PAVING WITH PLASTIC

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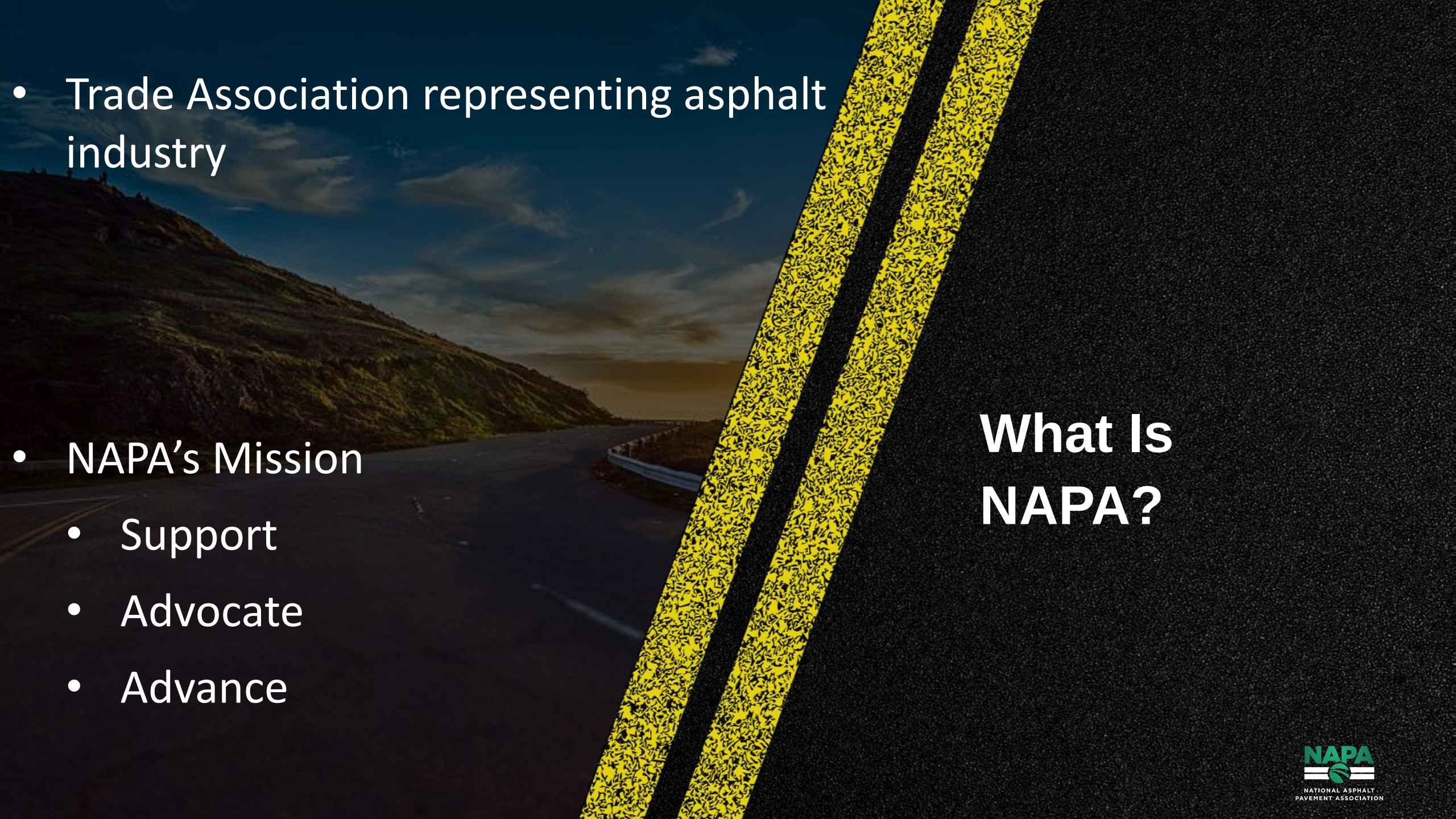

What Is NAPA?

- Trade Association representing asphalt industry

- NAPA's Mission
  - Support
  - Advocate
  - Advance

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Sustainability


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

FHWA Recycling Policy

- Three E’s
  - Engineering
  - Economics
  - Environment
- FHWA, 2015

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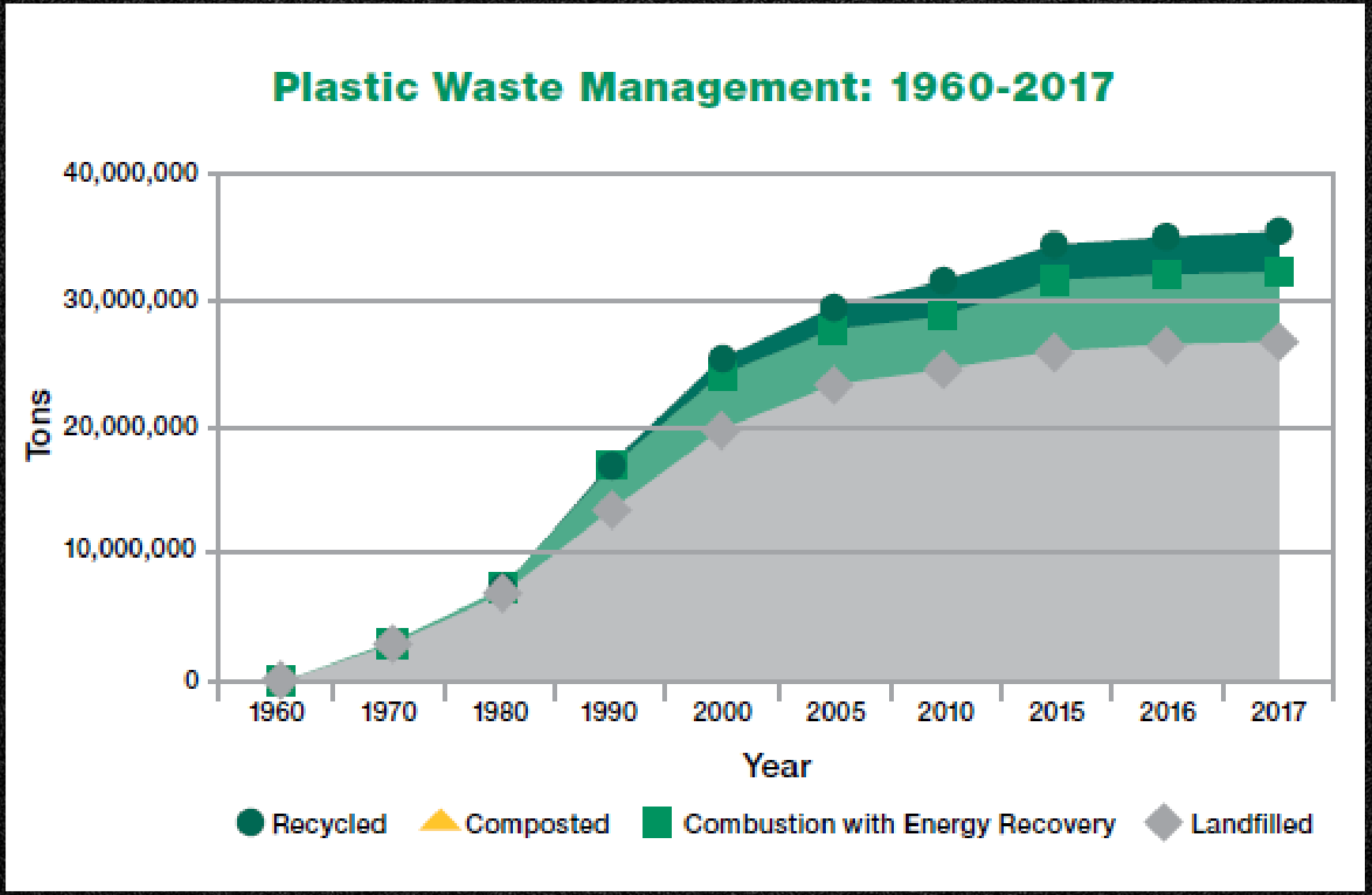
Current Status



(EPA, 2020)

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- Social media explosion
- Washington Post
- The Economist
- Addressing America's Surface Transportation Infrastructure Needs
- American Chemistry Council
- Plastics Industry Association

When Asphalt Went Viral

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- Reclaimed asphalt pavement
- Recycled asphalt shingles
- Recycled tire rubber
- Plastics?

It's Just Plastic, Right…?

Number	Type	Application	Melting Point (F)
1	Polyethylene Terephalate (PET)	Water Bottles	>482
2	High Density Polyethylene (HDPE)	Plastic bags	266 but can vary
3	Polyvinyl Chloride (PVC)	Pipes	212-500
4	Low Density Polyethylene (LDPE)	Trays	230-248
5	Polypropylene (PP)	Hinges	320-330
6	Polystyrene (PS)	CD Casing	GS at 212
7	Others	Baby bottles	---

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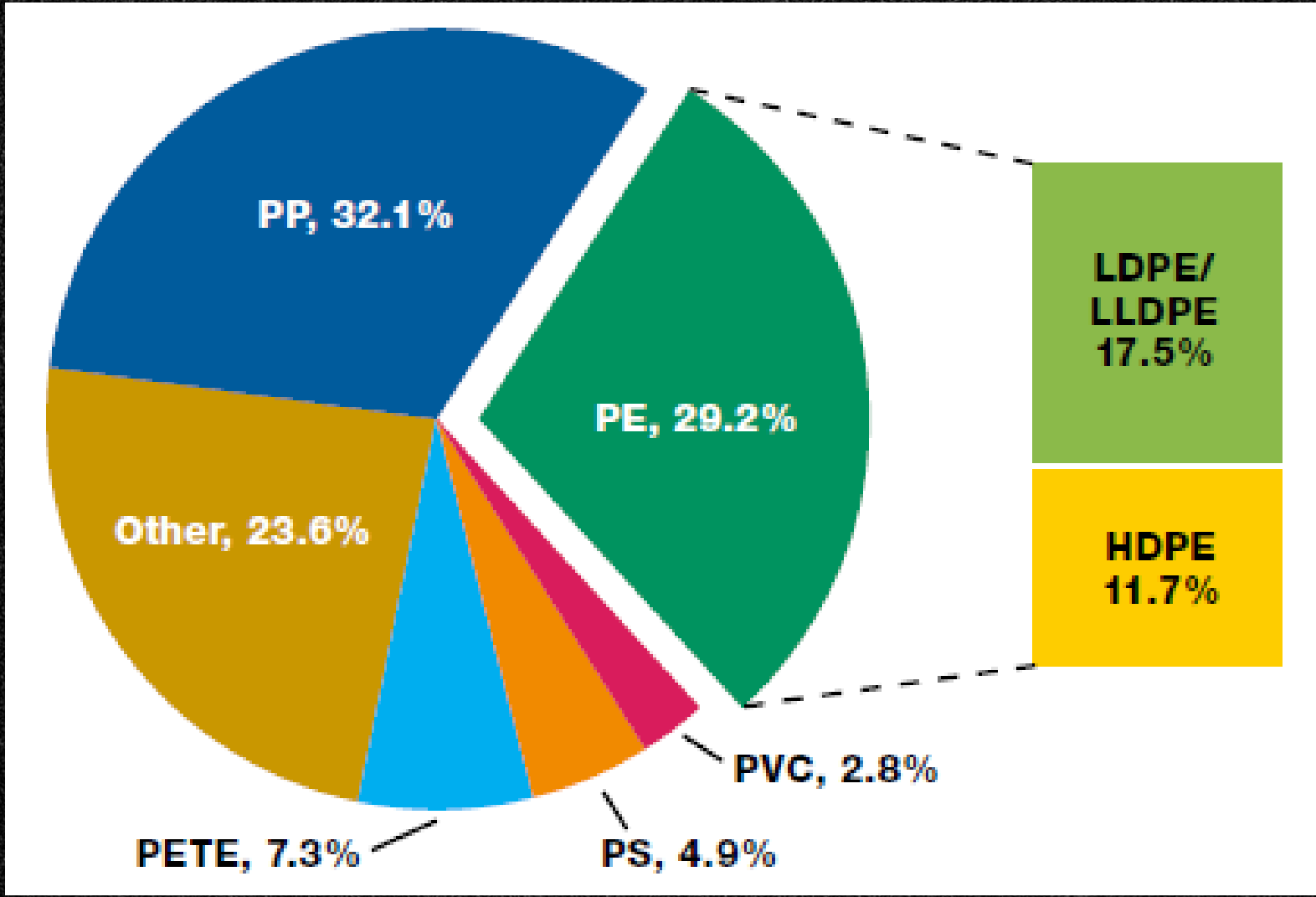
Plastic Breakdown in MSW



(DuBois, 20202; based on EPA, 2017)

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Plastic Recycling

- Plastics Recycling
  - Collection
  - Shredding
  - Washing
  - Decontamination
- Significant investment needed

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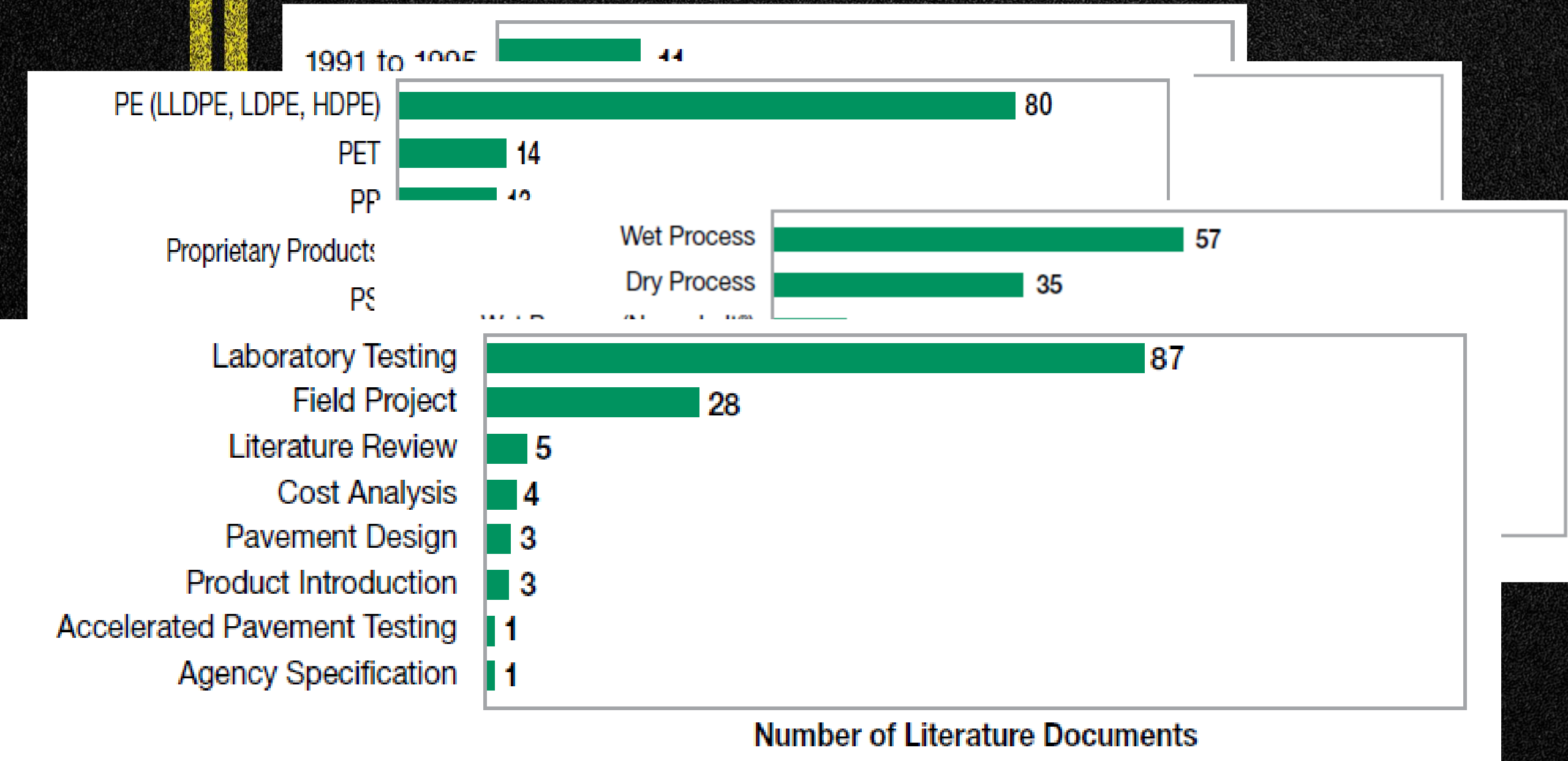
When In Doubt … Do A Lit Review



Wet v Dry

- Wet Process
  - Modification or replacement?
  - 2 – 8% by weight of binder
  - Low melting point needed
- Dry Process
  - Aggregate replacement
  - Mixture modifier
  - Aggregate modifier
  - 0.2 – 1% by agg weight

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Laboratory Binder Testing

- Binder Performance
  - Plastic stiffens asphalt binder
  - Little data on fatigue
  - Little data on low-temperature
- Phase separation tendencies
  - Additives may help
- PE insoluble in many solvents

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Laboratory Mixture Characterization

- Marshall stability
  - Increased Marshall stability
- Increased stiffness
- Increased rutting resistance
  - Wet – Stiffer binder
  - Dry – Increased agg friction
- Moisture damage
  - Positive or no impact

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Plant Operations

- Most documentation on plant operations relates to Novophalt®
  - High-shear blending unit

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- One study documented construction
  - Difficult to compact
  - Heavy rollers required
- French construction
  - Temperature sensitive,
    but compaction not an issue

Construction

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- Two potential concerns in literature
  - Leaching of toxic components
    - No adverse effects (one study)
  - Chlorine-based gases from PVC

Health & Safety

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Environmental

- Environmental Benefits
  - Preservation of resources
  - Reduction of solid waste
  - Emission reduction
- Environmental Concerns
  - Future recyclability
  - Ongoing work

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Field Projects

- 200 Field Projects in Literature
  - Improved rutting
  - More cracking
- New field projects
  - India
  - Australia
  - Canada
  - New Zealand
  - And More…

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Knowledge Gaps

- Sourcing of plastics
- Methods of incorporation
  - Modifier or replacement
- Binder characterization
- Mixture characterization
- Plant operations
- Construction
- H&S
- Environmental
- Field performance

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- Patience
- Partnership
- Communication

Moving Forward

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NAPA - IS-142
RECYCLED PLASTICS IN ASPHALT PART A:
State of the Knowledge
Richard Willis, PhD
Fan Yin, PhD, PE
Raquel Moraes, PhD
NAPA - IS-142
RECYCLED PLASTICS IN ASPHALT PART B:
Literature Review
Fan Yin, PhD, PE
Raquel Moraes, PhD
Anurag Anand
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- NCHRP 9-66
- FHWA Project
- Field Projects
  - California
  - Texas
  - Michigan
  - Wisconsin
  - Pennsylvania
  - More…

What's Happening

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THANK YOU!

RWILLIS@ASPHALTPAVEMENT.ORG

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