

ASPHALT *for* SUSTAINABILITY

Setting the Record Straight

National Asphalt Pavement Association

AN OFTEN-USED DEFINITION OF ENVIRONMENTAL SUSTAINABILITY is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”¹

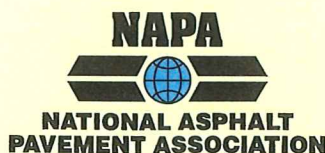
By any definition, asphalt is the sustainable material for constructing pavements. From the production of the paving material, to the placement of the pavement on the road, to rehabilitation, through recycling, asphalt pavements minimize impact on the environment. Low cost over the pavement’s life cycle, low consumption of energy for production and construction, low emission of greenhouse gases, and conservation of natural resources help to make asphalt the environmental pavement of choice.

Above all, what makes asphalt sustainable is the fact that only asphalt can be a perpetual pavement. Today’s asphalt pavements can be designed literally to last in perpetuity. Total pavement reconstruction is rendered virtually obsolete with a perpetual asphalt pavement. Instead, the asphalt pavement is engineered and built to last without requiring major structural rehabilitation or reconstruction, and needing only periodic surface renewal in response to distresses confined to the top of the pavement. Perpetual pavement is environmentally friendly because it is extremely long-lasting. When the surface is renewed, the material that is removed is recycled. Perpetual pavement is also budget-friendly and in most cases has a lower life-cycle cost than conventional asphalt or concrete pavements.

The American Concrete Pavement Association has made several statements about the sustainability of asphalt pavements that need to be addressed. Here are some of ACPA’s statements and NAPA’s factual responses.

The asphalt pavement industry has increased production of its product by 250 percent and reduced total emissions by 97 percent since 1970. The industry is keenly interested in processes that improve its energy efficiency and environmental friendliness. Today the industry is working on a new set of technologies to reduce the production temperature of its material. Known as warm-mix asphalt, these technologies reduce emissions and lower energy consumption. They also offer the potential for better performance and an extended paving season.

With over 94 percent of the 2 million miles of paved roads in the United States surfaced with asphalt, even relatively small but widely applicable advances in asphalt pavement technologies contribute greatly to energy efficiency and sustainability. Examples of such advances include Superpave and stone-matrix asphalt, which are designed to have a longer service life, even under very heavy traffic.





PERCEPTION:

“One of the unique distinguishing features of concrete pavements is their well-documented longevity compared to asphalt pavements. Most pavements are placed with a targeted design life of 20 years, but in reality concrete pavements generally last much longer, while asphalt pavements last less than 20 years.” —ACPA

REALITY: Studies from Kansas,² Oregon,³ Washington,³ Ohio,⁴ and Minnesota⁵ all show that asphalt pavements last as long as or longer than concrete pavements. In Oregon, the average age of concrete pavements on the interstates is about 30 years, the oldest being about 50 years. Asphalt pavements on interstate routes in Oregon are, on average, about 40 years old, with the oldest pavements being between 50 and 60 years old. In Washington, the asphalt pavements average in age between 35 and 40 years, with the oldest being about 50 years, and concrete pavements’ average age is about 35 years with the oldest being about 50 years.

What is more, the studies from Kansas² and Ohio⁴ show that asphalt pavements have a lower cost over their lives than do concrete pavements. Decades ago, using technology available at the time, an asphalt pavement would generally last 12 to 18 years before the first overlay was needed. Recent improvements brought about by better technology have been credited with extending the interval between construction and the first resurfacing of an asphalt pavement

to over 20 years. And, unlike with concrete, resurfacing an asphalt pavement can be done when traffic levels are at their lowest and the road can be turned back to traffic during rush hours. This enhances safety and convenience to the traveling public by minimizing delays for motorists.

In addition, many asphalt pavements built decades ago are functioning as perpetual pavements. Perpetual pavements are designed so that the pavement structure will last in perpetuity. Total pavement reconstruction is rendered virtually obsolete. The asphalt pavement is engineered so that distresses are confined to the top layer of the pavement. At infrequent intervals, the surface is removed for recycling, and replaced with a smooth, safe new surface. The Asphalt Pavement Alliance has awarded its Perpetual Pavement Award to over 27 agencies since 2001. In order to qualify for this award, the agency must submit documentation showing that the pavement has lasted more than 35 years with no structural failure. These sustainable pavements use fewer resources and have a lower lifetime cost than conventional pavements.

PERCEPTION:

“Concrete is 100 percent recyclable and reusable.” —ACPA

REALITY: Industry experts question how much concrete pavement is actually recycled back into concrete pavement. With Portland cement, the binder cannot be rehydrated after its initial use. Therefore, once the steel reinforcing material is extracted from reclaimed concrete, it is a low-value material which can be used only as aggregate in limited applications.

Asphalt pavement is America’s most recycled product. Recycling saves precious natural resources and reduces the carbon footprint of pavement construction. Of the 100 million tons of asphalt pavement reclaimed each year, about 75 million tons are mixed with virgin materials and incorporated into new asphalt pavement. This is called the *highest and best* use because the asphalt cement in the old pavement is reactivated, becoming part of the binder for the new pavement and replacing some of the virgin binder that would otherwise be required. Another 20 million tons of reclaimed asphalt pavement, or “RAP,” is reused in other ways in highway building.

Another way the asphalt industry recycles is through rubblization. When confronted with the need for reconstruction or major rehabilitation of a concrete pavement, rubblization in place of the concrete with an asphalt overlay is the easiest, lowest cost, and most effective way to rehabilitate the pavement in the shortest amount of time. The state of Arkansas estimated that it saved \$1.3 million per mile on 318 miles of rubblization projects—a total of \$413.4 million of taxpayers’ money—as compared to removing and replacing the existing concrete pavement. Rubblization saves energy because the rubblized pavement does not need to be hauled away and new base material does not need to be trucked in. Landfill space is saved. In addition, the need for mining and processing of virgin materials is reduced.

Aside from recycling its own product, the asphalt industry incorporates materials from other industries, including used tires, waste roofing shingles, glass, and many others, into high-quality pavements.

PERCEPTION:

*“Of the two types of highway pavements—**asphalt and concrete**—concrete pavements inherently have the lowest overall energy footprint. . . . The energy and sustainability benefits of hardened concrete used in transportation infrastructure overcome any drawbacks from the energy intensive manufacture of this one component [Portland cement].” —ACPA*

REALITY: In support of this assertion, the concrete industry cites a study performed by the Athena Institute and sponsored by the Cement Association of Canada.⁷ The asphalt industry’s response to these assertions is based on the environmental performance tool provided by the National Institute of Standards and Technology (NIST).⁸

The concrete industry’s study omits the energy consumed and the carbon dioxide emitted during production of Portland cement. For a life-cycle analysis of a construction material to be meaningful, however, it must include all aspects of production, construction, and disposal (or reuse/recycling) at the end of the material’s useful life.

The NIST tool is based on an extensive analysis of total life-cycle energy requirements and CO₂ emissions associated with different pavement types and designs. This analysis has been vetted at the highest public levels and EPA supports its use through the Environmentally Preferable Purchasing (EPP) Program, which is charged with carrying out Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management.

The NIST environmental performance tool should be considered as the gold standard for comparisons of true life-cycle energy consumption, greenhouse gas emissions, and any other environmental factors. Using the NIST software to compare different pavement types, there is little doubt about the environmentally superior life-cycle performance of asphalt pavements as compared to concrete.

Very little energy is required to produce asphalt, as a refinery typically expends energy to obtain products like gasoline, fuels, and lubricants; in some refineries, asphalt is the product remaining after all others have been extracted. However, the Department of Energy’s Energy Information Administration (EIA) assigns energy consumption values to the production of asphalt, and these are very low. According to the EIA, all carbon in asphalt is considered “sequestered.”⁸ In fact, due to the perpetual ability to reclaim and reuse asphalt pavement, the carbon (and energy) embodied in asphalt will likely remain sequestered indefinitely. Asphalt pavement may even be considered a renewable resource.

PERCEPTION:

“Concrete pavements have a direct effect on mitigating urban heat island effects. . . . Concrete has been used successfully, along with other light colored building materials and strategic planting, to reduce the urban heat island effect.”—ACPA

REALITY: Urban heat island mitigation is not a black and white issue. According to the United States Environmental Protection Agency, “there is no official standard or labeling program to designate cool paving materials, and research in this area is in an early stage. While studies show that pavements can affect the urban heat island and resulting air quality, results are complicated by several factors. These include the impact of shadows from nearby structures; changes in pavement characteristics over time; and the absorption by buildings of solar radiation reflected from the pavement surface.”⁹

Density, heat capacity, thickness, porosity, and a myriad of other factors affect pavement surface temperature as well. The co-directors of the National Center of Excellence: SMART Innovations for Urban Climate and Energy published an article in *Public Works* magazine emphasizing that factors other than pavement color play a large role in urban heat island

mitigation.¹⁰ EPA sponsors and looks to the National Center as leaders in this area. Not specifically mentioned in the *Public Works* article, but clearly identified in the satellite image that illustrates the article, the hottest surface temperature signature in Phoenix is the airport with its 23-inch-thick concrete runways. In the same article, the authors point out that open-graded asphalt pavement surfaces placed on top of concrete freeways are highly successful in reducing pavement surface temperature. EPA also recognizes that “[p]orous, or permeable, pavements benefit from the cooling effect of evaporation.”⁹ In addition, open-graded pavement systems have been shown to reduce the amount of pollutant loads.¹¹

PERCEPTION:

“If . . . [the] asphalt surfaces [on the National Highway System] were converted to concrete surfaces, it would save 2.1 billion gallons of diesel fuel per year at the pump (an \$8.2 billion dollar annual savings at \$4.00/gallon), reduce our dependence on oil, lower the emissions from vehicles, and decrease the cost of transporting goods.”—ACPA

REALITY: The concrete industry has cited a Canadian study as showing that concrete pavements provide better fuel efficiency for larger trucks.¹² This study, funded by the Portland cement industry in Canada, has several flaws which are noted in the report, but not mentioned by the ACPA. For instance, the researchers noted that the variability of the data was too great to show conclusive differences. Also, the asphalt pavement studied was considerably rougher than the concrete pavements.

In the end, the Canadian study proved what had already been shown in studies such as the one conducted in Nevada,¹³ that pavement roughness, not pavement type, is responsible for differences in fuel mileage. The Nevada study concluded that trucks running on a smooth pavement could save 4.5 percent on fuel consumption. Smoothness also means that truck tires don't bounce on the pavement and deliver the kind of impact loading they would on a rougher pavement. Some experts estimate

that increasing pavement smoothness by 25 percent results in a 9 to 10 percent increase in the life of pavements. As a rule, asphalt pavements are smoother than concrete pavements. Smoothness measurements on interstate highways in Oregon and Washington showed that asphalt pavements are on average 33 percent smoother in Oregon, and over 50 percent smoother in Washington.³ Long life contributes to asphalt's sustainability.



PERCEPTION:

“According to the Federal Highway Administration’s Technical Advisory on Price Adjustment Contract Provisions, construction of hot-mix asphalt roadways consumes more than five times as much diesel fuel as the construction of comparable concrete roadways.” — ACPA

REALITY: The fuel consumption statistics for pavement construction that are cited by ACPA are based upon a 1980 FHWA Technical Advisory that was intended to provide price adjustment indices for fuel consumption during the energy crisis of the late 1970s. It was based on data from a 1974 Transportation Research Board Circular.¹⁴ This information only covers part of

the energy consumption and does not take into account raw material acquisition such as aggregate, cement, and asphalt. It also assumes that a concrete plant will be erected near the job site but does not account for the energy or environmental cost to clear land, transport mobile concrete plant components, erect the plant, dismantle it, and restore the land.

PERCEPTION:

“Considering the associated reduction of carbon dioxide by constructing only concrete pavements, this would be equivalent to taking 2.7 million cars off the road annually.” — ACPA

REALITY: In a side-by-side life-cycle analysis, using the environmental performance software from the National Institute for Standards and Technology, the amount of CO₂ emissions

associated with constructing and maintaining a 50-year life cycle of an asphalt pavement is only about 30 percent of that associated with a concrete pavement.⁶

ENDNOTES

- ¹ Brundtland Report, "Our Common Future." Oxford: Oxford University Press. 1987.
- ² Cross, Steven A. and Robert L. Parsons, *Evaluation of Expenditures on Rural Interstate Pavements in Kansas*, Kansas University Transportation Center, University of Kansas, Lawrence, Kansas, February, 2002.
- ³ Transportation Research Board, *Pavement Lessons Learned from the AASHTO Road Test and Performance of the Interstate Highway System*, Transportation Research Circular E-C118, Washington, DC, July 2007.
- ⁴ Gibboney, Willis B., *Flexible and Rigid Pavement Costs on the Ohio Interstate Highway System*, Westerville, Ohio, 1995.
- ⁵ Lukanen, E., *Performance History of HMA Pavements with Aggregate Base and Portland Cement Concrete Pavements*, Minnesota Asphalt Pavement Association, New Brighton, MN, 2002.
- ⁶ Building for Environmental and Economic Sustainability; National Institute of Standards and Technology; (http://www.bfrl.nist.gov/oe/software/bees/please/bees_please.html. Downloaded July 2, 2008.)
- ⁷ "A Life Cycle Perspective on Concrete and Asphalt Roadways: Embodied Primary Energy and Global Warming Potential," Athena Institute, September 2006.
- ⁸ The Department of Energy's Energy Information Administration (EIA) (<http://www.eia.doe.gov/oiaf/1605/archive/87-92rpt/chap2.html>.)
- ⁹ USEPA Heat Island web site, Cool Pavements: (<http://www.epa.gov/heatisland/strategies/coolpavement.html> . Downloaded July 2, 2008.)
- ¹⁰ Golden, Jay S., and Kamil E. Kaloush, *A Hot Night in the Big City, How to Mitigate the Urban Heat Island*; Public Works Magazine, December 1, 2005. (<http://www.pwmag.com/industry-news.asp?sectionID=760&articleID=268116&artnum=1> , Downloaded July 2, 2008.)
- ¹¹ Barrett, Michael, et al., *Pollutant Removal on Vegetated Highway Shoulders Center for Transportation Research*, The University of Texas at Austin, October 2005, Rev. January 2006 (http://www.utexas.edu/research/ctr/pdf_reports/o_4605_1.pdf, Downloaded July 2, 2008.
- ¹² G.W. Taylor, P. Eng., & J.D. Patten. "Effects of Pavement Structures on Vehicle Fuel Consumption – Phase III," 2006.
- ¹³ Sime, M., et al., *WesTrack Track Roughness, Fuel Consumption, and Maintenance Costs*. Tech Brief published by Federal Highway Administration, Washington, DC. January 2000.
- ¹⁴ Technical Advisory on Price Adjustment Contract Provisions (Technical Advisory T 5080.3), Federal Highway Administration.
- ¹⁵ Roseen, Robert M., and T.P. Ballestero, *Porous Asphalt Pavements for Stormwater Management in Cold Climates*; HMA Magazine, National Asphalt Pavement Association, Lanham, MD, May/June 2008.
- ¹⁶ Hansen, D.I., R. S. James, and B. Waller, *Tire/Pavement Noise Study for Arkansas APA*, Asphalt Pavement Alliance, Lanham, MD, January 2005.
- ¹⁷ Hansen, D.I., R.S. James, and B. Waller, *Oklahoma Tire/Pavement Noise Study*, Asphalt Pavement Alliance, Lanham, MD, January 2005.
- ¹⁸ Hansen, D.J., R.S. James, and B. Waller, *Kansas Tire/Pavement Noise Study*, Asphalt Pavement Alliance, Lanham, MD, June 2005.
- ¹⁹ Rand, Dale A., *PFC Mixes Can Reduce Wet Weather Accidents*, HMA Magazine, National Asphalt Pavement Association, Lanham, MD, January/February 2007.

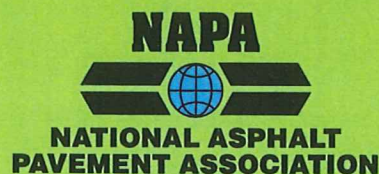
ASPHALT ALSO CONTRIBUTES TO ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY IN OTHER WAYS.

POROUS ASPHALT PAVEMENT. The same open-graded pavement type that is used to surface highways can also be used in porous asphalt pavement systems for storm water management. Placing a porous asphalt pavement on top of a stone recharge bed allows storm water to percolate through the pavement surface into the recharge bed, where it is stored until it can infiltrate into the soil. Porous asphalt pavements decrease runoff and increase filtration, improving water quality. A porous asphalt pavement parking system tested at the University of New Hampshire Stormwater Center exceeded 95 percent removal efficiency for total suspended solids.¹⁵ In addition, a recent study by the Texas Department of Transportation found a 90 percent reduction in total suspended solids by using a porous asphalt surface on a highway pavement.¹¹

Open-graded and porous pavements hold great promise for water quality improvement. Porous asphalt pavements of both types—open-graded surfaces for highways, and porous pavement systems for stormwater management—have been used widely for over 20 years with an excellent record of success.

QUIET PAVEMENTS. As developable real estate becomes increasingly scarce in the urban and suburban landscape, more residents find themselves in closer proximity to high-speed highways and their noise. A major component of that noise is generated at the tire-pavement interface. Many times, very expensive noise walls are constructed between the development and the highway. These walls often cost as much as \$50,000 per affected household. However, such noise walls have very limited effectiveness in reducing noise from the roadway, especially for residents living farther away. Using a low-noise asphalt surface means that the volume can be turned down at the source, and that noise walls can be reduced in height. For every 1 decibel reduction, the noise wall can be reduced by 3 feet. If one considers all the miles of urban roadways in the U.S., the savings could be in the hundreds of millions of dollars or more. It has been shown that asphalt pavements in the U.S. are quieter than concrete, anywhere from 1 to 10 decibels.^{16, 17, 18} This reduction in noise is of great importance to those residents' quality of life. It is an important societal and budgetary issue that researchers continue to find ways to mitigate roadway noise through better surfacing materials.

DON'T FORGET ABOUT SAFETY. While environmental sustainability is critically important, another factor is also of great interest to motorists, contractors, and highway departments alike: safety. Using open-graded asphalt surfacings on highways helps to eliminate tire splash and spray in rainstorms. Not only does this enhance tire-to-pavement contact, and therefore safety, it also improves drivers' visibility. In a high-accident area in Texas, replacement of a typical non-porous surface with porous friction course reduced wet-weather accidents by 93 percent and reduced fatalities by 86 percent.¹⁹ To date, a successful concrete open-graded surfacing material for high-speed pavements has not been developed because concrete's brittleness causes it to crack and ravel under traffic.



N a t i o n a l A s p h a l t P a v e m e n t A s s o c i a t i o n

5100 Forbes Blvd.
Lanham, MD 20706
+1.301.731.4748
Toll-free: 888.468.6499
Fax: +1.301-731-4621
www.hotmix.org