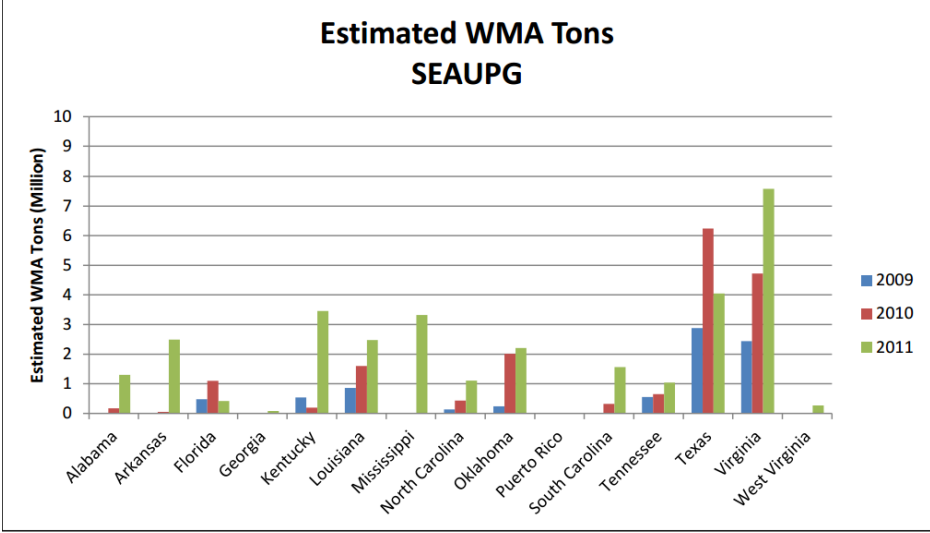
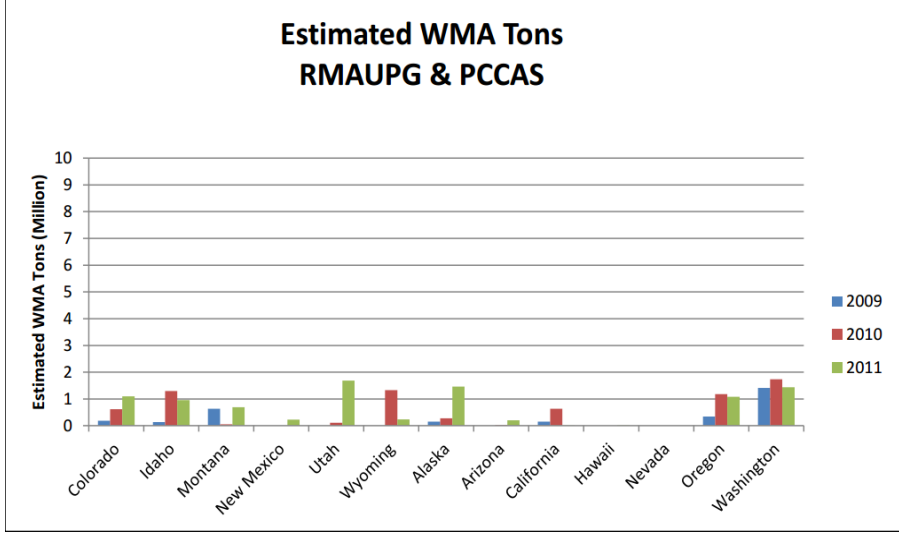
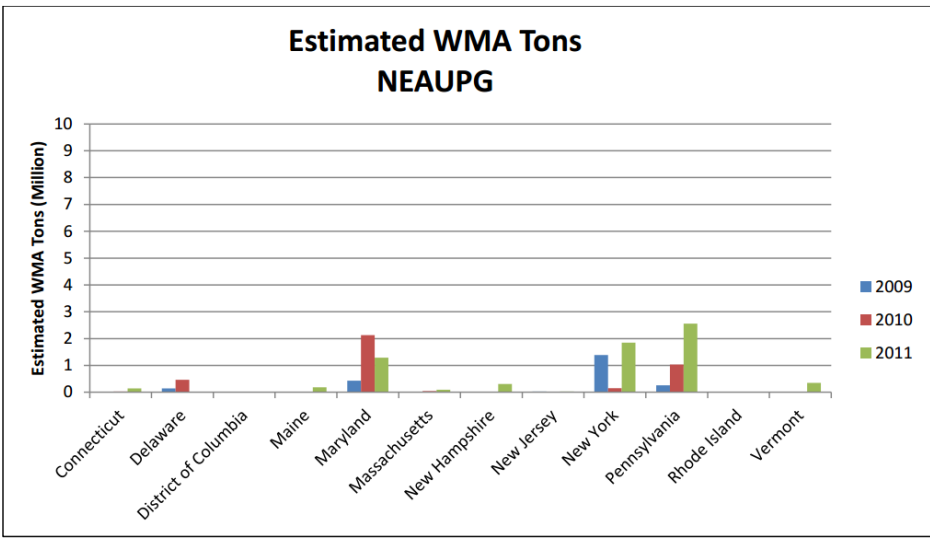
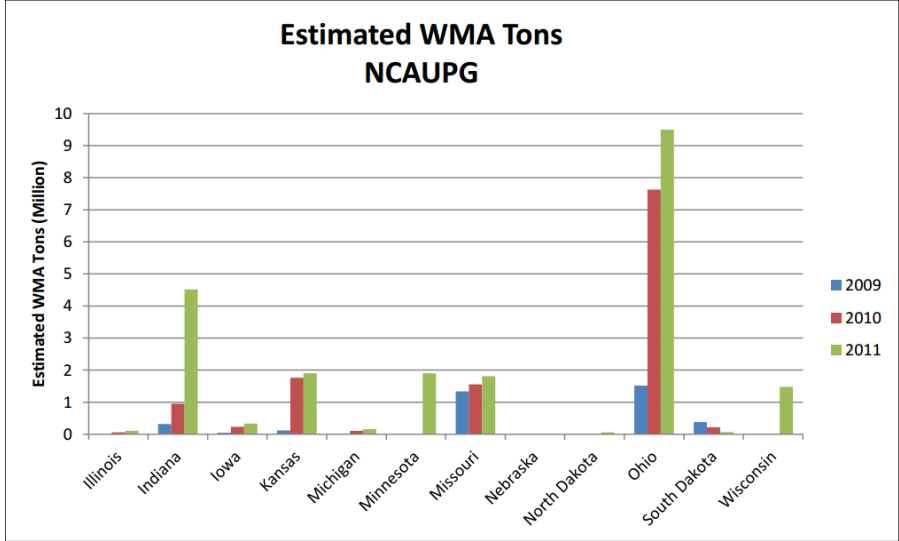


Warm Mix Asphalt (source: FHWA)

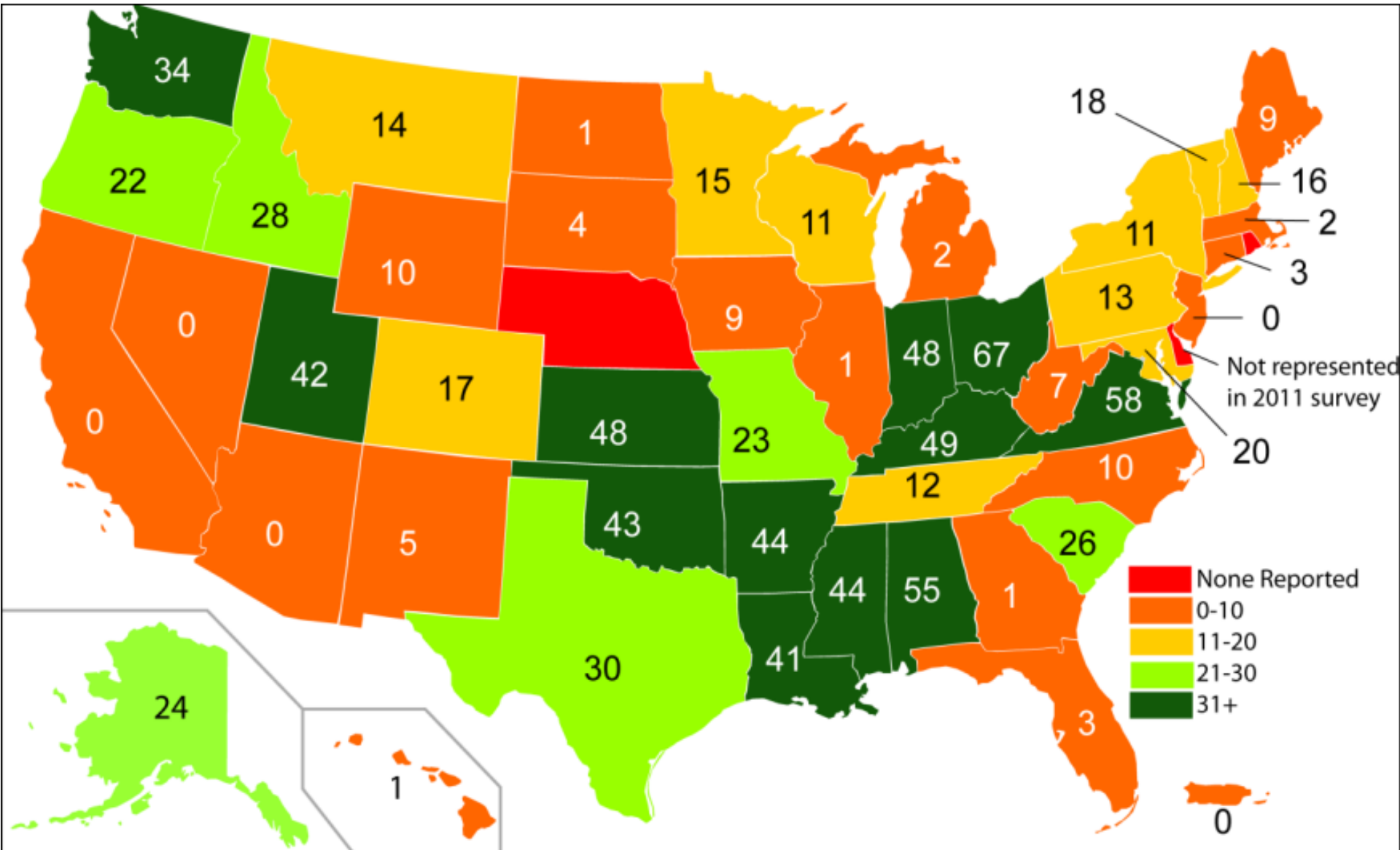
- WMA is produced at temperatures that are **30°F to 120°F** lower than the typical HMA temperatures of 300°F to 350°F.
- With WMA, temperatures generally start **30°F to 70°F** lower during mixing and remain lower during trucking, placement, and compaction.
- WMA technologies allow for production and placement of asphalt mixtures at temperatures **30°F to 75°F** lower than conventional HMA technologies.
- Reducing the production temperatures from 325°F for HMA to **around 265°F for WMA** saves ½ to 1 gallon of fuel per ton of mix*.

*Most asphalt plants are burning natural gas. The actual fuel savings by dropping the temperature is **8% to 10% for every 50°F**. Typical plants use 1.5 to 2 gallons of diesel per ton (assuming 10% saving, it will be **0.15 to 0.2 gallons per ton**). The fuel savings are 30 to 50 cents a ton. – Roger Sandberg of Maxam.



Source: NAPA

WMA Production as a Percentage of Total Asphalt Mix Production



Source: NAPA

Increased WMA Production from 2010 to 2011

- Total tonnage of WMA is estimated at 68.7 million tons in 2011. This is a **67 percent increase** over 41.1 million tons in 2010.
- In 2011, WMA was about **19 percent** of the total asphalt mixture market of about 360 million tons.
- **Plant foaming** is used most often in producing WMA, with about **95 percent** of the market; additives accounted for 5 percent of the market.

Warm-Mix Asphalt Production for 2012

Warm-mix asphalt is the generic term for a variety of technologies that allow the producers of asphalt pavement material to lower the temperatures at which the material is mixed and placed on the road by 10 to 100 degrees F.

***18. Did any of your plants in this state use Warm-Mix Asphalt technologies in 2012?**

Yes

No

Warm-Mix Asphalt Production for 2012

Warm-mix asphalt is the generic term for a variety of technologies that allow the producers of asphalt pavement material to lower the temperatures at which the material is mixed and placed on the road by 10 to 100 degrees F.

***19. What was average percent of mixes produced using warm-mix asphalt technologies in 2012 for the different sectors? (Use best estimate if data not available.)**

State DOT

Other Agency (City, County, FAA, Military)

Commercial & Residential

***20. What percentage of the total warm-mix asphalt (WMA) for 2012 was produced using the following technologies? (Use best estimate if data not available.)**

Chemical Admixture

Additive (Zeolite) Foaming

Plant Foaming

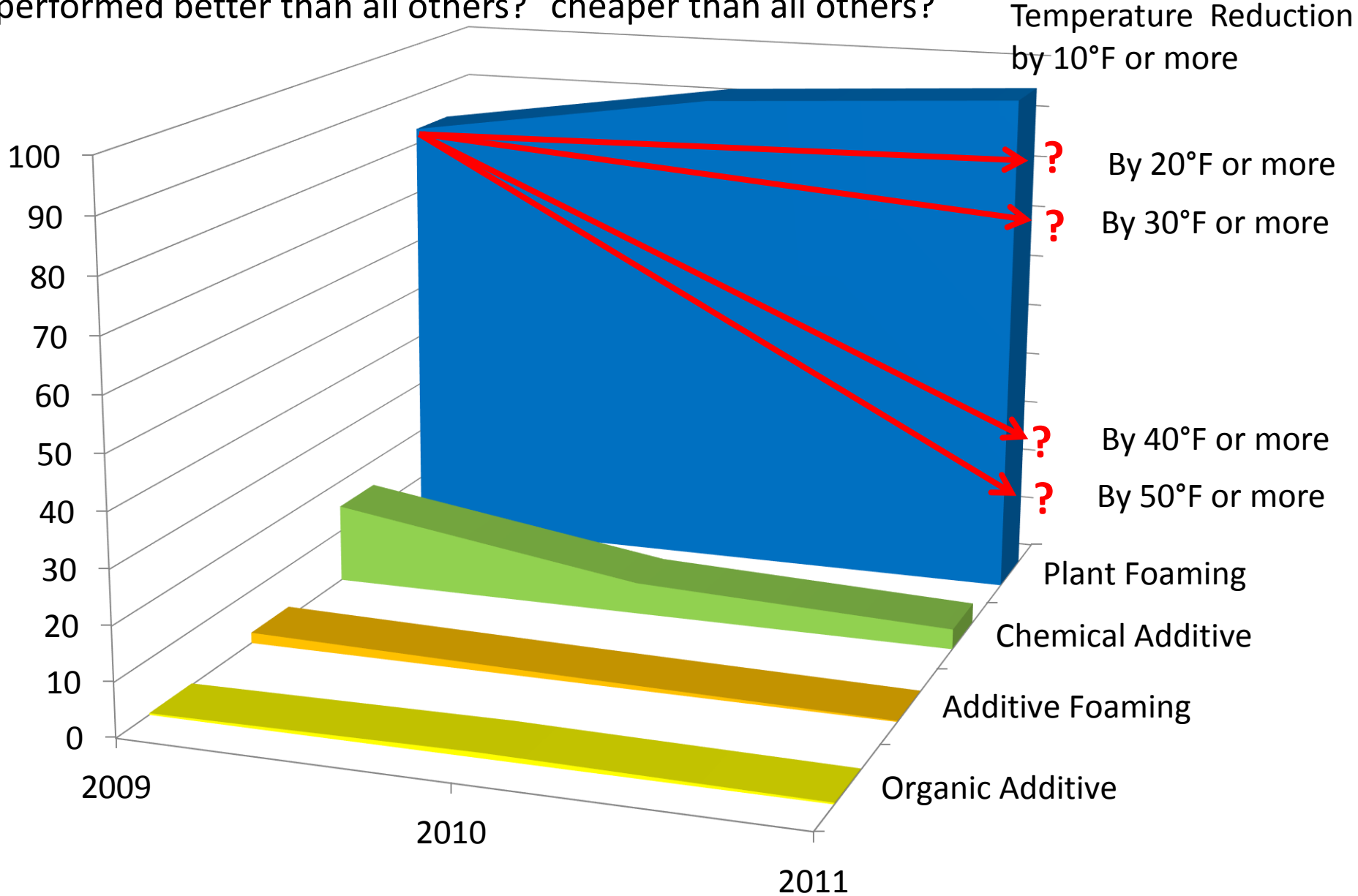
Organic (Wax) Additive

Source: NAPA

Percent WMA production in USA based on the survey by NAPA

Q1. Did WMA-foaming pavement performed better than all others?

Q2. Was WMA-foaming technology cheaper than all others?



Proposed Paradigm Shift to Revitalize the WMA

- **Re-define** the WMA by the reduction of temperature by **45°F or more** compared to HMA measured from the mix on the truck at the asphalt plant.
- Compute **the average and the standard deviation** of the measured mix temperatures from the truck.
- **Incentive** for producing the WMA mix with a significant reduction in the average temperature with a minimum standard deviation of the mix temperatures.
- To determine the optimum binder content, **the mix design** should be performed for all asphalt mixes including WMA mix.