Trends in RAP and RAS Use:
Building on Success and Expanding the Boundaries

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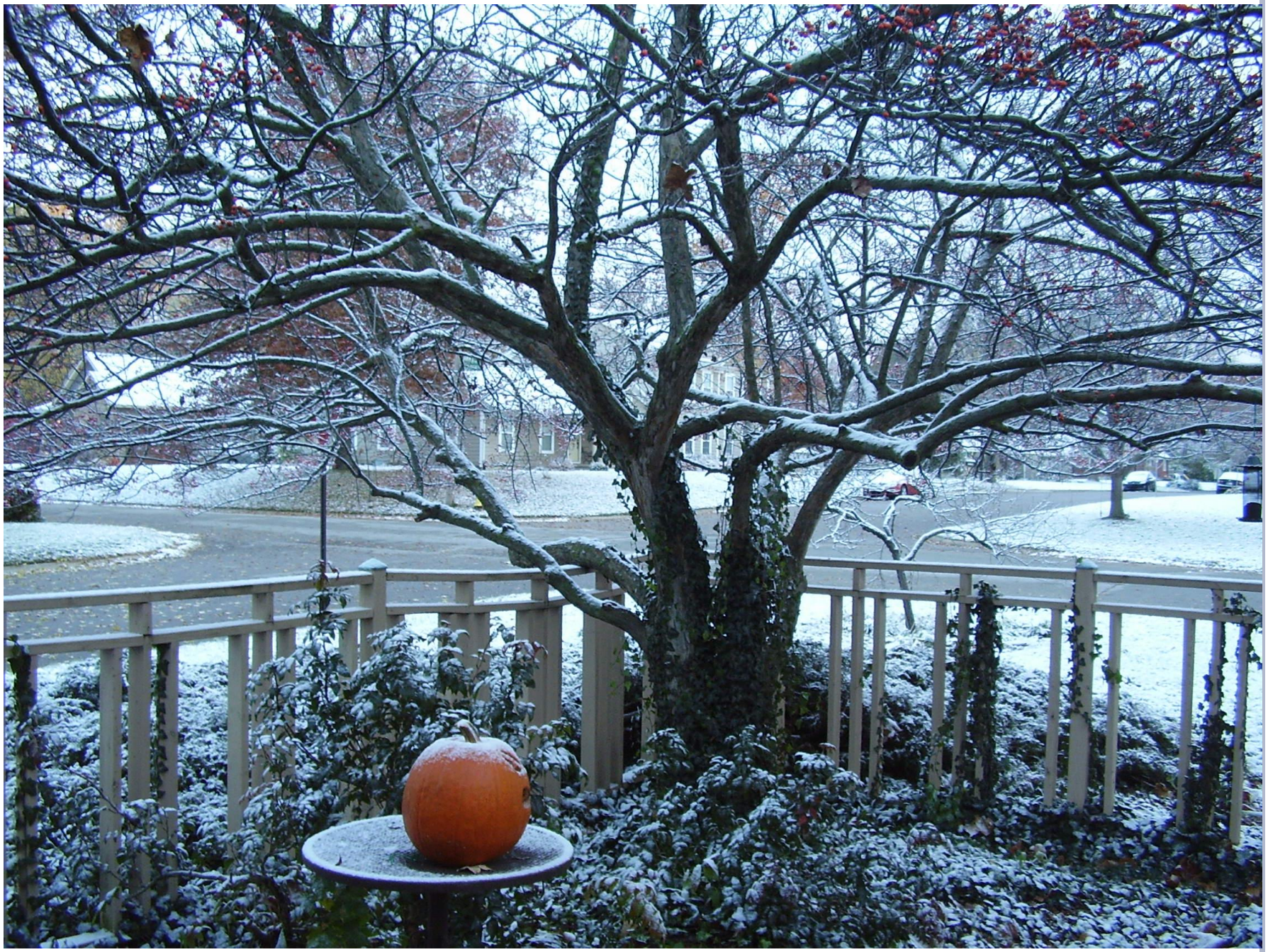
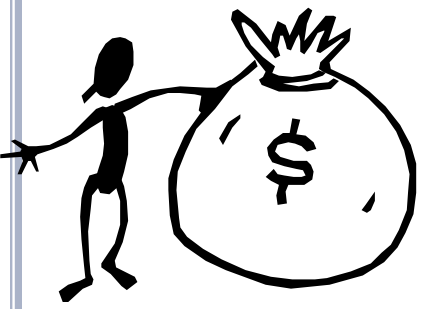


Building on Past Success

- Asphalt pavement is *the* most widely recycled material in the USA
- 100 million tons reclaimed annually
- 95% is reused or recycled
- $1.8 billion in savings each year
- Reduces demand for new aggregates and binder and the energy to produce them
- Can perform as well as virgin mixes



TODAY IN THE USA

Strong incentives to recycle more

- Economics
  - Saves money
  - Makes contractors more competitive
  - Helps asphalt retain market share
- Environmental
  - Increasing awareness, legislation, regulations

Increasing Trends in Asphalt Paving

- Recycling
  - Reclaimed Asphalt Pavement
  - Recycled Asphalt Shingles
  - Ground Tire Rubber
  - Other waste or by-product materials
    - Total Recycle Mix in Illinois
- Warm Mix Asphalt
  - May offer ability to use higher recycled contents through reduced aging

Reclaimed Asphalt Pavement (RAP)

Recycling began in USA over 40 years ago because of:

- Arab oil embargo – shortages and high prices
- Environmental concerns
- Development of milling machines

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And today???


WHAT TO DO WITH THE RAP?

Current AASHTO Guidelines

- Adjust grade of binder added to account for the hard, oxidized binder in the RAP
  - 0 to 15% RAP, no binder grade change
  - 16–25% RAP, decrease virgin binder grade
  - Over 25% RAP, test RAP binder to determine appropriate virgin grade (or allowable RAP content)
- Percentage by weight of RAP in the mixture.
- Based on non-fractionated mixes with about 5% binder in RAP and new mix.

Guidelines May Be Conservative

- Study for Indiana DOT showed they could use higher RAP contents before changing grade
  - Up to 25% RAP before changing grade
  - Up to 40% RAP by using one grade softer
- INDOT evaluated over 30 RAP stockpiles around the state
  - *They know what their RAP is like*

Changes Occurring in US Practice

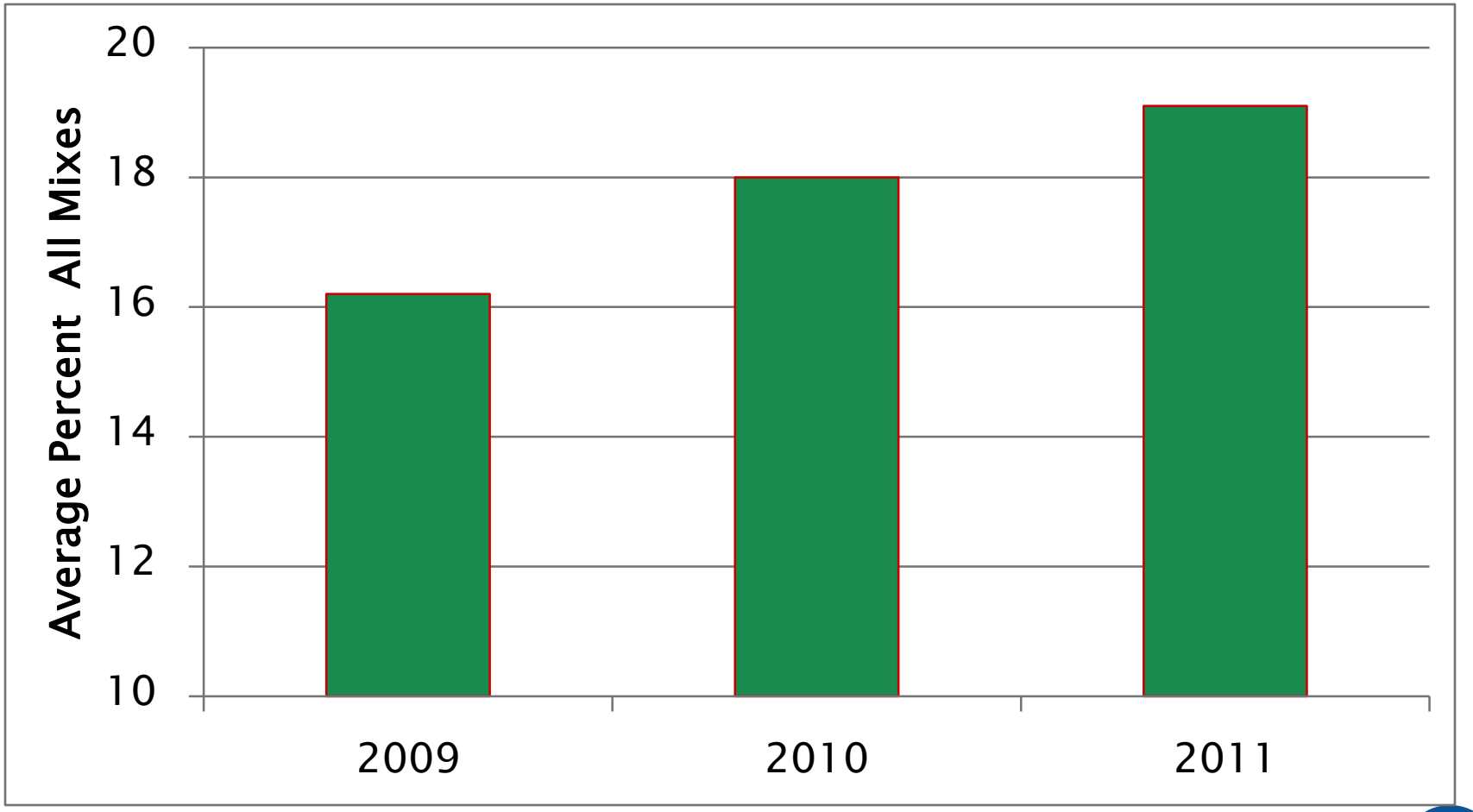
- States are moving to higher RAP contents in more mixtures (with or without grade change)
- More contractors are splitting the RAP into different size fractions
- More interest in using asphalt shingles; increasing use of tear-off shingles
- More states are expressing RAP content in terms of percent of RAP binder

Fractionated RAP = crushed and screened into different sizes

- Improves uniformity (remixes)
- Allows use of different sizes to meet mix design
- Better control of gradation (and binder content)

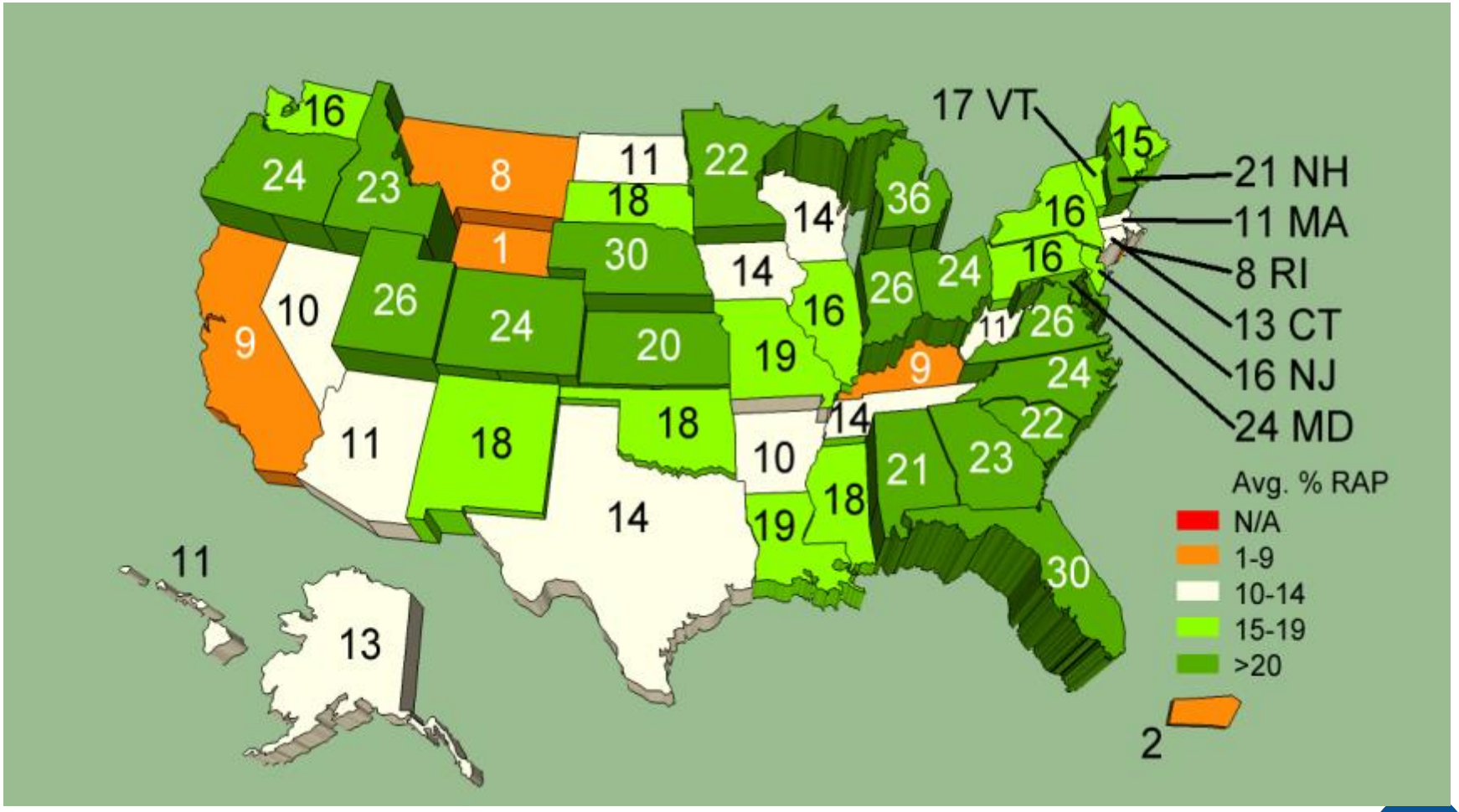
FRAP

How much RAP is in an Average Mix?



2012 NAPA/FHWA Survey

2011 Average RAP Content by State



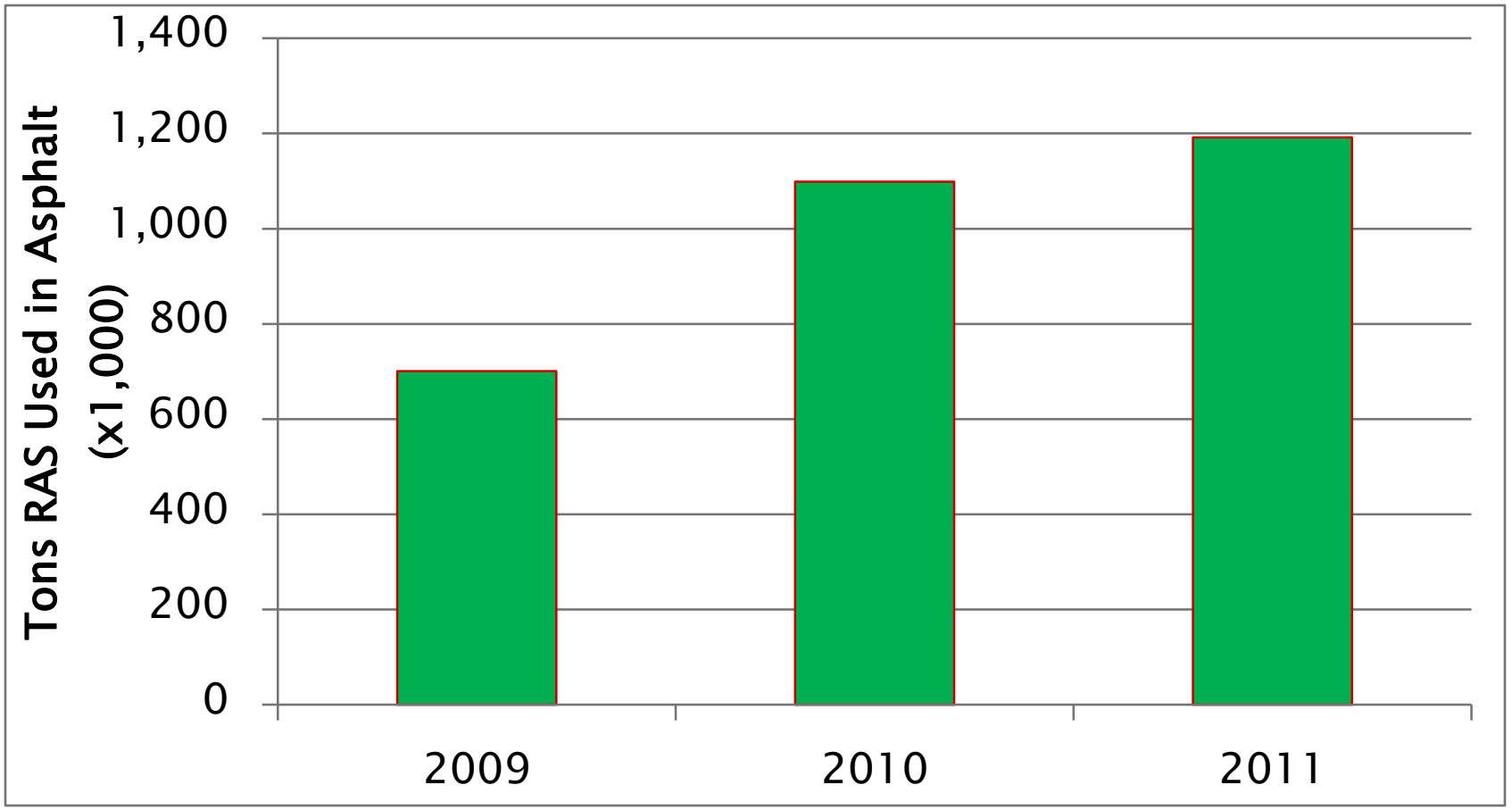
2012 NAPA/FHWA Survey

Recycled Asphalt Shingles (RAS)

RAS = Recycled Asphalt Shingles

- Recycling began in 1970's; increasing last 15 years
- Shingles can have high binder contents, ≥30%.
  - Contain hard, angular fine aggregate and fibers
    - Good for SMA
- But, shingle binder is very stiff (oxidized) so there is concern about cracking.
- So, allowable shingle content is about 20-25% of allowable RAP content.

Tons of RAS Used in Asphalt Mixes



Asphalt mix producers in 32 States use RAS

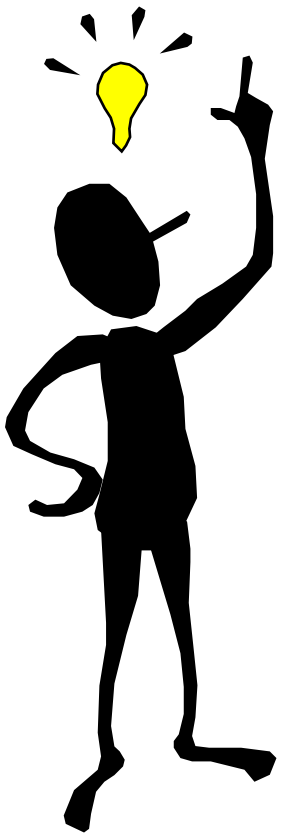
2012 NAPA/FHWA Survey

Binder Replacement

$$\frac{(AxB) + (CxD)}{E} \times 100\%$$

where A = binder content in RAP, %
B = RAP content in mixture, %
C = binder content in shingles, %
D = shingle content in mixture, %
E = total binder content in mixture, %

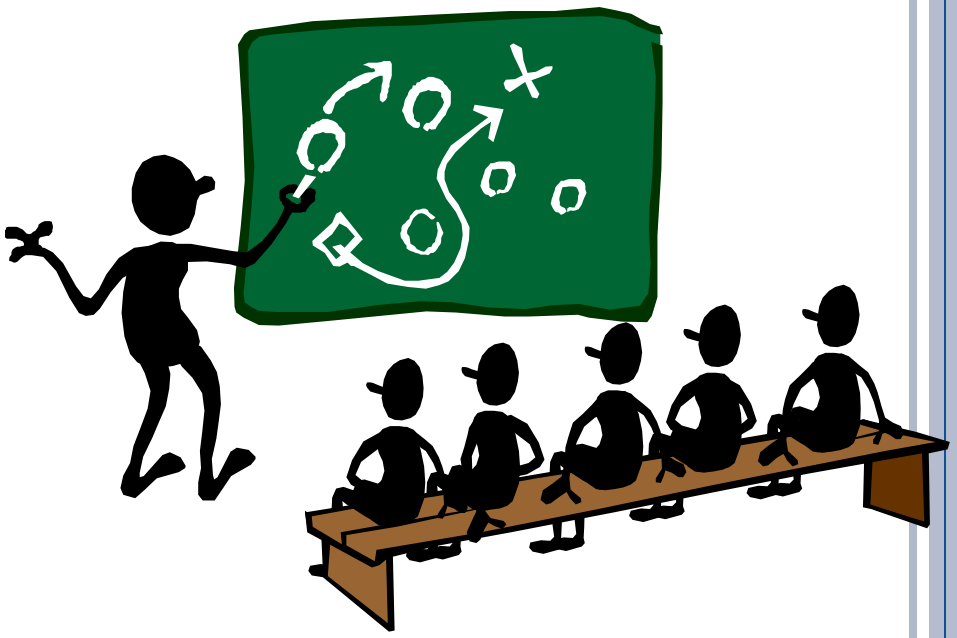
Alternates: Maximum Reclaimed Binder Content or Minimum Virgin Binder Content



What We Have Learned

- High RAP contents can work – can *perform well* – if properly designed, produced and constructed.
- Start with good mix design that accounts for the RAP.
- But, need attention to detail during construction.

Building on Past Success: Game Plan for Increased Use



- Sourcing
- Processing
- Stockpiling
- Reducing moisture
- Control during production

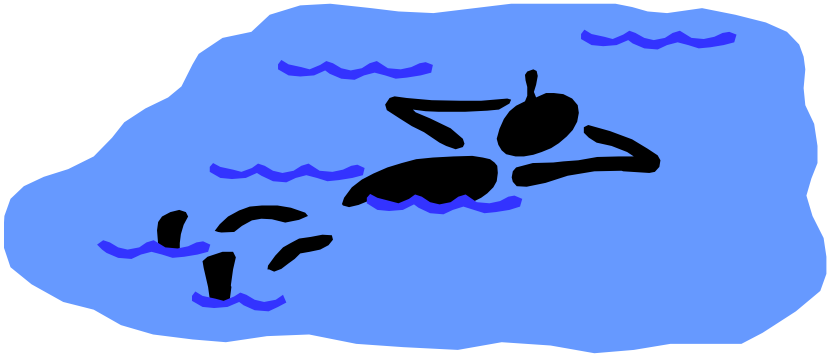
In Composite Pile

After Processing

Stockpiling Practices

- Avoid segregation
- Avoid contamination
- Reduce stockpile moisture
- Test stockpiles regularly – *know what is in your stockpiles!*

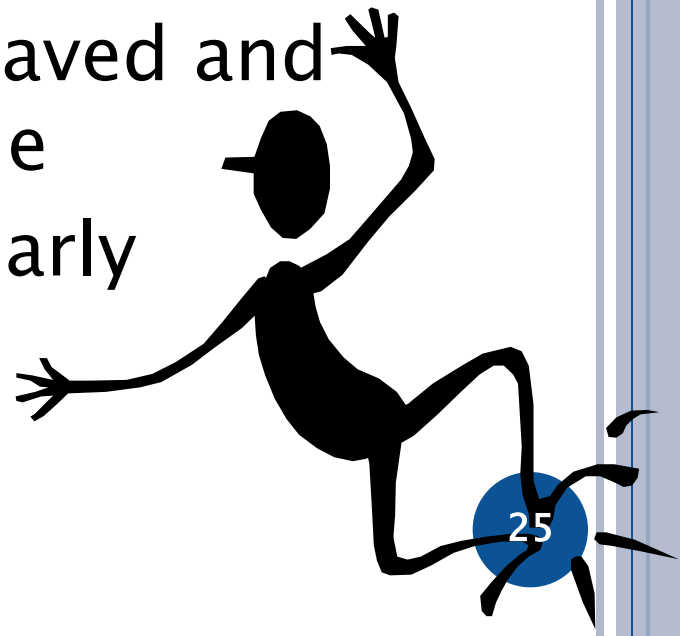
Reduce Stockpile Moisture



- Expect to lose 12% production capacity for every percent stockpile moisture above 2%
- Reduce fuel consumption and drying costs by keeping your materials dry
- Lower moisture leads to increased production capacity
- Lower maintenance costs
- Lower paving costs

Best Practices

- Mill layers separately when you can
- Process RAP and stockpile properly
- Consider fractionating the RAP
- Avoid contamination
- Keep the RAP and RAS dry –paved and sloped area, covered stockpile
- Test the RAP stockpiles regularly
- Watch plant production



Conclusions

- History of successful RAP and RAS use
- Building on past successful use and expanding
- Asphalt recycling is sustainable
- Asphalt recycling is economical
- Asphalt recycling works!

THANK YOU!

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