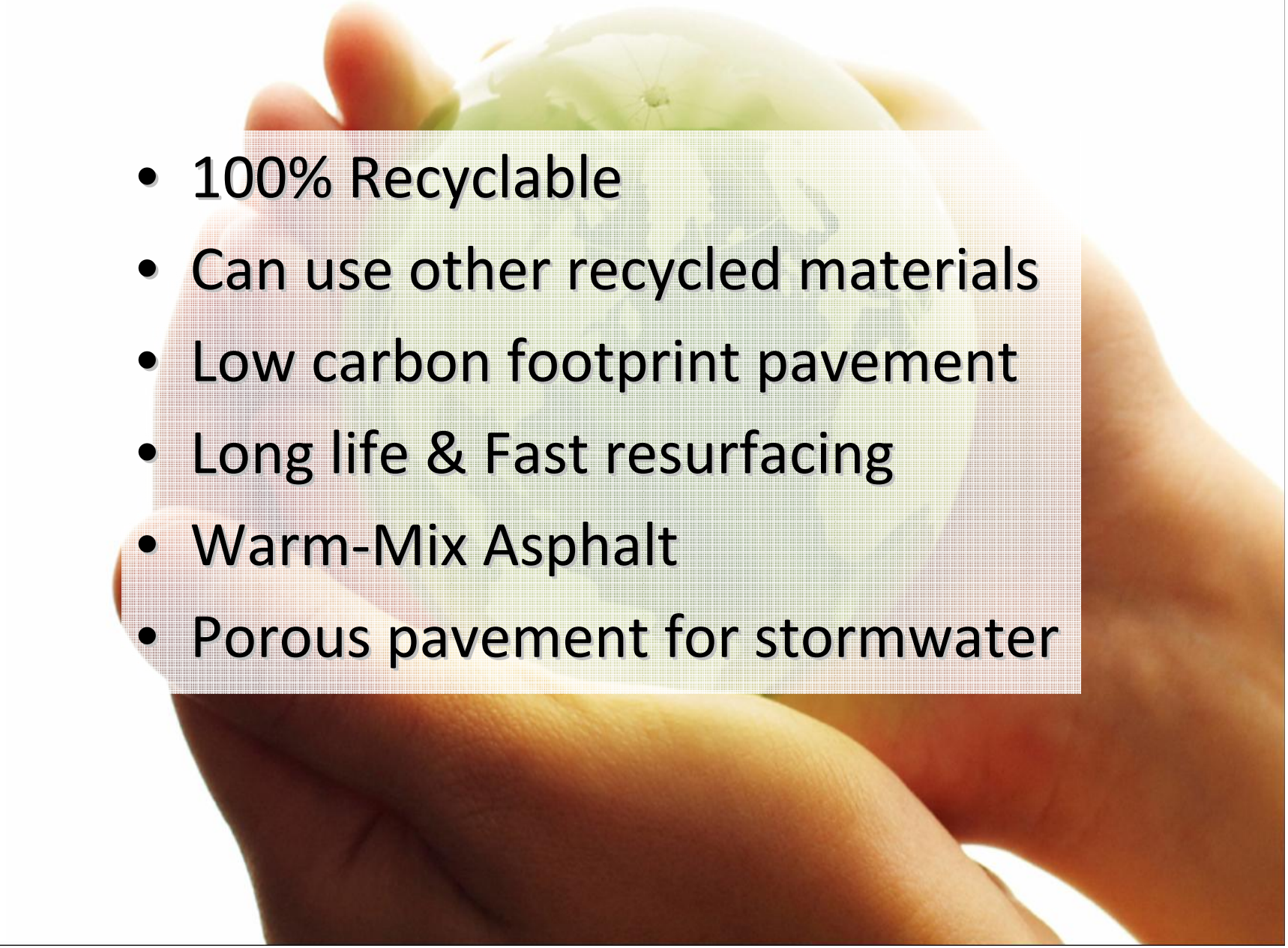
# Asphalt Pavement Sustainability

Kent Hansen, PE
Director of Engineering
National Asphalt Pavement Association

# Sustainability - Definition

- **Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.**
- **<u>Doing what is right</u>**

# Why is asphalt sustainable



- 100% Recyclable
- Can use other recycled materials
- Low carbon footprint pavement
- Long life & Fast resurfacing
- Warm-Mix Asphalt
- Porous pavement for stormwater

# Recycleability

- Asphalt is the No. 1 reused material
- 1995 FHWA Report to congress
  - 90 Million tons reclaimed
  - 80% recycled
- 2006 Contractor Survey
  - ~69% reused in HMA
  - ~27% other recycling
  - ~3% discarded

# Why Recycle RAP into HMA

- Best and Highest use
- Reduces demand for new materials
- Reduces carbon footprint
- Contains valuable materials
  - Aggregate ~95% >$10/ton
  - Asphalt ~5% > $600/ton
  - Value >$39.50/ton (minus processing)

# RAP from Multiple Sources


# Shingles

- Materials already used in HMA
  - >20% asphalt binder
  - Fibers
  - Sand
- Usually 5% of mix
  - Saves 1% binder > $6.00 ton
- Primarily from Mfg. Waste
- Tear-offs
  - Concern about asbestos
  - Not used since early 80's
  - 27,000 samples ~1% detected

## MoDOT News Release

*For more information contact Kristi Jamison at 573-526-2482 or Community Relations at 573-751-2840*

Over the past two years, MoDOT has allowed contractors to put used shingles that have been removed from rooftops into their asphalt mix. The result is a very durable, more-rut resistant asphalt at a much lower price.

"MoDOT embraces new ideas that not only help us become a more cost-efficient agency, but a more environmentally friendly one, too," said Director Pete Rahn. "By recycling asphalt shingles, we keep them

The use of recycled shingles saves $3 to $5 per ton of asphalt. That may not sound like much at first, but consider this: a typical resurfacing project would use about 30,000 tons of asphalt, for a savings of $90,000 to $150,000.

reduces the amount that ends up in landfills.

Shingle recycling also helps MoDOT reduce the amount of petroleum it uses in its road construction program. By using recycled asphalt shingles, the department reduces the amount of liquid asphalt in a mix design by 20 percent to 25 percent.

"MoDOT has incorporated a variety of waste materials on roadways," said Joe Schroer, field materials engineer. "However, we are on the cutting edge nationally for our efforts to reuse roofing shingles."

MoDOT is working with other agencies and organizations nationally to refine the specifications for the use of asphalt shingles as a hot-mix asphalt material.

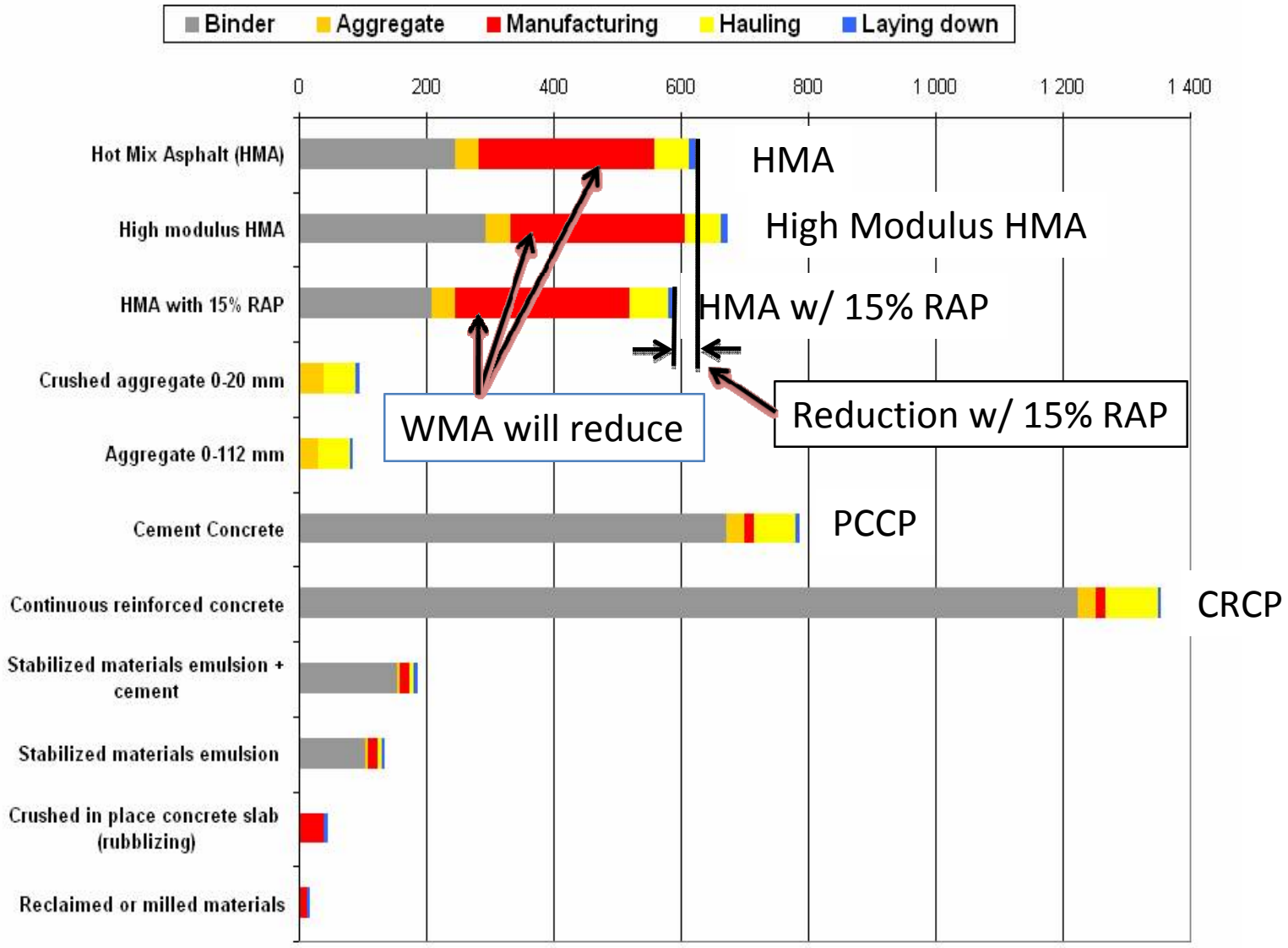
# Other Recycled Materials

- Crumb rubber (from tires)

- Steel slag

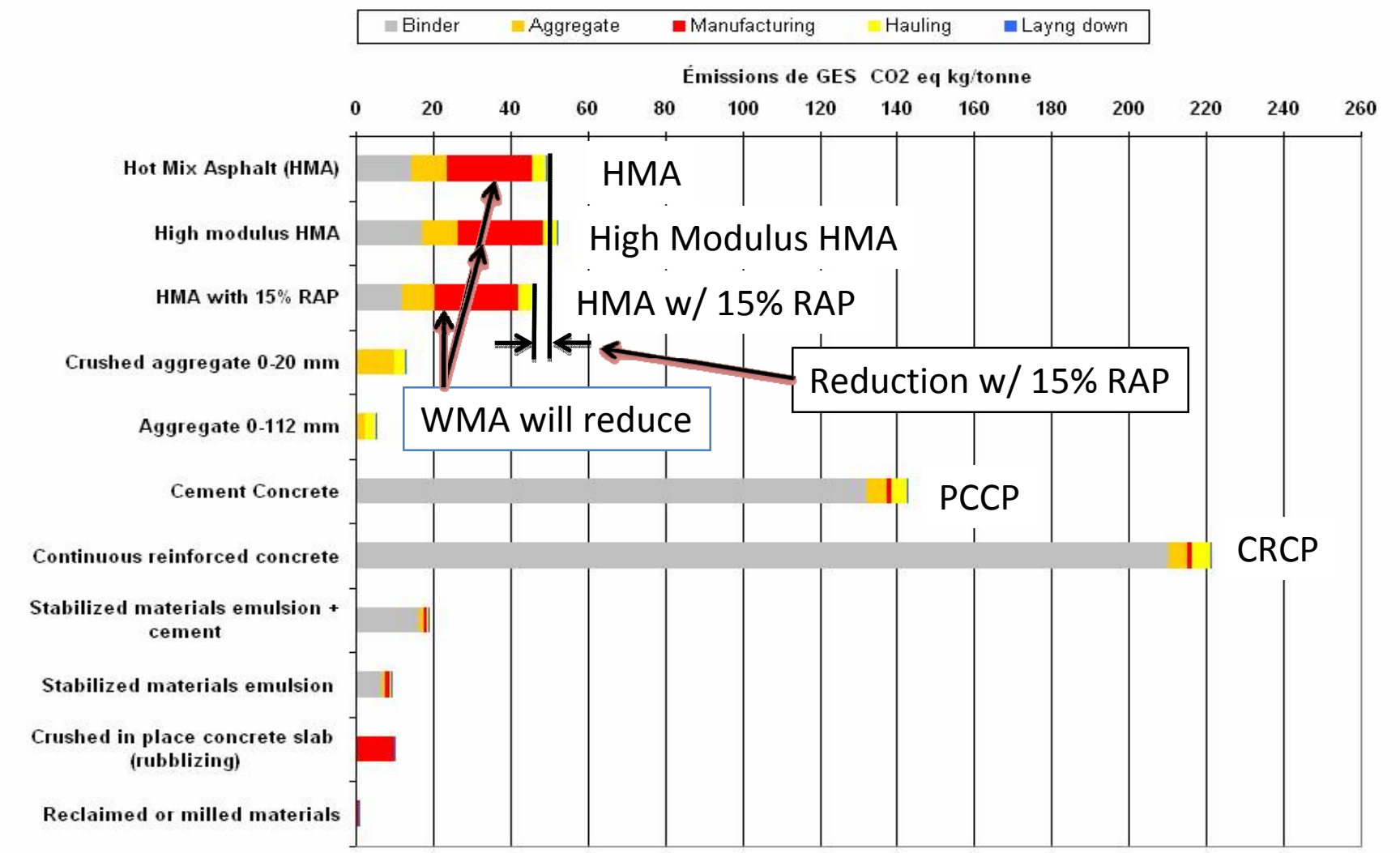
- Glass

# Energy Consumption per Tonne




**Ref: Analysis of energy consumption and greenhouse gas emissions,** Pierre T. Dorchies, M.Sc., P.Eng, Michel Chappat, Julian Bilal

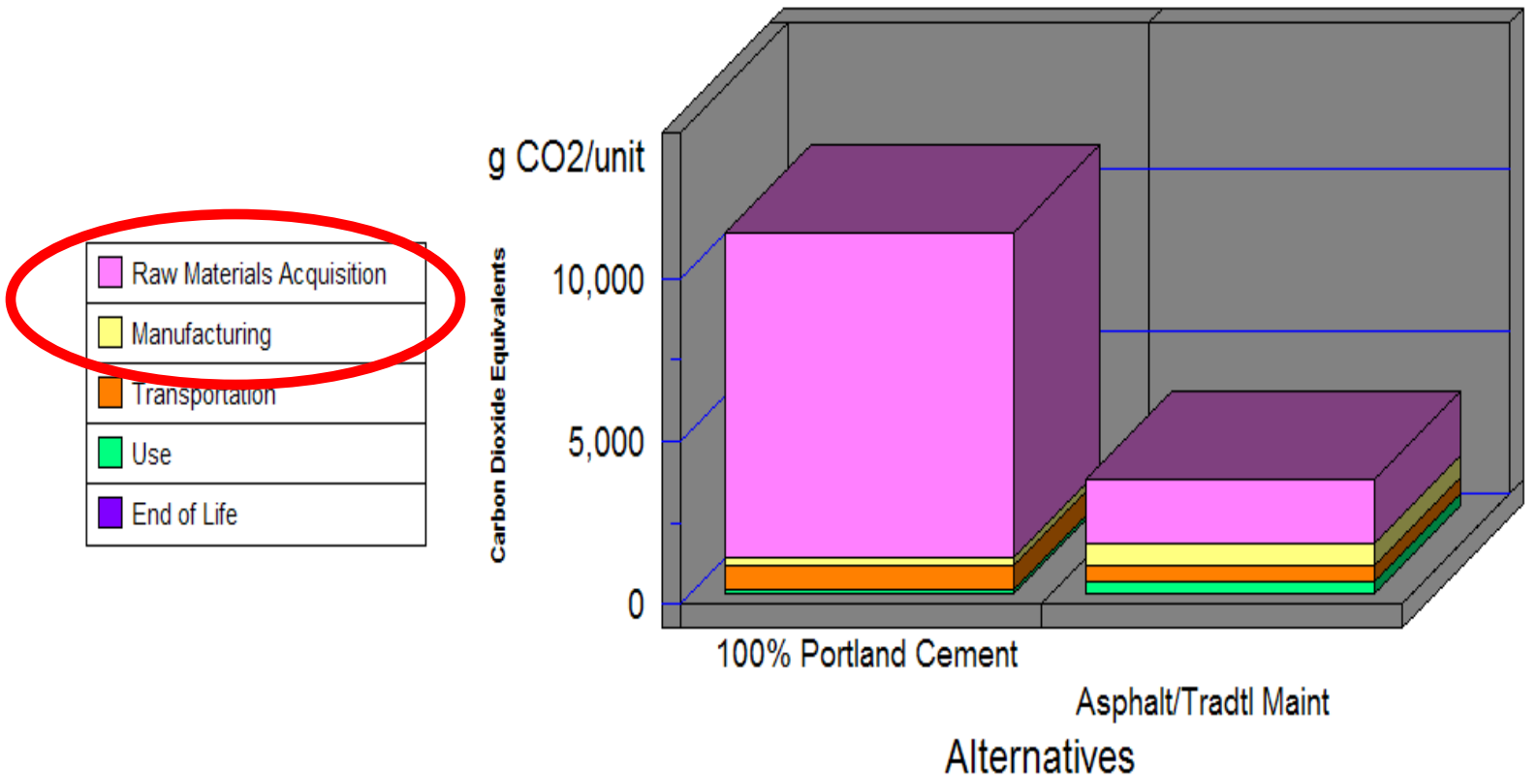
# $CO_2$ eq kg/tonne




**Ref: Analysis of energy consumption and greenhouse gas emissions,** Pierre T. Dorchies, M.Sc., P.Eng, Michel Chappat, Julian Bilal

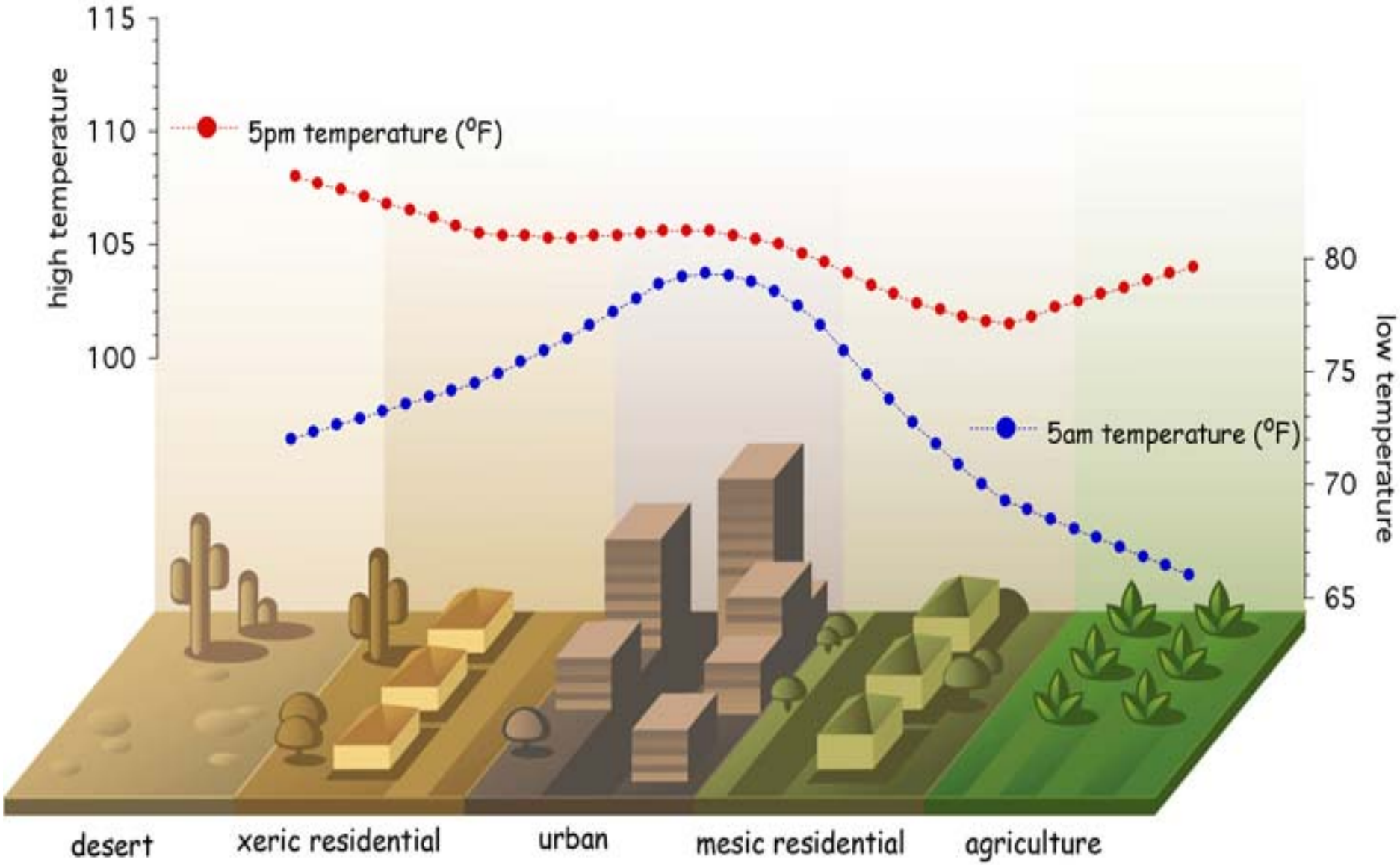

# BEES: econ. & env. impacts

# Global Warming by Life-Cycle Stage



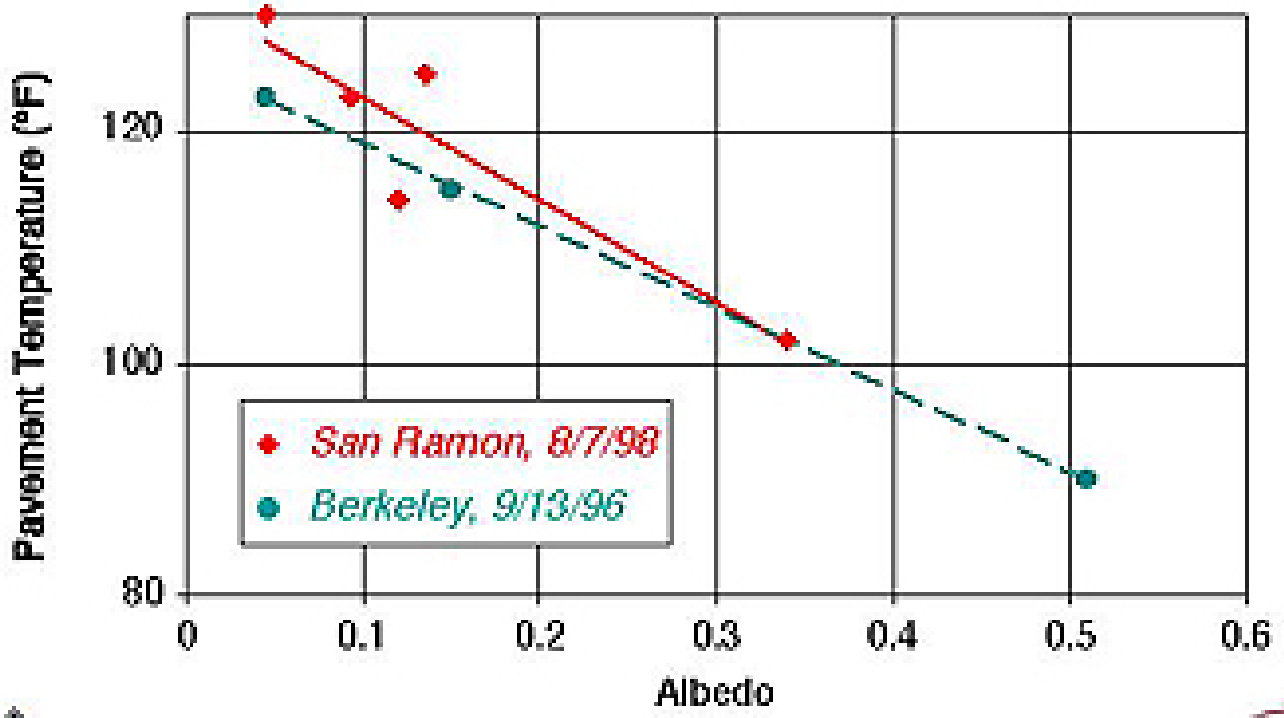

**Note: Lower values are better**

BEES

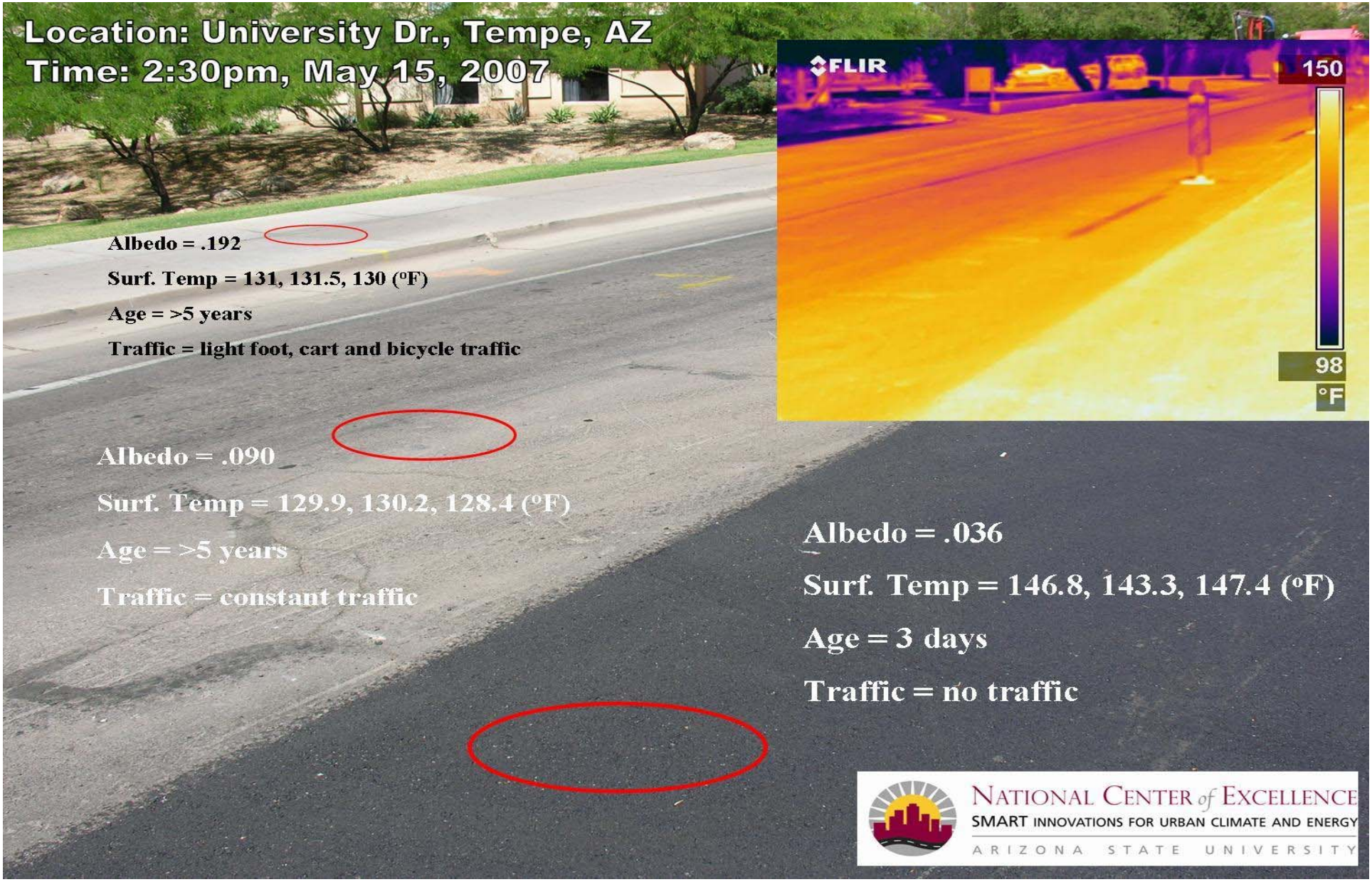



# *Urban Heat Islands*

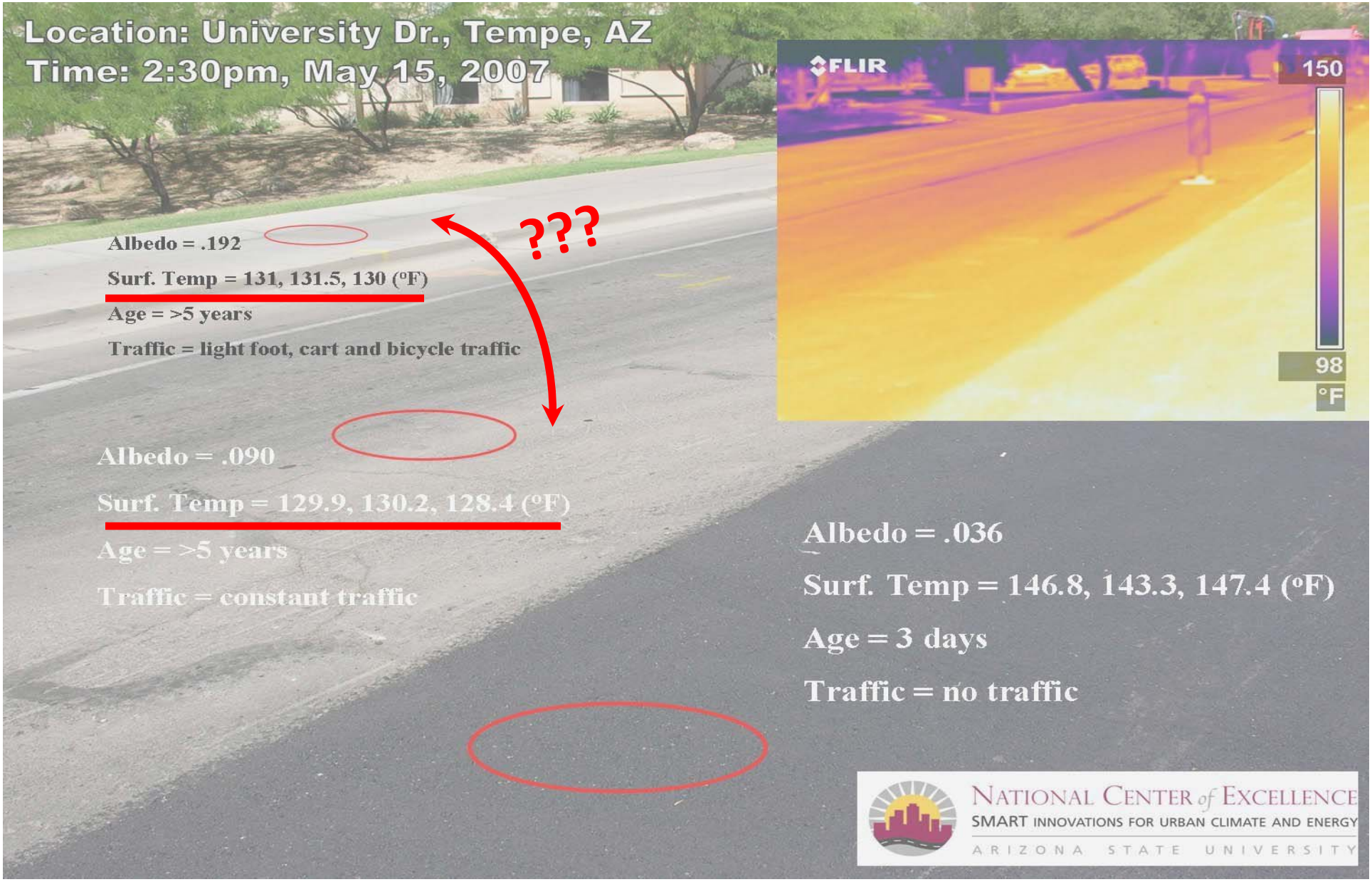
# Pavement Temperatures *vs.* Albedos




*myth or reality ?*




# *reflectivity & temperatures*

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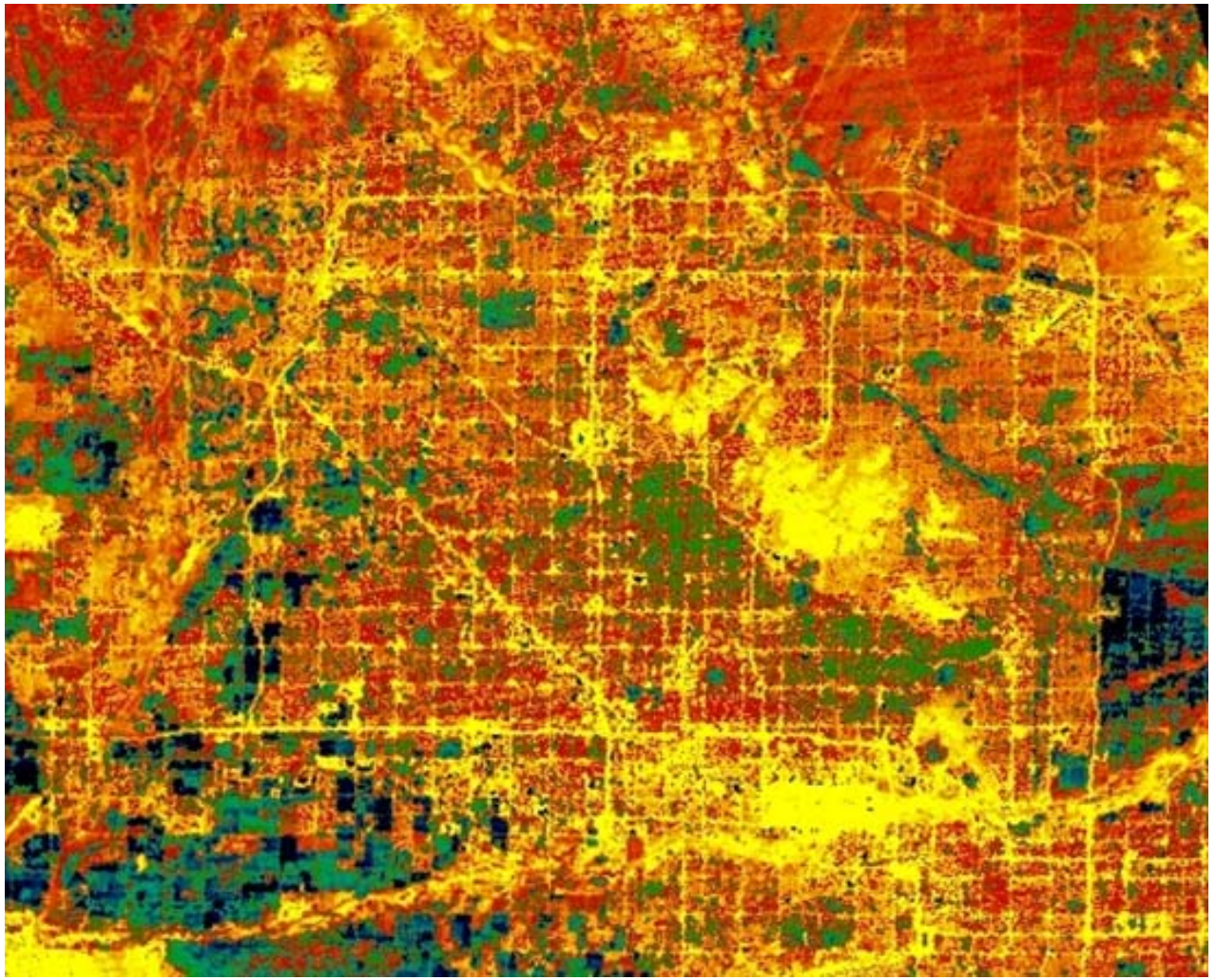
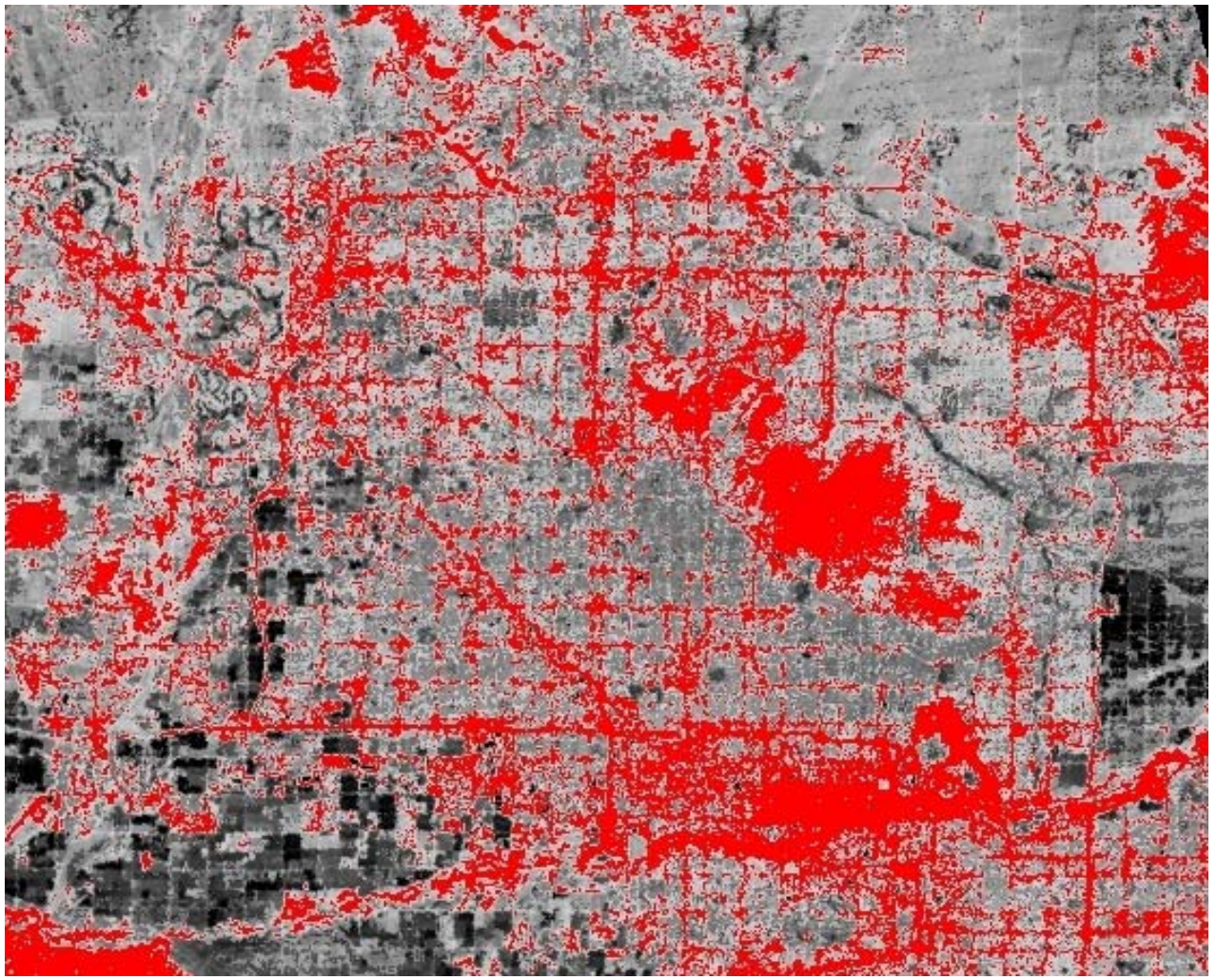
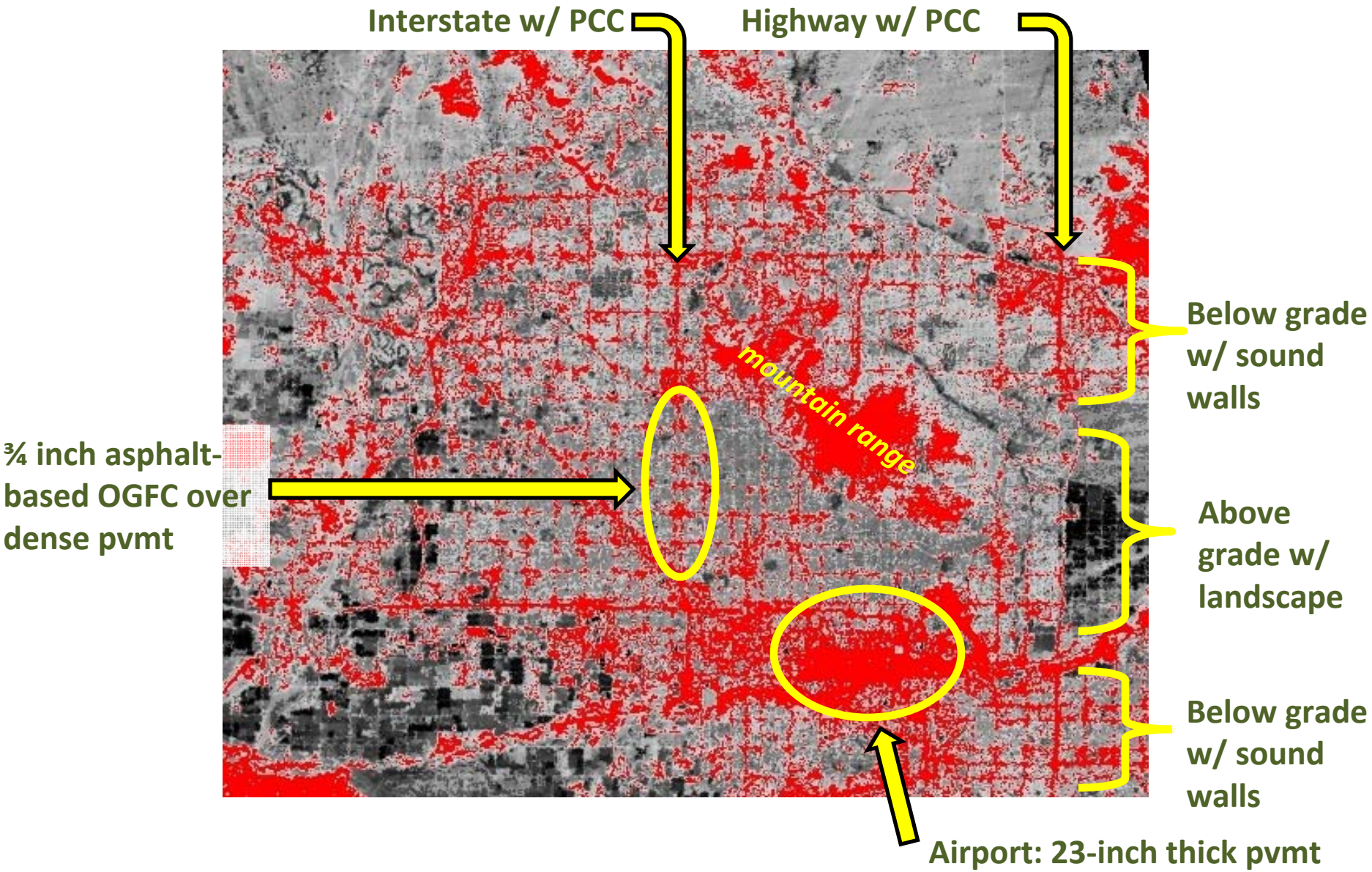


*cooler pavements*



*cooler pavements*




*cooler pavements*

Heat Island Effect

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Heat Island Home
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Cool Pavements
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## Cool Pavements

■ - Denotes link to glossary definition

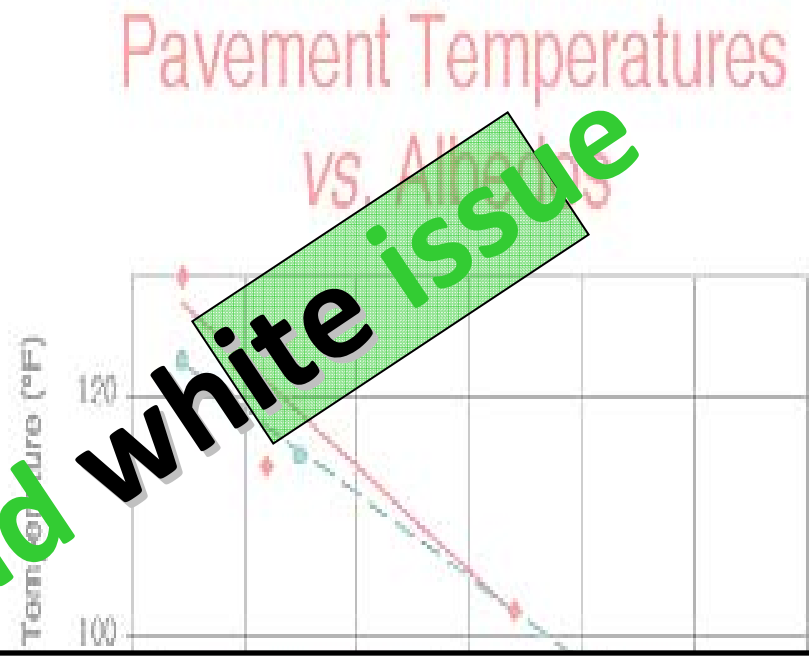
There is no official standard or labeling p
early stage.

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

There are
that lower
roadways

Investigat
Pavement
pavement
construct

Other fac
the best s
help with




It's NOT a black and white issue

- pavement thickness
- material capacities .
- surface vs. air temperature s
- pavement air voids (OGFC) cooler
- UHI does NOT cause Global Warming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Leadership in Energy and Environmental Design
What is LEED®?
The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ is the 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. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.
LEED provides a roadmap for measuring and documenting success for every building type and phase of a building lifecycle. Specific LEED programs include:
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LEED

## LEED: Leadership in Energy and Environmental Design

- Developed by USGBC
- National benchmark for design, construction, and operation of "green" buildings
- 5 key areas:
  - Sustainable site development
  - Water savings
  - Energy efficiency
  - Materials selection
  - Indoor environmental quality
- Earning LEED certification
  - Must meet certain criteria → credits / certification process
  - Levels based on total credits
- How asphalt pavements contribute to LEED credits

**Retail Certification Levels**

Certified: 26-32 points

Silver: 33-38 points

Gold: 39-51 points

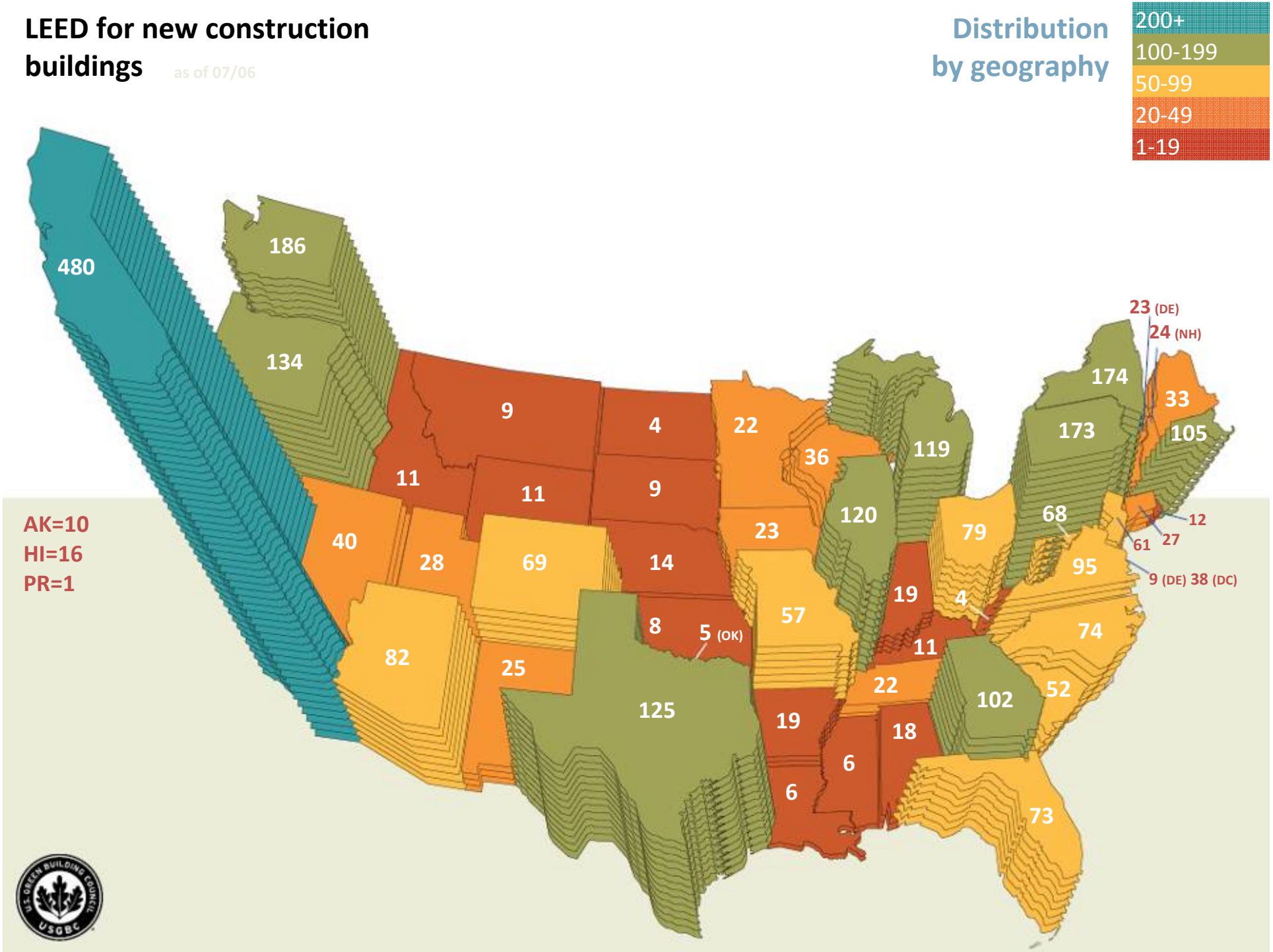
Platinum: 52-70 points

*LEED process*

# LEED for new construction buildings

as of 07/06

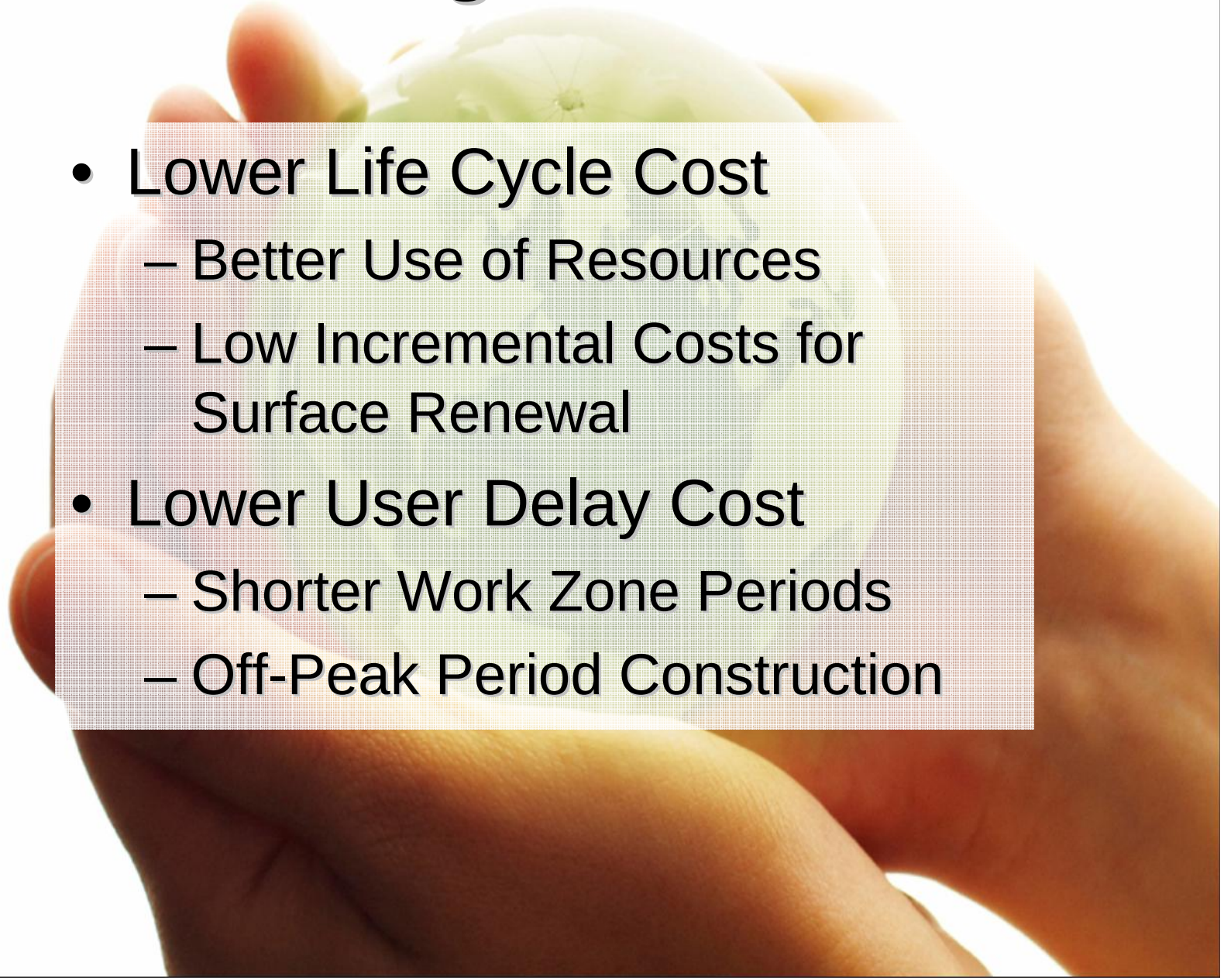
## Distribution by geography



# LEED Credits

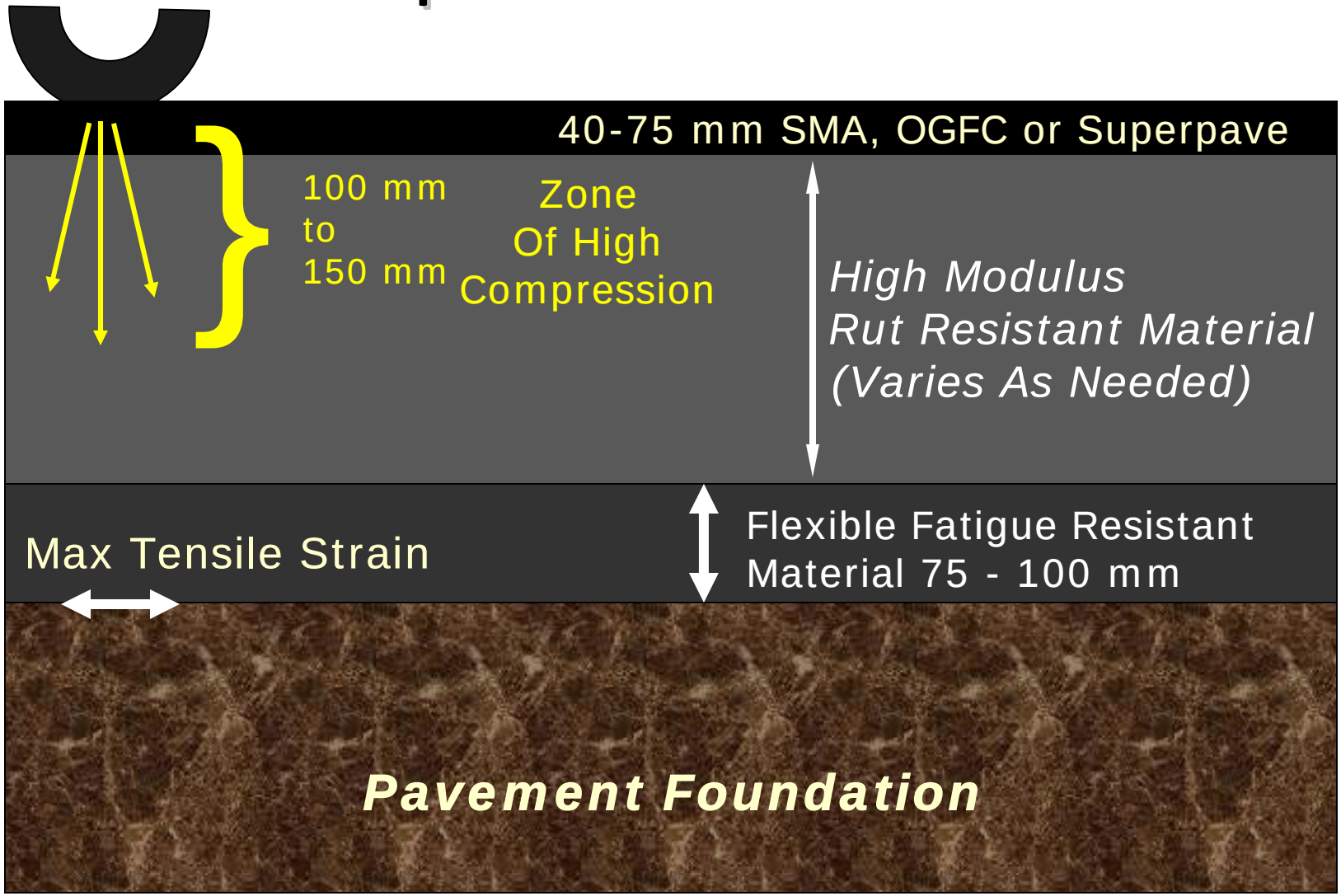
| Rating Category | Credit Description | Pavement Type | Credits |
|---|---|---|---|
| SS Credit 6.1 | SW Design: Quantity Control | Porous Asphalt | 1 |
| SS Credit 6.2 | SW Design: Quality Control | Porous Asphalt | 1 |
| SS Credit 7.X | Heat Island Effect: Non-Roof | Reflective Surf.<br>OG Asphalt<br>Porous Asphalt | 1 – 3 |
| MR Credit 2.X | Const. Waste Mgt. Divert from disposal | RAP | 1 – 2 |
| ID Credit 1.X | Exceptional Performance or areas not addressed | WMA<br>High RAP | 1 – 4 |

# Long Life



- Lower Life Cycle Cost
  - Better Use of Resources
  - Low Incremental Costs for Surface Renewal
- Lower User Delay Cost
  - Shorter Work Zone Periods
  - Off-Peak Period Construction

# Perpetual Pavement



# Rehabilitation

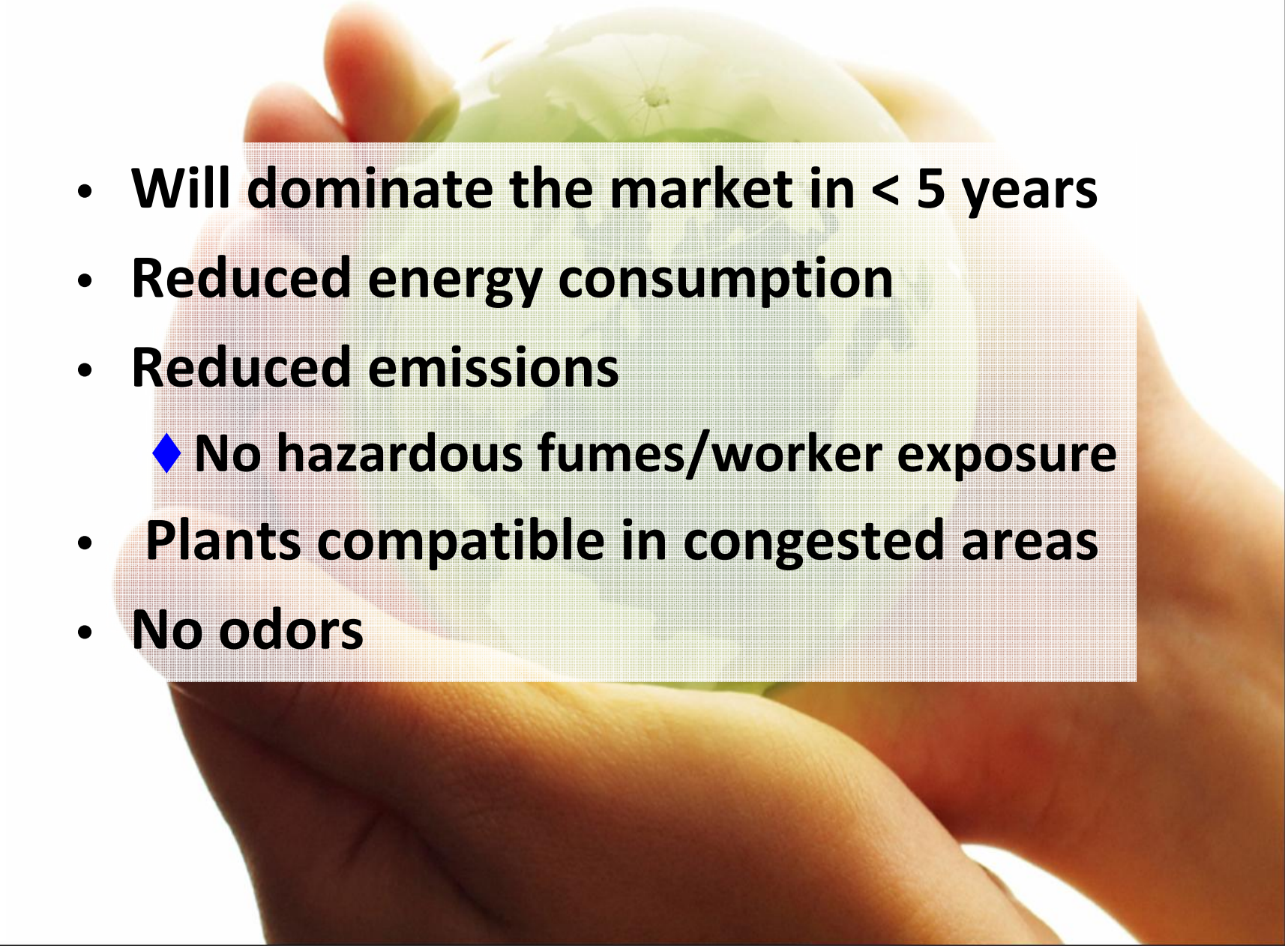
Possible Distresses

- *Top-Down Fatigue*
- *Thermal Cracking*
- *Raveling*

**Solutions**

- *Mill & Fill*
- *Thin Overlay*

# Warm Mix

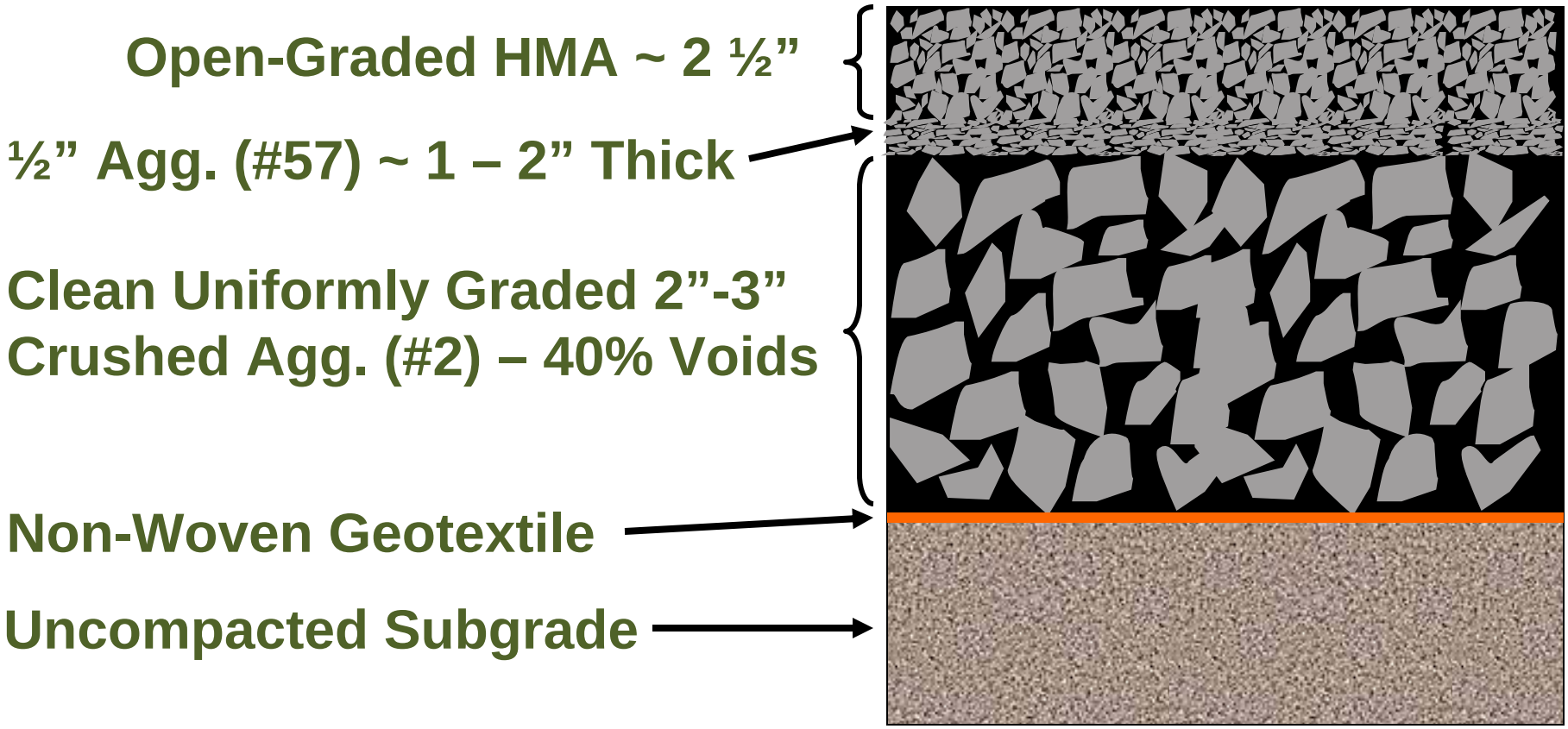


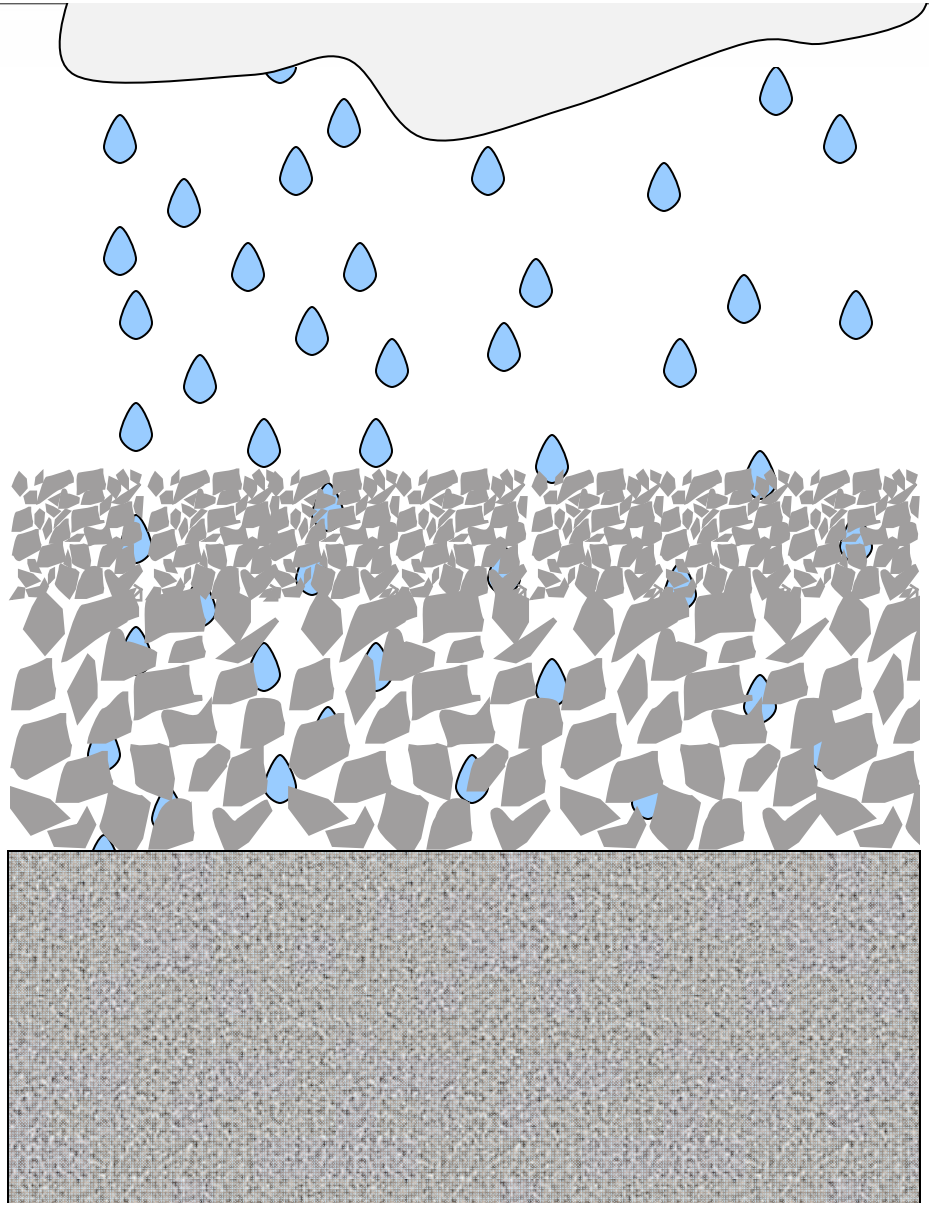
- **Will dominate the market in < 5 years**
- **Reduced energy consumption**
- **Reduced emissions**
  - **No hazardous fumes/worker exposure**
- **Plants compatible in congested areas**
- **No odors**

# Porous Asphalt Pavements w/ Stone Recharge Beds

Cahill Associates
ENVIRONMENTAL CONSULTANTS

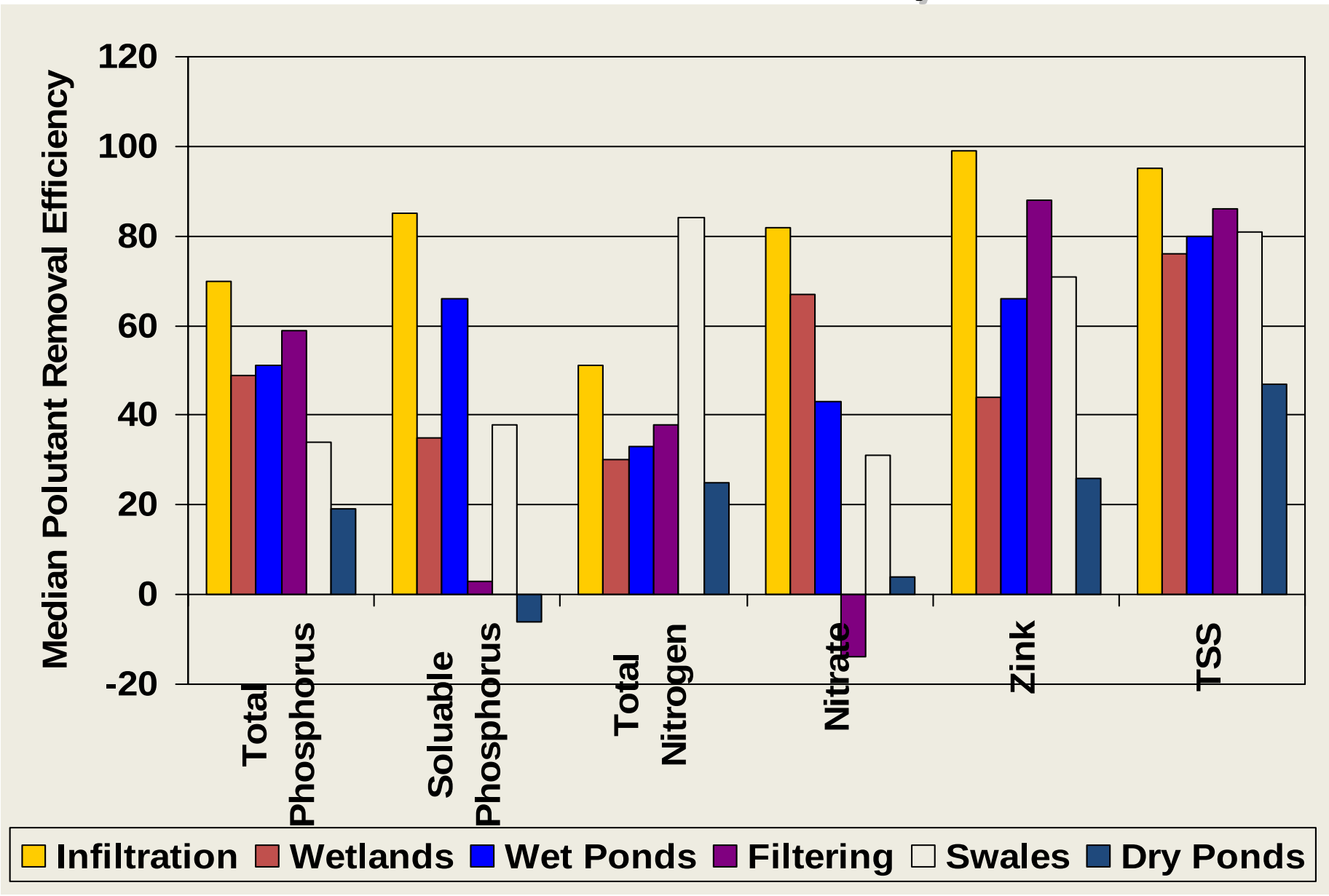
# What are Porous Pavements?





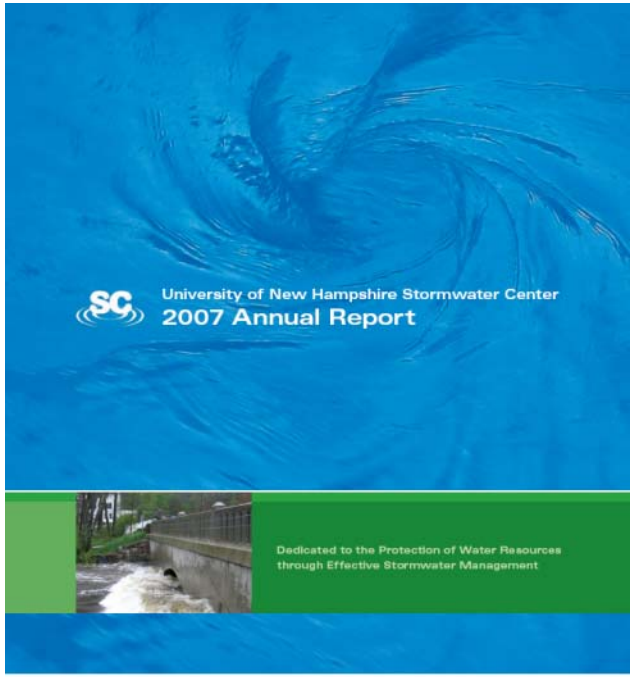
# Port of Portland

# Water Quality



# Water Quality

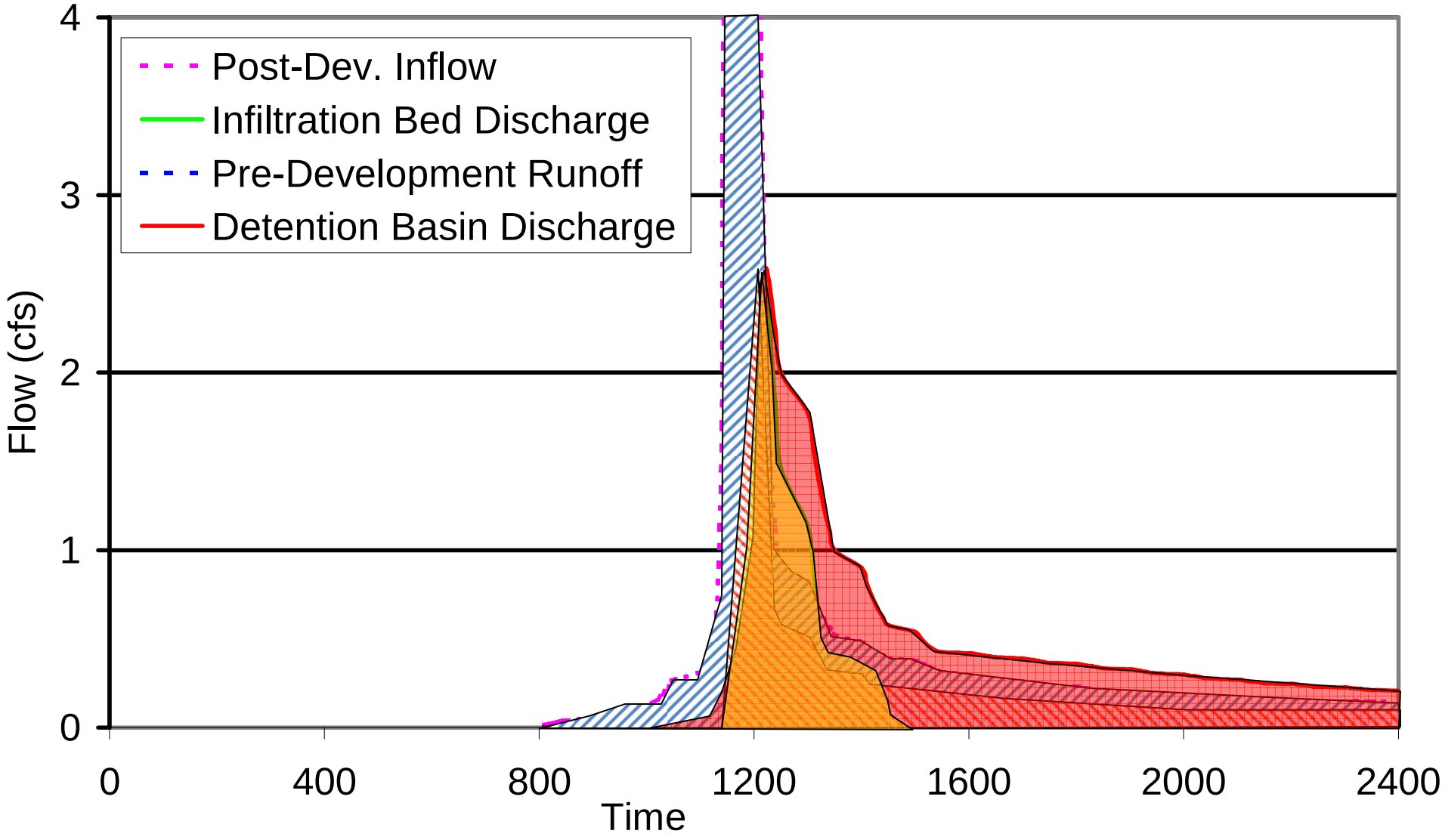
| Total Suspended Solids (% Removal) | Total Phosphorus (% Removal) | Total Zinc (% Removal) | Total Petroleum Hydrocarbons in the Diesel Range (% Removal) |
|---|---|---|---|
| **99** | **38** | **96** | **99** |




| Stormwater Treatment System | Reference | Total Suspended Solids (% Removal) | Total Phosphorus (% Removal) | Dissolved Inorganic Nitrogen (% Removal) | Total Zinc (% Removal) | Total Petroleum Hydrocarbons in the Diesel Range (% Removal) | Average Peak Flow (% Removal) | Average Lag Time (Minutes) |
|---|---|---|---|---|---|---|---|---|
| **Low Impact Development Systems** | | | | | | | | |
| **Bioretention Systems** | | | | | | | | |
| **Bio I with 48" BSM** | **UNH Stormwater Center** | **97** | **NA** | **44** | **99** | **99** | **85** | **615** |
| **Bio II with 30" BSM** | **UNH Stormwater Center** | **99** | **5** | **29** | **99** | **58** | **82** | **92** |
| | USEPA Fact Sheet: Bioretention | 90 | 70-83 | NA | NA | NA | NA | NA |
| Bioretention with 12" BSM | Winogradoff, 2001 | NA | NT | NT | 87 | NA | NA | NA |
| Bioretention with 24" BSM | Winogradoff, 2001 | NA | 73 | NT | 98 | NA | NA | NA |
| Bioretention with 36" BSM | Winogradoff, 2001 | NA | 81 | 23 | 99 | NA | NA | NA |
| **Gravel Wetlands (submerged, horizontal flow systems)** | **UNH Stormwater Center** | **99** | **55** | **99** | **99** | **99** | **81** | **315** |
| | Claytor & Schueler, 1996 | 80-93 | 80-89 | 75 | 55-90 | NA | NA | NA |
| | Winer, R., 2000 | 83 | 64 | 81 | 55 | NA | NA | NA |
| **Porous Pavement** | **UNH Stormwater Center** | **99** | **38** | **NT** | **96** | **99** | **68** | **790** |
| | NAPA, undated | 89-95 | 65-71 | NA | 62-99 | NA | NA | NA |
| | USEPA Fact Sheet: Porous Pavement | 82-95 | 65 | NA | NA | NA | NA | NA |
| | Winer, R., 2000 | 95 | 64 | NA | 99 | NA | NA | NA |
| **Surface Sand Filter** | **UNH Stormwater Center** | **91** | **33** | **NT** | **77** | **98** | **59** | **204** |
| | USEPA Fact Sheet: Sand Filters | 70 | 33 | NT | 45 | NA | NA | NA |
| | Claytor & Schueler, 1996 | 85 | 50 | NA | 71 | NA | NA | NA |
| | Bell, W., et al, 1995 | 61-70 | NA | NA | >82 | NA | NA | NA |
| | Winer, R., 2000 | 87 | 59 | NT | 80 | NA | NA | NA |
| **Tree Box Filter** | **UNH Stormwater Center** | **96** | **NT** | **37** | **96** | **88** | **NT** | **19** |
| **Manufactured Systems** | | | | | | | | |
| **ADS Water Quality Unit & Infiltration System** | **UNH Stormwater Center** | **99** | **81** | **NT** | **99** | **99** | **83** | **294** |
| | EPA Fact Sheet: Infiltration Trenches | NA | 60 | NA | NA | NA | NA | NA |
| **Aqua-Filter Stormwater Filtration System** | **UNH Stormwater Center** | **62** | **26** | **NT** | **52** | **59** | **NT** | **NT** |
| | USEPA website | 84 | NA | NA | NA | NA | NA | NA |
| **Hydrodynamic Separators** | **UNH Stormwater Center** | **27** | **1** | **NT** | **24** | **42** | **NT** | **NT** |
| | Low values from Bannerman, R. 2005; high values from laboratory-based testing from vendor* | 15-84 | NA | NA | NA | NA | NA | NA |
| | Claytor & Schueler, 1996 | 80-93 | 80-89 | 75 | 55-90 | NA | NA | NA |
| | Winer, R., 2000 | 83 | 64 | 81 | 55 | NA | NA | NA |
| **Conventional Structural Systems** | | | | | | | | |
| **Retention Pond** | **UNH Stormwater Center** | **72** | **16** | **54** | **93** | **83** | **81** | **424** |
| | USEPA Fact Sheet: Wet Detention Ponds | 50-90 | 30-90 | NA | 40-50 | NA | NA | NA |
| | USEPA Fact Sheet: Wet Detention Ponds | 80-90 | NA | NA | NA | NA | NA | NA |
| | Winer, R., 2000 | 79 | 49 | 36 | 65 | NA | NA | NA |
| **Swale** | | | | | | | | |
| **Stone Swale** | **UNH Stormwater Center** | **50** | **NA** | **NT** | **66** | **33** | **NT** | **NT** |
| **Vegetated Swale** | **UNH Stormwater Center** | **60** | **NT** | **NT** | **88** | **67** | **48** | **19** |
| | USEPA Fact Sheet: Vegetated Swales | 81 | 9 | 38 | 71 | NA | NA | NA |
| | Claytor & Schueler, 1996 | 30-90 | 10-65 | 0-80 | 71 | NA | NA | NA |

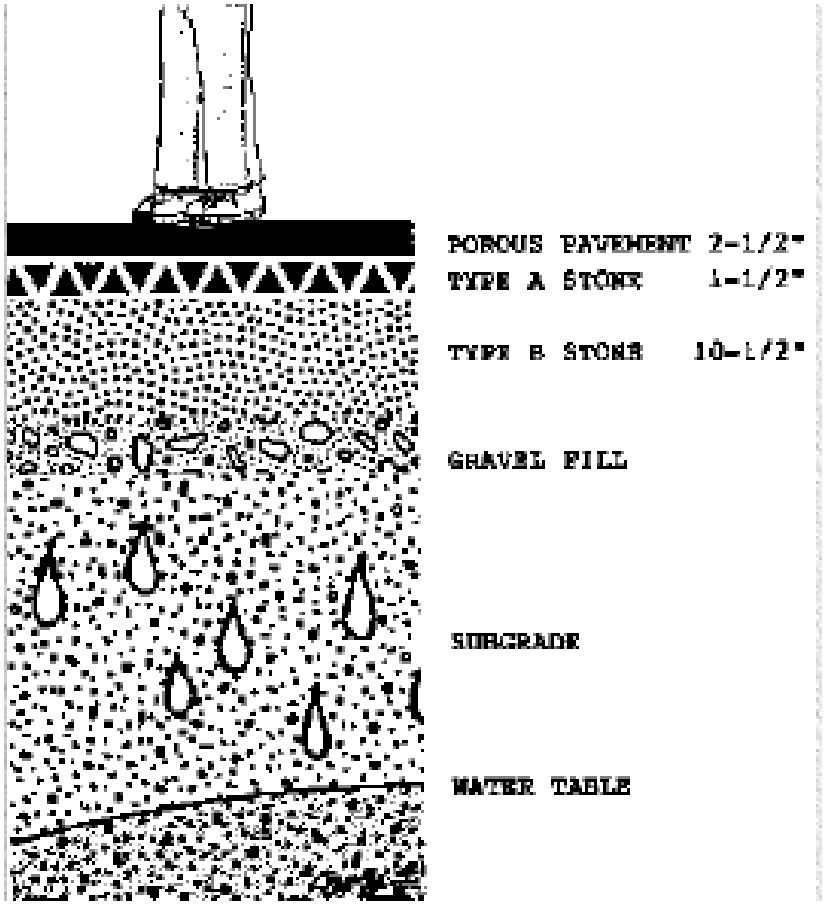
* Disparities between data generated in the laboratory and that derived from field studies are common.

# Detention vs. Infiltration



# Walden Pond 1977

**1997 Report: "Twenty years later, a *long time for one paving job on that busy* parking lot, it *still looks good and works well.*"**





2008

# Roads

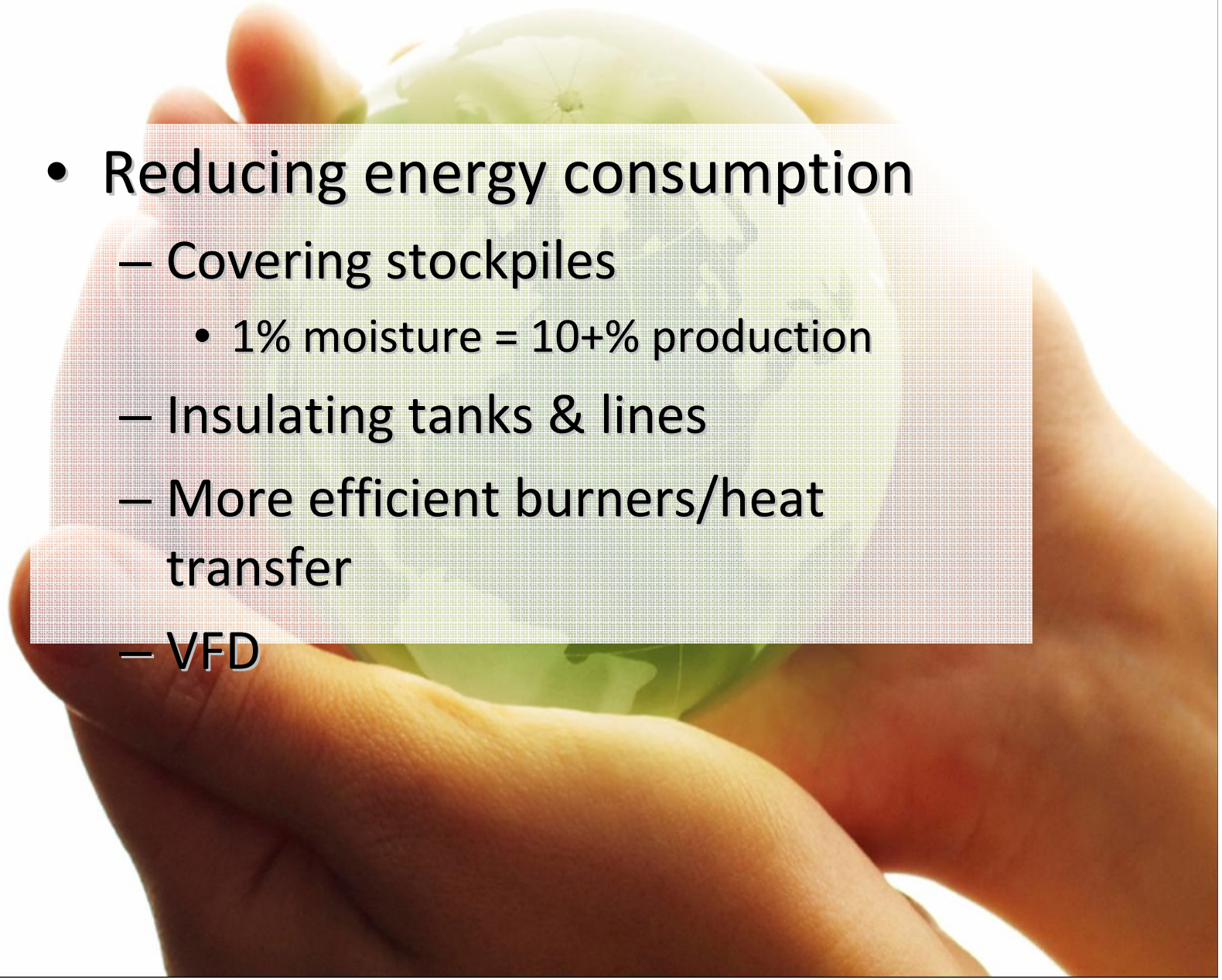

Arizona
Porous
Dense Graded


Portland, OR


Salem, OR


Chicago, IL

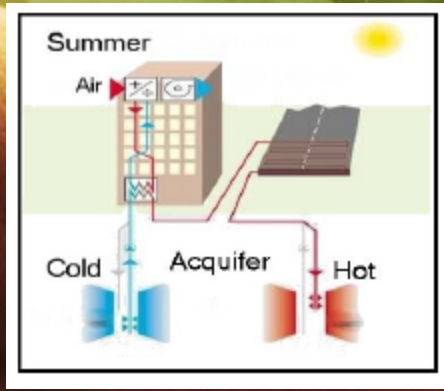
# What else are we or could we be doing

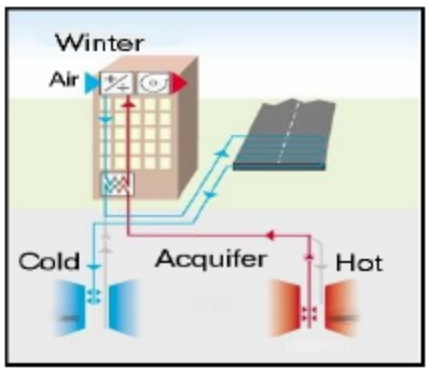


- Reducing energy consumption
  - Covering stockpiles
    - 1% moisture = 10+% production
  - Insulating tanks & lines
  - More efficient burners/heat transfer
  - VFD


RAP + Porous + Warm Mix
= Sustainability

# Innovation



# HMA Energy & Recycling Symposium

## December 3&4, 2008
## Atlantic City, NJ