

Environmental Benefits of Cold-in-Place Recycling in Wisconsin

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University of Minnesota (St. Paul Campus)

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Agenda

- Current Aggregate use in Road Construction
- Conventional Mill and Overlay Method vs. Cold-in-Place Recycling
- Research Methods
 - *Nine Case Studies*
 - *Life Cycle Assessment*
- Individual Project Example: STH 13
- Environmental Savings
 - *Percent Reductions*
 - *Cumulative Savings*
 - *Savings Predictions*



680 Mt/yr of virgin aggregate used in road construction^[a]



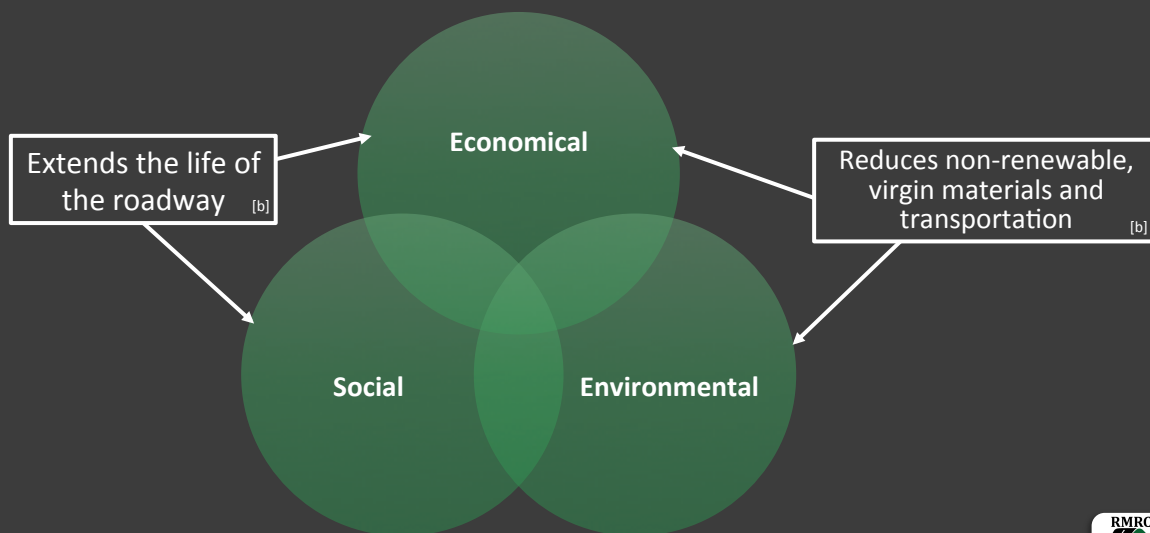
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Recognized Qualitative benefits of CIR



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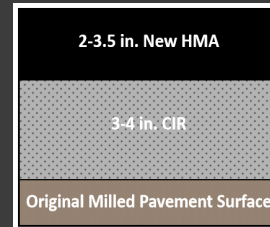
Construction Comparison

Conventional Mill and Overlay



- Mill existing roadway
- Haul to nearest asphalt plant
- Pave hot mix asphalt layer (4 in)

Cold-in-Place Recycling



- Mill existing roadway
- Crush and sort recycled asphalt pavement
- Mix with stabilizing agent
- Pave CIR
- CIR Cure (1-14 days)
- Pave hot mix asphalt layer (2-3.5 in)



Case Studies

CTH H (Reedsburg to Wisconsin Dells)

STH 13 (Medford to Westboro)

STH 27 (Sparta to Black River Falls)

STH 48 (Grantsburg to Frederic)

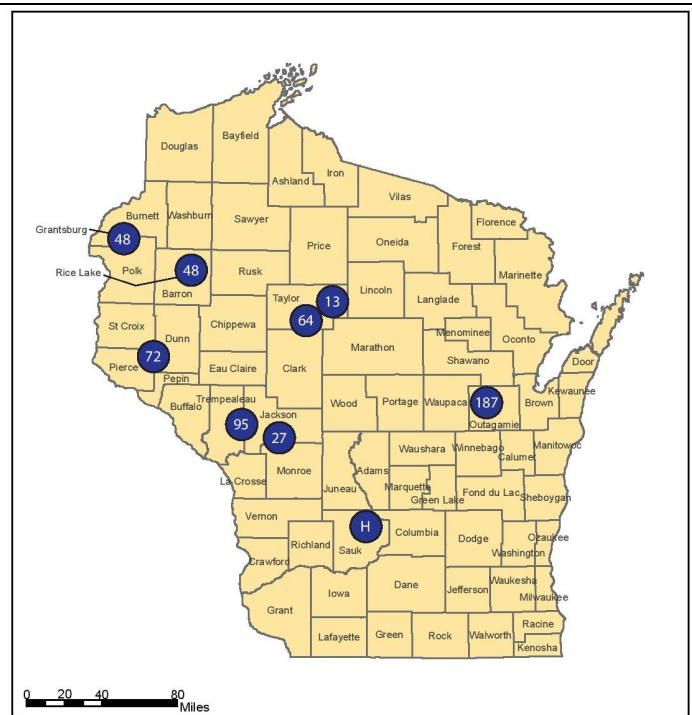
STH 48 (Rice Lake to Birchwood)

STH 64 (Gilman to Medford)

STH 72 (Ellsworth to Elmwood)

STH 95 (Blair to Merrilan)

STH 187 (Shiocton to North County Line)



Summary of Project Information

Project	MOL HMA Thickness (inches)	CIR Base Thickness (inches)	CIR HMA Thickness (inches)	Road Width (ft)	Project Length (miles)	Hauling Distance (miles)	Single- or Multi-Unit Recycling Train
CTH H	4.5	4	3.5	30	9.5	5.3	Multi
STH 13	4	4	2.25	30	5.64	11.6	Multi
STH 27	4	4	2.25	30	8.99	8.7	Single
STH 48 (Rice Lake)	4	3	2	30	8.10	10.3	Multi
STH 48 (Grantsburg)	4	4	2.25	24	12.5	4.3	Multi
STH 64	4	4	2.25	30	4.46	3.7	Multi
STH 72	4	4	2.25	30	4.63	18.3	Multi
STH 95	4	4	2.5	30	4.42	24.4	Multi
STH 187	4	3	2.5	30	9.84	21.3	Multi

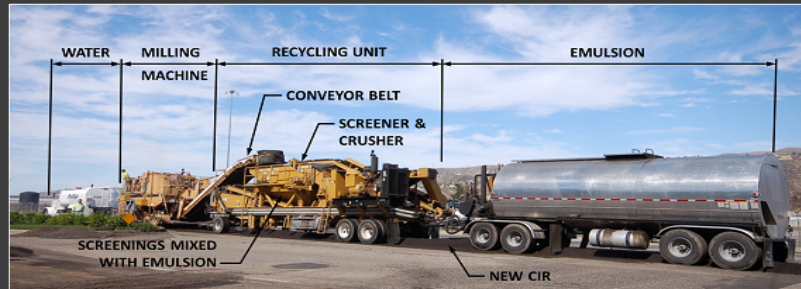
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Multi-Unit Recycling Train (8 projects)



[LA County Department of Public Works]

Single-Unit Recycling Train (1 project)



[Mathy Construction, 2016]

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Life Cycle Assessment: PaLATE

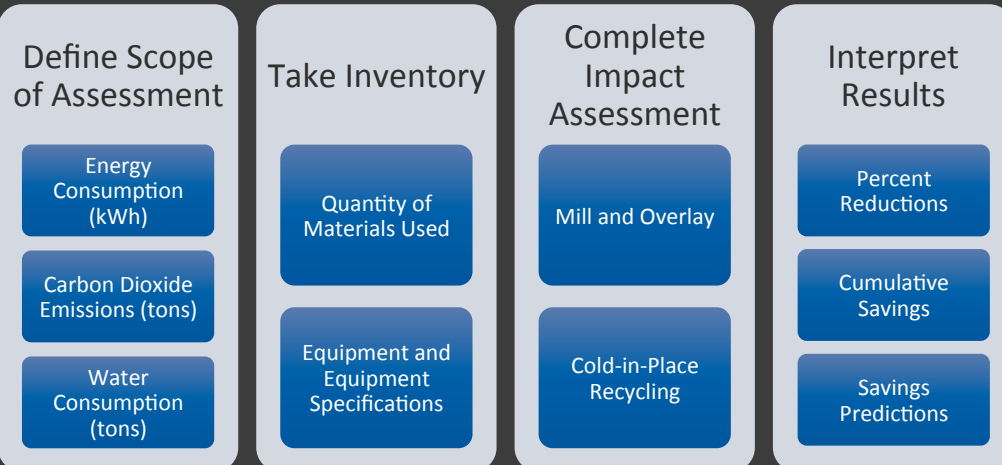
Pavement Life-cycle Assessment Tool for Environmental and Economic Effects

- Created by the Consortium on Green Design and Manufacturing from the University of California-Berkeley (2007), sponsored by RMRC
- Scope of Impact Analysis
 - Initial Construction
 - Maintenance Construction
 - End-of-life Analysis
- Components of Impact Analysis
 - Material Production
 - Material Transportation
 - Process (Construction)

The Wisconsin projects were evaluated as maintenance construction



Life Cycle Assessment



Assumptions

- MOL projects had 4-4.5 inches of HMA overlay.



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- Mix design is the same for the MOL and CIR processes for each project.



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- Mix design is the same for the MOL and CIR processes for each project.
- Hauling distance from the midpoint of each project to the closest HMA plant.

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Assumptions

- MOL projects had 4 inches of HMA overlay.
- Mix design is the same for the MOL and CIR processes for each project.
- Hauling distance from the midpoint of each project to the closest HMA plant.
- Water trucks were not included in analysis.

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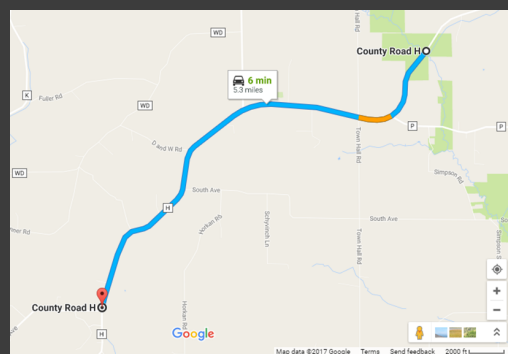
Assumptions

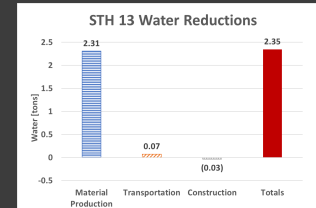
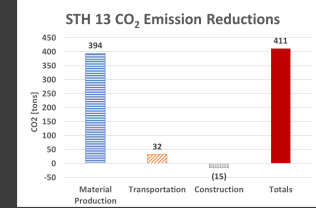
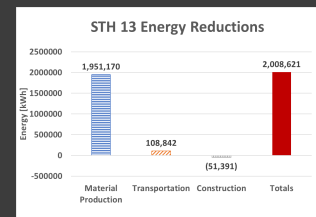
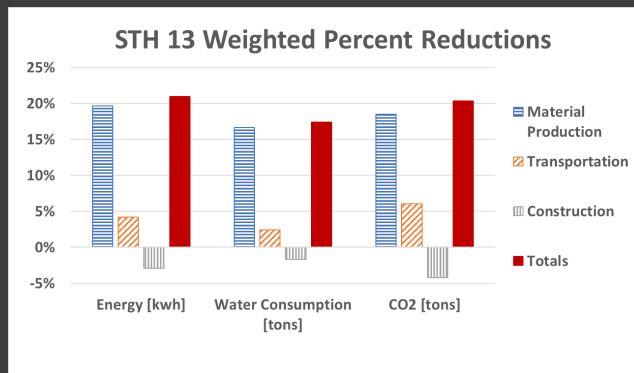
- MOL projects had 4 inches of HMA overlay.
- Mix design is the same for the MOL and CIR processes for each project.
- Hauling distance from the midpoint of each project to the closest HMA plant.
- Water trucks were not included in analysis.
- All projects using a multi-unit recycling train were assumed to use the same equipment.



STH 13 (Medford to Westboro)

Project ID	1610-03-62
Construction Year	2016
County	Taylor
Contractor (CIR)	WK
Contractor (MOL)	Mathy
Project Length (miles)	5.64
Hauling Distance (miles)	11.6
Road Width (feet)	30
Mill and Overlay HMA Thickness (inches)	4
Cold In-Place Recycling Thickness (inches)	4
Cold In-Place Recycling HMA Thickness (inches)	2.25
RAP Hauled Away during CIR (CY)	5,811
Binder (%)	6.3





STH 13 in Taylor County

- 5.6-mile project from Medford to Westboro
- Under construction in 2016 by WK and Mathy
- 4 inches of CIR under 2.25 inches of new HMA overlay
- 11.6-mile hauling distance
- Multi-unit recycling train

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Environmental savings by project

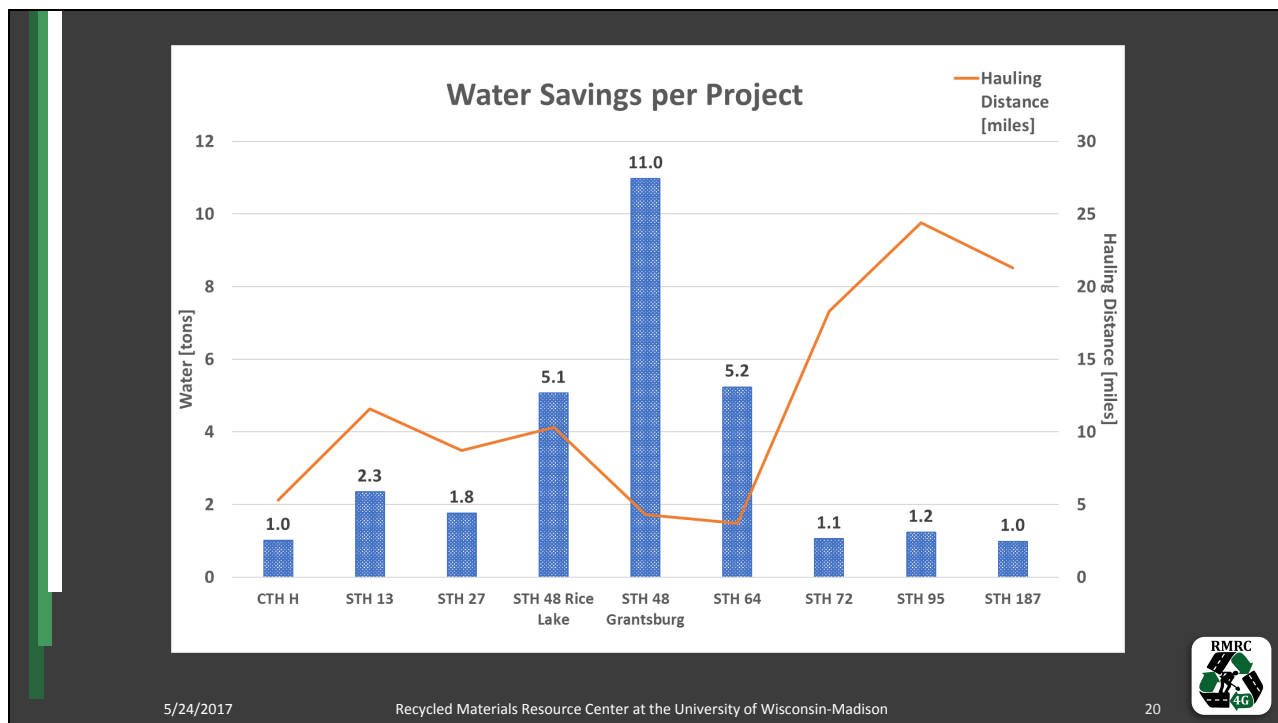
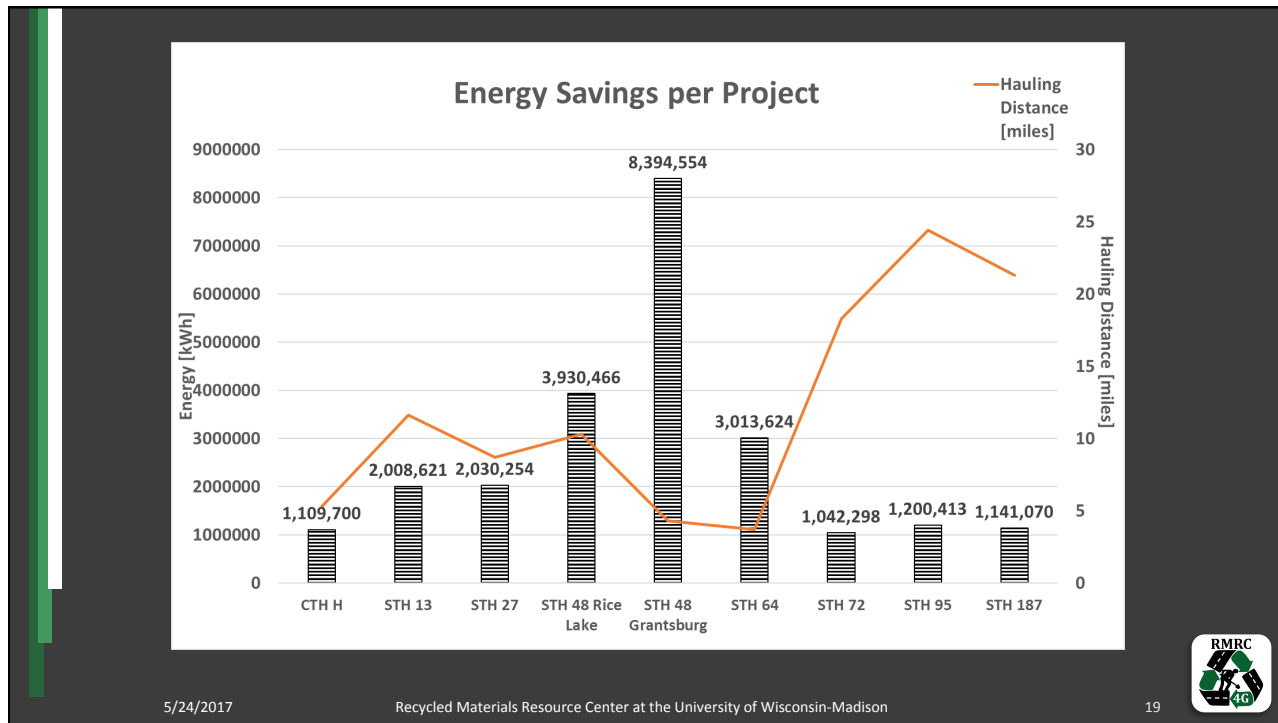
Project	Energy Consumption [kWh]	Water Consumption [tons]	Carbon Dioxide Emissions [tons]
CTH H	1,109,699	1.0	211
STH 13	2,008,621	2.4	411
STH 27	2,030,254	1.8	395
STH 48 Rice Lake	3,930,466	5.1	820
STH 48 Grantsburg	8,394,554	11.0	1,738
STH 64	3,013,623	5.2	676
STH 72	1,042,297	1.1	214
STH 95	1,200,412	1.2	250
STH 187	1,141,070	1.0	239
Total	23,871,000	29.7	4,955

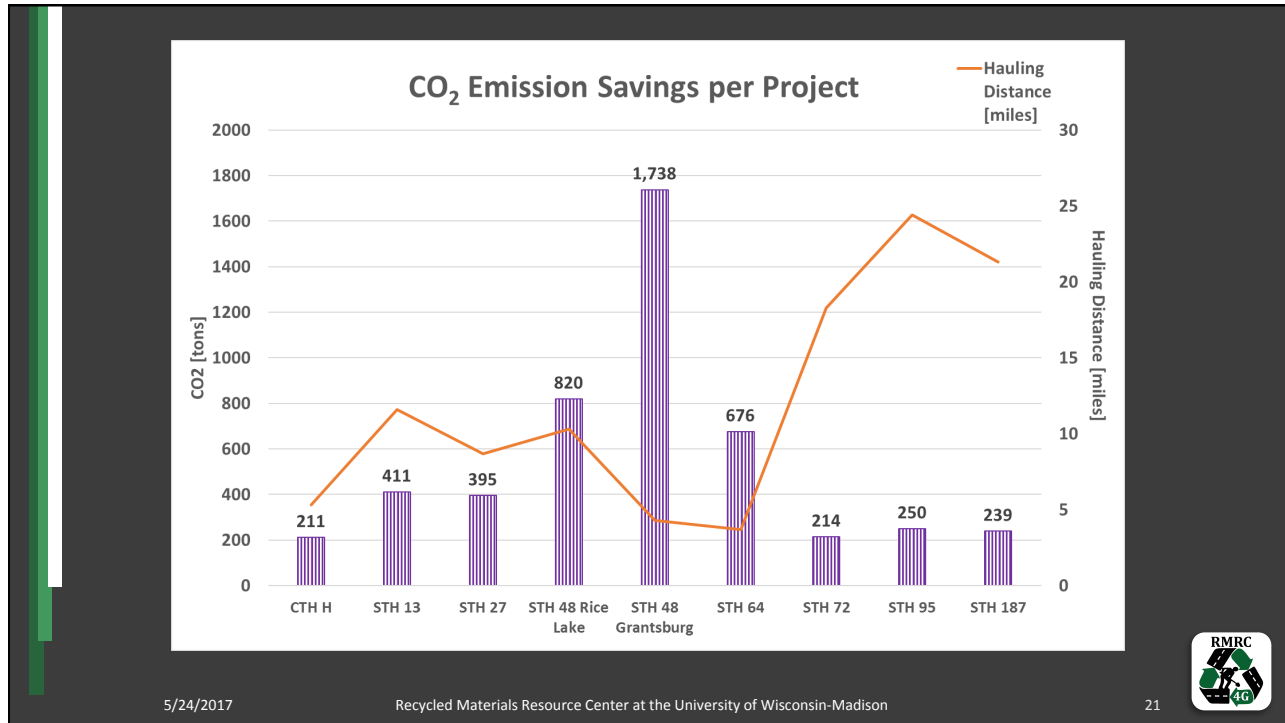
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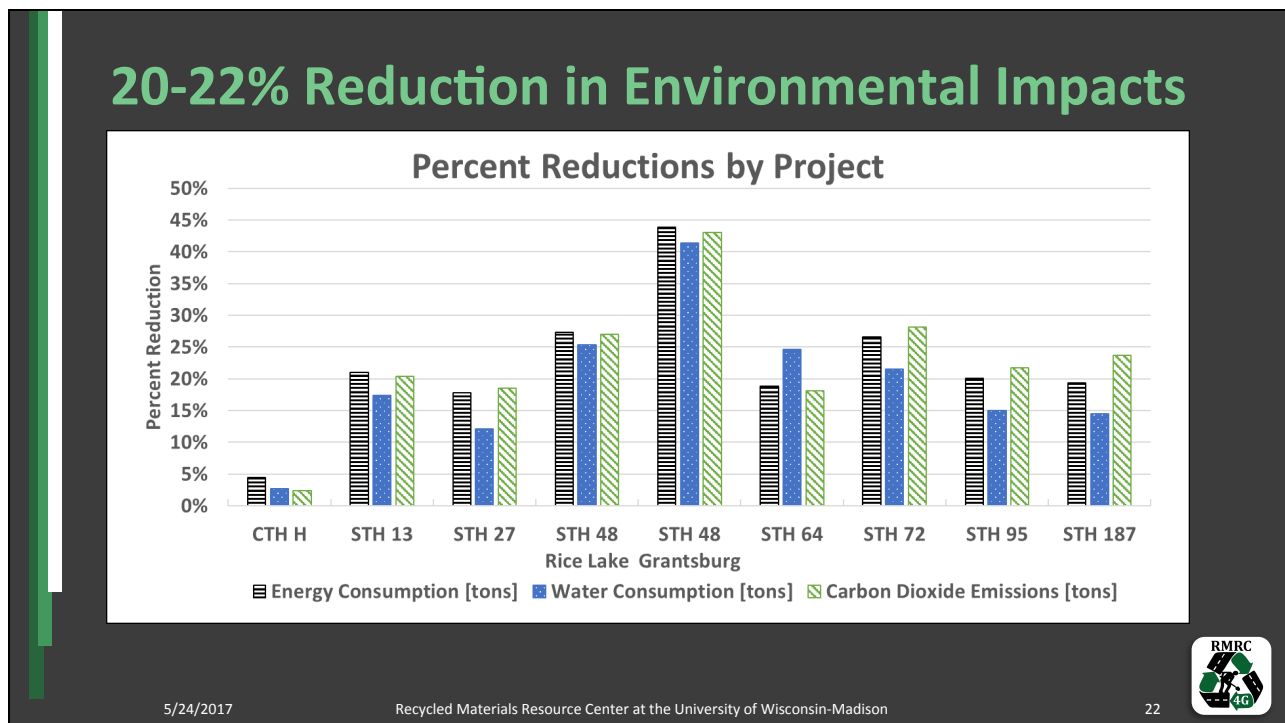




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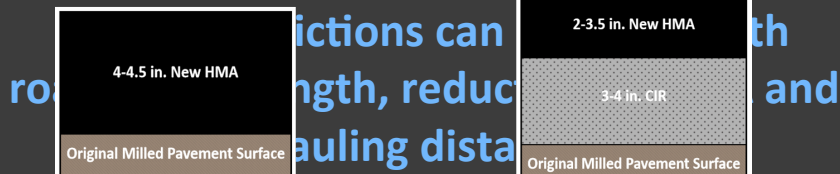
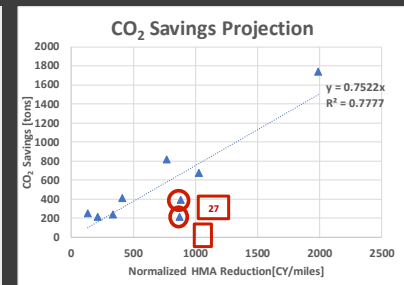
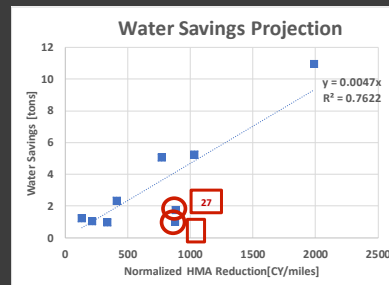
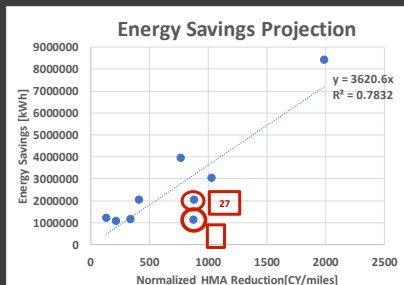


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Project Savings Predictions All Projects



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Total Environmental Savings 68 Road Miles

2,183 U.S. Households^[c]

23,871,001 kWh

956 Cars^[d]

4,955 tons of CO₂

158 Bathtubs^[e]

30 tons of water

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Thank you!

Questions?

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