Asphalt Rubber

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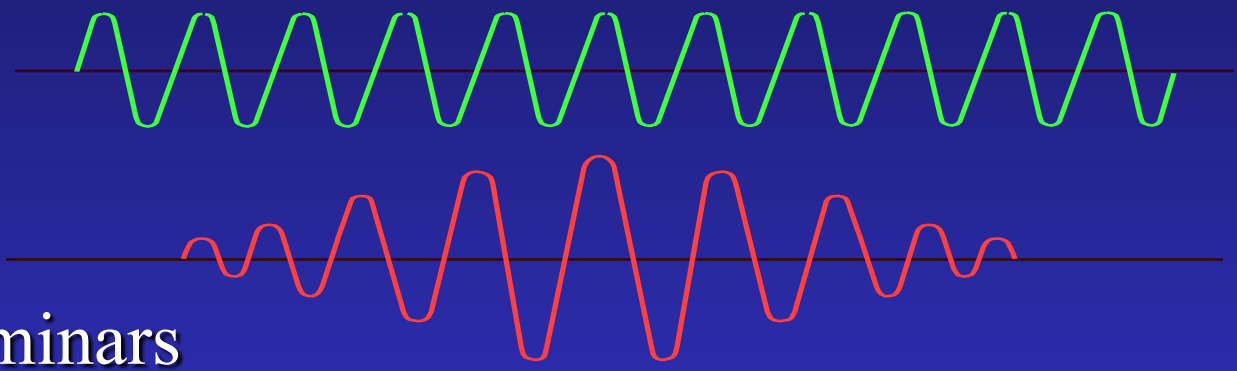
Jacobs Engineering

With assistance from:

The California Department of Resources Recycling and Recovery (CalRecycle)

TECHNOLOGY TRANSFER

THROUGH



- Seminars
- Field Assistance
- Information Sharing
- Guidelines
- Grant Assistance

Presentation Summary

- What is RAC
- Reduced Thickness Design
- Life Cycle & Cost Factors
- Noise Reduction
- Best Practices
- Specifications
- Mix Design Forensics & Case Studies

Presentation Summary

- Inspection
- Grants/Cooperative Purchase Program

Why should an agency choose asphalt rubber strategies?

- Has a long term performance history (over 30 years)
- Allows for higher binder contents in mixes
- Greater film thickness leads to improved durability and longer life
- Higher viscosity (Rut resistant)
- Higher softening point

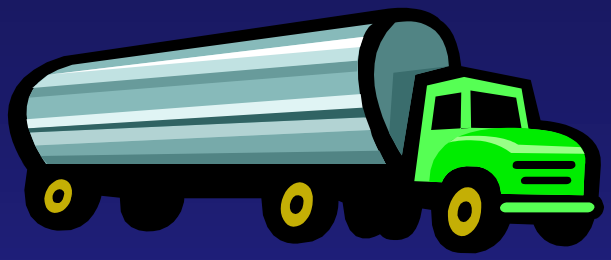
Why choose asphalt rubber?

- Less maintenance leading to increased safety
- Better resistance to reflective cracking
- Established life cycle cost-effectiveness
- Can be used in reduced thickness
- Less oxidation
- Proven alternative to costly reconstruction

Why choose asphalt rubber?

- Excellent color contrast for striping
- Quieter pavements

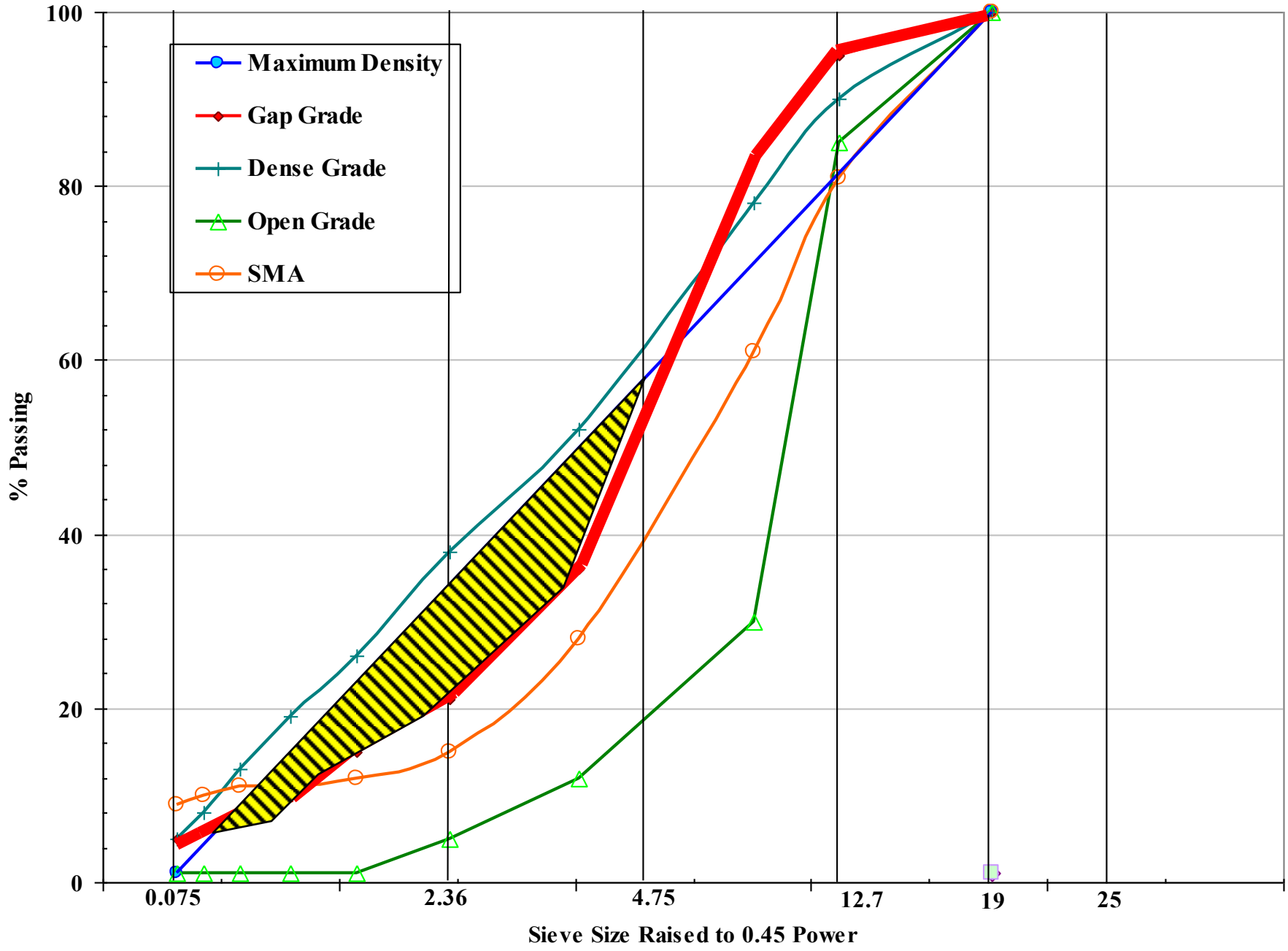

2,000 recycled tires per lane mile for a 2-inch overlay
2.4 tires per ton



Asphalt-Rubber as defined by ASTM D8-88

"Asphalt-Rubber is a blend of asphalt cement, reclaimed tire rubber and certain additives, in which the rubber component is at least 15% by weight of the total blend and has **reacted** in the hot asphalt cement sufficiently to cause swelling of the rubber particles."

Composite Power 45 Chart




Viscosity is what defines Asphalt-Rubber Binder
Asphalt-Rubber
1,500 to 2,500
Centipoises At 375°
Extremely Viscous
Rubberized Asphalt
Terminal Blend
300 to 600
Centipoises At 325°
Significantly Less
Viscous Than AR

Video

Design of Asphalt Rubber Pavements

- Uses a deflection based design method
- Up to 50 % reduction in thickness compared to conventional AC design thickness
- Over 1000 reduced thickness projects

Heavy Vehicle Simulator – UC Davis

Heavy Vehicle Simulator – UC Davis

Performance

Repetitions	Wheel Load	AC Overlay Section (3")	ARHM-GG Section (1.5")	ARHM-GG Section (1")
0-100,000	40kN	Fine cracks at 100,000	—	—
100,000 to 175,000	40kN	Block cracks at 175,000	—	—
Wheel load Changed to 80 kN				
175,000 to 200,000	80kN	Completely cracked	—	Fine cracks
200,000 to 237,000	80kN	Test stopped	—	Completely cracked
Surface Temperature Reduced to –5 C				
237,000 to 250,000	80kN	Test stopped	1/2 of section cracked	Test stopped

3” Conv. AC

1 1/2” ARHM

1” ARHM

Cost Factors

- When AR is in production the plant can not make conventional
- Small Projects = LARGE COSTS!!
  - Move-in costs
  - Fixed daily costs
- Haul distance and ambient temperatures
- Traffic control for cooling time

- Agencies can save $$ with coordination/procurement
- Rubber Plant may limit Production Rate
- Look for Caltrans projects
- Bidding in the Winter will allow efficient scheduling for the upcoming season
- Be flexible

Terminal Blend Modified Binder with Recycled Tire Rubber

www.paramountasphalt.com

WHAT ARE WE TALKING ABOUT?

Terminal Blended Tire Rubber Asphalt (TBTRA)

- Processing takes place at the manufacture's location. (the supplier's terminal)
- A process that completely integrates tire rubber particles into an asphalt binder.
- Tire rubber is at a micron size within the asphalt medium

WHAT ARE WE TALKING ABOUT?

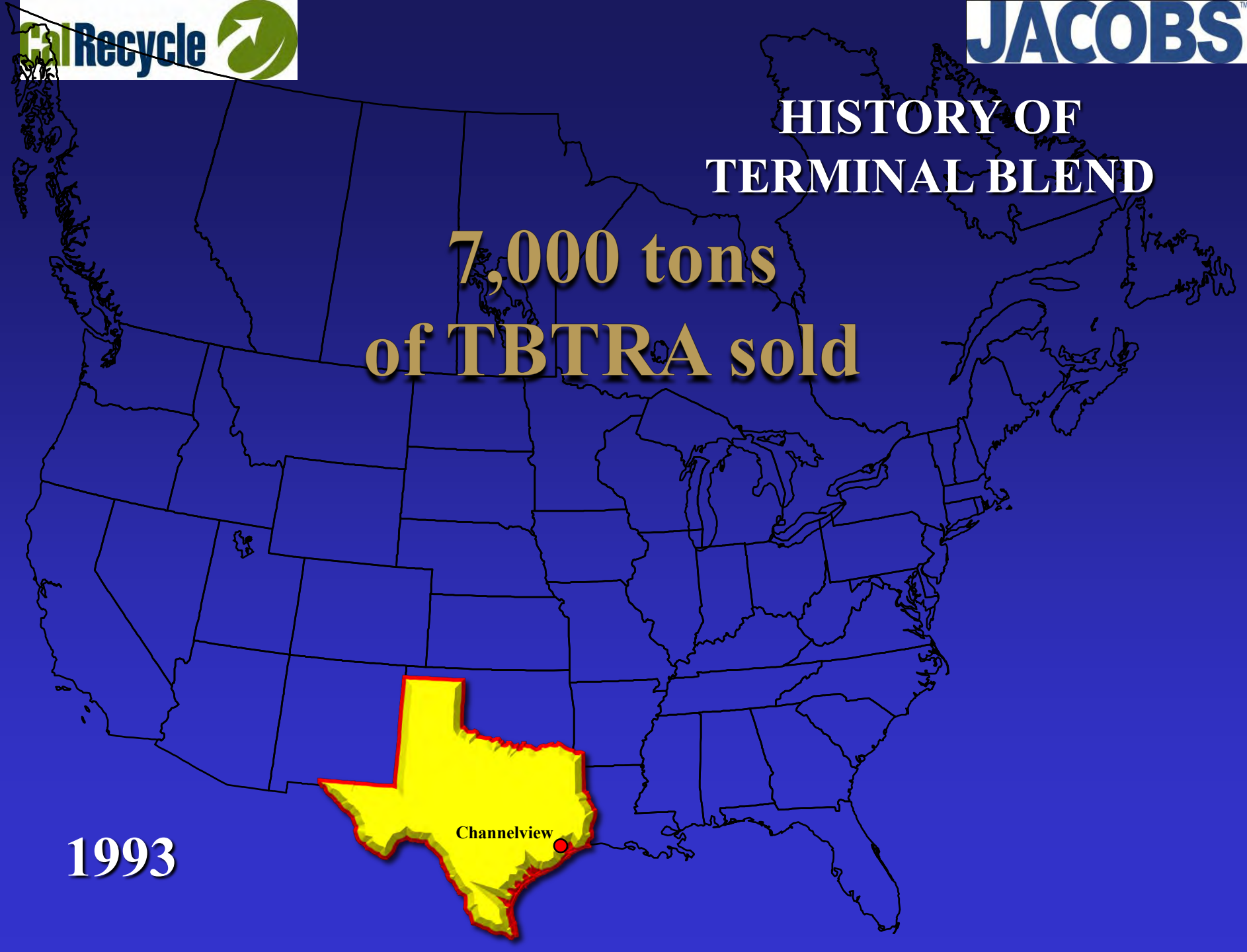
Terminal Blended Tire Rubber Asphalt (continued)

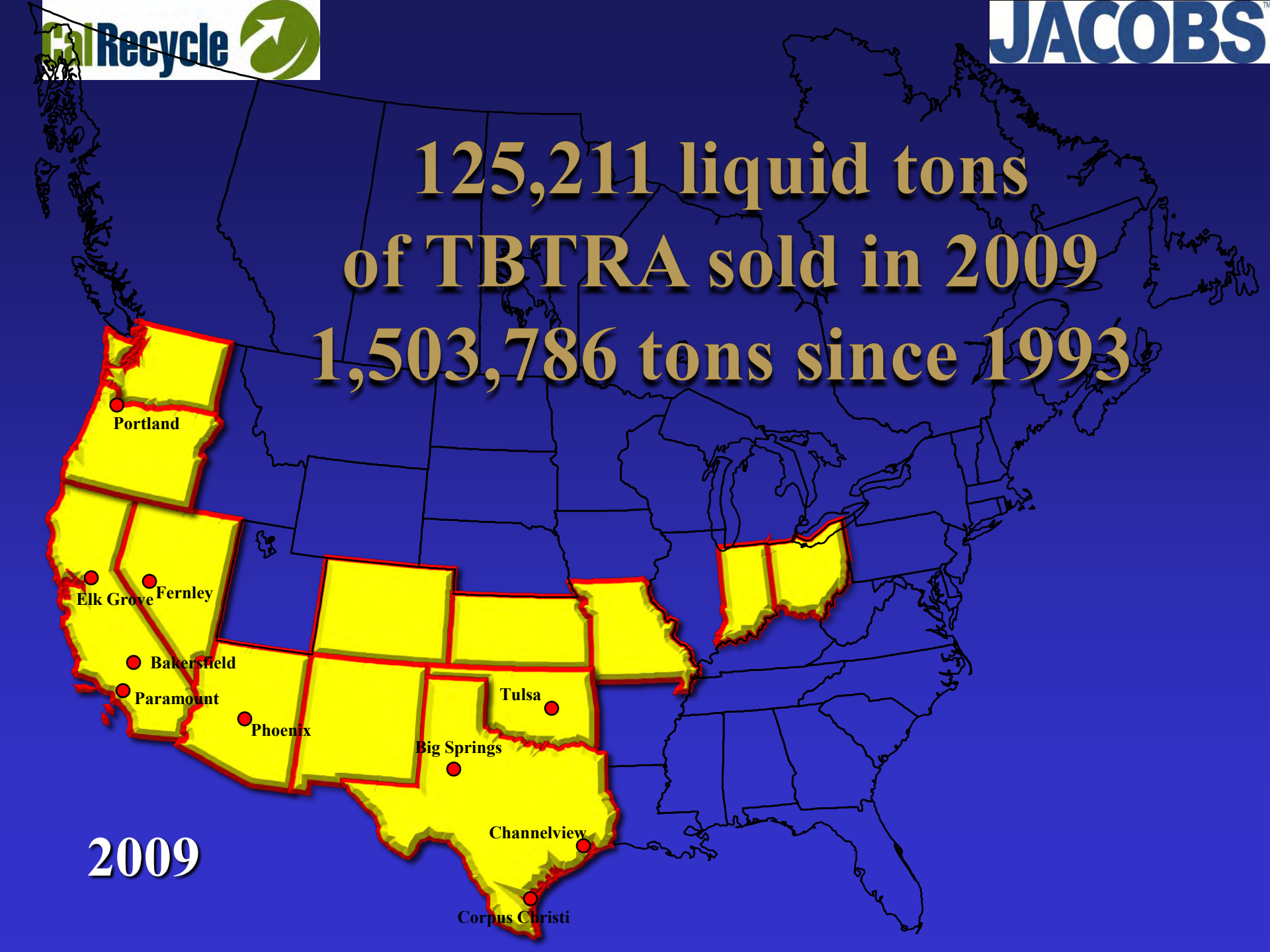
- Additional polymer modifiers can also be added to produce, certify and ship finish graded products from the manufacture's location.
- This material comes ready to use upon arrival
- Non proprietary product

Terminal Blended Tire Rubber Asphalt System

At 20 to 25 % Tire Concentration

HISTORY OF TERMINAL BLEND




125,211 liquid tons
of TBTRA sold in 2009
1,503,786 tons since 1993
Portland
Elk Grove
Fernley
Bakersfield
Paramount
Phoenix
Tulsa
Big Springs
Channelview
Corpus Christi
2009

- **Applications**
- **Hot Applied Chip Seal Binder**
  - **PG70-22TR and PG76-22TR**
    - Chip seal binder made up of 20% tire rubber fully digested and polymer
- **Binders for Dense Graded Hot Mix Asphalt**
  - Binders that are PG 64-28TR and PG76-22TR Graded
  - Similar spec as PG64-28PM and PG76-22PM
  - Binder that contains 10% up to 15% tire rubber
  - This binder can also be further modified with SBS co-block polymers

- **Applications (continued)**
- **Binders for Open, Gap and PFC Graded Hot Mix Asphalt**
  - Surface wearing course application PG64-28TR and PG76-22TR
  - Similar spec as PG64-28PM and PG76-22PM
  - Greenbook MAC-10TR and MAC-15TR
  - Binders that are PG Graded and can meet any Plus Specification
  - Binder that contains 10% up to 15% tire rubber
  - This binder can also be further modified with SBS co-block polymers

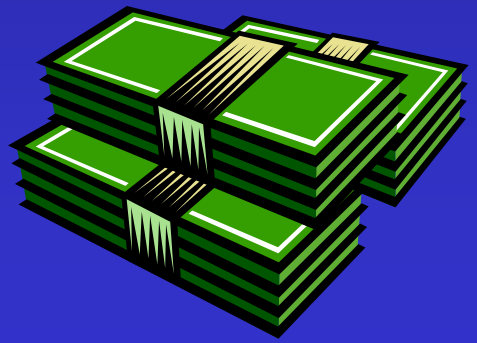
TR PROJECTS

- Significant Projects completed in 2010:
  - Siskiyou County PG64-28TR 18%TR 15% RAP
  - Contra Costa PG76-22TR 18%TR Grant $
  - District 1 PG64-28TR 18%TR WMA
  - District 2 PG64-28TR 18%TR Open & Dense
  - San Diego County PG76-22TR 18%TR Porous
  - Riverside MAC-15TR 15%TR GAP Grade
  - Lake Forest TRMSS 10% TR Emulsion

Complete listed of 2010 projects (Pic & Videos) can be found on www.ParamountAsphalt.com


LX4570
GRAHAM
CONTRACTORS

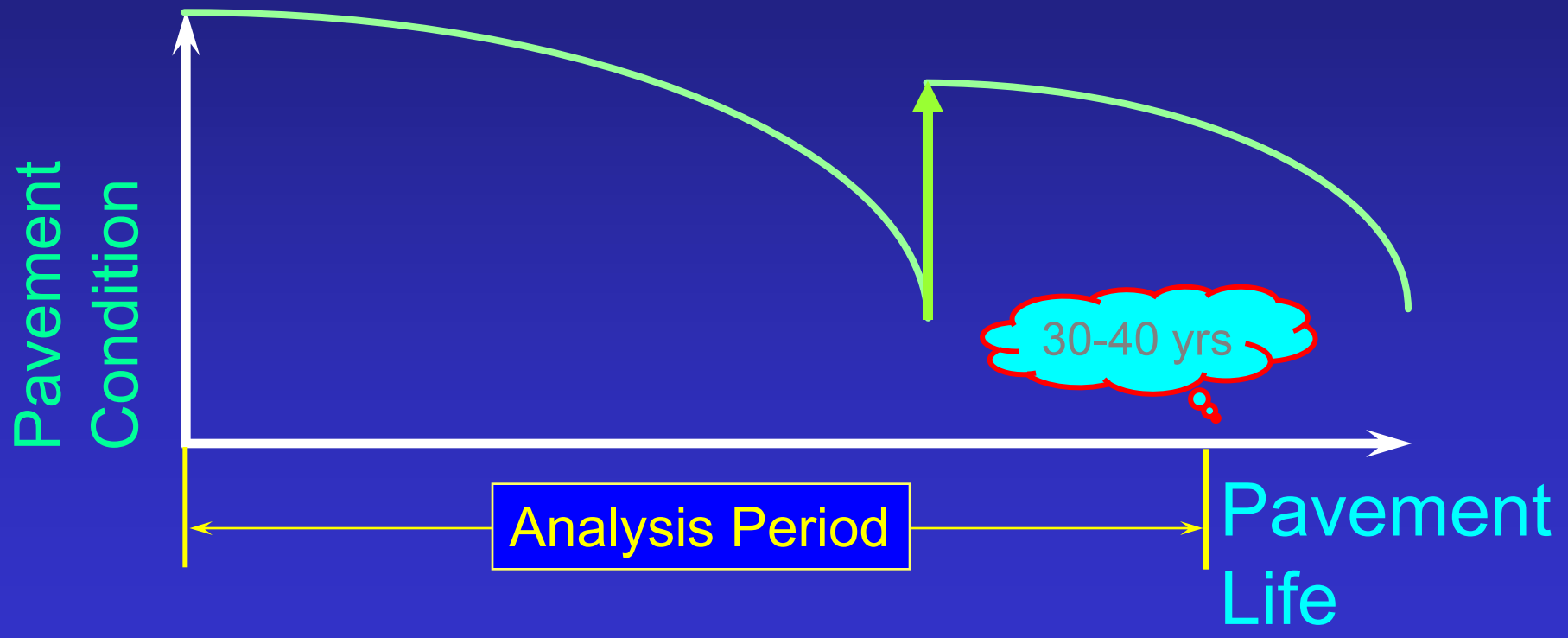
Cost Effectiveness of AR and Life Cycle Analysis UNR & Oregon State



LCCA Process

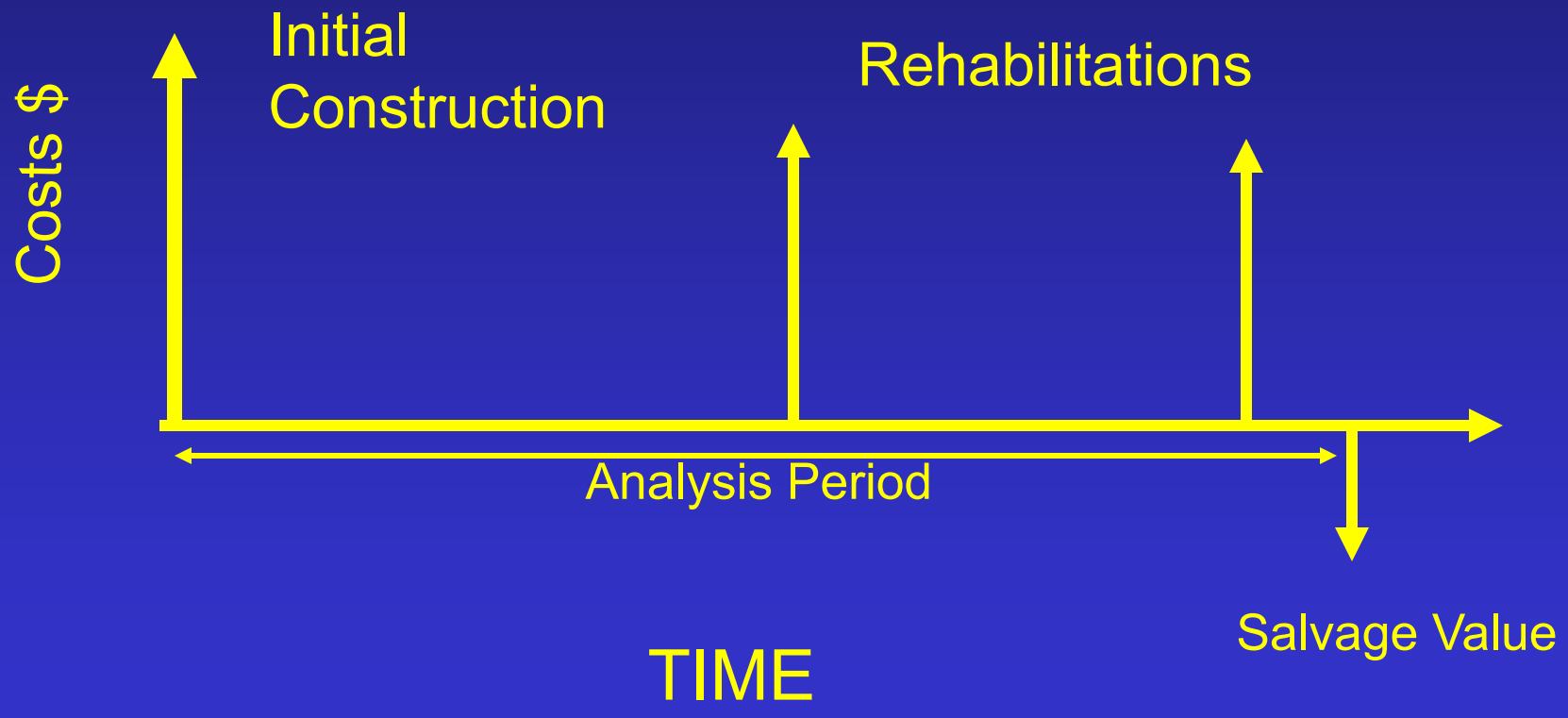
- Establish strategies for analysis period
- Establish M&R activity timing
- Estimate agency costs
- Estimate user and non-user costs
- Develop expenditure streams
- Compute net-present value
- Analyze results

Analysis Period



Include at least one Rehab.

Typical Expenditure Stream



Net Present Value

Results - Deterministic Approach

Scenario	Present Worth ($/yd)	
	Total	Savings w/ AR
Preservation - Chip Seal		
Conventional	18.39	
AR	15.87	2.52
Preservation - Thin HMA		
Conventional	20.69	
AR	17.33	3.36
Structural Overlay		
Conventional	21.97	
AR	14.63	7.34

Results - Probabilistic Model

Scenario	Percentage of times savings result using AR
Preservation - chip seal	86
Preservation - thin HMA	82
Structural Overlay	86

Noise Reduction with RAC

Noise Source	Decibel Level
Thunder Clap, Live Rock Music, Chain Saw	120
Steel Mill, Riveting, Auto Horn (1M)	110
Jet Take Off, Lawn Mower, Jack Hammer	100
Busy Urban Street, Diesel Truck, Food Blender	90
Garbage Disposal, Dishwasher, Freight Train	80
Freeway Traffic (15), Vacuum Cleaner	70
Conversation in Restaurant, Office, Background Music	60
Quiet Suburb, Conversation at Home	50
Library	40
Quiet Rural Area	30

- Vehicle-generated noise comes from:
  - engine,
  - exhaust system,
  - aerodynamic noise
  - tire noise.

Power train noise

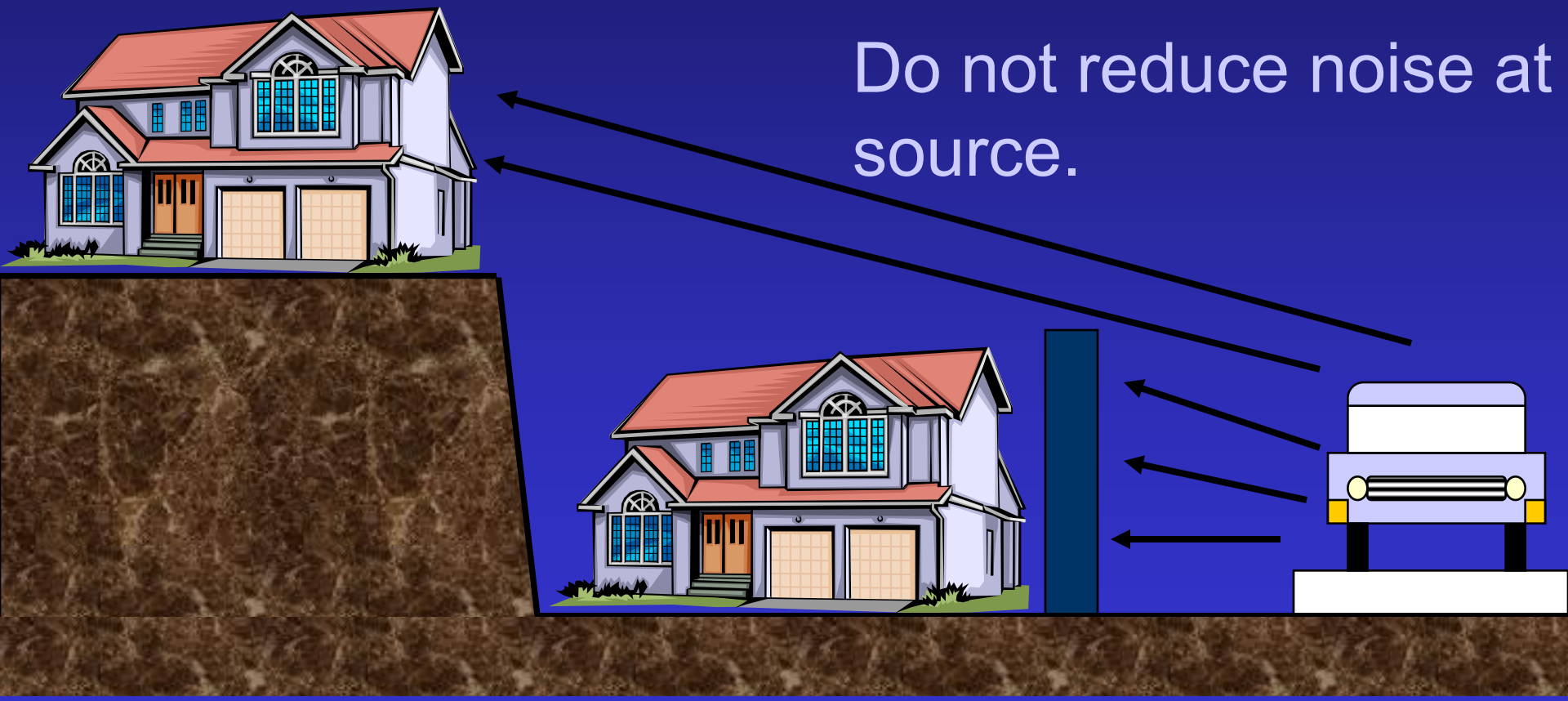
External factors

- For ≥ 40 mph, pavement/tire noise dominates.

Walls

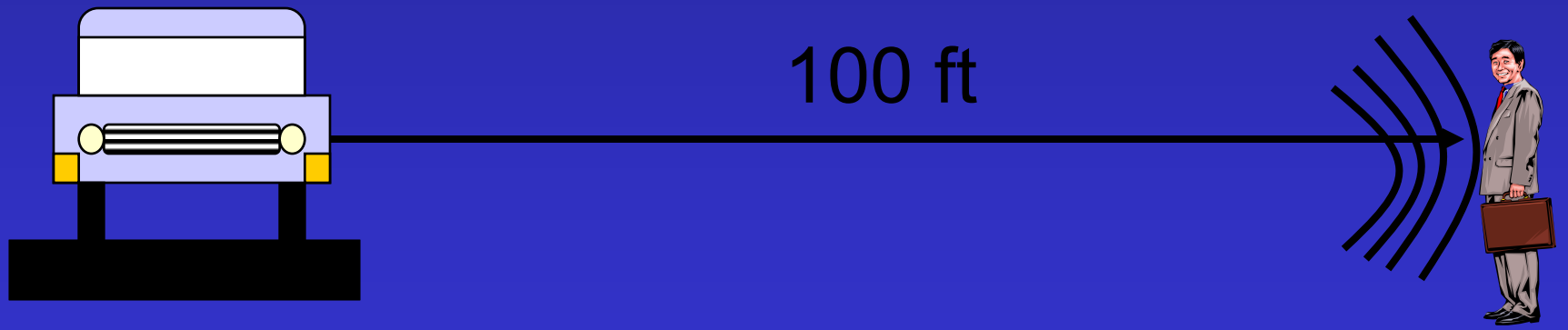
Effective only for those in line-of-sight.

Do not reduce noise at source.



A reduction of 3 dB(A) is like doubling the distance from the noise, reducing traffic volume by 50%, or reducing traffic speed by 25%

67 dB(A) - 3 dB(A) = 64 dB(A)



Hot Mix with Asphalt Rubber Binder Reduces Tire Noise

- Gap Graded Mix Design
  - Aggregate Structure with more binder
- Binder Strength
  - Film Thickness
  - Resists Oxidation Longer
  - Suppleness of mat

6-year Noise Study

Reduction compared to pre-overlay condition

Alta Arden	AR	1month	-6dB
		16 months	-5dB
		6 years	-5dB
Antelope*	AR	6 months	-4dB
		5 years	-3dB
Bond	CA	1 month	-2dB
		4 year	0dB

* (speed increase)

Specifications, Best Practices, Mix Design Forensics

Michael Robinson, PE

Kleinfelder

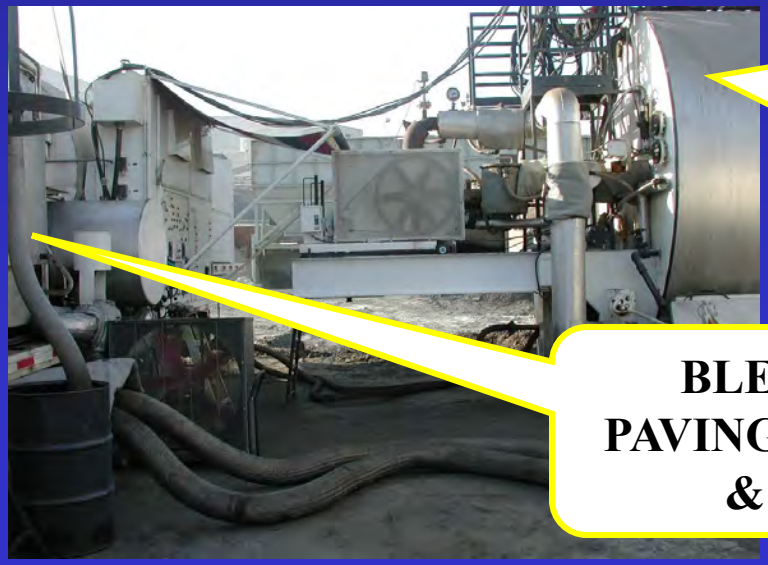
QUALITY CONSTRUCTION THROUGH QUALITY INSPECTION

YOU ARE THE KEY!

Mixing of paving asphalt and CRM

CRM PROPORTIONING:
-SCRAP TIRES (3 BAGS)
-HIGH NATURAL (1 BAG)

BLENDER CONTROL PANEL



MIXING/ REACTION TANK

BLENDING PAVING ASPHALT & CRM

Sampling combined aggregate

DRUM PLANT
BELT SAMPLE

INSPECTION AT THE PLANT (CONT.)

- Viscosity of asphalt rubber binder..
- Temperature of ARHM
- Samples of CRM, paving asphalt, asphalt rubber binder, aggregates, and ARHM

Haake Field Viscosity Test

1500 – 4000
Centipoise
At 375°F

TEMPERATURE OF ARHM

INSPECTION AT THE JOB SITE PRIOR TO PAVING

- Pre-Construction Meeting:
  - ✓ Approved mix design
  - ✓ Surface preparation
  - ✓ Delivery method
  - ✓ Rate of delivery & route
  - ✓ Staging
  - ✓ Other Issues (Refer to A-R Design Guide)

- Ambient temperatures (>55° F and rising)

INSPECTION OF JOB SITE DURING PAVING

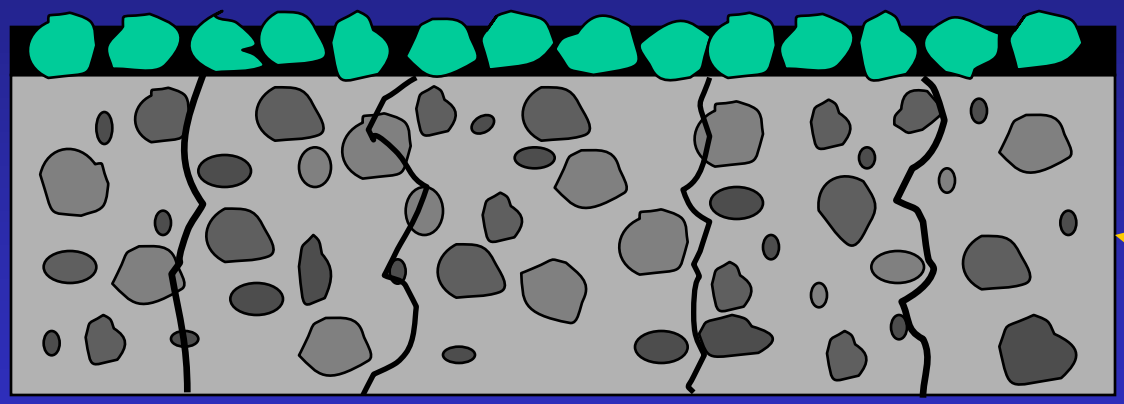
- R& R distressed areas (dig-outs) complete?
- Cracks over ¼ -inch wide sealed?
- Cold milling complete?
- Surface cleaned?
- Tack properly applied?

Acceptance Testing

- 92 – 97% of Rice density
- Reduced payment for missing target
- 500 tons (or portion thereof) per lot
  - One lab-compacted sample per lot
  - At least three cores for density per 500 Ton Lot

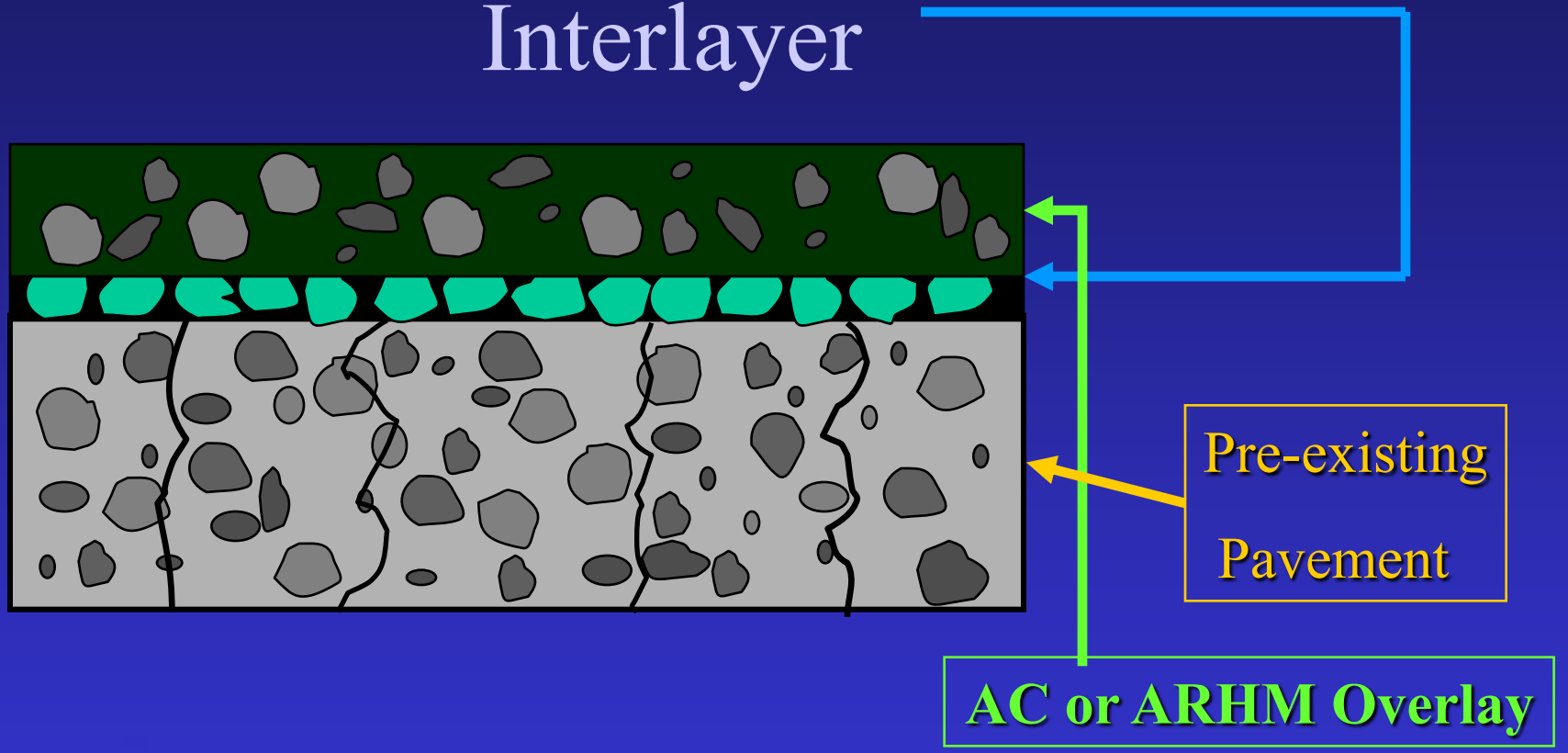
Asphalt-Rubber Binder in Chip Seal and Spray Apply Applications

ARCS (SAM)– Asphalt Rubber Chip Seal



Pre-existing Pavement

SAMI - Stress Absorbing Membrane Interlayer



Also known as a Two Layer System

Double Chip Seal – First Layer (PMAR Binder Application .62 GSY)


Double Chip Seal – First Layer (3/8" Hot Pre-Coated Aggregate)
BenCat
DANGER
DANGER

Double Chip Seal – Second Layer (Modified Binder .23 GSY)

Double Chip Seal – Second Layer (1/8" Hot Pre-Coated Aggregate Application)


Double Chip Seal Two Layer System

Finished SAM/ARCS Surface

1) Higher Binder Application Rates (.55 to 1.25 gallons per square yard)
2) Resistance to Reflective Cracking
3) Resistance to Aging = Longer Life
4) Higher Percentage of Aggregate Embedment/Retention
5) Alternative to Reconstruction

RAC Grants and Cooperative Purchasing Program

Two RAC Grant programs: (Up to $250,000 per jurisdiction)

1) the **Targeted RAC Incentive Grant program**, **Based on the differential cost of using RAC versus conventional**

Project(s) must use a minimum of 3,500 tons of RAC.

2) the **RAC Chip Seal Grant program**, aimed at new and limited users of rubberized chip seal material

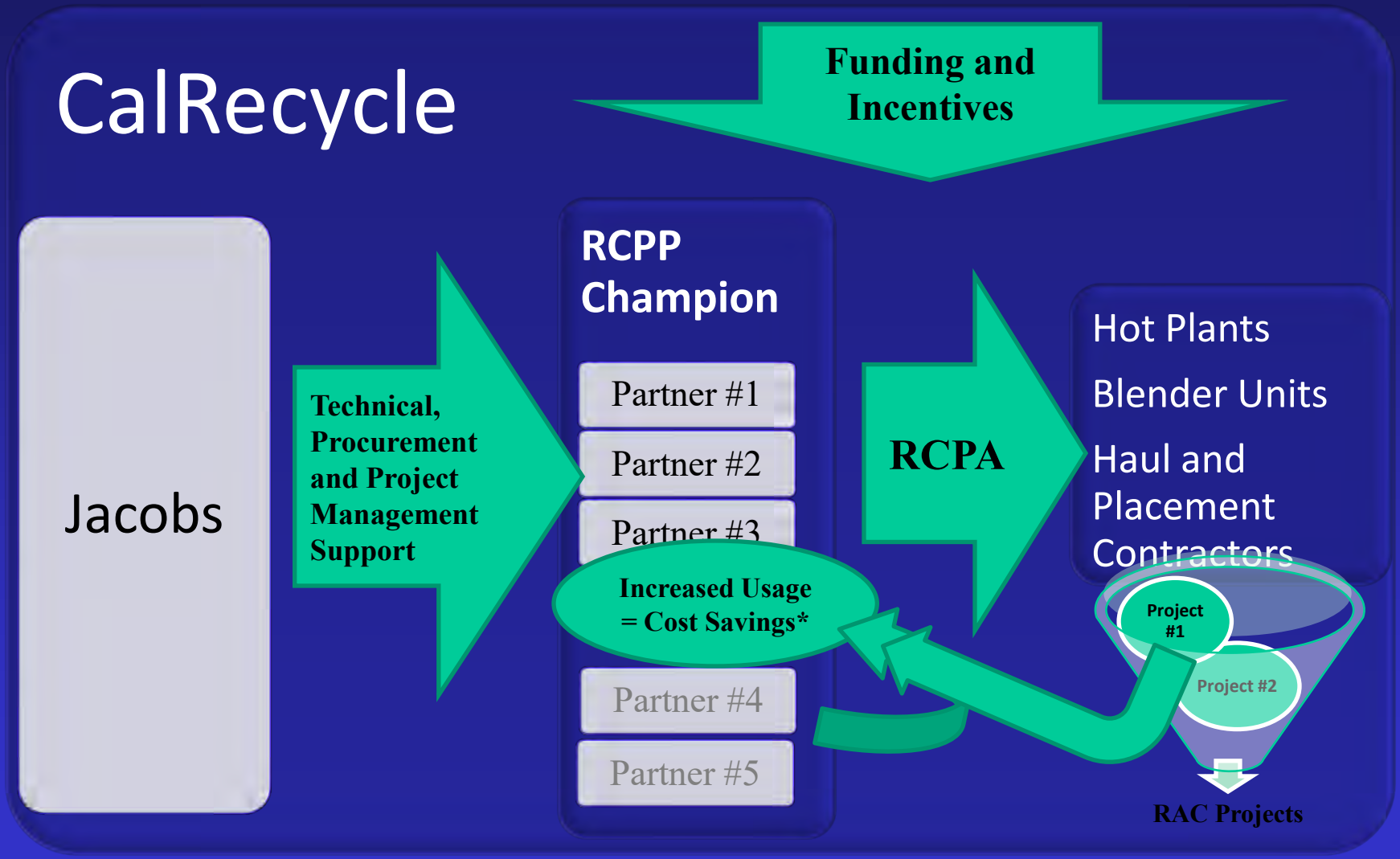
Project(s) must use a minimum area of 35,000 square yards of RAC chip seal material.

Allows terminal blend

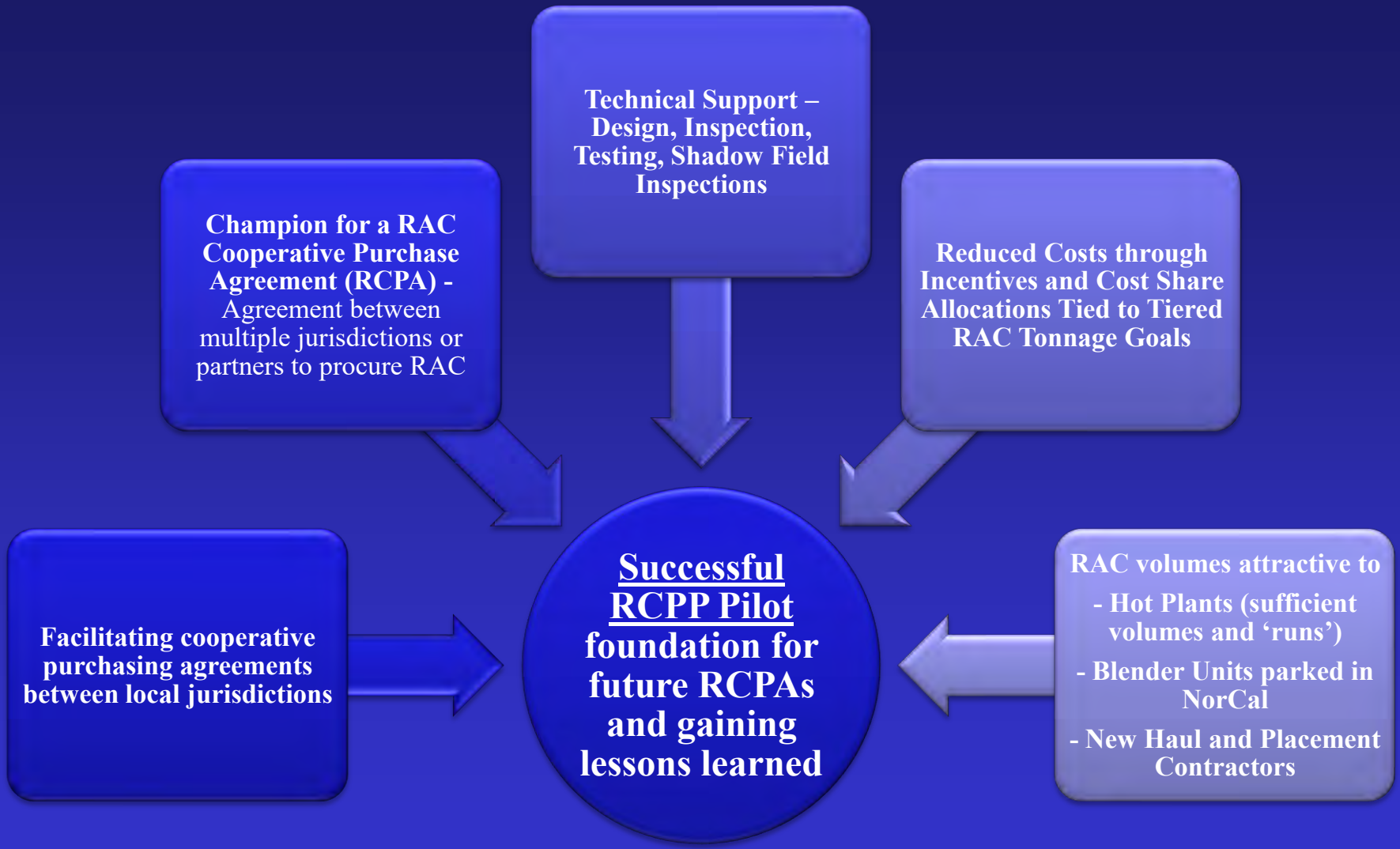
Reimbursement will be based on the following:

Category Grant Program	Number of Previous CalRecycle RAC Grants	Grant Award Basis
1: Targeted	0	Total grant based on a 100 percent differential (RAC versus conventional asphalt cost) reimbursement rate.
2: Targeted	1	Total grant based on a 70 percent differential (RAC versus conventional asphalt cost) reimbursement rate.
3: Targeted	2	Total grant based on a 40 percent differential (RAC versus conventional asphalt cost) reimbursement rate.
4: Chip Seal	0-1	Total grant award is based on $1.00 per square yard reimbursement rate.
5: Chip Seal	2-3	Total grant award is based on $0.50 per square yard reimbursement rate.

CalRecycle

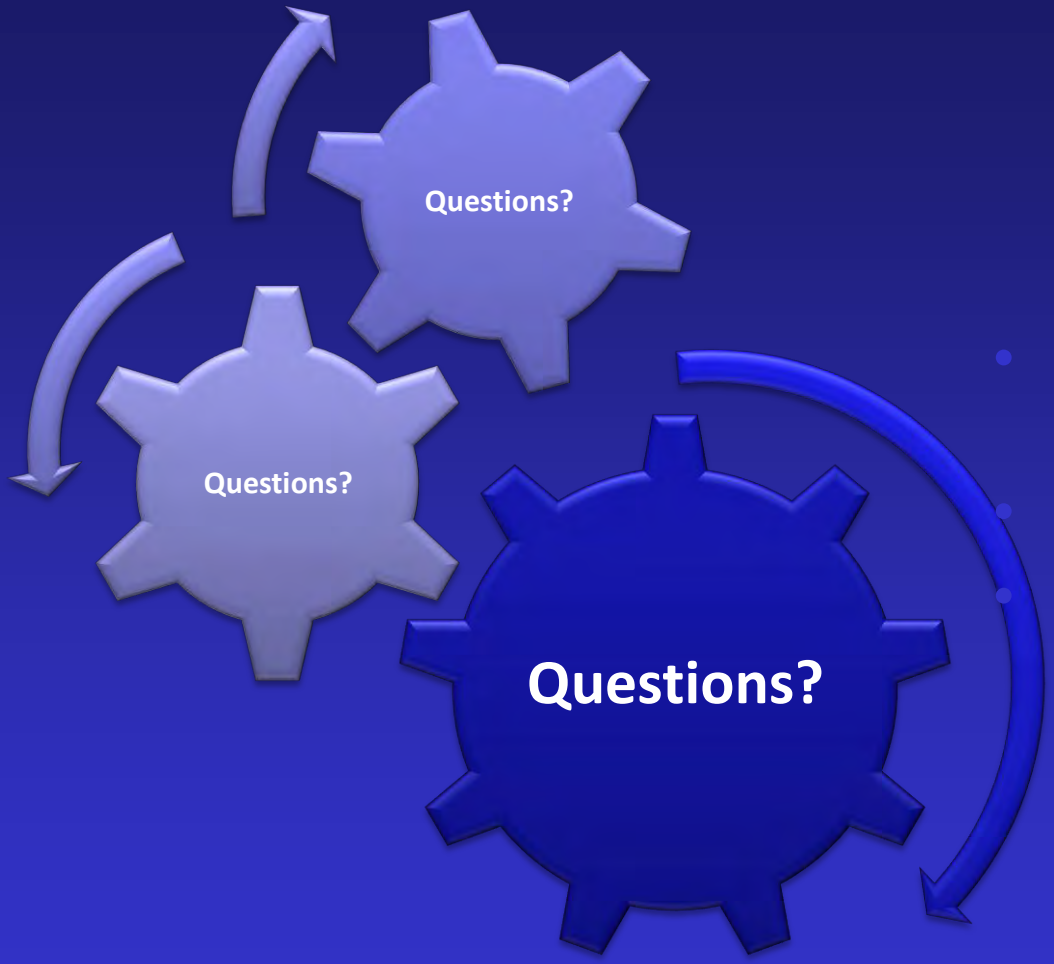


Savings*: Incentives and Cost Share Allocations for Tiered RAC Tonnage Goals


Technical Support – Design, Inspection, Testing, Shadow Field Inspections
Champion for a RAC Cooperative Purchase Agreement (RCPA) - Agreement between multiple jurisdictions or partners to procure RAC
Reduced Costs through Incentives and Cost Share Allocations Tied to Tiered RAC Tonnage Goals
Facilitating cooperative purchasing agreements between local jurisdictions
Successful RCPP Pilot foundation for future RCPAs and gaining lessons learned
RAC volumes attractive to
- Hot Plants (sufficient volumes and 'runs')
- Blender Units parked in NorCal
- New Haul and Placement Contractors

RCPP Pilot – Next Steps

1. Let us know if you're interested in participating by completing a "RAC Interest Survey"
2. Request a Technology Transfer Presentation
3. Attend Pilot Kick Off Session



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