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Environmental and economic trade-offs of different reclaimed asphalt pavement recycling strategies for the city of São Paulo

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Environmental and Economic Trade-offs of Different Reclaimed Asphalt Pavement Recycling Strategies for the City of São Paulo, Brazil

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OVERVIEW

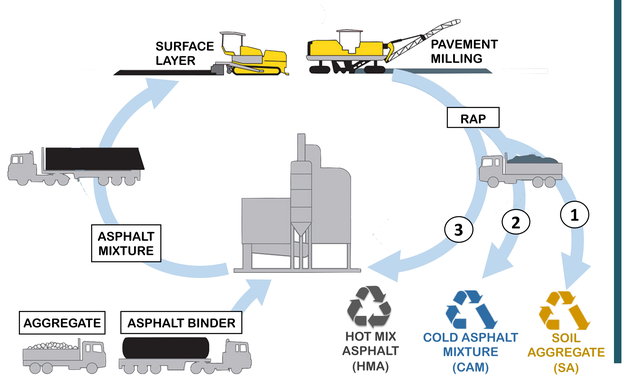
- Different destination scenarios can be considered to the end-of-life waste materials such as reclaimed asphalt pavement (RAP).
- The current practice in São Paulo city, Brazil, is downcycling the RAP into soil aggregate mix (base layer) or into cold asphalt mixture (base layer) in pavement rehabilitation and construction.
- The RAP recycling can improve the environmental performance and cost benefit of the pavement maintenance and construction strategies.
- If higher amount of RAP would be available and higher shares of RAP in the asphalt mixture would be considered, the difference between the recycling scenarios could be more pronounced.

Keywords: Environmental benefit, Cost analysis, Waste management, Case study

PAPER OBJECTIVE

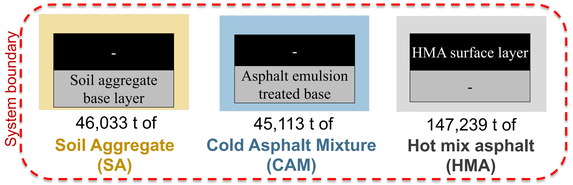
The present study aims to assess the environmental and economic performance of different RAP destination possibilities for pavement applications in the metropolitan area of São Paulo, Brazil.

WHAT IF WE ADD VALUE TO THE WASTE?

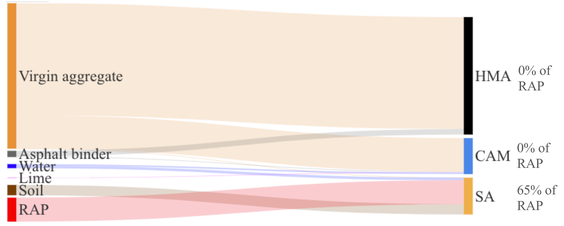


METHODS

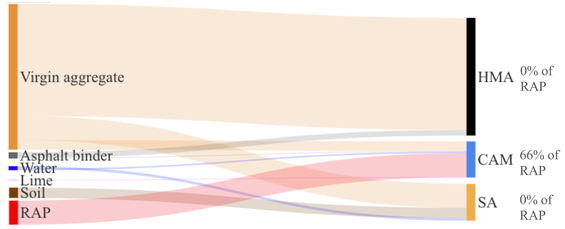
Declared unit: use of 30,000 t of RAP generated in one year, considering three destination scenarios per analysis. Life cycle impact assessment: Global Warming Potential (GWP) expressed in t CO_2eq (IPCC, 2021).



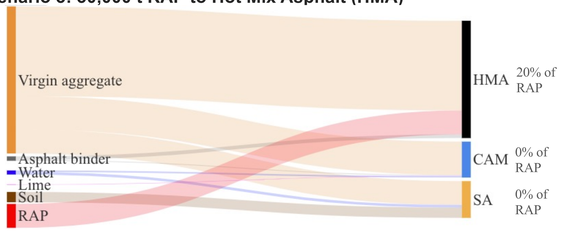
Scenario 1: 30,000 t RAP to Soil Aggregate (SA)



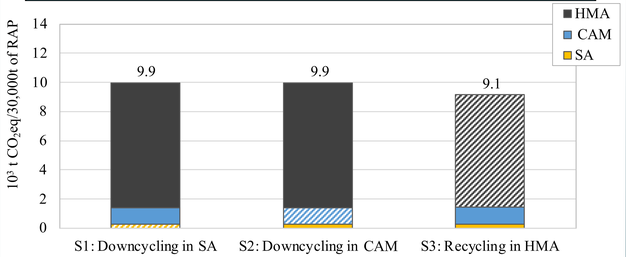
Scenario 2: 30,000 t RAP to Cold Asphalt Mixture (CAM)



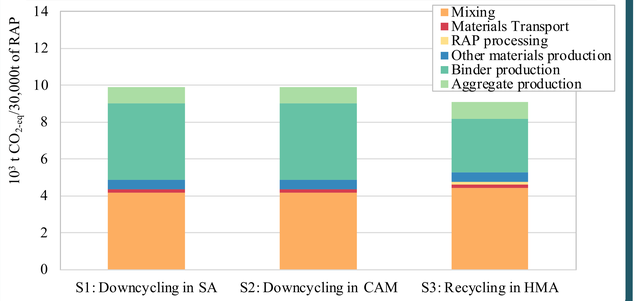
Scenario 3: 30,000 t RAP to Hot Mix Asphalt (HMA)



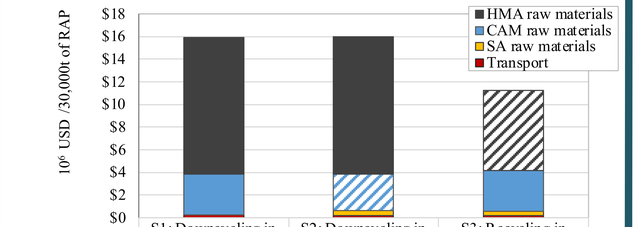
CO_2 EQUIVALENT EMISSIONS BY LAYER



CO_2 EQUIVALENT EMISSIONS BY LIFE CYCLE STAGE



ECONOMIC ANALYSIS BY LAYER



	S1: Downcycling in SA	S2: Downcycling in CAM	S3: Recycling in HMA
HMA raw materials	$12,109,224.94	$12,109,224.94	$7,103,236.71
CAM raw materials	$3,587,451.72	$3,225,908.63	$3,587,451.72
SA raw materials	$27,454.29	$410,237.43	$410,237.43
Transport	$228,855.36	$216,958.08	$182,673.24
Total	$15,952,986.31	$15,962,329.09	$11,283,599.10

* The hashing highlights composites with RAP

ECONOMIC ANALYSIS BY LIFE CYCLE STAGE

	S1: Downcycling in SA	S2: Downcycling in CAM	S3: Recycling in HMA
Aggregate	$2,091,079.04	$2,112,438.97	$2,149,564.93
Binder	$13,539,815.22	$13,539,815.22	$8,799,767.05
Other materials	$93,236.69	$93,116.81	$93,116.81
RAP processing	$-	$-	$58,477.07
Transport	$228,855.36	$216,958.08	$182,673.24

SUMMARY AND FINDINGS

This article showcases how LCA and cost analysis can be used to support more effective strategies towards increasing the circularity of the road infrastructure and mitigating climate change.

- **RAP recycling (S3) can reduce** both the **carbon footprint** and the **costs** with raw materials acquisition **compared to the downcycling scenarios (S1 and S2)** currently used by the city administration.
- The **environmental and economic benefits** are reached mainly due to the **reduction in asphalt binder production demand** in **recycling scenario (S3)**, because of the partially replacement by RAP binder activated during hot mixing process.
- The **economic analysis** reinforces how the **prices can be attractive** to practitioners and costumers into the presented **RAP recycling scenario (S3)**.
- **Informed decisions** are essential to direct **scarce financial and physical resources** towards more sustainable solutions, assigning **value to the recycled materials** and including credits to circular activities for **reducing both waste generation and resources exploration**.

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