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A Specialist Metals and Mining Market Strategy Advisory

Continuous Galvanised Steel Market Overview

2023 ILZSG Conference – Lisbon

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Presentation outline

- The purpose of this presentation is to review global galvanised steel market and developments across key segments to ultimately understand the implications for zinc demand
- The focus of this presentation is galvanised steel strip produced in continuous galvanising lines by producers (e.g.: ArcelorMittal, ThyssenKrupp, Tata steel etc.)
- While a broad review of global market developments will be provided, majority of the content focuses on the European market
- Key themes addressed in this presentation include
  - Demand mapping and outlining key drivers
  - Zinc coating characterisation
  - Continuous galvanising production routes and salient features

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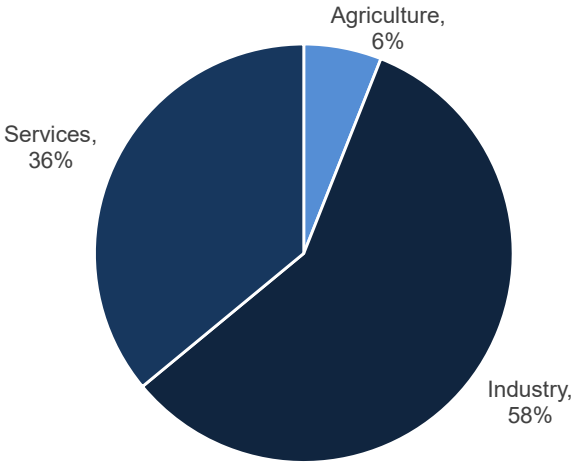
Corrosion protection is a key aspect of circular economy and galvanised steel is a vital part of this solution

- The global cost of corrosion estimated to ca US$3trillion. Industry accounts for more than 50% of the total corrosion cost
- Corrosion mitigation is one of the key elements in circular economy. The product life can be economically extended by appropriate corrosion protection coatings
- Automotive industry is a key player in supporting the circular economy objectives by ensuring and even enhancing the life of vehicles
- Galvanised steel plays a vital role in protecting and extending the life of steel products across a wide range of sectors
  - industry, agriculture, energy and construction

Global Cost of Corrosion ~US$3Trillion



Source: NACE and VTA Analysis

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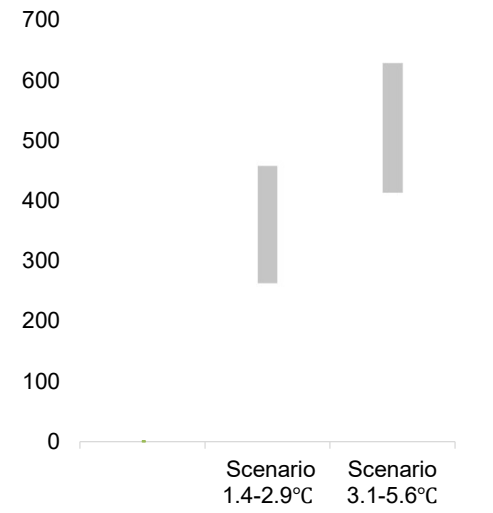
Climate change has a significant impact on corrosion causing deterioration of steel and concrete infrastructure such as bridges and highways

- A 2021-22 study in the US estimated infrastructure loss on accounts of corrosion segmented across steel and concrete bridges. The study estimates potential losses due to structural decline of steel and concrete bridges built during 2000-2020.
- The researchers analysed and presented the outcome across two climate change scenarios
  - 1.4-2.9℃ increase by 2100 relative to pre-industrial levels
  - 3.1-5.6℃ increase by 2100 relative to pre-industrial levels
- The losses could manifest in the form of damages to roads, bridges, ports and other infrastructure especially in the coastal urban areas, home to 40% of the US population
- One of the strategies to mitigate corrosion related losses is to employ galvanised steel - be it galvanised rebar, structural, plate etc. – where feasible

Range of Losses in Steel Structures by 2100, US$bn



Source: Zhang et al and VTA Analysis

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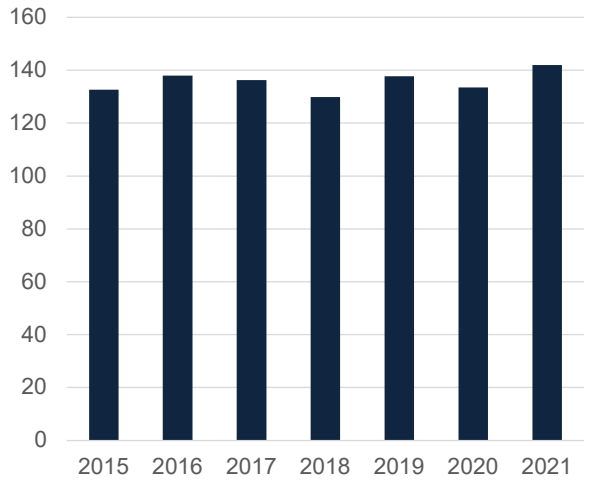
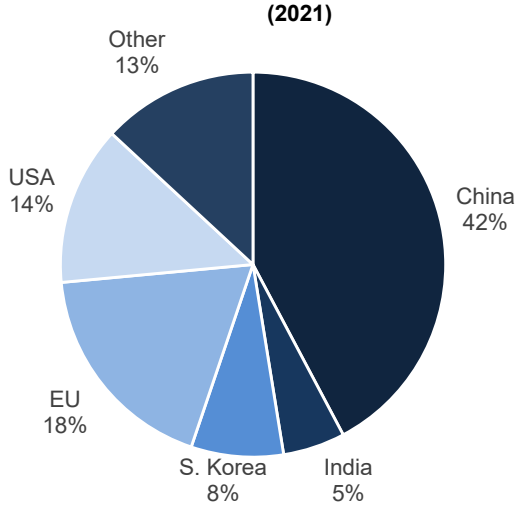
The global demand for continuous galvanised steel was ca.140mtpa in 2021. China accounted for ~40% of the supply and is also one of the major contributors to growth

World Galvanised Steel (continuous) Demand, Mt



World Galvanised Steel (continuous) Production (2021)



Source: Worldsteel, EUROFER and VTA Analysis

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The demand for galvanised steel is forecast to grow strongly in China and India driven by automotive and renewable energy sectors

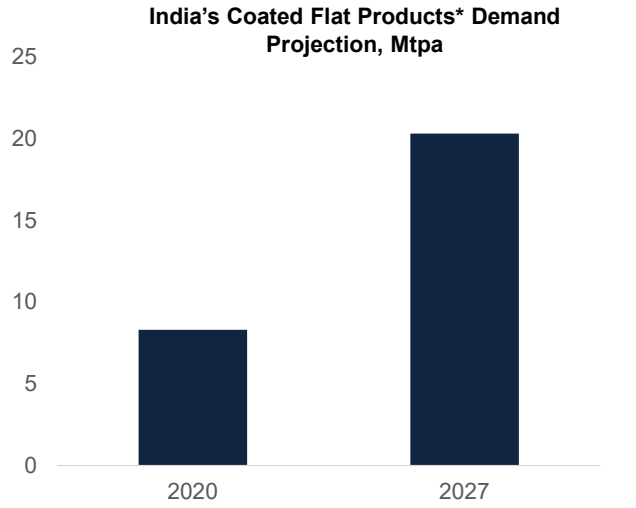
Regional Market Developments

Country/ region	Key growth trends
EU	• Challenges in the automotive sector impacting future growth potential for galvanised steel • Growth mainly driven by renewable energy, particularly solar power installations
USA	• Mature market • Growth in automotive market and greater emphasis on embedding the supply chain within the country
China	• Growth in automotive applications as the share of galvanised steel increases in Chinese automobile brands • Strong growth in renewable energy • Continued growth in construction sectors
India	• Greater use of galvanised steel in automobiles aimed at domestic markets and exports • One of the fastest growing solar power installations leading to a greater demand for galvanised steel

Source: VTA Analysis

India is set to be one of the major growth drivers for galvanised steel sheet driven by domestic market and government policy support

- India is anticipated to be one of the key growth drivers for galvanised steel in the future driven by the domestic market growth. Key growth drivers include growing automotive production, solar power investments and construction sectors
- Additionally, the government of India has drawn up policy initiatives to support growth in production of coated products through its Production Linked Incentive (PLI) programme
- The PLI scheme has a specific objective to strengthen high value specialty steel products used in automotive, construction, food and other market sectors
  - The products broadly include galvanised, colour coated, tinplate and others although galvanised products are likely to account for a significant proportion

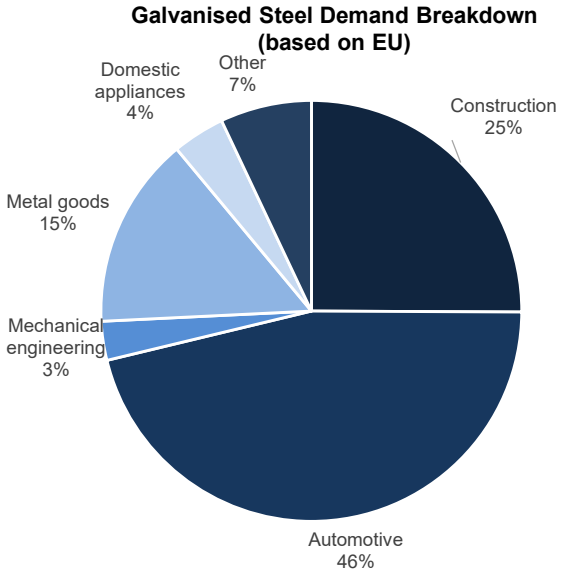


* this includes galvanised, colour coated, tinplate and other coated products

Source: JPC and VTA Analysis

While automotive and construction will remain key drivers of galvanised steel demand, solar energy is forecast to be amongst the key growth drivers

- Automotive industry accounts for 46% of the total galvanised steel consumption. Major applications include exposed panels, Body-in-white and other components
- Construction accounts for 25% of the demand and key areas of application include profiles, roofing panels, crash barriers and others
- Solar energy installations is one of the key growth areas for galvanised steel in the EU
- In addition to the above there is a significant volume of trade in galvanised components such as switch boxes, cable trays, profiles, panels and others. Thus, further adding to the overall consumption of galvanised steel products



Source: VTA Analysis

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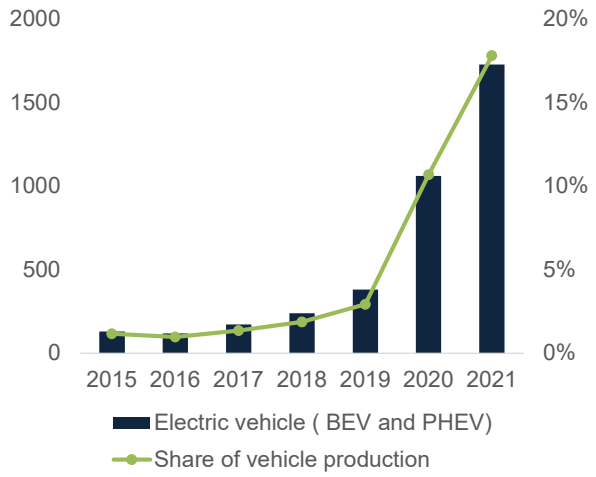
Galvanised steel continues to be a material of choice in EVs driven by favourable economics and technical viability

- The automotive sector is forecast to remain the prime driver of galvanised steel demand in the EU
- The demand for the galvanised steel is further supported by the growing production of electric vehicles
- The material of choice for vehicle manufacturing continues to be in favour of steel due to its better economics and availability of a wider range of high strength steel grades
- The cost differential between steel and lighter materials such as aluminium may be allocated towards incorporating higher energy density batteries without significantly hurting the price competitiveness of the vehicle

EU Electric Vehicle Production ('000)*



Source: ACEA and VTA Analysis

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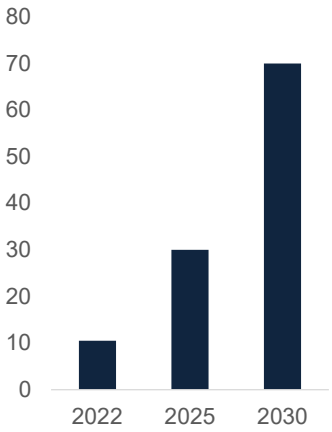
EV uptake is one of the key pillars to reach Net Zero which is driving several policy measures around the world

Policy Highlights Supporting EV Uptake

Country	2025	2030	2035
Norway			
Austria			
Ireland			
Netherlands			
UK			
Singapore			
Denmark			
Chile			
Japan			
EU			
Canada			
USA (25%)			

100% Zero Emission vehicles (including hybrid and fuel cell)
100% electrified sales
Ban on IC engines

Potential EV Sales under Net Zero Scenario (IEA), million units



Source: IEA and VTA Analysis

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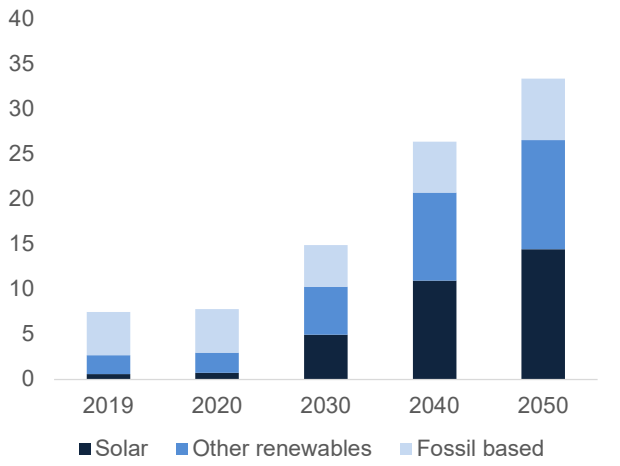
Net Zero commitments are further driving the growth in solar energy installations – supporting the demand for galvanised steel

- Solar energy installations will be one of the key growth drivers for galvanised steel in the future
  - Galvanised steel is used in the manufacture of mounting structures for solar panels.
- Under the IEA's Net Zero scenario renewables is forecast to account for more than 75% of the electricity generation capacity in the world by 2050
- Within the renewables solar energy is set to account for a significant share of the capacity. By 2050, solar power is forecast to account for ca 40% of the global electricity generation capacity
- Majority of the solar power capacity is forecast to locate in China, India and EU thus playing a key role in driving the demand for galvanised steel in these countries and elsewhere including EU

World Electricity Generation Forecast, TW (Capacity)



Source: IEA and VTA Analysis

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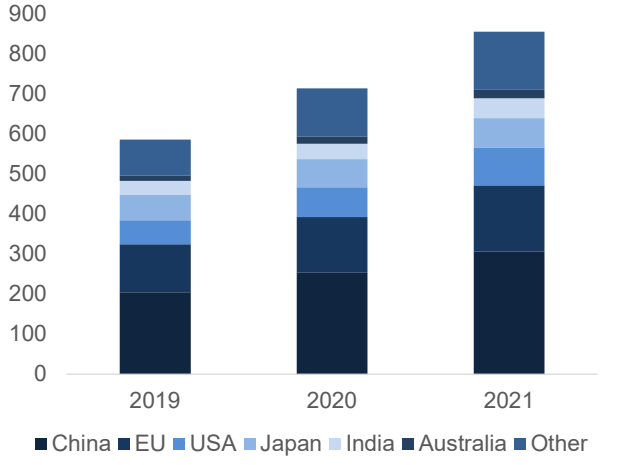
Thus far China, USA and EU account for 66% of the world's solar power capacity

- Global solar power generation capacity has grown by 46% between 2019-21 with China and EU being one of the key growth drivers
- China accounted for 35% of the world's solar power generation capacity following by EU at 19% in 2021
- Other significant players include USA, Japan and India with India growing at a very strong pace
- The urgency of NZE will continue to drive the growth in renewables and particularly solar. The global solar power capacity is forecast to grow more than 10-fold over the next 25 years or so
- Such strong growth rates are forecast to have a positive impact on the demand for galvanised steel and hence zinc metal

World Solar Power Generation Capacity, GW



Source: IEA and VTA Analysis

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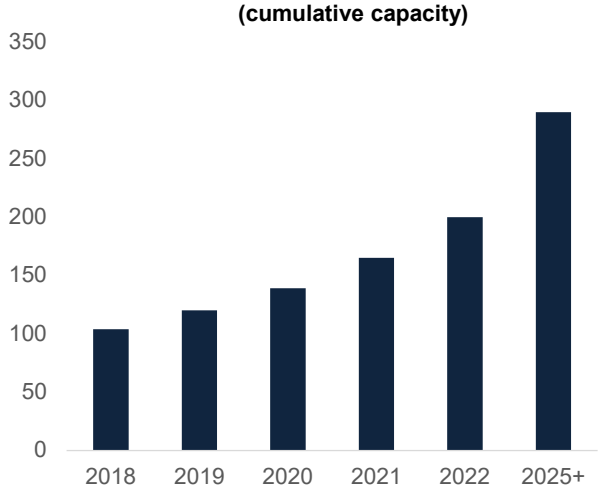
Solar power investments are also being enabled by regional policy support including easing of permitting and strengthening supply chain

- Solar energy installations will be one of the key growth drivers for galvanised steel in the EU in the future
  - Galvanised steel is used in the manufacture of mounting structures for solar panels.
- Renewable energy production is a cornerstone of EU's energy strategy and has been raising its targets upwards over the recent years
  - In 2023, it has set a provisional target of reaching 42.5% by 2030
- Key enablers for renewable energy growth include:
  - Reducing import dependency of solar panels
  - Strengthening panel manufacturing capability within the EU
  - Simplification of permitting processes

EU Solar Power Installation, GW (cumulative capacity)



Source: IRENA and VTA Analysis

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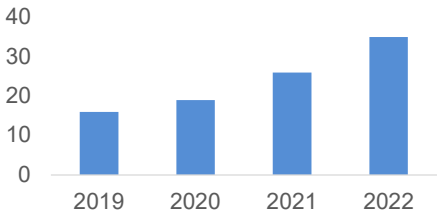
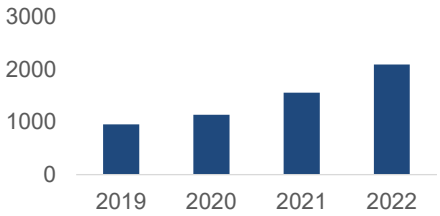
Solar power installations have a significant impact on steel demand and in particular galvanised steel

- The recent energy crisis has accelerated the installation of solar power plants. EU is forecast to add 25 to 40GW every year over the immediate future and the growth is expected to continue over the medium and long term
- With utility scale installations being a key aspect of the energy investments, the demand for galvanised steel (mounting structures) is forecast to grow strongly in the near future
- In addition, solar energy plays an important part in steel decarbonisation
  - E.g.: Partnership between steel companies such as ArcelorMittal and energy companies in solar power projects

EU Solar Power Annual Installation, GW



Estimated Steel Demand in EU Solar Power, '000 tpa



Source: IRENA and VTA Analysis

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The demand growth in solar energy also presents challenges in the form of soil corrosion, longevity of mounting structures and others

Material Challenges Associated with Galvanised Steel for Solar Power

Item	Attribute
Material challenges	• Durability and longevity of the structures • High strength to weight ratio to support the heavy panels while ensuring optimum material footprint • Corrosion resistance to environments operating in extreme weather conditions • Resistance to chemical attacks associated with soil where the panels frames are installed
Coping strategies	• Increase in Zn coating thickness • Targeted use of Zn-alloy coating to enable better performance without impairing material footprint

Source: Companies and VTA Analysis

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Each of the sectors value certain product attributes more than others depending on specific applications

Coating Attributes Valued Across Sectors

Sector	Applications	Corrosion resistance	Surface quality	Weldability	Paintability
Automotive	BIW applications, exposed panels, exhaust systems etc.	++	+++	++	+++
Domestic appliances	Refrigerators, ovens etc.	++	+++	+	+++
Construction	Roofing, cladding, purlins etc.	+++	+++	+	+++
Industrial	Equipment, Cabinets and panels, industrial ovens, heat shields etc.	++	+	+	+
Renewable energy - solar	Solar panel mounting	+++	+	+	+

Note: The mapping of coatings and their respective application sectors are only indicative and are not exhaustive and exclusive

Source: Companies and VTA Analysis

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Each of the coatings and their respective alloy signature impart specific functional properties

Zinc Coating Type and Functionality

Coating	Coating alloy mix	Corrosion protection	Surface quality	Weldability	Formability	Paintability
Galvanised (Z)	Zn	✓	✓	✓	✓	-
Galvannealed (ZF)	Zn + Fe	✓	-	✓	-	-
Galfan (ZA)	Zn + Al	✓	-	-	✓	✓
Zn-Mg	Zn+Mg+Al	✓	✓	-	✓	✓

Note: The mapping of coatings and their respective functionalities are only indicative and are not exhaustive and exclusive

Source: Companies and VTA Analysis

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This results in the development and greater use of functional coatings designed to address specific product application issues as they arise

Zinc Coatings by Sector

Sector	Coatings			
	Galvanised (Z)	Galvannealed (ZF)	Galfan (ZA)	Zn-Mg-Al
Automotive	✓	✓	✓	-
Domestic appliances	✓	-	-	-
Construction	✓	-	-	✓
Industrial	✓	-	✓	-
Renewable energy - solar	✓	-	-	✓

Note: The mapping of coatings and their respective application sectors are only indicative and are not exhaustive and exclusive

Source: Companies and VTA Analysis

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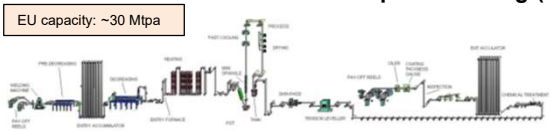
The production facilities must be geared to produce the appropriate galvanising coatings and be techno-economically feasible

Hot Dip Galvanising (HDG)

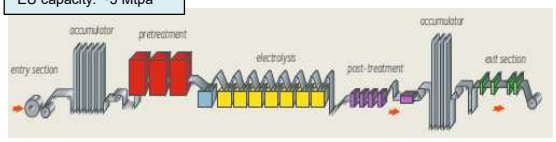
EU capacity: ~30 Mtpa



- Established technology
- High productivity
- Wider variety of coating alloys
- Enables thicker coatings
- Limitations with ultra high strength steels

Electrogalvanising (EZ)

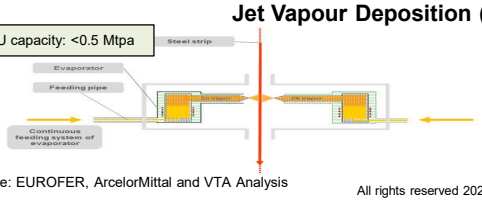
EU capacity: ~5 Mtpa



- Established technology
- Excellent surface quality
- Mainly pure zinc coating
- Compatible to coat ultra high strength steels

Jet Vapour Deposition (JVD)

EU capacity: <0.5 Mtpa



- New technology – commercialised in 2016/2017
- Better performance in coating high and ultra high strength steels with no hydrogen pick-up
- Mainly pure zinc coating
- Lower specific zinc consumption

Source: EUROFER, ArcelorMittal and VTA Analysis

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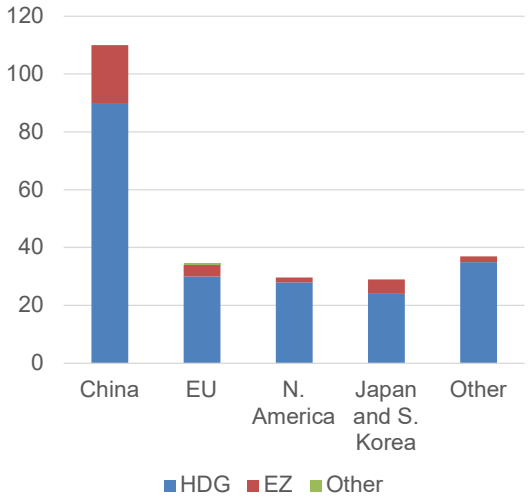
Globally, hot dip galvanising (HDG) is the most widely used process owing to its versatility and high productivity

- The global continuous galvanised steel capacity is estimated to be 240mtpa
  - HDG accounts for 86% of the total galvanizing capacity and electrogalvanising (EZ) accounts for the rest.
  - The newly emerging JVD accounts for less than 0.5mtpa
- China accounts for 32% of the global galvanising steel capacity. There has been a strong growth in the demand and production of galvanised steel driven by greater use of galvanised steel in Chinese automotive brands
- New galvanising lines are being installed in North America ensuring greater self-sufficiency and better equip to meet the growing demand from automotive sector
- Other significant growth region being India, where there is a strong potential to increase the share of galvanised steel in automotive and other sectors

World Continuous Galvanising Production Capacity, Mtpa



Source: Galvinfo, Galvatech 2021 proceedings, Companies and VTA Analysis

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The decarbonisation of steel industry, particularly in the EU, will have a significant impact on the value chain including galvanised steel

- Steel decarbonisation is the overarching theme governing various aspects of the supply chain and process elements including galvanising
- Key elements include
  - Focusing on energy and resource efficiency
  - Assessment of coating materials and their respective carbon emissions and opting for sources with lower carbon footprint
  - Migrating from gas based heating to electricity based heating in downstream processes such as rolling and coating, where relevant and feasible
  - Coating innovations to meet the required performance using less of the material (coating alloys such as Zn-Mg-Al)
  - Overall product (HDG/ EZ etc.) carbon footprint assessment – green labelling – for enhanced credentials with the customer
- EU is at the forefront of this transition through policy initiatives such as Carbon Border Adjustment Mechanism (CBAM) that potentially enables the transition
- As a result, suppliers exporting into the EU market too may have to follow the requirements or risk additional costs

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The continuous galvanising sector will continue to be a significant consumer of zinc as corrosion protection, coating flexibility and better techno-economics contribute towards product versatility

- Zinc coatings will remain the main choice for corrosion protection of steel products due to its versatility, techno-economics and ease of application
- With the ever increasing demands on performance in particularly challenging environments, zinc coatings are evolving towards zinc based alloys through small additions of Al and Mg
- Such Zinc alloy coatings are particularly valuable in solar projects and other such areas where the elements are prone to heavy corrosion over long periods of time
- Zinc coating is a cost effective proposition for the automotive industry in ensuring the desired life span for a typical automobile. The transition from IC engine to EV will likely make zinc an even more critical player as galvanised steel with a wide range of high strength variants offers the automotive companies with immense design flexibility
- Similarly, zinc coating enables better project feasibility for large industrial projects such as utility scale solar power projects by spreading the payback over longer periods of time

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Contact Details

Thanks again to the organisers of this conference for providing an opportunity to share my thoughts. Any questions / comments please feel free to reach out at the address below.

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