Climate Action Grant for Street Improvements in Santa Paula

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Table of Contents

List of Figures........ 9
Introduction........ 10
Chapter 1: Identifying the Need........ 10
Chapter 2: Identifying the Solution........ 13
Chapter 3: Repaving Techniques........ 14
Chapter 4: Use of Cold In-place Recycling........ 18
Chapter 5: Climate Action Grant Funding........ 19
Works Cited........ 22
Attachments........ 25

- Attachment1: Sample Grant Application for Cold In-place Recycling Project in Santa Paula
- Attachment 2: Cold In-place Recycling Case Study: The City of Napa, CA and Sonoma County, CA
- Attachment 3: Cold In-place Recycling Case Study: Nevada Department of Transportation Interstate 80

List of Figures

Figure 1: Survey Results of Needed Improvements to Santa Paula 11
Figure 2: Santa Paula Roadway Conditions Picture 12
Figure 3: Santa Paula Roadway Conditions Picture 2 13
Figure 4: Energy Use per Ton of Material (kg/t) 15
Figure 5: Greenhouse Gas Emission per Ton of Material (kg/t) 16
Figure 6: Greenhouse Gas Emission per Ton of Material (lbs/t) 16
Figure 7: Tons of Asphalt per Lane Mile 16
Figure 8: Greenhouse Gas Emissions per Lane Mile 17
Figure 9: Cost of Asphalt per Lane Mile Paved 17
Figure 10: Ventura County Transportation Commission Budgeted Expenditures by Program FY 2012/2013 19
Figure 11: Transit and Transportation Program Budget Tasks FY 2012/2013 20
Figure 12: Planning and Programming Program Budget Tasks FY 2012/2013 20

Introduction

Maintaining roadways is a vital aspect of transportation infrastructure. Virtually all methods of transportation utilize roads to move about, thus in order to keep transportation circulation flowing smoothly the upkeep of roadways is an important task. This project proposes the use of the Cold In-place Recycling technique to fix and repave the poorly maintained roads of the City of Santa Paula. The Cold In-place Recycling technique simultaneously helps to reduce greenhouse gas emissions emitted from repaving, while lowering the cost of repaving roadways. Both the Santa Paula Community Profile and the Santa Paula Community Plan completed by CRP 410 and 411 have identified that improvements of road conditions are a top priority for the community of Santa Paula. The main factor currently halting the City from making these improvements is a lack of available funds. This project will show the City the potential for receiving funding for future road improvements by suggesting that the repaving be done in a manner that reduces greenhouse gas emissions.

Included in this project will be a comparison of Cold In-place Recycling with traditional Hot Mix Asphalt repaving, and two alternate repaving techniques: Warm Mix Asphalt and Hot In-place Recycling. The four types of repaving techniques will be compared based on energy consumption, greenhouse gas emissions, and cost. The Cold In-place Recycling technique for repaving roadways will be proven to result in the lowest level of greenhouse gas emissions of the four techniques. Cold In-place Recycling reduces the amount of greenhouse gas emissions released by 80% compared to the traditional repaving technique. This 80% reduction qualifies an applicant for climate action grants. Also included in this project will be information on available climate action grant funding, and a sample grant application for the use of Cold In-place Recycling paving techniques on the roads of Santa Paula.

Chapter 1: Identifying the Need

The City of Santa Paula is located in Ventura County in Southern California. It is a moderately sized community that is home to 29,321 people (United States Census Bureau, 2012). It has a rich agricultural history and is considered to be the citrus capital of the world. This city has a lot to offer both residents and tourists alike, but a major factor holding Santa Paula back is the condition of the City's roadways. Improvement of the road conditions was identified in both the Santa Paula Community Profile and the Santa Paula Downtown Improvement Plan as a top priority for the community to address.

The Santa Paula Community Profile contains the results of a survey conducted as part of an October 29, 2011 community outreach event in Santa Paula. Community members were asked, "Which of the following characteristics do you feel are most important to improve?" 29% of responses indicate that street conditions are most in need of improvement. This category received the highest percentage of responses overall, indicating that the community of Santa Paula feels strongly that street conditions in the City need to be improved. The graph on the next page displays the spread of responses for the question of, "Which of the following characteristics do you feel are most important to improve?"

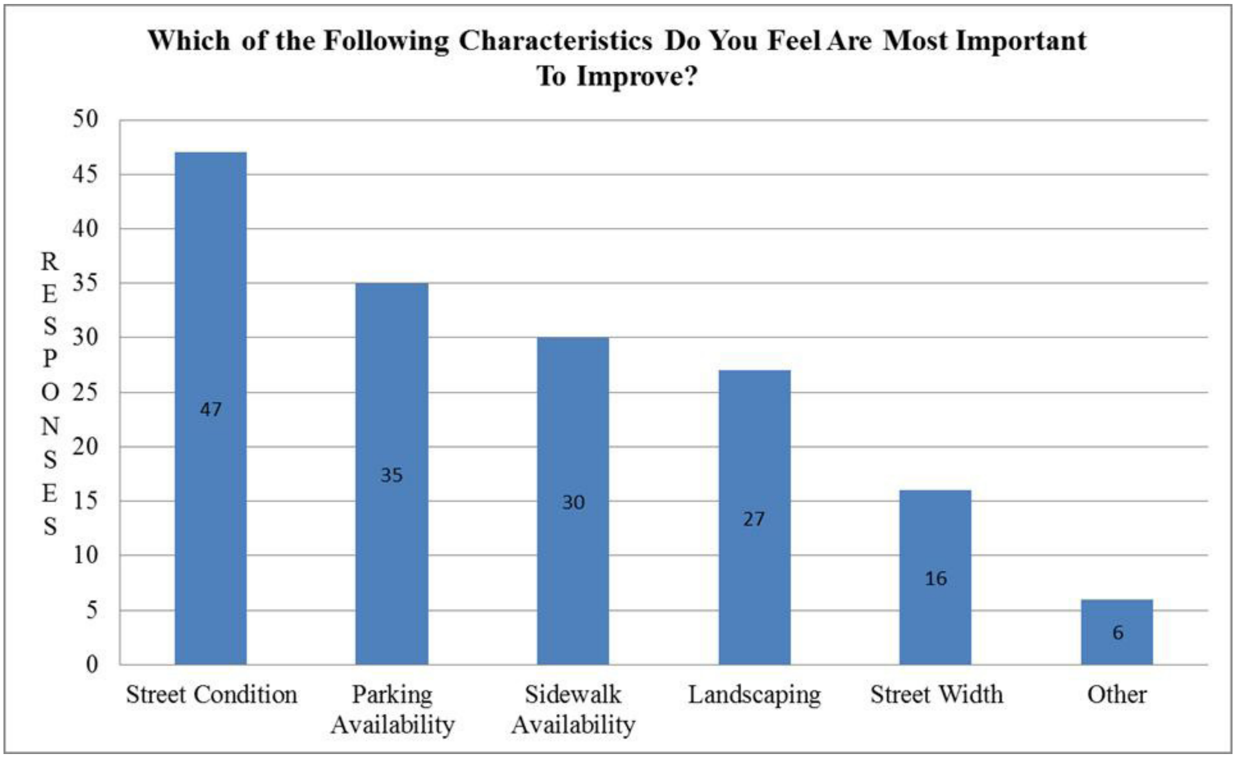

Figure 1: Survey Results of Needed Improvements to Santa Paula
Source: CRP 410, 2011

The following excerpt regarding the improvement of street conditions in Santa Paula comes from the Santa Paula Downtown Improvement Plan:

> *Designing, maintaining, and regulating streets impact more than just a city's traffic patterns. Streets exert influence over the buildings that line them and affect how it "feels" to spend time in an area. High speed, low quality streets are not conducive to getting pedestrians out and about, which in turn impacts the local economy and the area's reputation. Streets should be designed to give the city and its neighborhoods a recognizable image and provide a means of orientation and understanding of the city.*
>
> *Downtown Santa Paula possesses a potentially lively downtown that can be improved by upgrading the street and sidewalk conditions. By embracing the community's desire for improved street conditions, the City will become more appreciated by residents and visitors alike. The City must also maintain its wide sidewalks that promote walking, although improvements must be made to the overall quality.*
>
> *The need for street and sidewalk improvements stems from the Sidewalk Inspection Report and the Community Outreach Events held in October and November 2011, and detailed in the Community Profile.* (CRP 411, 2012)

The Santa Paula Downtown Improvement Plan also displays firsthand accounts of local residents and their views on their City's road conditions. A student of Santa Paula High School said

that, "Santa Paula is a safe community; however, there are some areas that can be improved… Our town is very beautiful but streets with holes, cracks, and pot holes catch the eye of many people." (CRP 411, 2012) The following pictures show the deteriorated condition of Santa Paula's roadways.

Figure 2: Santa Paula Roadway Conditions Picture
Source: CRP 411, 2012

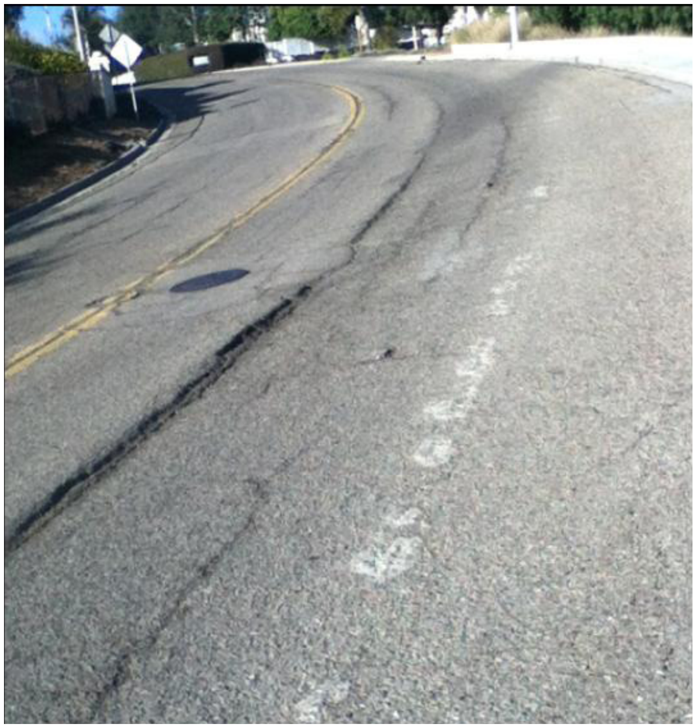

Figure 3: Santa Paula Roadway Conditions Picture 2
Source: CRP 411, 2012

Despite the emphasis on improvement of the City's street conditions by the Santa Paula community, the roadways in Santa Paula are not being improved. A City official stated at a February 2012 community outreach event for the Santa Paula Downtown Improvement Plan, that the main factor holding Santa Paula back from maintaining desired quality of its roadways is lack of available funds. Santa Paula is a small city with a small budget and with the economic downturn in the past years, the budget is very tight and not all desired projects are able to be carried out. (CRP 411, 2012)

Chapter 2: Identifying the Solution

As mentioned by City officials, in today's economy extra money for capital improvement projects can be hard to come by. However, one area that money can still be found is in that of climate action grants. Global warming is a very serious issue facing our planet, and federal, state and local agencies are emphasizing movement toward a greener, more sustainable way of life. Thus, grant funding may be available for municipalities that make strides to green up their act.

If the City of Santa Paula was to present a project for roadway improvements that increased sustainability and lowered greenhouse gas emissions, they would qualify for potential climate action grant funding in order to help fund their roadway improvements. A feasible project would be to repave their roads using a repaving technique that lowers greenhouse gas emissions compared to the traditional hot asphalt repaving technique. The rest of this project will focus on which type of repaving technique to support, and the current availability of climate action grant funding.

Chapter 3: Repaving Techniques

In order to qualify for a climate action grant, Santa Paula should support a project in which they repave their streets in a manner that lowers greenhouse gas emissions. This project will compare three types of alternate repaving techniques with the traditional Hot Mix Asphalt repaving technique. The three types of alternate techniques being looked at are Warm Mix Asphalt, Hot In-place Recycling, and Cold In-place Recycling. All techniques will be compared on the basis of energy consumption, greenhouse gas emissions and cost. From this analysis it will be determined which technique to support in order to qualify for a climate action grant.

Traditional Hot Mix Asphalt

Hot Mix Asphalt repaving is the most common type of repaving technique. Currently in the United States more than 90% of roads and highways are paved with this traditional Hot Mix Asphalt (Copeland, 2010). Traditional Hot Mix Asphalt repaving (also called mill and fill) consists of removing the existing asphalt from the roadway and replacing it with new asphalt. The existing asphalt is removed from the roadway by milling and taken by trucks and then discarded. None of the old asphalt is used in creating the new asphalt mix. The new asphalt is mixed and heated at an off-site plant and trucked back in to the project site. It is then laid over the roadway.

Warm Mix Asphalt

Warm Mix Asphalt is similar to the Hot Mix Asphalt technique in that the roadway is milled and the milled asphalt is removed and a new asphalt mix is brought back to the project site from a processing plant via truck. The difference between Warm Mix Asphalt and Hot Mix Asphalt is that in Warm Mix Asphalt, specially designed oils are added to lower the viscosity of the asphalt so that it can be mixed and paved at a lower temperature. Generally Warm Mix Asphalt is produced at a temperature 50-75 degrees Fahrenheit lower than Hot Mix Asphalt (Udelhofen, 2008). Warm Mix Asphalt saves in greenhouse gas emissions during manufacturing due to needing less energy to heat the mix to a lower temperature than compared with Hot Mix Asphalt.

Hot In-place Recycling

Unlike Hot Mix Asphalt and Warm Mix Asphalt, Hot In-place Recycling repaving does not require that the milled pavement be taken from the project site. In Hot In-place Recycling there is a single unit or train of equipment brought to the project site that heats the existing pavement to mill it, mixes the milled pavement with a rejuvenating agent, and compacts it onto the roadway in one single pass. By eliminating the need for trucks to remove the milled asphalt from the project site and bring asphalt mix to the site from processing plants, a great deal of greenhouse gas emissions are eliminated from transportation. (NBM & CW, 2010)

Cold In-place Recycling

Cold In-place Recycling is similar to Hot In-place Recycling in that no trucks are needed to remove the milled asphalt or to bring asphalt mix back to the roadway since everything is done on site. Like Hot In-place Recycling a single unit or train of equipment is used to mill the project site, mix the milled pavement and re-lay it on the ground. However, Cold In-place Recycling differs in that no heat is used before or after placement and that the asphalt emulsion must be aerated before the final compaction is done. Greenhouse gas emissions for Cold In-place Recycling are lowered due

to the reduction in trucks for transportation and due to the decrease in energy needed because the mix is not heated at all. (Caltrans Division of Maintenance, 2008)

Energy Comparison

The graph below shows the breakdown of energy used for each type of repaving technique from each step of production. It shows the energy use as a result of binders, aggregates, manufacturing, transportation, and laying. Hot Mix Asphalt results in an energy use of 680 kilograms per ton of material produced. Warm Mix Asphalt results in 654 (kg/t), Hot In-place Recycling in 570 (kg/t), and Cold In-place Recycling in 139 (kg/t). Cold In-place Recycling results in in a significant decrease in energy use compared to both Hot Mix Asphalt and the two types of alternative repaving methods. Cold In-place Recycling results in roughly an 80% reduction in energy use compared to Hot Mix Asphalt.

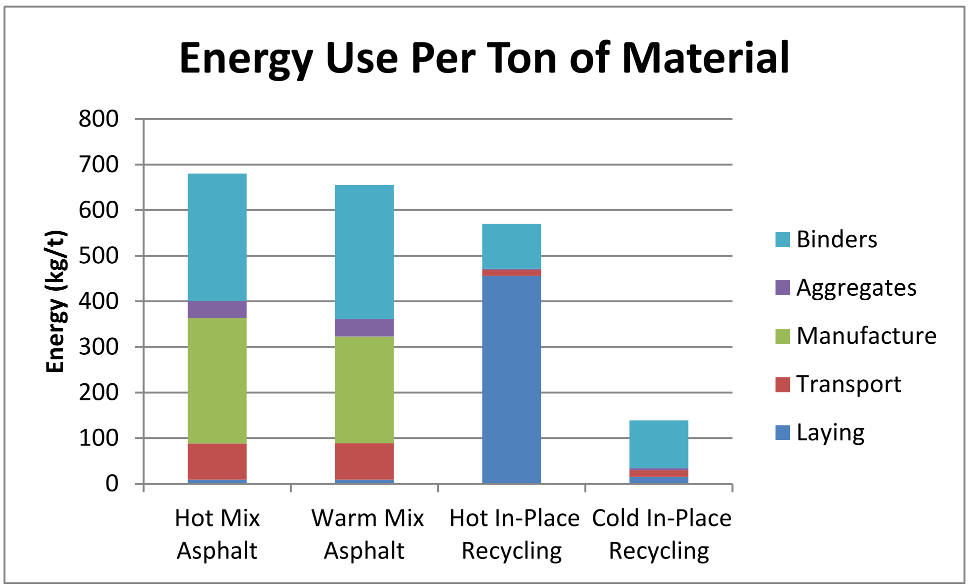

Figure 4: Energy Use per Ton of Material (kg/t)
Source: Chappat & Bilal, 2003

Greenhouse Gas Comparison

The graph on the following page shows the breakdown of greenhouse gas emissions (of carbon dioxide) for each type of repaving technique from each step of production. It shows the amount of greenhouse gas emissions as a result of binders, aggregates, manufacture, transport, and laying. Overall, Hot Mix Asphalt results in a greenhouse gas emission of 54 kilograms per ton of material produced. Warm Mix Asphalt results in 53 (kg/t), Hot In-place Recycling results in 42 (kg/t), and Cold In-place Recycling results in 10 (kg/t). Cold In-place Recycling results in a significant decrease of greenhouse gas emissions compared to Hot Mix Asphalt or either of the other alternative repaving methods. It results in roughly an 80% reduction of greenhouse gas emissions compared to Hot Mix Asphalt.

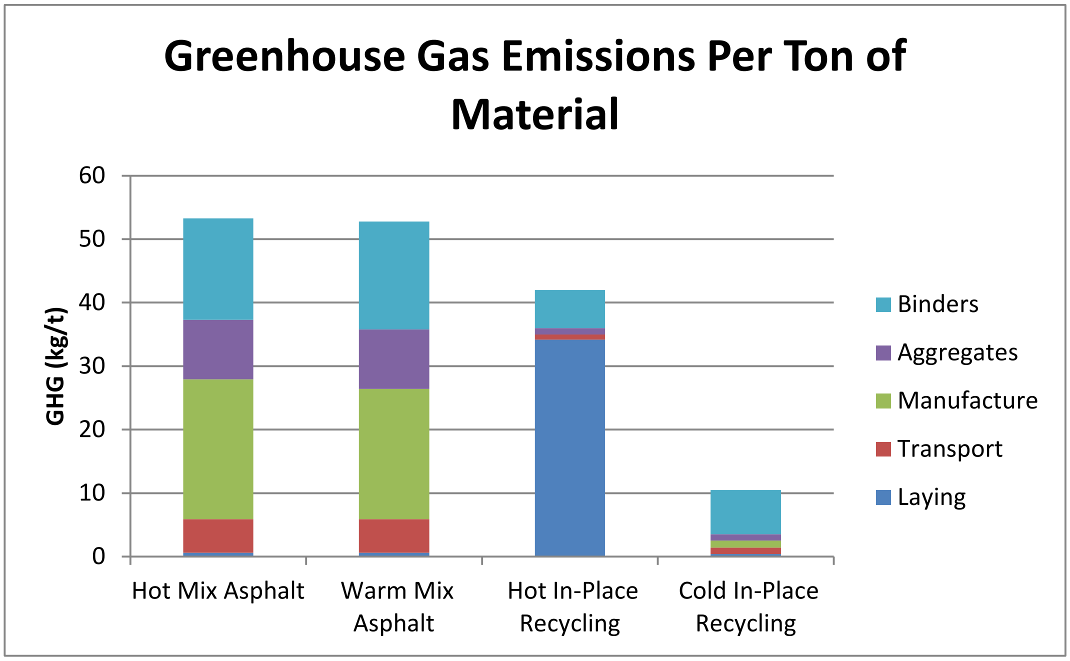

Figure 5: Greenhouse Gas Emission per Ton of Material (kg/t)
Source: Chappat & Bilal, 2003

When converted to pounds per ton of material, the greenhouse gas emission for the four types of repaving techniques are displayed in the table below.

Emission Source	Greenhouse Gas Emissions CO_2 (lbs/t)
Hot Mix Asphalt	108
Warm Mix Asphalt	106
Hot In-place Recycling	84
Cold In-place Recycling	20

Figure 6: Greenhouse Gas Emission per Ton of Material (lbs/t)
Source: Chappat & Bilal, 2003

The following table shows the amount of asphalt used per lane mile.

	Roadway Dimensions (ft.)				Asphalt Weight		
	Length	Width	Depth	Volume	Lbs/Cublic Ft.	Total Lbs	Tons
3" Ave. Depth	5,280	15	0.25	19,800	150	2,970,000	1,485

Figure 7: Tons of Asphalt per Lane Mile
Source: City of Napa, 2010

Using the greenhouse gas emissions in lbs/ton from Figure 6 for each repaving type, and Figure 7 which shows tons of asphalt needed per lane mile, the amount of greenhouse gas produced per lane mile can be determined for each repaving technique (Figure 8).

	Greenhouse Gas Emissions CO_2 (lb/t)	Tons of Pavement per Lane Mile	Greenhouse Gas Emissions (lbs of CO_2) per Lane Mile of Pavement
Hot Mix Asphalt	108	1,485	160,380
Warm Mix Asphalt	106	1,485	157,410
Hot In-place Recycling	84	1,485	124,740
Cold In-place Recycling	20	1,485	29,700

Figure 8: Greenhouse Gas Emissions per Lane Mile
Source: Figure 6 and Figure 7

Cold In-place Recycling results in a greenhouse gas emissions saving of 130,680 pounds of CO2 per lane mile paved when compared to Hot Mix Asphalt. This savings is a huge amount, and will increase with the more lane miles paved with Cold In-place Recycling.

Cost Comparison

Warm Mix Asphalt is cited as having a 10% cost reduction when compared to Hot Mix Asphalt repaving (Godkin, 2011). According to Caltrans, monetary savings of up to 50% can be achieved by using Hot In-place Recycling and savings of up to 55% can be achieved by using Cold In-place Recycling when compared to the cost of traditional Hot Mix Asphalt repaving (Caltrans Division of Maintenance, 2008).

The cost of Hot Mix Asphalt is cited to be $125 per ton of asphalt (N. Mathiesen, personal communication, June 4, 2012). The following chart (Figure 9) gives a breakdown of cost for producing the tonnage of asphalt needed to pave one lane mile of road. This is calculated for each of the repaving types using the tonnage of asphalt needed per lane mile calculated in Figure 7. The cost reduction for paving one lane mile of asphalt with Cold In-place Recycling verse Hot Mix Asphalt is $102,093.75. For projects paving more than one lane mile of roadway, the cost reduction will amount to an even more significant sum of money.

Repaving Type	Price Per Ton of Asphalt	Price Per Lane Mile
Hot Mix Asphalt	$125.00	$185,625.00
Warm Mix Asphalt	$113.75	$168,918.75
Hot In-place Recycling	$62.50	$92,812.50
Cold In-place Recycling	$56.25	$83,531.25

Figure 9: Cost of Asphalt per Lane Mile Paved
Source: Figure 7 and personal communication, 2012

As can be seen from this analysis, Cold In-place Recycling repaving saves users the most money. Reducing cost is important for Santa Paula because lack of funds has been their biggest obstacle in making street improvements. With a lower cost to complete the project, less grant money will need to be awarded and the funds that the City is required to match, should they receive grant funding, will be lower.

Conclusion

As can be seen by the analysis in this chapter, Cold In-place Recycling has the largest reduction of energy consumption, largest reduction of greenhouse gas emissions, and highest cost reduction when compared to traditional Hot Mix Asphalt repaving. Thus, a project using this technique has the highest probability of receiving climate action grant funding in order to carry out street improvements and is the repaving technique that Santa Paula should support.

Chapter 4: Use of Cold In-place Recycling

Despite the fact that Cold In-place Recycling reduces energy use, greenhouse gas emissions, and the cost of repaving, the process has not been widely used to repave roads in the United States. As mentioned in the previous chapter, more than 90% of roads in the US are currently paved with traditional Hot Mix Asphalt (Copeland, 2010). Research has led me to believe that there are two main reasons for Cold In-place Recycling's minimal widespread use thus far.

The first reason is that people are reluctant to stray from the status quo. Hot Mix Asphalt has been the traditional means of repaving for cities and counties across the nation for many years. People are naturally routed in tradition and tend to fear change, even if that change is positive. Because Hot Mix Asphalt has been working well, people see no reason to "risk" change, thus Cold In-place Recycling has been underused.

The second reason that Cold In-place Recycling has not been widely used is because of the misconception that Cold In-place Recycling is not as effective as Hot Mix Asphalt. People believed that because the material being used was recycled and not new material, that the end product would not be as smooth and durable as roads paved with Hot Mix Asphalt. This belief however, has been proven to be false. Numerous case studies have shown that Cold In-place Recycling performs as well as Hot Mix Asphalt and that the lifespan of Cold In-place Recycling is similar to that of Hot Mix Asphalt.

Maintenance Life of Cold In-place Recycling

Cold In-place Recycling has shown to produce high quality road surfaces. "Nevada's road quality rating has gone from a #30 to a #4 during the time the state has been using CIR as a preferred rehabilitation approach." (Udelhofen. 2006. Pg. 55) The Maintenance level of Cold In-place Recycling roadways has also shown to be low. "Most states using CIR report a life cycle from seven to eight years up to 12 to 15 years…Nevada's pavement management analysis is telling [Nevada] that they're getting 10 to 12 years of additional service life out of a road by using CIR approach, and as the technology improves, CIR is producing performance characteristics similar to hot mix." (Udelhofen, 2006 P. 55). This noted lifespan for Cold In-place Recycling roads is similar to the 15 to 20 year average lifespan of Hot Mix Asphalt roads (Iowa Department of Transportation, 2012) According to the Federal Highway Administration, "Advancements in equipment and chemical advances in binders has led to a process that produces a long lasting, durable, cost effective cold-place recycling technology…[It] performs as needed, cost[s] less, conserves material, and returns the road to use sooner and the driving public are satisfied due to more roads being improved for the money and less down time to the roads." (Federal Highway Administration, 2011) As can be

seen, the misconceptions about Cold In-place Recycling quality are false, it produces a high-quality product with environmental and economic benefits.

Chapter 5: Climate Action Grant Funding

Climate Action Grants provide funding for individuals and municipalities to complete projects which reduce greenhouse gas emissions and offset the effects of global warming. The following section will discuss the availability of climate action grant funding in which to fund a Cold In-place Recycling repaving project for the City of Santa Paula.

The Metropolitan Transportation Commission for the Bay Area sponsors an annual climate action grant under their Innovative Grants Program that a Cold In-place Recycling project would meet the required qualifications. In fact in 2010 Napa County and Sonoma County submitted a Cold In-place Recycling repaving project proposal to this grant and won funding to carry out their project. They received $5,288,000 to repave various roadways in both counties. The Metropolitan Transportation Commission's climate action grant offers up to $31 million in order to support a small number of high-impact, innovative projects. (City of Napa. 2010)

The City of Santa Paula is part of the Ventura County Transportation Commission (VCTC). The proposed Ventura County Transportation Commission budget for the 2012/2013 fiscal year lists proposed funding in program areas that could potentially be met by a Cold In-place Recycling climate action grant. The total Ventura County Transportation Commission budget for fiscal year 2012/2013 is $49,258,263 and is divided into six program areas. The division of funds between these program areas is shown in the chart below.

Program Budget Categories	Fiscal Year 2012/2013 Budget
Transit and Transportation	$14,371,854
Highway	$634,500
Rail	$2,844,300
Commuter Assistance	$539,500
Planning and Programming	$29,305,422
General Government	$1,562,687
Total Program Budget	**$49,258,263**

Figure 10: Ventura County Transportation Commission Budgeted Expenditures by Program FY 2012/2013
Source: Federal Highway Administration, 2012

Both the Transit and Transportation program and the Planning and Programming program are potential sources for funds for a Cold In-place Recycling project in Santa Paula. The division of the Transit and Transportation program budget for tasks (Figure 10) and the Planning and Programming program budget for tasks (Figure 11) are displayed on the following page.

Transit and Transportation Program Budget Tasks	Fiscal Year 2012/2013 Budget
Senior & Disabled Transportation Services	$360,355
Go Ventura Smartcard	$562,600
VISTA Fixed Route Bus Service	$5,571,150
VISTA Dial-A-Ride Service	$2,590,200
Nextbus	$176,100
Trapeze	$34,600
Transit Grant Administration	$5,076,849
Total Transit and Transportation Budget	**$14,371,854**

Figure 11: Transit and Transportation Program Budget Tasks FY 2012/2013
Source: Ventura County Transportation Commission, 2012

Planning and Programming Program Budget Tasks	Fiscal Year 2012/2013 Budget
Transportation Development Act	$27,953,197
Transportation Improvement Program/Monitoring	$316,475
Regional Transportation Planning	$664,100
Airport Land Use Commission	$9.30
Regional Transit Planning	$336,950
Freight Movement	$25,400
Total Planning & Programming Budget	**$29,305,422**

Figure 12: Planning and Programming Program Budget Tasks FY 2012/2013
Source: Ventura County Transportation Commission, 2012

Of the $14,371,854 allocated to Transit and Transportation, $5,076,849 is assigned to Transit Grant Administration. It is possible that through the Transit Grant Administration there may by an applicable grant that Santa Paula could apply for. However, the list of projects for 2013 has not been posted so it is unsure at this time if an applicable grant will be offered.

Similarly, of the $29,305,422 allocated to Planning and Programming, $316,475 is assigned to Transportation Improvement Programming/Monitoring. It is possible that a Cold In-place Recycling project for Santa Paula could receive some of these funds. However, a list of projects is not available at this time, so it is undetermined whether a climate action grant will be sponsored by the Ventura County Transportation Commission for the 2012/2013 fiscal year.

If the Ventura County Transportation Commission does not sponsor any climate action grants in 2012/2013, the City of Santa Paula could propose to the Commission that they consider funding such a grant in future years. Funding a climate action grant would be in line with California's climate goals to reduce the State's greenhouse gas emissions.

Although the Ventura County Transportation Commission does not have information regarding climate action grants that the City of Santa Paula would qualify for, there is climate

action funding from other sources that a Cold In-place Recycling repaving project by the City would qualify for. The Ventura County Air Pollution Control District has a Clean Air Fund which has approximately $35,000 available this year to fund projects that reduce air pollutant emissions (Ventura County Air Pollution Control District, 2012). Stringing together a handful of smaller climate action grants rather than relying on one large grant is a possibility in order to find funds to accomplish the necessary street improvements in the City.

Another source for potential grant funding is the federal government. The fiscal year 2013 budget for the Department of Transportation includes the plan for $305 billion to be spent over the course of six years for road and bridge improvements and construction. The United States Department of Transportation is also proposing $20 billion to go toward an incentive program called Transportation Leadership Awards that is designed to encourage fundamental reforms in the planning, building and management of transportation systems. These programs are to be paid for with the money saved from decreasing overseas military operations and thus are considered already fully paid for (United States Department of Transportation, 2012). These programs are potential sources for large sums of money for grants to be used for a Cold In-place Recycling repaving project.

Other climate action grants supported by the federal government in previous years are outlined in the chart below:

Grant Title	Grant Information
Congestion Mitigation and Air Quality Improvement (CMAQ) Program	· Provides support for transportation programs that contribute to greenhouse gas emissions reductions · Provided over $22 billion for 22,000 projects since 1992 *Source: Federal Highway Administration, 2011*
Exemplary Human Environment Initiatives (EHEI)	· Recognizes transportation initiatives that make our transportation system work better for the people who use it · Annual deadline is April *Source: Federal Highway Administration, 2011*
Surface Transportation Environment and Planning Cooperative Research Program (STEP)	· Authorized $16.875 million per year between fiscal year 2006 and fiscal year 2009 · STEP's objective is to improve the understanding of the relationship between surface transportation, planning and the environment *Source: Federal Highway Administration, 2011*
Transportation, Community, and System Preservation Program (TCSP)	· TCSP is a comprehensive initiative of research and grants to investigate the relationship between transportation, community, and system preservation plans and practices and identify private sector-based initiatives to improve such relationships *Source: Federal Highway Administration, 2011*
AB 118 Advanced Technology Demonstration Projects	· $2 million approved for 2012 · Purpose is to help accelerate the next generation of advanced technology vehicles, equipment, or emissions controls *Source: California Environmental protection Agency, 2012*
Innovative Clean Air Technologies Program (ICAT)	· Support development of new air pollution control technology · Ran from 1993 through 2008 *Source: California Environmental protection Agency, 2012*
Environmental Justice Small Grants Program	· Awarded more than $23 million to 1,253 communities since 1994 · Supports communities working on solutions to local environmental and public health *Source: United States Environmental Protection Agency, 2012*
Source Reduction Assistance Grant Program	· Purpose of the program is to support environmental projects that reduce or eliminate pollution at the source · $1,470,000 available for fiscal year 2012 *Source: United States Environmental Protection Agency, 2012*

These grants, if re-funded for the 2013 fiscal year, are potential sources for funding for the City of Santa Paula to complete a Cold In-place Recycling project in order to repave their roadways.

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Attachments

The attachments to this document are as follows:

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Attachment 1

Sample Grant Application for Cold In-place Recycling Project in Santa Paula

By: Lorien E. Clark

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California Polytechnic State University
San Luis Obispo
2012

1. Please identify the project area and total lane miles for this project.

The project area consists of four roads in downtown Santa Paula identified in the City of Santa Paula Downtown Improvement Plan to be major circulation roadways (CRP 411, 2012). The project area consists of the length of 10th Street (between Harvard Boulevard and Santa Barbara Street), Mill Street (between Harvard Boulevard and Santa Barbara Street), Santa Barbara Street (between 10th Street and Mill Street), and Main Street (Between 10th Street and Mill Street). The project area is shown on the Map below.

Figure 1: Map of Proposed Project Area

The total lane mileage for this project is 6.3 miles: 2 lane miles on 10th Street, 1.6 lane miles on Mill Street, 1.5 lane miles on Santa Barbara Street, and 1.2 lane miles on Main Street.

2. Please explain how this project reduces greenhouse gas emissions.

Assumptions:

- The amount of greenhouse gas emissions saved by replacing one ton of Hot Mix Asphalt with Cold In-place Recycling = 88 lbs of CO_2 (108 lbs – 20lbs) [see Figure 2]

Emission Source	Greenhouse Gas Emissions CO_2 (lbs/t)
Hot Mix Asphalt	108
Warm Mix Asphalt	106
Hot In-place Recycling	84
Cold In-place Recycling	20

Figure 2: Greenhouse Gas Emission per Ton of Material (lbs/t)
Source: Chappat & Bilal, 2003

- The average weight of one cubic foot of asphalt = 150 lbs

Source: California Department of Transportation, 2012 [see Figure 3]

- The average lane mile of roadway is 15 feet wide

Source: California Department of Transportation, 2012 [see Figure 3]

	Roadway Dimensions (ft.)				Asphalt Weight		
	Length	Width	Depth	Volume	Lbs/Cublic Ft.	Total Lbs	Tons
3" Ave. Depth	5,280	15	0.25	19,800	150	2,970,000	1,485

Figure 3: Tons of Asphalt per Lane Mile
Source: City of Napa, 2010

Result:

	Greenhouse Gas Savings (CO_2)		
	Greenhouse Gas per Ton of Pavement	Tons of Pavement per Lane Mile	Greenhouse Gas per Lane Mile
Cold In-place Recycling verses Hot Mix Asphalt	88	1,485	130,680

Figure 4: Greenhouse Gas Savings (CO2)
Source: Figure 2 and Figure 3

Thus, 130,680 lbs of greenhouse gas are saved per lane mile when using Cold In-place Recycling verse Hot Mix Asphalt repaving techniques. For the proposed project site (6.3 miles), the total pounds of greenhouse gas emissions saved by using Cold In-place Recycling verse Hot Mix Asphalt would be 823,284 lbs.

3. Please explain who will own and operate the equipment.

The City of Santa Paula will own and operate the equipment. After purchase of the necessary equipment for Cold In-place Recycling, the City can continue paving with this technology. This will save the City money on future repaving jobs and thus will result in paying off the price of the equipment and saving the City considerable money overall.

4. Are other public agencies able to use this equipment?

Yes, other public agencies will be able to rent this equipment out from Santa Paula in order to fund their own Cold In-place Recycling projects. This will result in less expensive, more environmentally friendly repaving for other public agencies, as well as, helping the City of Santa Paula to supplement the amount spent on the Cold In-place Recycling equipment.

5. Please provide details on how this could be replicated elsewhere in the region.

The Cold In-place Recycling repaving technique has been used on roadways in regions with both high and low traffic volumes. It can be used all around California. Other public agencies are able to either use Santa Paula's Cold In-place Recycling equipment to repave their roadways, or they could follow in Santa Paula's footsteps more directly to try and receive grant funding to purchase their own Cold In-place Recycling equipment.

Attachment 2

2010 Climate Initiatives Innovative Grant Program

Sonoma County and the City of Napa
Partnership for Sustainable Community Networks

CITY of NAPA

Section A—Project Description

Every form of transportation used today utilizes the most basic kind of public infrastructure: the road. Methods of transportation such as mass transit, air, and rail systems, made accessible to the public by roadways, are only possible if our road networks are sustained. Bicycles, pedestrians, buses, and vehicles rely on roads daily for purposes both fundamental and recreational. Keeping the roads in useable condition has become as challenging as it is essential.

The term sustainability has come to encompass a movement that has been steadily gaining recognition and momentum. However, it has not typically been a term associated with road construction. What we propose will expand the scope of the definition.

Global concerns about climate change, energy use, environmental impact, and limits to financial resources for transportation infrastructure require new and alternative approaches to planning, designing, constructing, operating and maintaining transportation systems. As public works departments across the country seek new solutions to reducing the impact of transportation on the environment, new technology and methods to traditional practices continue to be developed.

There can be no single right answer to achieving a reduction in greenhouse gas emissions. Rather, there must be many. Movement forward is not possible if traditional practices are not examined and revised as needs and new methods dictate. To that end, we are proposing a demonstration project that will markedly reduce GHG emissions while reducing the cost of road rehabilitation by recycling existing asphalt concrete pavements in place, eliminating the need to produce new material or transport it to the worksite. This project will also serve as a pilot program for other Bay Area communities, enabling them to consider this new GHG reduction technology.

The technology is known as Cold In Place Recycling (CIR), and has enjoyed success in Europe and Canada and the United States, but has not yet reached all the potential users in the San Francisco Bay Area. CIR begins with the grinding of the upper 2 to 4 inches of the existing distressed asphalt concrete pavement. The pavement is pulverized and recycled in place and mixed with recycling emulsifying agents or foamed asphalt, and then graded and compacted in the same way as new asphalt concrete. The process is green for several reasons. The first is the reuse of legacy aggregates and asphalt binders in the existing asphalt and minimizing the need for new aggregate materials. The source reductions often result in a nearly 80% reduction in greenhouse gas emissions over more conventional road rehabilitation treatments. There is also a reduction in emission associated with the hauling and disposal of road materials by heavy equipment.

True sustainability means not only seeking new ideas, but searching for innovative alternatives to existing methods.

The efficiency of the operation also results in emission reductions from improved traffic congestion management associated with road closures and traffic control detours and delays. Figure No. 1 delineates the energy expended for the traditional road process, called Hot Mix Asphalt, and the proposed new technology, CIR. The City of Napa and Sonoma County have teamed together to provide the Bay Area communities with demonstrations of this innovative technology. A joint powers agreement will be developed to that end.

Napa and Sonoma County are representative of many communities in the Bay Area. Sonoma County is largely rural, with the largest road network in the MTC region, and the lowest pavement condition level in the Bay Area. The City of Napa maintains 220 miles in an entirely urban setting.

CIR Train Process: The milling drums granulate the damaged road pavement very effectively to a depth of up to 8 inches. The pugmill mixer mixes the scarified material thoroughly with the injected quantities of binding agent and water, producing a new, homogeneous asphalt concrete in situ. The spreading auger spreads the material uniformly across the full width, enabling the paving screed to place and precompact it with maximum precision. After compaction by rollers, the recycled layer serves as a base layer for the new road.

While the source of this particular grant program lends itself well to purchasing equipment, this process is easily replicated because it need not depend upon equipment purchase to occur. Other agencies can find contractors in possession of the equipment and specify the desired process with the project design /bid/build approach.

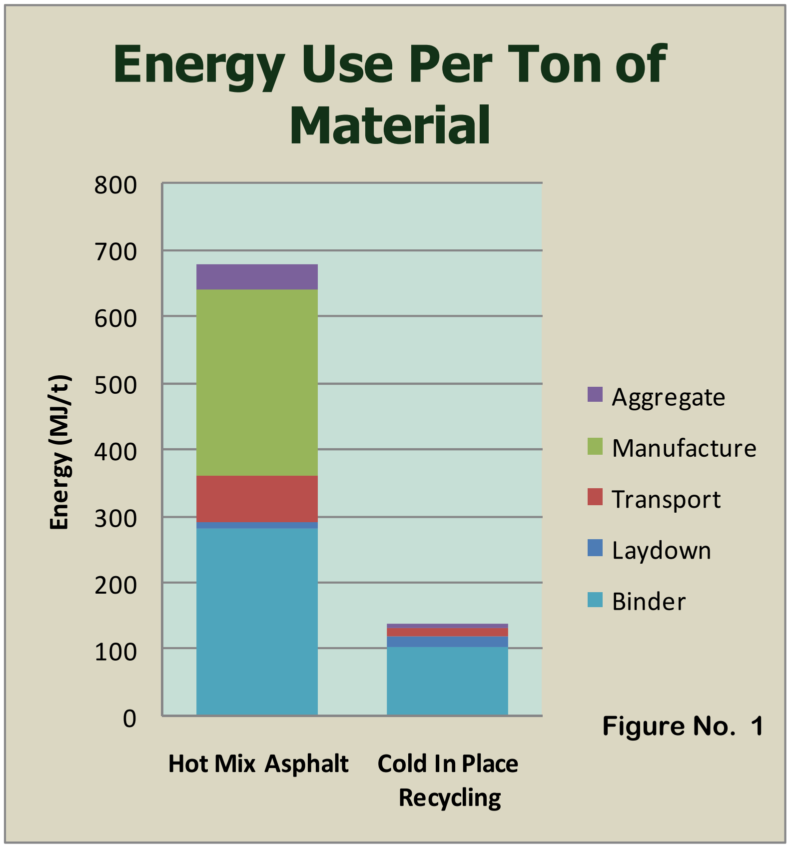
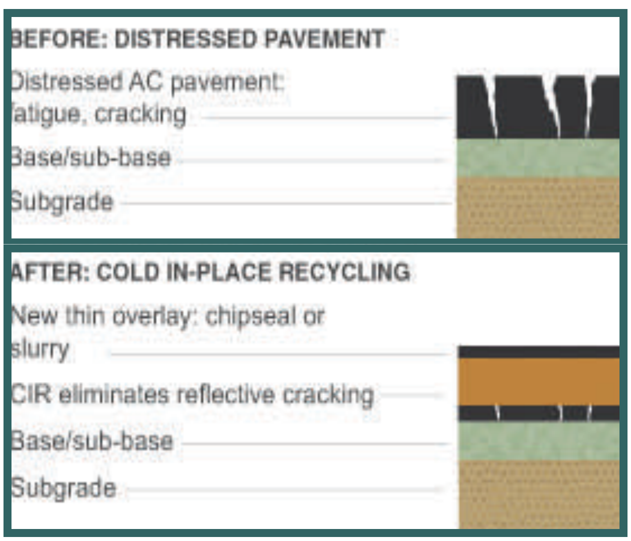


Figure No. 1



Section B—Scope of Work and Schedule

The Sonoma County project will support the transportation corridors between the Priority Development Areas (PDAs) within the county, linking these communities in a vital way. The Napa project will support its downtown area. The Freeway Drive project specifically lies on the Regional Bikeway Network and will upgrade existing Class III portion of the bike lanes to Class II. The Coombs street project supports a major public transit and truck and passenger vehicle transportation link from the southern commercial area to the downtown center.

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The Sustainable Community Networks project will purchase the CIR equipment for public use by Joint Powers Agreement. There are two applications of the equipment, which the city and county will demonstrate to other Bay Area communities and beyond. The JPA will issue a competitive Request for Proposals (RFP) to partner with qualified private sector contractors with specific expertise in this technology for services related to the completion of the cold in place recycling process on the chosen demonstration projects and maintenance of the agency-purchased equipment. The vendor will use the JPA-owned equipment in the process and provide all of the supporting equipment and emulsifying materials required to complete project design requirements supplied in the RFP. We anticipate the Freeway Drive/Golden Gate Drive and Adobe Road Projects to be completed in the Summer of 2011 and the Coombs Street and Bennett Valley Road Projects to be completed by September 2012. These 4 projects will demonstrate the equipment's use in a one-step operation. This application specifically is well-suited to roadway rehabilitation on longer lengths of roadway.

TABLE A: PROJECT SCHEDULE

Project Tasks	Begin Date	End Date
Joint Powers Agreement Development	Oct. 2010	March 2011
Equipment Procurement	Oct. 2010	March 2011
RFP for CIR Services	Jan. 2011	June 2011
Project Development	Oct. 2010	June 2012
Freeway Drive/Golden Gate Drive	Oct. 2010	July 2011
Coombs Street	Oct. 2010	June 2012
Adobe Road	Oct. 2010	July 2011
Bennett Valley Road	Oct. 2010	June 2012
Beard Road	Oct. 2010	Sept. 2011
Agency Education and Outreach	Oct. 2010	June 2012
Plan and Promote Workshops	Oct. 2010	Aug. 2011
Develop materials and deliver Workshops	Feb. 2011	Aug. 2011
Develop and post online learning portal	June 2011	June 2012

Movement forward is not possible if traditional practices are not examined and revised as needs and new methods dictate.

Photograph shows the before and after views, side by side, of a CIR project.

SONOMA COUNTY 1850 CALIFORNIA AGRICULTURE INDUSTRY RECREATION

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The second application of the equipment in the demonstration project concerns urban pavements which do not meet the lengths necessary to use the equipment in the "train" setting detailed above. The City of Napa will demonstrate a stationary application for communities to consider for shorter street sections through its Beard Road project. Local communities face some of the most significant challenges in maintaining these pavements as only locally derived revenues may be used on them. The Beard Road project will use the CIR equipment purchased under this program and will be scheduled to work as time allows after the Summer 2011 Projects are completed. The project schedule on Page 3 shows the number of days the equipment would need to be utilized for the various demonstration projects.

Section C—Response to Questions from Evaluation Committee

1. Please explain how this project reduces both GHG emissions and criteria pollutants.

The primary reason CIR reduces GHG emissions and criteria pollutants is that the process renders the mining, manufacture, transport and application of new pavement aggregate unnecessary. The assumptions and calculations used to determine the amount of impact are as follows:

Calculation Factors:

Factors used in calculating the GHG emissions benefits of the project are provided below. Note that emissions data has been converted from kg/metric ton to lbs/US ton.

Emissions Source	Emissions (CO_2e)	Data Source
Hot Mix Asphalt	108 lbs / ton asphalt	Bilal, Julian; Chappat, Michael; Colas Group; *Sustainable Development: The Environmental Road of the Future; 2003*
Cold In Place Recycling	20 lbs / ton asphalt	Bilal, Julian; Chappat, Michael; Colas Group; *Sustainable Development: The Environmental Road of the Future; 2003*
1 Passenger Car (12,000 miles/ year)	5.5 metric tons / year or 6.1 tons / year or 12,125 lbs/ year	www.epa.gov/otaq/climate/420f05004.htm

Assumptions:

- The amount of GHG emissions saved by replacing one ton of HMA with CIR = 88 lbs of CO_2e (108 lbs – 20 lbs)
- The average weight of one cubic foot of asphalt = 150 lbs. (Source: California Dept. of Transportation)
- The average lane mile of roadway is 15 feet wide

This project will remove approximately 2,227,167 lbs of CO_2e from the air, which is equivalent to taking over184 cars off the road for one year.

Average Emissions Savings per Mile of CIR Usage:

In order to quickly calculate the approximate GHG emissions savings by using CIR per lane mile of roadway, the area to be treated should be translated into the number of tons of asphalt used in a typical project using hot mix asphalt (HMA). The tons of asphalt is then multiplied by the GHG emissions savings factor of 88 lbs CO_2e / ton asphalt in order to determine the total savings.

CIR treatments usually recycle between 2 and 4 inches of the roadway's surface. Since the total amount of asphalt that will be needed depends a great deal on the thickness or depth of the treatment, an average depth of 3 inches is assumed.

Tons of Asphalt Per Lane Mile:

	Roadway Dimensions (ft.)				Asphalt Weight		
	Length	Width	Depth	Volume	Lbs/Cubic Ft.	Total Lbs.	Tons
3" Average Depth	5,280	15	0.25	19,800	150	2,970,000	1,485

GHG Emissions Savings:

	GHG Savings		
	CO_2e lbs./ Ton Pavement	Tons Pavement/ Lane Mile	CO_2e lbs./ Lane-mile Pavement
CIR	88	1,485	130,704

The number of passenger cars that would need to be removed from the road for a year in order to achieve the same GHG emissions savings as paving one lane mile of roadway with CIR instead of HMA is equal to: 130,704 lbs CO_2e (GHG savings from CIR) / 12,125 CO_2e (annual emissions from 1 passenger car) = 10.8

2. Please explain who will own and operate the equipment.

The City of Napa and Sonoma County will jointly own the equipment through the JPA. The City of Napa will act as the administrative agency in the JPA. The member agencies will jointly decide on the schedule for use of the equipment. The private sector contractor partner, who will be chosen through an RFP process, will operate and maintain the equipment.

On average, for every lane mile of roadway that CIR is used instead of traditional HMA, approximately 130,704 lbs of GHG emissions are saved, which is equivalent to taking 11 cars off the road for one year.

SONOMA COUNTY 1850 AGRICULTURE INDUSTRY RECREATION CALIFORNIA

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3. Are other public agencies, such as those outside of Sonoma and Napa counties, able to use this equipment?

Yes. The Joint Powers Agreement will be designed so that the addition of other public agency participants can be easily accomplished. As partners are added, the scheduling of the equipment becomes more complex, but additional partners could be accommodated without difficulty.

4. Please provide details on how this could be replicated elsewhere in the region.

This is addressed in two ways. The first section will talk about additional potential emissions savings from replicating the program in the region. The second section will discuss the planned outreach and education component of the project. The outreach and education component was supplied by our partner, Technology Transfer at U.C. Berkeley.

Potential Emissions Savings from Replication of CIR:

The Sustainable Community Networks project proposal includes a component for outreach and education in order to speed replication of the CIR technology across the Bay Area. CIR is most appropriate for roadways within a particular condition range. Very good roads would not use CIR as these roads typically only require a thin surface seal to rejuvenate the roadway. Likewise, roadways in very poor or failed condition must be reconstructed and CIR would be an insufficient treatment. However, the Bay Area has thousands of miles of roadways that require heavy maintenance or rehabilitation and could benefit from CIR. These roadways typically fall within a PCI of 25 to 69.

Each year, the Metropolitan Transportation Commission (MTC) publishes a report on the condition of the local roadways in the region. The report identifies the miles of roadways that fall within various condition categories. Based on this report, we can identify how many roadways in the Bay Area would qualify for CIR treatment. Assuming that all roadways for which CIR is appropriate were treated, the following calculations estimate the GHG emissions savings that could be realized if CIR were utilized:

Total L S & R System Potential:

Roadway Condition Range*	% of Total BA LSR Mileage	Lane Mileage	Cubic Ft.	Total Lbs. Asphalt	Tons Asphalt	Total CO_2e Savings
PCI: 60-69	12%	5042	66,558,096	9,983,714,400	4,991,857	484,210,148
PCI: 50-59	10%	4202	83,197,620	12,479,643,000	6,239,822	605,262,686
PCI: 25-49	8%	3362	88,744,128	13,311,619,200	6,655,810	645,613,513
Total:					17,887,488	1,735,086,365
Annual Passenger Car Reduction Equivalent:						**143,096**

*Source: MTC's 2009 Local Streets and Roads Regional Condition Summary

Since it would be overly optimistic to assume that funding will be available to rehabilitate all of the roadways in need in the near term, the analysis depicted in the table below looks at a realistic estimate of roadways that could be treated over the next five years, given the existing level of funding for Local Street and Road capital maintenance. The amount assumed for the annual capital funding available is based on revenue information collected in 2009 from a survey of all local jurisdictions on street and road maintenance need and revenue.

The GHG emissions savings potential if all candidate streets in the region were paved using CIR instead of traditional HMA is 1.6 billion lbs of CO_2e, which would be equivalent to taking 143,096 cars off the road for one year.

Note that only 30 percent of the funding is assumed to be used for roadways that could be treated with CIR, which is consistent with the proportion of roadway lane miles within the appropriate condition categories, to the total roadway lane mileage in the Bay Area. The average cost of treating one mile of roadway in the various condition categories is also estimated based on information derived from the 2009 Local Street and Road survey, and is weighted based on the proportion of lane mileage that exists within each of the relevant condition categories. The tonnage of asphalt that would be required to treat these roadways is also weighted according to the proportion of lane mileage in each of the condition categories—since a different thickness of asphalt is needed for roadways in varying condition.

5-Year Potential GHG Emission Savings:	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	5-Year Total
Total LSR Capital Funding Available (1,000s)*	$ 453,268	$ 466,934	$ 482,029	$ 459,041	$ 475,590	$ 2,336,863
Available for CIR Treatable Roadways (30%)	$ 135,980	$ 140,080	$ 144,609	$ 137,712	$ 142,677	$ 701,059
Avg. CIR Cost per Lane Mile*	248	248	248	248	248	248
Lane Mileage Funding Capacity	549	566	584	556	576	2,832
PCI: 60-69	220	226	234	223	231	1133
PCI: 50-59	183	189	195	185	192	944
PCI: 25-49	146	151	156	148	154	755
Tons of Asphalt Recycled with CIR	779,515	803,017	828,977	789,443	817,903	4,018,854
GHG Emissions Savings (lbs.CO2e)	**75,628,505**	**77,908,717**	**80,427,343**	**76,591,722**	**79,352,946**	**389,909,233**
Annual Passenger Car Reduction Equivalent:	**6,237**	**6,425**	**6,633**	**6,317**	**6,544**	**32,157**

*Source: 2009 Local Street and Road Needs, Revenue and Performance Survey

Training and Outreach Services—Designed and Provided by the Technology Transfer Program

The outreach component of this project will be two-fold, and will be implemented by the Technology Transfer Program. First, we will host two on-site workshops, inviting Bay Area city and county public works directors and decision makers to the demonstration projects. The one-day workshops will include an overview of the process and technical specifications, visits to the project sites, and discussion of how to replicate the process. Second, we will use video taken at the demonstration sites and in the workshops, combined with presentation materials and references to create an online learning portal. The portal will include training modules, streaming video and resources to provide cities and counties with the information they need to understand and implement CIR. This portal will be available via the internet, and will therefore have impact beyond the boundaries of the Bay Area, and extending beyond the term of the grant.

About the Technology Transfer Program

The Technology Transfer Program, a unit of the Institute of Transportation Studies at the University of California, Berkeley, is uniquely positioned to conduct this outreach because it has already established itself as the California transportation community's source for professional training, expert assistance and resources for public agencies. Their program conducts over 200 training sessions annually, reaching over 5,000 attendees; sends out quarterly newsletters, monthly emails and other publications to a mailing list of over 20,000 transportation professionals; and provides intensive technical assistance to dozens of local agencies and information resources to all the of State's cities, counties, regional and state transportation agencies.

SONOMA COUNTY 18 50 CALIFORNIA REPUBLIC AGRICULTURE INDUSTRY RECREATION CALIFORNIA

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The Technology Transfer Program's core strengths include an existing robust infrastructure for providing a wide range of training (in terms of both content development and administration/logistics), expert technical assistance and outreach services. The following resources would be available to this project with no direct charge to this project:

- information dissemination via monthly email announcements and quarterly newsletters, including a feature article on the CIR process in the newsletter and promotion of the workshops in the newsletter and announcements;
- the ability to develop online training modules using Articulate software;
- a commitment to host and maintain the learning portal beyond the term of the grant, to an information-rich website, currently serving over 8,000 unique visitors with approximately 30,000 pages each month;
- an online calendaring and registration system for the two live workshops;
- web meeting services for project meetings.

Section D—Approach to Program Evaluation

Project Specific Emissions Savings:

The Sustainable Community Networks project is proposing to rehabilitate approximately 13.4 lane miles of roadway using the CIR process within the City of Napa and Sonoma County. The roadways vary in width depending on requirements for bike lanes, parking area and shoulder width. The width of the lane mileage in Napa is greater than that of Sonoma since they are paving streets that run though an urbanized area.

Although the actual depth of the pavement treatment will not be determined until final design elements are concluded, the Pavement Condition Index (PCI) of the roadways—an average PCI of about 40—indicates that major rehabilitation is needed; therefore, a treatment depth of 3.5 inches was assumed for the purposes of this evaluation.

The table below estimates the GHG savings emissions using the general methodology described in Question 1 of Section C, but uses the actual dimensions of the roadways within the project limits instead of averages.

Emissions Benefits of Sustainable Community Networks Grant Proposal:

Jurisdiction	Roadway	Ln. Miles	Length (ft.)	Width (ft.)	Treatment Depth (ft.)	Cubic Feet	Total Lbs. Asphalt	Tons Asphalt	CO2e Savings / Ton*	Emission Savings (lbs CO_2e)
Napa	Freeway Dr. & Coombs St.	5.0	26338	20.0	0.3	153638	23,045,750	11523	88.0	1,014,024
Napa	Beard Rd.	1.0	2614	20.0	0.3	15684	235,2600	120	88.0	10,600
Sonoma Co.	Adobe Rd.	4.4	23067	13.5	0.3	90825	13,623,750	6812	88.0	599,456
Sonoma Co.	Bennett Valley Road	4.0	21240	15.0	0.3	92925	13,938,750	6969	88.0	613,272
Total:		**13.4**								**2,237,300**
Annual Passenger Car Reduction Equivalent:										**185**

Attachment 2

Paving Related Emissions Data Source:

A study was prepared in 2003 by a French Company, the Colas Group Sand for the first time, empirical data on energy use per ton of road material laid was calculated. Emissions inventories for the various components of the paving process were sourced by Colas from work done by the Athena Sustainable Materials Institute, Eurobitume and IVL Swedish Environmental Research Institute.

The study also cites that GHG emissions from road construction include carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4). The contributions of these gases are not alike and are therefore expressed as CO_2 equivalents. One kg (2.2 lbs) of N_2O and CH_4 is equivalent to 310 kg (683 lbs) and 21kg (46 lbs) of

The City of Napa and County of Sonoma have used this study as the basis for evaluating the GHG emissions for the proposed project. It included the different components of the paving process including the extraction and hauling of raw materials, the manufacture or preparation of the materials into a usable product, transport to the work site, and placement of the product and finishing of the construction.
CO_2, respectively.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own need.
--Mrs. Helen Brundtland, in a report to the United Nations, 1987

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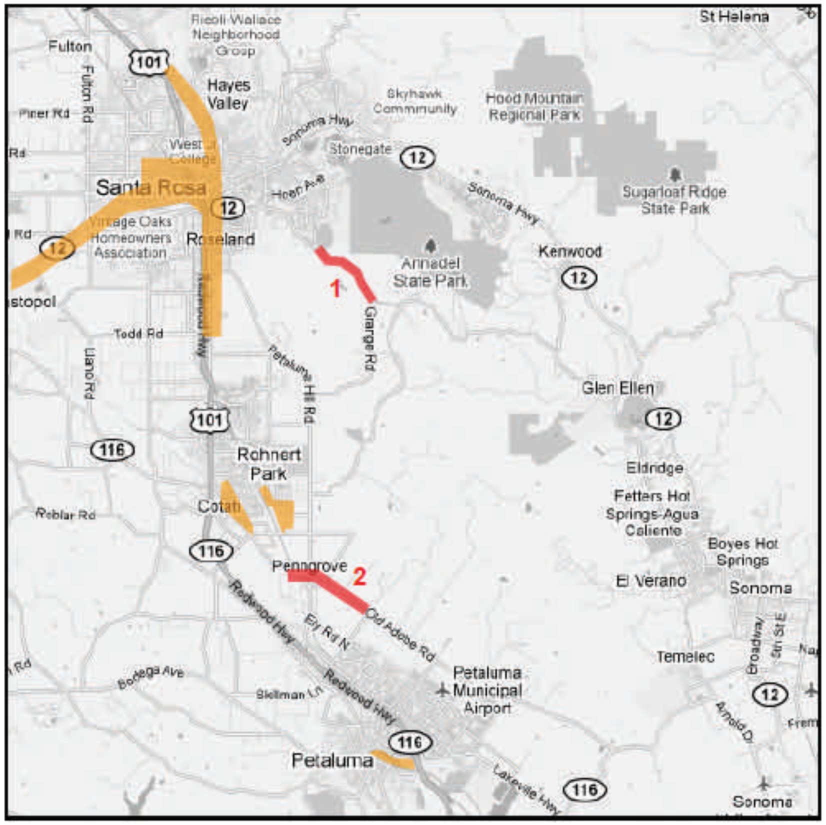
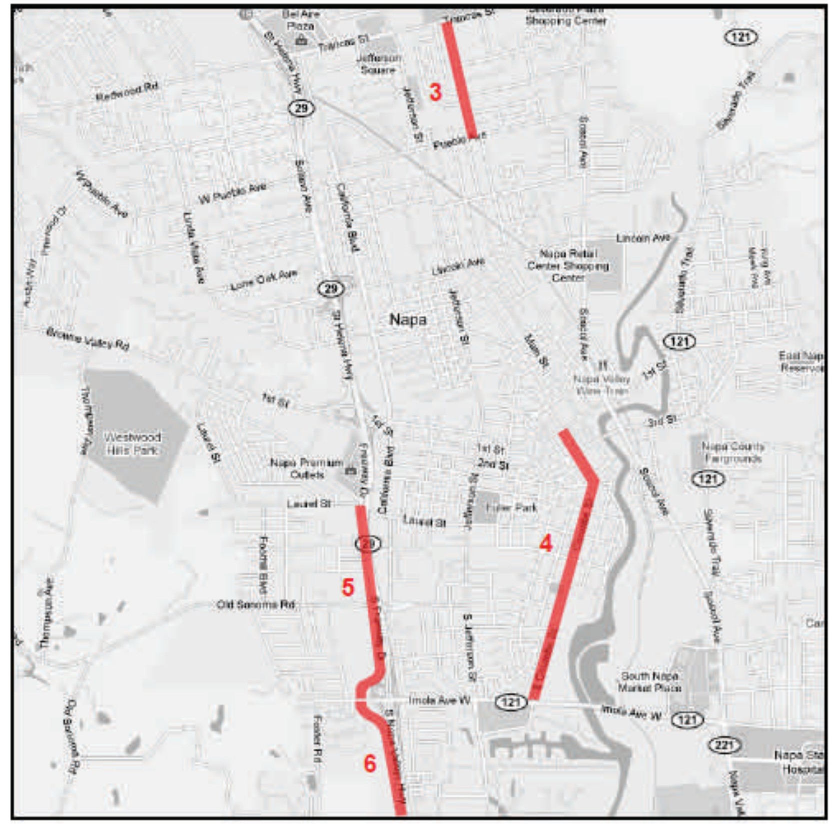
Attachment 2





Project Location

Priority Development Area

Map No.	Road Name	Location
1	Bennett Valley Road	Santa Rosa City Limit to Grange Road, SE of Santa Rosa
2	Adobe Road	Old Redwood Highway to Corona Road, N of Petaluma
3	Beard Road	Pueblo Avenue to Trancas Street, Napa
4	Coombs Street	Imola Avenue to First Street, Napa
5	Freeway Drive	Imola Avenue to Laurel Street, Napa
6	Golden Gate Drive	City Limit to Imola Avenue, Napa

Agency	Component	Grant Funds Requested	Match Amount	Match Source	Program Totals
Sonoma County/ City of Napa	CIR Equipment	1,150,000	150,000 150,000	Prop 1B (Sonoma) Gas Tax (Napa)	1,450,000
Sonoma County	CIR Demo Project	2,500,000	750,000	Prop 1B	3,250,000
City of Napa	CIR Projects: Freeway Drive Coombs (1st to Imola) Beard Road	 638,000 880,000 80,000	 140,000 220,000 20,000	 Gas Tax (All)	 778,000 1,100,000 100,000
City/County	Outreach/Educational Items for Agencies	40,000	10,000	Gas Tax/1B	50,000
	TOTALS:	**5,288,000**	**1,440,000**	**(Match 27%)**	**6,728,000**

County of Sonoma:

Stephen B. Urbanek, P.E.
Pavement Preservation Manager
2300 County Center Drive B100
Santa Rosa, CA 95403
(707) 565-3884
surbanek@sonoma-county.org

City of Napa:

Marlene Demery, P.E.
1600 First Street
Napa, CA 94558
(707) 257-9520
mdemery@cityofnapa.org

Past practice should be a catalyst, rather than an impediment, for change.

Attachment 3

Nevada Golconda CIR project a first

Nevada has successfully maintained its road system with cold in-place recycling over the past decade, but the Golconda I-80 was its first interstate CIR

By Greg Udelhofen, editor

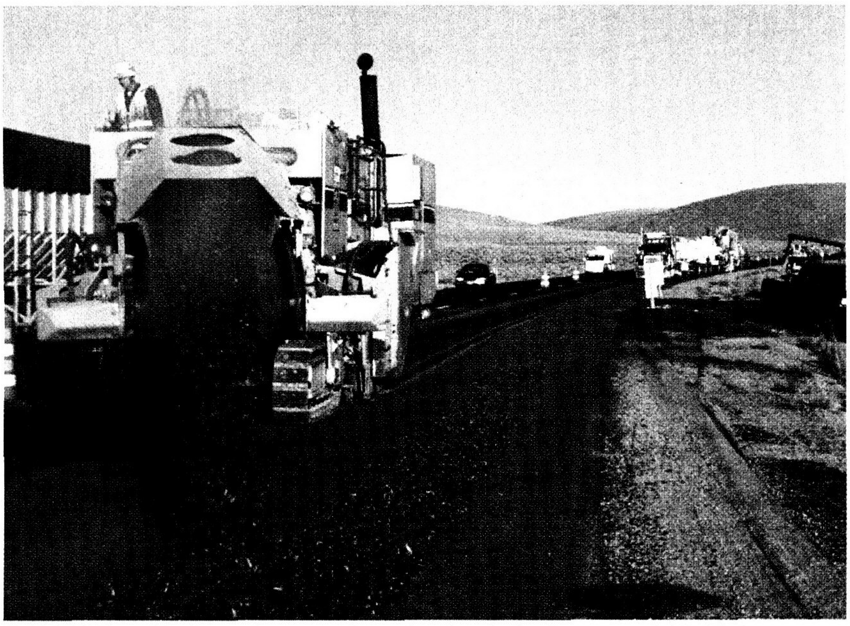
The Nevada Department of Transportation (NDOT) has been successfully performing cold in-place recycling (CIR) since the mid 1990s, and this past summer it decided to put the process to the test on Interstate 80 west of Elko. The Humboldt County project, between MP 29.38 and 42.19 was probably not the easiest debut of NDOT's interstate CIR attempt, due largely to the heavy traffic volume and steep grade required to traverse the Golconda Summit, but the resulting success proved it to be a most viable approach to rehabilitating the state's main east/west corridor.

The construction strategy consisted of CIR three inches of the existing asphalt sur-

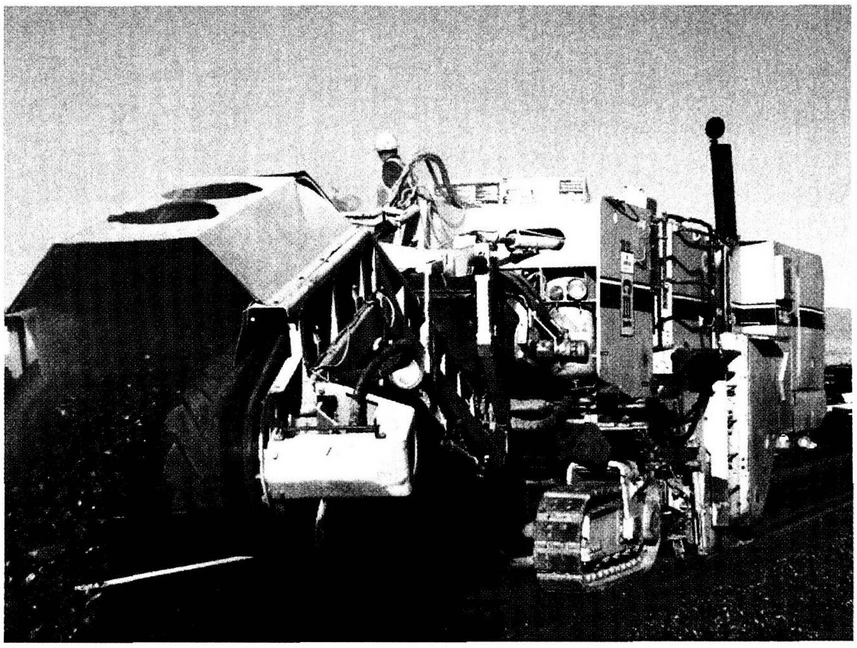
face and then placing four inches of NDOT's specified Plant-mix Bituminous Surface overlay (a dense-graded mix) followed by a ¾ inch of open-graded wearing course. Based on the existing condition of this portion of I-80, NDOT believed this rehabilitation strategy would be the most cost-effective approach; however, since it was the first interstate recycling project in the history of NDOT, there was a lot of anxiety leading up to construction.

The amount of traffic that I-80 carries was of primary concern in the planning and safe execution of the recycling project. The Annual Average Daily Traffic (AADT) at the time of recycling was 6,620, with approximately 50 percent of that volume being truck traffic. Based on the AADT, percentage of trucks, truck equivalency factor, and the projected growth rate of vehicle usage, the 20-year Equivalent Single Axle Loads (ESALs) was calculated to 14,988,198. To protect the recycled mat from a high percentage of truck traffic, public traffic was not allowed to run on the recycled surface for a minimum of three days. Once the first two-inch lift of dense graded hot mix was placed, public traffic was allowed to travel on the surface for a maximum of 14 days before the second lift had to be placed.

Another factor that posed an added challenge was whether or not the CIR train could traverse the steep incline over Golconda Summit (a six percent grade). Normally, the recycling train would travel downhill due to the weight of the equipment. However with safety concerns over the recycling train traveling against the flow of traffic, NDOT requested that construction activities flow with traffic. As a contingency to assist the train up the steep grade, a Cat 988 loader was attached to the front of the train and used several times to help pull the recycling train up the steepest portion of the grade.



The final concern in executing a recycling project on this major interstate was completing the work to protect the CIR mat from the harsh winter weather conditions the Golconda Summit endures. Timing was critical and NDOT wanted the recycled mat covered with the new hot mix overlays to prevent any weather-related damage to the recycled material. But the timing and coordination between the recycling contractor, Valentine Surfacing, and the paving contractor, Frehner Construction, allowed the work to begin in March and to be completed in September. NDOT allowed 220 working days for the project, which was finished in only 140 working days. For NDOT, the proj-



The construction strategy consisted of CIR three inches of the existing asphalt surface and then placing four inches of NDOT's specified Plant-mix Bituminous Surface overlay (a dense-graded mix) followed by a 3/4 inch of open-graded wearing course.

ect was hailed as a complete success.

CIR process

Vancouver, WA-based Valentine Surfacing performed the CIR of the existing asphalt roadway, milling 563,000 square yards at a depth of three inches of the old pavement surface on the 13-mile-long project.

To minimize traffic disruptions, the interstate project was divided into approximate six-mile segments in east and westbound directions, allowing milling and paving to be conducted simultaneously throughout the duration of the work. Working with general contractor, Frehner Construction, a paving contractor based in Las Vegas, Valentine milled the inside 12-foot-wide travel lane along with the inside 4-foot-wide shoulder, using a CMI Roto-Mill, which conveyed the millings to a screen and crusher (specifications required that all milled material had to be sized at minus 1-1/4 inches), which then transferred the processed millings to a pugmill where the cationic medium set (CMS-2S) emulsion was added. The recycled asphalt was then deposited in a windrow behind the CIR train for laydown and compaction.

Valentine milled the inside 12-foot-wide travel lane along with the inside 4-foot-wide shoulder using a CMI Roto-Mill, which conveyed the millings to a screen and crusher, then transferred the processed millings to a pugmill where the emulsion was added.

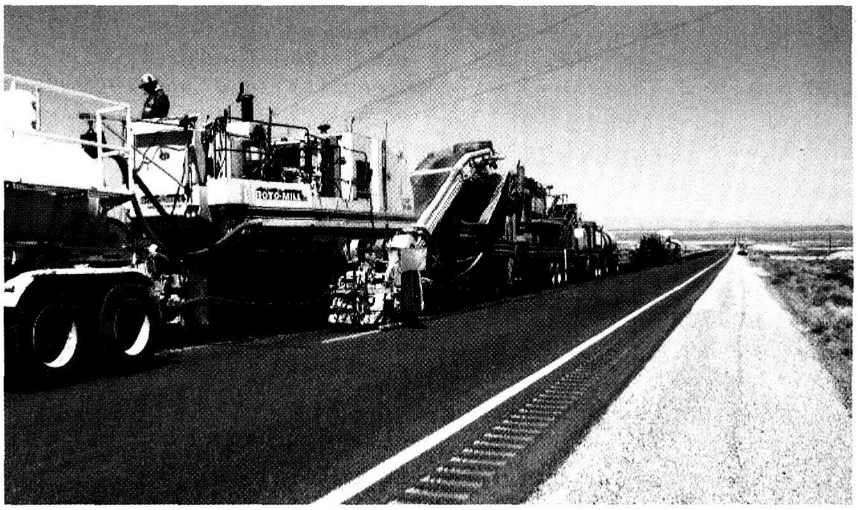
The same process was followed on the outside 12-foot travel lane, and again on the 10-foot-wide outside shoulder, according to Chuck Valentine, owner of Valentine Surfacing.

"Each CIR project is a little differ-

Attachment 3

ent, and on this one Nevada specified the emulsion we used as well as adding a lime slurry during the milling process," Valentine says. "The lime slurry acts as an anti-stripping agent, and helps cure and strengthen the recycled asphalt."

The end result of the CIR process is a treated base course, after it has several days to cure, ready for a new hot mix overlay.



Ready for the hot mix

With the concern NDOT expressed about leaving the recycled mat unprotected over the winter, Frehner established an aggressive paving schedule to complete the project in one construction season. Frehner outfitted two paving crews, one to place the recycled cold mix and one to place the hot mix.

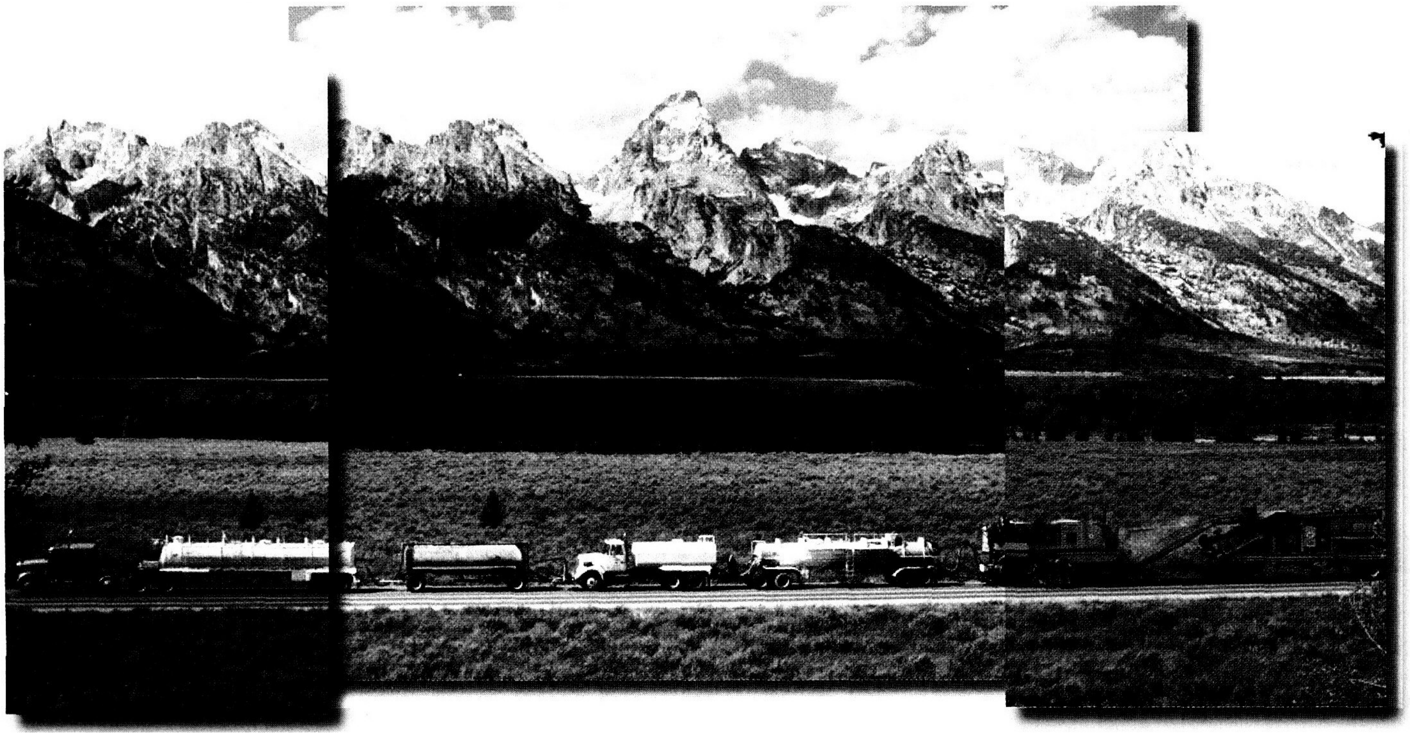
According to Gary Isaman, Frehner's Elko, NV area manager, about the only difference in placing the cold mix versus the hot mix was the lag time between placement and compaction.

"We had to wait a half hour to 45 minutes after the paver laid the cold mat before we could begin our rolling pattern, because it took that time for the lime to begin setting the emulsion," Isaman says. "Once we could get on it, we were able to achieve 90 to 92 percent density."

Project specifications required up to 10 days for moisture content in the recycled mat to drop to 2 percent before Frehner could begin placing the hot mix, but due to weather conditions, the curing process took only three to five days.

Once the recycled mat reached the specified moisture content, Frehner's hot mix crew, using a Blaw-Knox 5510 paver, began placing the first of two 2 1/2-inch mats of dense-graded asphalt. The new 5-inch overlay was then covered with a ¾-inch open-graded wearing course.

"We used pneumatic rollers on the cold mix, finishing with a steel-drum roller, and steel and pneumatic rollers on the hot mix," Isaman say. "We achieved are required 92 percent density on the 2C (hot mix) and the only time we operated our rollers in a vibratory mode was when we did a re-roll of the cold mat prior to placing the hot mix. NDOT specified the re-roll for additional compaction density before placing the new asphalt. We also achieved the required Type A



smoothness spec required by NDOT, which meant we didn't have any grinds to correct any detected surface deviations. (NDOT's Type A smoothness index allows 5 inches of ¼-inch deviations per lane mile).

CIR continues to perform

As Nevada continues to use CIR as a cost-effective maintenance approach, its past success supports the efforts to expand its use on interstate road projects.

"For the past 15 years, Nevada has been successful in cold recycling low-volume (traffic) roads, and I knew they could be successful in cold recycling an interstate road," Valentine says. "A lot of the restrictions concerning traffic and preventing traffic on the recycled mat until it could be covered with new asphalt had to do with NDOT's desire to make this first interstate cold recycling project successful. But as the project moved along, we were able to convince them (NDOT) that they could allow traffic on the recycle mat and not worry about damaging it before the new asphalt was placed."

The CIR process saved a considerable amount of time and money compared to Nevada's conventional Road Bed Modification rehabilitation, where 8 to 10 inches of road surface is pulverized and 2 percent cement slurry is added to stabilize and strengthen the pulverized base before a 4-inch hot mix overlay is placed.

"Once NDOT started to use cold in-place recycling on roads, they started to realize the cost benefit through the number of miles they could reconstruct versus the number of miles they were reconstructing with the Road Bed Modification approach," Valentine says.

"They realized that by being able to improve more miles with the same dollars they were spending on their old rehabilitation approach, they would be able to raise the overall quality of their road system," he continues. "In fact, Nevada's road quality rating has gone from a #30 to a #4 during the time the state has been using CIR as a preferred rehabilitation approach.

"Most states using CIR report a life cycle from seven to eight years up to 12 to 15 years," Valentine adds. "Nevada's pavement management analysis is telling them that they're getting 10 to 12 years of additional service life out of a road by using the CIR approach, and as the technology (the emulsions in particular) improves, CIR is producing performance characteristics similar to hot mix." ■