Recycling
in
Asphalt Paving Operations

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Texas Department of Transportation


“We should treat our roads as assets, not consumables that can be used up, thrown away and replaced with new ones.”
- Don Brock, Astec Industries

Mission & Vision

Provide a transportation system that is:

- Safe
- Efficient
- Environmental Sensitive
- and Cost Effective

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Why Recycled Materials

- Environmental Stewardship
  - Conserve Natural Resources
  - Air Quality
  - Water Quality
- Government Support
  - Local and State
  - TCEQ
- Economics – passing on the savings or passing on the cost

Environmental Stewardship

- Conserve Materials
- Reduce Waste
- Reduce Energy Consumption
- Improve Air and Water Quality
  - CO_{2eq} emissions
- Paving Technologies that provide these Environmental Attributes
  - Warm Mix Asphalt (WMA)
  - **Reclaimed Asphalt Pavement (RAP)**
  - **Recycled Asphalt Shingles (RAS)**

Recycled Materials

must:

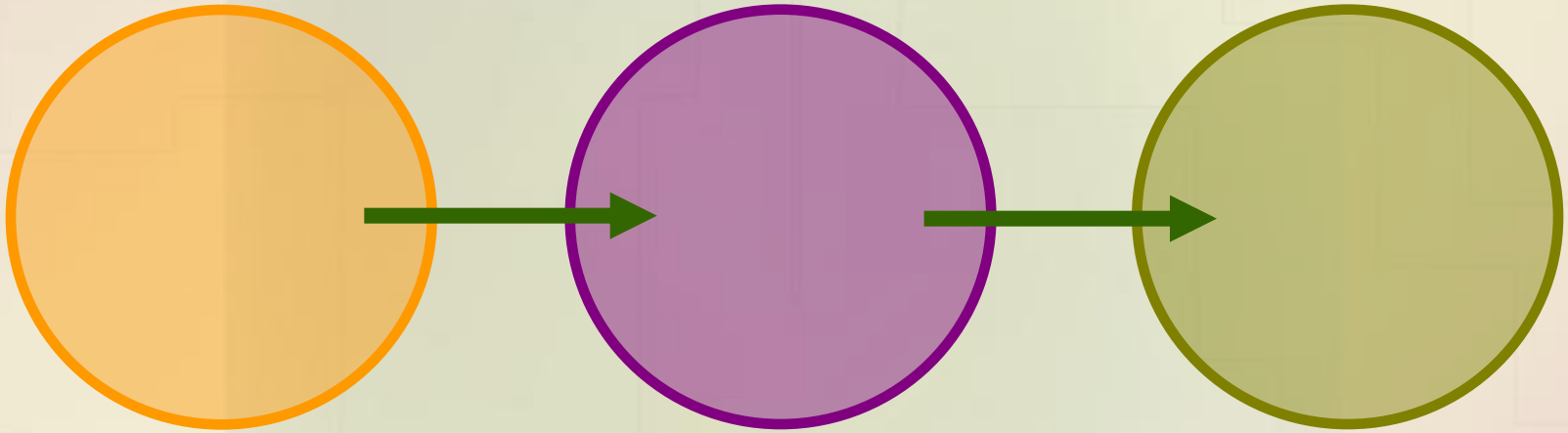
- Be safe
  - People
  - Environment
- Meet specifications
- Perform well
- Be readily available
- Be cost effective

Recycled Materials

What does TxDOT recycle?

- **Reclaimed Asphalt Pavement (RAP)**
- Fly Ash
- Crushed Concrete
- Tire Rubber (TR & AR)
- Compost
- **Recycled Asphalt Shingles (RAS)**
- Foundry Sand

. . . Connecting the Dots



Environmental Awareness

Agency Support

Economic Value

Today reclaimed asphalt pavement is the most recycled material in the world

Using RAP:

- Reduces construction costs
- Conserves resources
- Reduces waste

Recycled Asphalt Pavement

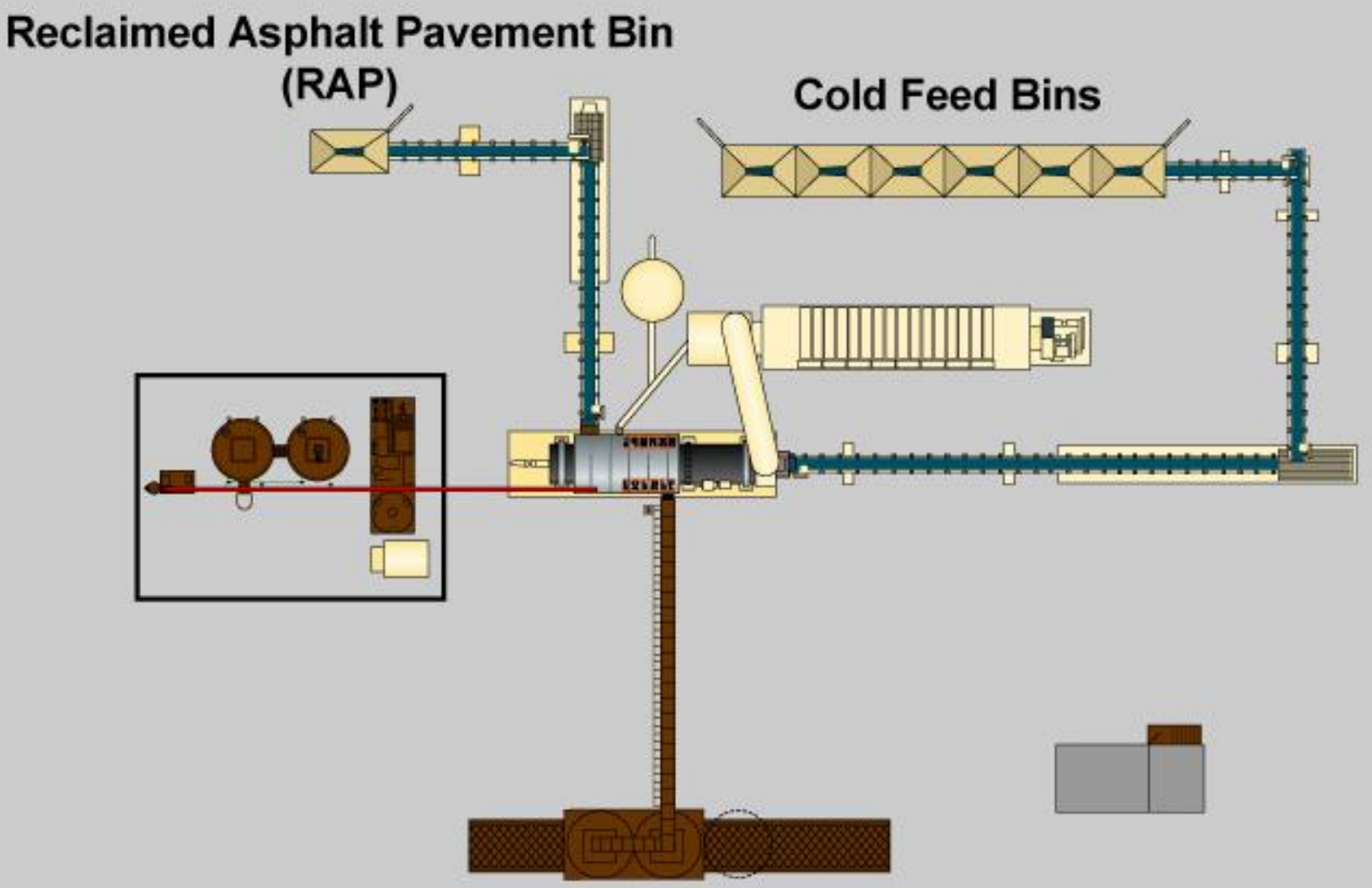
Using RAP in Texas

- TxDOT uses a significant amount of RAP each year.
- But we only used an average of about 3% RAP in our HMA in 2006.

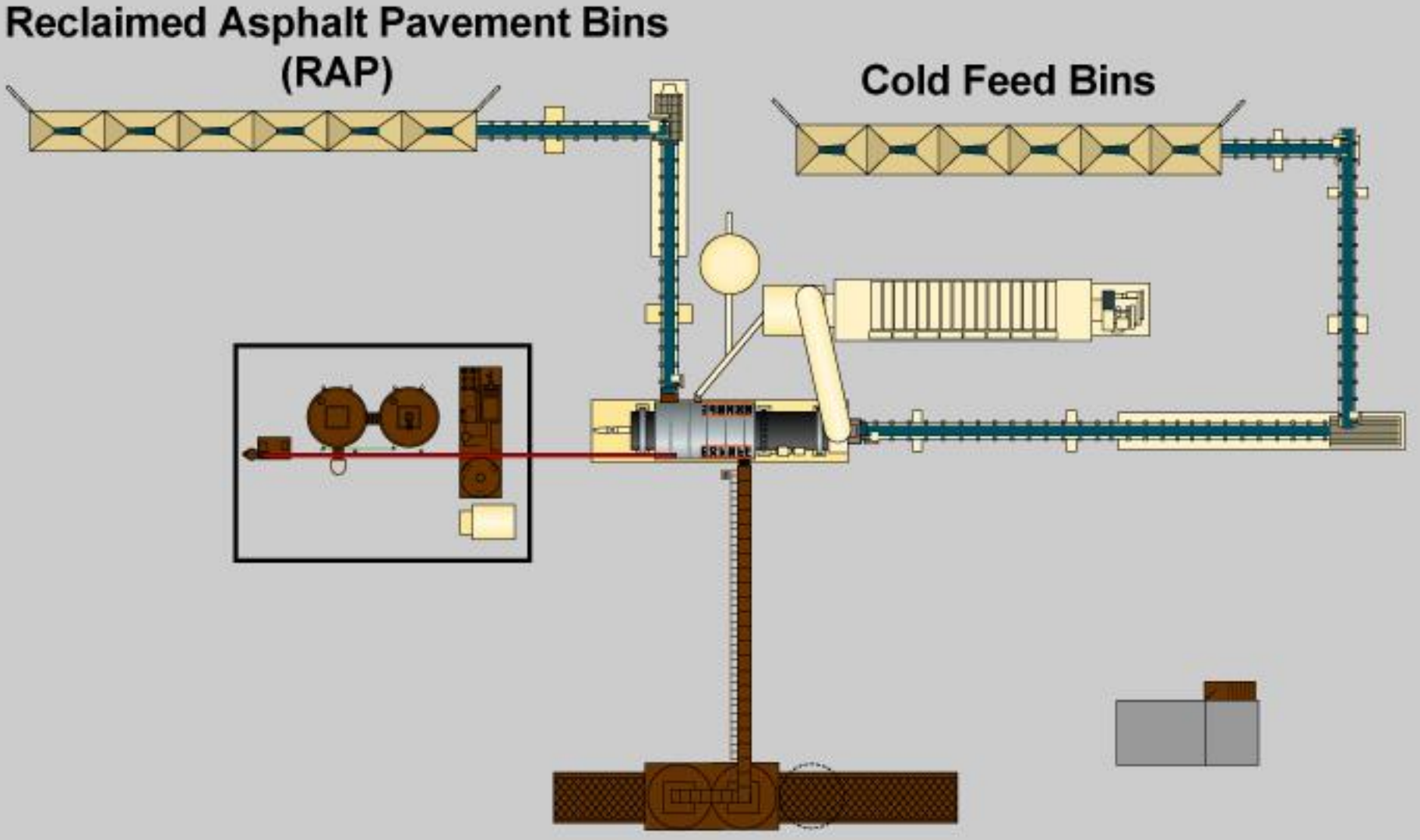
Variability

Unacceptable levels of variability in many RAP stockpiles prevented us from using more RAP in HMA.

Fractionate the RAP Stockpiles



1980-1990's HMA Facility with Single RAP Bin



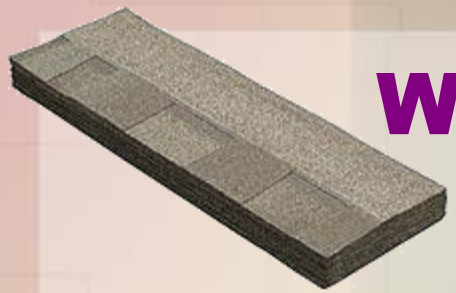
Today's HMA Facility with Multiple RAP Bins

How did we increase our use of RAP?

- Allow the contractor the option to retain ownership
- Encourage the use of fractionated RAP
- Discourage the use of un-fractionated RAP
- Determine the greatest value for the material

Recycled Asphalt Shingles (RAS)

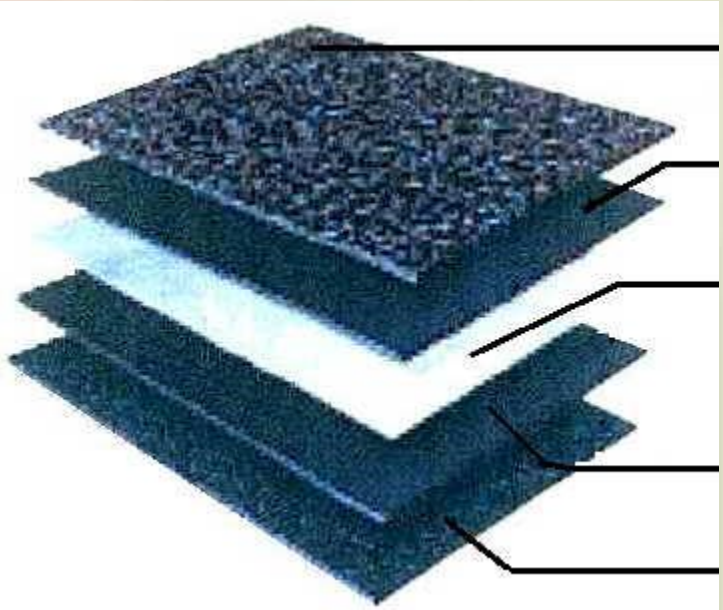
- Approximately 13 million tons of asphalt shingle waste is generated per year
  - Post manufacture (scrap): 1.5 million tons
  - Post consumer (tear-offs): 11.5 million tons
- Less than 5% of shingle waste is recycled



Why Recycled Shingles?

- A good source for asphalt
- Reduces landfill consumption
- Conserves natural resources

Typical Shingle Composition



Granular/aggregate

Waterproofing asphalt

Base (fiberglass or organic felt)

Waterproofing asphalt

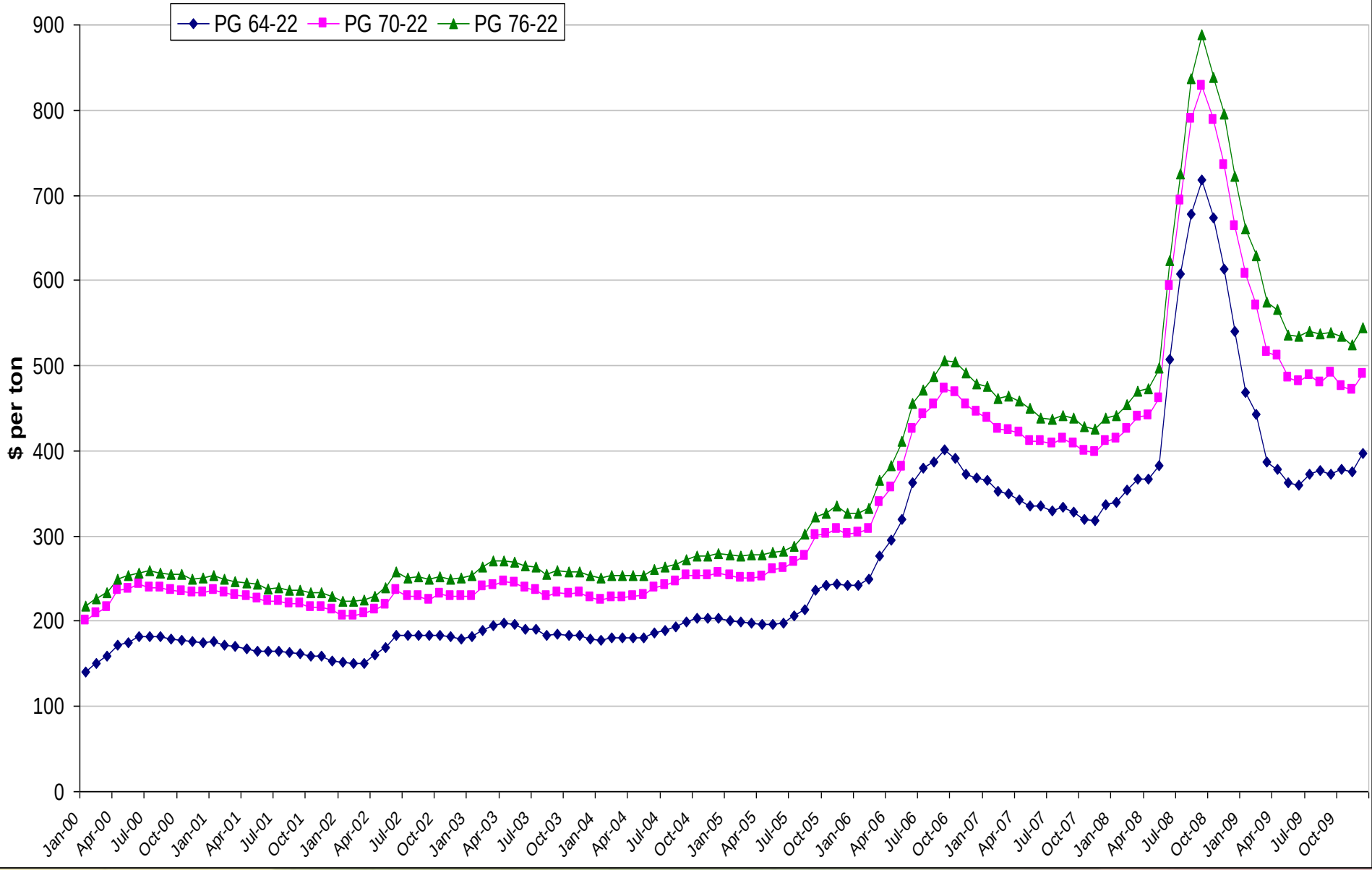
Back surfacing

Component	Organic Felt	Fiberglass Mat
Asphalt cement	**30-36%**	**19-22%**
Felt (Fiber)	2-15%	2-15%
Mineral aggregate (#30)	20-38%	20-38%
Mineral filler/stabilizer	8-40%	8-40%

SH 31, Navarro County

- May, 1997
- Type C with AC-20
  - Section 1 – 5% man. waste
  - Section 2 – 5% tear-offs
  - Section 3 - Control
- Initial construction issues with tear-offs section
- Overall performance good - comparable to control
- Part of first research project in Texas

Louisiana Asphalt Index



- Allow Manufactured Waste
  - Memo - March, 2006
  - Treated the same as RAP – counter flow drum
  - Up to **15%**
- Added residential tear-off shingles
  - Memo – Feb., 2009
  - Asbestos certification and testing
  - Deleterious material < 1.5%
  - No direct flame for shingle material

Rule of Thumb

*An addition of **5% RAS** or **20% RAP** in the mix gives roughly one grade bump in the binder as shown by the DSR.*

High Temp Grade		
Type D PG 64-22	**20% RAP**	**5% Shingles**
67	**71**	**74**

*That same addition of **5% RAS** or **20% RAP** in the mix shows the stiffness doubling as shown by the Hamburg*

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- **Special Provision to Item 341-024**
- **Allows manufactured waste and residential "tear-offs"**
  - up to 5%
  - deleterious limited to 1.5%
  - 100% passing 1/2" sieve, 95% passing 3/8" sieve
- **RAS can be combined with**
  - RAP
  - WMA
  - Substitute Binders (lower binder grade)

New Specification

Table 1A
Maximum Allowable Amounts of Recycled Binder, RAP & RAS

Mixture Description & Location	Maximum Ratio of Recycled Binder[1] to Total Binder (%)	Maximum Allowable % (Percentage by Weight of Total Mixture)		
		Unfractionated RAP[2]	Fractionated RAP[3]	RAS[4]
Surface Mixes[5]	35	10	20	5
Non-Surface Mixes[6] < 8 in. From Final Riding Surface	40	15	30	5
Non-Surface Mixes[6] > 8 in. From Final Riding Surface	45	20	40	5

Approved List

- Have met regulatory and specification requirements
- Have a quality control plan for asbestos testing plan in place
- Keep records of materials processed for chain of custody purposes

Nonhazardous Recycled Materials

NOTE: Refresh the page to view the most current list.

The following producers are prequalified to supply the listed nonhazardous recycled materials, based on a history of satisfactory environmental testing and a documented quality control plan, as described in DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines."

The materials shown on this list are prequalified based on environmental suitability only; engineering suitability must still be determined according to the appropriate engineering specifications for the application in which they are used.

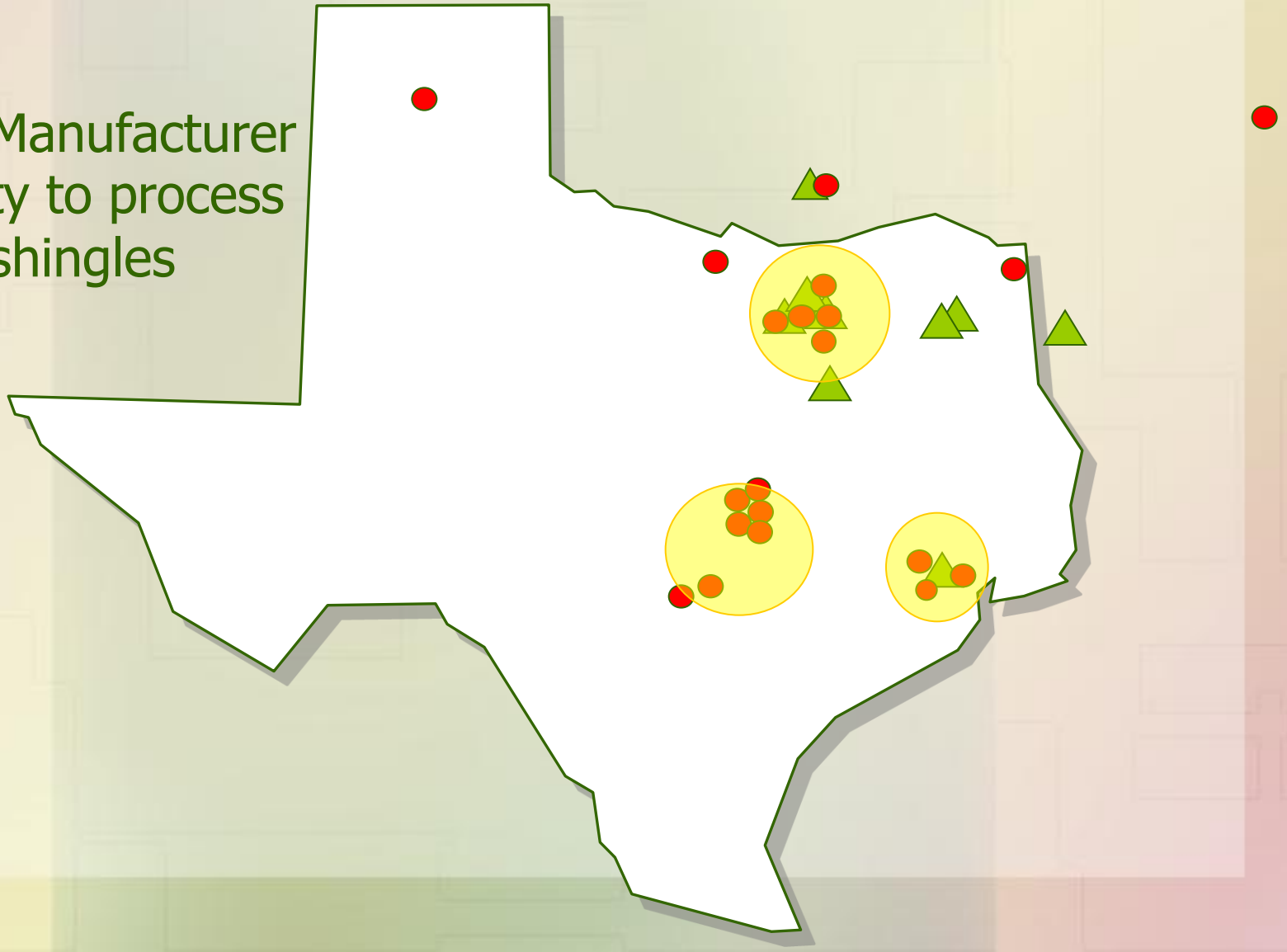
The Department reserves the right to randomly sample and test prequalified materials at any time for specification compliance.

Prequalified Producers of Nonhazardous Recycled Materials

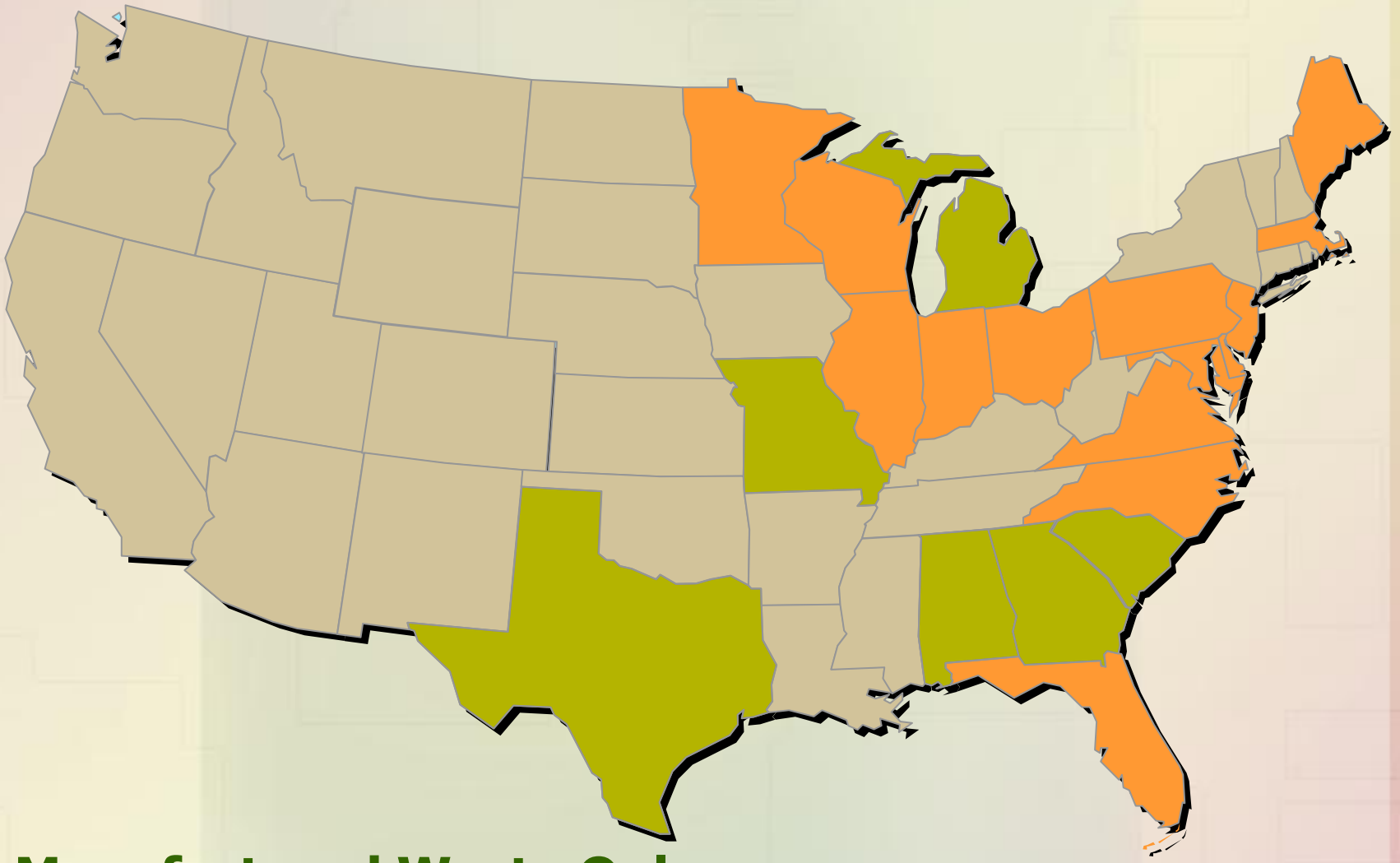
Producer	Contact Info	Recycled Material	Primary Applications
HPP Corporation Genoa Red Bluff Facility D12120B-SOUT07	Mark Briggs 2070 Genoa Red Bluff Houston, TX 77034 (281) 487-0766	Concrete, Asphalt, Road Base, Industrial Sands, Ceramics, Filter Cakes, Soils, Construction Debris	Base, Flexible Base, Embankment, Backfill
Flex-O-Lite 1601 Northwest 19th St. Paris, TX 75460	Owen Fox 1601 Northwest 19th St. Paris, TX 75460	Glass Cullet	Glass Traffic Beads
Potters HC 30, Box 20 Brownwood, TX 76801	Gary Whyte HC 30, Box 20 Brownwood, TX 76801	Glass Cullet	Glass Traffic Beads
Swarco 900 North Denton Mexia, TX 76667	Kevin Stanley 900 North Denton Mexia, TX 76667	Glass Cullet	Glass Traffic Beads
Weissker 60 Dundaff St. Carbondale, PA 18407	Bill Wade 60 Dundaff St. Carbondale, PA 18407	Glass Cullet	Glass Traffic Beads
Southwest Shingle Recycling 9550 South Central Expressway Dallas, TX 75241	Melissa Eisenberg 9550 SouthCentral Expressway Dallas, TX 75241 (510) 593-1197	Shingles (Pre-consumer and tear-off)	Asphalt Concrete
APAC-Texas, Inc. Gribble Plant 11050 Luna Rd. Dallas, TX 75229	David Morton (214) 926-9116	Shingles (Pre-consumer)	Asphalt Concrete

Plants & Processors

- Shingle Manufacturer
- Capability to process asphalt shingles



National Use



Manufactured Waste Only

Man. Waste & "Tear-Offs"

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Asphalt Roofing Shingles

Asphalt Roofing Shingles

"Recycling of asphalt shingles comes in as not only an economically viable addition to our hot-mix toolbox, but an environmentally conscientious change that can benefit everyone."
(From Roofs to Roads, *Texas Asphalt Magazine*, April 2009)

Specifications, Authorizations

TxDOT special provisions allow contractors to add up to 5% RAS to asphalt pavement:

- Special Provision 341-024 Dense-Graded Hot-Mix Asphalt (QC/QA)
- Special Provision 340-003 Dense-Graded Hot-Mix Asphalt (Method)

A Texas Commission on Environmental Quality (TCEQ) Authorization Memo allows hot mix plants to include either post-industrial or tear-off recycled asphalt shingles (RAS) under the TCEQ Air Quality Standard Permit for Permanent Hot Mix Asphalt Plants.

Overview

Each year, U.S. shingle manufacturers and roofers generate more than 11 million tons of asphalt shingle scrap, primarily removed from roof tops.

Worksheet

Recycled Materials Blending Program

Enter Fields Highlighted In Blue

Mixture Information

% Asphalt form JMF	5.0
Layer	Surface
Binder Grade	PG 76

Virgin Material Costs

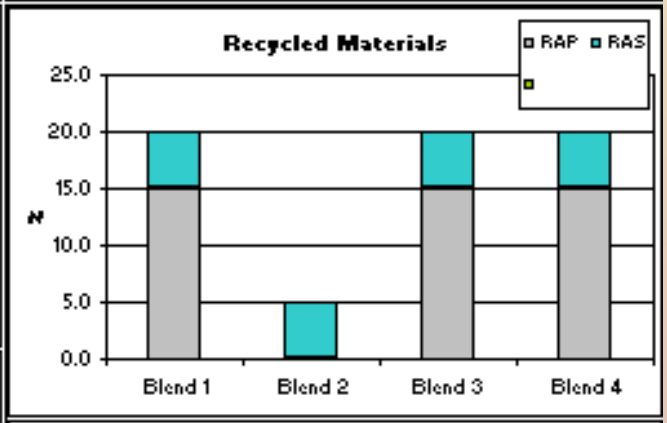
	$ / Ton
Aggregate	22.00
PG 76	538.00
PG 70	480.00
PG 64	377.00
Price / Ton of Mix	$ 47.80

Recycled Material Costs

		$ / Ton	% Asphalt
1)	RAP	15.00	5.0
2)	RAS	20.00	20.0
3)			

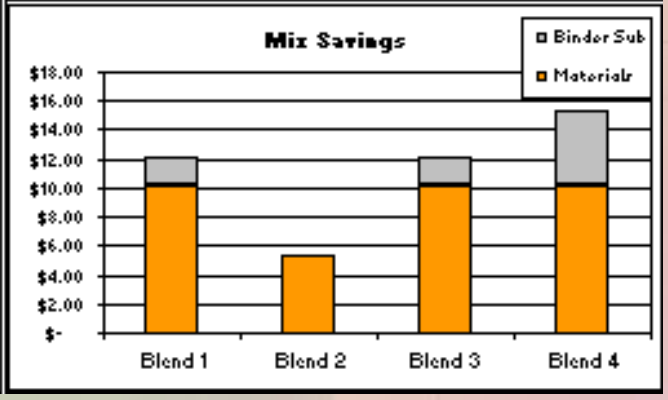
Blends

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Binder Grade	PG 76	PG 70	PG 76	PG 70	PG 64
% RAP	0.0	15.0		15.0	15.0
% RAS	0.0	5.0	5.0	5.0	5.0
	0.0				
% Recyled Material Limit			**20**		
% Recycled Binder	0.0	35.0	20.0	35.0	35.0
% Recycled Binder Limit			**35**		



Economics (Mix Savings)

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Recycle Material Savings	$ -	$ 10.18	$ 5.26	$ 10.18	$ 10.18
Binder Substitution Savings	$ -	$ 1.89	$ -	$ 1.89	$ 5.23
Total Savings	$ -	$ 12.07	$ 5.26	$ 12.07	$ 15.41
Adjusted Price/Ton	$ 47.80	$ 35.74	$ 42.54	$ 35.74	$ 32.39



Economics (Value of Recycled Material)

(Replacement Value - Cost)

RAP	$ 32.80
RAS	$ 105.20
	$ -

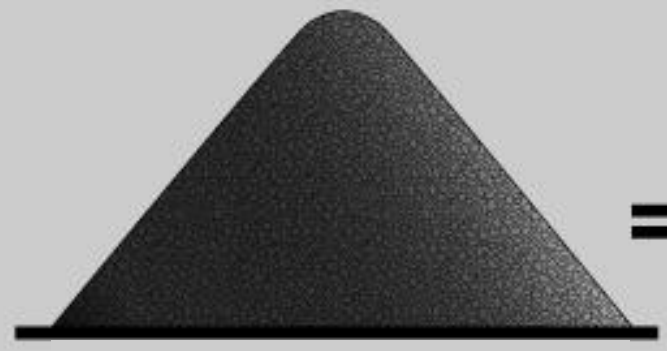
Cost Savings

Price ($/Ton)			
Type D PG 64-22	with 20% RAP	with 5% Shingles	with 15% RAP & 5% Shingles
$39.75	$34.80	$36.10	$32.39

Bottom Line

- An available 13 million tons of shingle waste, containing 25% liquid AC
- 3.25 million tons of reclaimable liquid AC
- At $475.00 per ton that's **$1.5 billion** worth of liquid asphalt every year

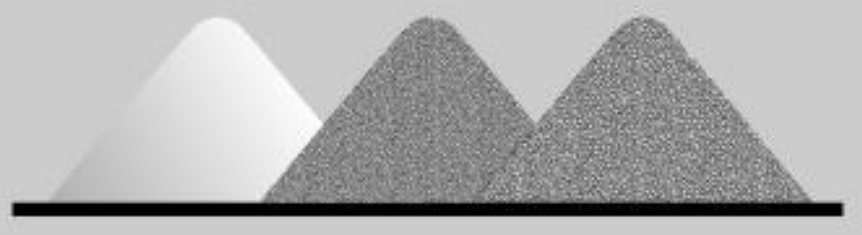
RAP is Worth the Virgin Material it Replaces



10,000 Tons of RAP

=

20 – 6000 Gallon Transport Trailers of Asphalt and 9500 Tons of Aggregate



Using 20% RAP in HMA reduces carbon emissions by about 8.5%

Recycled Asphalt Shingles

10,000 tons of ground shingles replaces:

- **468,000 gallons of asphalt**
- **8,000 tons of aggregate**

- **Using 5% RAS in HMA reduces carbon emissions by approx. 7.0%**

Combined Technologies

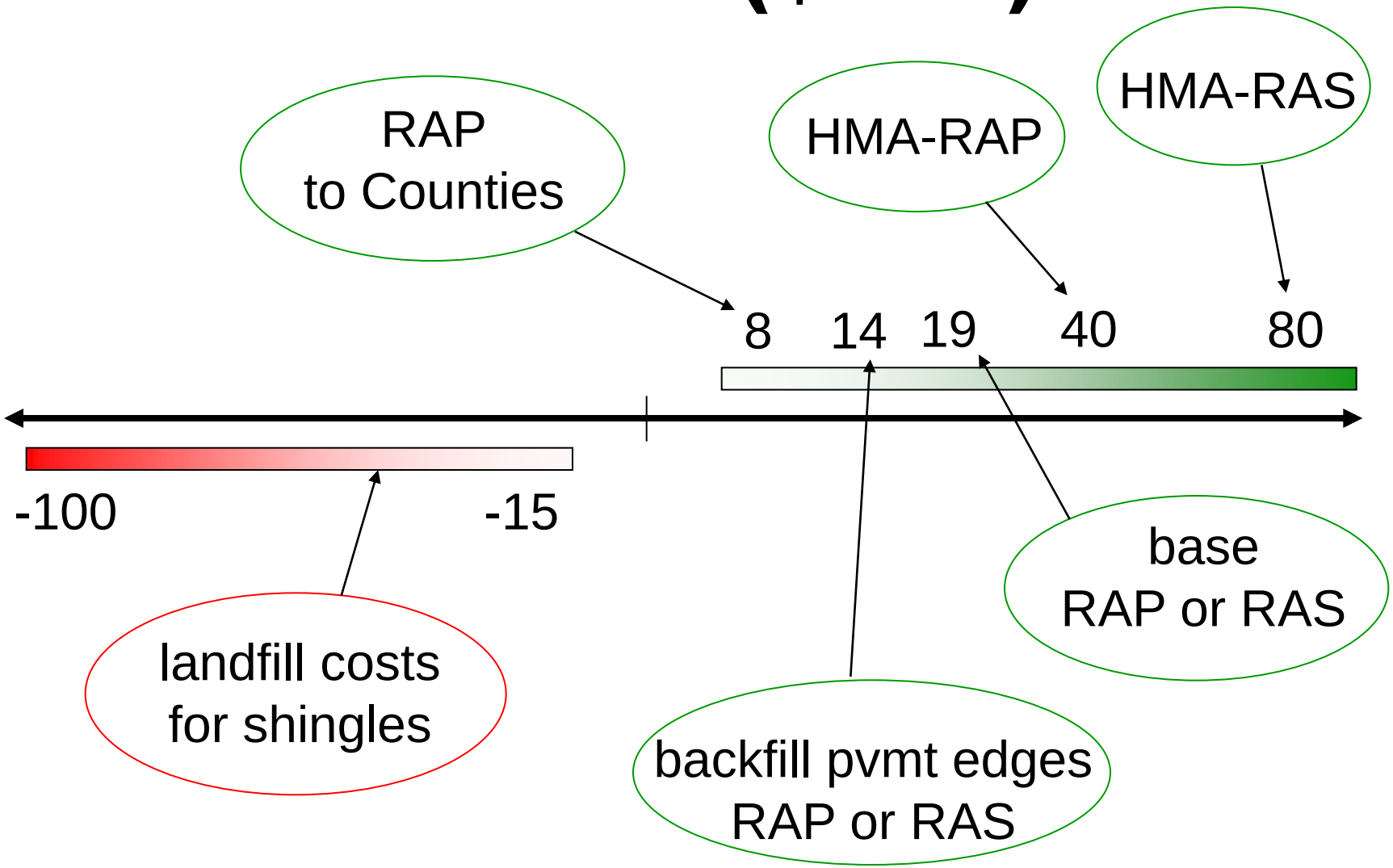
- **WMA with 15% RAP and 5% RAS**
  - 83 lbs. of carbon emissions per ton of mix as compared to 109 lbs. with HMA and no recycled materials

That's over a 23% reduction in emissions

Technology Use - FY 2010

Material	Quantity (Tons)
RAP	630,000
RAS	27,000
Total Mix	9,000,000

Value ($/ton)


RAP
to Counties
HMA-RAP
HMA-RAS
8
14
19
40
80
-100
-15
landfill costs
for shingles
backfill pvmt edges
RAP or RAS
base
RAP or RAS

Questions?