SUSTAINABLE ASPHALT MIXES FOR AIRFIELDS

2011 CAPTG Workshop
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Airfield Pavements Challenges

- FOD Concerns (for Jets)
- Loading Conditions
  - Gross weights
  - Tire pressures
- Lack of Kneading from Traffic

The majority of airfield pavement is very infrequently directly loaded by a tire.

Consequently, this lack of kneading action accelerates "Block Cracking" as the pavement ages (becomes oxidized).


Deterioration of Airfield
Pavements Can Lead to
Foreign Object Damage (FOD)
of Jet Engines

747-400 Max Gross Weight: 850,000 lbs
Main Gear Tire Pressure: 210 psi

C-141B Max Gross Weight: 325,000 lbs
Main Gear Tire Pressure: 190 psi

F-16D Max Gross Weight: 37,500 lbs,
but 285 PSI Tire Pressure on Main Gear

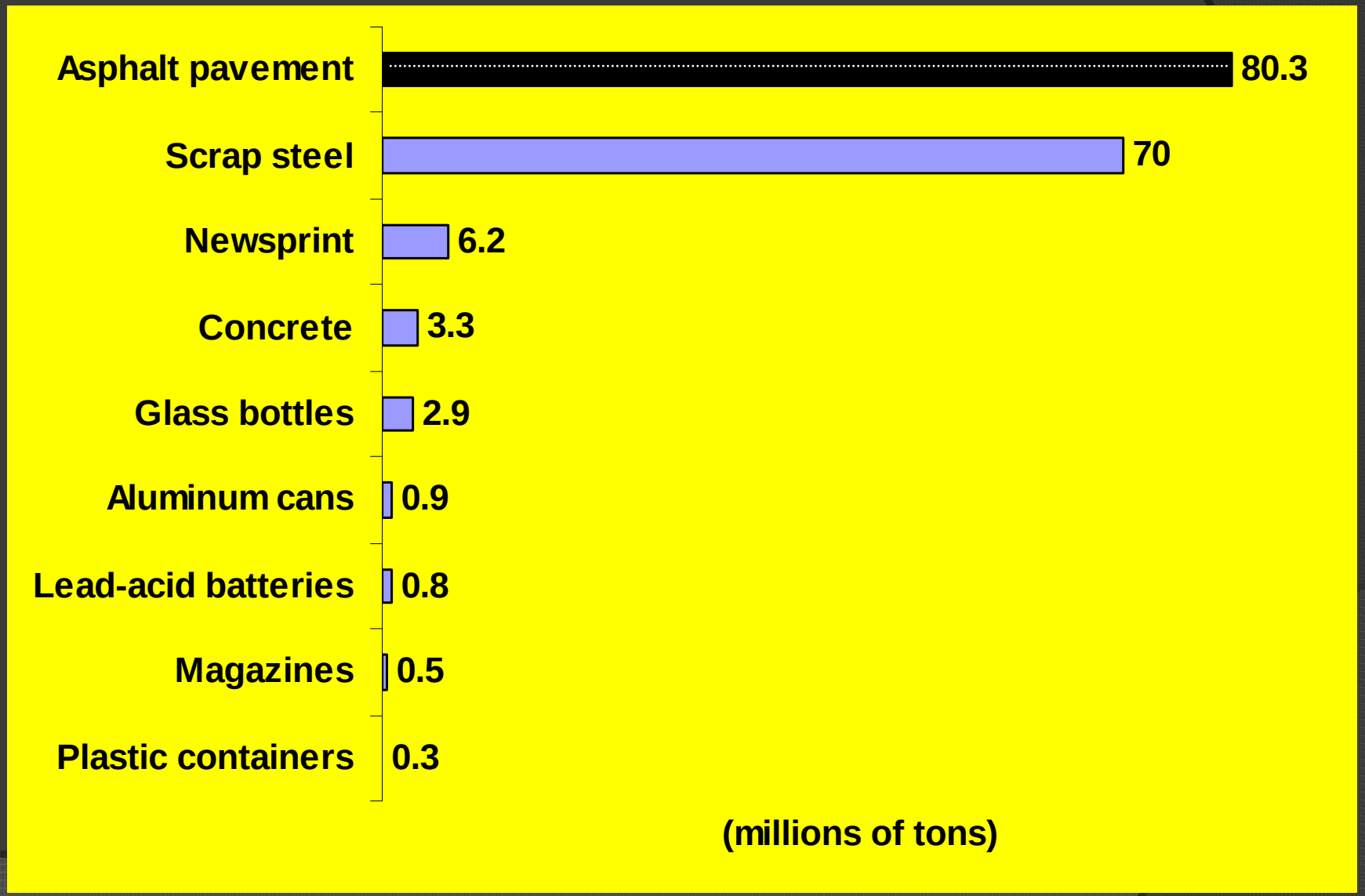
Raytheon King Air 200: Max Wt 12,500 lbs
Tire Pressure: 150 psi

Why Recycle Asphalt?

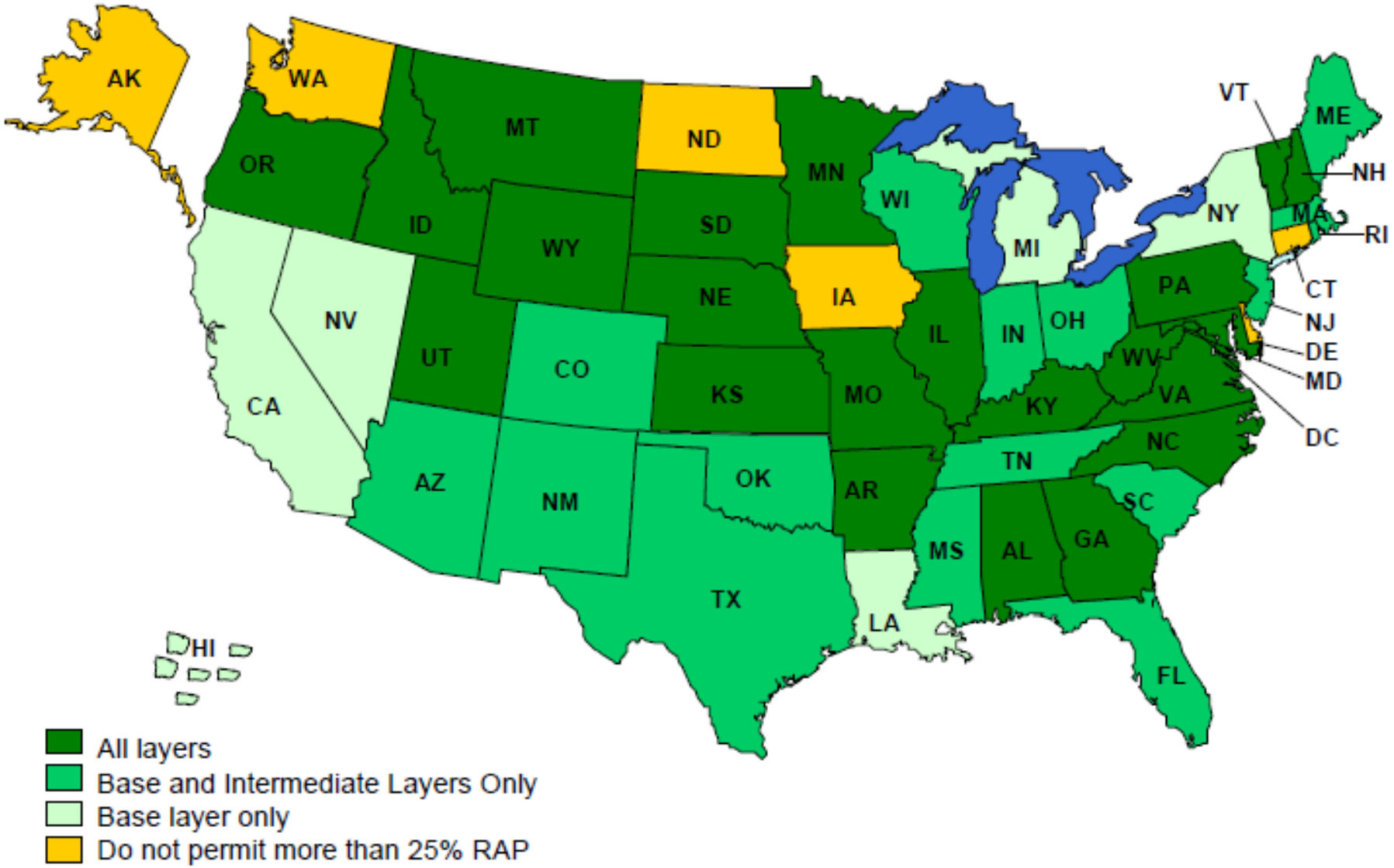
- Three key requirements must be satisfied for asphalt pavement recycling to be successful.

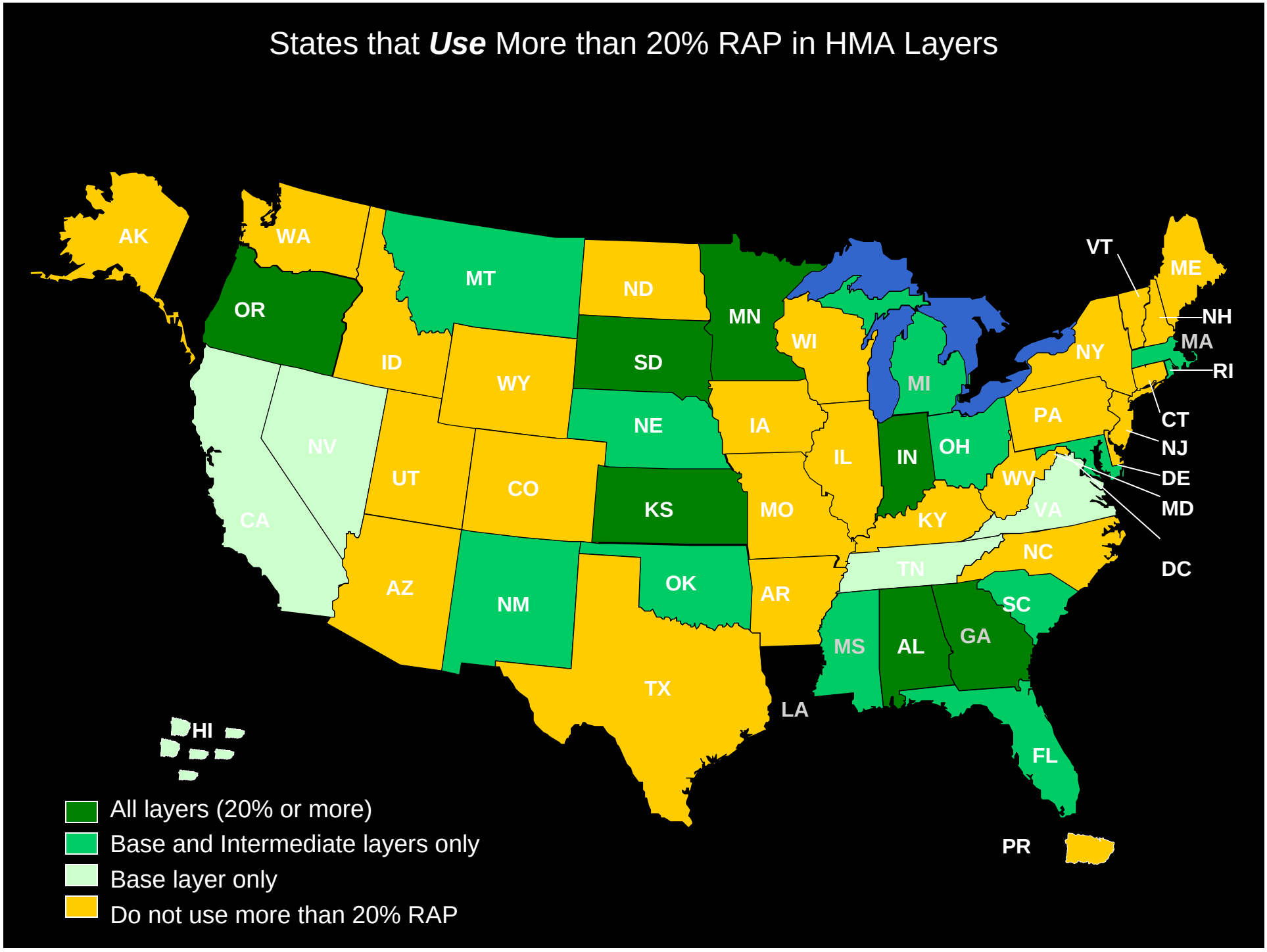
  Recycled asphalt pavements must:
  - be cost effective,
  - be environmentally responsible, and
  - perform well.

Annual Recycling Tonnage



States that Permit more than 25% RAP




States that *Use* More than 20% RAP in HMA Layers
AK
WA
OR
CA
ID
NV
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WY
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SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
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MS
MI
IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
VT
ME
NH
MA
RI
CT
NJ
DE
MD
DC
HI
PR
All layers (20% or more)
Base and Intermediate layers only
Base layer only
Do not use more than 20% RAP

Benefits of Recycling

- Reduction in construction costs.
- Less disposal materials.
- Reduced transportation cost.
- Conservation of aggregates and binders.
- Conservation of energy.
- Preservation of environment (reduction in toxic and greenhouse gas emissions).

What Do We Know Recycling Asphalt?

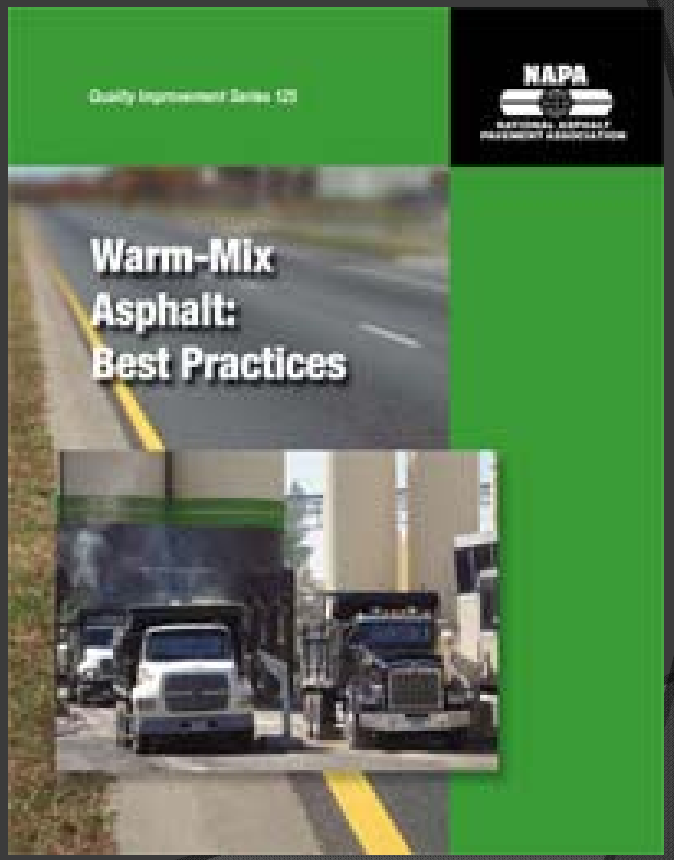
- RAP has been successfully used in Ontario since the late 70's with good performance…
- We collectively want to use RAP?
- There's consensus that we have to do something to maintain quality (performance)
- We all share the same concerns - so really we have no choice - we have to do it right!

Sustainable Asphalt Mixes

- Other recycled products are used in making asphalt pavement
  - Scrap Tires
  - Slag Aggregate
  - Roofing Shingles etc.
- Newer technologies
  - Warm Mix Asphalt
  - Porous Asphalt
  - Improved Porous Friction (PFC) for Airfields

Today's Challenges

- High cost of fuel
- High cost of AC
- Greenhouse gas reductions
- Carbon tax
- ‘Green’ Specifications
- HMA construction constraints
- Quality = Sustainability



Warm Mix Asphalt

- Reduced Emissions
- Reduced Fumes
- Reduced Fuel Consumption
- Reduced Viscosity/Flow Enhancer
  - Improved Workability
  - Extend Paving Window
  - Cold Weather Paving
  - Increase Percentage of RAP
- Improved Quality

What Will Drive the Market ?

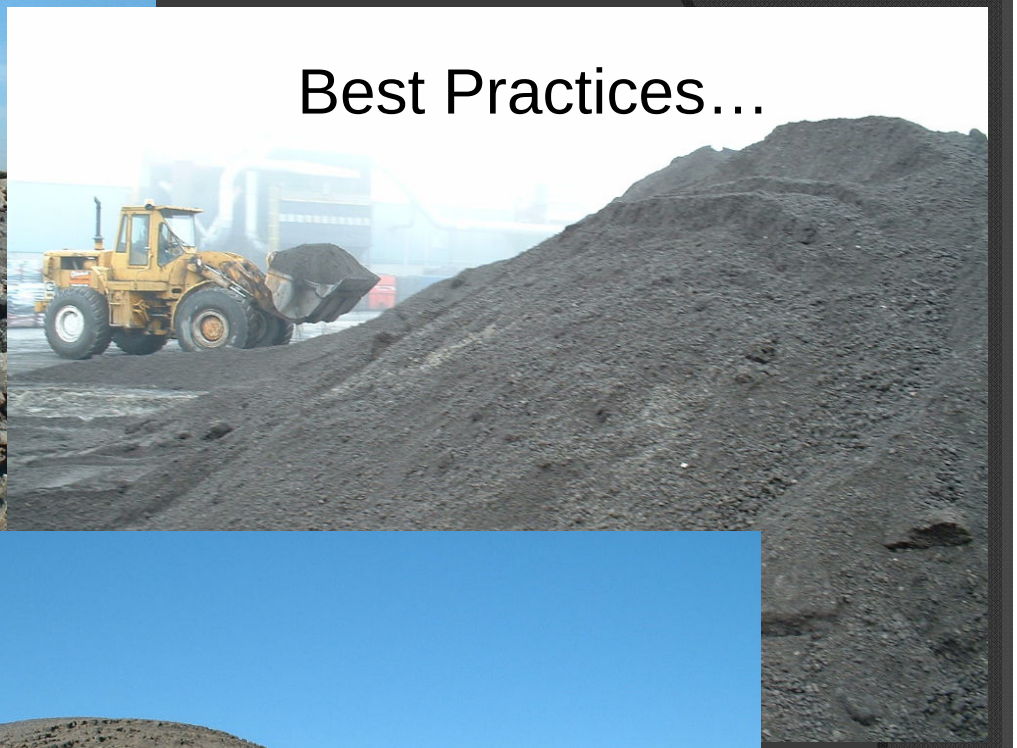
- **Emissions**
- **Worker Safety**
- **Increased use of RAP**
- **Density Specifications**
- **Higher Fuel Costs**
- **Extended Paving Window**
- **Cold Weather Paving**
- **The Need to Improve Quality**

Improved guidelines for RAP

- FHWA Mix ETG developed guidelines based upon consensus and limited testing (≤15%, 16-25, 25%+).

- NCHRP 9-12, “Incorporation of RAP in the Superpave System”
  - *Guidelines for Incorporating RAP in Superpave*
  - *Use of RAP in Superpave: Technicians’ Manual*

Best Practices…

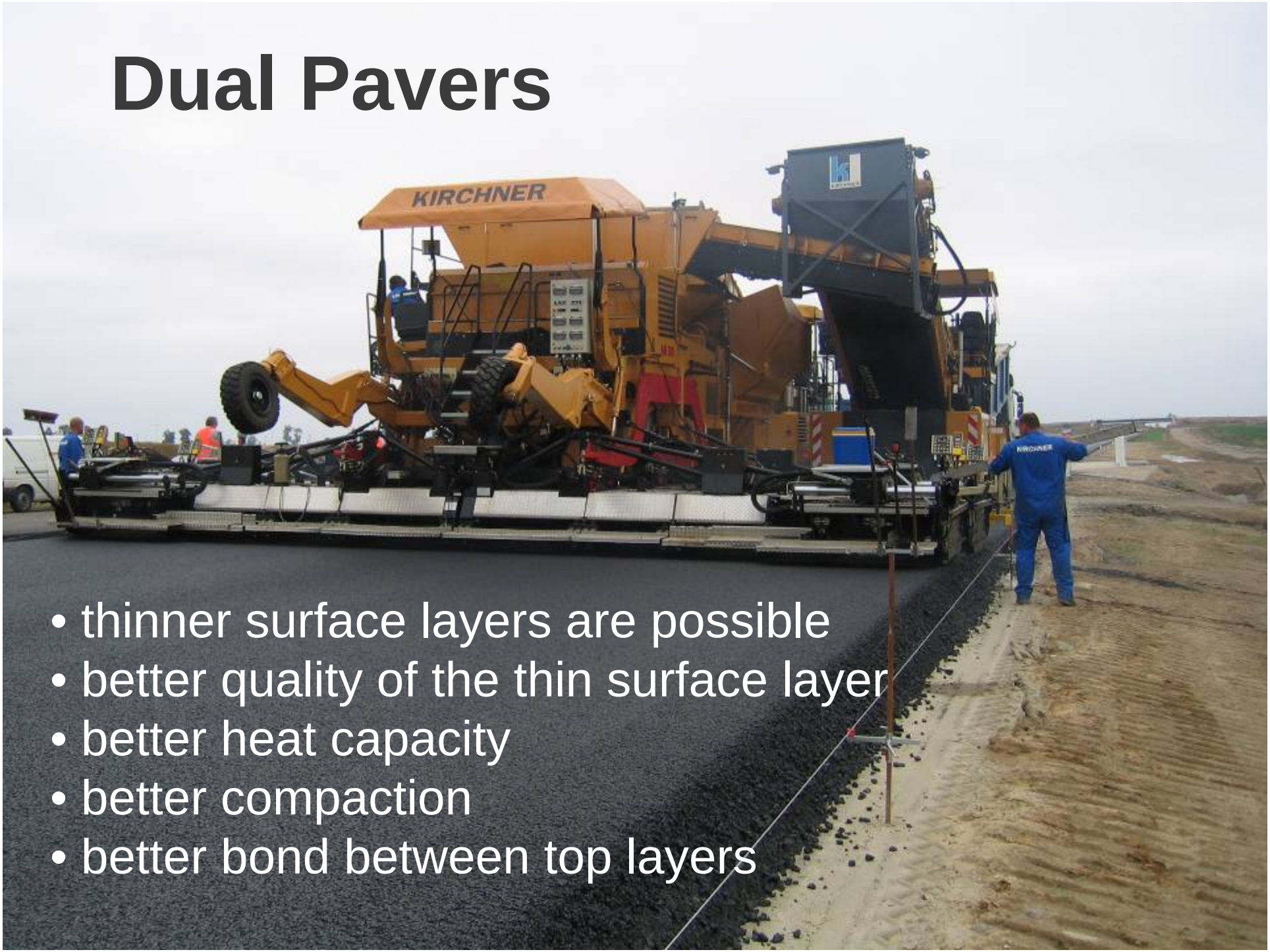


Processing RAP

Laydown & Placement

Good Construction Techniques

Dual Pavers



- thinner surface layers are possible
- better quality of the thin surface layer
- better heat capacity
- better compaction
- better bond between top layers

Production: 2200 meters/day
About 7000 tons of asphalt/day


SMA
Binder layer
F 300C/S KOMPAKTASPHALT

US (FHWA) Perspective

- Probably the **greatest single upfront cost saving measure available to US highway** agencies today is increasing the use of RAP in the construction and rehabilitation of asphalt pavements.
- The majority of State DOTs use between 10 and 20% RAP, but have potential to use up to 30%.
- Contractors can effectively use RAP often and in high amounts with *processing and production best practices.*

"FHWA Recycled Materials Policy"

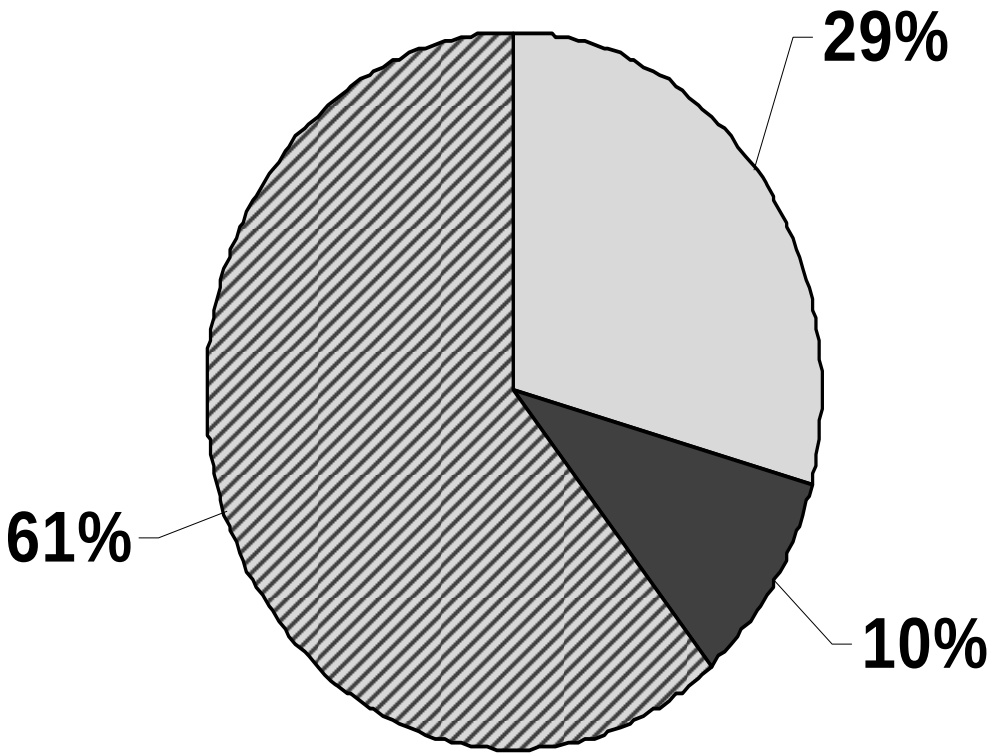
- FHWA recognizes need to increase the highway industry's overall use of recycled materials
- Engineering, Economic, and Environmental benefits
- First consideration in materials selection
- Initial review of engineering and environmental suitability
- Assessment of economic benefits should follow selection process
- *Remove restrictions with no technical base*

Where is the US Heading?

- *Verify that complete or close to complete blending is not necessary for performance*
- *Alleviate recommendations for binder changes based on complete blending*
- *Replace extraction and recovery with performance testing*
- *Provide guidance for optimizing binder content in RAP mixes and determining RAP amount limits to mitigate fatigue and durability issues*

National Center for Asphalt Technology
NCAT
at Auburn University

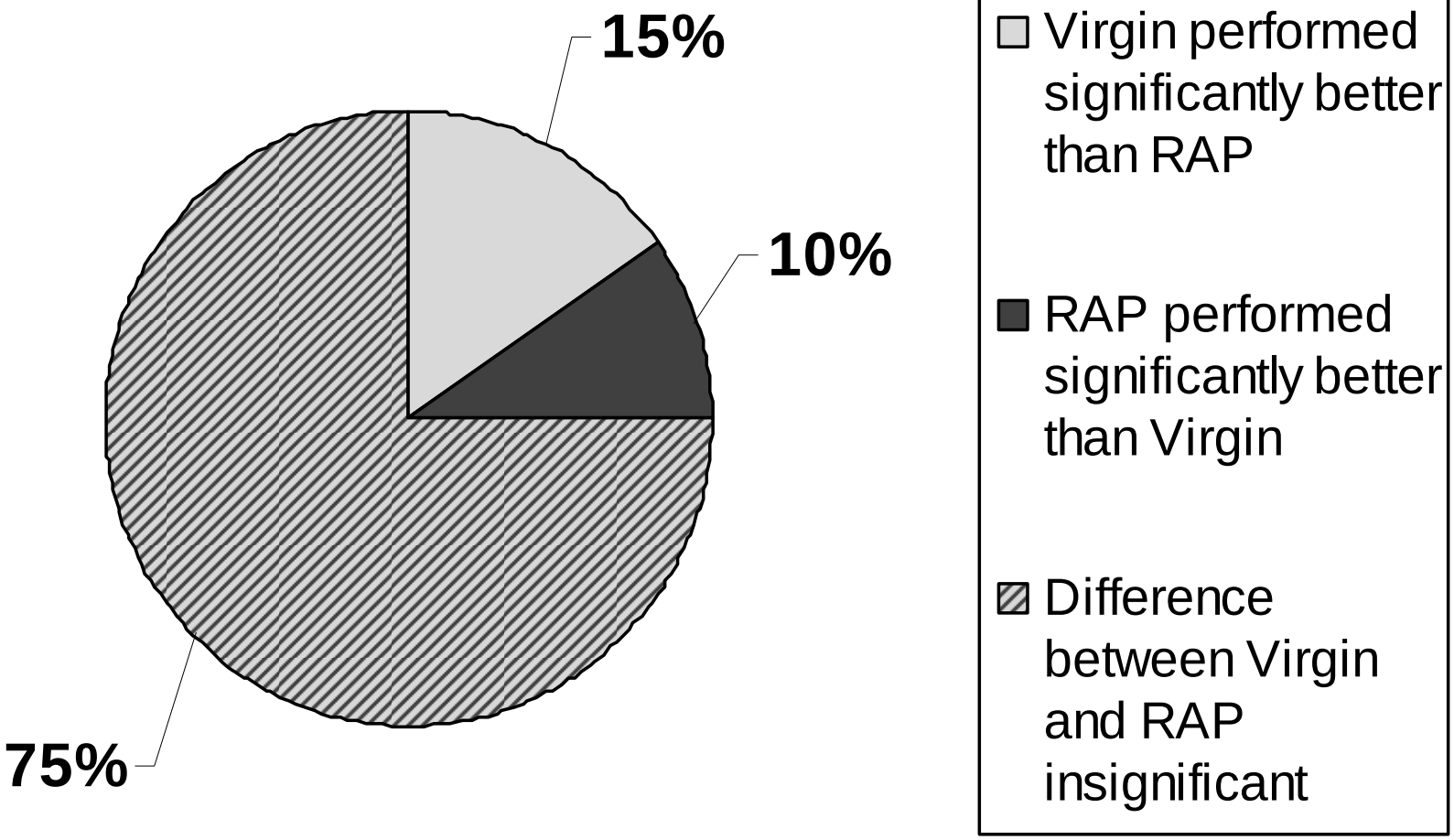
Fatigue Cracking



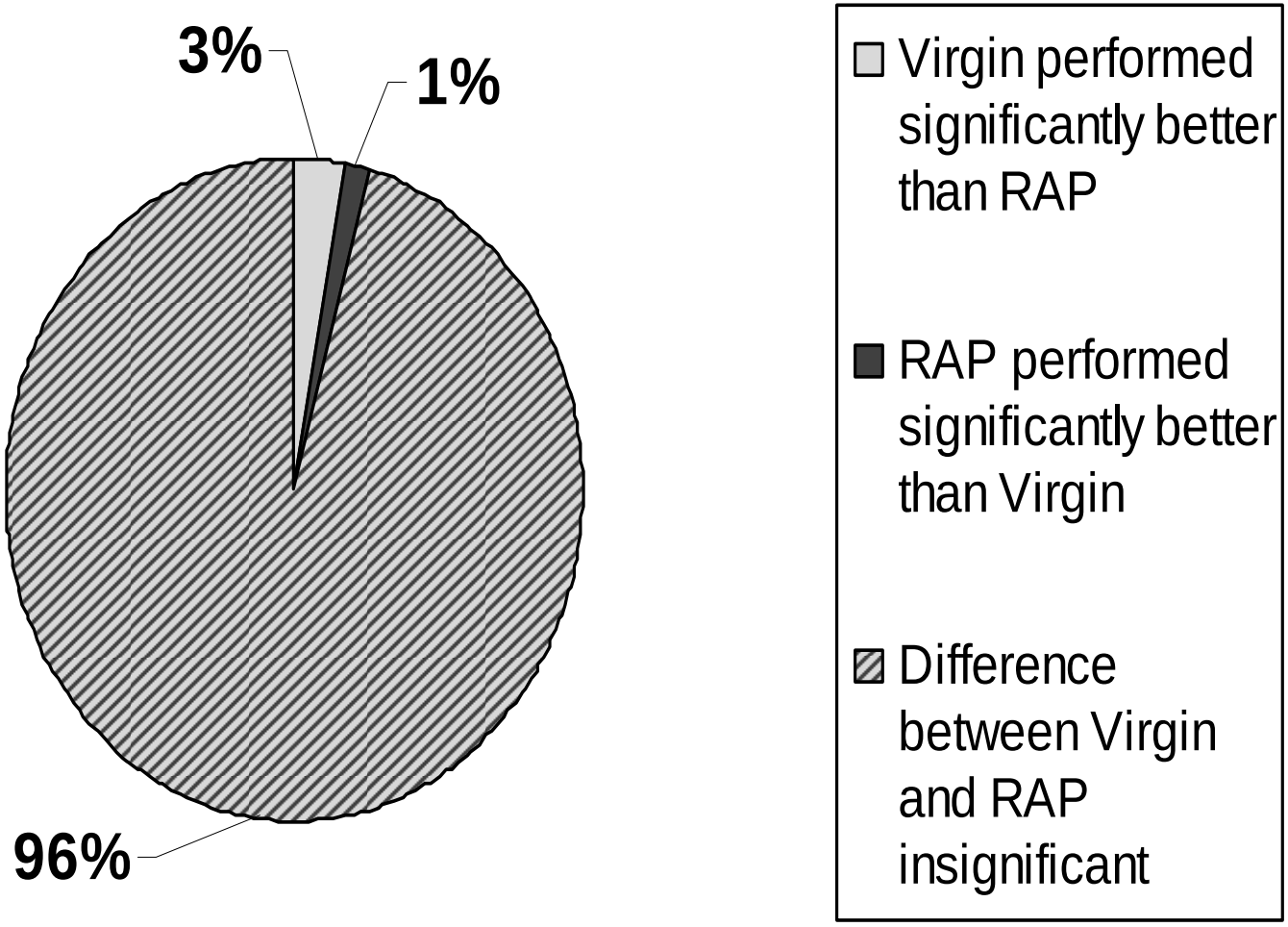
SPS-5 Projects (LTPP)

- Virgin performed significantly better than RAP
- RAP performed significantly better than Virgin
- Difference between Virgin and RAP insignificant

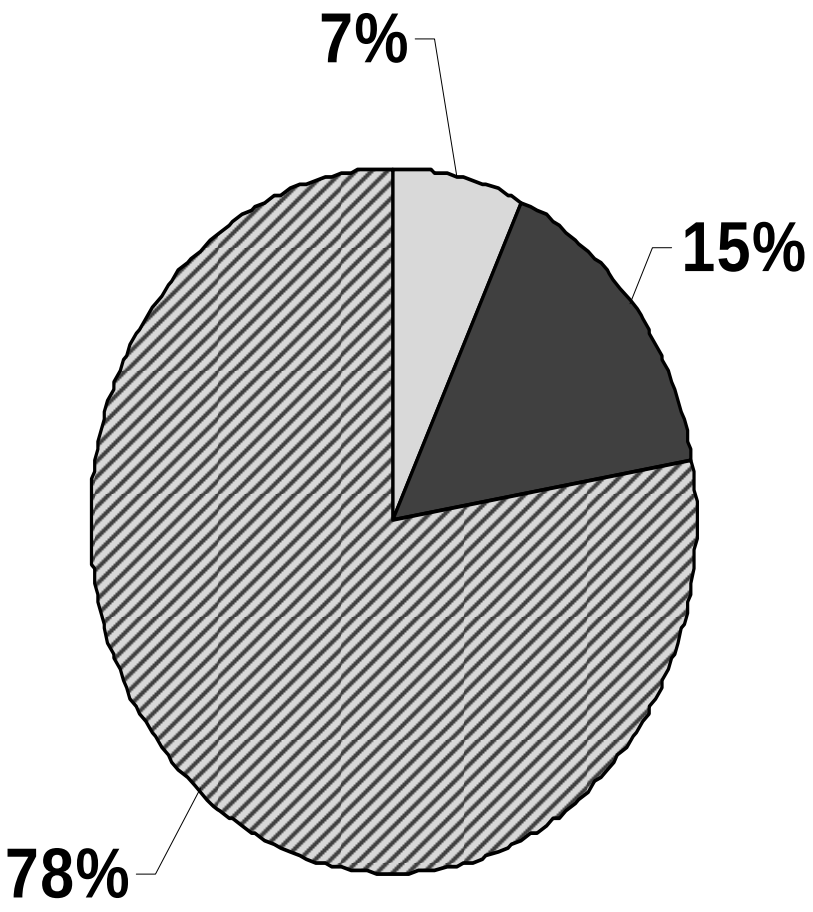
Longitudinal Cracking



Block Cracking



Raveling


7%
15%
78%
Virgin performed significantly better than RAP
RAP performed significantly better than Virgin
Difference between Virgin and RAP insignificant

Summary of ongoing research in the US…

- Experience and data supports that when used properly - higher RAP contents provide similar or better performance than virgin mixes – however, plant and field data is sporadic.
- On-going research results indicate high RAP use is possible without adversely affecting performance.
- More studies are needed with emphasis on plant mixtures and field performance.

We're Not Alone...

- In the US, there's a national effort to increase RAP use
- Current research looking at high RAP contents i.e. greater than 25 %
- Main Goal:
  - *"Encourage the use of recycled materials in the construction of highways to the maximum economical and practical extent possible with equal or improved performance" - FHWA*

Partners

- AASHTO Subcommittee on Materials Recycling Task Force
- Asphalt Institute
- Asphalt Recycling and Reclaiming Association (ARRA)
- Asphalt Research Consortium (ARC)
- National Asphalt Pavement Association (NAPA)
- National Center for Asphalt Technology (NCAT)
- North Central Superpave Center (NCSC)
- Recycled Materials Resource Center (RMRC)

The Challenge

“When faced with a challenge, look for a way, not a way out."

---David Weatherford

The Solution...

You got to be careful if you don't know where you're going, because you might not get there - *Yogi*

The Ontario Study

- Fundamental questions that need to be addressed include:
  - How does RAP effect mix properties?
  - What kind of testing is appropriate to predict long term field performance?
- Evaluate the impact that RAP has on two common Ontario mixes and provide some new guidelines on the usage of RAP

The Project Team

- Ontario Ministry of Transportation (Pamela Marks & Seyed Tabib)
- OHMPA (Sandy Brown & Fernando Magisano)
- CPATT (Dr. Susan Tighe, Co-Principal)
- DBA (V. Aurilio, Co-Principal)
- IRAP – Additional Funding Support

Ontario

ohmpa
Ontario Hot Mix Producers Association

CPATT

DBA

PGAC Grade Selection

% RAP in Mix	Zone 1	Zone 2	Zone 3
0 to 20 %	52-34	58-34	58-28
21 to 40 %	52-40	52-40	52-34

AAPTP Project 05-06 – Final Report
Use of Reclaimed Asphalt Pavements (RAP) in Airfields HMA Pavements, July 2008

Table 26 Recommendations on the Use of RAP in HMA Mixes of Airfield Pavements.

Type of Mix	Recommended Virgin Asphalt Binder Grade	RAP Percentage		
		Recovered RAP Grade		
		PGXX-22 or lower	PGXX-16	PGXX-10 or higher
Surface and Base Mix	No change in binder selection	< 20%	< 15%	--
Base Mix	Select virgin binder one grade softer than normal (i.e. select a PG58-28 if a PG64-22 would normally be used)	20% – 25%	15% – 25%	--
Surface and Base Mix	Follow recommendations from blending charts	--	--	< 10%

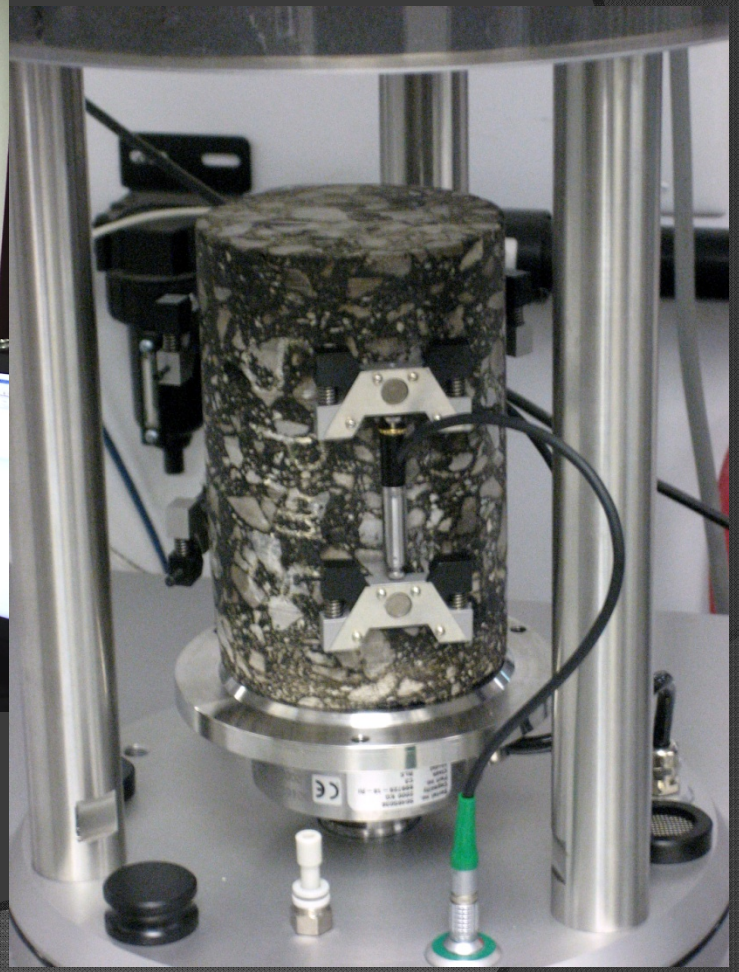
Table 27 AASHTO T283 Recommendations for RAP Containing Mixes.

Virgin target binder	Dry Tensile Strength at 77°F	Tensile Strength Ratio at 77°F	Notes
PG64-XX or higher	Minimum 90 psi	Minimum 80%	• Severe climatic conditions might require multiple freeze-thaw cycles. • Consider anti-strip additive to improve long-term durability.
PG58-XX or lower	Minimum 70 psi	Minimum 80%	

Provisional Scope

Mix Design		SP12.5				SP19					
RAP Source		PG 58 -28	PG 58-34	PG 52-34	PG 52-40	PG 58 -28	PG 58-34	PG 52-34	PG 52-40		
RAP Content	0%	1	2	3	4	37	38	39	40	0% RAP	RAP Source
	15%	5	6	7	8	41	42	43	44	RAP A	
		9	10	11	12	45	46	47	48	RAP B	
	20%	13	14	15	16	49	50	51	52	RAP A	
		17	18	19	20	53	54	55	56	RAP B	
	30%	21	22	23	24	57	58	59	60	RAP A	
		25	26	27	28	61	62	63	64	RAP B	
	40%	29	30	31	32	65	66	67	68	RAP A	
		33	34	35	36	69	70	71	72	RAP B	

Performance Testing



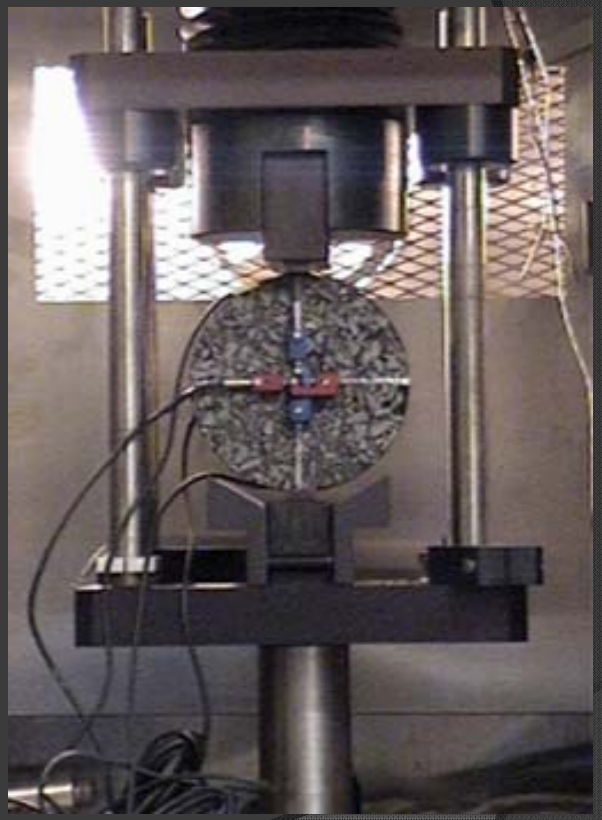
Asphalt Mix Performance Tester (AMPT)

One Approach…

- Perform Dynamic Modulus Tests on Plant Produced Mixture
  - Plant Mixed Condition
- Recover Binder, Test and Estimate Dynamic Modulus Using Predictive Model
  - Fully Blended Condition
- Compare Measured and Estimated

Indirect Tensile Test

- Low temperature creep compliance test
  - 0, -10, -20°C
- Low temperature strength test -10°C
- Determine stiffness, strength, and critical cracking temperature, T_c



Low Temperature & Fatigue

Heavy Loads

Payload up to: 150 metric tons

Antonov An 124

The Problem?

Looking south on Taxi A at AD

Performance=Sustainable!

And, That`s a RAP…