and Dominion**
  - **Incentives for new reactor construction -- $18.5 B in federal loan guarantees**
  - **Liability and construction delay protection due to NRC failure to comply with schedule for inspection, tests, analyses, and acceptance criteria**
    - **For first two new reactors, US government will pay 100% of construction delay costs up to $500M**
    - **For reactors three through six, US government will pay 50% of construction delay costs up to $250M**

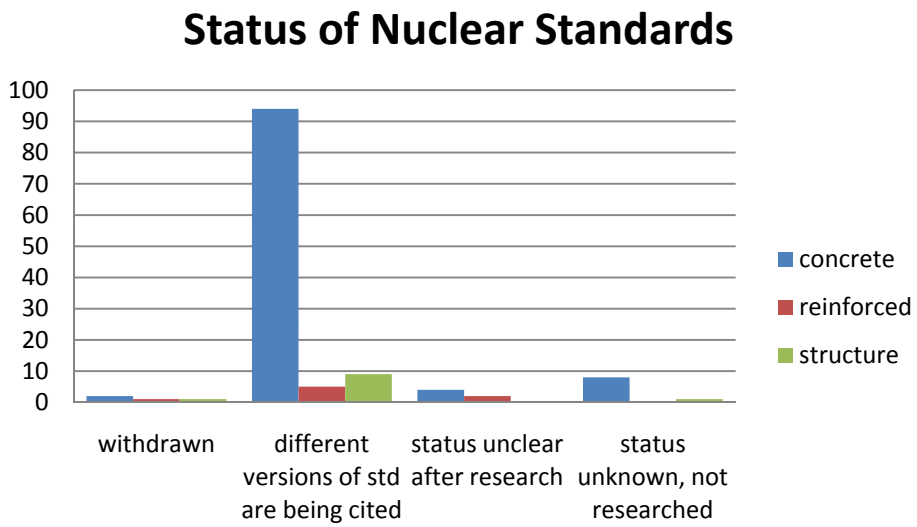
What is the Need?

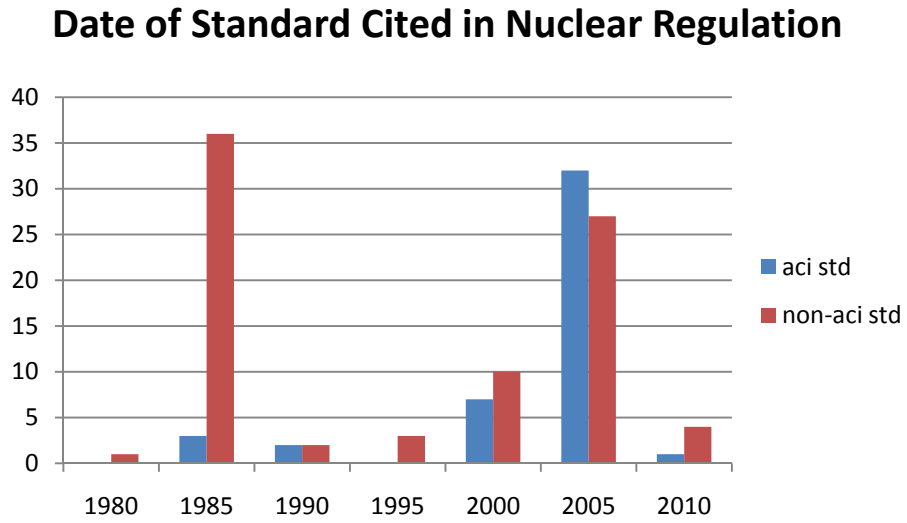
- Standards and Codes
  - Over 6000 standards and codes are cited for constructing GEN III reactors
    - DOE -- Mattson study -- http://publicaa.ansi.org/sites/apdl/Documents/Meetings%20and%20Events/2009%20NESCC/NESCC%20Meeting%20-%20June%201,%202009/NESCC%2009-002%20Meeting%20Report%20(6%201%2009)(revised%207.1.09).pdf
    - NRC report – Codes and Standards and Other Guidance Cited in Regulatory Documents – NUREG/CR-5973
- In both reports, approximately 10% of standards and codes are related to concrete, reinforced concrete, and concrete structures
    - 86% associated with aggregates, cement, and concrete
    - 6% associated with reinforced concrete
    - 8% associated with structural analysis of reinforced concrete structures

Common Discrepancies from DOE Mattson Report Regarding Standards Cited in NRC Regulations

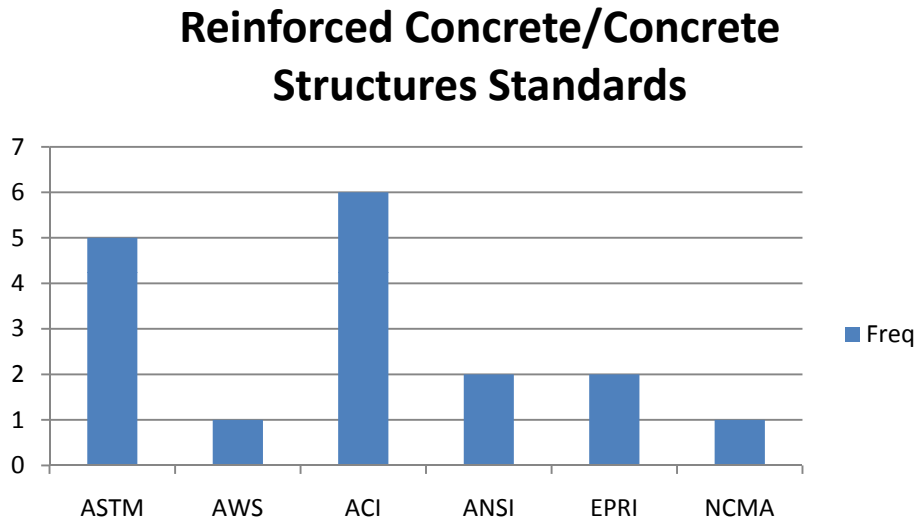
Standard Title	Standard ID	Date	NRC	AP 1000 DCD	AP 1000 COLA	GE DCD	Dominion COLA
Standard Specification for Concrete Aggregates (most recent version is 2002)	ASTM C33	1998	X				
Building Code Requirements for Structural Concrete and Connections (most recent version 2008)	ACI 318	2005 2002 No date	 X	 X	 X	X X	X X
Specification for Solid Load Bearing Concrete Masonry Units (most recent version 1998)	ASTM C145-31	1986	X				
Manual of Standard Practice for Detailing Reinforced Concrete Structures (standard could not be located)	ACI 315	1999 No date	 X			X	X
Method for Ultimate Load Analysis of Concrete Containment (status of standard not researched)	EPRI-NP-4869M	1987				X	X

Overview of Concrete Related Standards Cited in DOE Mattson Report





Reinforced Concrete and Structural Concrete Standards



Date of Standards Cited in Nuclear Regulations

SDO	1970	1980	1990	2000
ASTM	2	0	1	2
AWS	0	1	0	0
ACI	0	0	3	3
ANSI	2	0	0	0
EPRI	0	2	0	0
NCMA	1	0	0	0
AWWA	0	0	1	0

First Task Group Established Under Auspices of NESCC

Concrete Codes and Stds. For Nuclear Power Plants

- **Chairman:** Clarissa Ferraris, NIST
- **Group Established: Dec. 2009**
- **Membership:** 21 (as of 1/18/10) at least, 9 from ACI in addition to representatives from
  - Bechtel Power
  - AISC
  - Westinghouse Savannah River
  - AREVA
  - Exelon
  - EPRI
  - Stevenson &Associates
  - Westinghouse
  - US-NRC
  - ASME
  - Constellation /Unistar
  - Southern Company
  - Sargent & Lundy
  - ASTM
  - Purdue Univ
- **ACI presence on Task Group**:
  - ACI represented by Chuck Zalesiak and Mat Senecal (staff)
  - Chairs of ACI 359 and 349 are members
- **3 meetings already held by conference calls in 2010; first in-person meeting ACI** Chicago (March 2010)
- Expect to establish Reinforced Concrete and Concrete Structures Group during the May 26, 2010 NESCC meeting

Recent Happenings

- In FY10,
  - Obama pledged $8.3 B loan to construct two nuclear reactors (anticipated initial cost of each reactor is $7B a piece; combined cost is $14B).
  - Expected completion date 2016 to 2017
  - 3500 construction jobs; 800 permanent jobs
  - Elimination of 16 million tons of carbon dioxide
- In FY11, Obama administration has requested increase in federal loan guarantees to >$54 B (this is a $36 B increase).
- DOE currently negotiating loan guarantees with three other nuclear facility owners.
- Presently, 13 applications for new power plants are pending before NRC
- DOE expects to construct 20 GEN III reactors in total

What Needs to be Done

1. Assist NESCC
2. Identify conflicts
3. Assist in resolving conflicts quickly
4. SDC to be the champion for ACI effort

FLY ASH

EPA considering proposing a rule to regulate fly ash.

TVA's Kingston Power Plant

- December 22, 2008, dike fails
- 5.4M cubic yards of ash slurry released
- 26 homes impacted
- No loss of life
- $1B cleanup costs estimated

Resource Conservation and Recovery Act - 1976

Subtitle C – Federal regulatory control of hazardous waste

Subtitle D – Solid waste subject to State regulation

1993, 2000 EPA determined fly ash did not warrant management as hazardous waste

ACI Actions

1. Letter to Administrator Lisa Jackson
2. Meeting at OMB
3. Conference call with EPA

Likely Proposal

1. Options
   A. Regulate under *Subtitle D* – impose performance criteria for States, deadline, trigger federal takeover for nonperformance
   B. Hybrid – beneficial use exempt from hazardous waste designation, impounded ash a hazardous waste
2. No preferred option
3. May 2010 announcement

Obama Pledge – December 2009

2005 Baseline

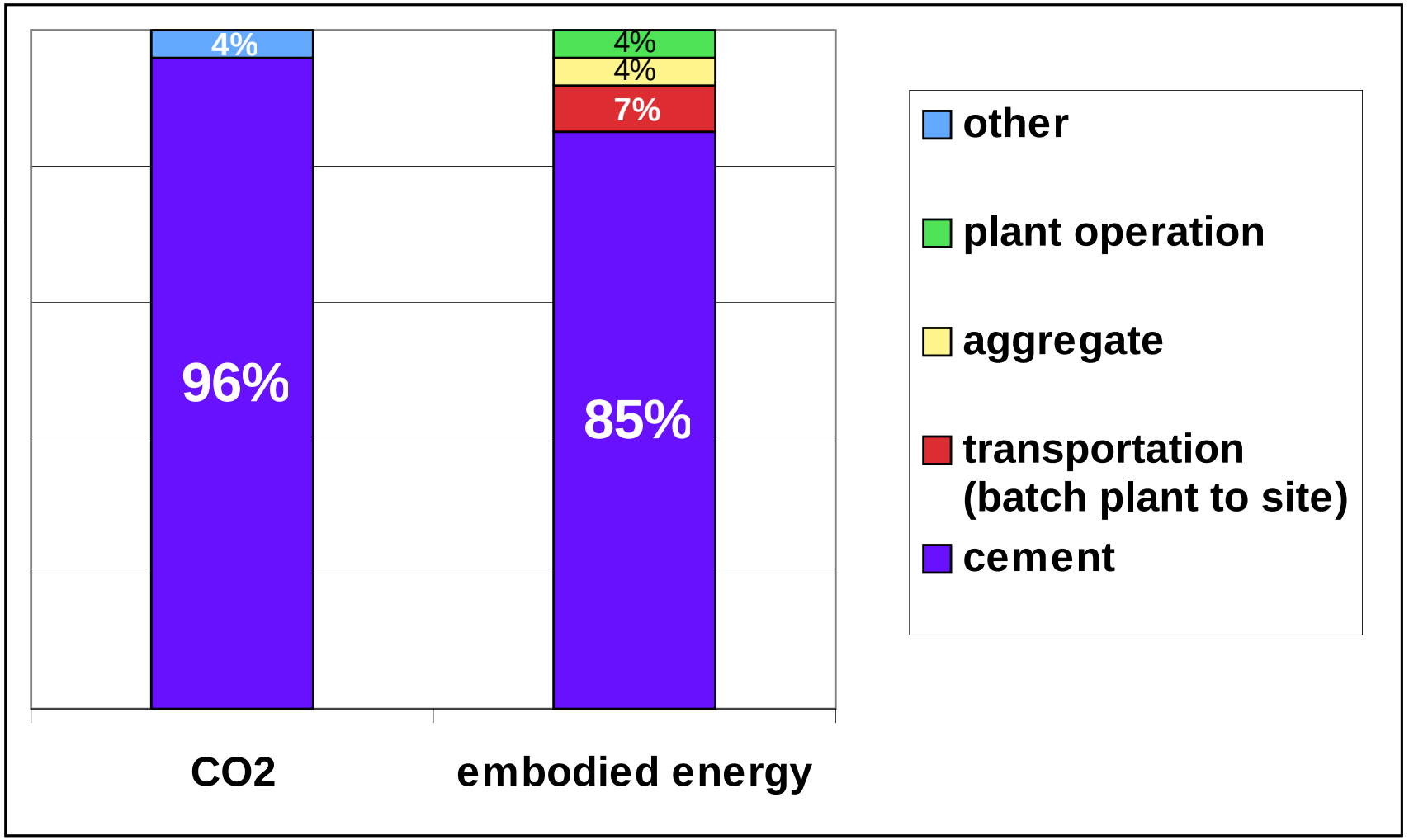
17% Greenhouse Gas Emission Reduction by 2020

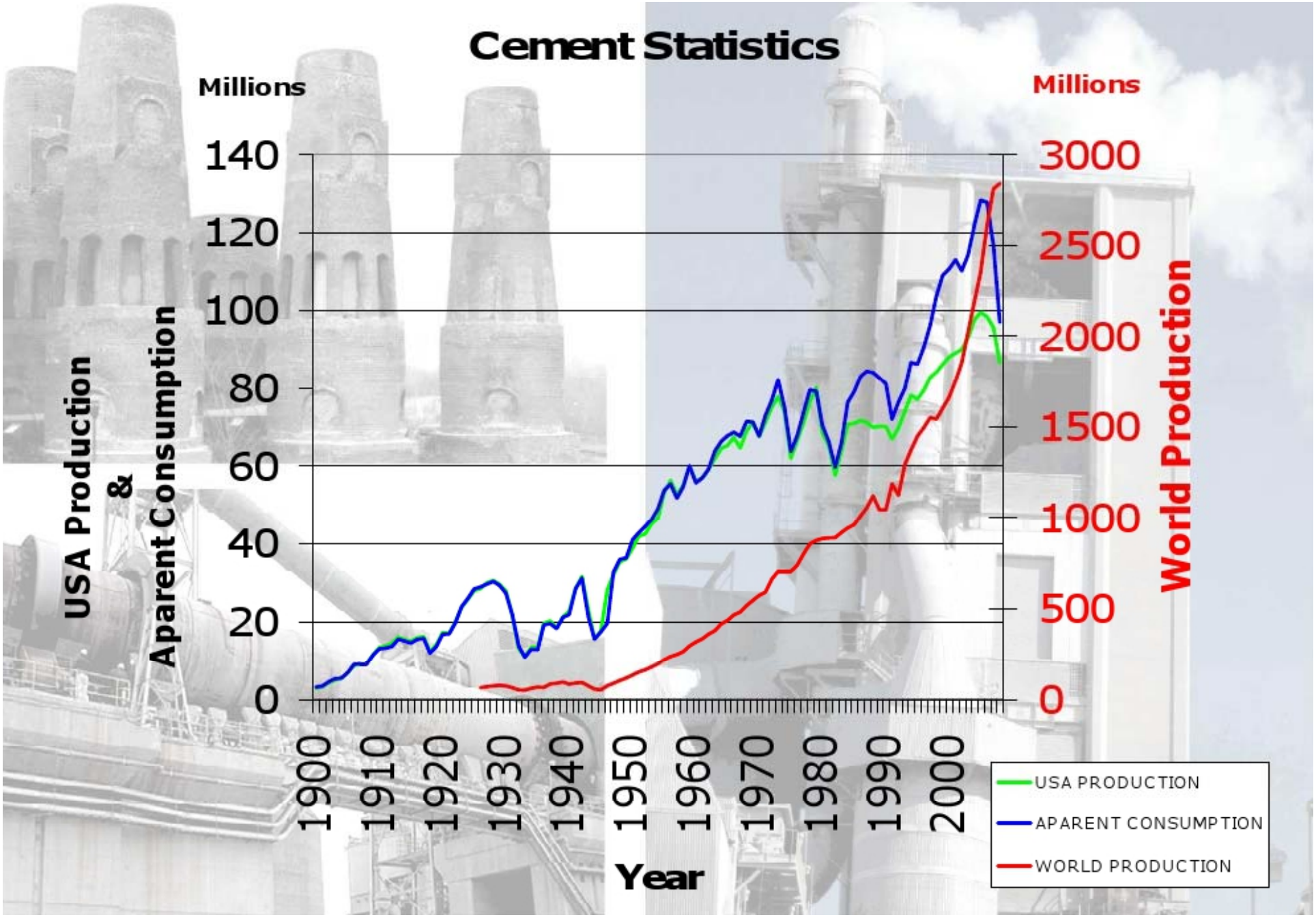
83% Greenhouse Gas Emission Reduction by 2050

1990 Baseline

3% Reduction by 2020

Cement: Primary Source of CO_2 & Embodied Energy in Concrete




Cement Statistics
Millions
Millions
USA Production & Aparent Consumption
World Production
140
120
100
80
60
40
20
0
3000
2500
2000
1500
1000
500
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Year
USA PRODUCTION
APARENT CONSUMPTION
WORLD PRODUCTION

Large reductions in CO_2 for concrete are

NOT

limited by current technology – they are limited by acceptance by engineers.

PCA Goals

1990 Baseline

- 10% CO_2 reduction per ton of cement by 2020
- 60% kiln dust reduction per ton of clinker by 2020
- 20% energy reduction by 2020

NRMCA

2007 Baseline – per cubic yard of concrete

Embodied Energy

- 20% reduction by 2020
- 30% reduction by 2030

Carbon Footprint

- 20% reduction by 2020
- 30% reduction by 2030

Water

- 10% reduction by 2020
- 20% reduction by 2030

Waste

- 30% reduction by 2020
- 50% reduction by 2030

Recycled Content

- 200% increased by 2020
- 400% increased by 2030

Currently

Concrete meets Obama Pledge

40% below 2005 baseline

Concrete meets Kyoto Target

93% of 1990 baseline

We could continue to meet pledge.

Will we?