

Green Highways:

American Concrete Paving Industry's Perspective

National Concrete Consortium
Sustainability in Concrete Construction



April 9th, 2008

Baton Rouge, Louisiana

Lets get one thing straight!

- So-called “global warming” is just a secret ploy by wacko tree-huggers to make America energy independent, clean our air and water, improve the fuel efficiency of our vehicles, kick-start 21st-century industries, and make our cities safer and more livable. Don't let them get away with it.

- Chip Giller



...st a secret ploy

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ore livable.

What are Green Highways?

- Environmentally and Economically Sustainable Concrete Pavements!

- What is sustainability?

“Meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs”

[UN General Assembly 1987]



Green Highways Initiative



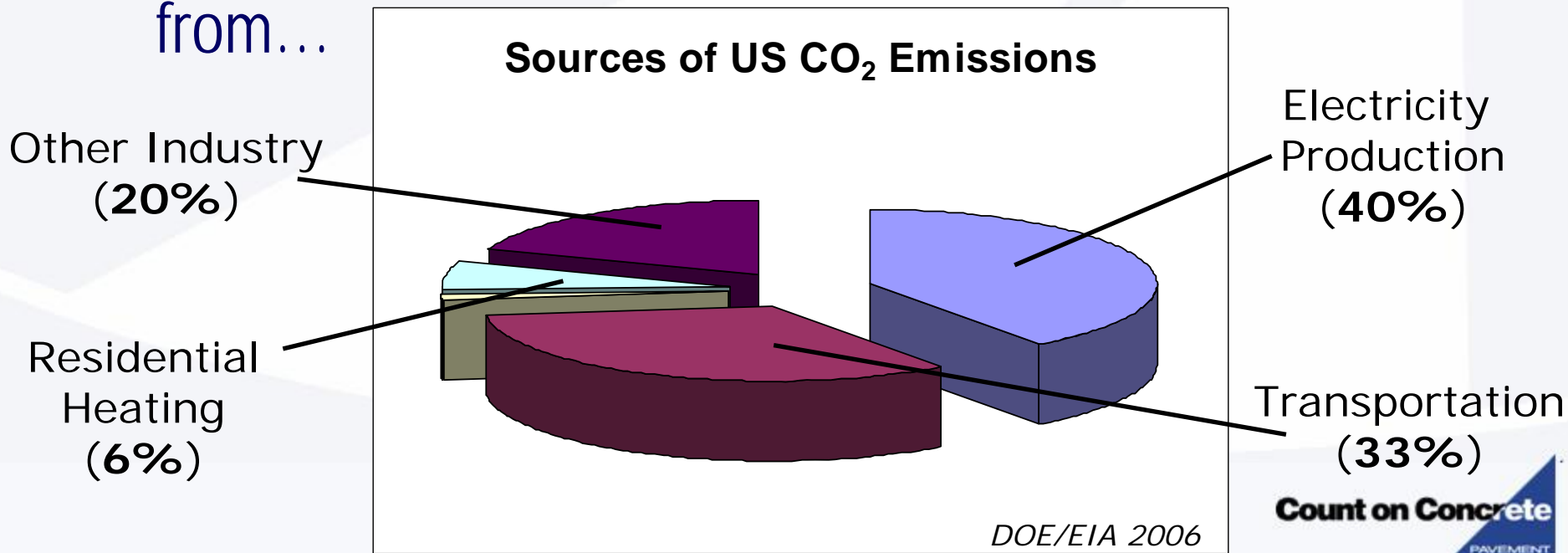
- In 2005, EPA started the Green Highways Initiative as an instrument for coordinating environmentalism and transportation
- Focus on demonstrating and ensuring that sustainable practices and economic success can go hand-in-hand!
- **This is indeed true of concrete pavements!**



Concrete is
100%
Recyclable

What about Cement?

- Although cement is a relatively energy and CO₂ intensive material to manufacture... cement manufacturing accounts for only 1.5% of US CO₂ emissions – the balance comes from...



What about Cement?

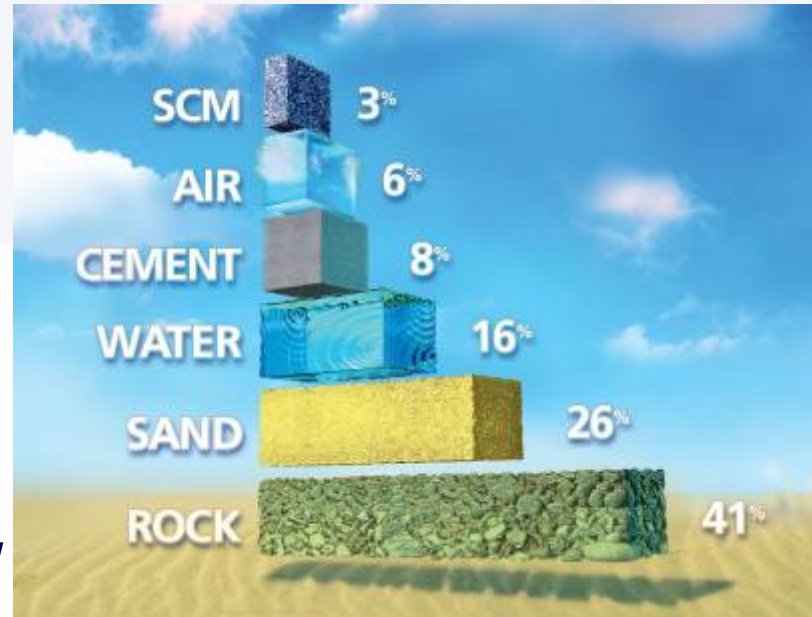
- Includes CO₂ emissions of cement manufacture for all concrete and masonry uses (not just pavement)...
- Concrete most widely used material on earth, apart from water (*www.wbcasd.org*)
- Cement industry has lowered the amount of energy required to make a ton of cement by 33% since 1972
- CMS program pledge another 10% by 2020



World Business Council for Sustainable Development

What about Concrete?

- 92% of paving concrete is comprised of materials that have a low CO₂ footprint...
- All these materials are available/manufactured here in the US, often locally
- Overall sustainability benefits associated with use of concrete for pavements dramatically outweigh the impact of the cement manufacturing process...



Concrete Pavements!

- **Longevity** - hallmark of concrete pavements
- I-10 east of Los Angeles: Originally constructed in **1946** as part of US Route 66
 - Ground in 1965 (1st continuous grinding project in north America) to correct joint spalling and faulting
 - Reground for 3rd lease on life in 1984
 - In 1997 the 51 yr old PCCP was ground again
 - Today the concrete is carrying 240,000 vpd...



A true testament to concrete pavement sustainability!

Concrete Pavements!

- Not just isolated example in California...
- 50 year old pavements common in US...
- Route 23 Minnesota
 - Built 1948 (Ogilvie)
 - JPCP, 9", doweled
 - PSR 4.1 (very good)
 - > 50%, >50yr are >3.1
- TX, NY, IA, SC, WA...



Longevity means...

Less-frequent reconstruction

- Lower consumption of raw materials
 - Cement, aggregates, steel
- Lower energy consumption
 - Raw material processing
 - Rehab and reconstruction
 - Congestion



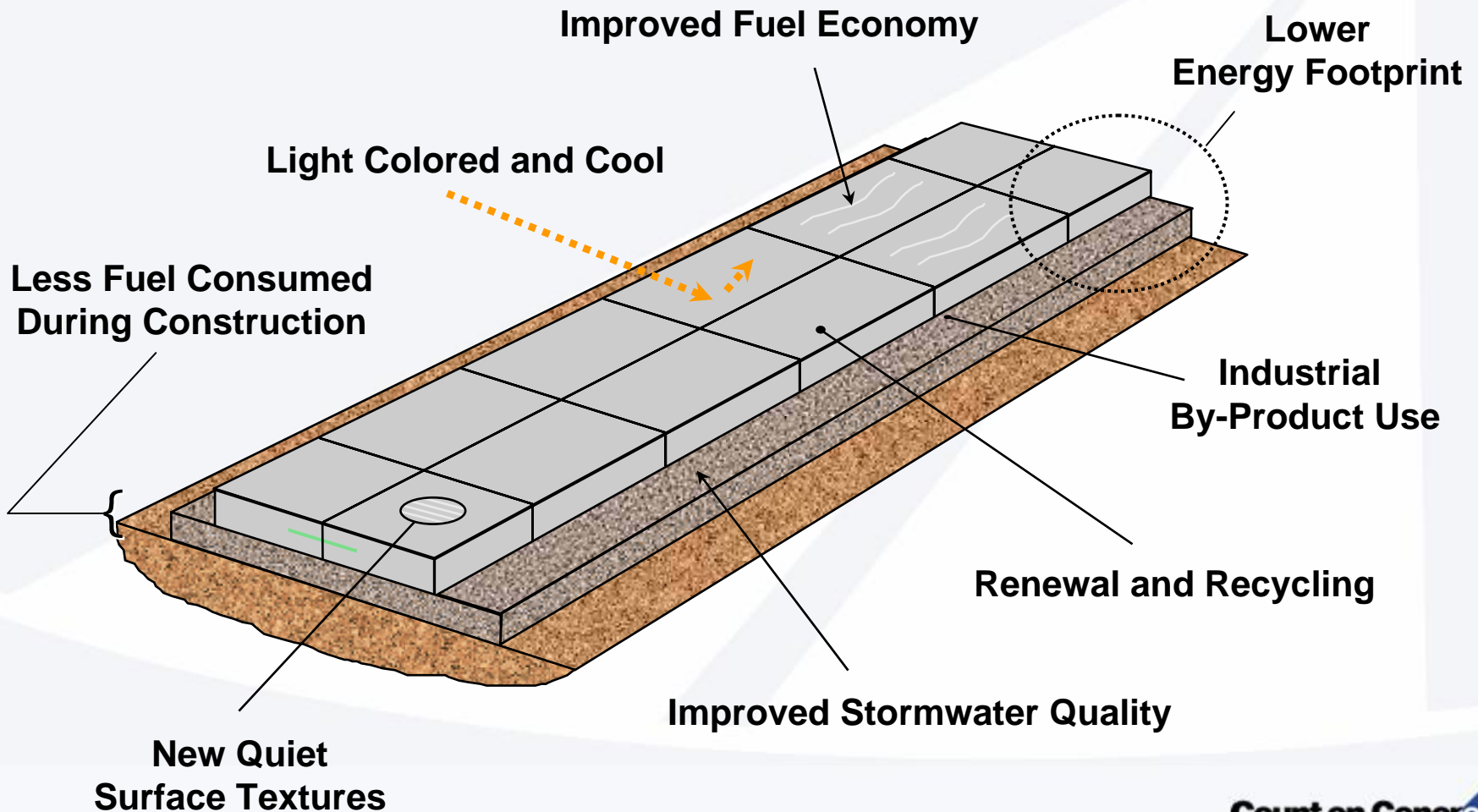
Longevity means... (cont.)

- Reduction in pollutants
 - Manufacturing, construction, congestion
- Lives saved
 - Rigid structure, profile durability
 - Infrequent construction zones
- All these translate into real economic benefits...



Longevity is a crucial element of sustainability!

Green Benefits *Beyond* Longevity



Improved Fuel Economy

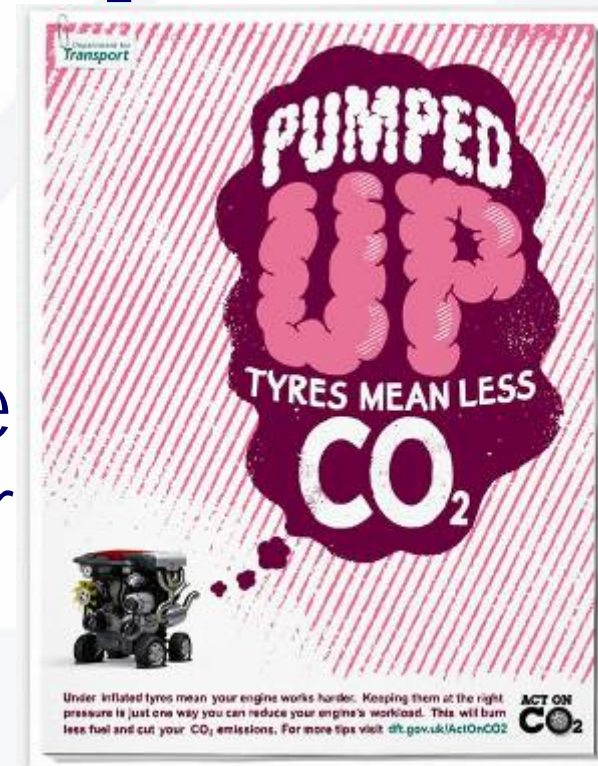


- Rigid surface → less deflection → less loss
- In-depth study by NRC Canada and NRCan
- Significant fuel consumption reductions for trucks on concrete pavement (0.8-6.9%)
- Average savings **per truck** (100,000mi, 5.5mi/G, \$3.19/G)
\$2,233 – 8.1tn CO₂ – 183lb NO_x – 22lb SO₂
- Huge environmental and cost savings...

Improved Fuel Economy: Example

62 mile long arterial highway; 20,000 vpd;
15% trucks; 5.5mpg; 30yr design life...

- An average of **165,000 tons CO₂** saved
- Greater than **three times** as much CO₂ as emitted during cement manufacture!
- CO₂ associated with concrete pavement is compensated for during the **first 9 years**



Improved Fuel Economy

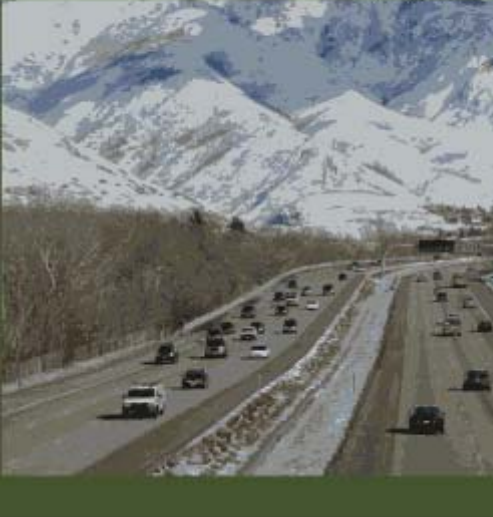
- Series of publications to illustrate this point...

GREENER HIGHWAYS

The Concrete Alternative

Heavy trucks use between 0.8% and 6.9% less fuel when traveling versus an asphalt pavement. These fuel savings lead directly to gas emissions and air pollutants.

See reverse for specifics for a portion of I-80




GREENER HIGHWAYS

Fuel savings and reduced emissions translate into real opportunities for greening a short segment of I-80 >>>


An Environmentally Friendly I-80

Highway agencies can realize significant economic and environmental benefits for the public during highway improvements with concrete pavements. Concrete's low pavement deflection reduces truck fuel consumption rates compared to asphalt surfaces. These reduced consumption rates translate into direct dollar savings as well as reductions in various engine pollutants.

The results for the short segment of I-80 from State St. to the mouth of Parleys Canyon present a compelling case. The charts below show a range of potential annual fuel savings and reductions in pollutant emissions that can be achieved if this I-80 corridor is reconstructed with concrete, rather than switching to asphalt. The case study is based on results from a study performed by the National Research Council of Canada's (NRC's) Centre for Surface Transportation Technology (CSTT) in January 2006. The research concluded that trucks use up to 6.9% less fuel on rigid concrete pavements than flexible asphalt pavements, due to concrete's lower pavement deflection.



Asphalt Pavement



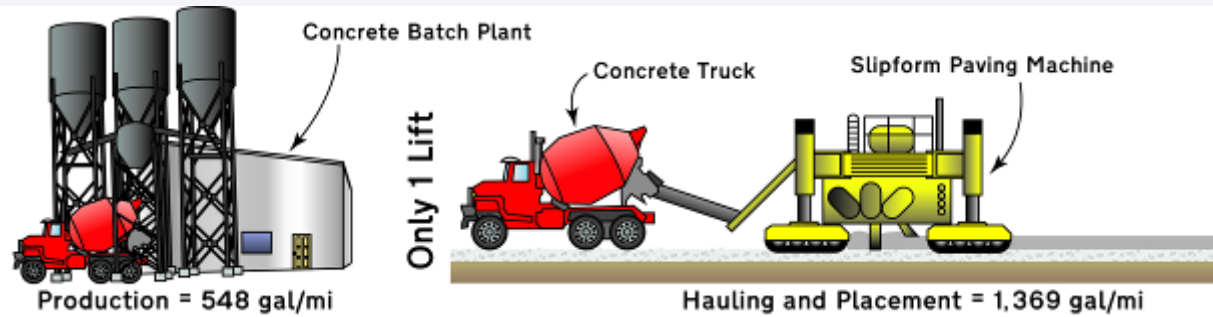
Concrete Pavement

Annual Impact of Reconstructing the 4 miles of I-80 from State St. to the mouth of Parleys Canyon in Concrete instead of switching to Asphalt

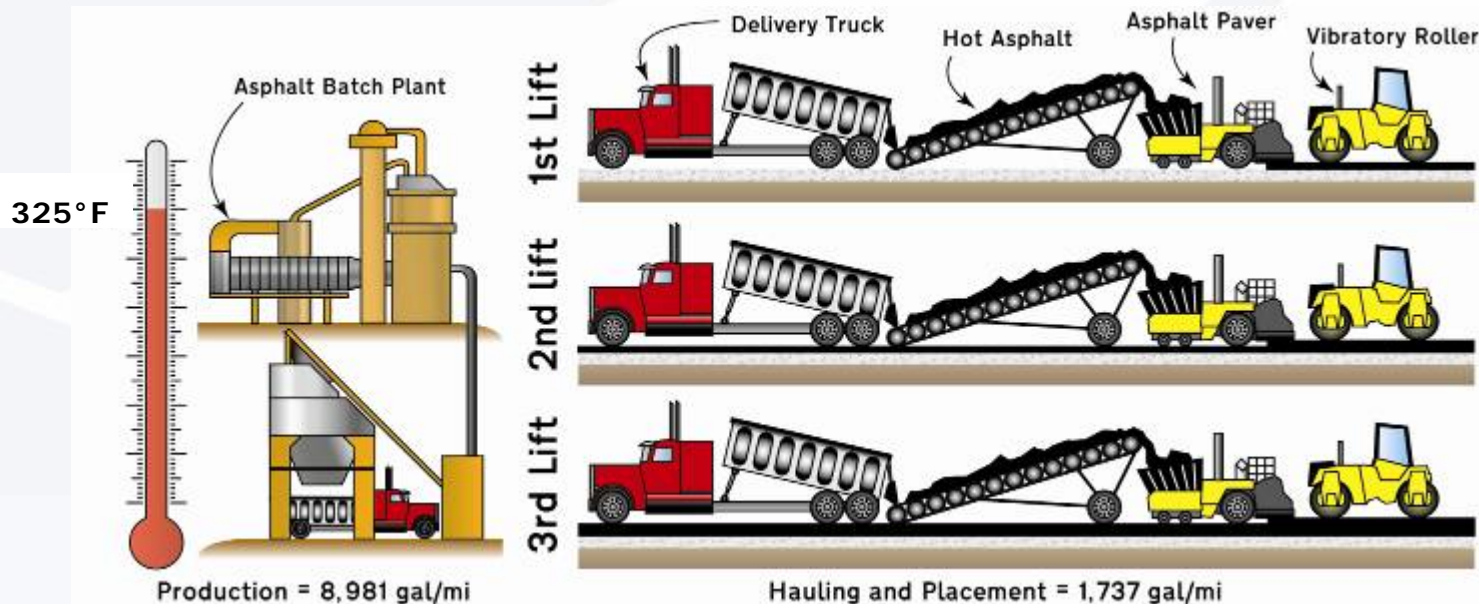
Impact Category	Metric	Min	Avg	Max
Economic Impact	Fuel Savings (gallons/year)	31,939	153,709	275,478
	Dollar Savings (U.S. dollars/year)	\$96,625	\$445,756	\$798,887
Environmental Impact	CO ₂ Reductions (tons/year)	368	1,770	3,170
	NO _x Reductions (tons/year)	4	20	36
	SO ₂ Reductions (tons/year)	0.5	2.5	4.5

References: EPA 430-F-05-001, February 2005. NRC-Canada, CSTT-HVC-TR-058, Taylor and Pettin, January 2006. Assumptions: Traffic volume of 94,000 vehicles per day with 16% trucks, truck fuel mileage of 5.5 miles/gallon, and a local diesel fuel price of \$2.90/gallon.

Lower Fuel Consumption during Construction



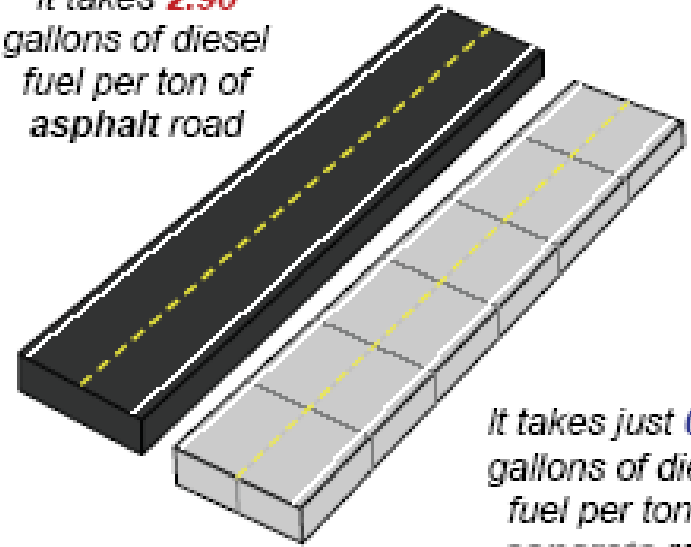
- FHWA TA T5080.3 on *Price Adjustment Contract Provisions* give Fuel Usage Factors (*FHWA 1980*)
 - Construction of HMA roadways consumes 5½ times as much fuel (diesel) as construction of concrete roadways



Lower Fuel Consumption during Construction

- FHWA estimates that 500 million tons of HMA placed annually
- If concrete roadways were placed instead, it would amount to an annual fuel savings of **1.2 billion gallons** [1.45BG – 0.25BG]
- Savings are staggering - CO₂ equivalent to taking 2.7 million cars off the road!

It takes **2.90** gallons of diesel fuel per ton of asphalt road



It takes just **0.50** gallons of diesel fuel per ton of concrete road

Use of Industrial By-Products

- Concrete is a huge consumer of industrial by products (SCM's primarily)
- Up to 25% FA, 50% SC, ternary blends
- Reduces disposal, lowers cement intensity (with its CO_2) and improves both performance and longevity!
- Slag aggregates.



Renew-ability, Recycling and Reuse

- Grinding – CalTrans expect 17 years additional life from pavement grinding jobs
- Concrete 100% recyclable – in new concrete, subbases and granular fill (even on-site operations)
- Carbon sequestering through carbonation:
 - 60% of the CO₂ emitted during cement production is due to calcination, which can be recaptured at the end of its life (*RMRC '05*)
- 53 million tires used in cement kilns (*EPA '03*)



Summary

- Concrete pavement is the sustainable choice!
- Lower overall energy footprint!
 - Long lasting and Renewable
 - Less fuel and CO₂ to construct
 - Less resource intensive
- Better fuel economy – less CO₂, NO_x and SO_x
- Urban Heat Island mitigation, better Visibility
- Use of industrial by-products
- Opportunities for improved water quality!

(Courtesy NRMCA)

Count on Concrete

PAVEMENT

In Conclusion...

- North American concrete paving industry strongly supports sustainable development
- Concrete pavements are the clear choice for environmentally sensitive and economically sustainable roadways – key is **LONGEVITY!**

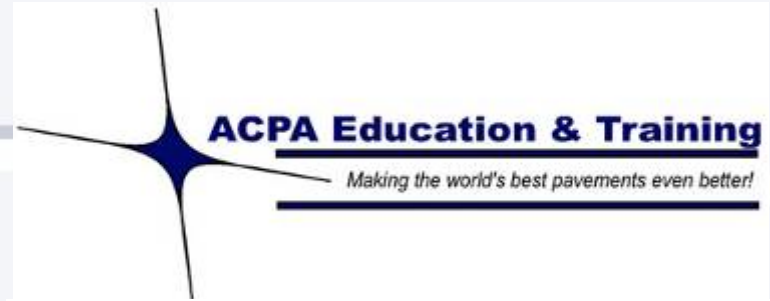
- truly Green Highways
in more ways than one!



Resources...

- ACPA published a Special Report on Green Highways
- Printed in October 2007
- Available on our website at:

www.pavement.com



Topics for our 2008 program :

- Concrete Mix Design Basics
 - Concrete Pavement Materials
 - PCCP Sustainability
 - Curing
 - Hydration Processes
 - Introduction to the M-E PDG
 - Joint Layout and Design
 - Life Cycle Cost Basics
 - Materials Incompatibility
 - Maturity
 - Slipform Paving Operations
 - Soil Stabilization
 - Texturing Concrete Pavements
 - Thickness Design – Municipal
 - Troubleshooting Slabs on Grade
- PROFESSORS SEMINAR
CONCRETE PAVEMENT 101/201

Questions?

