In-Place Pavement Recycling - Moving Towards a Sustainable Future

Northeast and Mid Atlantic States
In-Place Recycling Conference
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Outline

- Ontario road system overview
- Past - What have we learned
- Present - Current practices and improvements
- Sustainable Future - Challenges

Ontario Road System

- **Provincial System**
  - Funded through provincial taxes
  - 16,520 centre-line km, 3000 bridges
  - $ 2.4 B Capital Constr.

- **Municipal System:**
  - 152,000 centre-line km 132,000 bridges

MTO Pavement Network Composition

- Provincial Road Network
  - freeway 8,900 lane-km
  - arterial 13,000 lane-km
  - collector 9,800 lane-km
  - local 7,500 lane-km
- 95% ==> Bituminous pavements
- 5% ==> Concrete and other types of pavements
- 70% of Canada's exports and $1.2 trillion in goods are carried on Ontario's provincial highways


Hwy 17, Northern Ontario


Hwy 401, Toronto

Green Pavement Initiatives

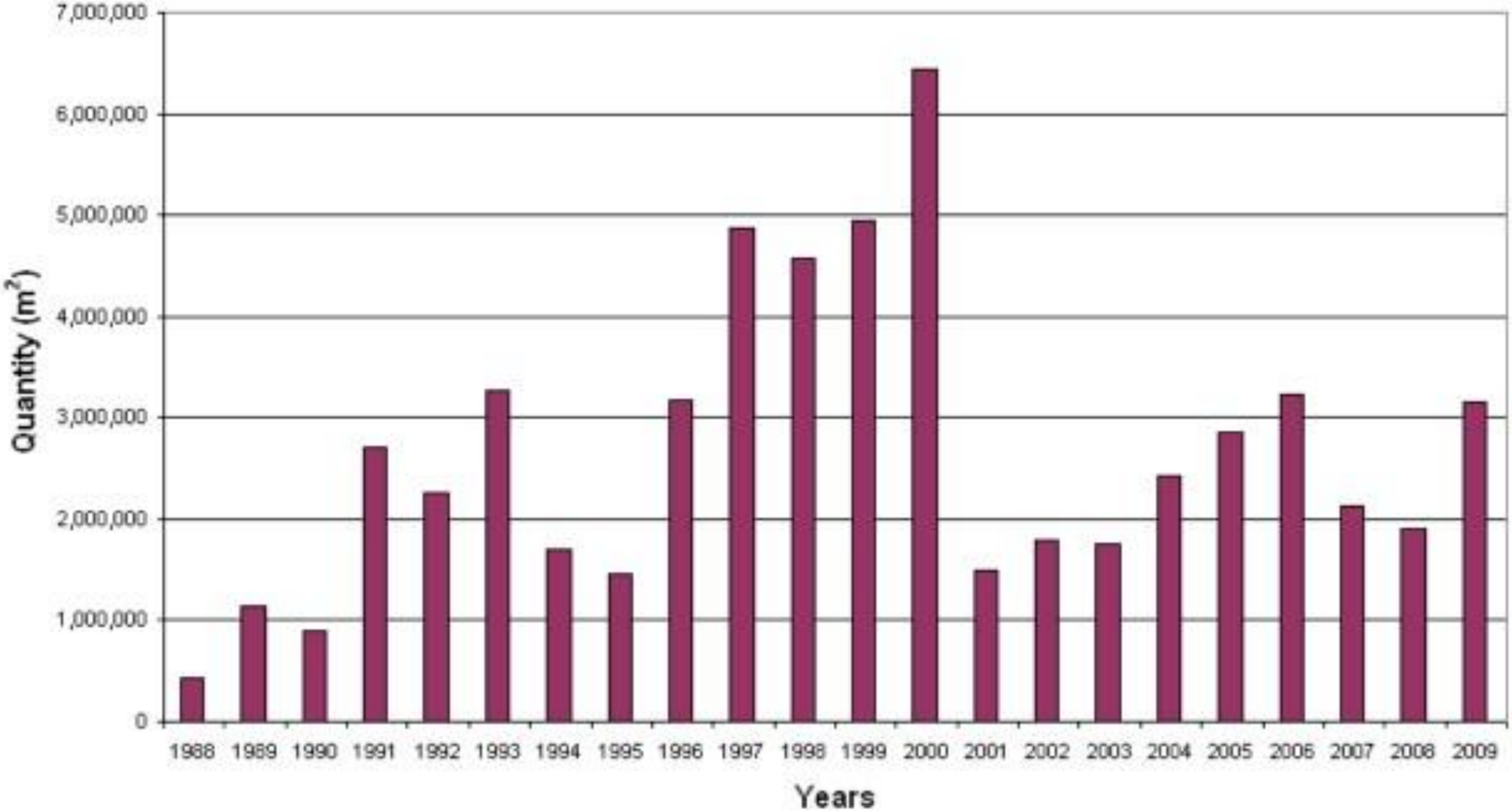
Environmentally friendly pavement design, preservation and rehabilitation strategies include:

- Reuse and recycling of materials
  - Pavement recycling
  - Roof shingles, rubber tires, glass and ceramics
  - Blast furnace slag, fly ash and silica fume
- Warm mix asphalt concrete
- Drainable/permeable pavements
- Reduced noise and perpetual pavements

Implementation of Pavement Recycling in Ontario

- Central plant recycling - late 70's
- Milling, partial depth - early 80's
- Full depth reclamation - mid 80's
- Cold in-place recycling - 1989
- Hot in-place recycling - 1990
- FDR with EA (FA) - 2000
- CIR with EA (FA) - 2003

MTO In-situ Asphalt Recycling Quantities



Full Depth Reclamation - FDR

Hot In-Place Recycling - HIR

Cold In-Place Recycling -CIR

FDR with Expanded Asphalt Stabilization

CIR with Expanded Asphalt

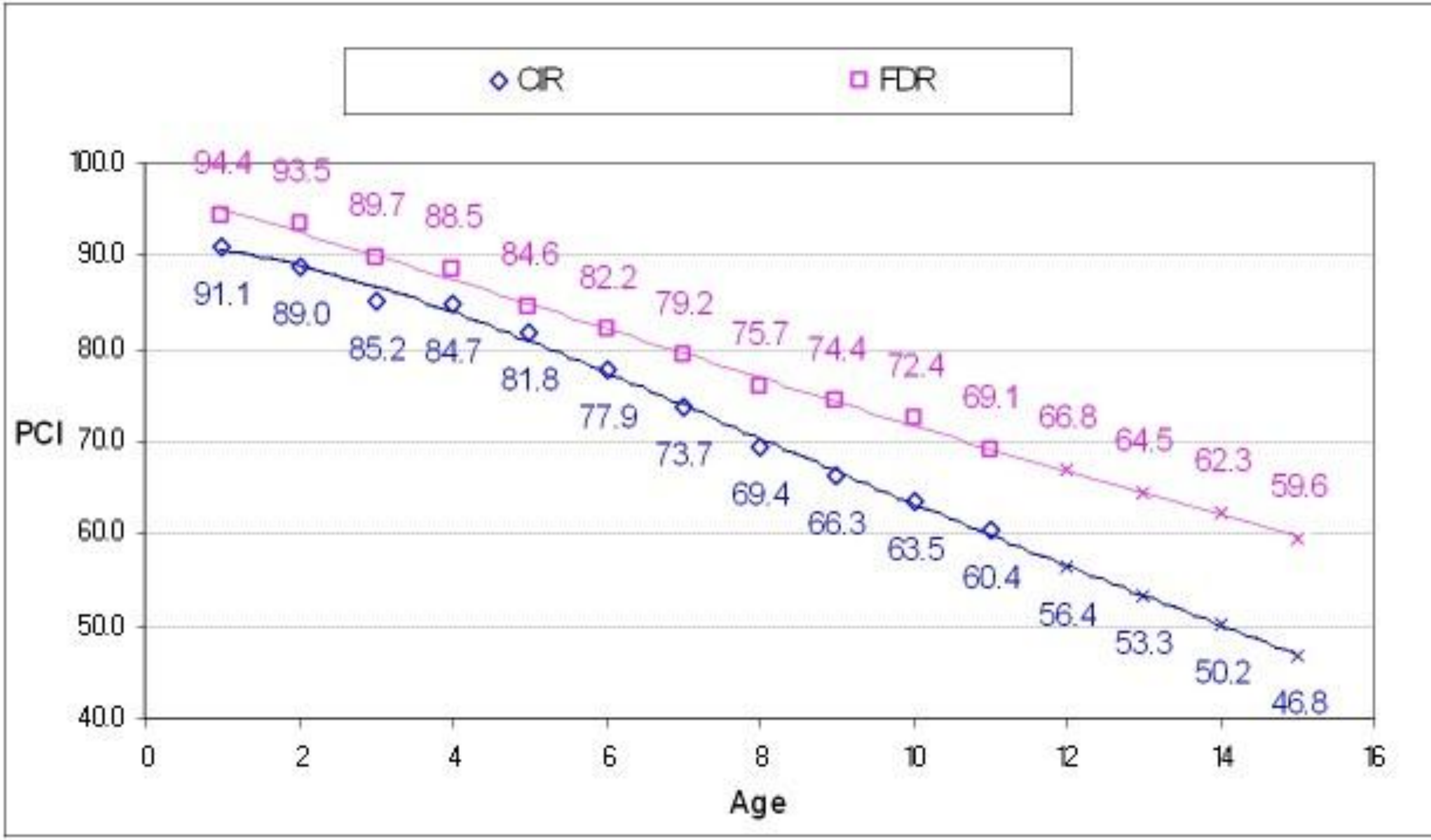
10 Years Summary of Quantities

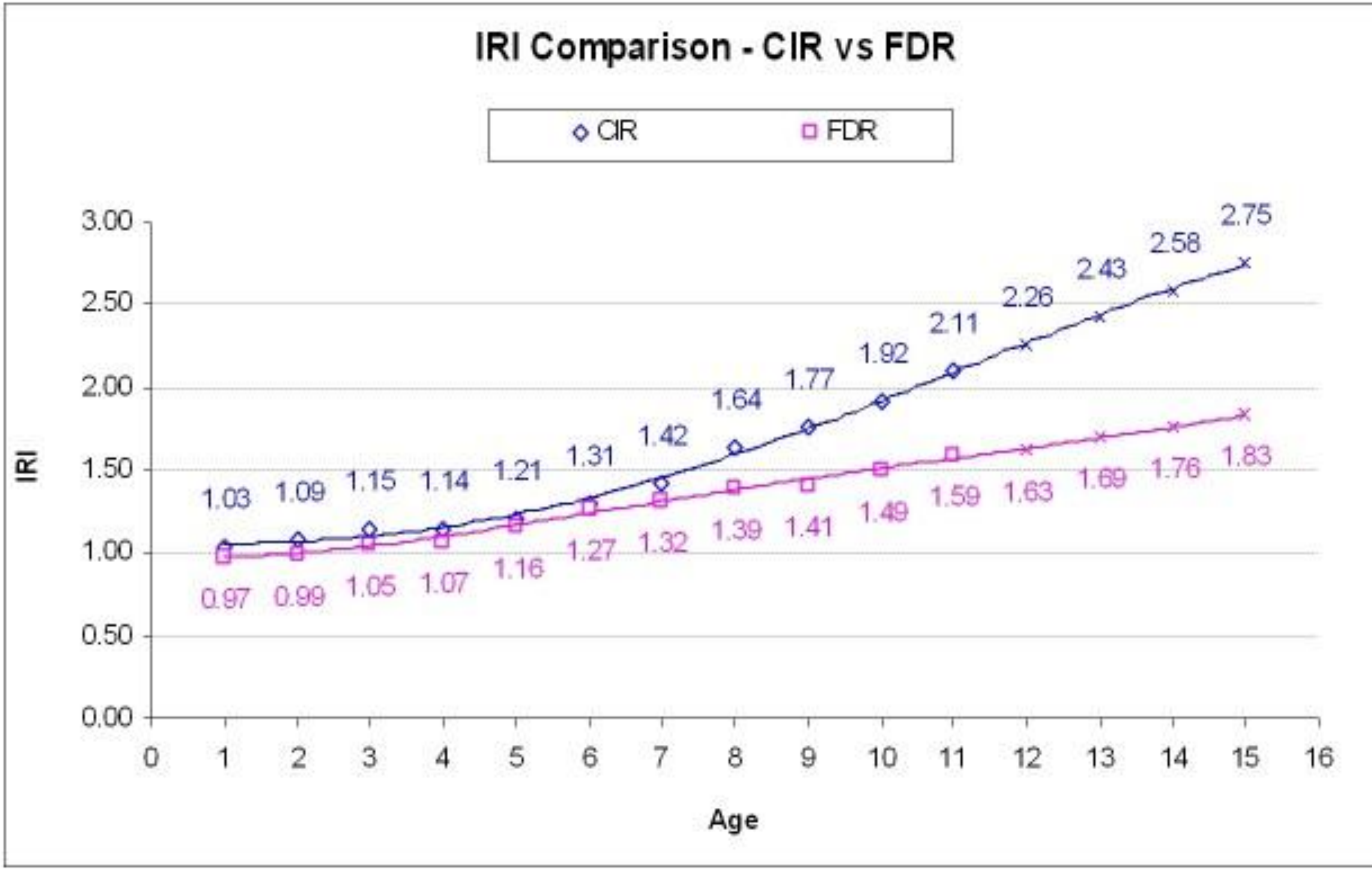
• Full Depth Reclamation (FDR)	20,184,245 m^2
• Hot In-place Recycling (HIR)	324,124 m^2
• Cold In-place Recycling (CIR)	3,448,496 m^2
• FDR with Expanded Asphalt	2,005,061 m^2
• CIR with Expanded Asphalt	1,248,812 m^2
• Total Since 2000:	**27,210,738 m^2**

Past Performance

- In-situ recycled pavements have performed well, often carrying significantly more traffic over their service life than anticipated.
- Designs built in the past have evolved from theory, road tests, and trial and error.
- Lessons have been learned from design problems/flaws, materials, and construction practices that have caused problems.

PCI Comparison – CIR vs. FDR





IRI Comparison - CIR vs FDR
CIR
FDR
3.00
2.50
2.00
1.50
1.00
0.50
0.00
IRI
1.03
1.09
1.15
1.14
1.21
1.31
1.42
1.64
1.77
1.92
2.11
2.26
2.43
2.58
2.75
0.97
0.99
1.05
1.07
1.16
1.27
1.32
1.39
1.41
1.49
1.59
1.63
1.69
1.76
1.83
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Age

Current Practice

Recent improvements in **design**, **materials** and **construction** processes have significantly increased the benefits of in-situ recycling techniques.

Improvements in technology have provided cost effective designs and optimization of rehabilitation strategies.

Design Improvements

Comprehensive Construction and Material Specifications

- OPSS 330, Full depth reclamation
- OPSS 334, Cold recycled mix
- OPSS 333, Cold in-place recycling
- OPSS 332, Hot in-place recycling
- OPSS 331, FDR with Expanded Asphalt Stabilization
- OPSS 335, CIR with Expanded Asphalt

Available online:

http://www.mto.gov.on.ca/english/transrd

Towards a Sustainable Future

What is Sustainable Development?

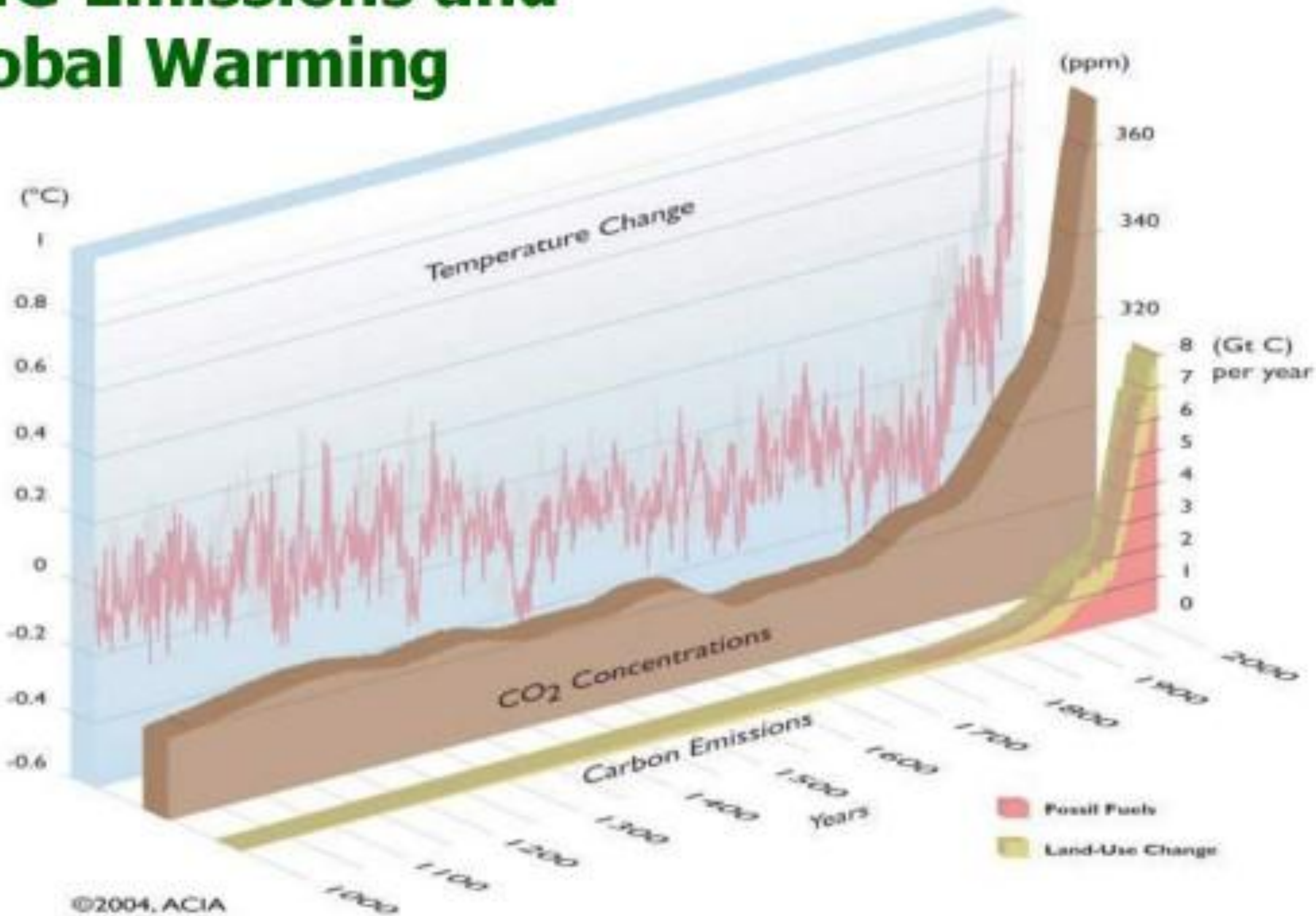
"…. Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Towards a Sustainable Future

To achieve sustainability, every corporate decision should consider the impact of the triple-bottom-line.

"What are the Social, Economic, and Environmental (SEE) Impacts of the decision"

GHG Emissions and Global Warming



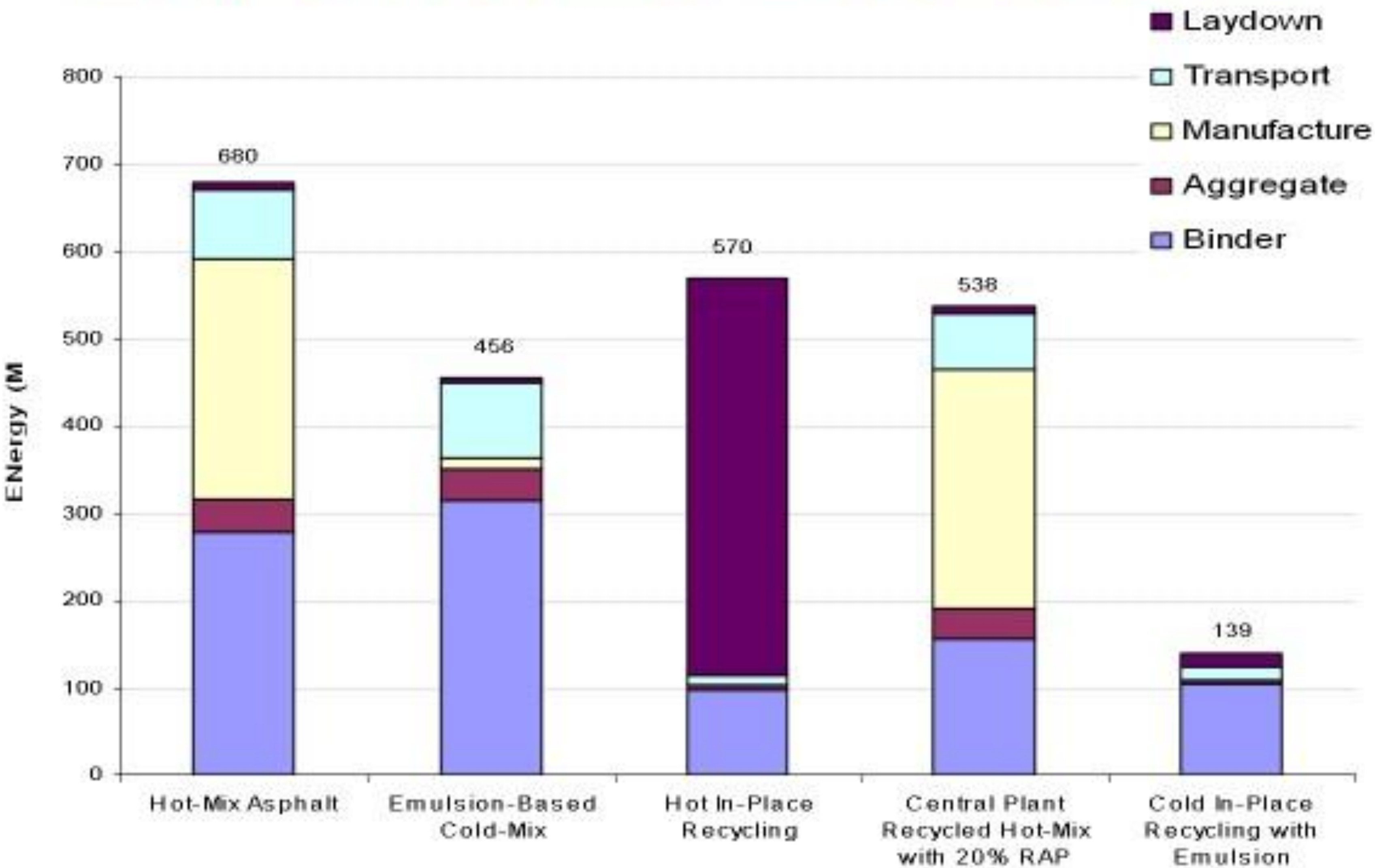
Variation in Mean Surface Temp and CO_2 Concentration

Sustainable Pavement Criteria

" ....safe, efficient, environmentally friendly pavements meeting the needs of present-day users without compromising those of future generations"

- In-situ recycling technologies address the main criteria for a sustainable pavement:
  - Optimizing the use of natural resources
  - Reducing energy consumption
  - Reducing greenhouse gas emissions
  - Limiting pollution
  - Improving health, safety and risk prevention
  - Ensuring a high level of user comfort and safety

Energy Use Per Tonne Of Material Laid Down



Source: *The Environmental Road of the Future, Life Cycle Analysis* by Chappat, M. and Julian Bilal. Colas Group, 2003, p.34

Sustainable Pavements

- The report concludes that recycling technologies are the most promising tool to assist in the selection of environmentally friendly flexible pavements.
- MTO's primary pavement design/rehabilitation goal is to provide safe durable roads that maximize the use of recycled materials.

Ontario Case Study

Environmental Benefits of
In-place Recycling (CIR + CIREAM)
vs.
Mill and Overlay

Impact Evaluation

- **PaLATE** software -

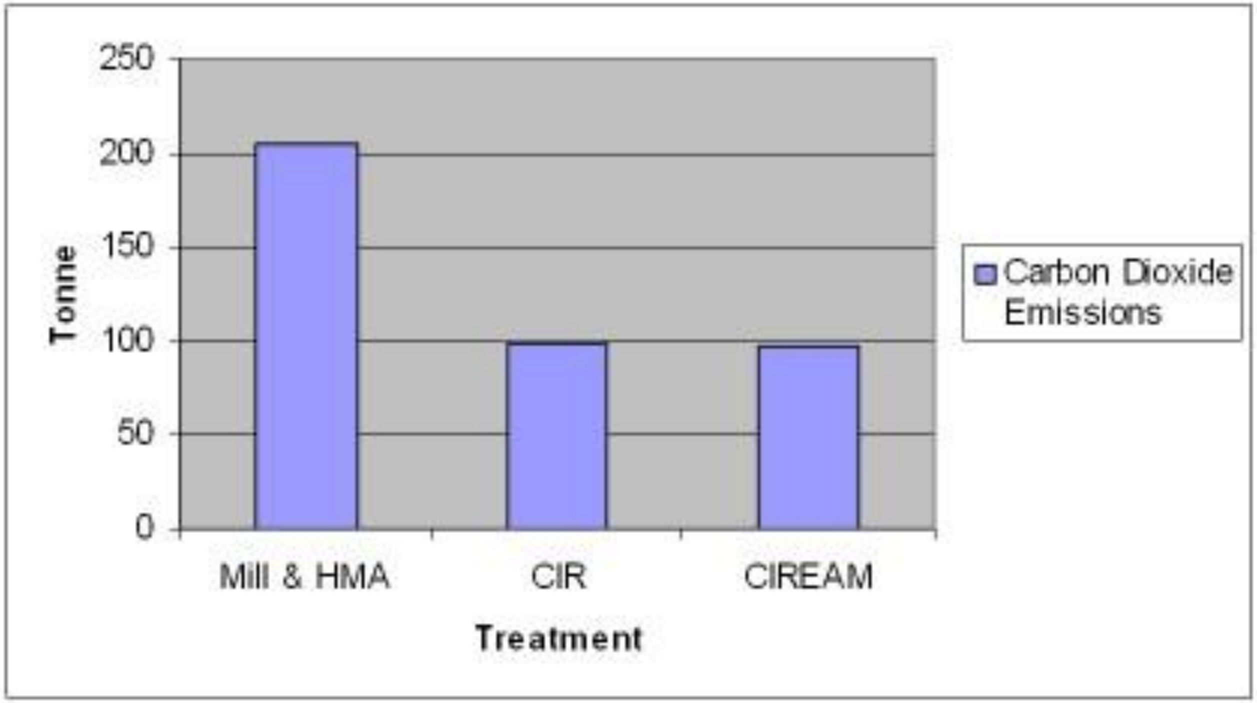
  Pavement Life-cycle Assessment for Environmental and Economic Effect
- Created by Dr. Horvath of the University of California at Berkley with funding from the Recycled Materials Resource Centre/FHWA
- Assists decision-makers in evaluating the use of recycled materials in highway construction (both LCC and Environmental Impacts).

Study Assumptions

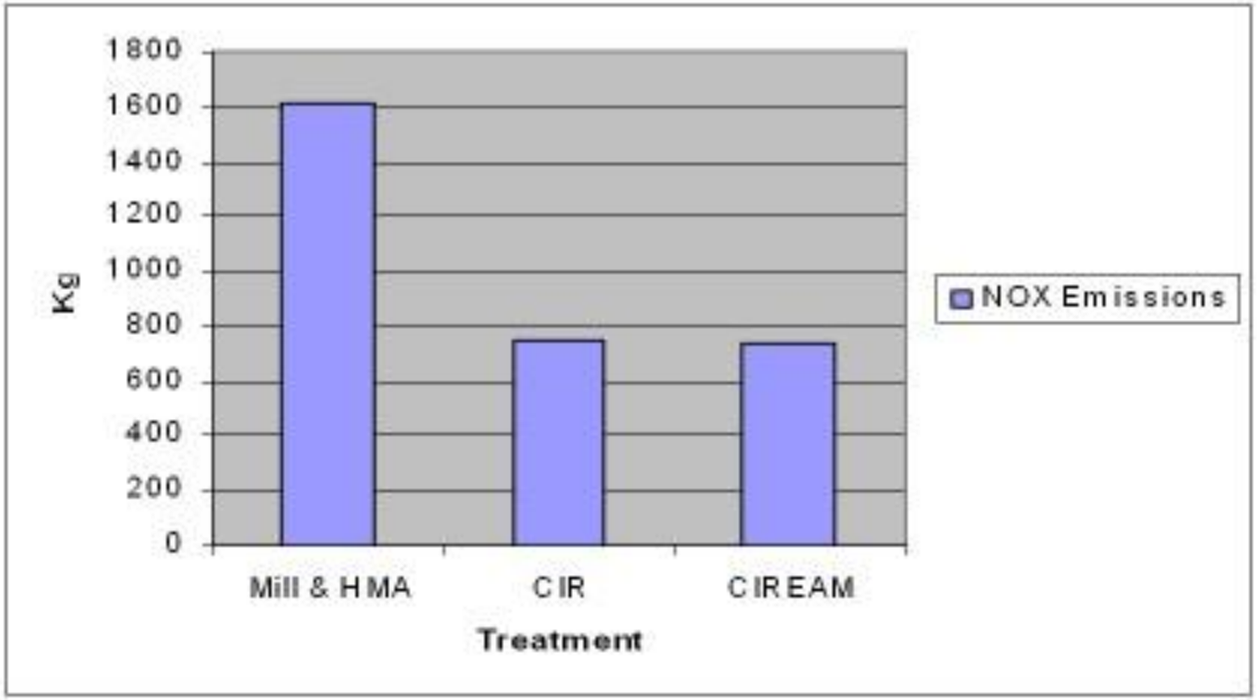
	CIR	CIREAM	M&O
Existing HMA Depth	150mm	150mm	150mm
New HMA	50mm	50mm	130mm
% AC	5%	1.0% & 5%	5%
% Emulsion	1.2%	0	0

Using PaLATE model, the following emissions were calculated and compared:

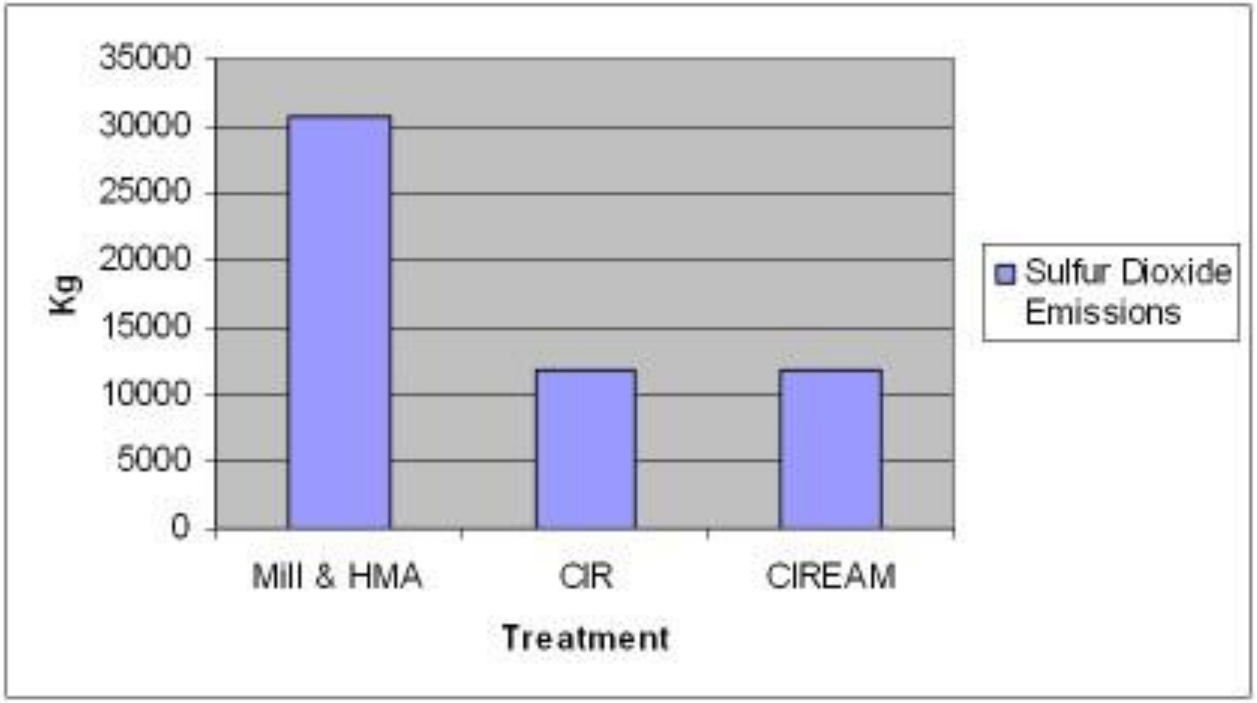
CO_2 Emissions



NO_x Emissions



SO_2 Emissions



Environmental Benefits

- Per 2-lane km, CIR/CIREAM emits approximately 50% less GHG, consumes 62% less aggregates, and costs 40-50% less when compared to a conventional mill and overlay treatments
- Since the implementation of CIR/CIREAM contracts, MTO has reduced GHG emissions by:
    - **127,000 tonnes** of CO_2
    - **1,000 tonnes** of NO_x
    - **22,100 tonnes** of SO_2

And saved **1.7 million tonnes** of aggregates

Technology Transfer

- CIR/CIREAM are two of the most environmental friendly flexible pavement rehabilitation techniques available; they reduce Life Cycle Costs, reuse existing non-renewable material, minimize new materials and reduce on site transportation.
- MTO actively promotes CIR/CIREAM through technical papers, presentations and by example

What's next?

- Current Life Cycle Costing (LCC) includes:
  - Initial, and discounted main/rehab costs and remaining life costs
  - User costs
- We now have the tools to calculate GHG emissions and energy savings – PaLATE software
- MTO has developed a rating system to quantify and encourage pavement sustainability
- We are moving towards including an environmental component into LCC (Environmental benefits/credits).
- Insures that the best treatment is selected to benefit economic, social and environmental needs

  - a Sustainable Approach.

Existing Green Rating Systems

- LEED® for Buildings
- University of Washington Green Roads
- NYSDOT GreenLITES Project Design Certification Program
- Alberta/Stantec Green Guide for Roads
- TAC Green Guide for Roads

MTO Green Rating System Categories

Category	Goal	Points
Pavement Design Technologies	To optimize sustainable designs. These include long life pavements, permeable pavements, noise mitigating pavements, and pavements that minimize the heat island effect.	8
Materials & Resources	To optimize the usage/reusage of recycled materials and to minimize material transportation distances.	13
Energy & Atmosphere	To minimize energy consumption and GHG emissions.	10
Innovation & Design Process	To recognize innovation and exemplary efforts made to foster sustainable pavement designs.	4
	Maximum Total:	**35**

GreenPave Rating System Overview

Category / Sub-Category

Pavement Technologies (8 Points)	Material & Resources (13 Points)	Energy & Atmosphere (10 Points)	Innovations & Design Process (4 Points)
Long-Life Pavement Design 3 Points	Recycled Content 5 Points	Reduce Energy Consumption 3 Points	Innovation in Design 2 Points
Permeable Pavement 1 Point	Undisturbed Pavement Structure 3 Points	GHG Emissions Reduction 3 Points	Exemplary Process 2 Points
Noise Mitigation 2 Points	Local Materials 3 Points	Pavement Smoothness 1 Point	
Cool Pavements 2 Points	Construction Quality 2 Points	Pollution Reduction 3 Points	

Blue font designates sections applicable only to constructed pavements (Construction Quality, Pavement Smoothness, Pollution Reduction)

Green Adjustment

- Green Discounted Life Cycle Cost (GDLCC)

- **GDLCC = LCC – Green Adjustment**

- For example:
    - Using a 20 % Adjustment
    - $1,000,000 LCC
    - Green Rating =12 points; maximum 35 points

- GDLCC = $1,000,000 – (20%*(12/35)* $1,000,000))
- GDLCC = $931,429

Summary

We will better achieve our sustainable pavement goals through:

- Building on current industry/ministry partnerships in the development of improved in-situ recycling specifications and design/construction procedures
- Encouraging continued innovation by the province's in-situ recycling contractors
- Supporting dedicated research programs to advance the technology
- Increasing technology transfer to accelerate adoption of in-situ recycling concepts

Conclusions

- There is an increased focus on sustainable asset preservation in Ontario, both at the provincial and municipal levels
- Pavement preservation and rehabilitation incorporating timely insitu recycling treatments can significantly extend pavement life and result in improved network performance over time
- Implementation of **sustainable** AM principles and performance measures are critical to addressing infrastructure investment requirements and **environmental stewardship** over the long-term

Thank you!

Questions?

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