

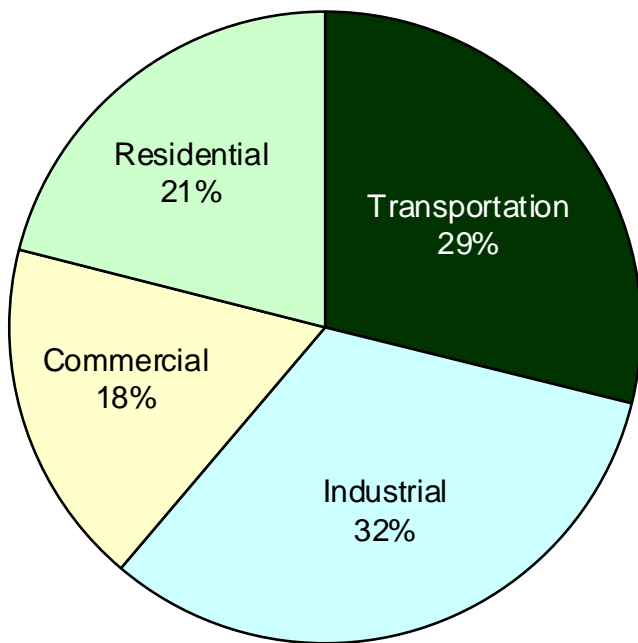


Green Roads

more sustainable roads for a better transportation future

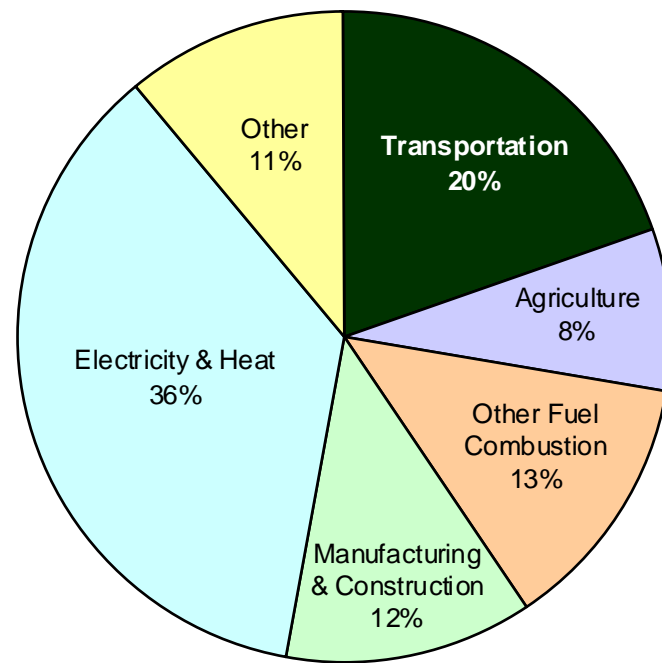
Transportation uses lots of energy and produces lots of emissions.

2006 U.S. Energy Use



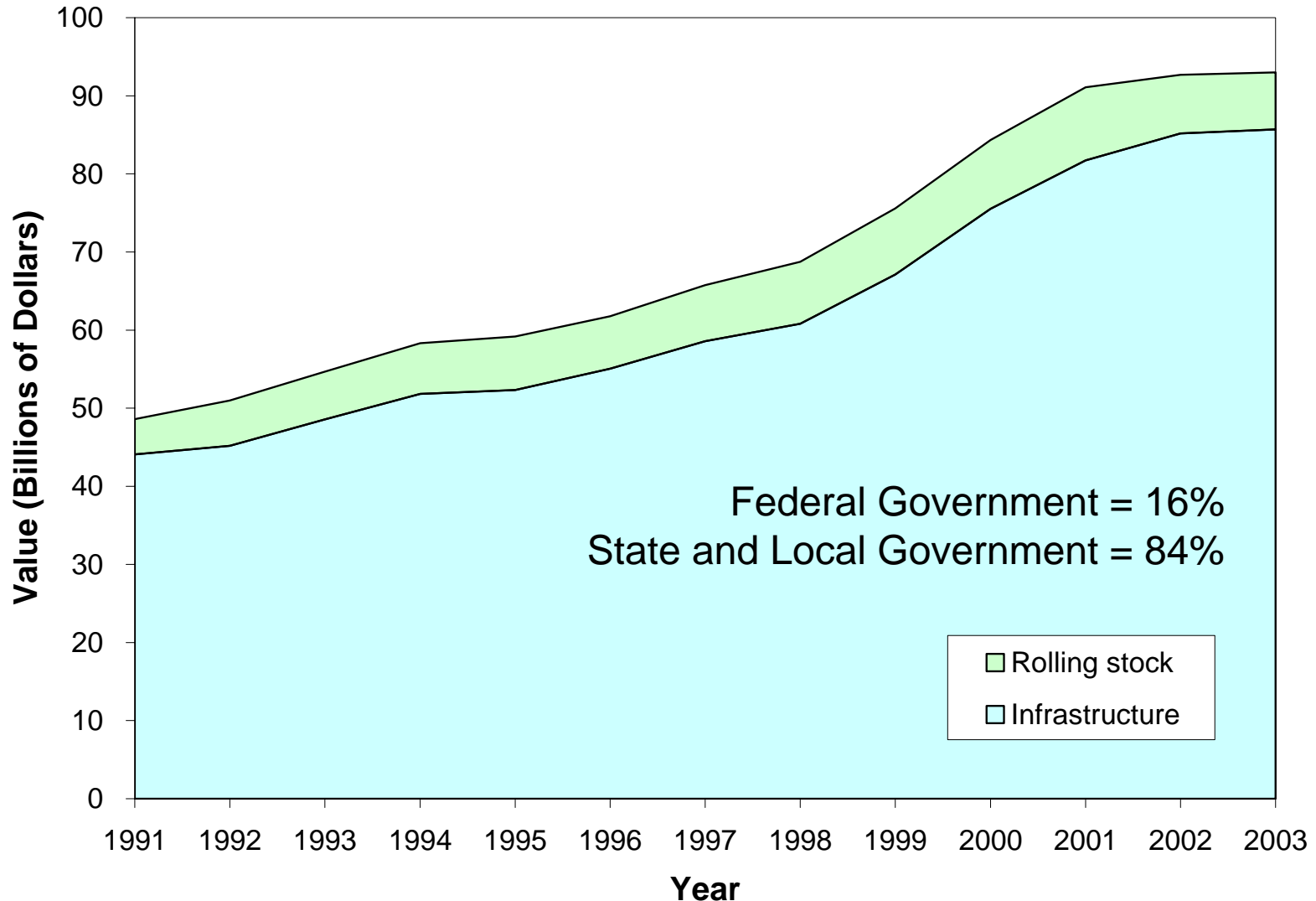
Transportation Energy Data Book (U.S. DOE)

2000 CO₂ Emissions by Source
Industrialized Countries



2007 Little Green Data Book (World Bank)

And we spend a lot of money and resources on transportation infrastructure.



Roads use a lot of materials every year.

For Pavement Alone

Individual materials	Amount Used per Year	Cost per Year
Virgin aggregate	1,300 million tons	\$10 billion
Asphalt	40 million tons	\$13 billion
Cement	10 million tons	\$1 billion
Total	1,350 million tons	\$24 billion

Conglomerate materials	Amount Used per Year	Cost in Place
Hot mix asphalt (HMA)	600 million tons	\$36 billion
Portland cement concrete (PCC)	60 million tons	\$6 billion
Total	660 million tons	\$42 billion

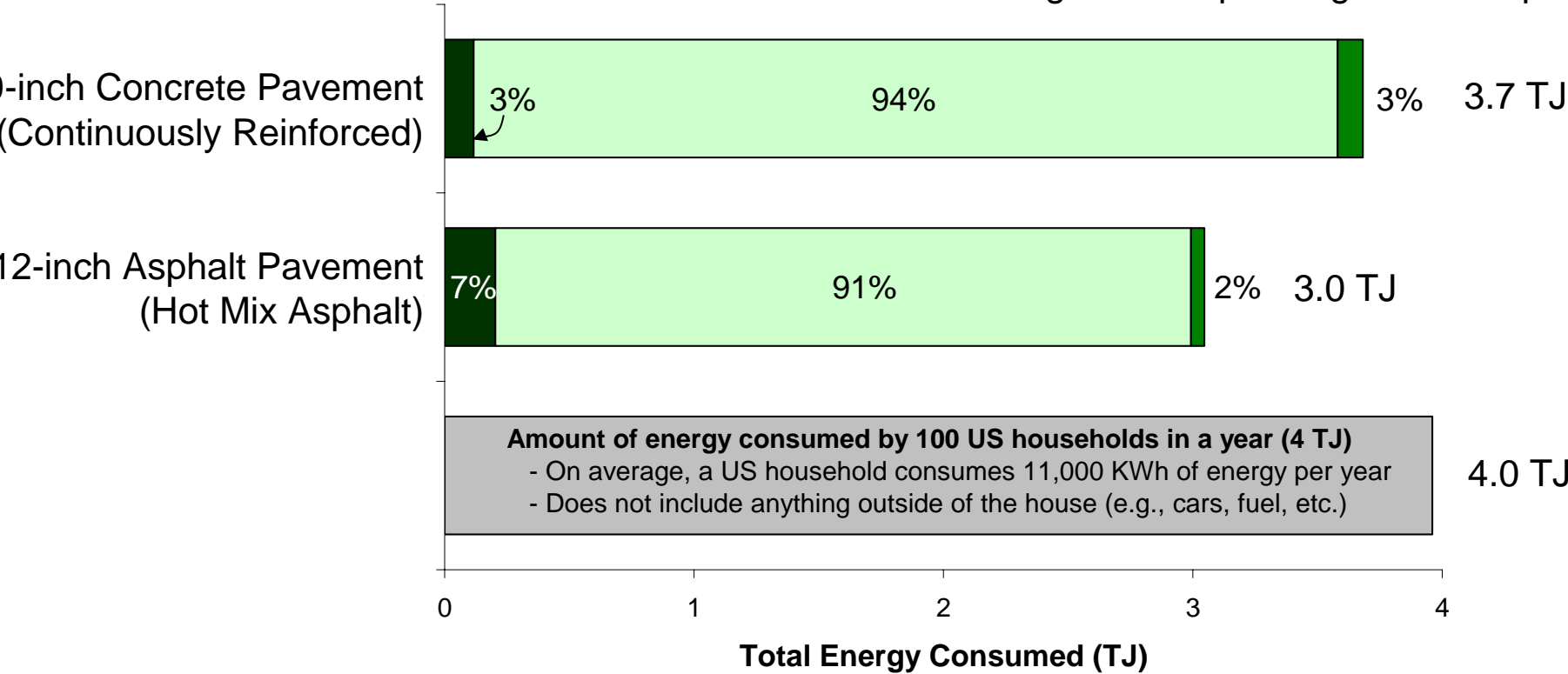
Building roads consumes energy...

Amount of Energy Required to Build 1 Lane-Mile of Pavement



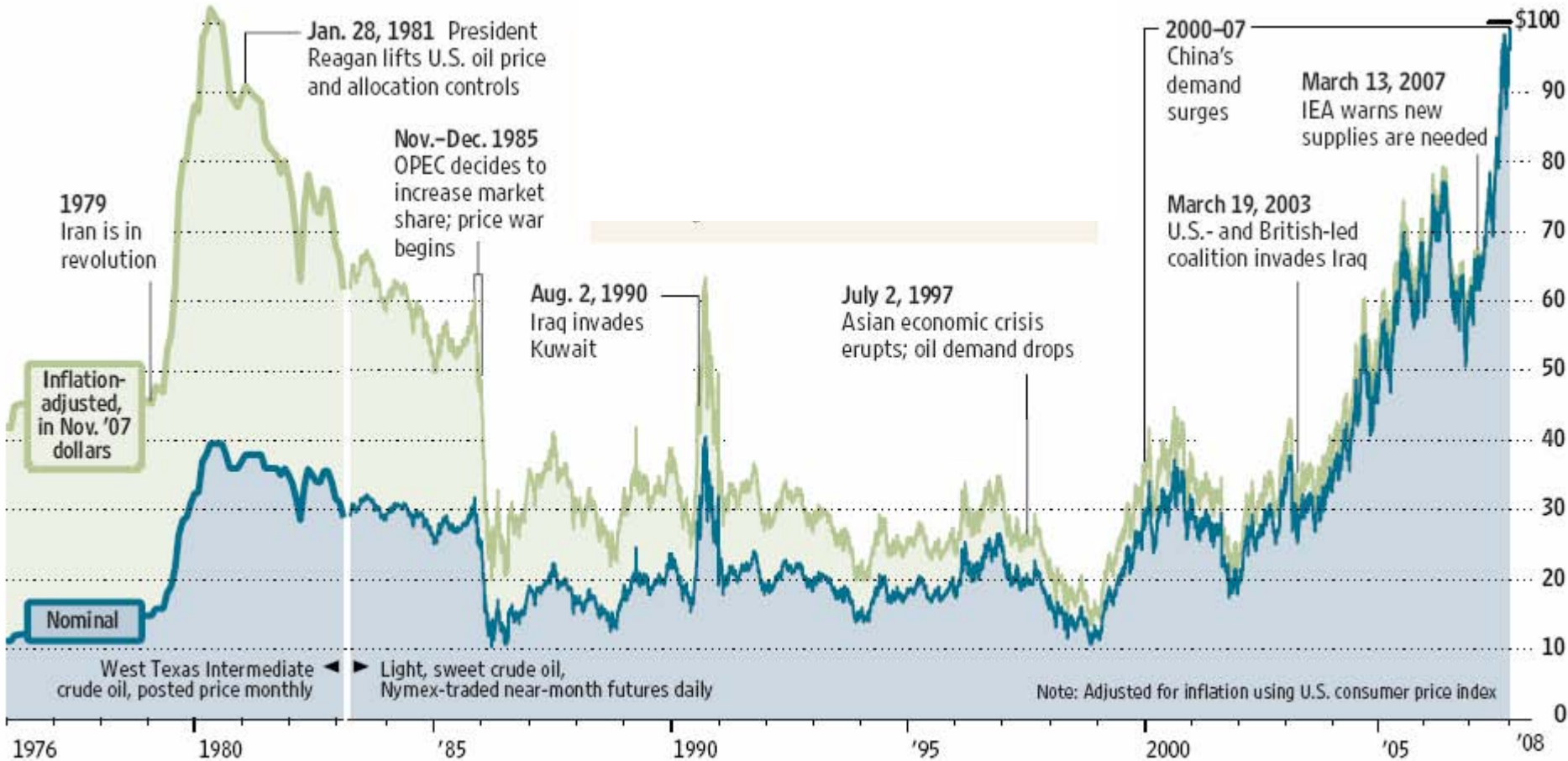
Notes:

- 90%+ from manufacturing
- Numbers change a lot depending on assumption



Data from: Zapata and Gambatese, Energy Consumption of Asphalt and Reinforced Concrete Pavement Materials and Construction, *J. of Inf. Sys.*, vol. 11, issue 1, p. 9-20.

...and energy costs serious money.



Sources: Oil & Gas Journal via the St. Louis Federal Reserve; U.S. Energy Information Administration; New York Mercantile Exchange via Thomson Datastream; "The Prize: The Epic Quest for Oil, Money & Power"; Labor Department; WSJ Market Data Group

From *Wall Street Journal*, 3 Jan 2008, p.A1.

But it's not just about the money. There are environmental consequences too.



11/10/2004

picture from David Timm, Auburn Univers

There are also social consequences.



Overtown. Miami, FL.

- Peak population: 40,000
- Current population: 8,000

I-395 through Overtown, F

Picture from Windows Live Search Ma

Sustainability

Goal

Sustain economic prosperity and a high quality of life for all while protecting the natural systems of the planet.

Key Components

- Economic
- Environmental
- Social



Support for sustainability everywhere.

The Economist

JANUARY 27th - FEBRUARY 2nd 2008 www.economist.com

Shake-up in Big Pharma
China's space blast
Europe's rotating slump
Serbia's encouraging election
Hating Hillary Clinton



The greening of America



GIVE GREEN

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Natural

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ESCAPE HYBRID

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*View disclaimer



Greener Lifestyles™



sustainable furniture



sustainable gifts



wholesale

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about us

Sustainable Generation Portfolio

What makes an electric generation portfolio sustainable? BC Hydro wrestles with this question and has come up with some ideas. These ideas can be used to guide decisions as to what generation resources are allowable in a sustainable portfolio or to stimulate discussion as to what sustainability means in practice.

To date, much of the debate around what constitutes environmentally friendly generation devolves into a debate as to the definition of green energy or renewables, or alternative energy, each with supposed characteristics that make it somehow preferable to conventional forms of generation, such as coal-fired, nuclear, or large hydroelectric facilities [1]. A great deal has been written on this subject without ever resolving the

are in steep-sided valleys that have a natural vegetation cover of temperate coniferous forest; these facts are significant when assessing the impacts of construction and operation of these facilities.

Our thermal facilities are one steam turbine plant (Burnard generation station, 912 MW using natural gas) and two combustion turbines (90 MW using natural gas or diesel). All six units at Burnard are equipped with selective catalytic reduction technology, which has our emissions of NO_x by 90%.

Additions to the Mix: Planned additions of grid-connected generating assets are mostly combined-cycle gas turbines (CCGT), with some green and alternative energy

BC Hydro is on the path to sustainability

Octavia Blvd., San Francisco, CA



© 2007 Microsoft

SR 20 through North Cascades National Park, WA



Making Sense of Sustainability: Green Roads Rating Standard

What is it?

A rating system designed to distinguish high-performance sustainable new or redesigned/rehabilitated roads.

What does it do?

It awards credits for approved sustainable choices and can be used to certify projects based on total point value.

How does it help?

Provides a straightforward means of understanding and quantifying sustainability in roadway design and construction.

LEED™

(Leadership in Energy and Environmental Design)

A “...nationally accepted benchmark for the design, construction, and operation of high performance green buildings. LEED gives building owners and operators the tools they need to have an immediate and measurable impact on their buildings’ performance.”

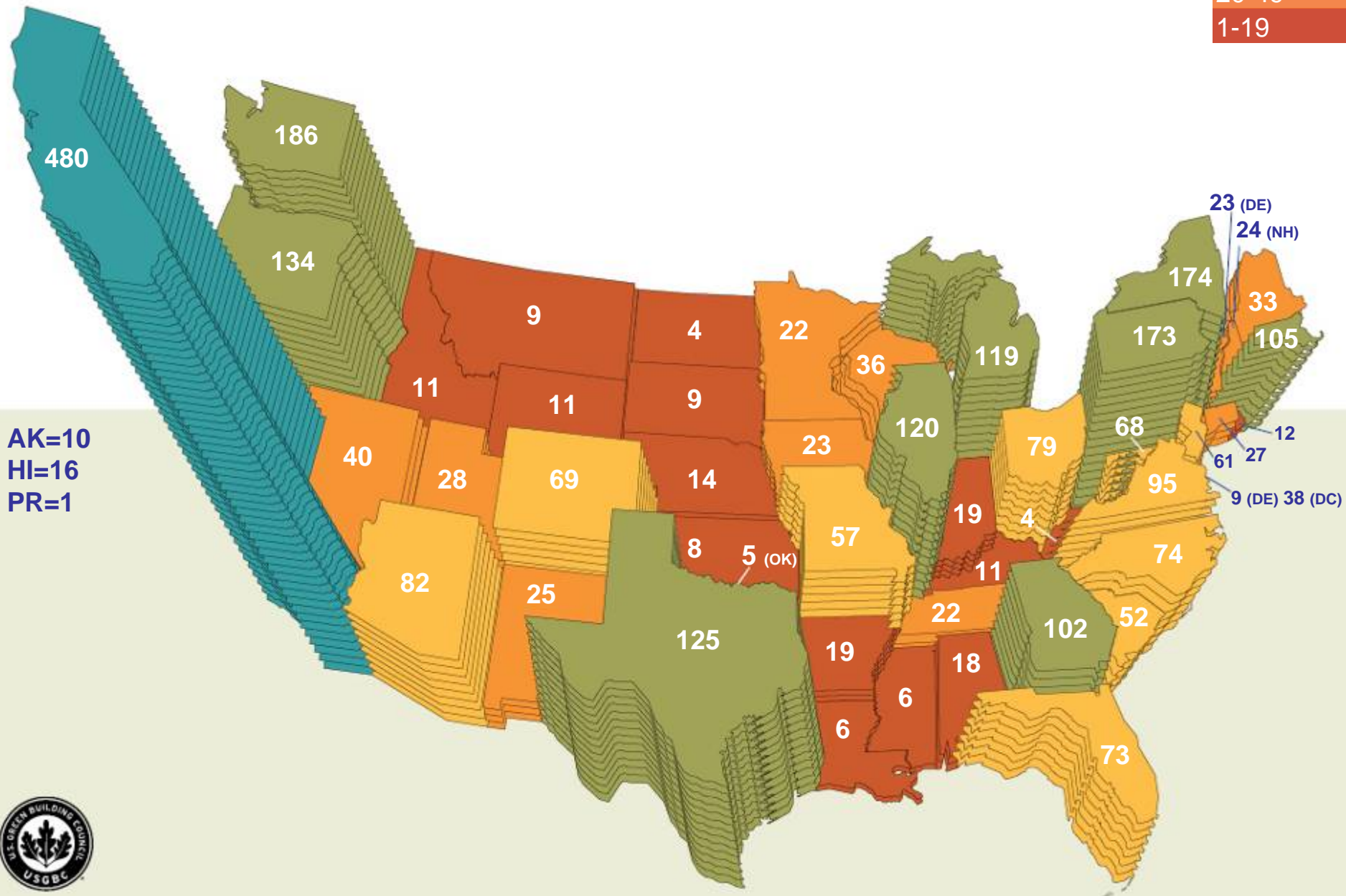
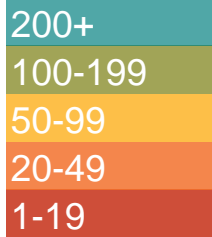
-U.S. Green Building Council

LEED certification standards

- New Commercial Construction and Major Renovation Projects
- Multiple Buildings and On-Campus Building Projects
- Existing Building Operations and Maintenance
- Commercial Interiors Projects
- Core and Shell Development Projects
- Homes
- Neighborhood Development
- Schools

LEED for new construction buildings as of 07/06

Distribution by geography



AK=10
HI=16
PR=1





Green Roads

more sustainable roads for a better transportation future

Green Roads is a rating system designed to distinguish high-performance sustainable new or redesigned/rehabilitated roads.

It awards credits for approved sustainable choices/practices and can be used to certify projects based on point value.

Developing Partnerships

ansNow, State Pavement Technology Consortium, CH2M Hill, University of Toled

Green Roads Categories

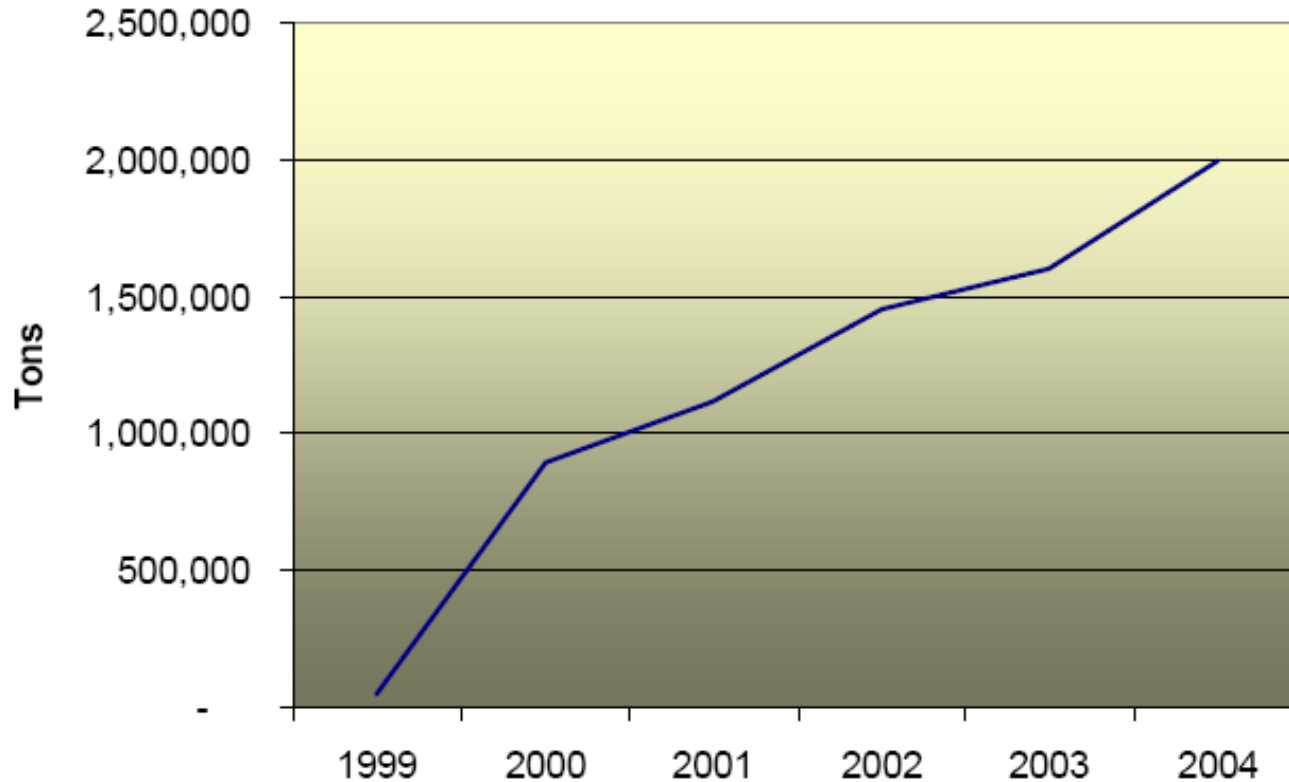
Category	Goal	Credits
Sustainable Design	Reduce impacts due to design choices including the road alignment.	10
Materials & Resources	Reduce impacts from material extraction, processing and transport.	11
Stormwater Management	Reduce impacts of polluted stormwater and treatment devices.	8
Energy & Environment	Improve human and wildlife health.	12
Construction Activities	Reduce impacts from construction activities.	9
Innovation	Encourage innovation in design.	4
		Total
		54

Materials & Resources (MR)

Description	Credits
Construction Waste Management	1
Reuse of Pavement	2
Recycled Content	4
Pavement Life Cycle Assessment	3
Regionally Provided Material	1
Total Credits Available	11

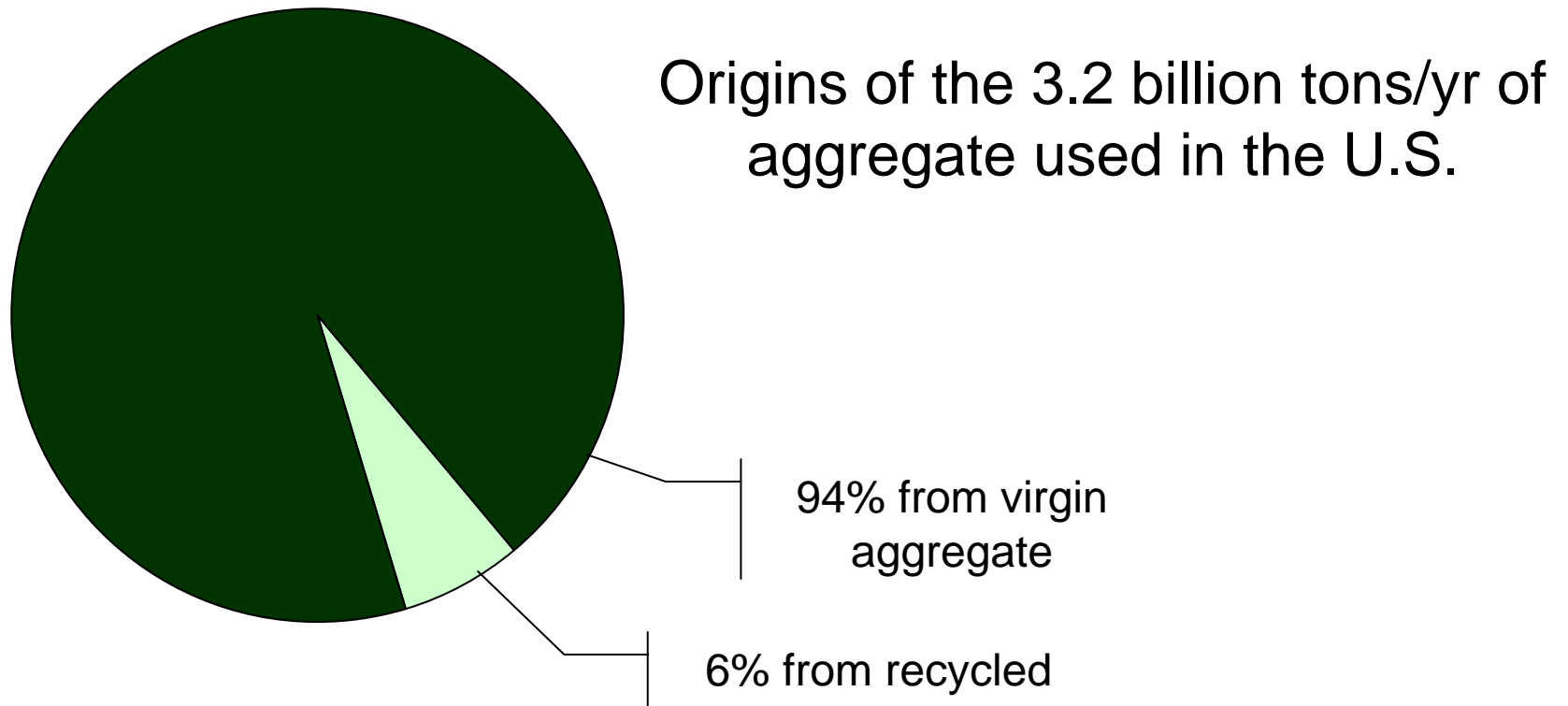
We have done well recycling hot mix asphalt and portland cement concrete as part of road construction.

Asphalt and Concrete Recycled 1999 to 2004



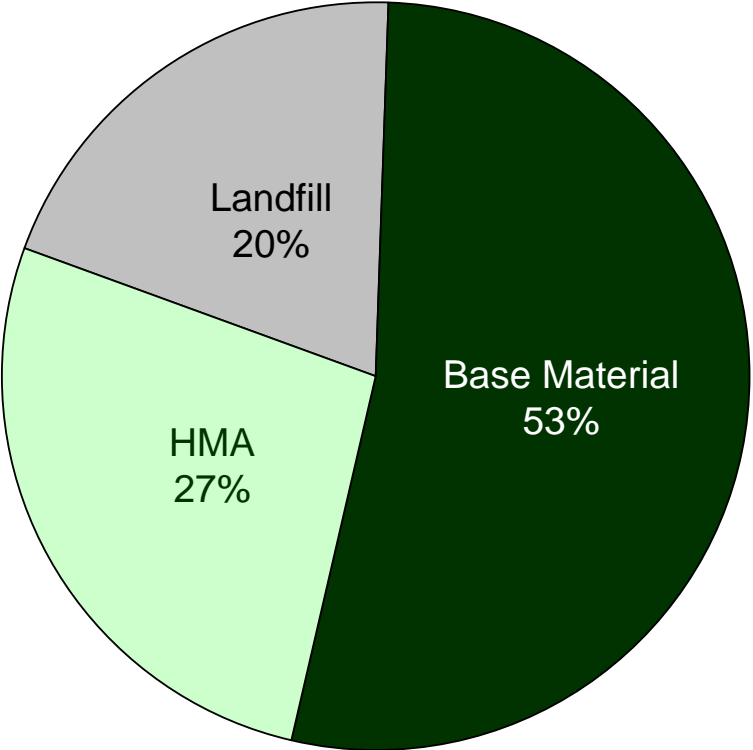
HMA/PCC recycling = 51% of diverted waste

But we can do better.

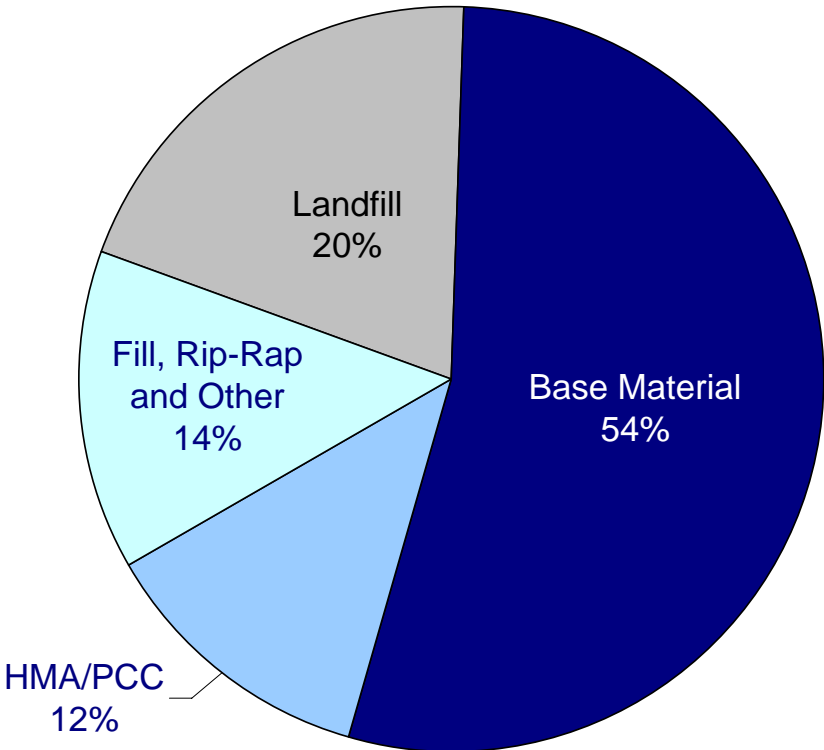


We can reduce the amount to landfills,
and increase the amount to high-value surfacings.

Destination of Recovered HMA



Destination of Recovered PCC



Example MR Credit

Recycled Content

4

One credit

One credit: Use recycled content to a minimum of 20% in the HMA/PCC and 40% of the total material in the structure if base course is included in the project.

Two credits: Use recycled content to a minimum of 30% in the HMA/PCC and 50% of the total material in the structure if base course is included in the project.

Three credits: Use recycled content to a minimum of 40% in the HMA/PCC and 60% of the total material in the structure if base course is included in the project.

Four credits: Use recycled content to a minimum of 50% in the HMA/PCC and 70% of the total material in the structure if base course is included in the project.

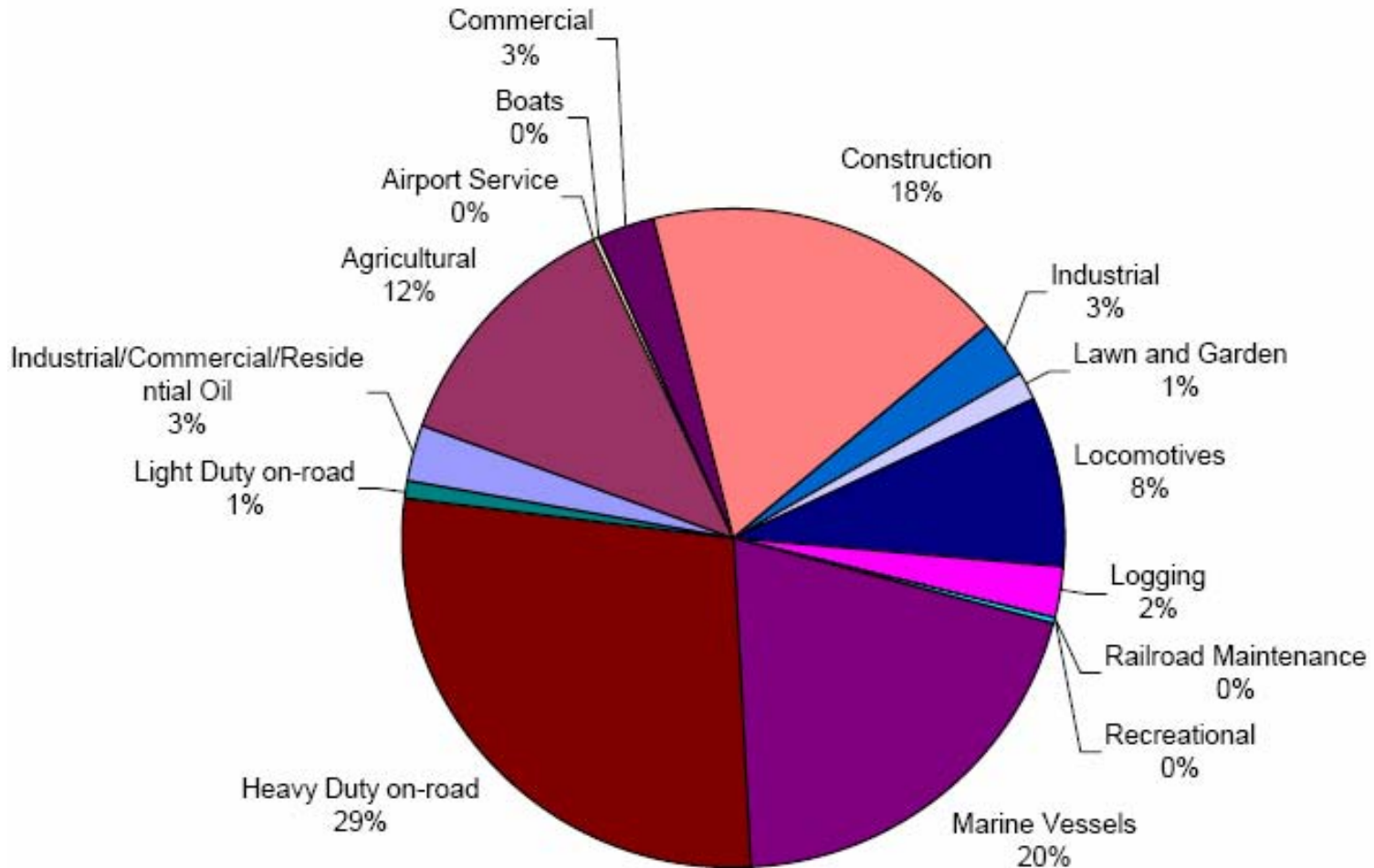
Construction Activities (CA)

Description	Credits
Reduced Diesel Emissions	1
Reduced Fossil Fuel Dependency	1
Temporary Stormwater Control	1
Noise Mitigation Planning	1
Paving Emissions	1
Construction Quality	2
Quality Process	2
Total Credits Available	9

"Diesel exhaust harms health more than any other air pollutant in Washington State."

-Washington State Department of Ecology

Sources of Diesel PM_{2.5} in Washington State (2002)



Example CA Credit

Reduce Diesel Emissions

1

Credit

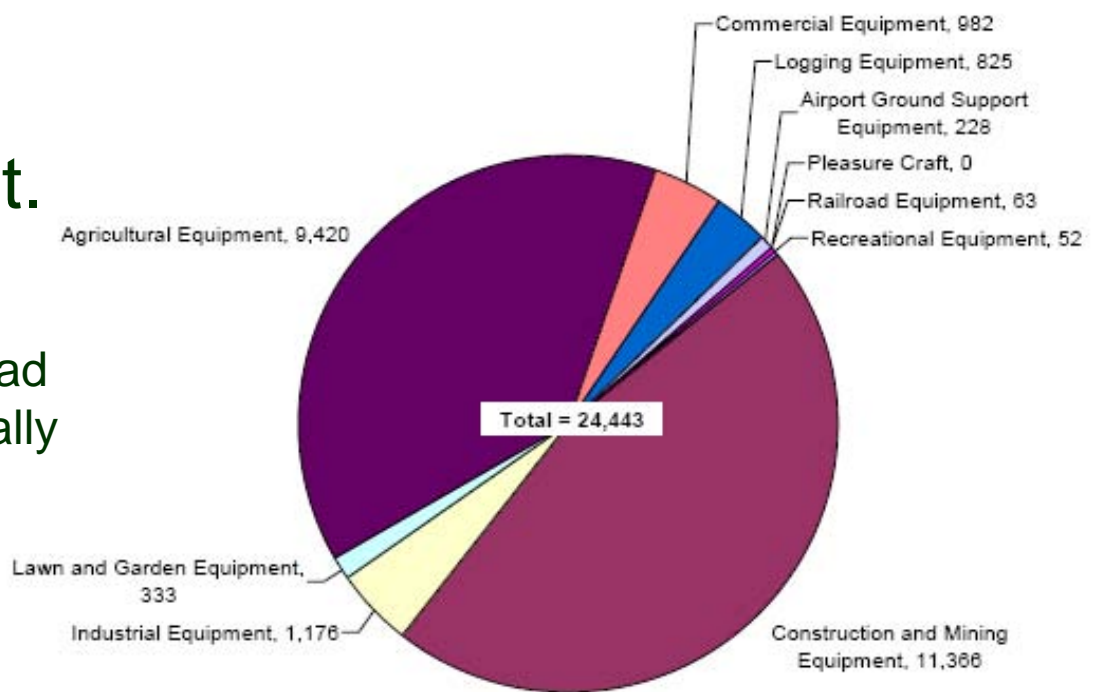
50% of the non-road diesel engine fleet used in construction should have installed emission reduction exhaust retrofits and add-on fuel efficiency technologies complying with the EPA Tier 4 emission standard.

Credit limit is based on the “Diesel Particulate Emission Reduction Strategy” for Washington State as set forth by the Washington State Department of Ecology and as described in Washington regulations.

This generally means retrofit or replacement.

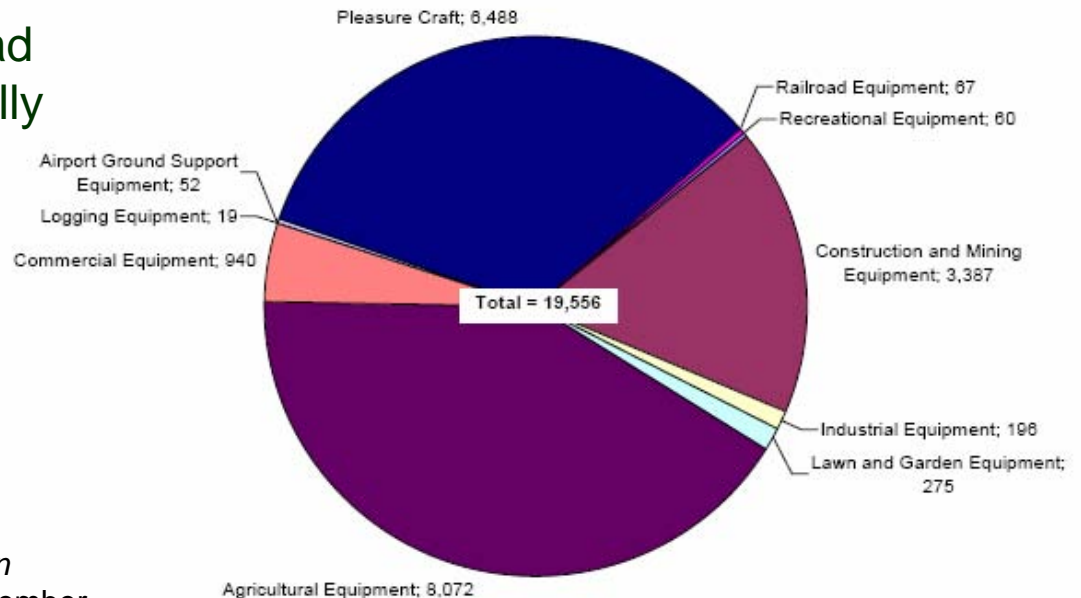
Number of Heavy-Duty Non-Road Diesel Engines that are Potentially Suitable for **Exhaust Retrofits** (MY 1996 or newer, ≥ 175 hp)

11,366 engines
in construction and mining



Number of Heavy-Duty Non-Road Diesel Engines that are Potentially Suitable for **Replacement** (MY 1995 or older)

3,387 engines
in construction and mining



Certification Levels

**Green Road
certified**



19-25 credits

**Green Road
certified**



SILVER

26-31 credits

**Green Road
certified**



GOLD

32-37 credits

**Green Road
certified**



EVERGREEN

38+ credits



Green Road
certified

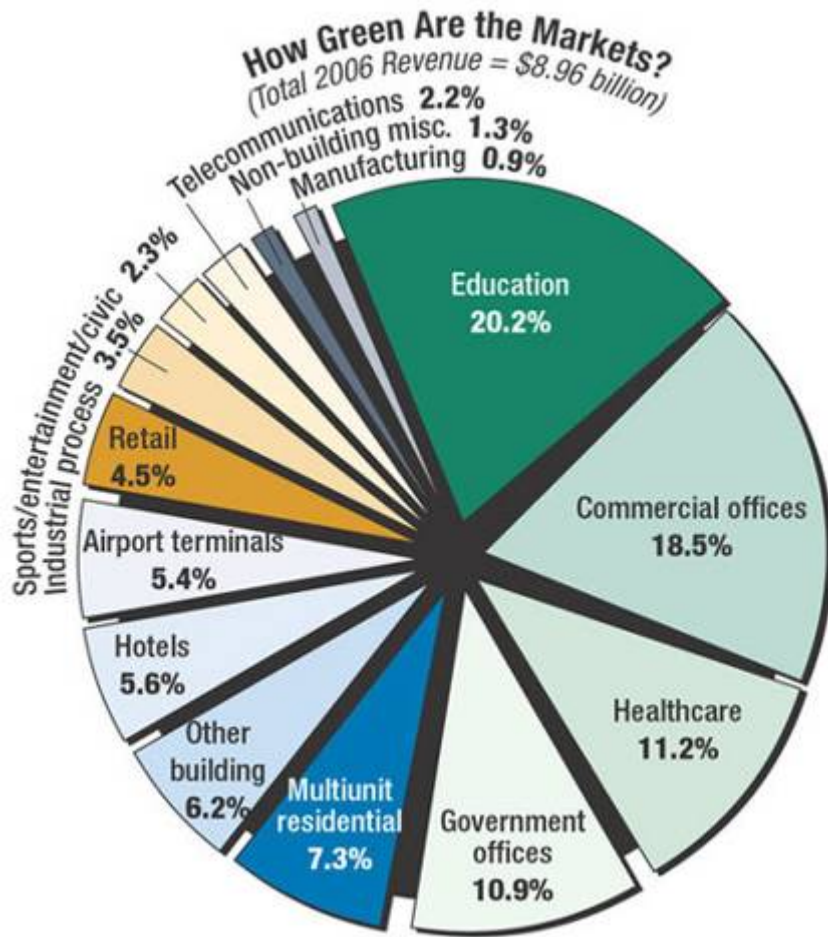


EVERGREEN

Why bother with a rating standard?

- More sustainable roads
- Specific benefits:
 - Defines basic roadway sustainability attributes
 - Greater participation in roadway sustainability
 - Better evaluation of tradeoffs and decisions
 - Provide means for sustainability assessment
 - Allows innovation because it is end-result oriented
 - Confer marketable recognition on projects

We need to be on the map.



Joseph J. Kracum, Kracum Resources, LLC

Glenwood Canyon, CO

Source: *ENR* (24 Sep 2007)
The Mainstreaming of Green Building (Tulacz, G.J.)

Where do we go from here?

- Fully develop each item
- Calibrate rating system
- Industry/agency participation

See at: www.greenroads.us

With Whom Are We Working?

- Funding
 - TransNow (US DOT Region 10 UTC)
 - State Pavement Technology Consortium
 - Research/Materials offices of CA, MN, TX, WA
- Private Enterprise
 - CH2M Hill (Bellevue, WA office)
- Others

See at: www.greenroads.us

Initial WSDOT/UW Collaboration

- Unofficial
- Inspect credits and refine if necessary
- Case studies
 - 4 typical paving projects
 - 4 paving projects with some aspects of sustainability or environmental stewardship
 - Both types of projects were not classified as certified as-constructed, but it was determined that they could reach a level of certification with some effort.

Existing WSDOT Sustainability Practices

- Like many organizations, WSDOT has goals:
 - Reduce GHG emissions
 - Improve fuel efficiency/reduce dependence on non-renewable sources
 - Reduce energy usage
 - Increase recycling
 - Reduce air pollution

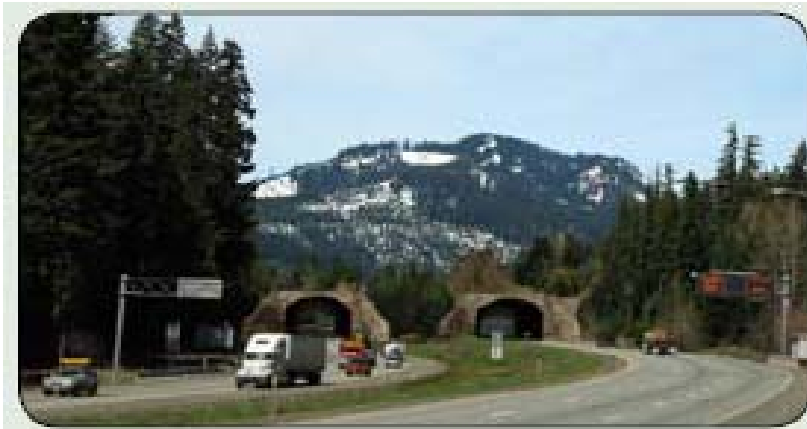
Sustainability Practices - Construction Projects

- Commitment to reduce pollution/GHG
 - HOV system
 - Commute trip reduction
 - Transportation demand management
- Increase pedestrian/bicyclist safety
 - Safe routes to schools



Sustainability Practices - Construction Projects

- Stormwater management
- Roadside vegetation management practices
- Pile driving
- Fish passage
- Wildlife crossings



After.



Sustainability Practices - Construction Projects

- Use of recycled materials
 - Asphalt pavement
 - Portland cement concrete rubble
 - Glass
 - Steel furnace slag
- Quieter pavements
- Long life pavements
- Warm mix asphalt



WSDOT Green Roads Effort

- As a partner of the State Pavement Technology Consortium (SPTC)
 - State DOT members include California, Minnesota, Texas, and Washington
- The SPTC decided to fund the Green Roads effort
- Goal of this study:
 - Review credits
 - Perform case studies in each state
 - Propose a pilot project in each state
 - Present the idea to local Contractors

**Sustainability is the next great game in transportation.
The game becomes serious when you keep score.**

Green Roads keeps score.

