Hot-Dip Galvanizing (HDG) & Sustainability

Building a Sustainable Infrastructure w/ Short Span Steel Bridges

Webinar | May 17, 2022

American Galvanizers Association
Protecting Steel for a Sustainable Future

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

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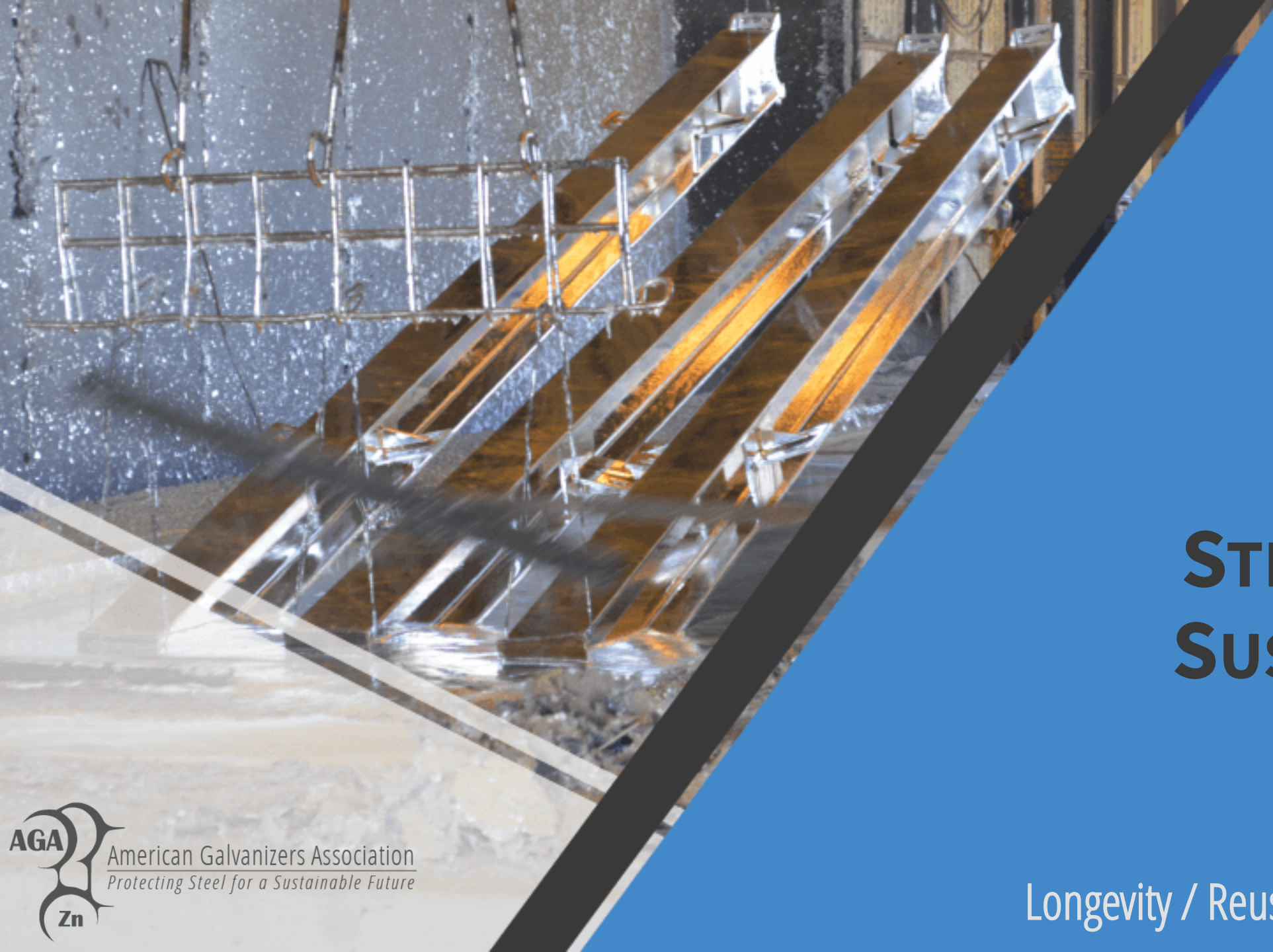


Steel + Zinc = Sustainability

Longevity / Reuse / Repurpose / Recycle

AGA Zn
American Galvanizers Association
Protecting Steel for a Sustainable Future

Sustaining Steel with Zinc (Hot-Dip Galvanizing)

Natural, Abundant Elements

Infinitely Renewable Resources

Maintenance Free Longevity

Natural, Abundant Elements

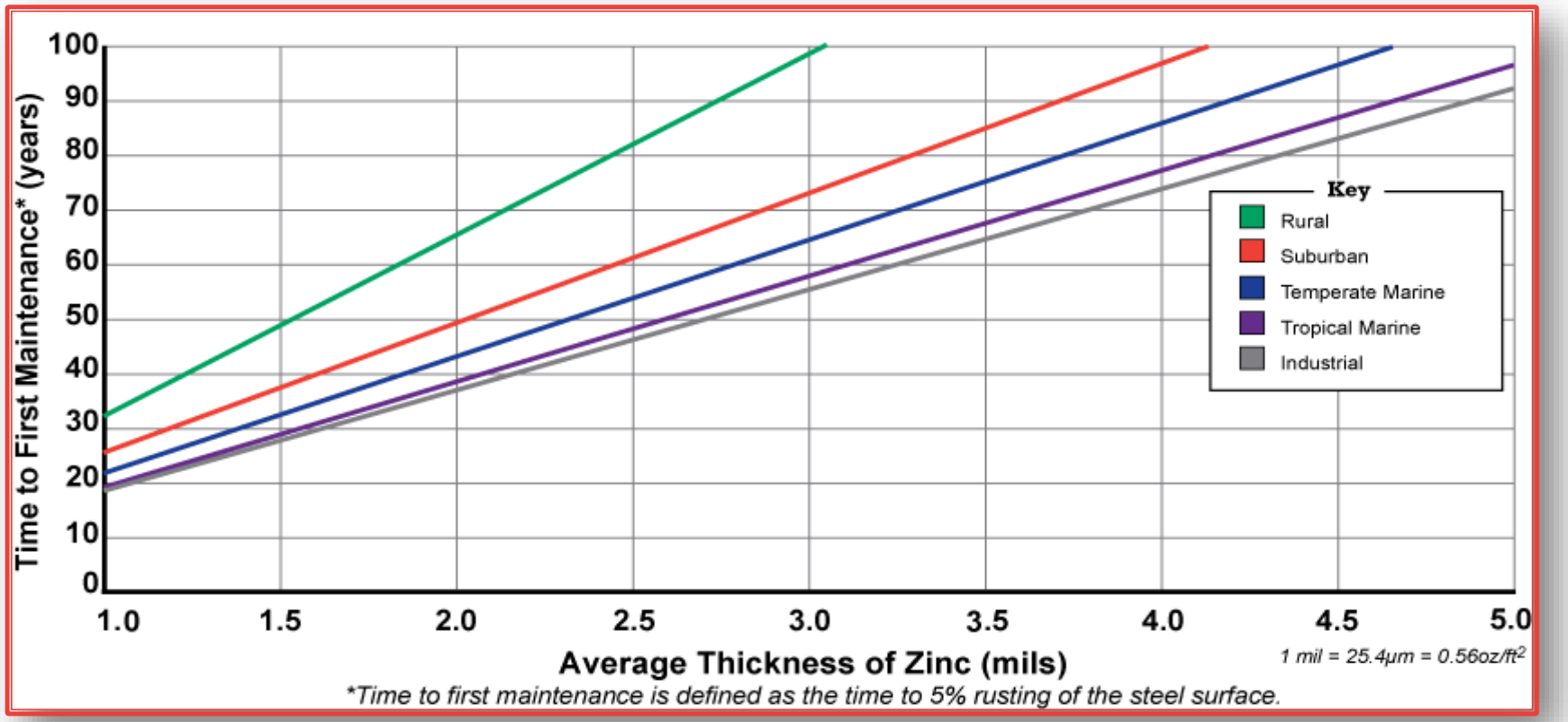
Iron (steel) 4th and Zinc 24th
most abundant elements
in the Earth's crust

Naturally found in air, water, and soil
5.8 million tons of zinc are cycled
through the environment annually

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%

Longevity in Atmosphere: Time to First Maintenance



- Zinc Coating Life Predictor (ZCLP)
  - Real World Data

https://zclp.galvanizeit.org

HDG Environmental Impact

Health Product Declaration (HPD) & Environmental Product Declaration (EPD)

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Health Product Declaration (HPD)

- Material ingredients list, similar to Safety Data Sheet (SDS)
  - Chemical inventory to 0.1% (1000 ppm)
  - Specific to each manufacturer, but for HDG, zinc is the key
- AGA has HPD available on HPDcollaborative.com based on zinc types
  - High grade/Special high grade
    - > 99% Zn
  - Prime Western
    - > 98% Zn
    - Rarely used if at all

Environmental Product Declaration (EPD)

- Cradle-to-Gate study
  - Production Stage (A1-A3)
    - A1 Raw Materials Production (steel/fabrication/zinc)
    - A2 Inbound Transportation
    - A3 Manufacturing (galvanizing)
- Sphera, Inc.; verified by UL Environment
  - LCA to ISO 14040/14044
  - EPD to ISO 14025
- PCR: *North American Designated Steel Construction Products*
- https://galvanizeit.org/epd

ENVIRONMENTAL PRODUCT DECLARATION

HOT-DIP GALVANIZED STEEL AFTER FABRICATION

GALVANIZED HOT-ROLLED SECTIONS, PLATE, AND HOLLOW STRUCTURAL SECTIONS
AMERICAN GALVANIZERS ASSOCIATION

The San Diego Central Library façade and dome utilizes hot-dip galvanized hot-rolled sections, plate, and hollow structural steel sections.

Use of this EPD is limited to North American AGA members. Member names are available at galvanizeit.org/galvanizers/.

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Protecting Steel for a Sustainable Future

Hot-dip galvanizing is a proven steel corrosion protection system that transcends time with little economic or environmental impact. From artful sculptures and building facades to utilitarian bridges, utility poles, and other infrastructure, hot-dip galvanized steel is an important part of everyday life.

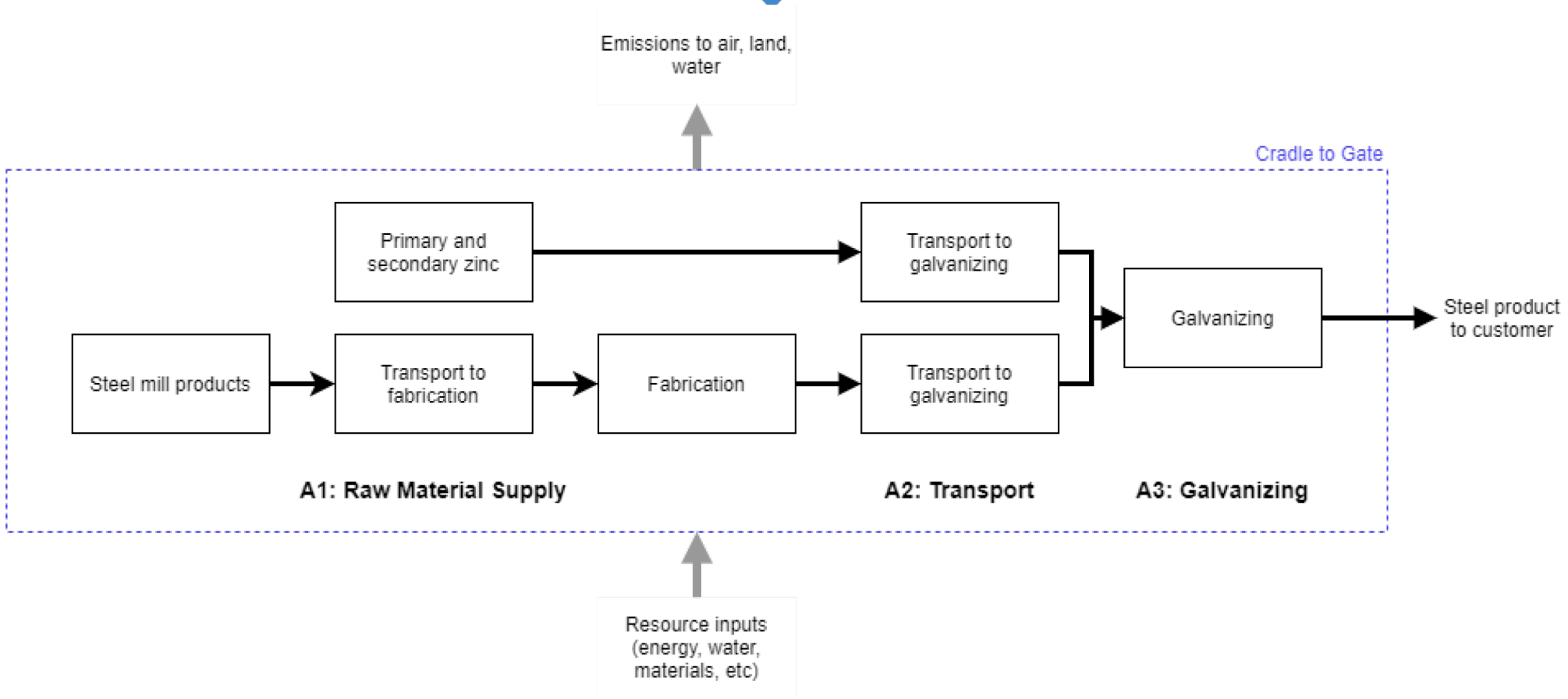
Not only does hot-dip galvanizing provide decades of maintenance-free longevity, its primary components, zinc and steel, are both 100% recyclable, making hot-dip galvanizing an infinitely renewable building material.

Sustainability and corrosion protection are intrinsic whenever hot-dip galvanized steel (HDG) is used. Lower maintenance of installed HDG steel ensures less natural resources are consumed, less emissions are released, and less money is spent over the life of a project.

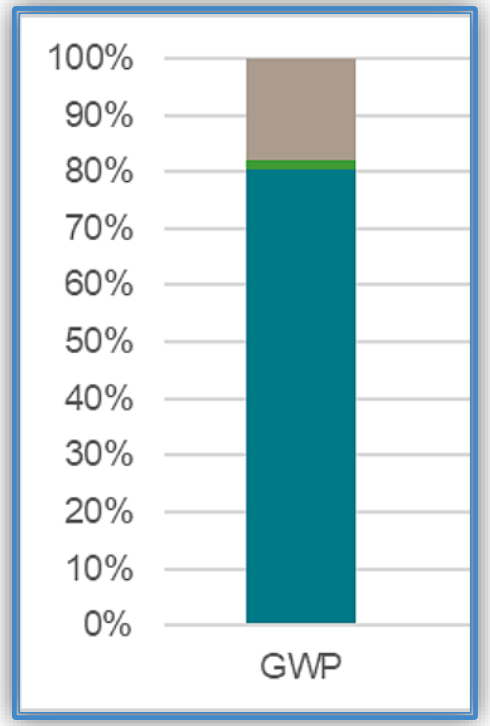
The American Galvanizers Association (AGA) is a not-for-profit trade association serving the after fabrication (batch) hot-dip galvanizing industry in North America.

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

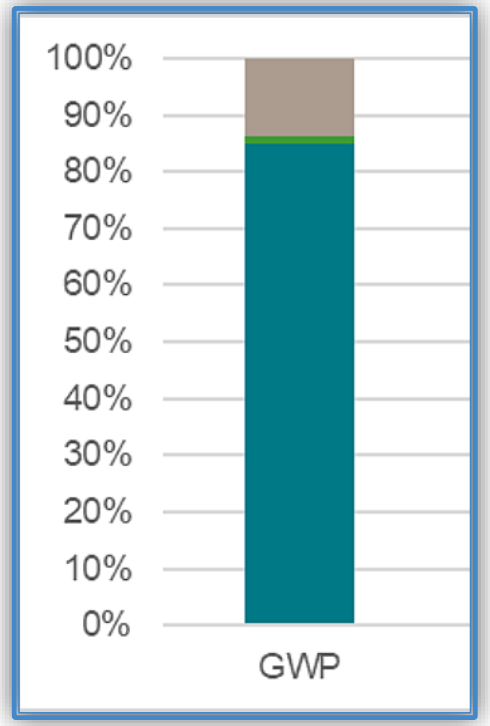
Cradle-To-Gate Analysis



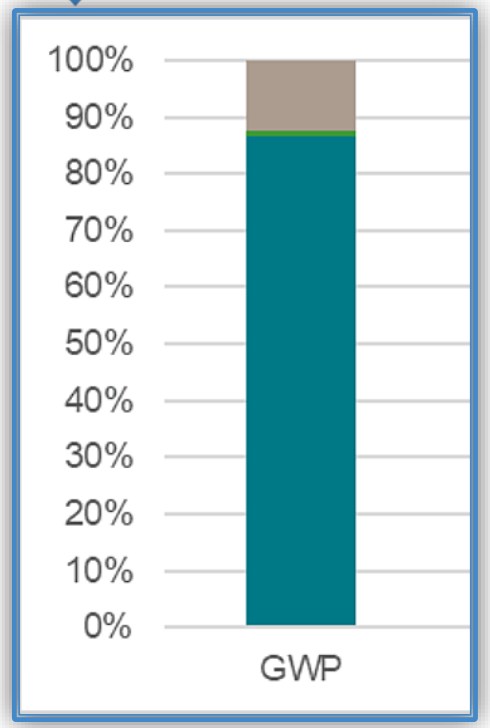
Impact of HDG on Global Warming Potential



Structural Steel



Plate



HSS

- HDG Accounts for…
  - 17% - Structural Steel
  - 14% - Plate
  - 12% - HSS

- A1 - Raw Materials
- A2 - Transportation
- A3 - Galvanizing

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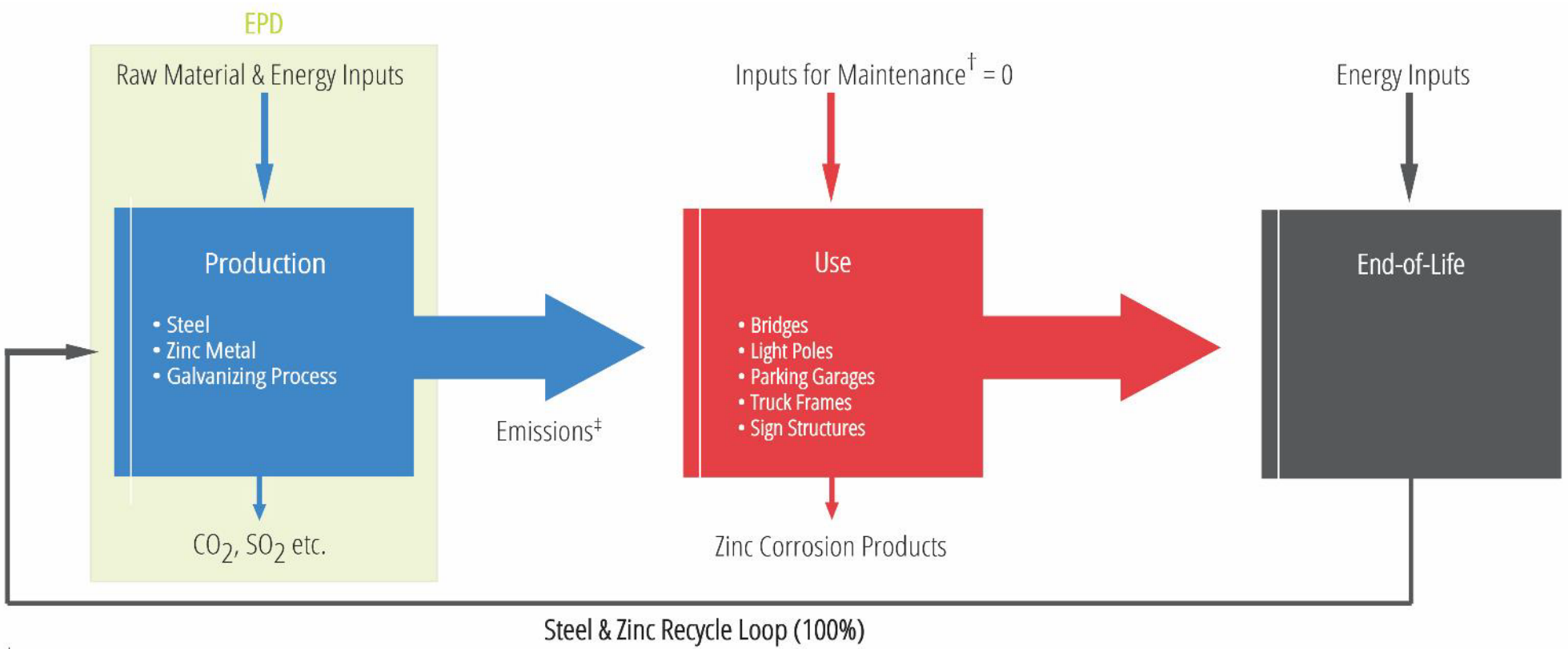
Life-Cycle Assessment (LCA) of HDG



† For all but the most aggressive environmental conditions, there are no energy/raw material inputs during use (75+ years).

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

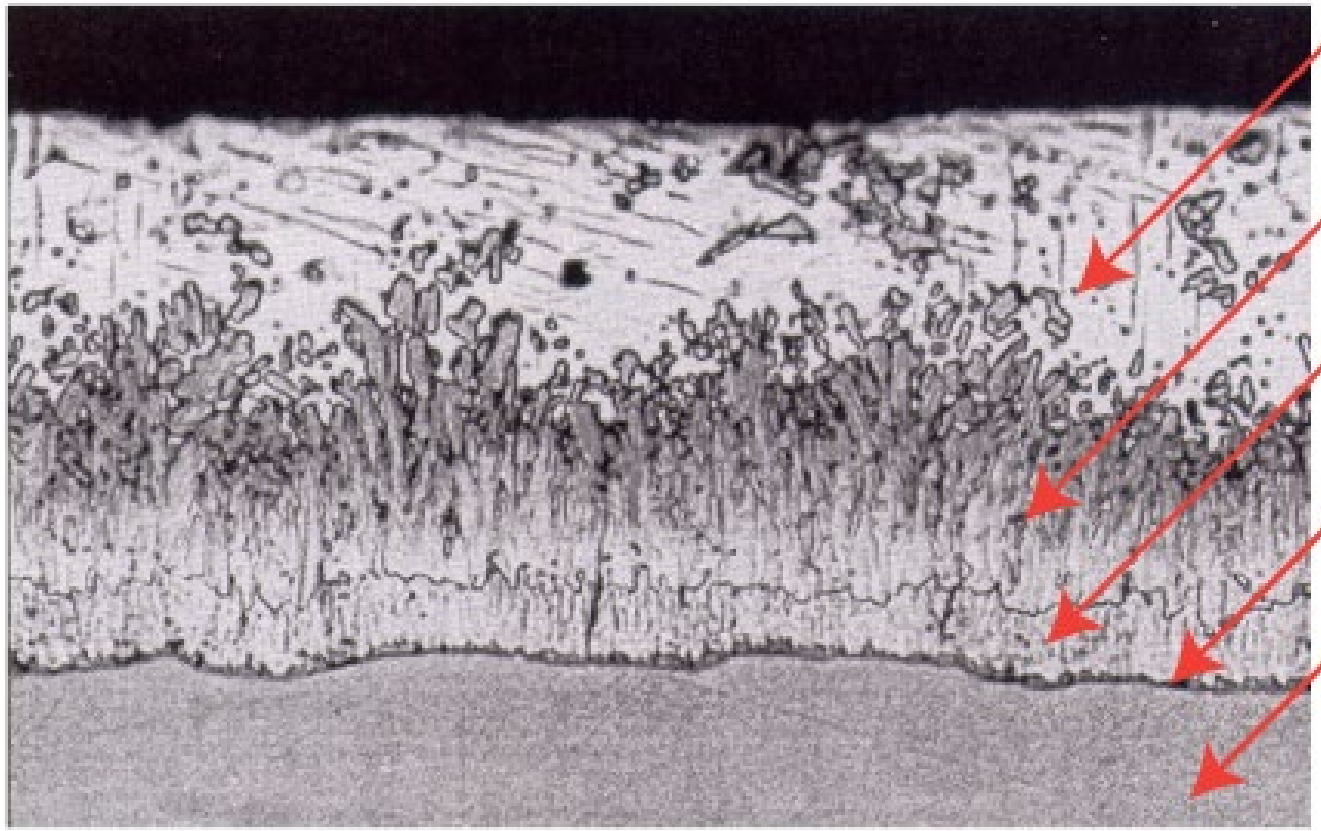
Reuse of Galvanized Steel

- 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

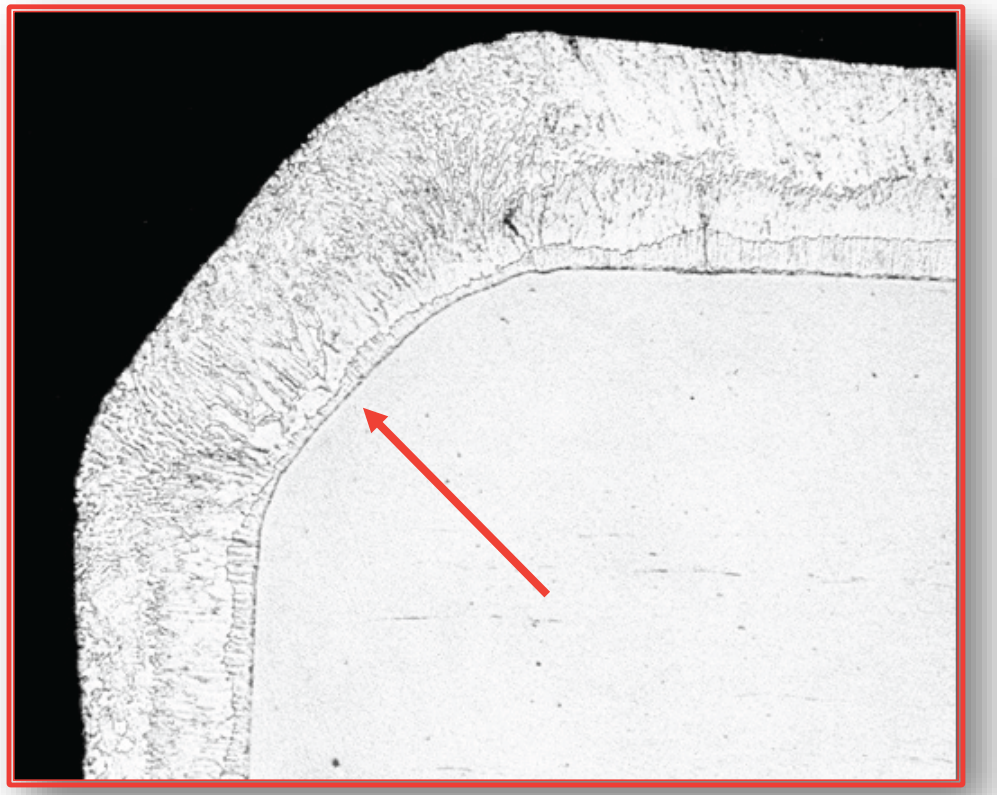
Delta
(90% Zn 10% Fe)
244 DPN Hardness

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

Base Steel
(100% Fe)
159 DPN Hardness

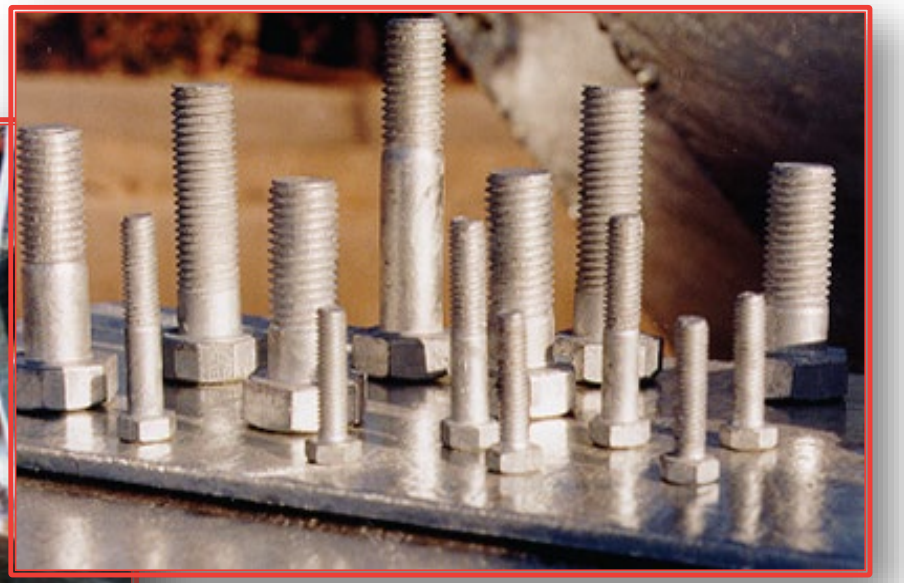
- Bond strength: 3,600 psi
  - Metallurgical bond
- Intermetallic (Zn-Fe) layers
  - Harder than base steel

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

Case Study Parameters

- Typical mix of size/shapes
  - 200 ton project
  - 70 year design life
  - Moderately industrial environment (C3)
- Surface Preparation/Application
  - SP-10 automated (duplex to SP-16)
  - All coats applied in the shop

LCCC: Inputs

PROJECT SIZE

Enter amount of steel to be coated.

ft² tons

EXPECTED LIFE-SPAN

Amount of time before this structure is no longer maintained or in use.

Years

STRUCTURE TYPE

Specify the size and/or complexity of the structure.

- Select One -

MEMBER TYPE

Select the project's structural makeup.

- **Typical mix size/shapes** 250 ft² / ton
- **Large Structural** 100 ft² / ton
- **Medium Structural** 200 ft² / ton
- **Light Structural** 400 ft² / ton
- **Light Trusses** 500 ft² / ton

SERVICE LIFE ENVIRONMENT

Select the environment that represents your project's location.

- **Rural** Mild/Low Corrosion (C2)
- **Industrial** Moderate/Medium Corrosion (C3)
- **Heavy Industrial** Severe/Very High Atmospheric Corrosion (C5-I)
- **Seacoast** Very high Atmospheric Corrosion (C5-M)

LCCC: Report

Life-Cycle Cost Calculator

System Selection > 1. Coatings > 2. Preferences > 3. Project Specs > 4. Report

Cost-Comparison Report

Review and customize before printing

Cost-Comparison Report

The cost of galvanizing vs. a paint system

Cost Comparison

HDG vs. IOZ/Epoxy/Polyurethane

	HDG	Paint System
Initial Cost Per ft²	$2.16	$4.98
Total	$108,000.00	$249,050.00
Life-Cycle Cost Per ft²	$2.16	$31.39
Total	$108,000.00	$1,569,500.00
AEAC Per ft²	$0.07	$1.08

For this project...
HDG Life-Cycle Cost Savings: 93%

DETAILED COST COMPARISON

HDG vs. IOZ/Epoxy/Polyurethane

Cost Of Galvanizing	Today's Cost	Net Future Value	Net Present Value
Original Galvanizing	$2.16	$2.16	$2.16
Total Price / ft²	**$2.16**	**$2.16**	**$2.16**

Cost Of Paint System	Today's Cost	Net Future Value	Net Present Value
Original Painting	$4.98	$4.98	$4.98
Touch-Up - Year 21	$2.49	$5.68	$3.05
Maint. Repaint - Year 31	$4.48	$15.42	$6.08
Full Repaint - Year 42	$8.47	$43.97	$12.71
Touch-Up - Year 63	$2.49	$29.47	$4.58
Total Price / ft²	**$22.91**	**$99.52**	**$31.39**

PRINT PREVIEW

CUSTOMIZE REPORT

Project Name

Subtitle

Your Company's Name

Address

City, State & Zip

Your Name

Title

Tel

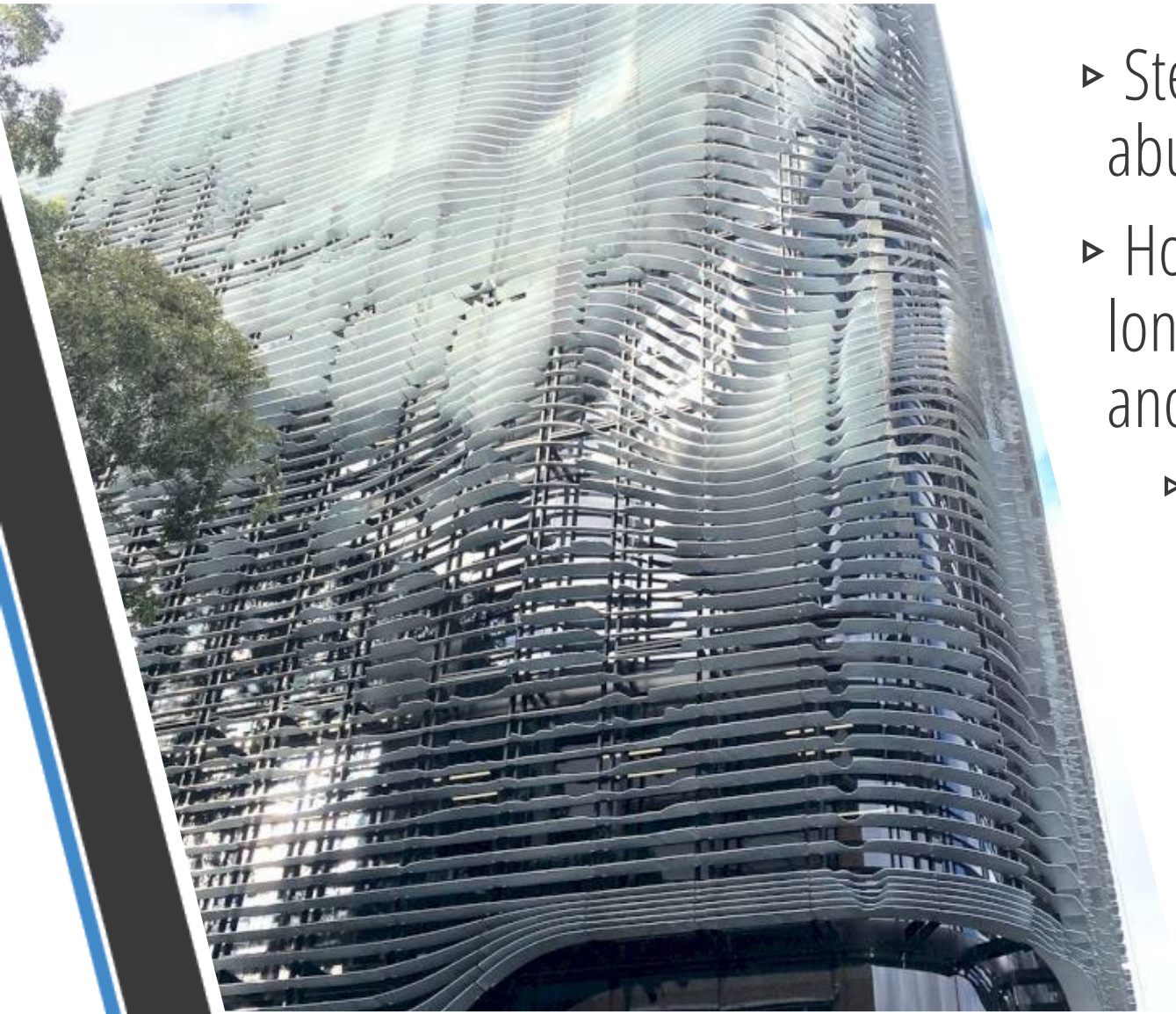
Email

Update

Initial Cost: System	$/ft^2	Total
Hot-Dip Galvanizing	$2.16	$108,000
Epoxy/Epoxy	$3.20	$159,800
Inorganic Zinc/Epoxy	$3.48	$174,150
Epoxy/Polyurethane	$3.45	$172,350
Inorganic Zinc/Epoxy/Polyurethane	$4.98	$249,050
Galvanizing/Epoxy/Polyurethane (Duplex)	$6.65	$332,600
Metallizing	$9.14	$457,050

Life-Cycle Cost (70 years): System	$/ft^2	Total	AEAC
Hot-Dip Galvanizing	$2.16	$108,000	$0.07
Epoxy/Epoxy	$32.02	$1,601,000	$1.10
Inorganic Zinc/Epoxy	$26.70	$1,335,000	$0.92
Epoxy/Polyurethane	$34.53	$1,726,500	$1.19
Inorganic Zinc/Epoxy/Polyurethane	$31.39	$1,569,500	$1.08
Galvanizing/Epoxy/Polyurethane (Duplex)	$15.66	$783,000	$0.54
Metallizing	$51.97	$2,598,500	$1.78

Sustainable Development & HDG



- Steel and Zinc are both naturally occurring, abundant, highly recyclable materials
- 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

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Questions & Comments

- American Galvanizers Association
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