

# Ground Glass Pozzolans – A More Sustainable Solution for Recycled Glass & Concrete

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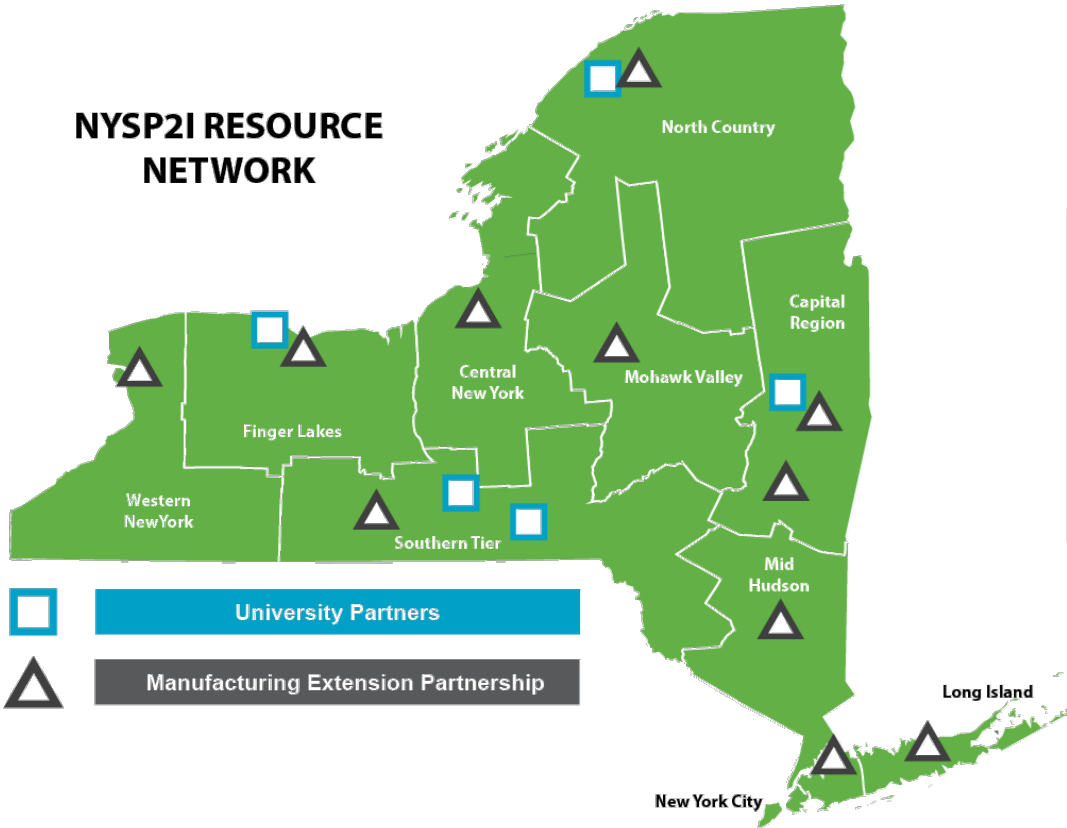
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# NYS Pollution Prevention Institute

- HQ at RIT
- Established in 2008
- \$3.9M in annual NYS funding administered through the NYS Department of Environmental Conservation
- Focus areas include:
  - Sustainable Manufacturing Assessments
  - Supply Chain Sustainability
  - Technology Commercialization
  - Food Waste Diversion
  - Outreach & Education
  - Research & Development
  - Emerging Contaminants



## NYSP2I RESOURCE NETWORK



Department of  
Environmental  
Conservation



**NEW YORK**  
Manufacturing  
Extension Partnership

# Assistance for NYS Companies, Municipalities & Non-Profits

- **Must be NY-based**
- **Typical project cost range is \$15-\$50k**
- **NYSP2I funding offsets most of the project cost to the organization**
  - Expenses are non-capital expenses
  - RIT's engineering, technical and project management services
- **Post-project reporting**
- **Typical project takes about 2-6 months**



## Third-Party Test and Evaluation of Glass Pozzolan

- **Client requested assistance with third-party testing and evaluation of their glass pozzolan utilizing cathode ray tube (CRT) panel glass as an alternative feedstock**
- **Supported by RIT's Staples Sustainable Innovation Laboratory and the Electronic Recyclers International (ERI)**
- **Partnered with Clarkson University – Center for Advanced Materials Processing (CAMP)**
- **Objectives:**
  - Examine the functional viability of cathode ray tube (CRT) panel glass as a feedstock for glass pozzolan
  - Quantify the environmental impacts associated with glass pozzolan feedstocks
  - Examine the comparative impacts of the glass pozzolan feedstocks to ordinary portland cement (OPC) and concrete

## Value of Project

- Add value to waste materials
- Reduce risks associated with CRTs currently in storage
- Reduce environmental impacts of cement and concrete
- Foster a more circular economy
- Study results advance body of knowledge in this area
- Furthers NYSP2I's mission to increase the sustainability of NYS



# Third-Party Test and Evaluation of Glass Pozzolan

- **Two Samples were prepared:**
  - One sample consisted of 5% CRT panel glass, 95% conventional glass pozzolan from material recovery facility (MRF)
  - One sample consisted of 15% CRT panel glass, 85% MRF glass pozzolan
- **Clarkson performed ASTM material & performance testing of the feedstock and three concrete mix samples**
  - Two concrete mixtures contained 80% ordinary portland cement (OPC) and one each of the CRT-MRF blends prepared by the client
  - The third concrete mixture consisted solely of OPC which served as the control mix

## Third-Party Test and Evaluation of Glass Pozzolan

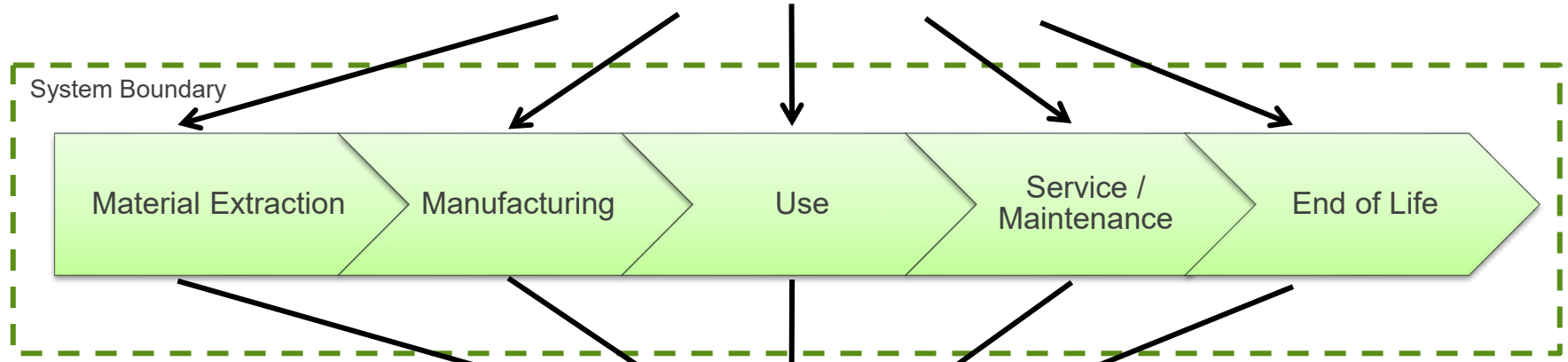
- **Findings indicate that CRT panel glass blended with material recovery facility (MRF) container glass is a functionally viable pozzolan for cement**
- **Life Cycle Assessment (LCA) was then used to:**
  - quantify the environmental impacts associated with glass pozzolan feedstocks
  - examine the comparative impacts of the glass pozzolan feedstocks to OPC in concrete



# Life Cycle Assessment

## Inputs

Natural Resources (energy, material, water)



## Outputs

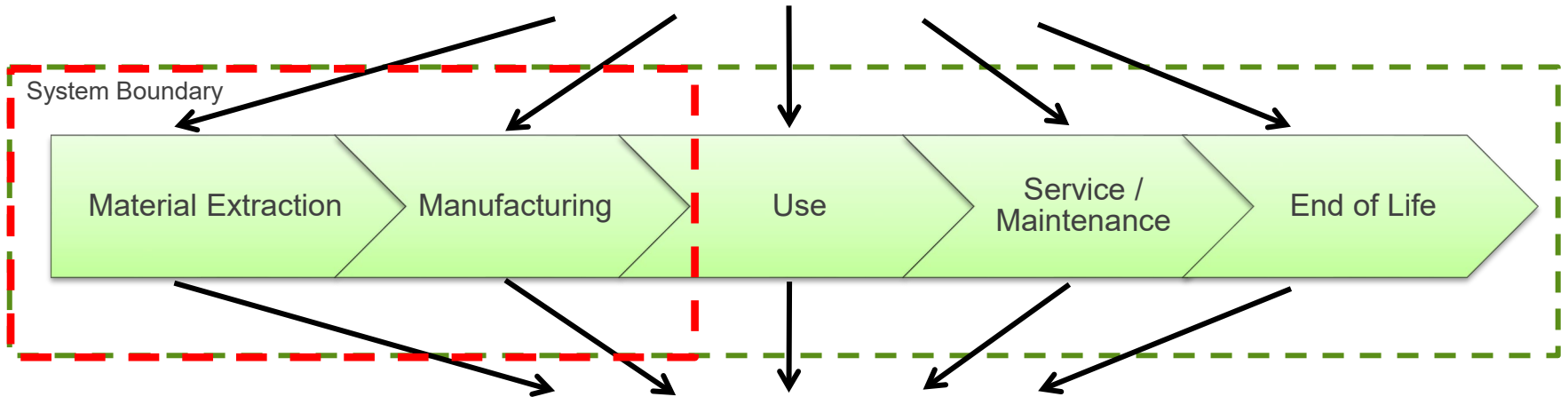
Emissions (air and water pollution), Waste (municipal and hazardous)

## Impacts

# Life Cycle Assessment – Cradle to Gate

## Inputs

Natural Resources (energy, material, water)



## Outputs

Emissions (air and water pollution), Waste (municipal and hazardous)

## Impacts

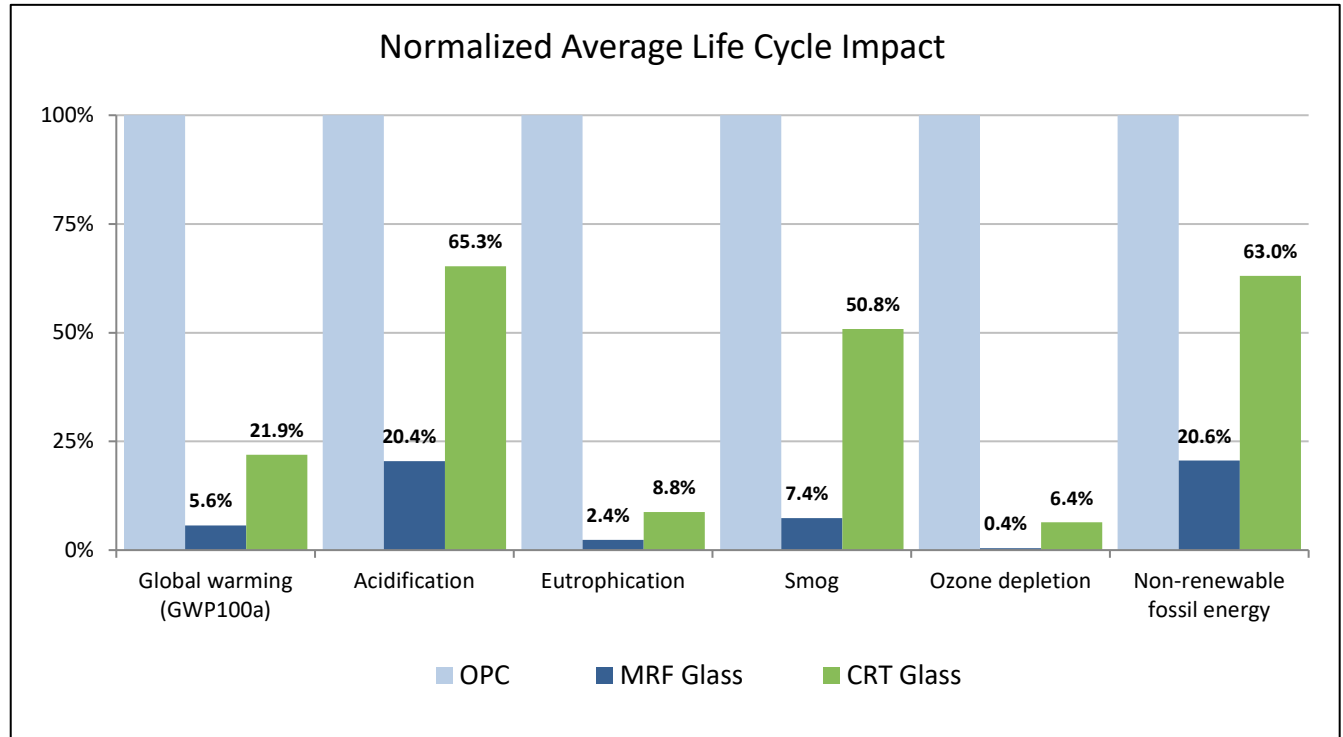
# Life Cycle Assessment

- **Life Cycle Assessment (LCA) analyzed:**
  - Glass Pozzolans
    - 100% MRF glass pozzolan
    - Mixed-glass pozzolan: 15% CRT panel glass & 85% MRF glass
  - Cement with and without glass pozzolans
    - 100% OPC
    - 80% OPC & 20% MRF glass pozzolan
    - 80% OPC & 20% Mixed-glass pozzolan
  - Concrete produced with the three different cements

# Life Cycle Assessment Findings

## Cement Feedstocks

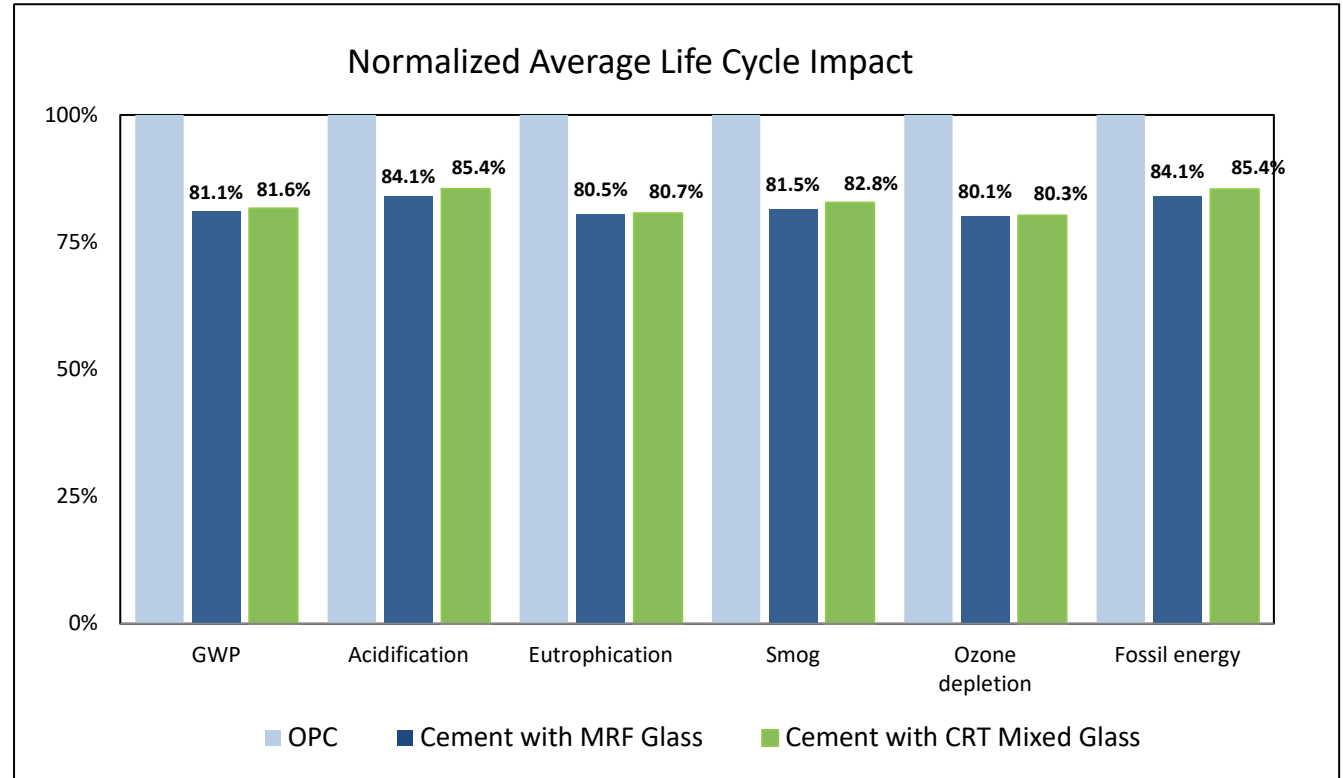
- MRF glass pozzolan has significantly less environmental impact than OPC (79.4% - 99.6% less)
- CRT panel glass has less environmental impact than OPC but more environmental impact than MRF glass (34.7% - 93.6% less)



# Life Cycle Assessment Findings

## Cement Environmental Impacts

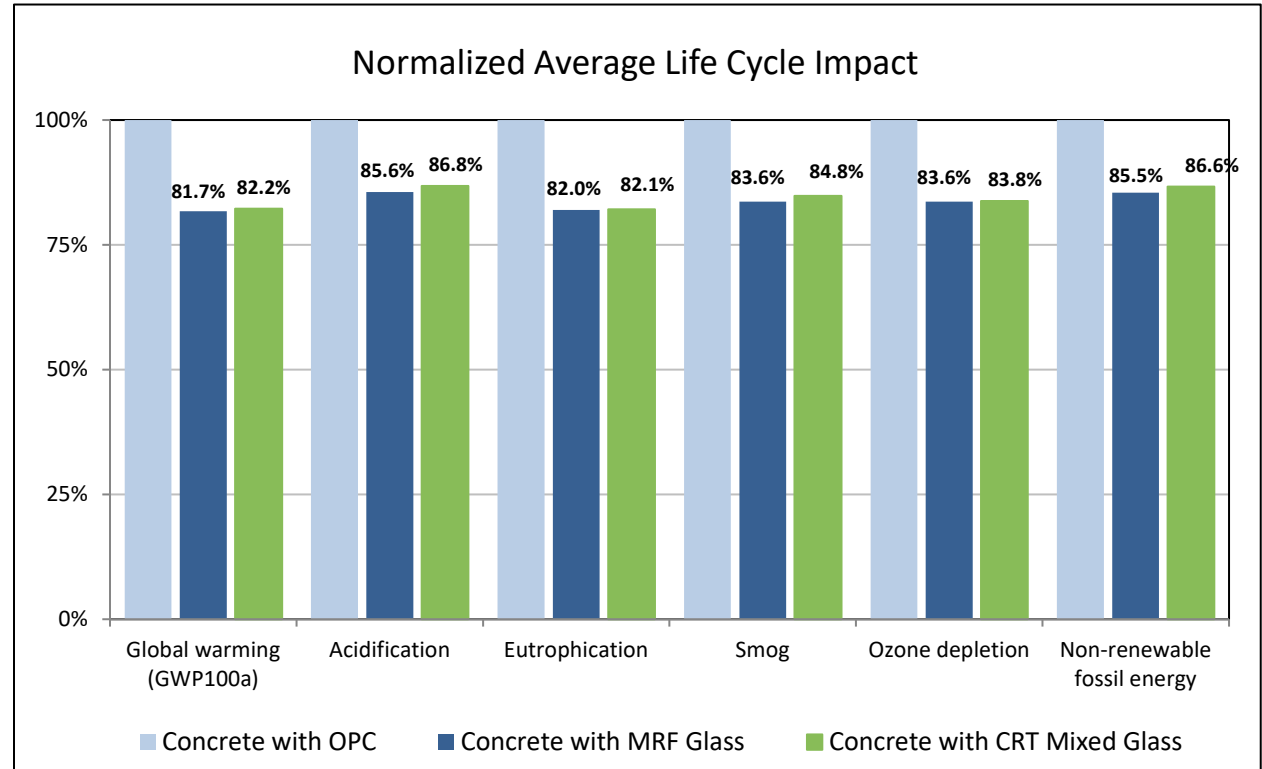
- Cement with glass pozzolan had at least a 14.6% reduction in impacts as compared to OPC
- Cement with CRT mixed glass had minimal change in impact over cement mixed solely with MRF glass



# Life Cycle Assessment Findings

## Concrete Environmental Impacts

- Concrete with glass pozzolan had at least a 13.2% reduction in impacts as compared to concrete with solely OPC
- Difference between concrete with MRF glass versus concrete with CRT mixed glass was insignificant



## Life Cycle Assessment Findings

- CRT panel glass was found to be a functionally viable feedstock for glass pozzolan
- Glass pozzolan feedstocks had significantly less environmental impact than OPC
- Using glass pozzolan feedstocks in cement and concrete significantly reduced environmental impacts

## References

- Hilton, B., Bawden, K., Winnebeck, K., Chandrasiri, C., Ariyachandra, E., & Peethamparan, S. (2019). The functional and environmental performance of mixed cathode ray tubes and recycled glass as partial replacement for cement in concrete. *Resources, Conservation and Recycling*, 151, 104451.
- [https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/docs/resources/Urban\\_Mining\\_Northeast\\_Evaluates\\_Performance\\_Testing\\_of\\_Concrete\\_Mixtures.pdf](https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/docs/resources/Urban_Mining_Northeast_Evaluates_Performance_Testing_of_Concrete_Mixtures.pdf)
- [https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/docs/resources/Urban\\_Mining\\_Northeast\\_Evaluates\\_Environmental\\_Impact\\_of\\_Pozzotive\\_in\\_Cement.pdf](https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/docs/resources/Urban_Mining_Northeast_Evaluates_Environmental_Impact_of_Pozzotive_in_Cement.pdf)
- [https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/docs/resources/NYSP2I\\_KLAW\\_Industries\\_Evaluates\\_GHG\\_Emissions\\_Reduction\\_Potential\\_for\\_Cement\\_Replacement\\_Product.pdf](https://www.rit.edu/affiliate/nysp2i/sites/rit.edu.affiliate.nysp2i/files/docs/resources/NYSP2I_KLAW_Industries_Evaluates_GHG_Emissions_Reduction_Potential_for_Cement_Replacement_Product.pdf)
- <https://klawindustries.com/case-studies>



# Thank You

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