

Basics	ePAVE LLC	Pavement Surface Coatings	GAF	GuardTop	National Concrete Pavement Technology Center
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Product	ePAVE Cool Pavement Technology	Endurablend	GAF DuraShield	CoolSeal	Concrete Overlays
General					
What is the expected timeline to develop and commercialize the solution if it is not currently available?	ePAVE is developed and is in commercialization stage with two product formulations for both asphalt and concrete pavement surfaces: one for roads and another for non-vehicular surfaces. We have applied ePAVE on several road projects, schools, bike lanes. Our next upcoming projects are a few school playgrounds, a movie studio parking lot and loading stage, a driveway, a parking lot and a resort.	Endurablend is available now and has been installed for over 10 years as an Coating	GAF DuraShield is commercially available today. It is a two-part epoxy-fortified acrylic pavement coating and uses the same technology that we have been using with our StreetBond Pavement Coatings for over 25 years. Currently we sell directly to our GAF Certified Applicators who then bid the jobs and install the product.	CoolSeal by GuardTop was developed in 2011. Guardtop has been manufacturing pavement maintenance products since 1983 and coolseal was designed to be a high performance maintenance product as well as an urban heat island mitigation. CoolSeal has been applied throughout the United States and in 4 other countries. It can be shipped globally.	Concrete overlays have been constructed on top of old, dark, worn, pavements of all types for over 40 years. However, their adoption has been limited to a relatively small number of applications in some states. Implementation can move forward immediately. This approach serves to improve / restore pavement structural performance at the same time as increasing albedo, with a minimum of negative environmental impacts.
What surface and air temperature reductions resulting from the roadway solution, daytime and nighttime, have you identified?	For vehicular roads, ePAVE yields daytime reduction of 5 to 7 degrees. For non-vehicular surfaces, ePAVE yields a daytime reduction of up to 20 degrees. We have not measured the nighttime temperature reduction.	We have noted an 18 degree C difference in white Endurablend and associated asphalt	GAF DuraShield Solar Gray Pavement Coating has a Solar Reflectance of 34% (SR = 34). Its color is a medium gray and include special pigments that allow it to achieve a high reflectance, while keeping the color dark enough to better hide dirt and tire pick-up and reduce glare. We believe this is the optimal balance of reflectance, glare mitigation, and aesthetics for pavement surfaces. b. As for temperature reductions, it depends on a lot of factors such as time of day, ambient temperature, amount of sunshine, wind, surface texture, dirt and tire marks. It also matters if you are comparing to new asphalt, old asphalt, or freshly seal coated asphalt. Compare any solar reflective coating to new asphalt or newly seal coated asphalt and the temperature difference will be higher than comparing to aged asphalt. c. As the ambient temperature increases, the temperature difference between a solar reflective coated asphalt and a non-coated asphalt will increase. For example, at 80°F ambient temperature the difference may only be 8°F - 10°F, while a 90°F ambient temperature the difference could be 15°F- 20°F or more. In hotter ambient temperatures a solar reflective coating provides the most benefit. d. On an 80°F day in July 2020, the City of LA reported DuraShield temperature reduction as compared to uncoated streets in the same neighborhood to average 8°F.	CoolSeal has seen surface temperature reductions ranging between 15-40 degrees Fahrenheit depending on weather conditions. Air temperature reduction data has been more limited but recently NASA's ecostress satellite measured a neighborhood that had coolseal applied in 2019 and saw a 2 degree temperature reduction both during the day and at night. Guardtop now has access to NASA's LST satellite data so in the future air temperature data from each installation will be easily obtained.	By increasing the albedo of a pavement surface by up to four times, the amount of heat absorbed by the pavement can be similarly reduced. (https://ntrs.nasa.gov/app/uploads/2019/12/quantifying_pvm_albedo_w_cr.pdf) Mixtures containing slag cement or white cement can further increase the albedo. This technique is used by groups seeking to gain LEED points in parking lots. One challenge is that data has shown that dirt collecting on concrete overlays can reduce the albedo, it still remains higher than that of darker systems.
How simply can the solution be integrated into existing roadway management and maintenance operations?	This solution is very simple to integrate and can be used in lieu of traditional resurfacing materials before the underlying surfaces deteriorate. Since ePAVE preserves pavement surfaces, it extends the life of and could be used to eliminate major damages to a surface.	Endurablend is applied topically on asphalt or concrete to existing substrate at approx 2 mm	DuraShield can be easily integrated into existing roadway management and maintenance operations. It can be applied using standard seal coat equipment	CoolSeal was designed with simplicity in mind. Since it is an asphalt based sealcoat it does not require any special equipment or training to install. CoolSeal is fully compatible with the existing road maintenance equipment and practices used by municipalities and contractors. In addition to its cooling benefits, CoolSeal extends the life of the asphalt surface. By applying CoolSeal about every 7 years to a roadway you can triple the lifespan of an untreated asphalt surface.	This approach has been successfully adopted by many agencies such as Iowa DOT as a regular part of their roadway management operations.
What is the global warming potential associated with manufacturing the roadway solution in production and use phase?	With a thermal emittance of 0.90 and Solar reflectivity index of 32-40, ePAVE effectively reduces both surface and ambient air temperatures, mitigating Urban Heat Island effects. It also dramatically lowers the greenhouse gas emission by sealing the underlying asphalt surfaces. We haven't measured the impacts in the production phase.	Endurablend is extremely durable, cement based and can be installed in virtually any color	DuraShield is a water-based, acrylic based product and low VOC, (less than 50 grams/liter). Production includes transportation, raw materials, installation. Advantages include... DuraShield is applied in a thin film, so not a lot of heavy material to transport. It is durable and long lasting, so it does not need reapplication as frequently as other coatings. Longer lasting equates to less raw materials, production, transportation, and installation impacts. A recent study conducted by ASU found that a "polymer-coated binder had the lowest degree of aging when compared to other binders extracted from various RAP binders. Less aging in general means less cracking and longer service life".	Since CoolSeal is an asphalt based product there is little to no global warming or greenhouse gas potential during the manufacturing process. CoolSeal is mixed and applied at ambient temperatures using recycled materials that would otherwise end up in landfills. Asphalt is the most recycled material in the world and the main component of Coolseal. Many plastics and acrylics have been proven to be very toxic to manufacture and may outweigh some of the cooling benefits. While acrylics and plastics may perform well we have maintained our asphalt based approach due to the data about plastics and greenhouse gases.	Research has shown that stiffer, smoother pavements reduce the fuel consumption of the vehicles traveling on them. Especially truck traffic. Adopting concrete overlays will significantly reduce the carbon footprint of the vehicles that travel those routes (http://cshub.mit.edu/pavements/pvi).
Add any additional information for the proposed solution.	Attached are: Safety data Sheets, Technical Bulletin, Case studies and a whitepaper. B. For more photos, please visit our website: www.epave.com C. YouTube Channel: https://www.youtube.com/channel/UCFwFMVjGco276duGIL30G		Attached are job profiles, Product Data Sheet and Safety Data Sheet.	See attached.	An abundance of material is available at cptechnic.org/overlays. A database of existing overlays can be found at http://overlays.acpa.org/webapps/overlayexplorer/index.html
Cost and Installation					
Can the solution be purchased and installed by in-house department staff (i.e. does not require a licensed installer)?	Yes. ePAVE could be installed in-house following a proper one hour training by ePAVE.	No	Yes, it can be installed by in-house department staff and we can assist in training. To issue the extended warranty, the installer must be a GAF Authorized Applicator - Pavement Coatings, trained and certified by GAF.	Yes	No, Any contractor able to place concrete pavements will be able to do this work
If so, does it require special equipment to install it? If yes, what equipment is needed?	Yes, it requires a mixer and a hand squeegee or a box squeegee		DuraShield can be installed in a variety of methods including standard seal coat equipment or a texture sprayer. Drivable machinery that sprays the coating quickly can also be used. In addition, DuraShield can be applied with a squeegee, roller, or brush for smaller areas.	No	No
If so, what is the cost per square yard for materials: \$/SY	The cost is \$4.50 per SY		Material costs can vary by application. A lightly traveled neighborhood street would require less material than a more heavily traveled parking lot, like a Home Depot. Hot, dry climates require less material than temperate climates with a lot of rain and/or snow. Current costs range from about \$2.50 - \$5.00/sy	Material is about \$13.50 per square yard on a two coat application	See below
What is the cost per square yard for material if installed by contractor	If material is installed by a contractor, the material and installation would cost between \$10.00 to \$27.00 per SY, depending on the colors chosen and thickness of the application required.	Monolithic \$45 to 590 Per sy and if patterned, 590 to 1350 per sy	Installed cost vary depending on various factors, including location, project size and complexity, and the particular contractor. Some areas require union labor and/or have established prevailing wages. While we do not control pricing or labor of an installer, we are aware of labor rates to install the product as low as \$1.00 - \$1.35 per square yard and as high as \$3.00 - \$4.00. With large volumes and innovation, we hope to bring down labor costs considerably.	All in cost for material and labor is between \$4-\$4.75 per square yard	Concrete overlay materials costs will vary by region and market - but are comparable with conventional concrete mixture costs - \$70 to \$100 /cubic yard
What is the average installation rate:	Average installation rate is 6000 SY/Day	On an airport we applied 60,000 sf in a day but in urban environments 10,000 sf per day is more realistic	The amount of SY/day depends on the equipment used and number of crews. We currently have Applicators who are able to do 5,000 to 6,000 SY/day per crew. With large volumes and innovation, we hope to increase installation rates considerably.	Average installation rate is about 22,000 SY for two coats of material	Constructed costs of concrete overlays have been reported to range in price from \$3.29 /sy/inch to \$6.14 /sy/inch
Use Cases					
What are the appropriate uses for the solution (e.g., pavement type, age, condition, climate)? Please provide appropriate case studies, testing, and/or supporting research.	ePAVE is engineered to be used on both asphalt and concrete surfaces. Asphalt could be a few days old to 10 years old. Concrete surfaces need to cure before ePAVE application. A pavement condition index of 70 and higher is recommended. If a pavement is deteriorated, cracks and potholes should be sealed with a recommended product before ePAVE application. Based on lab testing and field experience to date, ePAVE may be used in any climate. Case studies attached.	We have done no studies on albedo and Endurablend. However, we have been on surfaces for 10 years with 60,000 per day	DuraShield is mostly used on Hot Mixed Asphalt (HMA) surfaces that are either new or old, (as long as asphalt is structurally sound). It can also be used on concrete (PCC) with a primer. Pictures of jobs are attached. More additional information is available upon request.	Like any asphalt based sealcoat CoolSeal is designed to be applied to surfaces in relatively good condition for the purpose of maintenance that surface. It can be applied to surfaces that are older with some cracking. CoolSeal cannot be applied surfaces with excessive potholes and structurally failed areas.	Concrete overlays can be applied to most existing pavements, normally as part of regular maintenance to extend pavement life, restore ride quality or increase load carrying capacity. Many examples are reported at http://overlays.acpa.org/webapps/overlayexplorer/index.html One challenge in urban environments is that increasing the elevation of a pavement 4 inches may take some careful detailing to ensure ongoing compatibility with crossings, driveways, service manholes and overhead bridge clearances.
What are the safety, slipperiness, and friction characteristics (e.g. friction Surface Coefficient of Friction)?	A Typical ePAVE surface under wet and dry condition is higher than of industry standard (>0.50). Surface Friction Average Dry condition=72.7, Surface Friction Average Wet condition=68	Endurablend is applied with either intermixed aggregate or topically applied aggregate to achieve FN40 numbers as high as 65.	Per ASTM E303-93 test, the Dry Friction is >65 and Wet Friction is >35. In addition, the British Pendulum test results are also attached (Attachment D).	Coolseal has an average coefficient of friction of .82 when dry and .76 when wet under ASTM C1028 specification	Coefficient of friction is the same as any concrete surface, controlled by the type of fine aggregate in the mixture and the finishing work conducted on it. Loss of friction is uncommon over time
What is the curing time including how quickly the road can open to traffic after installation given average temperatures, partly sunny, and non-humid conditions? How does this compare to existing relevant products?	ePAVE cures in one hour in 70°F and higher. In temperatures below 70°F, it could vary between 1 to 4 hours. Traffic could be open immediately as soon as it cures. Similar products have a much longer curing time, some as high as 12-24 hours to cure before opening to traffic.	Endurablend will cure to traffic in 2 to 3 hours after installation in daylight. It is cement based, nighttime cure takes significantly longer	Assuming 73°F (23°C) and 37% humidity (ASTM D5895) the product should be dry to touch in 35 minutes. For driving traffic we recommend a minimum of 4 hours in dry sunny climates and 24 hours or more in cool temperate or humid climates.	Coolseal takes about an hour to dry under average conditions and must cure for a few hours before being opened to traffic. Most projects with municipalities that we have completed have closed streets from 7AM-5PM. This is on par with regular asphalt sealants.	Typically, traffic can be returned to the pavement within 3 to 7 days.
Is it sensitive to placement in cool weather, i.e. 50° F and falling?	No	Only with regard to cure time Not performance. It is applied at 2 mm and is cement based so cure is temperature sensitive	DuraShield is installed at 50°F and rising.	Yes, CoolSeal must be applied on days where temperatures are 50 degrees and rising. As is typical with most asphalt coatings to allow for proper drying and surface adhesion.	Paving is discouraged at 40°F and falling
Is it sensitive to placement in high humidity or damp conditions?	No	We have noted an 18 degree and associated asphalt	DuraShield can be installed in high humid climates, but it will require longer dry times than dry, arid climates.	As with traditional black sealcoat there is no issue with applying CoolSeal in humid conditions.	No - in fact high humidity will increase concrete hydration leading to improved characteristics.
How long does this treatment typically last under average traffic conditions in years? How does this compare to similar products?	Based on case studies, ePAVE has lasted 5 years on a road with 2 million vehicles per year. This translates to 10 years and higher for residential roads and much longer for areas without vehicular traffic such as playgrounds, pedestrian areas and bike lanes. B. Based on the data we have, typical cool pavement products last less than one year and some do not function under heavy vehicular traffic, especially around Stop sign at intersections with a hard stop.	We know of no other products which have been installed for 10 years in 60,000 vehicle per day traffic and still performed.	Average traffic conditions is subjective, but we have found that DuraShield will last years longer than typical asphalt emulsion products used today. Generally we recommend a typical recoat cycle every 5-7 years. Based on testing performed in 2018 by PRR, (a third party construction materials testing lab) DuraShield wore much slower and kept its color much longer than several other competitive pavement coatings that were also tested. In a typical recoat, a full re-application may not be necessary. Instead we recommend two layers in the worn area (typically wheel paths) and then one coat over the entire area.	Coolseal on average lasts about 7 years. Traditional black asphalt sealcoats last about 4 years (https://ntrs.nasa.gov/app/uploads/2017/09/iowa_concrete_overlay_performance_w_cvr.pdf)	Data from Iowa shows that typical lifetime is 25 to 40 years
Can it be re-applied over itself for renewal?	Yes	Yes	Yes. DuraShield bonds well to itself even years later. The surface just needs to be clean, dry and free of contaminants such as grease and oils.	Yes, Coolseal is typically reapplied after 7-10 years after the initial application has started to wear off but there is no issue with applying before wear has occurred. Coolseal can also be applied over existing surface treatments with no issue such as traditional black sealcoat, slurry seal, fog seal, chip seal, and micro surfacing.	Yes
Is it recommended for heavy traffic conditions like urban arterials?	Yes	Yes	Yes, however it will require a thicker initial application and a more frequent recoat cycle. The product wears due to traffic so the more traffic the more wear. Rolling traffic is not as much a wear concern as is sheer from acceleration, braking and turning.	Coolseal current flagship formulation is designed for lower traffic streets with speed limits of 35 MPH or less but we have developed a high traffic formulation with larger aggregate to meet slip resistance specifications for larger arterials.	Yes
Are standard MUTCD compliant white and yellow markings clearly visible?	Yes	Yes	Our coating is a medium gray color so white and yellow lines show up better than typical concrete surfaces. That said some customers have painted a black border around the white and yellow lines to make them stand out more.	Yes, see attached photos.	Yes

Basics	Contact Name	Email	Phone	Product	General	Describe the product	What is the expected timeline to develop and commercialize the solution if it is not currently available?	What surface and air temperature reductions resulting from the roadway solution, daytime and nighttime, have you identified?	How simply can the solution be integrated into existing roadway management and maintenance operations?	What is the global warming potential associated with manufacturing the roadway solution in production and use phase?	Add any additional information for the proposed solution.
ePAVE LLC	Klara Moradkhan	klara@epavelc.com	818-620-3308	ePAVE Cool Pavement Technology		ePAVE is a polymer based pavement coating made up of a liquid solution and dry blend powder.	ePAVE is developed and is in commercialization stage with two product formulations for both asphalt and concrete pavement surfaces: one for roads and another for non-vehicular surfaces. We have applied ePAVE on several road projects, schools, bike lanes. Our next upcoming projects are a few school playgrounds, a movie studio parking lot and loading stage, a driveway, a parking lot and a resort.	For vehicular roads, ePAVE yields daytime reduction of 5 to 7 degrees. For non-vehicular surfaces, ePAVE yields a daytime reduction of up to 20 degrees. We have not measured the nighttime temperature reduction.	This solution is very simple to integrate and can be used in lieu of traditional resurfacing materials before the underlying surfaces deteriorate. Since ePAVE preserves surfaces, it extends the life of and could be used to eliminate major damages to a surface.	With a thermal emittance of 0.90 and Solar reflectivity index of 32-40, ePAVE effectively reduces both surface and ambient air temperatures, mitigating Urban Heat Island effects. It is also durable and long lasting, so it does not need replacement as frequently as other coatings. Longer lasting equates to less raw materials, production, transportation, and installation impacts. A recent study conducted by ASU found that a "polymer-coated binder had the lowest degree of aging when compared to other binders extracted from various RAP binders. Less aging in general means less cracking and longer service life".	Attached are: Safety data Sheets, Technical Bulletin, Case studies and a whitepaper. B. For more photos, please visit our website: www.epavelc.com C. YouTube Channel: https://www.youtube.com/channel/UCFwFMV1xGee276duG4L30g
Pavement Surface Coatings	Robert Wilson	bob@pavementsurfacecoatings.com	973-632-7426	Endurablend		Endurablend is a polymer modified cement thin overlay.	Endurablend is available now and has been installed for over 10 years as an Coating	We have noted an 18 degree C difference in white Endurablend and associated asphalt	Endurablend is applied topically on asphalt or concrete to existing Substrate at approx 2 mm	Endurablend is extremely durable, cement based and can be installed in virtually any color	
GAF	Lee Martucci	lee.martucci@gaf.com	480-625-5553	GAF DuraShield		DuraShield is an epoxy-modified acrylic coating	GAF DuraShield Solar Gray Pavement Coating has a Solar Reflectance of 34% (SR = 34). Its color is a medium gray and include special pigments that allow it to achieve a high reflectance, while keeping the color dark enough to better hide dirt and tire pick-up and reduce glare. We believe this is the optimal balance of reflectance, glare mitigation, and aesthetics for pavement surfaces. b. As for temperature reductions, it depends on a lot of factors such as time of day, ambient temperature, amount of sunshine, wind, surface texture, dirt and tire marks. It also matters if you are comparing to new asphalt, old asphalt, or freshly seal coated asphalt. Compare any solar reflective coating to new asphalt or newly seal coated asphalt and the temperature difference will be higher than comparing to aged asphalt. c. As the ambient temperature increases, the temperature difference between a solar reflective coated asphalt and a non-coated asphalt will increase. For example, at 80°F ambient temperature the difference may only be 8°F - 10°F, while a 90°F ambient temperature the difference could be 15°F - 20°F or more. In hotter ambient temperatures a solar reflective coating provides the most benefit. d. On an 80°F day in July 2020, the City of LA reported DuraShield temperature reduction as compared to uncoated streets in the same neighborhood to average 8°F.	DuraShield can be easily integrated into existing roadway management and maintenance operations. It can be applied using standard seal coat equipment	DuraShield is a water-based, acrylic based product and low VOC, (less than 50 grams/liter). Production includes transportation, raw materials, installation. Advantages include... DuraShield is applied in a thin film, so not a lot of heavy material to transport. It is durable and long lasting, so it does not need replacement as frequently as other coatings. Longer lasting equates to less raw materials, production, transportation, and installation impacts. A recent study conducted by ASU found that a "polymer-coated binder had the lowest degree of aging when compared to other binders extracted from various RAP binders. Less aging in general means less cracking and longer service life".	Attached are job profiles, Product Data Sheet and Safety Data Sheet.	
GuardTop	Davis Koles	davis@guardtop.com	310-970-4271	CoolSeal			CoolSeal has seen surface temperature reductions ranging between 15-40 degrees Fahrenheit depending on weather conditions. Air temperature reduction data has been more limited but recently NASA's ecostress satellite measured a neighborhood that had CoolSeal applied in 2019 and saw a 2 degree temperature reduction both during the day and at night. GuardTop now has access to NASA's LST satellite data so in the future air temperature data from each installation will be easily obtained.	CoolSeal was designed with simplicity in mind. Since it is an asphalt based sealcoat it does not require any special equipment or training to install. CoolSeal is fully compatible with the existing road maintenance equipment and practices used by municipalities and contractors. In addition to its cooling benefits, CoolSeal extends the life of the asphalt surface. By applying CoolSeal about every 7 years to a roadway you can triple the lifespan of an untreated asphalt surface.	Since CoolSeal is an asphalt based product there is little to no global warming or greenhouse gas potential during the manufacturing process. CoolSeal is mixed and applied at ambient temperatures using recycled materials that would otherwise end up in landfills. Asphalt is the most recycled material in the world and the main component of CoolSeal. Many plastics and acrylics have been proven to be very toxic to manufacture and may outlast some of the cooling benefits. While acrylics and plastics may perform well we have maintained our asphalt based approach due to the data about plastics and greenhouse gases.	See attached.	
National Concrete Pavement Technology Center	Peter Taylor	ptaylor@iastate.edu	515-294-9333	Concrete Overlays			Concrete overlays have been constructed on top of old, dark, worn, pavements of all types for over 40 years. However, their adoption has been limited to a relatively small number of applications in some states. Implementation can move forward immediately. This approach serves to improve / restore pavement structural performance the same time as increasing albedo, with a minimum of negative environmental impacts.	By increasing the albedo of a pavement surface by up to four times, the amount of heat absorbed by the pavement can be similarly reduced. (https://trns.ltrr.iastate.edu/nppl/uploads/2019/12/quantifying_pavnt_albedo_w_cv.pdf) Mixtures containing slag cement or white cement can further increase the albedo. This technique is used by groups seeking to gain LEED points in parking lots. One challenge is that data has shown that dirt collecting on concrete overlays can reduce the albedo, it still remains higher than that of darker systems.	This approach has been successfully adopted by many agencies such as Iowa DOT as a regular part of their roadway management operations.	Research has shown that stiffer, smoother pavements reduce the fuel consumption of the vehicles traveling on them. Especially truck traffic. Adopting concrete overlays will significantly reduce the carbon footprint of the vehicles that travel those routes (http://chub.mit.edu/pavements/pv).	An abundance of material is available at cptechcenter.org/overlays. A database of existing overlays can be found at http://overlays.acpa.org/webapps/overlaysplorer/index.html
Lhoist North America	Melissa Sewell	melissa.sewell@lhoist.com	817-235-6257	Lhoist Mineral Slurry			The solution was tested at laboratory scale and on a small private road section in Belgium, Europe. Scaling up the solution to measure durability and performance requires a careful evaluation of the skid resistance in different conditions. We have data but we may need additional data points for confirmation. The product used is currently available at large scale, it derives from an already commercialized product used for other applications. The method of application is based on truck spreading and is also already well developed for other applications and may only need some minor adaptations.	On a road-section test realized in Belgium, for an average daily ambient temperature of 77°F and a maximum of 93°F, surface temperature reduction of up to 20°F at daytime and 47° at nighttime have been measured. However, Belgium summer climate is not the most relevant to precisely characterize our product performances. We consider that the results obtained here are limited and we expect better results in more severe conditions.	The integration is simple. As a special mineral slurry, it requires a 15-minute homogenization by mechanical mixing once a day. A mechanical cleaning of the road is recommended before applying the slurry on the asphalt pavement. Application is carried out with a truck equipped with spreading nozzles. The optimal frequency of application is yet to be determined, we expect it be once or twice a year.	For the manufacturing phase, the global warming potential is distributed between: - the energetic impact of the mineral slurry manufacturing process (extraction and processing), and the water supply, which depend on local characteristics, - and the fixed part of CO2 released during the process which represents from 1550 lbs./ton to 1850 lbs./ton of product. During the use phase, the installation of the product does not require the use of particularly impactful methods. The aforementioned information is true for one application of the product	See attached
Pavement Technology Inc	Chris Evers	cevers@pavetechinc.com	727-638-1699	PlusTi		PlusTi is a polymerized maltene-based petroleum resin asphalt binder rejuvenator that includes TiO2.	PlusTiTTM is commercially available today. To date Pavement Technology Inc has already successfully applied PlusTiTTM on projects for over a dozen agencies across the Country. Development of the technology began in 2016 with pilot projects spanning 2017 to 2019 and project implementation beginning in 2020. Ongoing research continues to take place at the Texas Transportation Institute located at Texas A&M. PlusTi is in the early stages of rolling out the technology and is prioritizing OCA CRP participants as part of the roll out. The technology has been applied in: A select list of PlusTiTTM completed to date: Cincinnati, OH, Summit County, OH (Akron), Austin, TX (TXDOT), Raleigh, NC, Cary, NC, Charlotte, NC, Greenville, SC, Orlando, FL, Orlando International Airport (MCO), Bartow, FL (FDOT Test Section), Charlotte County, FL, Delray Beach, FL (South Florida), St. Petersburg, FL (LEED project) under construction. PlusTi is capable of rapidly scaling production and application capabilities to meet significant future demand over the next few years. We are committed to working with our Cool Roadways Partners at the Agency level to begin the process of evaluating and deploying the PlusTiTTM technology.	Ongoing pilot projects are currently tracking UHI metrics including Solar Reflectance Index, Emisivity, Albedo, and pavement temperature changes. One of the primary benefits PlusTiTTM expects to gain from being in the Cool Roadways Partnership is more field analysis of the positive effects of increasing SRI through more diverse geographically located projects using all of the aforementioned metrics. PlusTi has demonstrated consistent ability to increase SRI by between 350% to 450% (see attached case studies). Many recently resurfaced asphalt roads will have an SRI reading of between 5 and 10, PlusTiTTM targets an SRI value of 40 and consistently delivers results in the field. PlusTiTTM is currently on our projects on either asphalt or concrete pavements. Current pilot projects focus on meeting existing USGBC LEED criteria making this solution easily deployable immediately without extensive design standard or procurement procedure changes which might delay deployment. This enables the use of a standardized measurement that levels the playing field rather than focus on albedo which some technologies may not effect (PlusTiTTM does not affect albedo) to get positive results. Measure SRI either in the field or lab is quick and doesn't require expensive instrumentation to gather. Fitting into an existing and widely accepted standard to measure UHI mitigation performance will enable more rapid deployment of viable solutions. Some academic estimates based on the dramatically higher SRI values the PlusTiTTM technology produces and assuming scale deployment, range air temperature improvement by 5-7 degrees.	Is a few words, PlusTiTTM can be integrated into any pavement preservation program quite easily. Utilizing proven pavement penetrating technology to deliver vital chemicals into a pavement matrix is a process thousands of Public Works Agencies have been deploying for over 50 years. The topical spray application offers cost and efficiency advantages for integrating highly specialized, plant-mixed molecular pavement preservation materials into existing pavement infrastructure. Application can occur as a part of new construction, rehabilitation projects or as a part of existing preventative maintenance operations. Significant cost advantage occurs from focusing on the top layers of roadways rather than incorporating expensive materials throughout pavement layers not impacted and hence not reacted by sunlight. The fact that the technology essentially piggybacks a proven preservation strategy enables agencies to deploy at scale which is critical in the light on UHI. Without the ability to scale, cities face an uphill battle to significantly impact UHI. In addition, the added benefits of extended roadway life cycles as an economically feasible cost make PlusTiTTM an attractive solution for agencies impacted by tight budgets. For hundreds of agencies around the country who already use asphalt rejuvenation in their preservation programs, integration comes even easier as a simple shift to the photocatalytic capable application, PlusTiTTM.	Production of the PlusTiTTM technology does not appreciably contribute to global warming as it does not use a carbon intensive manufacturing process. Additionally one key benefit of this technology is the ability to leverage well-known photocatalytic science, previously unavailable for the roadway microenvironment, to directly reduce NOx emissions by 20-50% or greater at the point source, providing a previously unthinkable direct positive impact on urban air quality without having to alter our transportation infrastructure or impact consumer (three) choices. Retrofitting existing infrastructure to become part of the solution not the source of air pollution would be a monumental achievement. Mobile source emissions are the number one contributor to photochemical smog. NOx emissions carry a 298x GWP when compared to CO2. One mile of PlusTiTTM treated pavement is the approximate equivalent of planting a 20 acre forest. The other key benefit, of course, is the ability to meaningfully reduce the heat absorption of the pavement which promotes both tremendous community-wide health benefits; lowers electric utility (economic) stress; and extends pavement life/carbon footprint by reducing oxidative damage. Standard pavement preservation with asphalt rejuvenation already carries a 500 to 1 reduction in carbon emissions. When evaluated in total, the PlusTiTTM technology stands alone in roadway processes capable of being "carbon negative".	See attached
ThermaCote				ThermaCote®		Thermacote is a ceramic acrylic coating.	ThermaCote® is already in the market place and ready to go.	ThermaCote® is installed similarly to paint with spraying being the best alternative as ThermaCote® has a low weight at around 5 lbs. per gallon or 6 kilos per liter wet and thick as it is 80 % solids. ThermaCote® does need a clean dry surface for proper application and that is usually produced by power washing the substrate to be coated as a part of the prep work. We have done road applications where we used no water resources to wash the surface but instead used brooms and forced air to clean with as a show of support for a community that suffers through droughts and tight water resources on a regular basis. LA	Since there is no harmful "off-gassing" when ThermaCote® dries and cures on a road surface it is much more friendly to the environment than most paints and coatings which can lose as much as 55% or more of the material into the air from off-gassing while drying. It is common to see the use of several different products on a roadway which all off gas and lower the applied or wet film thickness to the dry film thickness or what is left after drying and curing. A 10 - 12 mil application of ThermaCote® will leave a dry film thickness of 10 - 11 mils. We allow no hazardous materials into our facility and produce clean energy saving products in a facility operating one shift per day Monday - Friday. Transportation from Atlanta would be worse but the lightweight of the product allows for full truckloads or shipping containers that are literally full from the front to back and to the top!	ThermaCote® has been traction tested and is shown to be "NOT SLIPPERY" when wet. Tested for US Roads, International Roads, International Air Port Runways, Australia's strict Anti-Slip for swimming pool decks; McDonald's 'slippery when wet' ramp test. Setter 303 test / LA approval	
Western Colloid	Steve Jackson	stevejacksongroup@gmail.com		ArmorTop (Stealth Gray #375-G and #375-G Environmental and California Tan #375-T and #375-T Environmental)			Western Colloid Inc. developed Stealth Gray #375-G in the mid 1990's. Because we were the leading manufacturer of cool roofing solutions, we were asked to come up with a solution to lighten the tarmac at Skunk Works, the manufacturer and creator of the Stealth Bomber. In order to avoid satellite surveillance from foreign spies, Skunk Works wanted the surface of their facility located at Edwards Airforce Base in California Desert to be the same Gray color as the color of the bomber so the bomber would essentially blend in and disappear when rolled out onto the tarmac. We created Stealth Gray so the radiant heat from the tarmac matched that of the gray bomber achieving our stealthy goal. Fun Fact: Once the bomber technology was completed the Stealth Bomber was painted Black because the project to color everywhere the Bomber went was massive and Black was a closer match to the asphalt surfaces around the world. In 2012 Western Colloid was asked by then Governor Jerry Brown to create a cool surface for playgrounds in the Mojave desert. With the help of Lawrence Berkeley Labs, We developed California Tan #375-T to match the surface of the California Desert. Recently we have developed a non-asphaltic base product that is fuel resistant, long lasting and environmentally friendly. The product is designed for surfaces where fuel, oil and jet fuel are present and surfaces where the end user is looking for additional surface longevity, typical surface longevity for Shepherd Color specialties in high-performance inorganic pigments that are widely used in building products. Besides being highly durable color, they also have functional properties like IR reflectivity. We have a wide range of IR reflective black pigments that form the basis of cool coating products by absorbing in the visible for dark colors and reflecting the IR for less solar induced heat build-up. These pigments can be used in a wide range of materials such as paints, coatings, plastics and concrete.	ArmorTop Stealth Gray and California Tan achieve a solar reflectivity greater than 30. The surface temperature typically will match the ambient temperature and immediately cools off when not in direct sun and at night. Unlike black or darker surfaces that absorb and radiate heat throughout the night thus creating a Heat Island, our cool seal coat products keep surface temperatures down.	ArmorTop Stealth Gray and California Tan feel and act like a typical asphalt seal coat product and can be applied by spray, broom or squeegee. We always recommend a two coat application.	Western Colloid Inc. manufactures cool roofs, Cool pavement and environmentally friendly pavement products. Our goal is to cool all surfaces down and complete this task in an environmentally safe way by using materials that are non hazardous and non carcinogenic.	
Shepherd Color	Mark Ryan	mryan@shepherdcolor.com					IR Black pigments allow about a 0.20 increase in reflectance values, which often leads to about 10-15C difference in surface temp.	IR Black pigments are used in coatings and directly in concrete. Shepherd Color has the ability to tailor pigment properties and chemistry for specific properties. Time line for customization would be about 6 months for an optimization of current pigment chemistry (lab to pilot plant production) or 18 months for a new pigment chemistry, depending on regulatory approvals.	At this time we don't have a direct measurement of embodied carbon, but we are working to determine it.		

Basics	Cost and Installation	Can the solution be purchased and installed by in-house department staff (i.e. does not require a licensed installer):	If so, does it require special equipment to install R? If yes, what equipment is needed?	If so, what is the cost per square yard for materials: \$/SY	What is the cost per square yard for material if installed by contractor	What is the average installation rate:
ePAVE LLC		Yes. ePAVE could be installed in-house following a proper one hour training by ePAVE.	Yes, it requires a mixer and a hand squeegee or a box squeegee	The cost is \$4.50 per SY	If material is installed by a contractor, the material and installation would cost between \$10.00 to \$27.00 per SY, depending on the colors chosen and thickness of the application required.	Average installation rate is 6000 SY/Day
Pavement Surface Coatings		No			Monolithic \$45 to \$90 Per sy and if patterned, \$90 to \$150 per sy	On an airport we applied 60,000 sf in a day but in urban environments 10,000 sf per day is more realistic
GAF		Yes, it can be installed by in-house department staff and we can assist in training. To issue the extended warranty, the installer must be a GAF Authorized Applicator – Pavement Coatings, trained and certified by GAF.	DuraShield can be installed in a variety of methods including standard seal coat equipment or a texture sprayer. Drivable machinery that sprays the coating quickly can also be used. In addition, DuraShield can be applied with a squeegee, roller, or brush for smaller areas.	Material costs can vary by application. A lightly traveled neighborhood street would require less material than a more heavily traveled parking lot, like a Home Depot. Hot, dry climates require less material than temperate climates with a lot of rain and/or snow. Current costs range from about \$2.50 - \$5.00/sy	Installed cost vary depending on various factors, including location, project size and complexity, and the particular contractor. Some areas require union labor and/or have established prevailing wages. While we do not control pricing or labor of an installer, we are aware of labor rates to install the product as low as \$1.00 - \$1.15 per square yard and as high as \$3.00 - \$4.00. With large volumes and innovation, we hope to bring down labor costs considerably.	The amount of SY/day depends on the equipment used and number of crews. We currently have Applicators who are able to do 5,000 to 6,000 SY/day per crew. With large volumes and innovation, we hope to increase installation rates considerably.
GuardTop		Yes	No	Material is about \$13.50 per square yard on a two coat application	All in cost for material and labor is between \$4-\$4.75 per square yard	Average installation rate is about 22,000 SY for two coats of material
National Concrete Pavement Technology Center		No. Any contractor able to place concrete pavements will be able to do this work	No	See below	Concrete overlay materials costs will vary by region and market – but are comparable with conventional concrete mixture costs – \$70 to \$100 / cubic yard	Constructed costs of concrete overlays have been reported to range in price from \$3.29 /sq/ft to \$6.14 /sq/ft
Lhoist North America		Yes	Yes. A street cleaning truck and a spreading truck. The spreading truck should have nozzles and side protection equipment to ensure a homogeneous & clean application without side projections.	Our product price is anticipated to be less than 0.55/SY.	TBD for USA, depending on the job size and the contractor fees. But we expect that our product application cost would be less than 15/SY on top of material supply cost	TBD. Example: Spreading truck driving at 6 miles per hour and spreading 2 yards wide. Working for 6 hours: ~ 130,000 SY in a day.
Pavement Technology Inc.		No, the process is installed by qualified contractors with specialized equipment to ensure quality. A network of qualified applicators will be established throughout North America over the next several years.			The installed cost is dependent on geography and project size, but ranges are \$2-\$2.50 per square yard (concrete application is \$3-\$3.50 per square yard) making PlusTITM a cost-effective solution. Existing funding from the FHWA Congestion Mitigation & Air Quality Improvement Program (CMAAQ) can be accessed by Agencies that currently qualify.	The average production rate for PlusTITM depends on the surface type (asphalt vs. concrete) and the functional classification of the roadway (local, collector, arterial, highway) but can range from 20,000 to 40,000 S.Y. typically per day.
ThermaCote		Yes! We do like to 'certify' installers since this 'ain't paint' but it costs nothing and can usually be accomplished in a phone call and a YOUTUBE video with personnel familiar with paint and coatings applications. We like training in house personnel as the municipalities can see larger ROI from the purchase by installing it themselves.	Yes. Installers will need a spray pump capable of picking up 2 gallons per minute at the pump end. We recommend a GRACO 7900 gas powered sprayer which can pick up 2 gallons per minute and deliver production amounts of 10,000-20,000 sf per day of coating installed substrate.	The average cost of ThermaCote® is \$10 - \$20 per square yard depending on the thickness of the application.		The average installed rate of ThermaCote® is \$18 per square yard and a 3 person crew can average 3,000 + square yards of application per day.
Western Colloid		All ArmorTop Cool Seal products can be applied by any asphalt seal coat contractor. The application process can be sprayed, broom or squeegee. The surface must be prepped prior to application by cleaning free of all loose debris, oil spots and other compromised areas that would inhibit proper adhesion to the surface. If the asphalt is aged and beyond its life cycle (evidence of raveling, softness, crumbling, cracking or alligatoring) then we do not recommend an ArmorTop application.			The cost per square yard for material typically runs in the range of \$55.00 to \$60.00 for material for a two coat application. Labor charges are typically in the range of \$1.00 to \$1.40 per square yard.	Contractors can apply anywhere from 25,000 to 50,000 square yards per day. This depends on their efficiency and skill level coupled with equipment used. Spray application is typically more efficient.
Shepherd Color		Paints can be readily made with rudimentary equipment and applied with common equipment. Pigment can be readily mixed into cementitious materials like concretes, stucco or other materials. No licensed installer required.		IR Black pigments are around \$20/kilo. A kilo of paint would make a gallon of paint, that at 100microns/4mils and cover about 40sq.meters. Of course that is with out a binder, solvent and additives. If used in plastics, pigment is used at about a 1% wt/wt loading	Unknown	Average install rate is that for common coatings.

Basics	Use Cases	What are the appropriate use cases for the solution (e.g., pavement type, age, condition, climate)? Please provide appropriate case studies, testing, and/or supporting research.	What are the safety, slipperiness, and friction characteristics (e.g. typical Surface Coefficient of Friction)?	What is the curing time including how quickly the road can open to traffic after installation given average temperatures, partly sunny, and non-humid conditions? How does this compare to existing relevant products?	Is it sensitive to placement in cool weather, i.e. 50° F and falling?	Is it sensitive to placement in high humidity or damp conditions?	How long does this treatment typically last under average traffic conditions in years? How does this compare to similar products?	Can it be re-applied over itself for renewal?	Is it recommended for heavy traffic conditions like urban arterials?	Are standard MUTCD compliant white and yellow markings clearly visible?
ePAVE LLC		ePAVE is engineered to be used on both asphalt and concrete surfaces. Asphalt could be a few days old to 10 years old. Concrete surfaces need to cure before ePAVE application. A pavement condition index of 70 and higher is recommended. If a pavement is deteriorated, cracks and potholes should be sealed with a recommended product before ePAVE application. Based on lab testing and field experience to date, ePAVE may be used in any climate. Case studies attached.	A typical ePAVE surface under wet and dry condition is higher than of industry standard (10.50). Surface Friction Average Dry condition>72.7. Surface Friction Average Wet condition>48	ePAVE cures in one hour in 70°F and higher. In temperatures below 70°F, it could vary between 1 to 4 hours. Traffic could be open immediately as soon as it cures. Similar products have a much longer curing time, some as high as 12-24 hours to cure before opening to traffic.	No	No	Based on case studies, ePAVE has lasted 5 years on a road with 2 million vehicles per year. This translates to 10 years and higher for residential roads and much longer for areas without vehicular traffic such as playgrounds, pedestrian areas and bike lanes. B. Based on the data we have, typical cool pavement products last less than one year and some do not function under heavy vehicular traffic, especially around Stop sign at intersections with a hard stop.	Yes	Yes	Yes
Pavement Surface Coatings		We have done no studies on albedo and Endurablend. However, we have been on surfaces for 10 years with 60,000 per day	Endurablend is applied with either intermixed aggregate or topically applied aggregate to achieve FN40 numbers as high as 65.	Endurablend will cure to traffic in 2 to 3 hours after installation in daylight. It is cement based, nighttime cure takes significantly longer	Only with regard to cure time Not performance. It is applied at 2 mm and is cement based so cure is temperature sensitive	We have noted an 18 degree and associated asphalt	We know of no other products which have been installed for 10 years in 60,000 vehicle per day traffic and still performed.	Yes	Yes	Yes
GAF		DuraShield is mostly used on Hot Mixed Asphalt (HMA) surfaces that are either new or old. (as long as the asphalt is structurally sound). It can also be used on concrete (PCC) with a primer. Pictures of jobs are attached. More additional information is available upon request.	Per ASTM E303-93 test, the Dry Friction is >65 and Wet Friction is >35. In addition, the British Pendulum test results are also attached. (Attachment D)	Assuming 73°F (23°C) and 37% humidity (ASTM D5895) the product should be dry to touch in 35 minutes. For driving traffic we recommend a minimum of 4 hours in dry sunny climates and 24 hours or more in cool temperate or humid climates.	DuraShield is installed at 50°F and rising.	DuraShield can be installed in high humid climates, but it will require longer dry times than dry, and climates.	Average traffic conditions is subjective, but we have found that DuraShield will last years longer than typical asphalt emulsion products used today. Generally we recommend a typical recoat cycle every 5-7 years. Based on testing performed in 2018 by PRL (a third party construction materials testing lab) DuraShield wore much slower and kept its color much longer than several other competitive pavement coatings that were also tested. In a typical recoat, a full re-application may not be necessary. Instead we recommend two layers in the worn area (typically wheel paths) and then one coat over the entire area.	Yes. DuraShield bonds well to itself even years later. The surface just needs to be clean, dry and free of contaminants such as grease and oils.	Yes, however it will require a thicker initial application and a more frequent recoat cycle. The product wears due to traffic so the more traffic the more wear. Rolling traffic is not as much of a wear concern as is shear from acceleration, braking and turning.	Our coating is a medium gray color so white and yellow lines show up better than typical concrete surfaces. That said some customers have painted a black border around the white and yellow lines to make them stand out more.
GuardTop		Like any asphalt based sealcoat CoolSeal is designed to be applied to surfaces in relatively good condition for the purpose of maintenance that surface. It can be applied to surfaces that are older with some cracking. CoolSeal cannot be applied surfaces with excessive potholes and structurally failed areas.	CoolSeal has an average coefficient of friction of .82 when dry and .76 when wet under ASTM C1028 specification	CoolSeal takes about an hour to try under average conditions and must cure for a few hours before being opened to traffic. Most projects with municipalities that we have completed have closed streets from 7AM-5PM. This is on par with regular asphalt sealants	Yes, CoolSeal must be applied on days where temperatures are 50 degrees and rising. As is typical with most asphalt coatings to allow for proper drying and surface adhesion.	As with traditional black sealcoat there is no issue with applying CoolSeal in humid conditions.	CoolSeal on average lasts about 7 years. Traditional black asphalt sealcoats last about 4 years.	Yes, CoolSeal is typically reapplied after 7-10 years after the initial application has started to wear off but there is no issue with applying before wear has occurred. CoolSeal can also be applied over existing surface treatments with no issue such as traditional black sealcoat, slurry seal, fog seal, chip seal, and micro surfacing.	CoolSeal current flagship formulation is designed for lower traffic streets with speed limits of 35 MPH or less but we have developed a high traffic formulation with larger aggregate to meet slip resistance specifications for larger arterials.	Yes, see attached photos.
National Concrete Pavement Technology Center		Concrete overlays can be applied to most existing pavements, normally as part of regular maintenance to extend pavement life, restore ride quality or increase load carrying capacity. Many examples are reported at http://overlays.acpa.org/webapps/overlayexplorer/index.html One challenge in urban environments is that increasing the elevation of a pavement 4 inches may take some careful detailing to ensure ongoing compatibility with crossings, driveways, service manholes and overhead bridge clearances.	Coefficient of Friction is the same as any concrete surface, controlled by the type of fine aggregate in the mixture and the finishing work conducted on it. Loss of friction is uncommon over time	Typically, traffic can be returned to the pavement within 3 to 7 days.	Paving is discouraged at 40°F and falling	No – in fact high humidity will increase concrete hydration leading to improved characteristics.	Data from Iowa shows that typical lifetime is 25 to 40 years (https://intrans.iastate.edu/app/uploads/2017/09/iowa_concrete_overlay_performance_w_cvr.pdf)	Yes	Yes	Yes
Lhoist North America		Solution to be used on low albedo surfaces. Preferably asphalt pavements (old or new). The application on concrete roads could be less relevant as those surfaces already have a higher albedo. Solution to be applied in dry conditions. Avoid spreading during rainfall or on wet road.	Friction tests have been carried out on lab scale and on pilot test sections using a Pendulum Skid Resistance Tester. We found out that the product does not affect the friction characteristics of the pavement on which it is applied due to its thin thickness. We have not identified any asphalt formulations yet that would prevent the use of our solution. Furthermore, a similar product is used as tack coats protection and does not impact the quality of the pavement surface. However, slippery situations at the time of the application need to be further considered and evaluated.	The curing time is more or less equal to the drying time of the water content of the slurry (a few hours). This is yet to be confirmed but the opening to traffic can be done during the same day, provided that the solution has dried (which should be fast in summer application periods).	No	No. Air humidity and wind conditions may impact drying time. Although road humidity is impacting, and the solution should not be applied under rainy conditions or if the road is wet. What is meant by wet here are the conditions when the surface porosity of the pavement is filled with water. If the road is wet but not saturated with water (pores are not filled with water), then spreading the solution may be an option, this has not been tested yet.	The durability is still under assessment as the coating degrades over time. In any case the product would be a seasonal application product and we expect to demonstrate that one application per year is necessary.	There are no contraindications. The product can easily be integrated in maintenance processes and seasonally applied. Like salting roads in winter in cold regions.	TBD. It is one of the questionings regarding the solution and for which we need a partnership with a community willing to run a test with us. For now, the durability is under evaluation for low to medium traffic conditions.	TBD. While we might have some ideas to comply the pavement marking regulations, this is still something that must be further assessed.
Pavement Technology Inc.		PTI and its manufacturing arm- D&D Emulsions, Inc. (D&D) are "turn-key" developers, manufacturers, distributors, and applicators of these promising "cool" roadway solutions. We have spent the last five years developing and perfecting this viable technology capable of retrofitting existing transportation infrastructure to become pollution-reducing and solar reflective. This solution has focused on asphalt and concrete roadways, runways and parking lots by harnessing the long-known photocatalytic properties of titanium dioxide (TiO2) nanoparticles. PTI has continued the development of solutions for both asphalt and concrete of any functional classification. Agencies can immediately deploy, at scale, on pavements of varying age rated from 80 PCI and higher thereby preserving pavements that are in good condition. PlusTiTM is naturally beneficial for pavements thus bypassing the traditional challenges facing new environmental technologies. The very same challenges that the GCCA correctly identifies and lists in the 891 are mostly solved by PlusTiTM products. Use of this process is beneficial and economically feasible regardless of pavement owner and jurisdiction. We anticipate wide-scale adoption from DOTs, cities, counties, airports, private developers and any other environmentally conscious private businesses with pavement infrastructure to maintain. Moreover, PTI has developed a process which achieves each of the	PlusTiTM is a very safe material (SDS attached) considered non-toxic. The photocatalytic TiO2 used in PlusTiTM technology is also used in household items such as paints and even an inactive ingredient in some toothpastes and sunscreens. Friction characteristics are not adversely impacted, current pilot projects are already showing results indicating safety and friction characteristics are actually improved with this solution due to the fact that TiO2 is a material with super hydrophilic properties.	Utilizing this technology typically enables traffic to be returned to the treated pavement in 60 minutes or less and requires very minimal disruption when compared to other treatments requiring longer curing times. Application typically only requires single lane closure. Emergency vehicles are always allowed access. The material is a penetrant and is not damaged should a vehicle need access during this curing period. It also will not damage citizens' vehicles or driveways should the resident prematurely drive on the treated pavement.	Yes, the material is emulsified with water and as such application recommendations are for the temperature to be 50° F and rising ensure adequate penetration. Freezing conditions at time of application or shortly after application are to be avoided.	Yes. It is recommended that application take place on dry pavements. High humidity can affect how quickly the treated pavement can be returned to traffic.	PTI is currently monitoring real time long term aging results to determine longevity. From our current long term pilots we anticipate that the treatment will provide results for between 5 to 7 years before requiring additional treatment. The material is a penetrant and becomes an integral part of the roadway with no material on the surface to wear away. The performance specification addresses the quality control monitoring of the product at the time of application. To maximize the increase in SOI and NOx reduction the specification (attached) calls for minimum concentration of TiO2 in parts per million at or near the surface of the pavement.	Yes. Roadways treated with this material can be retreated after the initial application. Depending on long term testing data analysis, retreatment would be recommended 5 to 7 years after initial treatment for best results.	Yes. PTI has multiple products capable of being applied in all traffic conditions. Pavement materials type, roadway functional classification and traffic levels are taken into consideration pre-project to ensure proper materials selection.	Yes. One of the distinct advantages of using this technology, it does not obliterate the existing pavement markings nor change the retro-reflectivity of the pavement markings. Furthermore, the integrity of the pavements natural color is maintained and there are no visual distractions for motorists. (pictures of Orlando, Florida below)
ThermaCote		All driving substrates from asphalt to concrete can be coated using ThermaCote® if they are clean and dry for the application. Attaching the Los Angeles Roads and Streets approval with testing.	Attaching a test report from 'Sotter' regarding traction testing for the '303 International roadway standard'	In Abu Dhabi we were able to resume operating on asphalt at 20 minutes after the application of ThermaCote® at approximately 10 US miles / 0.25mm of applied thickness.	YES! Above 50F and not falling and warmer direct sun days are recommended for better adhesion and drying.	ThermaCote® is a waterborne acrylic and cannot be installed on wet surfaces or while it raining. A hot day with high humidity would not be much of a concern and this is looking back at the Abu Dhabi install which was about 120° and 80-90% humidity.	We are recommending a thickness of 10 US mils / 0.25mm which will be high cost effective compared to other solutions even if it required a recoat in two - three years would be less expensive than options which are currently deployed.	Yes	Yes although we would like to evaluate ThermaCote® in a heavy traffic situation such as a local roadway before placing it on an expressway. We are currently attempting to work with our state DOT to secure some review locations for applications of ThermaCote®.	YES! and ThermaCote® is available in colors making it ideal for special parking sections of large parking lots of sports and concert venues to coincide with "red parking" "blue parking" "green parking" etc....
Western Colloid		All ArmorTop products are best applied to surfaces that have not reached the end of their life cycle. Conversely new asphalt surfaces should have a sufficient curing time of about one year. This allows the asphalt binder to evaporate out the heavy oil and will allow the seal coat to adhere to the surface. Aged, raveled, cracked, alligator and previously seal coated surfaces should not be seal coated until the surface has been improved. Our products are only as good as the surface we are going over. All ArmorTop products are designed for roads (25mph or less), parking lots, playgrounds, school parking lots, tarmacks and industrial properties. As part of our mix design, we use slate as an aggregate to give the product weight, skid resistance and durability. The beauty of slate is that it always lays flat and does not shed from the surface like a round sand pebble. Because the surface is flat, surface slipperiness is increased thus limiting speeds to at or below 25 miles per hour.	Surface effect: Color pigment at normal loadings doesn't effect surface properties.	Surface curing time is anywhere between eight and twenty four hours depending on time of year and ambient temperature.	ArmorTop should never be applied in Temperatures below fifty five degrees or on moist and/or rainy days.	The perfect application conditions are warm sunny days between 75 and 95 degrees.	ArmorTop surfaces typically last anywhere between three to five years before reapplication is recommended. Longevity is largely based on environmental conditions (rain) and traffic loads.	All ArmorTop products are designed to be reapplied over itself for renewal. If the surface was originally completed with a Coal Tar based seal coat then a primer will have to be applied prior to application.	We do not recommend that ArmorTop be used on high speed urban arterials.	Standard traffic paint and thermoplastic can be applied to all armor top products.
Shepherd Color		Use cases: None published on cool roads.	Surface effect: Color pigment at normal loadings doesn't effect surface properties.	Curing Time: Color pigment doesn't affect curing time.	Cool pavement effect: Color pigment doesn't affect application window.	Humidity: Color pigment doesn't have an effect.	Product life-cycle: Color pigment is inorganic and has multidecade color retention. Life cycle determined more by resin/binder resistance.	Recoat: Color pigment doesn't negatively affect recoatability.	Color pigment can be used in high traffic systems.	Contrast with MUTCD depends on shade chosen.