



# EXTENDING THE LIFE OF STEEL BRIDGES 100 YEARS AND BEYOND

Building a Sustainable Infrastructure  
w/ Short Span Steel Bridges

Webinar | May 11, 2021

# ABOUT THE AMERICAN GALVANIZERS ASSOCIATION

- ▶ Non-profit trade association established in 1933
  - ▶ Serves as a *unified voice* and provides *expertise* in the after fabrication hot-dip galvanizing industry
- ▶ Provides technical support on innovative application and technological developments in hot-dip galvanizing for corrosion protection
  - ▶ Free assistance for North American specifiers
  - ▶ Resource for our members

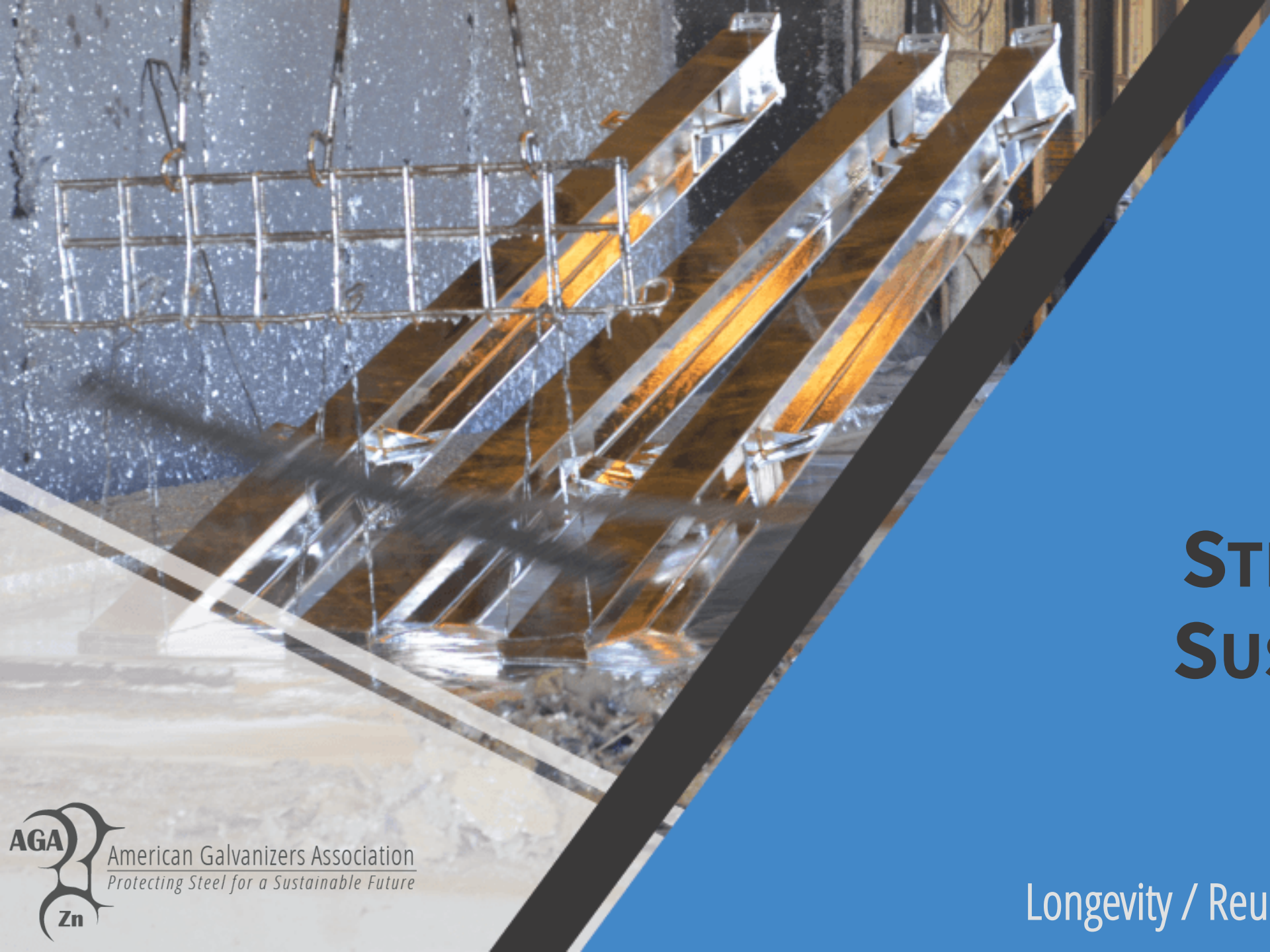
## PRESENTER



**John Krzywicki**

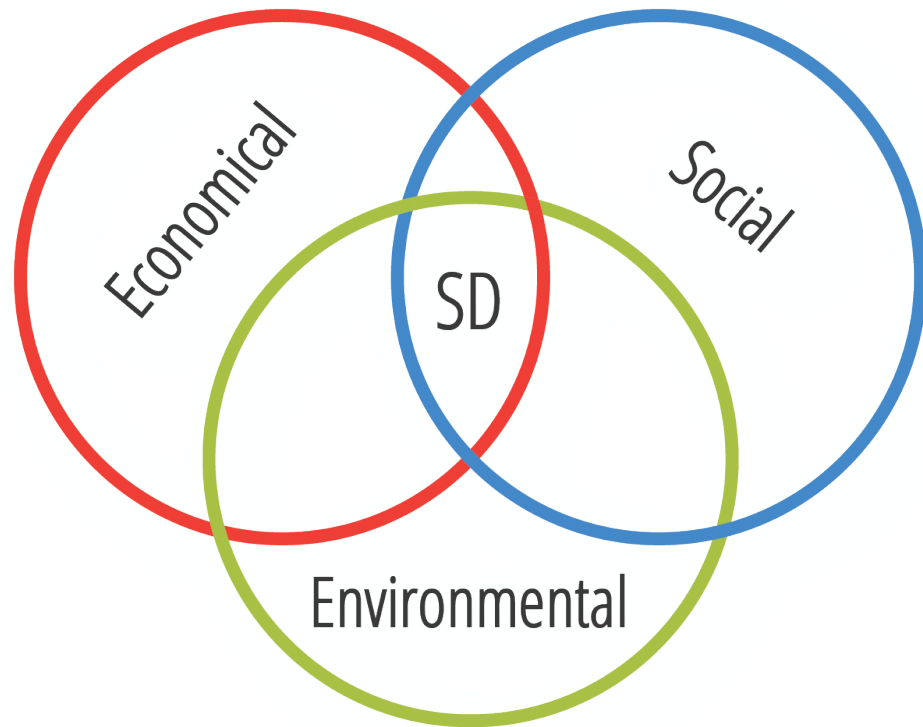
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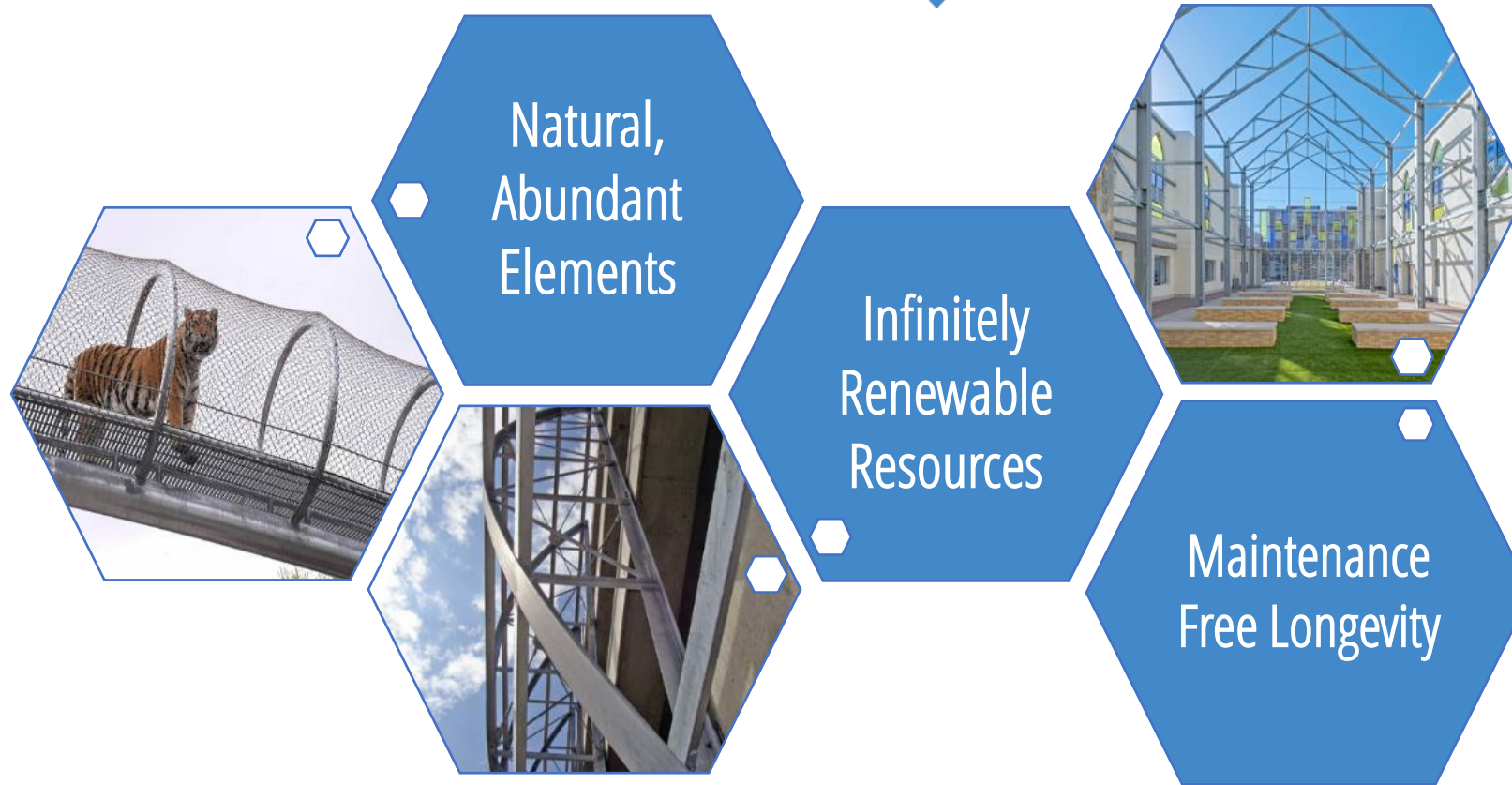
# STEEL + ZINC = SUSTAINABILITY

# DEFINING SUSTAINABLE DEVELOPMENT



- ▶ Sustainable Development (SD) is the social, economic, and environmental commitment to growth and development that meet the needs of the present without compromising the ability of future generations to meet their own needs.

# SUSTAINING STEEL WITH ZINC (HOT-DIP GALVANIZING)

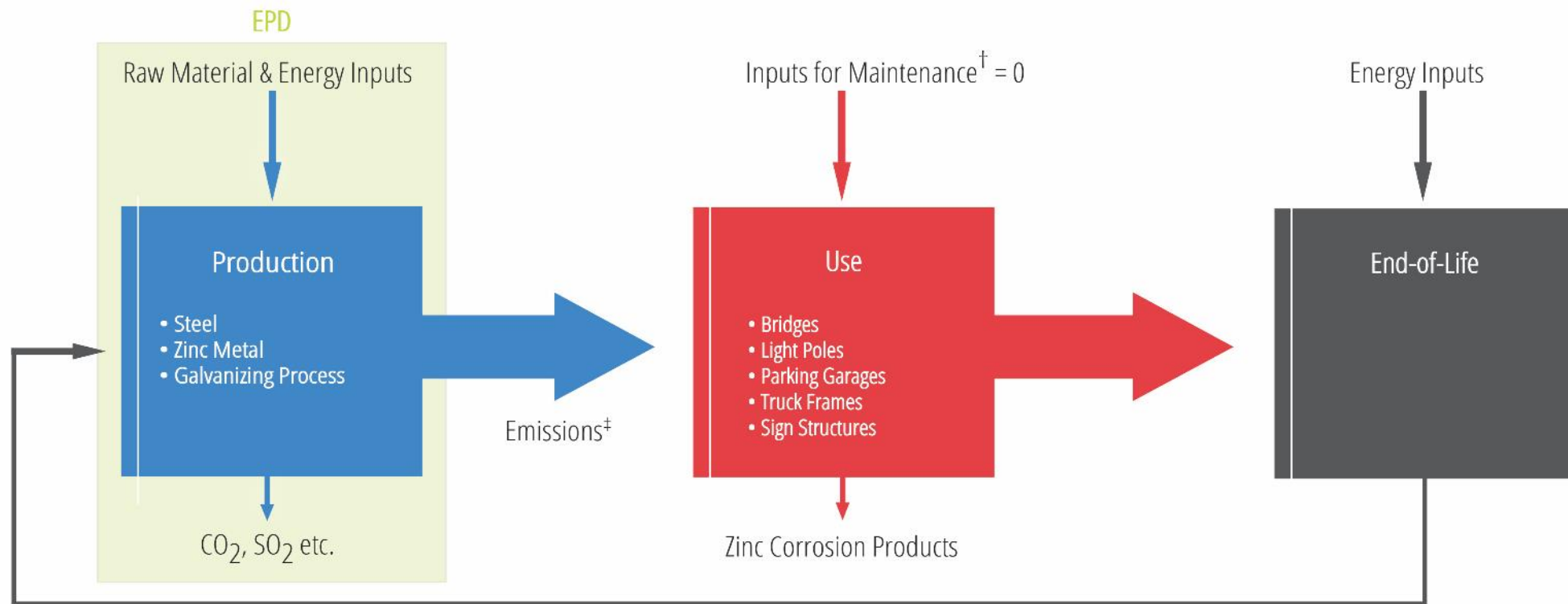


# INFINITELY RENEWABLE RESOURCES

- ▶ Steel + Zinc are 100% recyclable
  - ▶ Multi-cycled without loss of any properties
  - ▶ 90% structural steel from recycled sources
  - ▶ 30% of world zinc supply from recycled sources
- ▶ High Reclamation Rates
  - ▶ Steel most recycled material in world, virtually 100% is reclaimed
  - ▶ Zinc = 80%



# LIFE-CYCLE ASSESSMENT (LCA) OF HDG



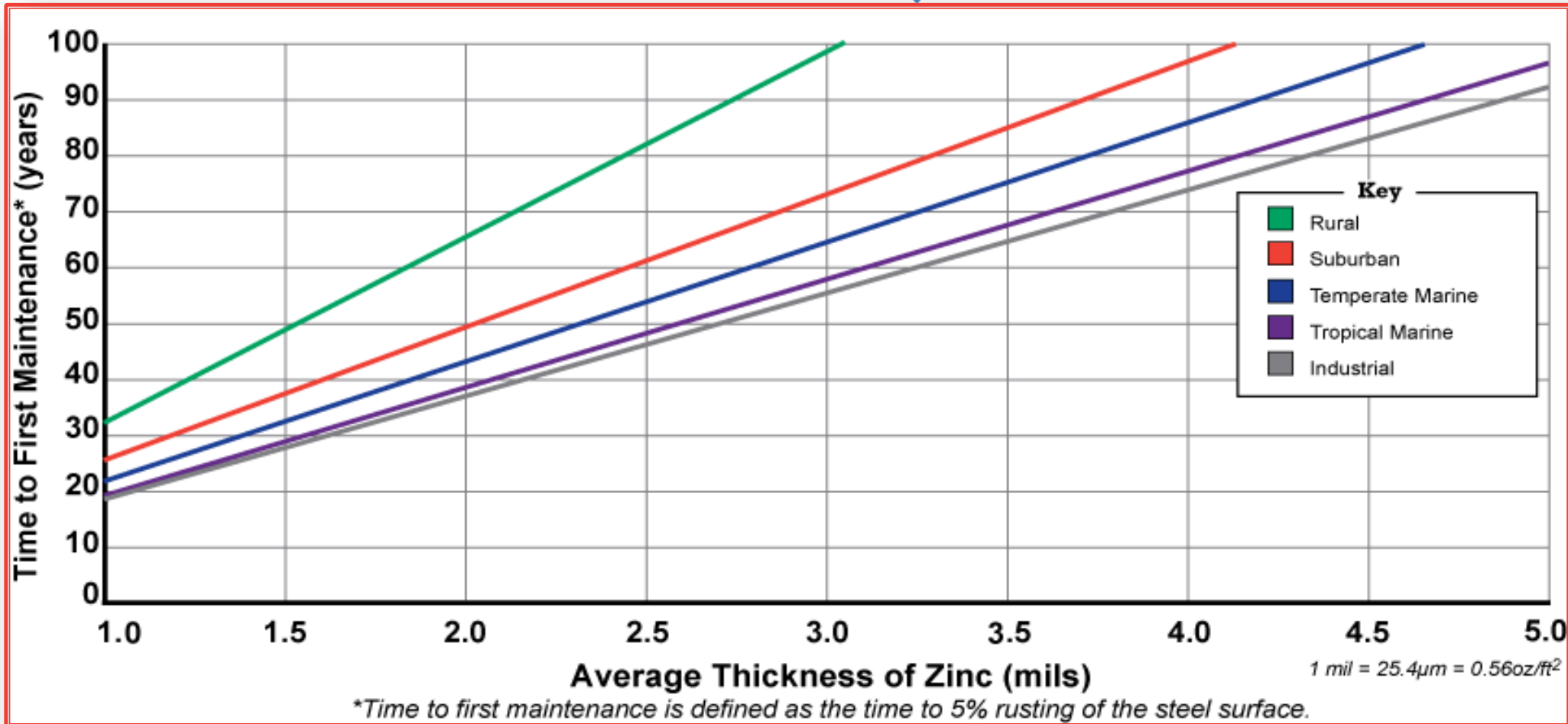
Steel & Zinc Recycle Loop (100%)

<sup>†</sup> For all but the most aggressive environmental conditions, there are no energy/raw material inputs during use (/5+ years).

<sup>‡</sup> For hot-dip galvanized steel, naturally occurring zinc oxide, zinc hydroxide, and zinc carbonate.



# LONGEVITY IN ATMOSPHERE: TIME TO FIRST MAINTENANCE





<https://youtu.be/3FoA7G0IHGk>

## STEARNS BAYOU BRIDGE

Ottawa County, MI

• 1966



# REUSE OF GALVANIZED STEEL

- ▶ HDG provides long-term maintenance free corrosion resistance to steel
- ▶ Allows for two avenues of reuse
  - ▶ Reuse without reprocessing
  - ▶ Recoat and reuse
- ▶ Reuse saves:
  - ▶ Resources & Energy
  - ▶ Environmental Impact (emissions)
  - ▶ Money





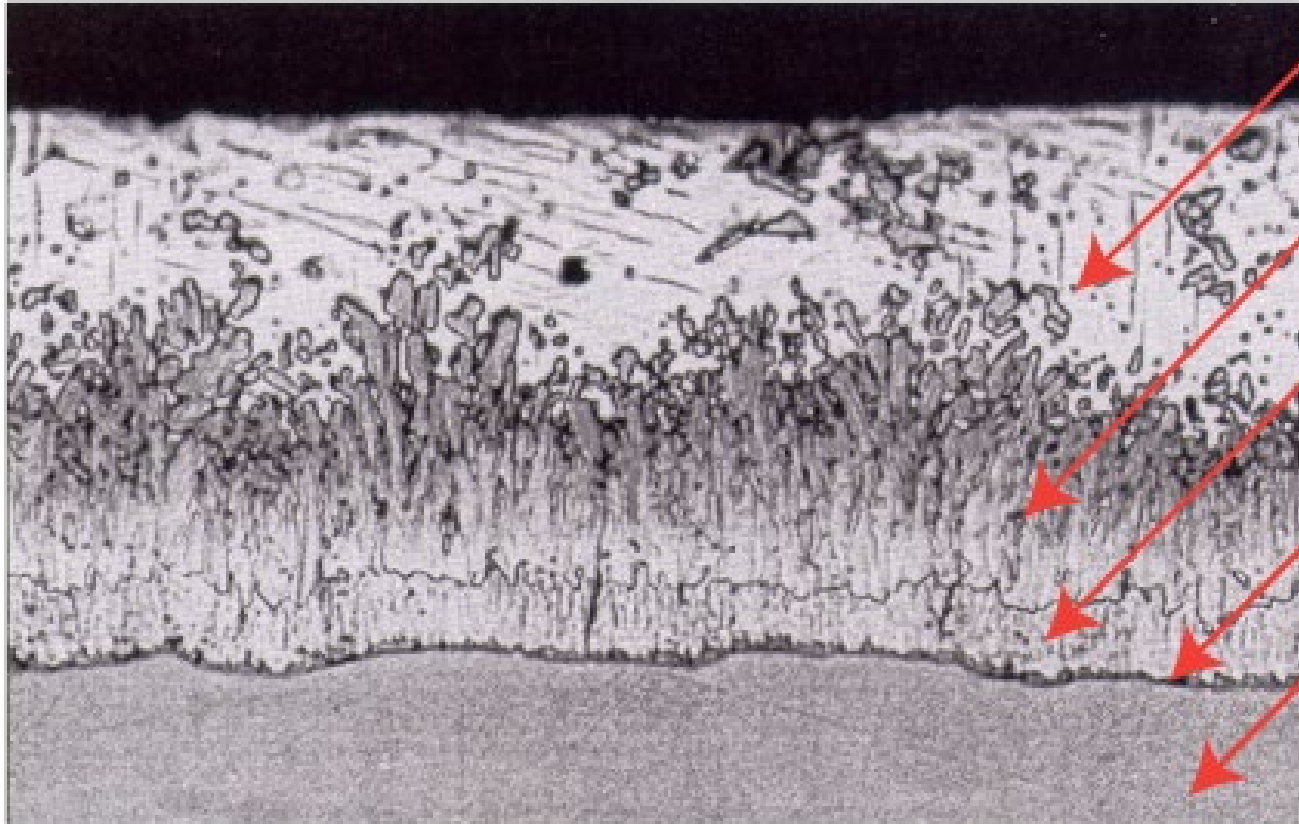


## FORE RIVER BRIDGE

Quincy, MA • 2002



# DURABILITY: ABRASION RESISTANCE



**Eta**  
(100% Zn)  
70 DPN Hardness

**Zeta**  
(94% Zn 6% Fe)  
179 DPN Hardness

**Delta**  
(90% Zn 10% Fe)  
244 DPN Hardness

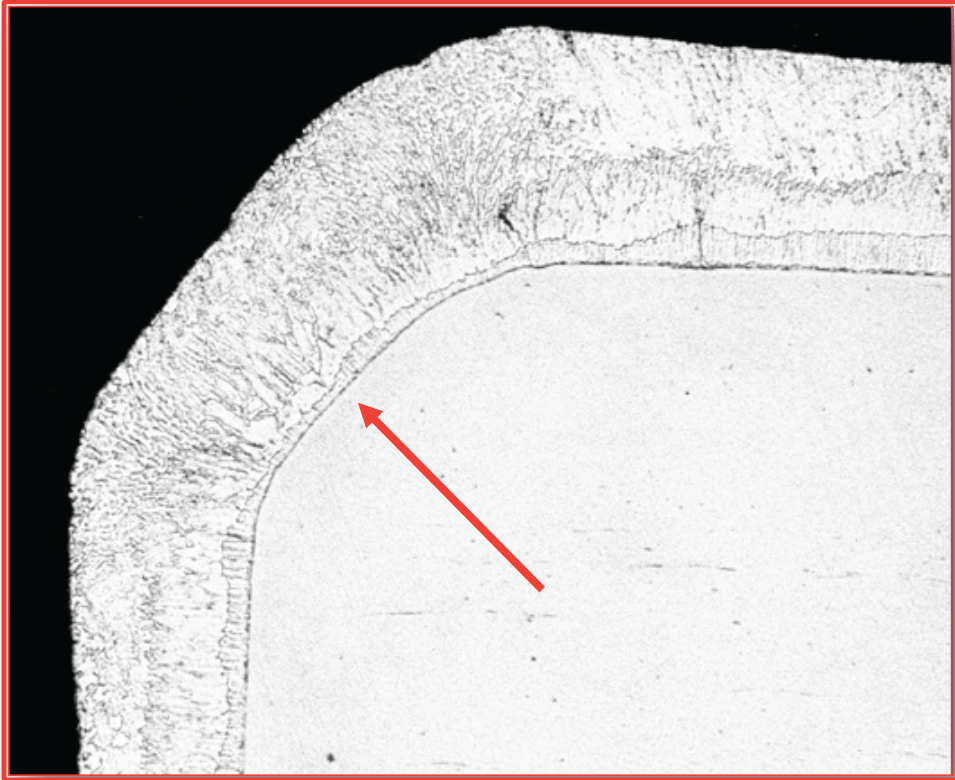
**Gamma**  
(75% Zn 25% Fe)  
250 DPN Hardness

**Base Steel**  
(100% Fe)  
159 DPN Hardness

- ▷ Bond strength: 3,600 psi
  - ▷ Metallurgical bond
- ▷ Intermetallic (Zn-Fe) layers
  - ▷ Harder than base steel

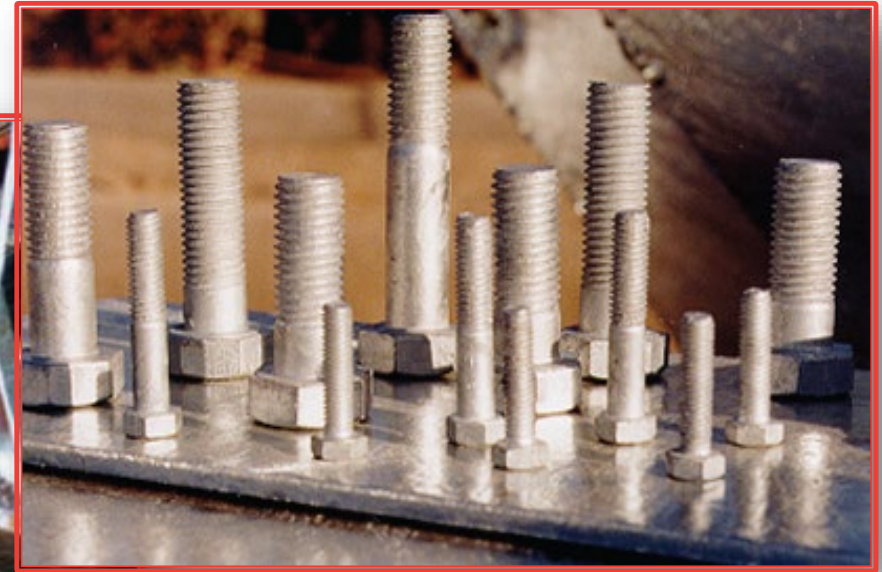


# DURABILITY: UNIFORM PROTECTION, COMPLETE COVERAGE



Same thickness at edge/corner  
coating grows perpendicular to the surface

Interior coverage



Fully-coated threads



<https://youtu.be/iJ7qXkV6WDI>



**RIVIERE COCHON  
GRAS BRIDGE**

Perches, Haiti • 2019





## MICHIGAN M-102 BRIDGE RAIL

Detroit, MI • 2007



# ECONOMIC ADVANTAGES

- ▶ Initial cost benefits
  - ▶ Overall material cost, as well as time savings
- ▶ Life-cycle cost savings
  - ▶ Total cost of project throughout its life
    - ▶ Includes maintenance costs and time value of money
    - ▶ HDG often initial cost IS life-cycle cost
- ▶ Life-cycle cost calculation automated online at [lccc.galvanizeit.org](http://lccc.galvanizeit.org)

## Case Study Parameters

- ▶ Typical mix of size/shapes
  - ▶ 50,000 ft<sup>2</sup> project
  - ▶ 75 year design life
  - ▶ Moderately industrial environment (C3)
- ▶ Surface Preparation/Application
  - ▶ SP-10 automated (duplex to SP-16)
  - ▶ All coats applied in the shop



Initial Cost: System	\$/ft <sup>2</sup>	Total
Hot-Dip Galvanizing	\$1.76	\$88,000
Epoxy/Epoxy	\$2.92	\$146,150
Inorganic Zinc/Epoxy	\$3.17	\$158,650
Epoxy/Polyurethane	\$3.14	\$157,050
Inorganic Zinc/Epoxy/Polyurethane	\$4.53	\$226,300
Galvanizing/Epoxy/Polyurethane (Duplex)	\$5.28	\$263,950
Metallizing	\$8.37	\$418,550

Life-Cycle Cost (75 years): System	\$/ft <sup>2</sup>	Total	AEAC
Hot-Dip Galvanizing	\$4.29	\$214,500	\$0.11
Epoxy/Epoxy	\$51.91	\$2,595,500	\$1.34
Inorganic Zinc/Epoxy	\$39.92	\$1,996,000	\$1.03
Epoxy/Polyurethane	\$57.73	\$2,886,500	\$1.49
Inorganic Zinc/Epoxy/Polyurethane	\$41.53	\$2,076,500	\$1.07
Galvanizing/Epoxy/Polyurethane (Duplex)	\$22.84	\$1,142,500	\$0.59
Metallizing	\$62.80	\$3,140,000	\$1.62

# SUSTAINABLE DEVELOPMENT & HDG



- ▶ Social, economic, and environmental factors all are important to future quality of life
- ▶ Zinc is natural, abundant, infinitely renewable
- ▶ Hot-dip galvanizing's maintenance-free longevity provides both environmental and economic benefits
  - ▶ Reduced maintenance =
    - ▶ Less energy, resources, emissions over life
    - ▶ Less cost, freeing capital for new projects



# QUESTIONS & COMMENTS

- ▶ American Galvanizers Association
  - ▶ [www.galvanizeit.org](http://www.galvanizeit.org)
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