ASPHALT: *a contractor's perspective on the environmentally sustainable pavement*

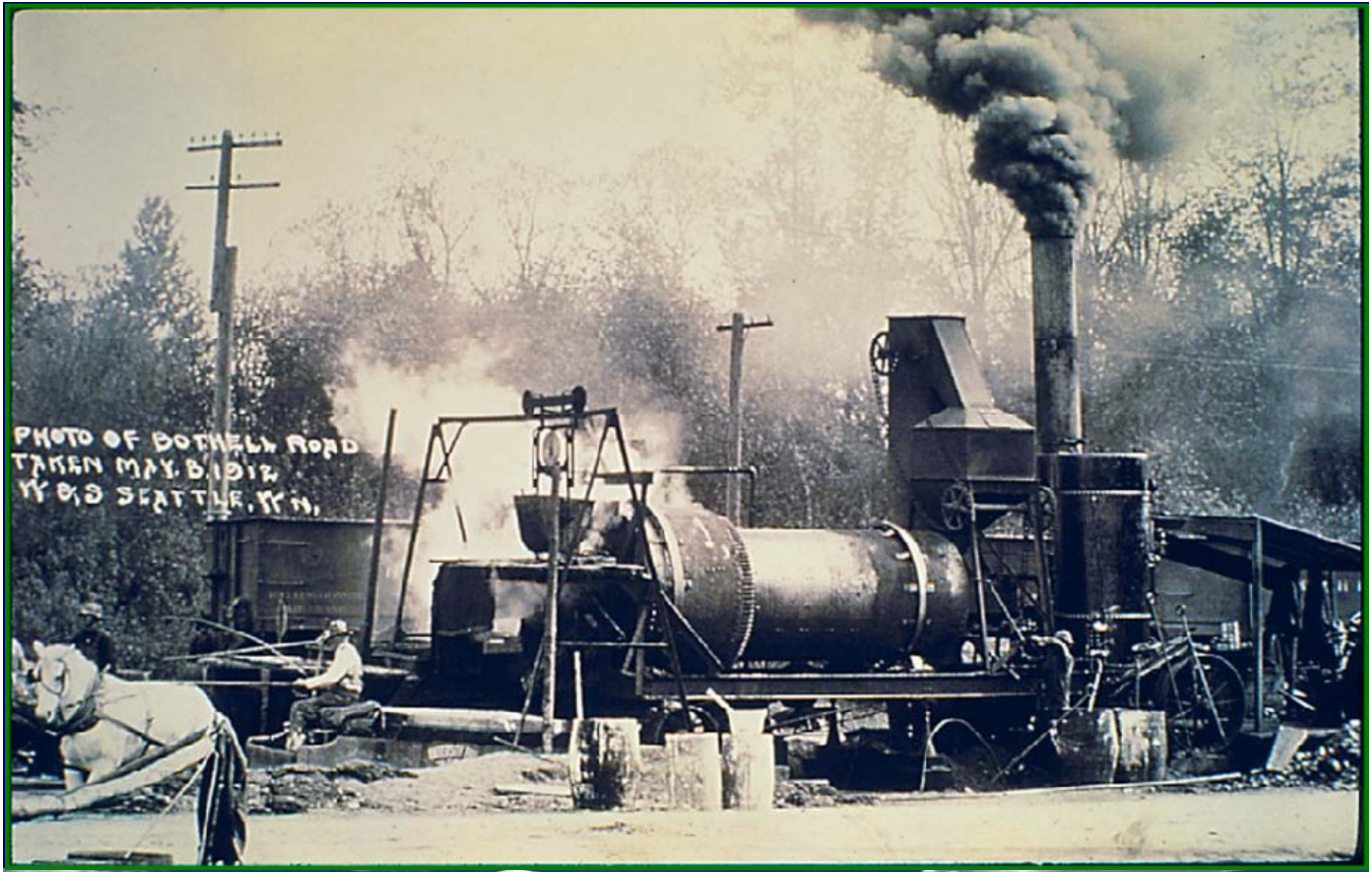
Greening the Blacktop

NAPA

ASPHALT:

the environmentally sustainable pavement

- **Stormwater management / porous pavement**
- **UHI and reflective asphalt pavements**
- **Recycled materials / RAP**
- **Env. Performance and Carbon Footprints**
- **Warm Mix Asphalt**

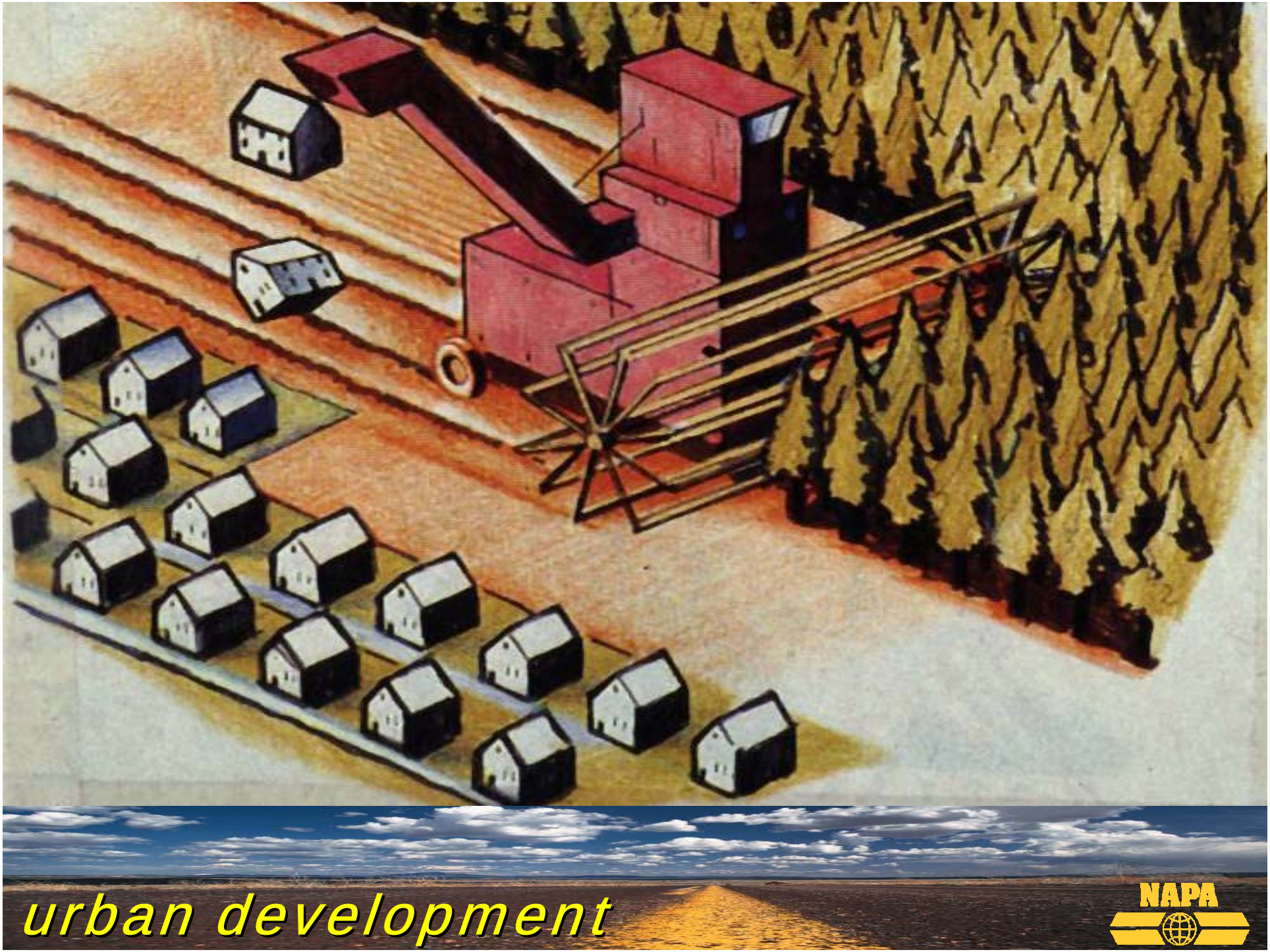


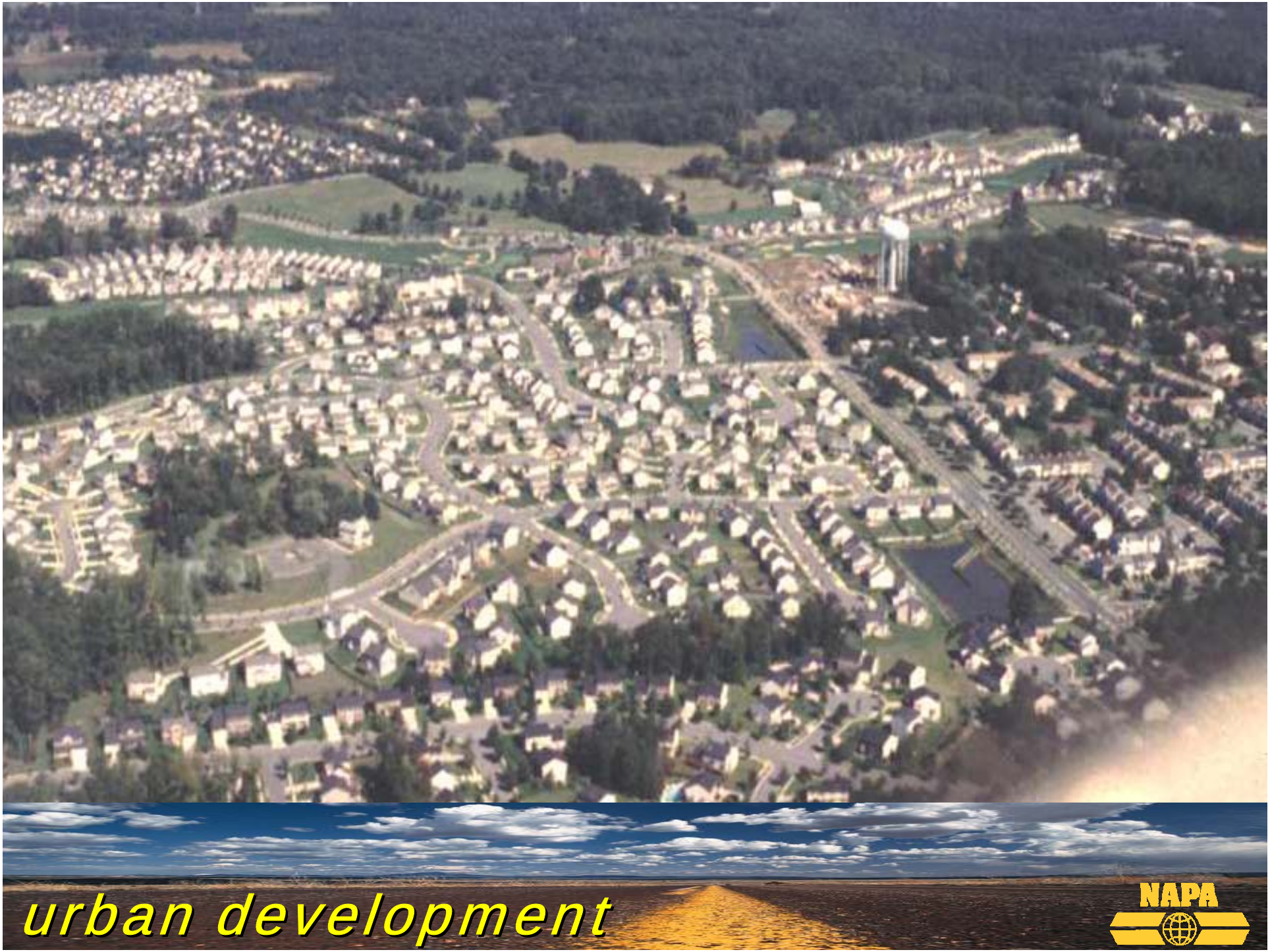
early 1900s HMA plant

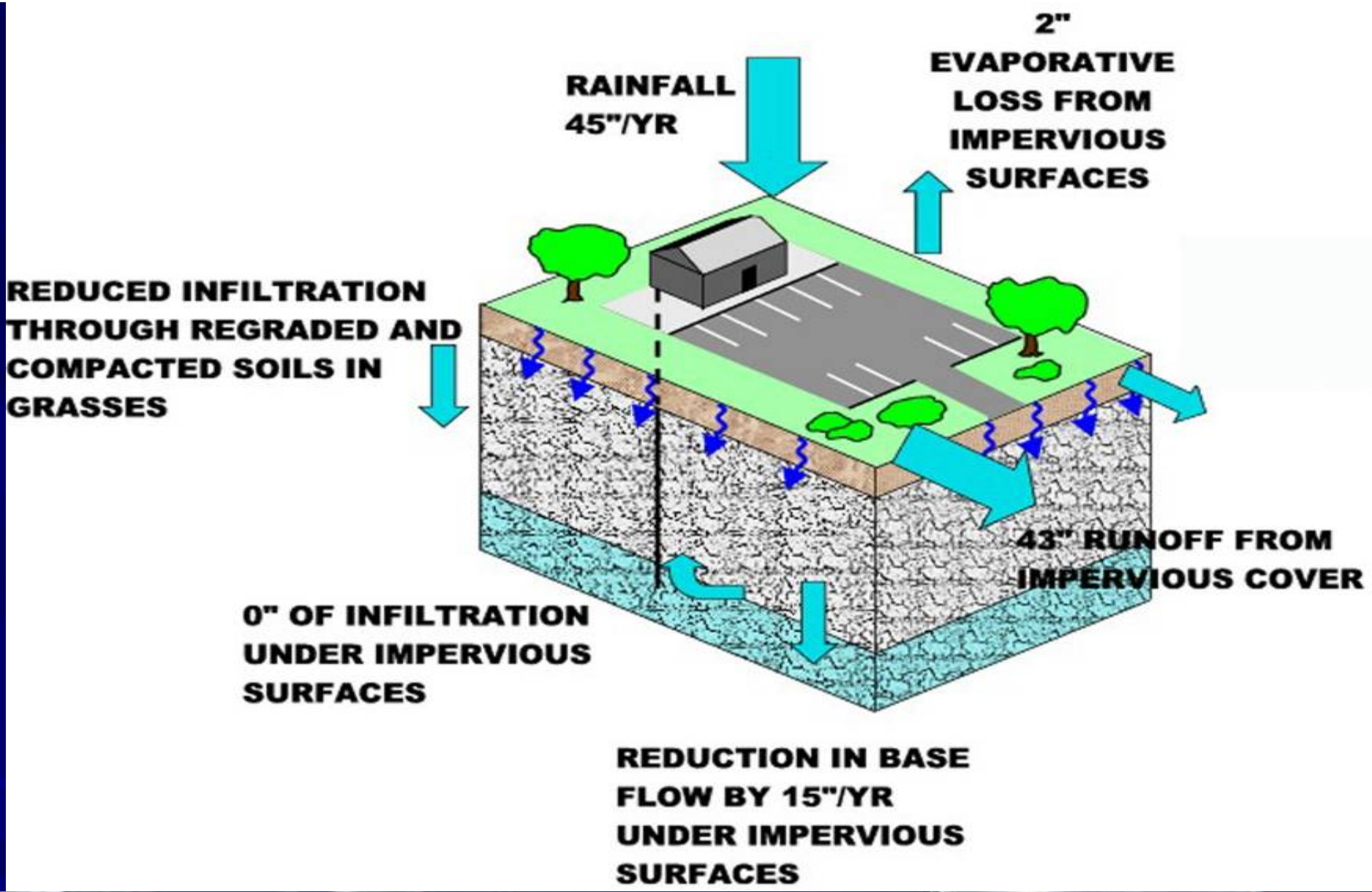
NAPA

early 2000s HMA plant

NAPA

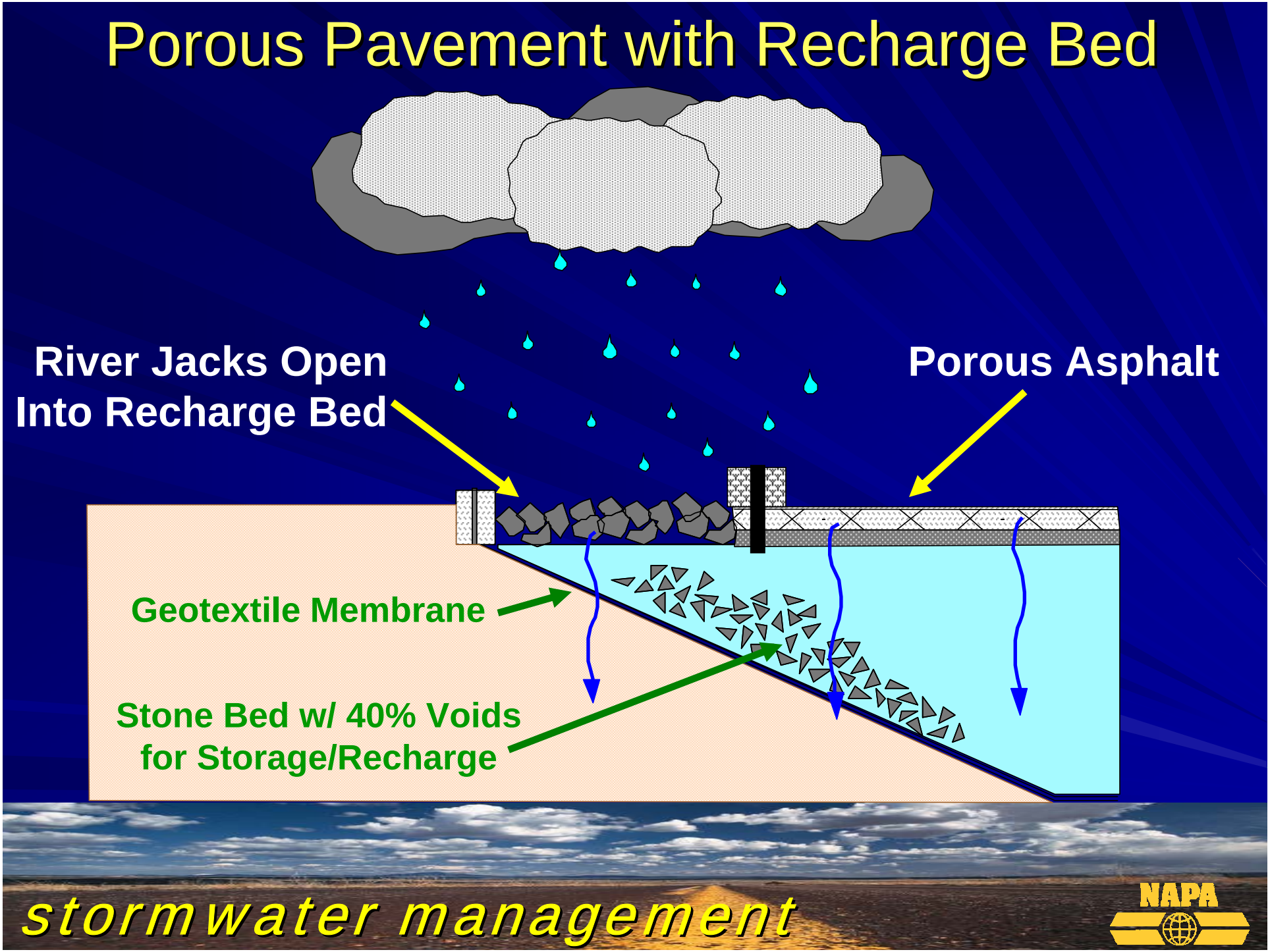

urban development
NAPA


urban development
NAPA


RAINFALL
45"/YR
2"
EVAPORATIVE
LOSS FROM
IMPERVIOUS
SURFACES
REDUCED INFILTRATION
THROUGH REGRADED AND
COMPACTED SOILS IN
GRASSES
43" RUNOFF FROM
IMPERVIOUS COVER
0" OF INFILTRATION
UNDER IMPERVIOUS
SURFACES
REDUCTION IN BASE
FLOW BY 15"/YR
UNDER IMPERVIOUS
SURFACES


stormwater management
NAPA

Porous Pavement with Recharge Bed



stormwater management

NAPA

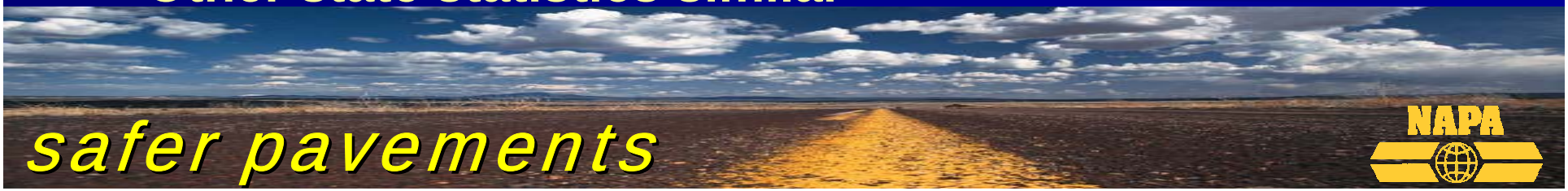

stormwater management
NAPA


Standard Pavement
Porous Pavement
Univ. NC: add'l parking lot constructed ca. 2002

Benefits of Porous Pavement

- **Economic**
  - Reduces/Eliminates the land space consumed by conventional detention facilities
  - Helps prevent excessive flooding and minimizes need for control measures
- **Aesthetic**
  - Eliminates the need for unsightly detention basins
  - Preserves areas such as woods/open space
- **Environmental**
  - Limits peak stormwater discharge and improves water quality of any runoff
  - Reduces amount of impervious surfaces

- **Dense-graded asphalt pavements were historically the standard for roadways**
  - Provides structure, strength, and smoothness
  - Smoothness can cause water overspray
- **Open-graded Friction Courses (OGFC) developed to minimize overspray**
  - Developed in the late 1940s (airports)
  - Pavement contains greater air voids
  - Thin OGFC pavement above dense-graded mat
- **OGFC Highly successful in minimizing accidents**
  - Calif-DOT identified a 50% decrease in deaths and 20% decrease in accidents after Hwy re-paved using OGFC
  - Other state statistics similar



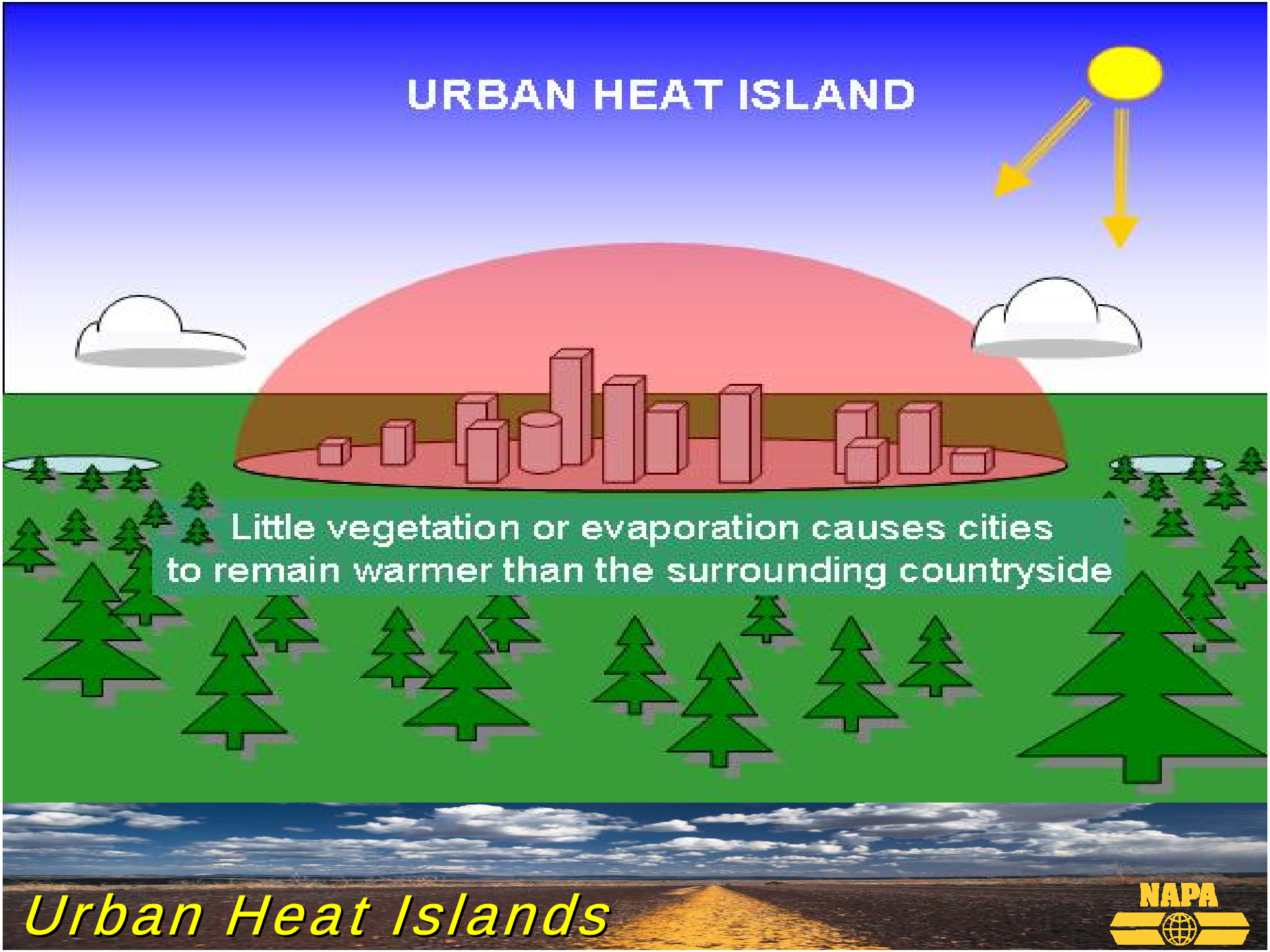
Spray Reduction: OGFC on Freeway

- Vehicles on highways generate a significant amount of noise
- Noise from the tire / pavement interface accounts for over 75% of the vehicle noise
- Sound-walls are expensive and are only somewhat effective if placed in the line-of-sight
  - They reduce noise minimally and only over certain distances from the roadway
  - Sound-walls can increase UHI effects because they decrease air movement across pavement surface
- Traffic Noise can be significantly reduced using Open-Graded Friction Courses (OGFC)

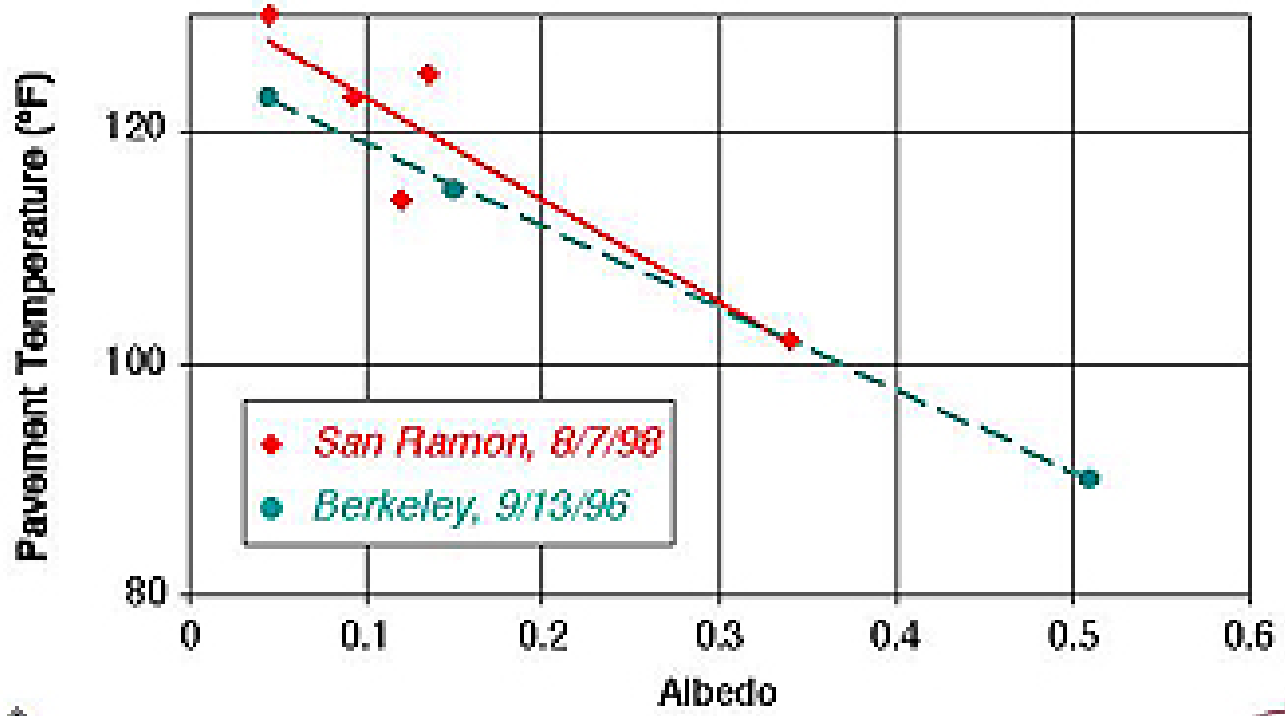
Noise Reduction: AR-OGFC on Highway

quieter pavements

NAPA


URBAN HEAT ISLAND
Little vegetation or evaporation causes cities
to remain warmer than the surrounding countryside
Urban Heat Islands
NAPA

Pavement Temperatures *vs.* Albedos



myth or reality ?

NAPA

Location: University Dr., Tempe, AZ
Time: 2:30pm, May 15, 2007

Albedo = .192

Surf. Temp = 131, 131.5, 130 (°F)

Age = >5 years

Traffic = light foot, cart and bicycle traffic

Albedo = .090

Surf. Temp = 129.9, 130.2, 128.4 (°F)

Age = >5 years

Traffic = constant traffic

Albedo = .036

Surf. Temp = 146.8, 143.3, 147.4 (°F)

Age = 3 days

Traffic = no traffic

NATIONAL CENTER of EXCELLENCE
SMART INNOVATIONS FOR URBAN CLIMATE AND ENERGY
ARIZONA STATE UNIVERSITY

reflectivity & temperatures

NAPA

Location: University Dr., Tempe, AZ
Time: 2:30pm, May 15, 2007

Albedo = .192

Surf. Temp = 131, 131.5, 130 (°F)

Age = >5 years

Traffic = light foot, cart and bicycle traffic

Albedo = .090

Surf. Temp = 129.9, 130.2, 128.4 (°F)

Age = >5 years

Traffic = constant traffic

Albedo = .036

Surf. Temp = 146.8, 143.3, 147.4 (°F)

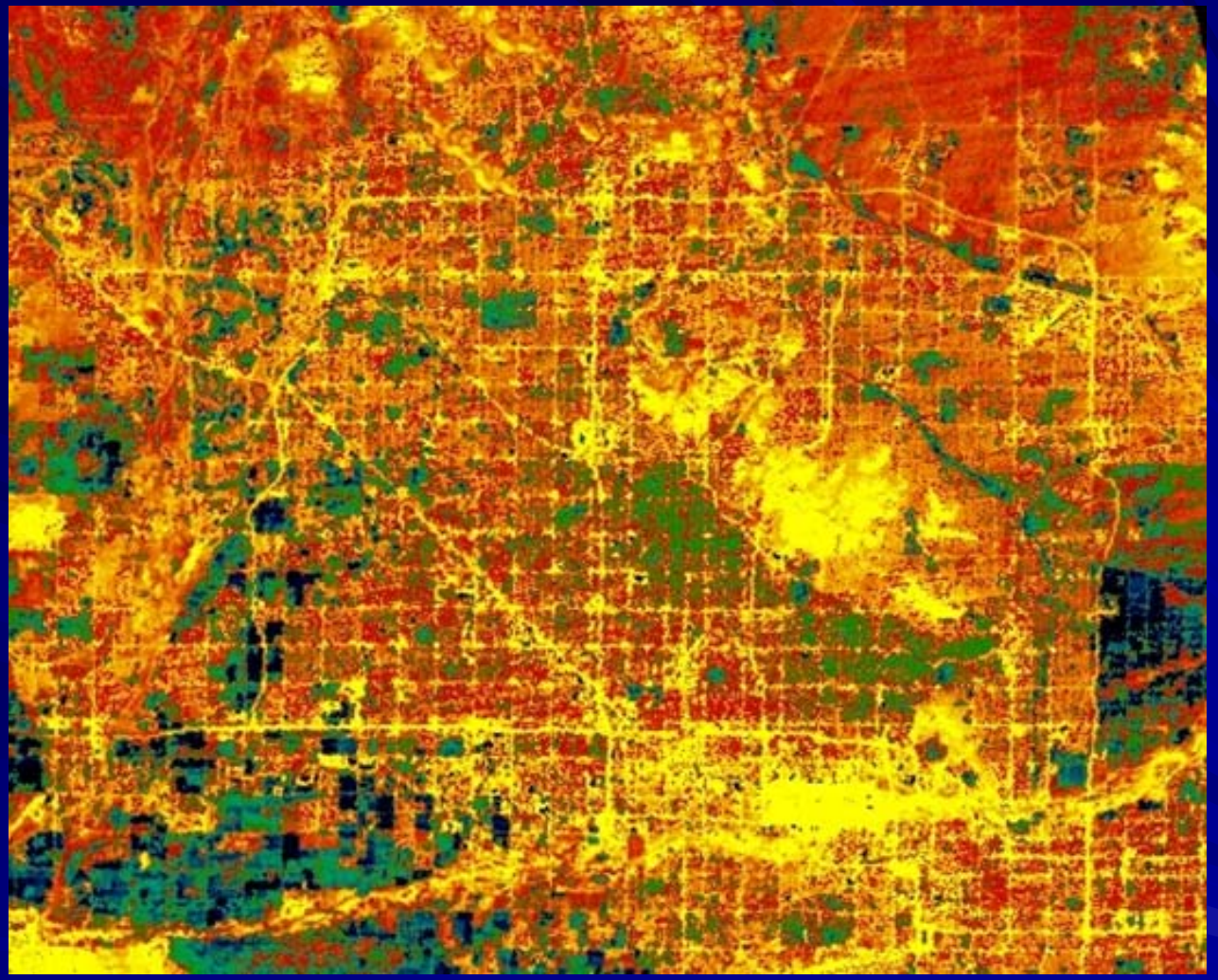
Age = 3 days

Traffic = no traffic

NATIONAL CENTER of EXCELLENCE
SMART INNOVATIONS FOR URBAN CLIMATE AND ENERGY
ARIZONA STATE UNIVERSITY

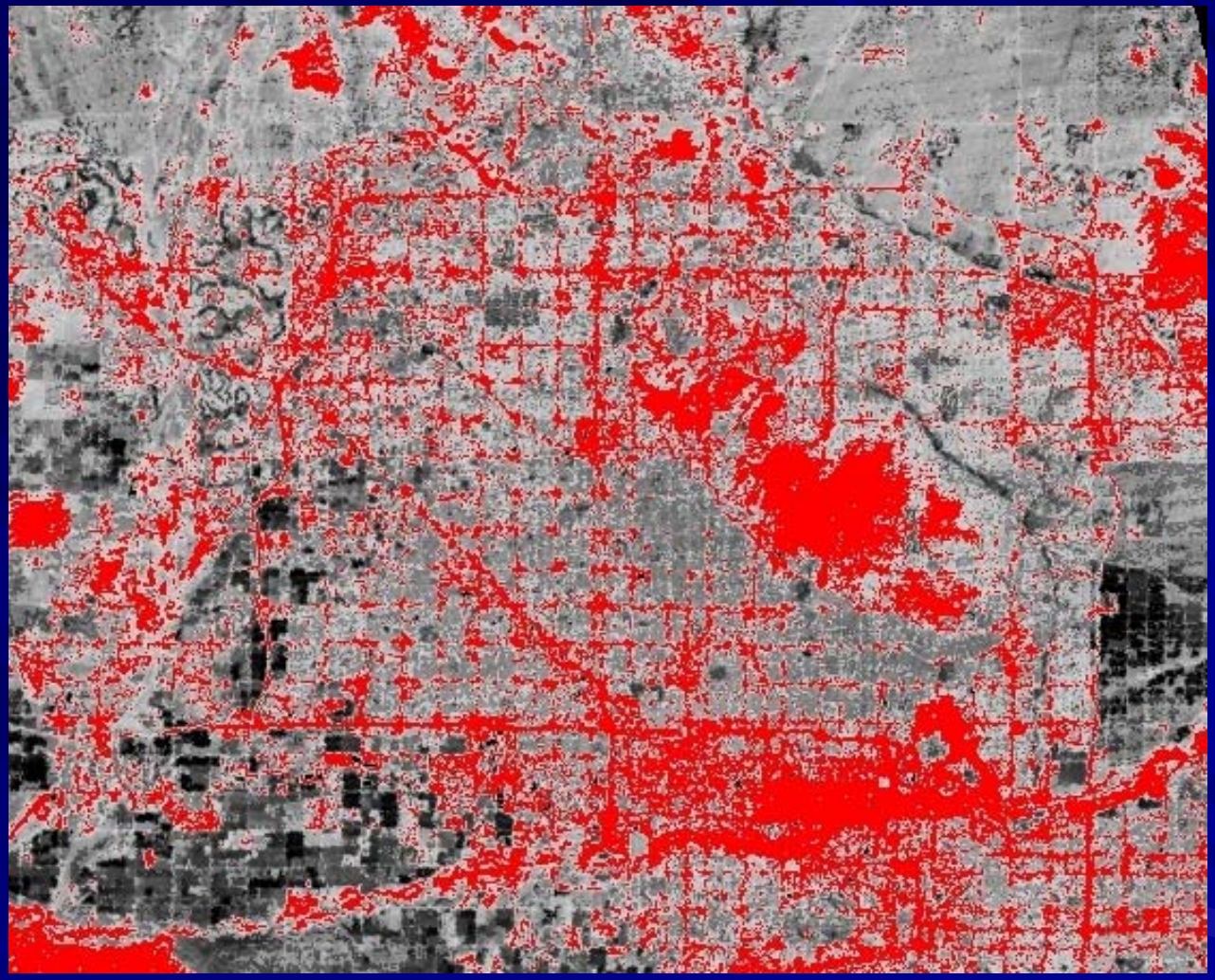
reflectivity & temperatures

NAPA



cooler pavements

NAPA

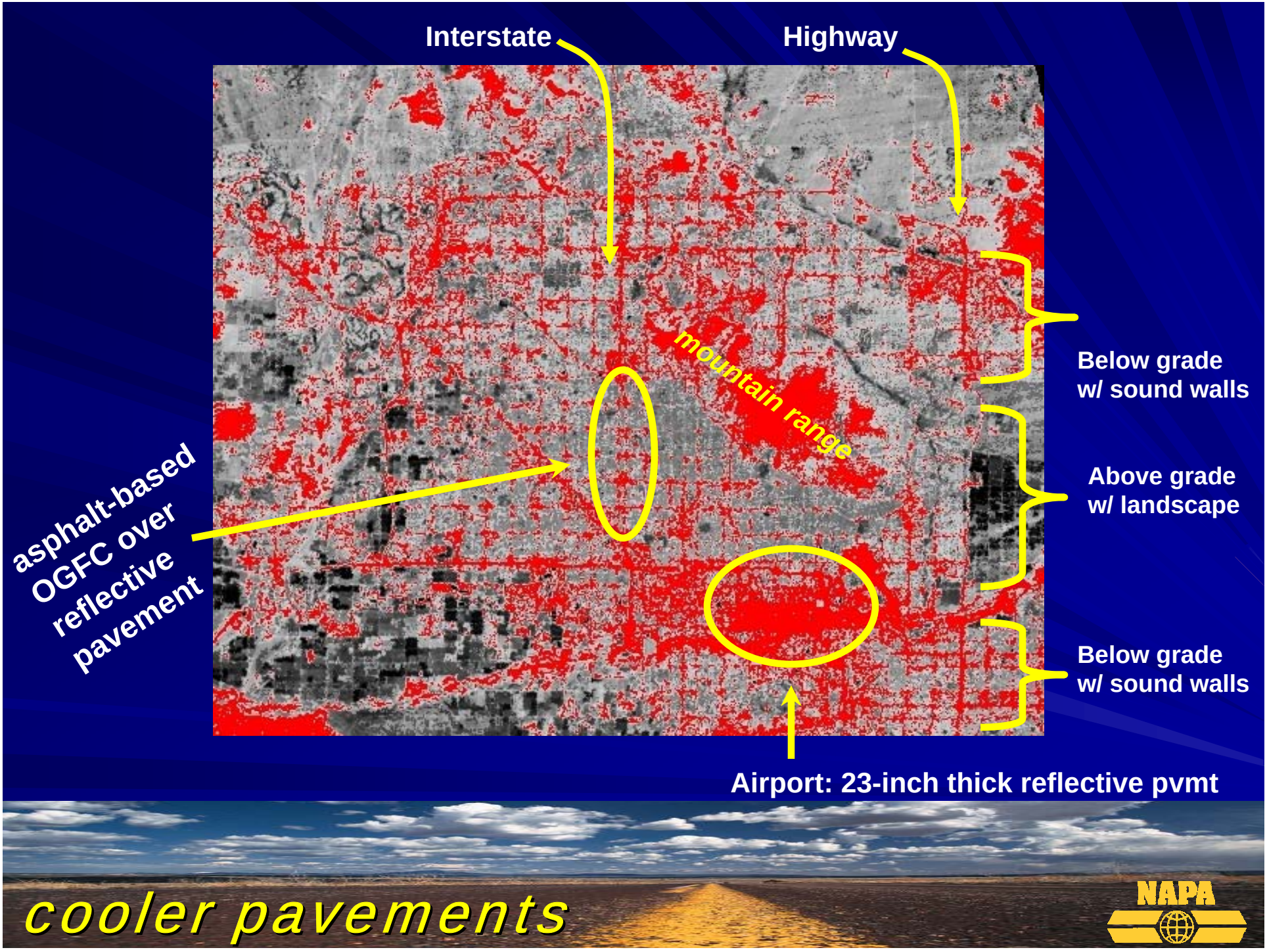


cooler pavements

NAPA

cooler pavements

NAPA


Interstate
Highway
mountain range
asphalt-based OGFC over reflective pavement
Below grade w/ sound walls
Above grade w/ landscape
Below grade w/ sound walls
Airport: 23-inch thick reflective pvmt
cooler pavements
NAPA

Heat Island Effect

Contact Us | Print Version Search:

EPA Home > Heat Island Effect > What Can Be Don

- Heat Island Home
- Basic Information
- Where You Live
- Energy Savings
- Heat, Health & Environment
- Research
- What Can Be Done
  - Community Actions
  - Cool Roofs
  - Green Roofs
  - Trees & Vegetation
  - Cool Pavements
- Pilot Project (UHIPP)
- Newsroom
- Publications
- Calendar
- Related Links
- Frequent Questions
- Glossary

Cool Pavements

■ - Denotes link to glossary definition

There is no official standard or labeling p
early stage.

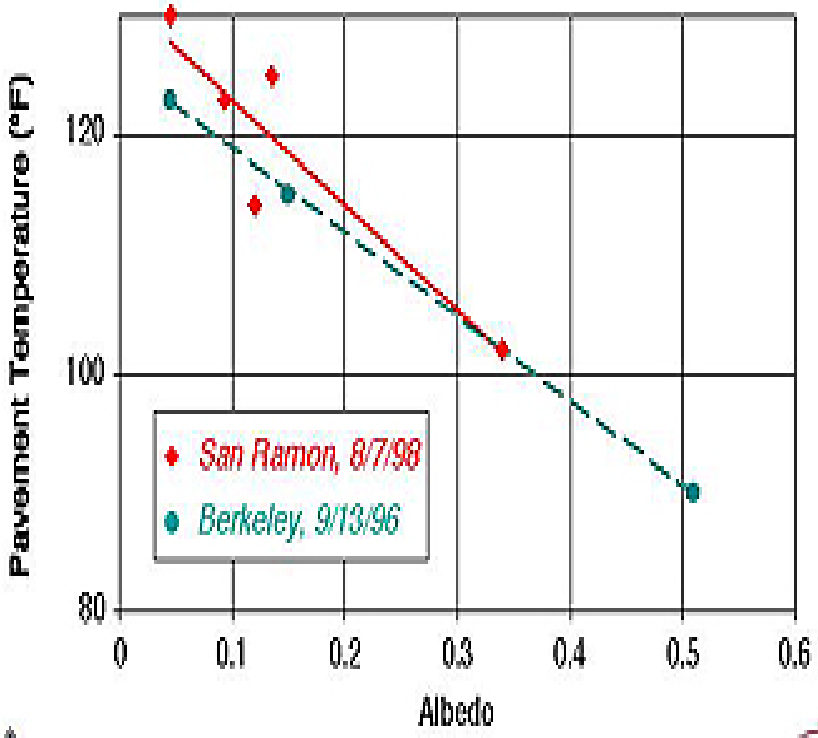
While studies show that pavements can a
several factors. These include the impact
time; and the absorption by buildings of s

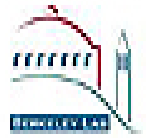
There are situations, however, where cor
that lower surface temperature and achie
roadways with large expanses of paved s

Investigations of cool paving materials ha
Pavements with higher solar reflectance
pavements benefit from the cooling effec
construction are essential in applying eith

Other factors affecting performance, cos
the best solutions may occur where multi
help with storm water runoff as well as p

Pavement Temperatures vs. Albedos





? cooler reflective pavements ?

NAPA

Heat Island Effect

Contact Us | Print Version Search:

EPA Home > Heat Island Effect > What Can Be Don

Heat Island Home
Basic Information
Where You Live
Energy Savings
Heat, Health & Environment
Research
What Can Be Done
Community Actions
Cool Roofs
Green Roofs
Trees & Vegetation
Cool Pavements
Pilot Project (UHIPP)
Newsroom
Publications
Calendar
Related Links
Frequently Asked Questions
Glossary

Cool Pavements

■ - Denotes link to glossary definition

There is no official standard or labeling p
early stage.

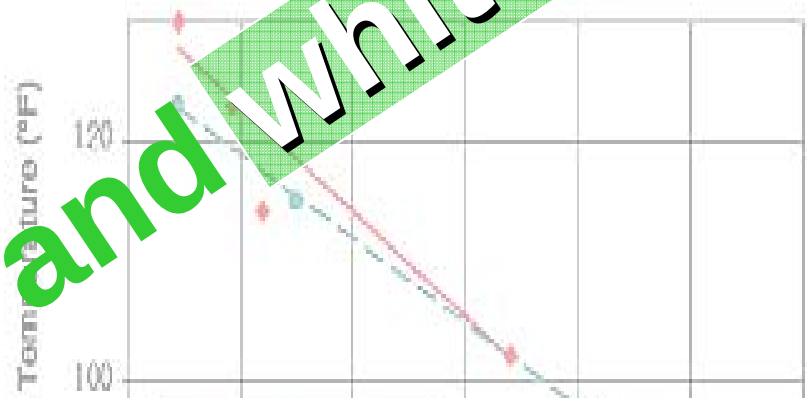
While studies show that pavements
several factors. These include the
time; and the absorption by buildi

There are
that lower
roadways

Investiga
ave
pave
constructi

Other fact
the best s
help with

Pavement Temperatures vs. Air Temps



It's NOT a black and white issue

- pavement thickness
- material capacities .
- surface vs. air temperatures
- pavement air voids (OGFC) cooler
- UHI does NOT cause Global Warming

Surface Chip Seals and Coatings:
using reflective / light-colored chip / paints

reflective pavements

NAPA

“Gritting”: reflective chips and aggregate

reflective pavements

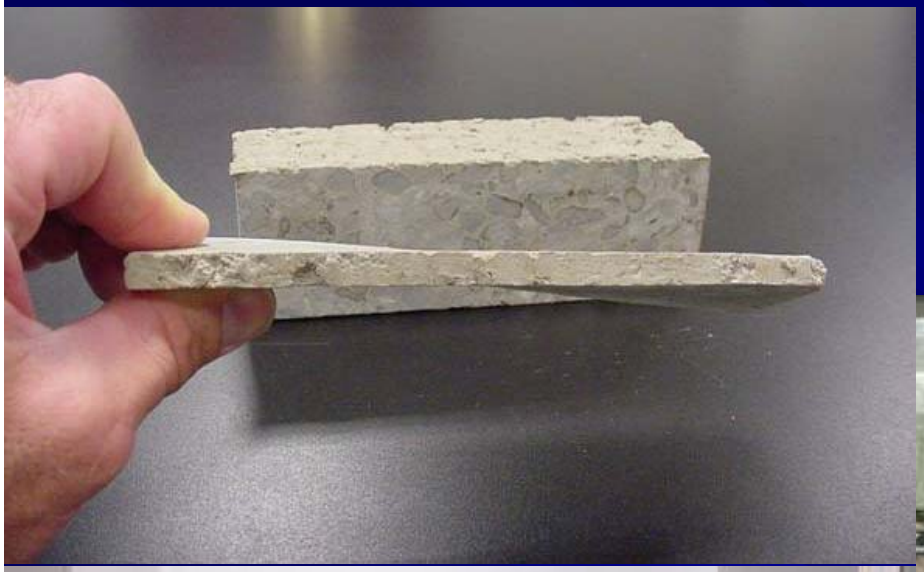
NAPA

Shot-Blasting:
abrading surface binder

reflective pavements

NAPA

Synthetic and Colored Binders:
using reflective aggregates

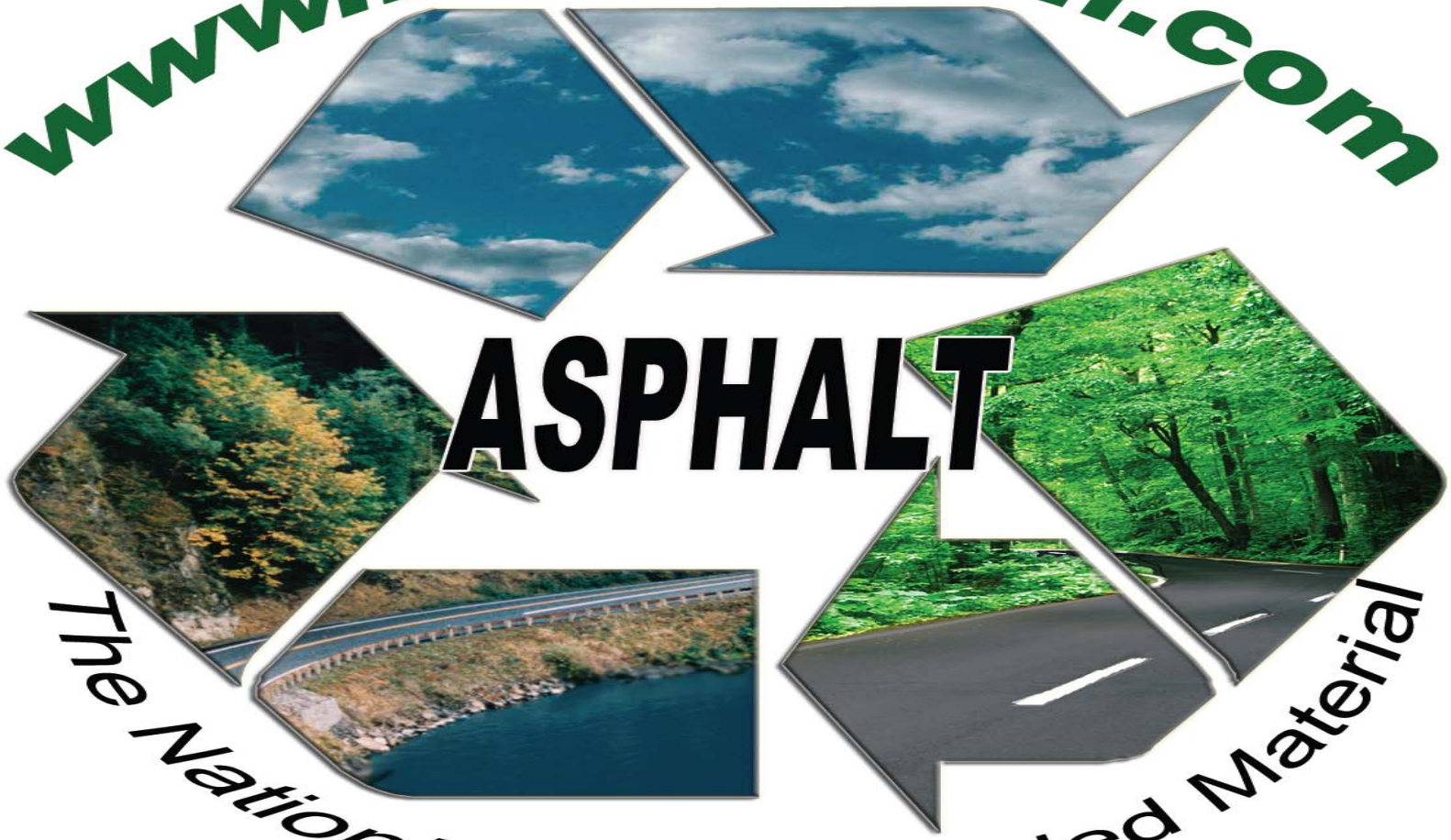


Synthetic / Colored Binders:
using reflective / colored aggregates

reflective pavements

NAPA

www.PaveGreen.com



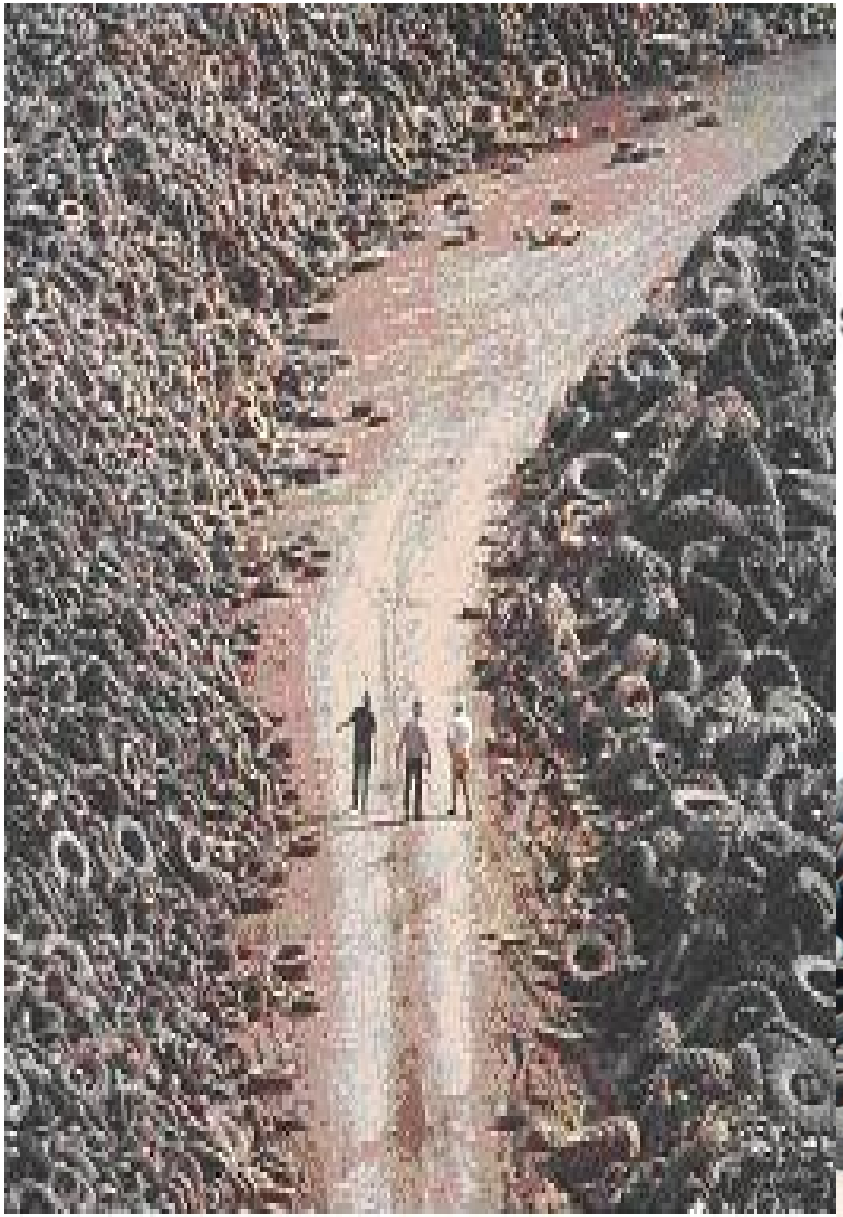
ASPHALT

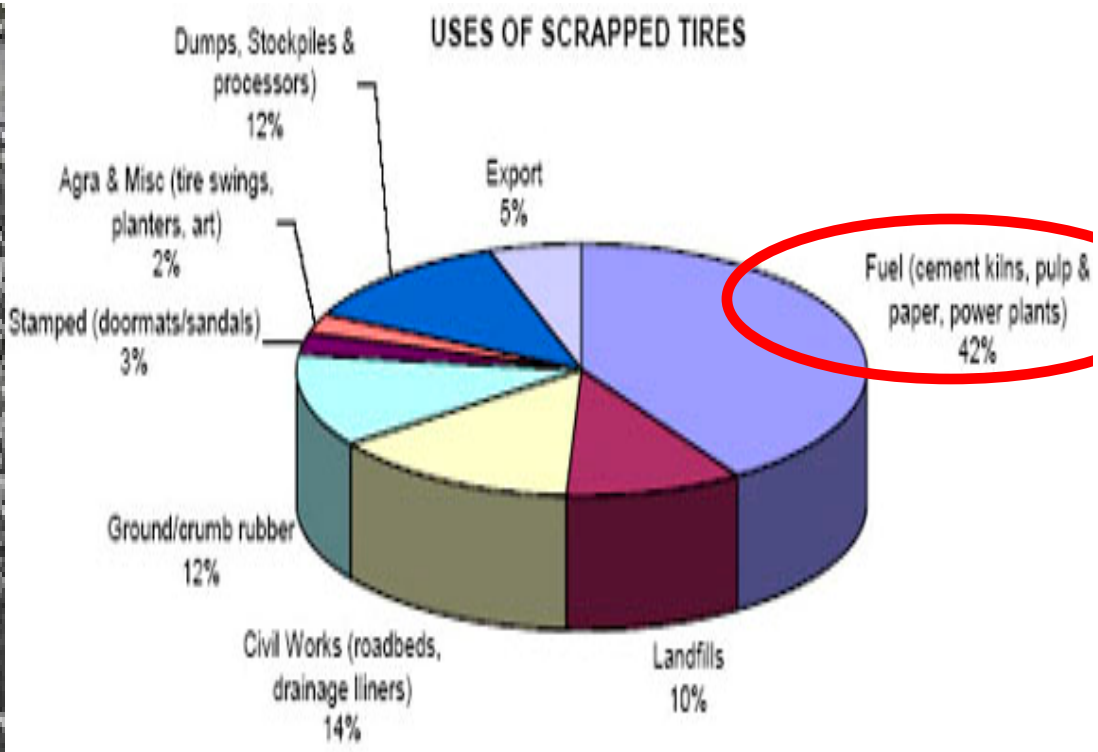
The Nation's # 1 Recycled Material

Common Recycled Materials in Asphalt Pavements

- Shingles
- Crumb / Tire Rubber
- Glass
- Slag
- Foundry sand
- All are in different stages of utilization / evaluation

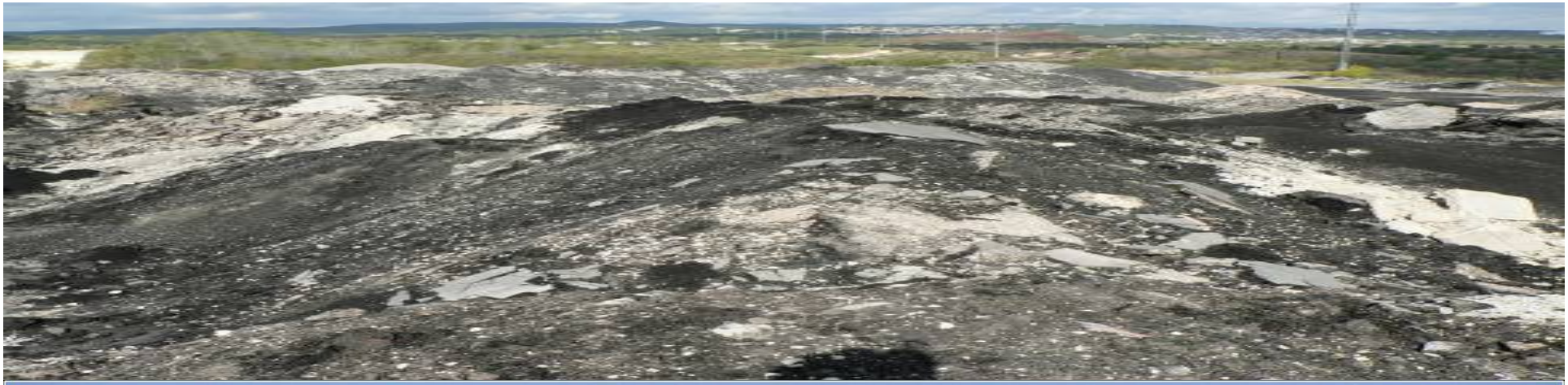

asphalt shingles




USES OF SCRAPPED TIRES
Dumps, Stockpiles & processors) 12%
Agra & Misc (tire swings, planters, art) 2%
Stamped (doormats/sandals) 3%
Export 5%
Fuel (cement kilns, pulp & paper, power plants) 42%
Ground/crumb rubber 12%
Civil Works (roadbeds, drainage liners) 14%
Landfills 10%


scrap tires
NAPA


milling asphalt pavement
NAPA



reclaimed asphalt pavement "RAP"

NAPA


sizing RAP
NAPA

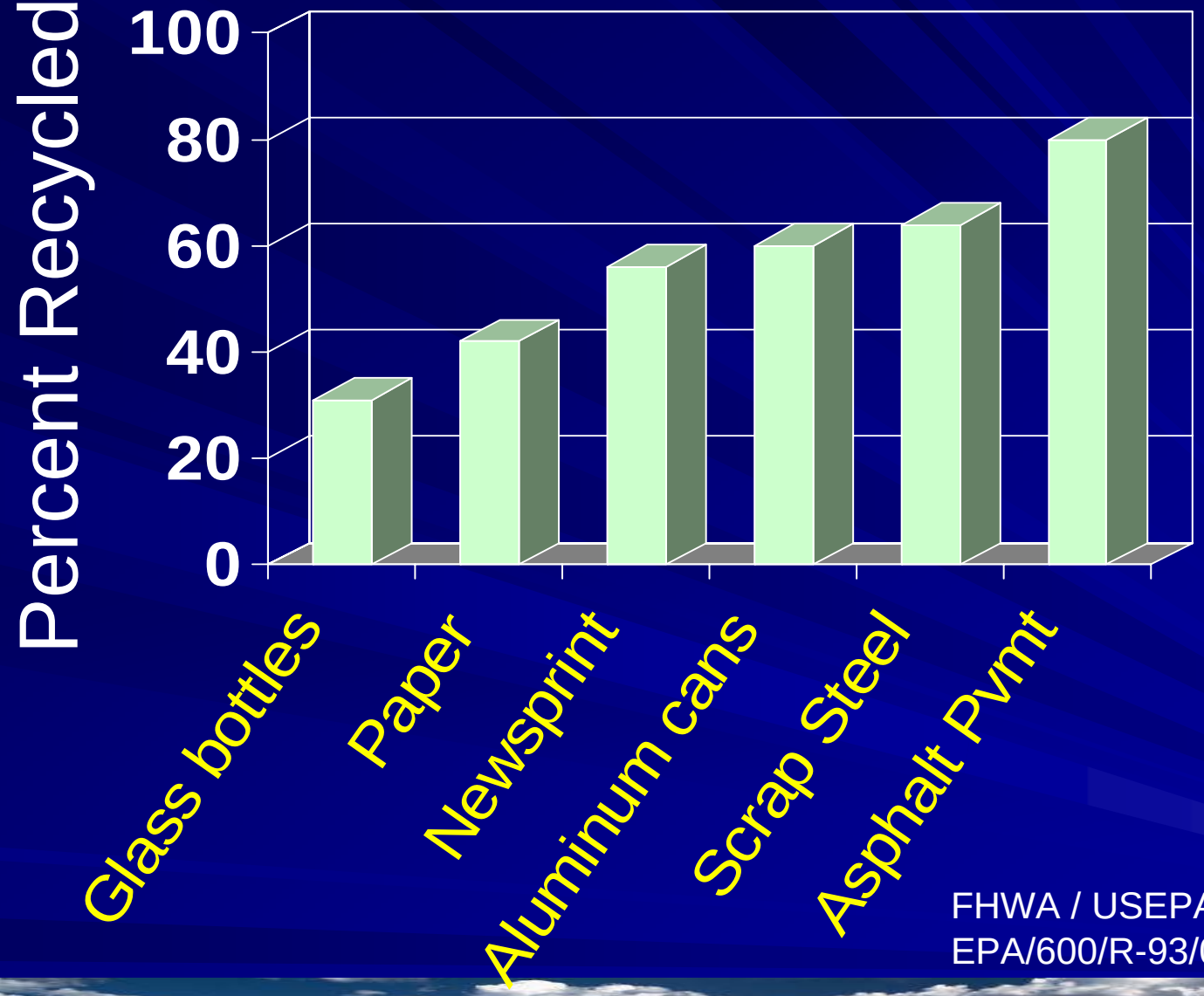
sizing RAP

processing RAP

NAPA

Reclaimed Asphalt Pavement "RAP"

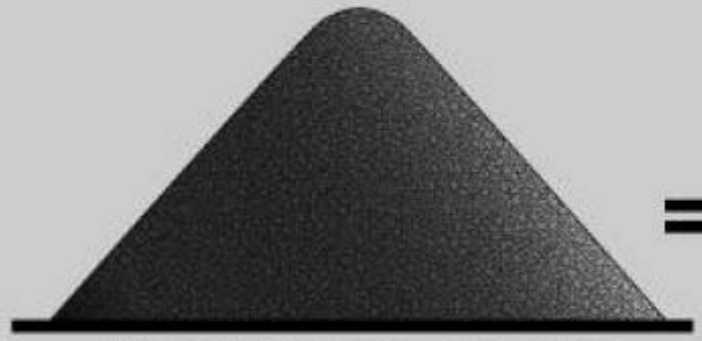
- Removed and/or reprocessed pavement materials containing asphalt and aggregates
- Over 80 percent of the asphalt pavement, removed each year for widening and resurfacing, is re-used
- Represents close to 100 million tons / year
- RAP is the Nation's No. 1 recycled material in both total amount and percentage recycled



FHWA / USEPA Report to Congress, EPA/600/R-93/095.

recycled pavement

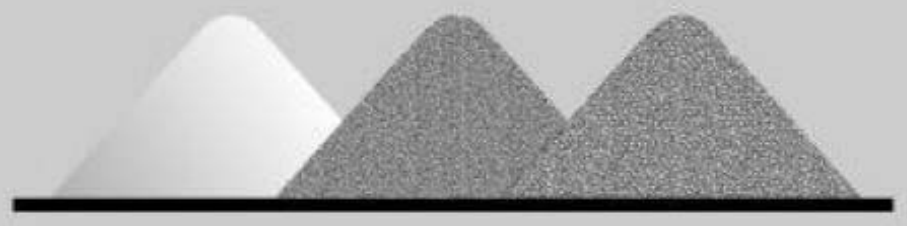
NAPA



30,000 Tons of RAP

=

70 - 6,000 Gallon Transport Trailers
and 28,200 Tons of Clean Aggregate



RAP: sustainable & carbon neutral

NAPA

Building and Fire Research Laboratory

Office of Applied Economics

NIST National Institute of Standards and Technology

Home | Research Areas | Publications | Software | Staff | Contact

BEES® 4.0

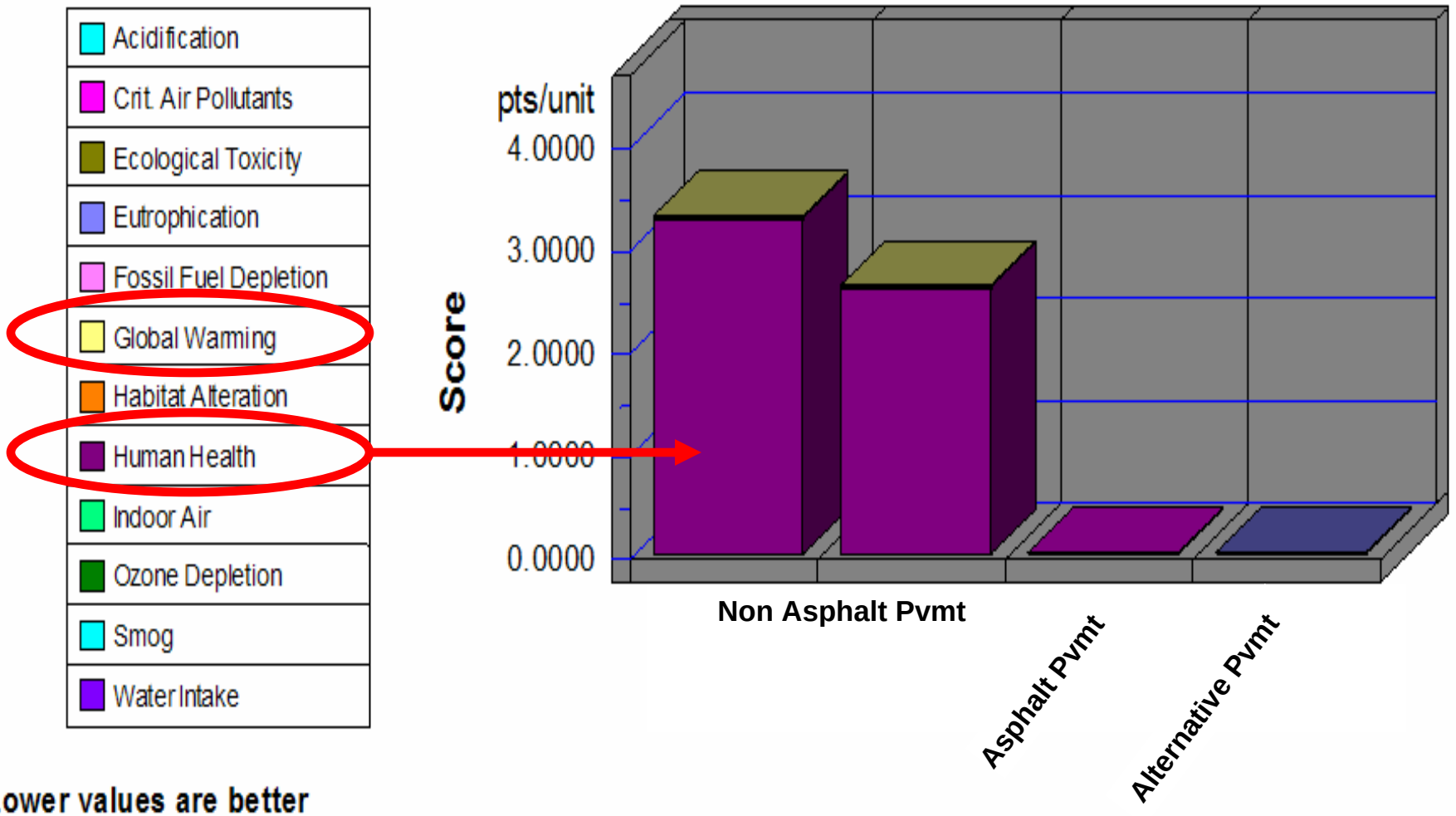
Home

Download

BEES Please

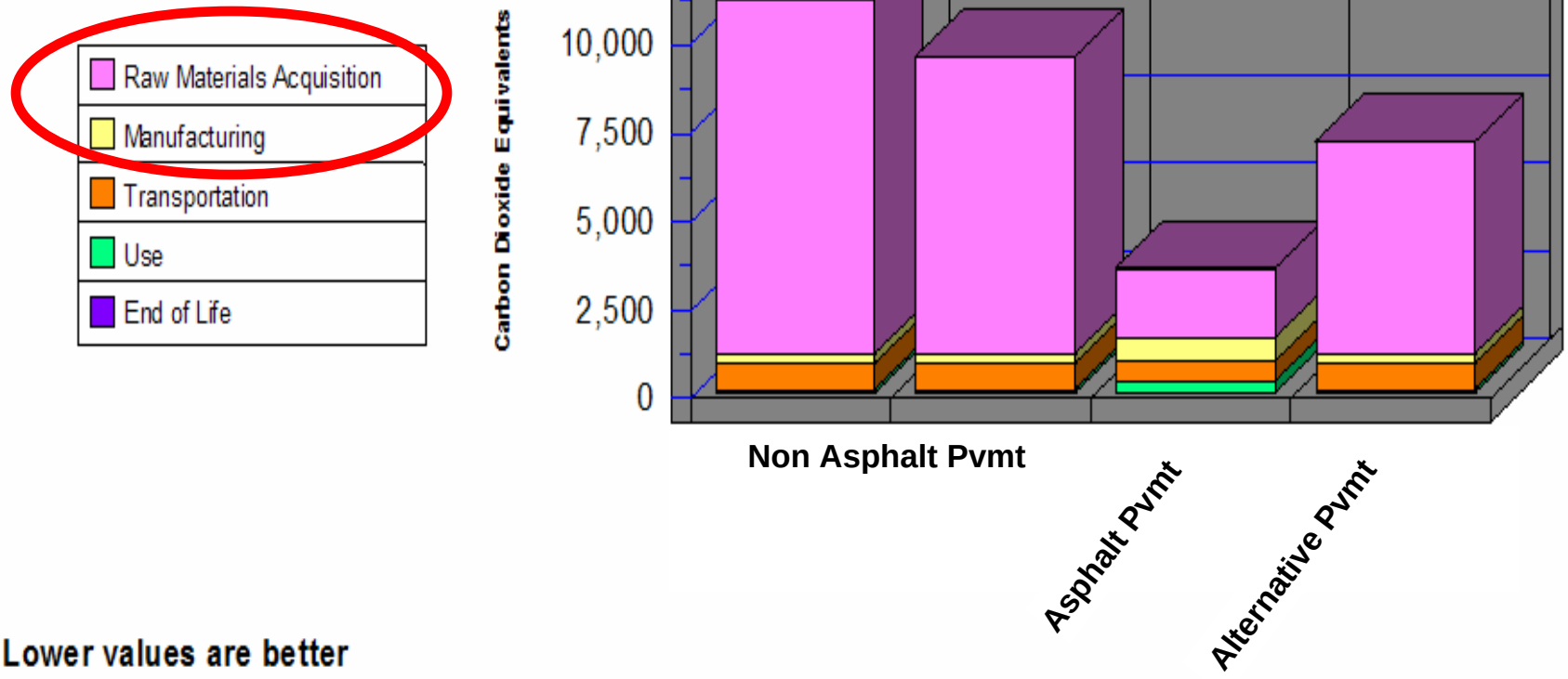
The BEES (**B**uilding for **E**nvironmental and **E**conomic **S**ustainability) software brings to your fingertips a powerful technique for selecting cost-effective, environmentally-preferable building products. Developed by the NIST (National Institute of Standards and Technology) Building and Fire Research Laboratory the tool is based on consensus standards and designed to be practical, flexible, and transparent. Version 4.0 of the Windows-based decision support software, aimed at designers, builders, and product manufacturers, includes actual environmental and economic performance data for 230 building products.

Environmental Performance



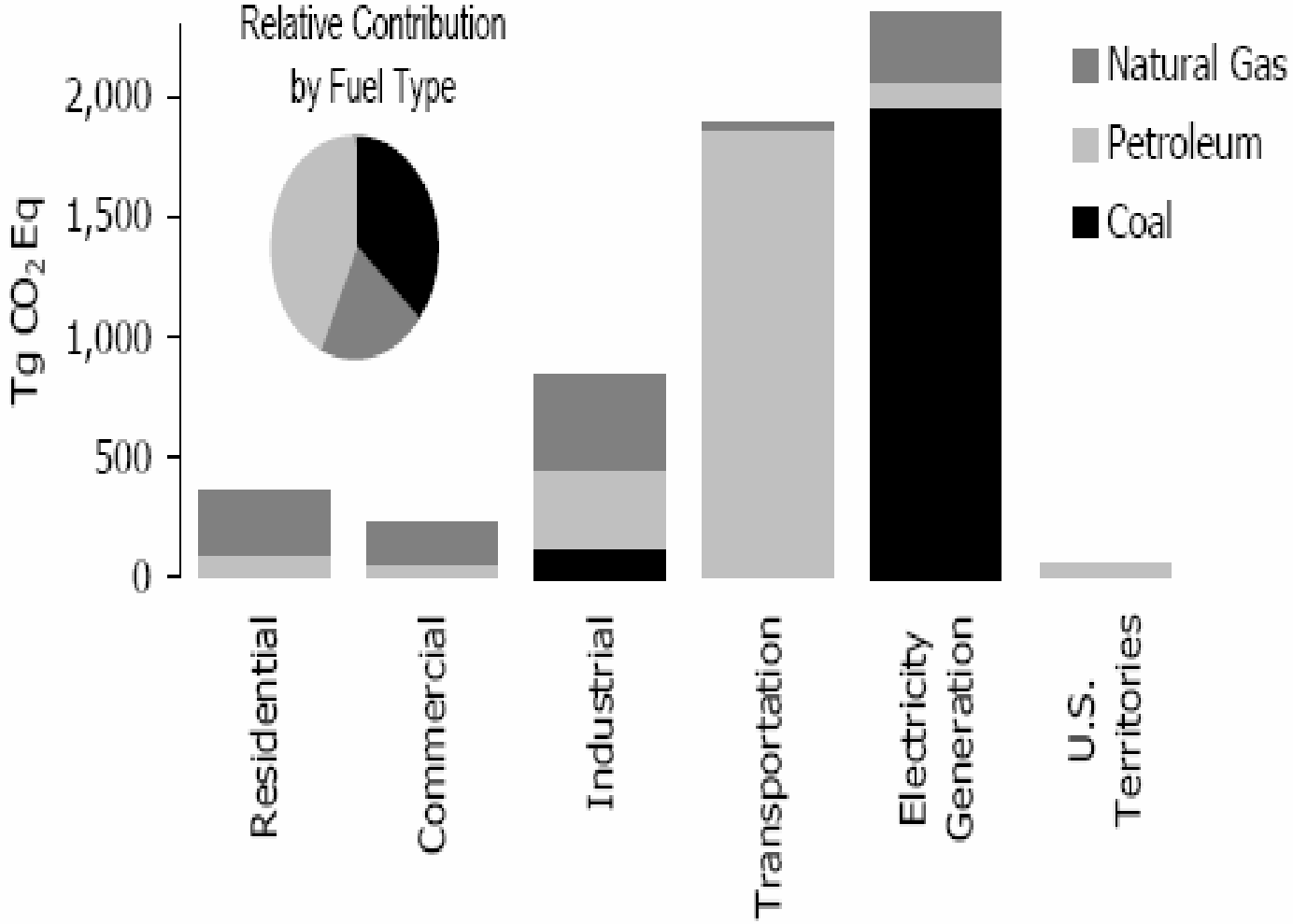
Note: Lower values are better

Global Warming by Life-Cycle Stage



Note: Lower values are better

- CO2 emissions generally linked to energy expenditures; less energy → less CO2 emissions
- UHI may be "real" but is only local; NOT a contributor to Global Warming – *Sci. American*
- Avg. automobile emits ~ 6 tons CO2 annually
- Avg. HMA plant emits ~ 2,500 tons CO2 = 0.0023 Tg
- GHG emissions from HMA production pales in comparison to other industrial sources . . .



Source: EPA 430-R-07-002 US GHG Emissions

Figure ES-6: 2005 CO_2 Emissions from Fossil Fuel Combustion by Sector and Fuel Type

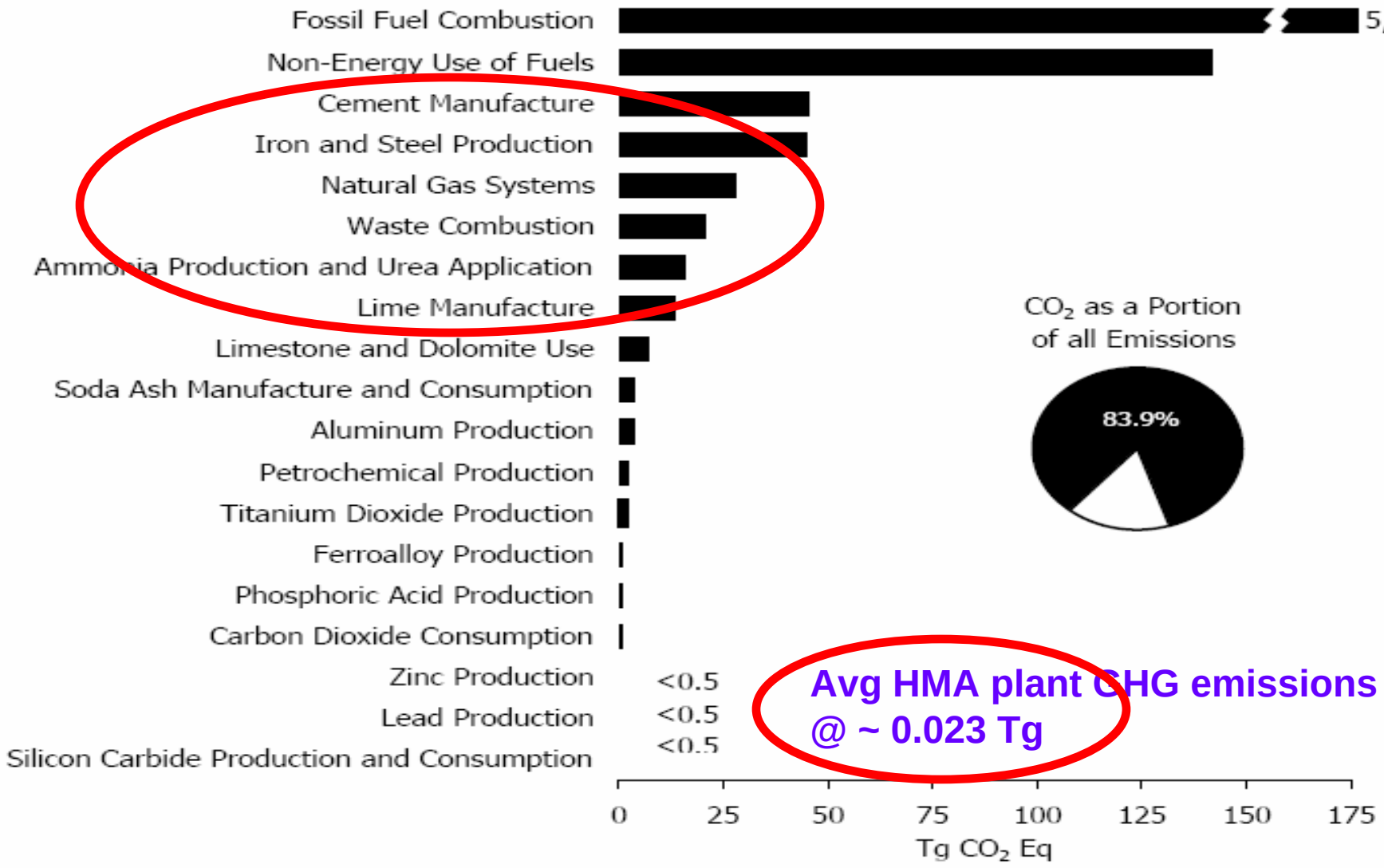
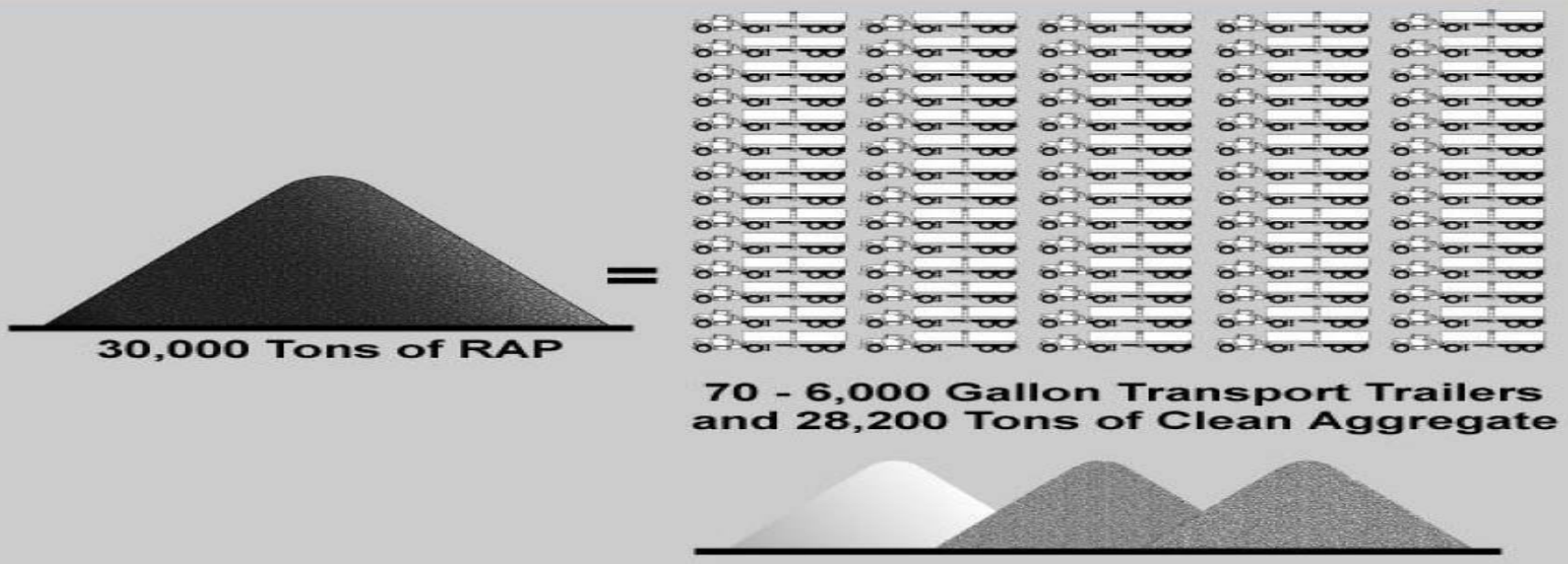


Figure ES-5: 2005 Sources of CO_2

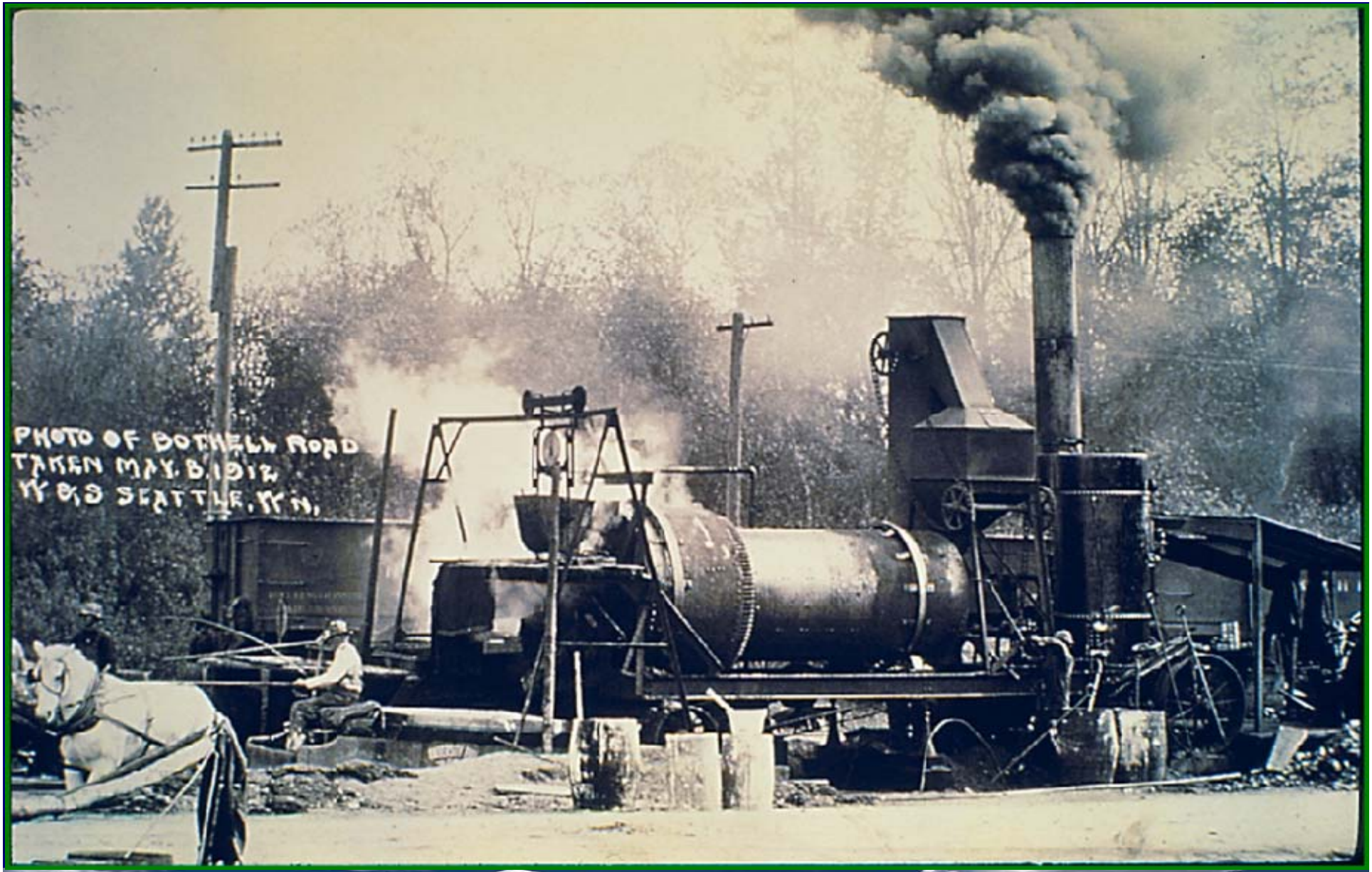
Source: EPA 430-R-07-002 US GHG Emissions

The entire annual CO2 / greenhouse gas emissions / carbon footprint from a typical hot-mix plant (~ 2,500 tons) could be totally offset by using 20 - 25% RAP in pavement mix designs -- accomplished by minimizing acquisition of energy intensive (natural) raw materials such as aggregate and petroleum asphalt.



RAP: sustainable & carbon neutral

NAPA



continually changing technology . .

NAPA


Spray Saver
Spray Saver
Spray Saver
SCALE HOUSE AND PLANTS
to drive efficiency = $$ / env comp
NAPA

Warm Mix Asphalt ("WMA")

NAPA

- **Many different technologies**
  - Waxes, emulsions, and water foaming processes
  - Costs differ: some higher, some lower
- **End-result: to lower mix temperatures**
  from 300 oF → ~ 250 oF (or lower)
  - Less energy demand / fuel consumption
  - Less emissions: plant and field
- **Quantifying energy and emissions**
  - ~ 15% less fuel consumption (min.)
  - ~ 15% less CO2 emissions (min.)
  - Lower NOx, particulate, other emissions
- **States, Producers, Contractors, FHWA all interested**
  - Performance research and many field trials

ASPHALT:
the environmentally sustainable pavement

- Porous pavements manage stormwater
- OGFCs are safe and quiet
- Reflective / OGFC / Porous can mitigate UHI
  - Remember: UHI doesn't cause Global Warming
- Asphalt pvmts accept recycled goods / are recycled (RAP)
- HMA pavements are environmentally preferred
  - Low energy to construct, low carbon footprint, fast speed of construction
- Warm Mix lowers energy consumption & emissions
- RAP can offset the entire annual HMA GHG emissions

greening the blacktop

NAPA

ASPHALT

The Sustainable Pavement

ENERGY & RECYCLING

PERFORMANCE

WATER QUALITY

CLEAN AIR & COOL CITIES

Asphalt is the sustainable material for constructing pavements.

From the production of the paving material, to the placement of the pavement on the road, to rehabilitation, through recycling, asphalt pavements minimize impact on the environment. Low consumption of energy for production and construction,

www.pavegreen.com

NAPA