Comprehensive LCC of a Pavement Recycling Project in Virginia

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TRB

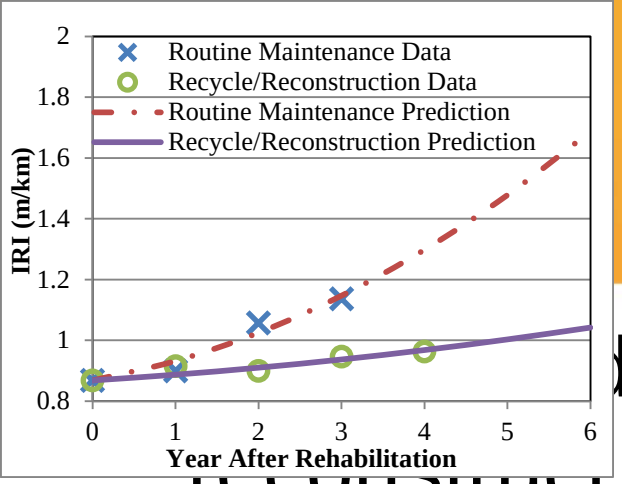
U.S. Department of Transportation Federal Highway Administration

WORLD ROAD ASSOCIATION MONDIALE DE LA ROUTE 1909-2009

VDOT Virginia Department of Transportation

Outline

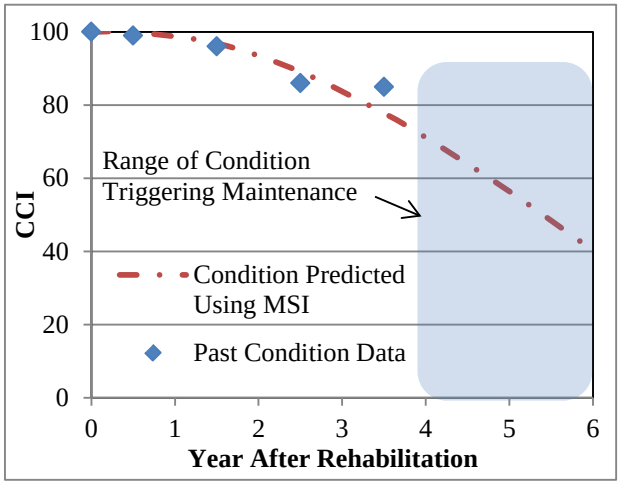
- **Review of the Project**
  - **Methods Used**
  - **Results of Comprehensive LCA**
- **LCC and LCCA**
- **Analysis of the Project**
- **Conclusions**

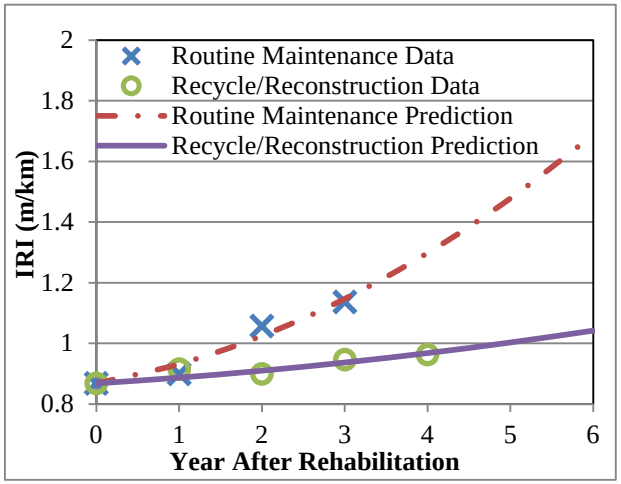


I-81 Project

d novel recycling methods to reconstruct a project on I-81

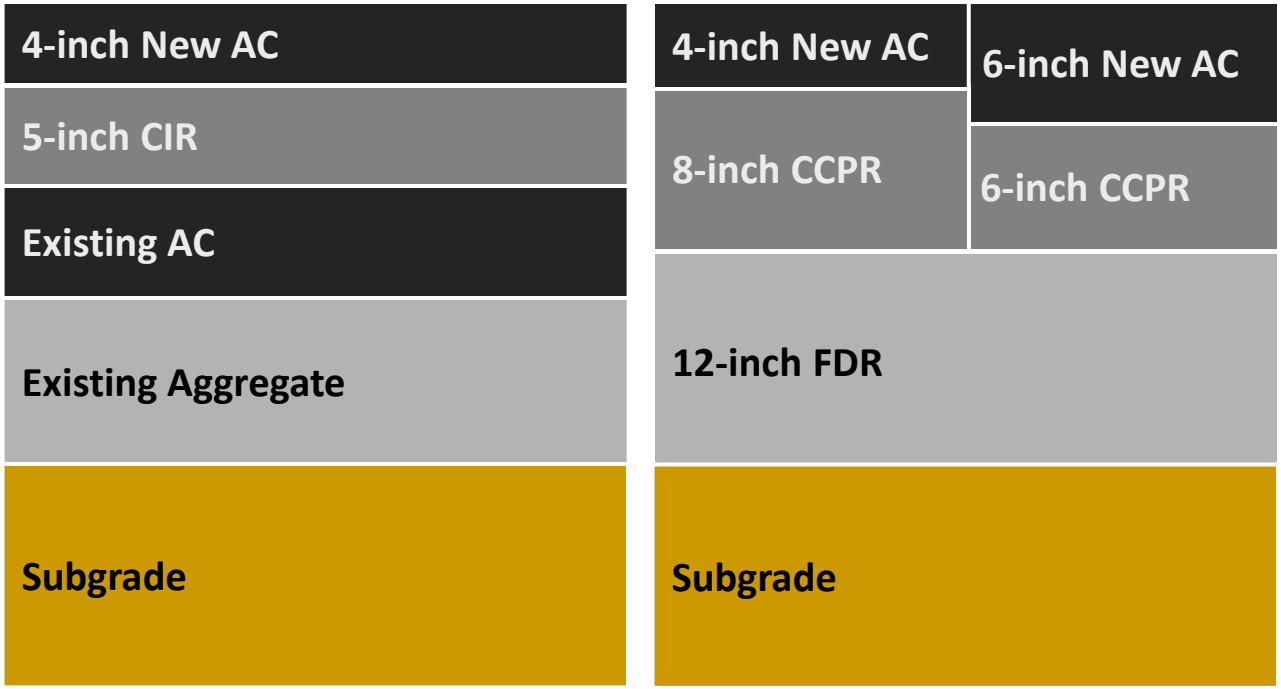
- Apparent structural problems
- Prior to reconstruction, pavement required maintenance every 4-6 years





I-81 Recycling Project

- AADT = 23,000 (28 percent trucks)
- 7.2 lane miles




Cold In-Place
Recycling

Cold Central-Plant Recycling

Full-Depth Reclamation

Performance of Project

Comprehensive LCA

- **50 year time horizon**
- **Included all phases minus EOL**
  - Use phase evaluated using Chatti and Zaabar's NCHRP models and MOVES
  - Traffic congestion effects considered using MOVES
  - Impact Assessment using TRACI
- Each Alt had different rehab schedules

Description of Alternatives

- Corrective Maintenance
  - 2 inch mill and OL on a 4 to 6 year basis
  - Limited patching based on VDOT schedule
- Recycling
  - What was implemented
  - Maintenance Schedule based on VDOT guide
- Reconstruction
  - All virgin materials and traditional practices
  - Same maintenance as recycling

Comprehensive LCA

	CC	AC	EU	HH
Recycling-based	(-22%) 121,398	(-19%) 20 886,765	(-28%) 20,305	(-29%) 47,618
Reconstruct	(-21%) 123,727	(-19%) 20 813,273	(-28%) 20,471	(-28%) 48,213
Corrective Maintenance	173,898	29,176,659	28,245	67,368

	PS	ARD MR	ARD FF
Recycling-based	(-29%) 284,244	(-40%) 0.0022727	(-31%) 2,466,662,453
Reconstruct	(-28%) 288,991	(8%) 0.0041290	(-30%) 2,498,445,378
Corrective Maintenance	400,392	0.0038097	3,564,507,198

Comprehensive LCC

- **LCC links processes with cash flows**
  - **More detailed than LCCA**
  - **Splits variable and fixed costs**
  - **Designed to be used with LCA results**
- **LCCA can be ‘black box’**
  - **LCC can be more transparent**

Cost Data

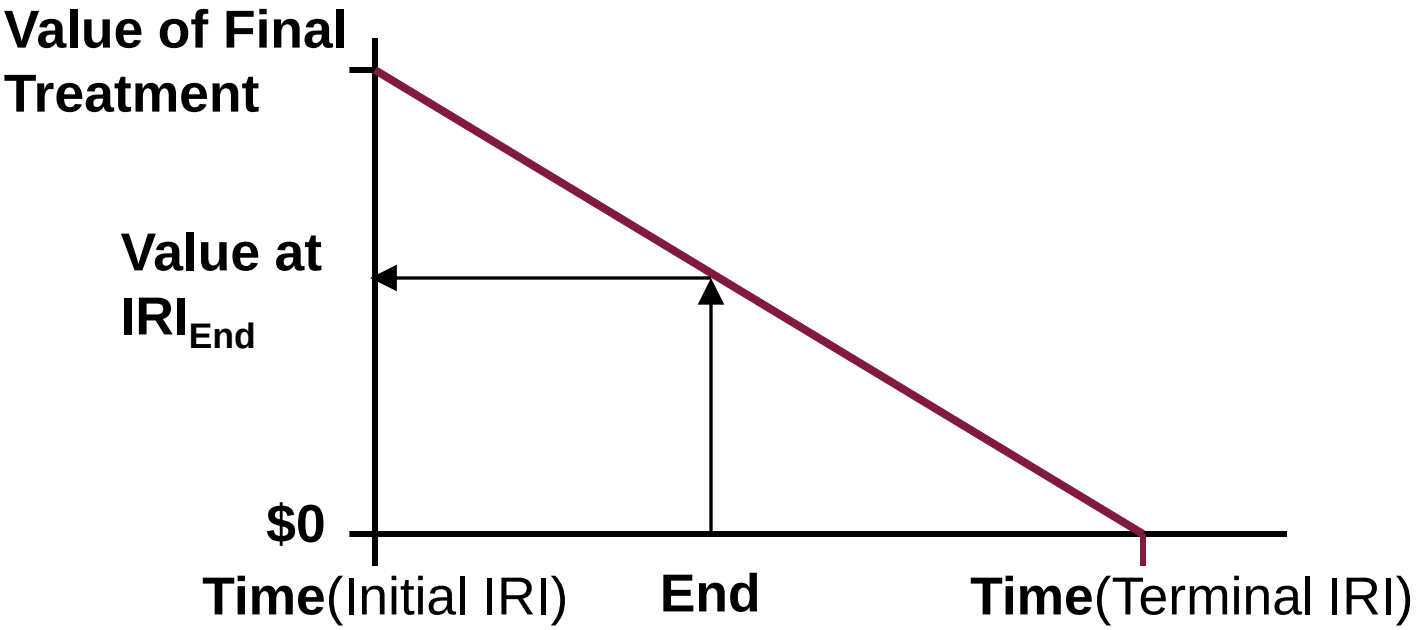
- **Costs were disaggregated as much as possible**
  - VDOT data was requested
  - Literature data used where more local data not available
  - Equipment relative value was accounted for
- **NPV was calculated**
  - 2.3% discount rate per OMB (2013)

User Costs

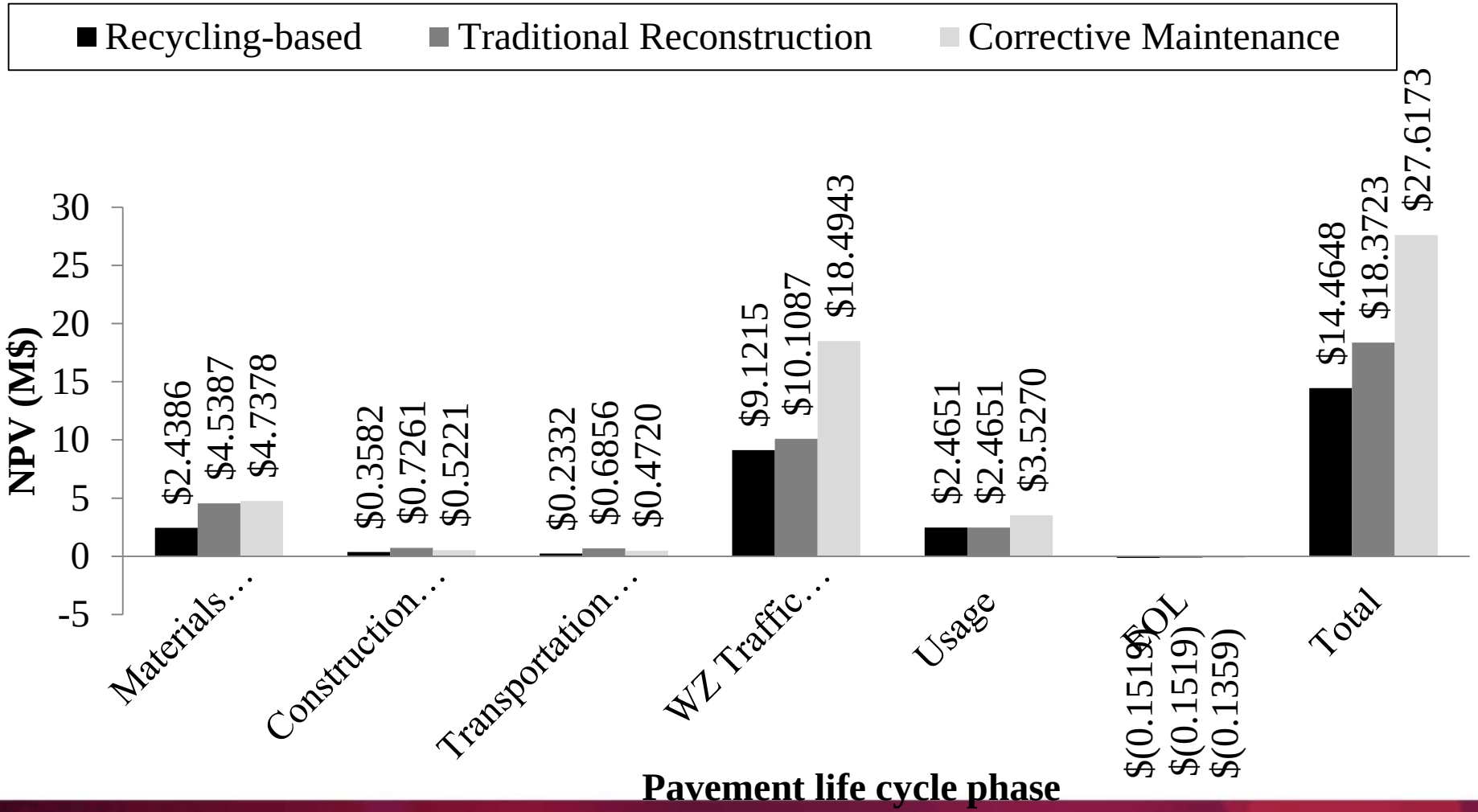
- **Work Zone**
  - Costs due to time lost in queueing
  - Values from USDOT OST (2003), adjusted accordingly
  - VOC were also accounted for
- **Use Phase**
  - VOC models: HDM calibrated models by Chatti and Zaabar

End of Life

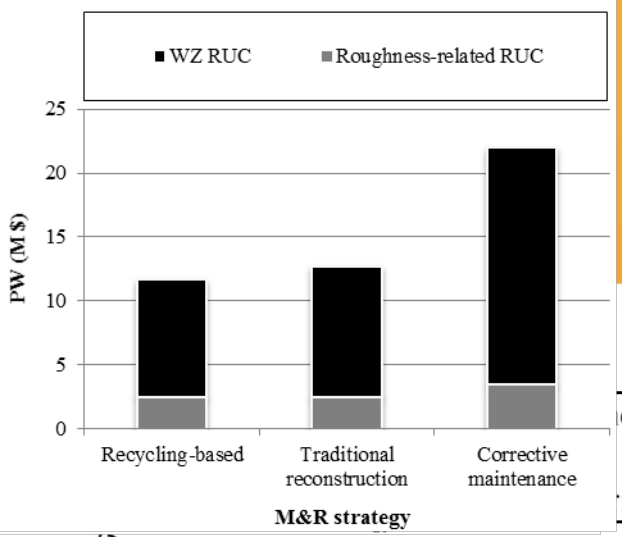
- **Residual value based on terminal IRI**
  - 200 inches/mile as terminal
    - Very poor on VDOT Dashboard

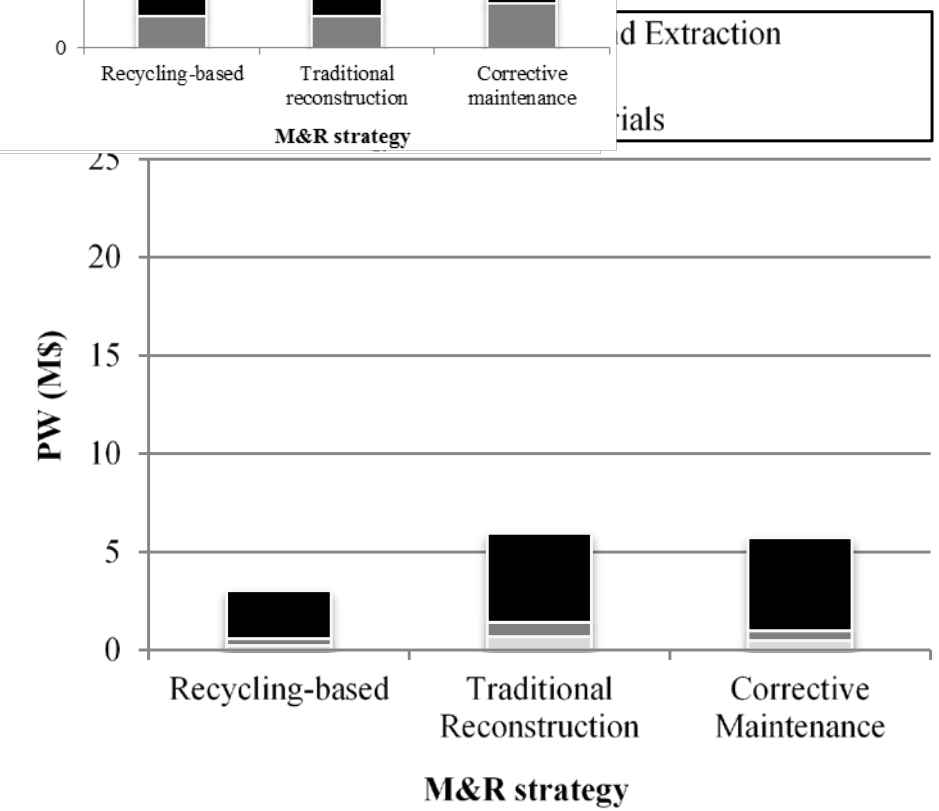


Results


Recycling-based
Traditional Reconstruction
Corrective Maintenance
NPV (M$)
30
25
20
15
10
5
0
-5
$2.4386
$4.5387
$4.7378
$0.3582
$0.7261
$0.5221
$0.2332
$0.6856
$0.4720
$9.1215
$10.1087
$18.4943
$2.4651
$2.4651
$3.5270
$(0.1519)
$(0.1519)
$(0.1359)
$14.4648
$18.3723
$27.6173
Materials…
Construction…
Transportation…
WZ Traffic…
Usage
EOL
Total
Pavement life cycle phase

Results


WZ RUC
Roughness-related RUC
PW (M $)
25
20
15
10
5
0
Recycling-based
Traditional reconstruction
Corrective maintenance
M&R strategy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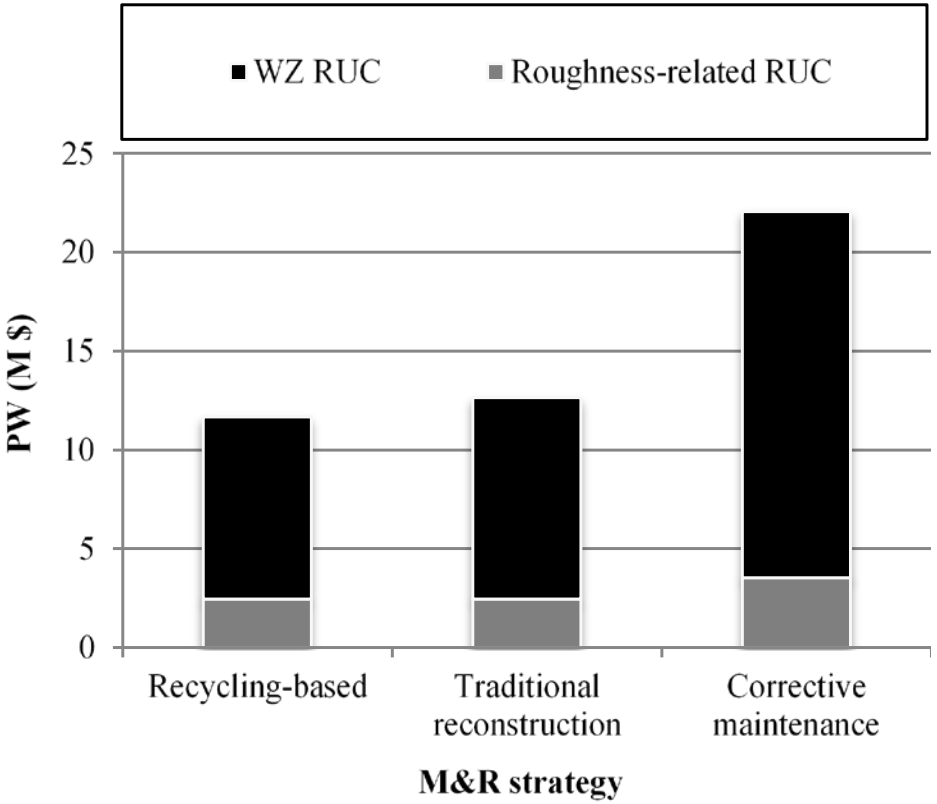
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Recycling-based
Traditional reconstruction
Corrective maintenance
M&R strategy

Conclusions

- **Recycling based strategy better in LCA and LCC terms**
- **For each alternative**
  - **Materials phase and WZ traffic management most expensive**
- **Linking LCC and LCA guides to better understanding of sustainable management**

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Thank You

Sustainable Transport…