



J-Band & Sustainability

September 2021



Making a difference today for a better world tomorrow.

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Situation

Situation

- J-Band® is growing
 - More agencies using on more roadways
 - Project number doubled in 2020
- Financial story is compelling and communicated well
 - Benefit: 3-5x the cost of the material, per IDOT
- Sustainability story can be added
 - Stakeholders are hungry for impact and collaboration
 - Greenwashing risk must be managed

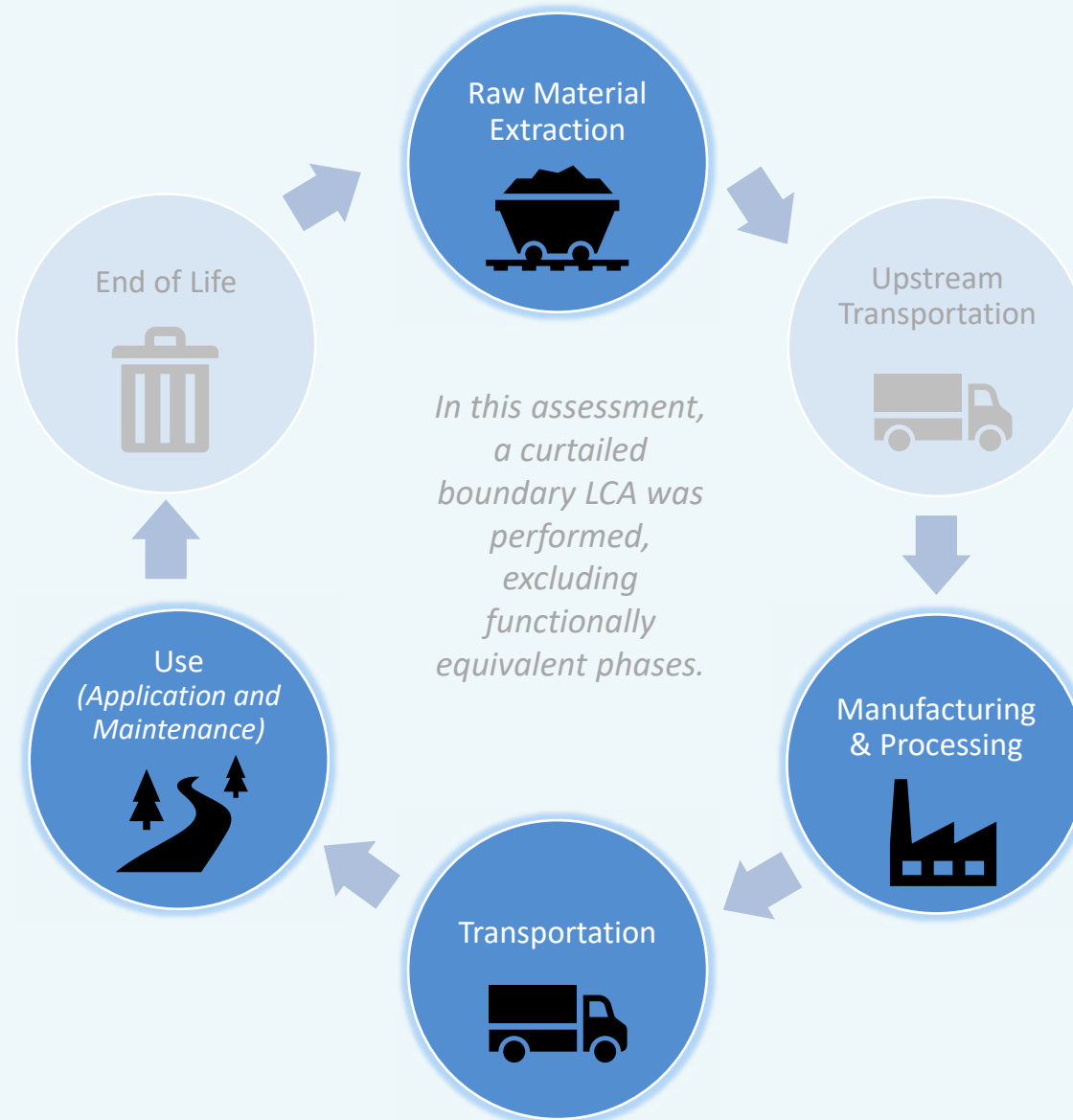
	Stakeholder	Sustainability Goals
FEDERAL		• Decrease emissions of greenhouse gases (GHGs) and other pollutants • Ensure transportation infrastructure resiliency
		• For the Federal Highway Administration (FHWA), sustainability encapsulates a diversity of concepts, including efficient use of funding, incentives for construction quality, regional air quality, resilience considerations...
STATE		• ODOT is the first transportation agency to have a comprehensive Sustainability Plan • Careful material selection and management ...and lowering demand for raw materials ...can also reduce operating costs while increasing environmental benefits.
CITY		• Hundreds of members have signed the Climate Mayors letters committing to the Paris Agreement • C40 is a network of the world's megacities committed to addressing climate change.
OTHER		• Over 40 North American airports have received funding from FAA to create sustainability plans, including baseline GHG inventory, reduction targets

Key Questions

- How does J-Band **compare to alternative joint solutions** in the categories of air quality, greenhouse gas emissions, and safety?
- How will J-Band's sustainability **benefits shift in the future**, due to weather pattern changes, distracted driving, and possible policy developments?
- Which agencies and organizations that have **control over the adoption** and expansion of J-Band also have **interest in sustainability**?
- How can J-Band **communicate** its sustainability benefits to those parties?

Comparative Life Cycle Assessment

A **Life Cycle Assessment (LCA)** is the compilation and evaluation of the inputs, outputs, and potential **environmental impacts of a product system** throughout its five life cycle stages.



When comparing multiple products, a **curtailed-boundary comparative LCA** can be used to assess only differing phases, while **functionally equivalent** phases can be excluded from quantification.

Assessing Audience For Sustainability

Selected Audience

- Which customers want to hear about sustainability?
- What topics are they most interested in?
- How can J-Band help them meet their goals?

State or municipal transportation agencies	Minnesota	Illinois	New York	Delaware	Pennsylvania
	Michigan	Texas	California	Washington	NJ/NY Port Authority
Contractors	Tri-State Asphalt	Milestone	Granite Construction	ColasUSA	CRH
Regional or Federal entities	DOT Sustains	Sustainable Highways Initiative (FHWA)	Transportation and Climate Initiative (TCI)	National Asphalt Pavement Association (NAPA)	

A comprehensive table summarizing the audience assessment findings was shared with AMI. Key takeaways are summarized on the following slides.

State or Municipal Agencies



- DOTs have a role to play in helping states achieve **state-wide emission reduction targets**.
- Energy and GHG emission goals focus on **facility usage** and **electrification** of transportation sector.
- Rise in programs aimed at increasing the use of '**green**' products, sustainable practices, and innovative new techniques and materials. Life Cycle Assessment (**LCA**) and Environmental Product Declarations (**EPDs**) are increasingly common.
- Many agencies have goals to achieve **zero work-zone fatalities**.

Contractors

- As a group, contractors tend to be in the initial phases of their sustainability journeys, though Granite Construction and CRH were noted exceptions.
- There is a focus on **optimizing efficiency** and transitioning to **low-carbon technologies** in order to meet GHG reduction targets.
- Meeting all air emission limits is a priority.
- Companies are looking to use **new technologies and materials** with improved sustainability attributes.
- **Safety** is a core goal or company value for most contractors.

Regional or Federal Entities

- These groups are more focused on the **big picture** of sustainability, raising **awareness** and offering **support**, instead of dealing with in-depth details and target setting.
- They are looking to advance energy efficiency and reduce GHG emissions throughout the industry, through **collaboration, technical assistance, and support**.
- There is a focus on improving **community health** and **quality of life** through a reduction in air pollutants.
- Parties are dually-focused on sustainable **innovation** and climate change **resiliency**.

Interview Insights



- Local DOTs, regional transportation districts, and “super-regionals” (ex. Chicago tollway, Florida tollway, NJ Turnpike, etc.) have the **autonomy and dexterity** to be early adopters of new technologies.
- While not yet widespread, Environmental Product Declarations (**EPDs**) are growing in **use and commonality**, with several states now requiring them.
- **LCAs and EPDs** are beginning to be **gateways** to bidding (i.e.. a box to be checked) and will likely evolve to become determinants in bid selection (i.e.. your performance demonstrated on the LCA/EPD will factor into bid decisions, similar to cost). The frequency of this was reported to be greater in 2021 than over the previous five years combined.
- There has been movement towards developing a framework for a **LEED-type system** for infrastructure. Greenroads and ENVISION were mentioned as ones to watch.
- The **Federal Aviation Administration** is working with the asphalt industry to accelerate longitudinal joint solutions.

Audience Leaders

- State leaders include WA, CA, NY/NJ, PA, MN
 - Other states not included in the assessment but referenced as leaders during industry interviews: OR, CO, AZ
- Leading contractors include Granite and CRH



Quantifying J-Band's Benefits

Alternative Scenarios Analyzed



Lifecycle Stage		Description	J-Band	Joint Adhesive (JA)	IR Heater	PWMB
Materials Production	Extraction & Processing	<i>Extraction of all raw materials used during road paving and/or joint treatment</i>	(HMA products) + Additional asphalt binder production	(HMA products) + Additional asphalt binder production	(HMA products) + Propane production	(HMA products) + 6" additional HMA production
	Transportation (upstream)	<i>Movement of materials from point of extraction to production facility</i>	Differences at this stage are built into the upstream emission factors selected for the materials associated with each joint treatment. Upstream emission factors were selected for upstream transportation within the system boundary.			
	Manufacturing	<i>Manufacturing processes and inputs to create joint treatment materials</i>	(HMA products) + VRAM manufacture (electricity consumption, heat)	(HMA products) + JA manufacture (electricity consumption, heat)	(HMA products) + Propane processing	(HMA products) + HMA manufacture (electricity consumption, heat)
Construction Process	Transportation (downstream)	<i>Movement of materials from production facility to job site</i>	(HMA transport) + Distributor spray truck, pick-up truck	(HMA transport) + Asphalt emulsion distributor, pick-up truck	(HMA transport)	(HMA transport) + Dump trucks (additional waste)
	Use	<i>Application of HMA and joint treatment; lifetime maintenance</i>	(Traditional HMA) + VRAM application + Maintenance	(Traditional HMA) + JA application + Maintenance	(Traditional HMA allows for pass of IR Heater) + Maintenance	(Traditional HMA) + Application and milling of additional 6" HMA + Maintenance
	End of Life	<i>Management of materials at road end of life.</i>	Standard road rehabilitation and waste management			

Alternative Scenarios – Impacts Quantified

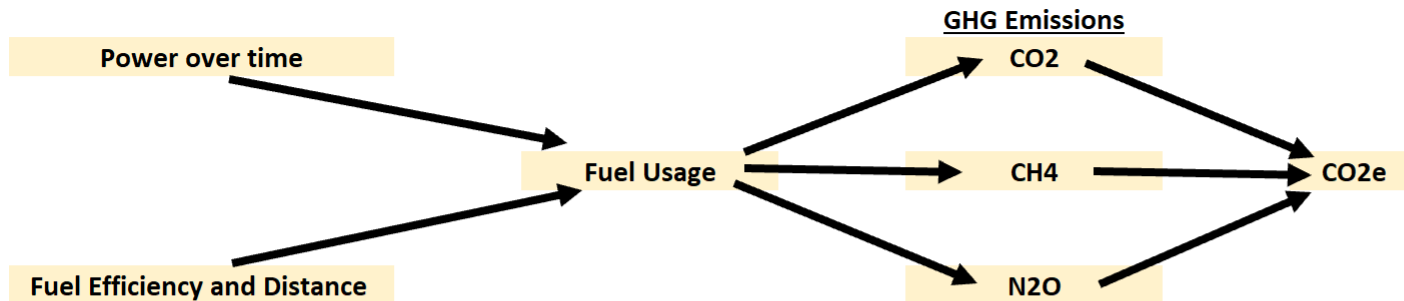


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	End of Life	<i>Management of materials at road end of life.</i>	<i>Standard road rehabilitation and waste management</i>			

Factors italicized in parentheses represent the factors that are consistent among the four treatments and are excluded from quantification.

Methods

- Interviews with Industry Experts
- Equipment specific information
 - Reference manuals for trucks, generators, pavers, etc.
- Agency Data
 - Safety data: FHWA, BLS
 - Energy and Fuel data: Dept. Of Energy, EPA
 - Pollutant and Air Quality Data: EPA, Federal Regulations, NC DEQ



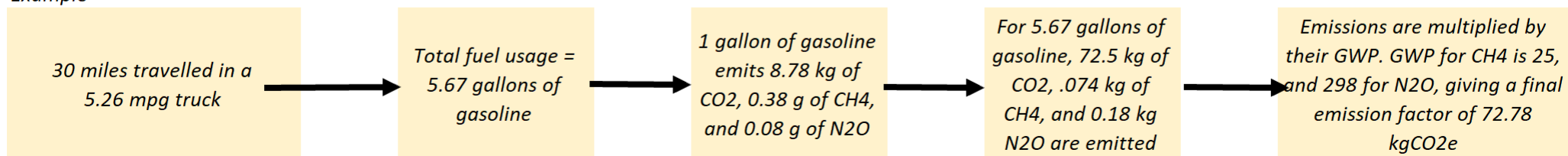
Emissions are calculated from vehicles, generators, heaters, etc.

Total fuel used, separated by fuel type

Each fuel type has associated GHG emissions

GHGs are normalised to CO2 equivalent based on their Global Warming Potential (GWP)

Example



Assumptions

- This comparative life cycle assessment is focused on the singular life cycle of a joint. Modelling the full life cycle of a road, including additional asphalt and maintenance trips necessary on parts of the road not along the centerline joint, is out of scope for this assessment. In addition, the highly varied methods and needs for roads across different regions and road types would reduce the accuracy of the assessment.
- The model parameters presented in this deck are for a 1-mile stretch of paving that is located 50 miles away from the manufacturing site for J-Band and Joint Adhesive, and 30 miles away for IR Heater and Pave Wide/Trim Back.
- Emissions originating from vehicles idling in traffic slowdowns caused by road work are not included in the accounting. The social benefits of reduced congestion for the traveling public have not been accounted for, either. Both of these factors, had they been accounted for, would likely tip the scales further in favor of J-Band.
- With a lack of detailed manufacturing data and with the difference in composition between J-Band and Joint Adhesive materials being deemed insignificant, Joint Adhesive manufacturing emissions are estimated as a fraction of J-Band manufacturing emissions.
- Due to lack of data on fuel usage at slow vehicle speeds during application, fuel usage is based on highway and city fuel usage values.

Greenhouse Gas



- GHG emissions were analyzed for five stages across the life cycle of a road: materials extraction, manufacturing, transport, application, and maintenance. Not all stages are applicable to every alternative.
- In the base case of a 1-mile project 50 miles from manufacturing to job site for J-Band and Joint Adhesive, and 30 miles away from IR Heater and PWTB, J-Band emits 175 kg of CO2 equivalents/yr over the 18-yr projected life.
- Despite J-Band having over fifteen times the materials phase emissions as some of the other alternatives, J-Band has fewer than three times as many averaged per-year lifetime emissions. This reduction in proportion is largely due to the significantly reduced need for maintenance and a quicker application process, in addition to an increased longevity of the pavement.
- Looking at the application and maintenance phase, J-Band emits 23 kg of CO2 equivalents/yr, less than half of the emissions associated with other alternatives.

		GHG Emissions (kgCO2e)			
		J-Band	Joint Adhesive	IR Heater	PWTB
Materials-phase	Extraction	2,269.4	126.1	111.9	3,042.4
	Manufacture	458.6	35.6		
Use-phase	Transport	136.3	160.0	-	58.1
	Application	2.7	119.5	400.0	1,834.1
	Maintenance trips	274.7	444.2	444.2	444.2
Total over lifetime		3,142	885	956	5,379
Averaged per-year emissions		175	59	60	359

*Greenhouse Gas Emissions, in kilograms of CO2 equivalents, broken down by segments of joint treatment lifecycles. This is for a 1-mile project distance, 50 miles away from manufacturing site**

*Distance only applies to J-Band and Joint Adhesive. Distance between the home base and project site for IR heater and PWTB is assumed to be 30 miles.

Air Quality

- Materials production and road construction and repair typically results in emissions of harmful compounds impacting local human health and environment.
- Project emissions of regulated criteria air pollutants were comparatively assessed and included volatile organic compounds (VOCs), carbon monoxide, nitrogen oxides (NOx), and fine particulate matter (2.5m diameter and smaller).
- All four compounds were combined into a pounds of pollutant metric.

			Kg Pollutant (VOC/CO/NOx/PM2.5)			
			J-Band	Joint Adhesive	IR Heater	PWTB
Materials-phase	Extraction		3.06	0.17	0.50	108.36
	Manufacture		3.27E-04	1.82E-05		5.71
Use-phase	Transport		1.38	1.68	-	0.74
	Application		0.03	0.66	0.67	55.67
	Maintenance trips		0.82	4.84	4.84	4.84
Total over lifetime			5.29	7.35	6.02	175.33
Averaged per year emissions			0.29	0.49	0.38	11.69

*Kilograms of pollutants broken down by segments of joint treatment lifecycles. This is for a 1-mile project distance, 50 miles away from manufacturing site**

*Distance only applies to J-Band and Joint Adhesive. Distance between the home base and project site for IR heater and PWTB is assumed to be 30 miles.

Safety

- Application and maintenance work on J-Band is expected to result in far fewer injuries and fatalities compared to the alternatives.
- The reduction in required maintenance is the largest contributor to the reduced safety incidents of J-Band.
- Safety metrics were calculated based on expected man-hours for each phase of work, combined with BLS and FHWA safety data.

	Injuries per million miles				Fatalities per million miles			
	JBand	Joint Adhesive	IR Heater	PWTB	JBand	Joint Adhesive	IR Heater	PWTB
Application	21	32	189	284	0.7	1.1	6.3	9.5
Maintenance Trips	44	837	837	837	1.5	28.0	28.0	28.0
Total over lifetime	65	868	1026	1120	2.2	29.1	34.4	37.5
Average per year	4	58	64	75	0.1	1.9	2.1	2.5

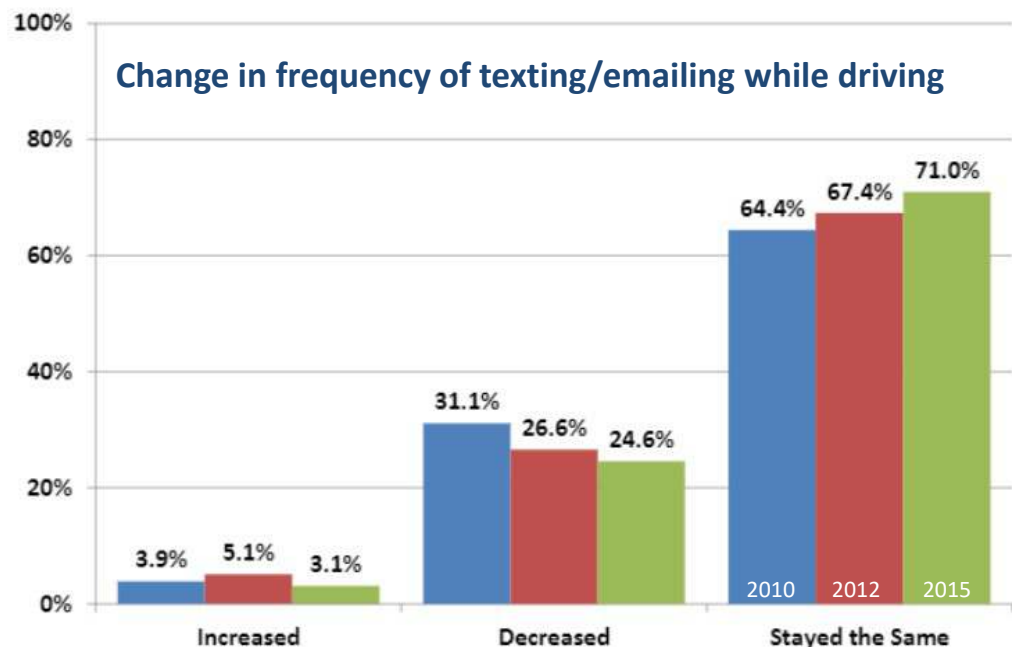
Number of worker safety incidents. Safety metrics have been normalized to one million miles for ease of comprehension.

Trends Affecting J-Band's Sustainability Edge

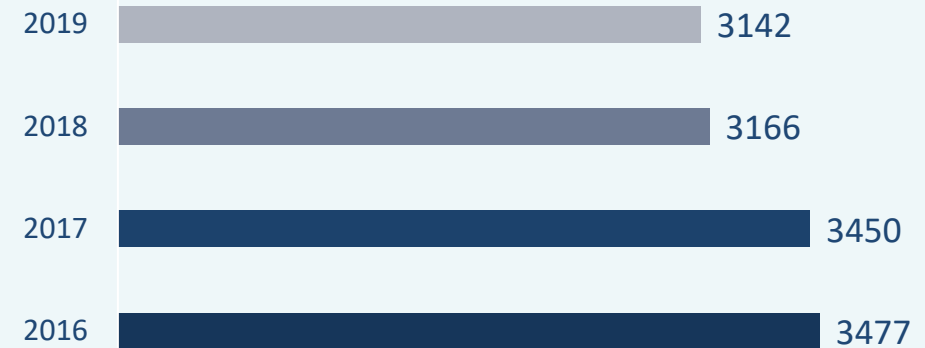
Distracted Driving

A potential increase in distracted driving could result in an increase in **wear and tear** on the centerline joint, leading to an **increased need for maintenance** on roads. In this case, an increase in maintenance requirements would give J-Band a further advantage over its competitors.

Causing Increase	Causing Decrease
Cell phone use	Autonomous vehicles
Complex in-vehicle information system	Regulation



Distracted driving deaths



Source: NHTSA Survey Data via The Zebra

Joint failure

Joint reflection cracking not generally load initiated

Inconclusive impacts of centerline rumble strips

Worker Safety

Work zone safety incidences are on the rise, leading to **an increasing number of injuries and deaths** among roadway construction workers. As J-Band reduces the need for maintenance, maintenance crews spend significantly **less time exposed to dangerous work zones** compared to alternative solutions.

Worker Fatalities in Road Construction Sites⁸

The following types of fatal work zone crashes increased from 2018 to 2019:

	2018	2019
• Involving a Rear-End Collision	141 21%	182 24%
• Involving a CMV	215 35%	250 33%
• Where Speeding Was a Factor	172 26%	239 31%

Worker fatalities in road construction sites

124	135
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Source: FHWA Work Zone Facts and Statistics

Worker safety trends

Slight upward trend in deaths

Previous 3-yr average: 133 deaths



Conclusions

Key Questions Answered

→ How does J-Band compare to alternative joint solutions in the categories of air quality, greenhouse gas emissions, and safety?	J-Bands materials-phase emissions are high due to the quantity of materials inputs. Under the base conditions of the model, J-Band's use-phase emissions are considerably lower than the alternatives, with relative averaged per-year emissions falling in between.
→ Will J-Band's safety benefits become even more important in the future due to distracted driving and future policy developments?	Due to distracted driving , centerline rumble strips are becoming increasingly common. Future policy developments are expected to increase their usage. They can reduce head-on collisions and can be installed without compromising road life when J-Band is applied. With worker deaths trending upwards over the last few years, longer-lasting roads decrease the amount of time workers are exposed to dangerous work zones in the middle of the road.
→ Which agencies and organizations that have control over the adoption and expansion of J-Band, also have interest in sustainability?	Most state DOTs and agencies acknowledge the role that they have in helping to achieve state, regional, etc. greenhouse gas emission reduction targets . Similarly, for contractors that have shown an interest in sustainability, their focus on implementing sustainable solutions and reduction targets is growing.
→ How can J-Band communicate its sustainability benefits to stakeholders?	Stakeholders in the interviews recommended transparency again and again. The findings are only as valuable as peoples' trust in them. Sharing openly is essential to building that trust. We recommend disclosing results, including data sources, assumptions, calculations, and findings.

Conclusions

- J-Band's benefits largely come from the **reduced need for maintenance**. With minimal repairs needed over the years, maintenance crews can make **fewer and shorter trips**, preventing greenhouse gas emissions and reducing the number of safety incidences for both workers and drivers.
- J-Band **extends the lifetime** of a pavement beyond the 15 years typical of traditional pavement. Over the long term, there are fewer pavement rehabilitations and replacements required with the use of J-Band.
- In addition to the air quality and greenhouse gas benefits seen in this assessment, the reduced asphalt usage comes with a significant **reduction in emissions** compared to alternative joint solutions.

J-Band's benefits go beyond the financial. Its safety benefits and reduced greenhouse gas and pollutant emissions have much to offer customers looking to build for a more sustainable future.

We believe these results should be recognized, and the role that J-Band can play in the decarbonization of the transportation sector should be emphasized.

Contacts



Gary Yoder
919.301.0419
gyoder@climeco.com

Emily Damon
413.687.2980
edamon@climeco.com

Caroline Kelleher
484.381.2667
ckelleher@climeco.com