Megatrends and their influence on the global steel industry

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World Steel Association

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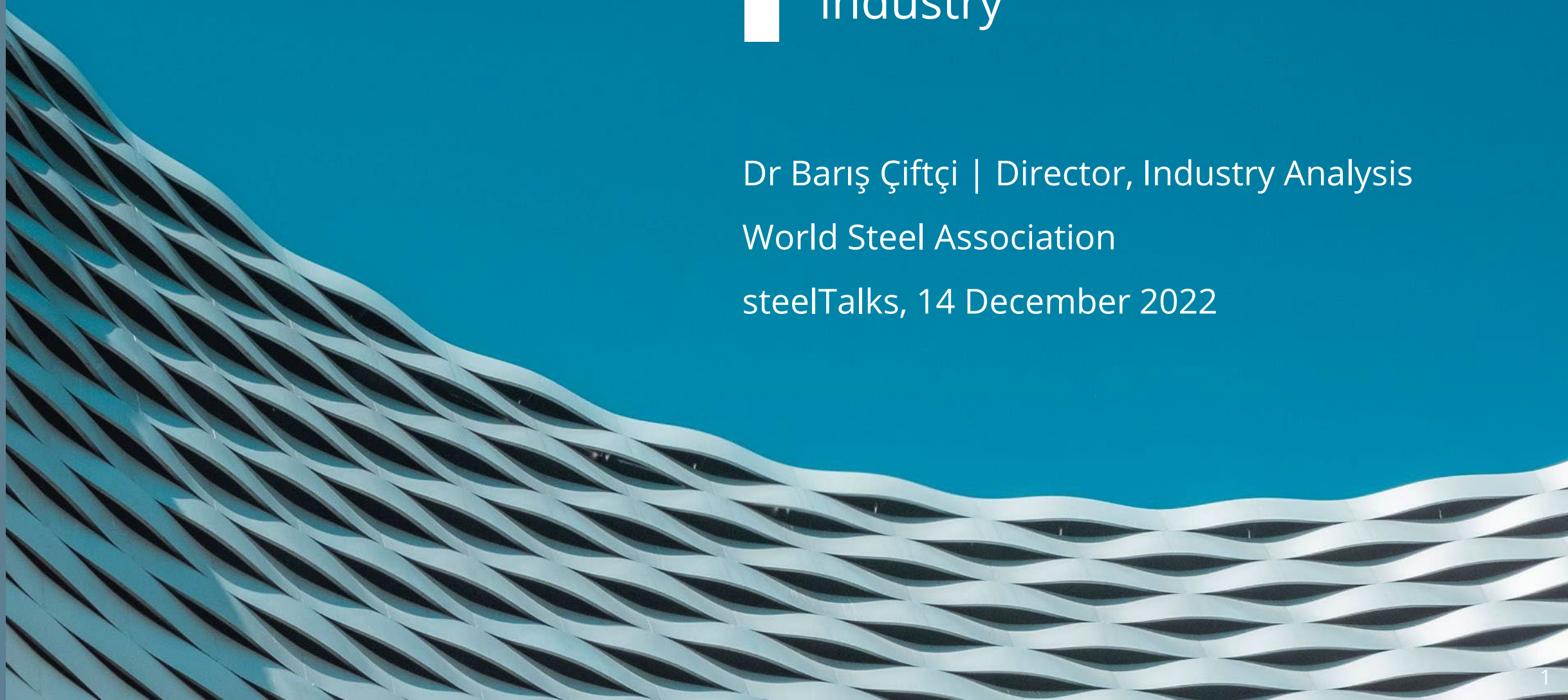

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worldsteel's Megatrends Evaluation Project

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Megatrends Evaluation – a study by the members for the members

An 18-month study on megatrends and the resultant industry-specific consequences

Vision and strategies for sustainable growth of the global steel industry from a long-term perspective

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GERDAU

posco

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Overview of Megatrends and their influence on global socioeconomic and geopolitical landscape

Categorising megatrends

Common characteristics:

- Sustained/long-term
- Broad scope/reach
- Major impact

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Categorising megatrends

Source: Adapted from Blackrock, 2019, "Megatrends: the forces shaping our future", report accessed here on 18 June 2020.

Broad outlines of a possible new vision emerging: **Sustainable & Resilient**

Environment

- Decarbonisation
- Climate change adaptation
- Restoring biodiversity loss, cutting pollution, water scarcity, reducing materials intensity

Social

- Mitigate (income) inequality
- A new consensus addressing political divide
- Education & training
- Social transfer programmes

Economical

- Rebuild infrastructure
- Maintain / enhance competitiveness
- Leading the new tech & economy
- Create jobs in high-value-adding and tradable sectors
- Focus on green tech, strategic sectors and commodities

Major economies announcing new policy frameworks aiming to govern the rapid transformation towards green & smart era while fixing the imbalances brought about by hyper-globalization era

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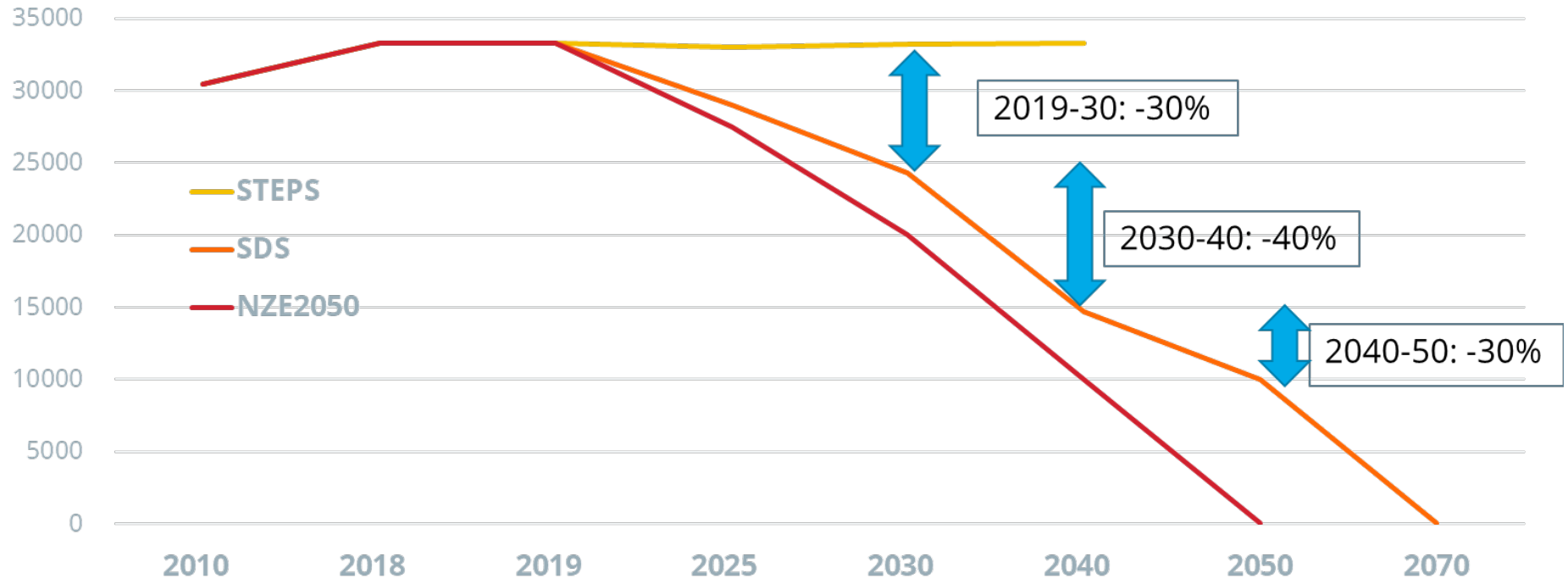
Humanity's 21st century decarbonisation challenge requiring a rapid transformation to green and smart

Energy-related CO2 emissions in IEA's STEP, SDS and NZE2050 scenarios

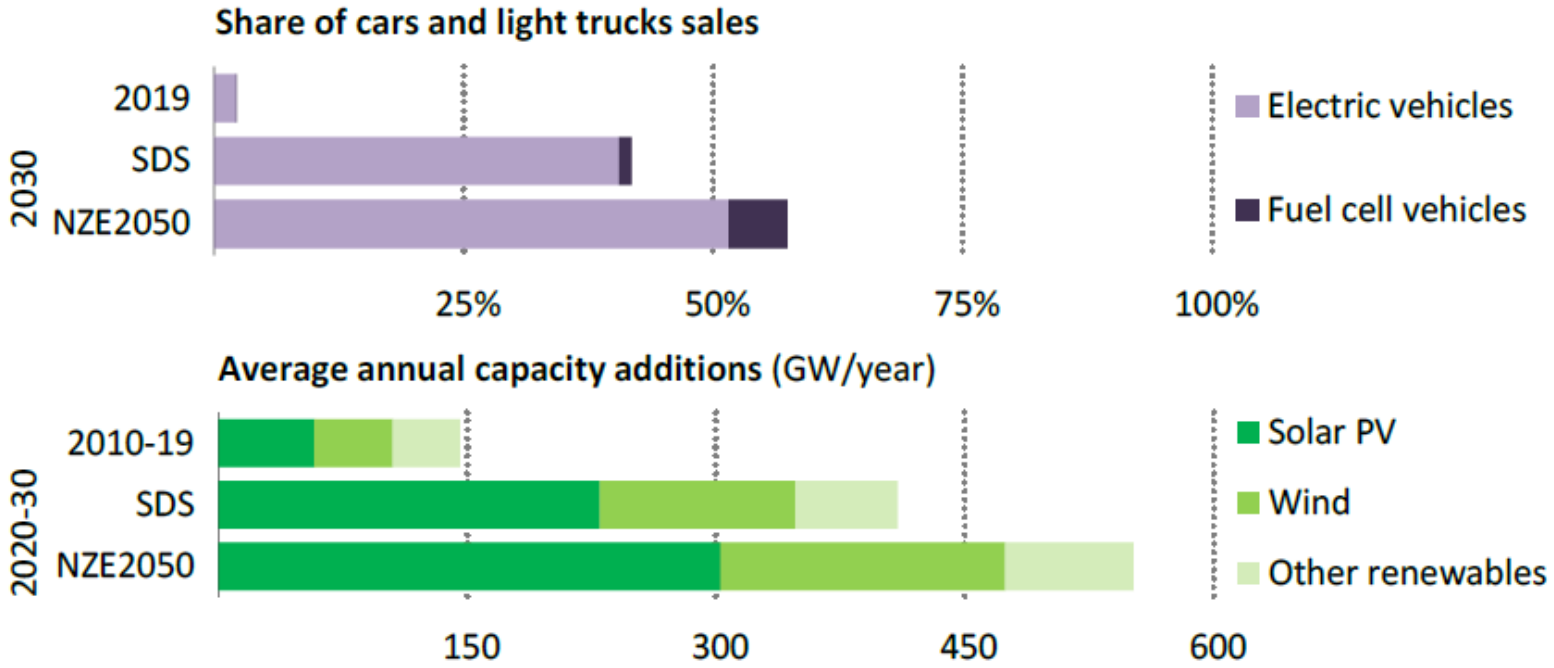


Source: IEA World Energy Outlook 2020

IEA's SDS trajectory for CO2 emissions, which is inline with Paris Agreement objective of "well below 2 °C warming" requires that CO2 emissions drop 30% in 2020s, 40% in 2040s and 30% in 2050s

Humanity's 21st century decarbonisation challenge

Evolution of selected technologies in the Sustainable Development Scenario and Net Zero Emissions by 2050

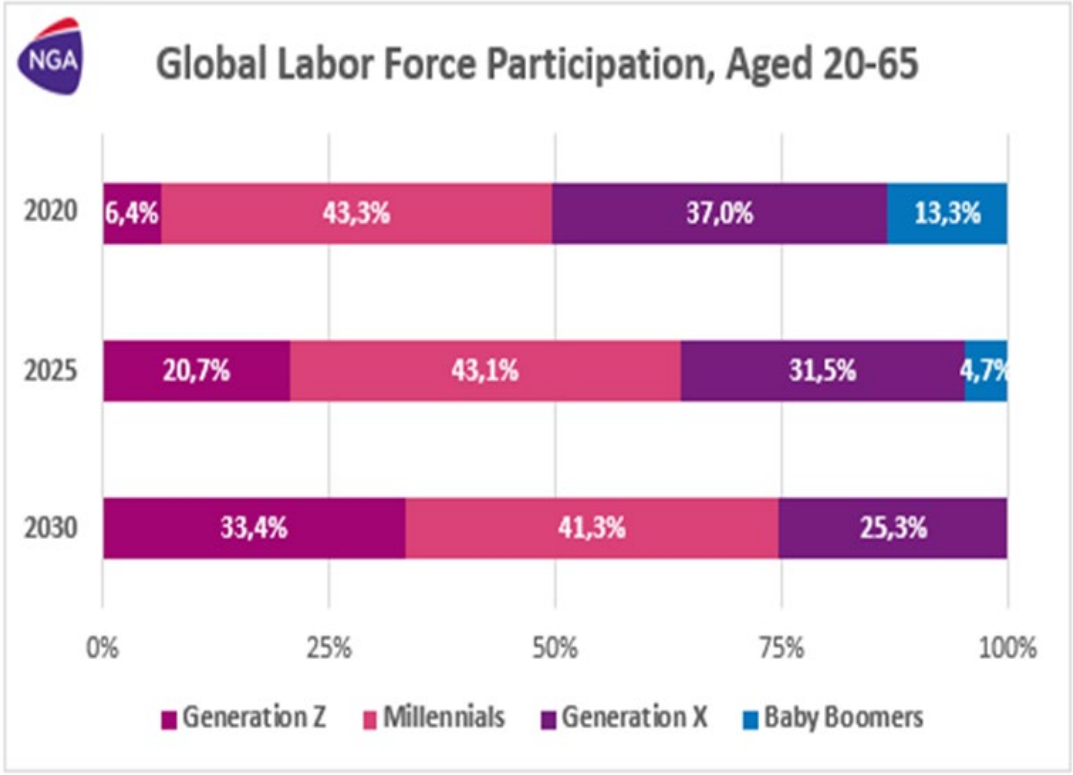


Source: IEA World Energy Outlook 2020

"The SDS maps out an energy transformation of huge magnitude and scope; the changes required in the NZE2050, inside and outside the energy sector, go well beyond this."

Changes in individual preferences and social norms to accelerate

- Generation Z entering their 20s in 2020s and playing an increasingly bigger role in society
- Expect accelerating changes in individual preferences and social norms towards “responsible” (e.g. secular shift in buying preference for EVs)
- Continued growth in pressure for sustainability & resilience (preparedness against safety risks)



By 2030: secular shifts in preferences & norms towards responsible alternatives, immense pressure for sustainability

Source: https://www.pewresearch.org/topic/generations-age/ via Lettink, A., 2019, “No, Millennials will NOT be 75% of the Workforce in 2025 (or ever)!

Multi-polar geopolitical order
From globalisation to regionalisation

A continued gradual retreat from globalisation with strengthening nationalistic forces, protectionist policies & pressure for back/near-shoring

Regionalisation / bifurcation on ease of aligning interests and establishing standards with key allies or regional partners and security concerns

By 2030 “One world two systems” paradigm applying at varying degrees for many sectors, esp. strategic sectors & materials

Trade barriers likely to be relatively high

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Conclusions for the megatrends and their influence on global socioeconomic and geopolitical landscape

Green transition and technological progress - main transformative forces of the 21st century

The transformation is likely to accelerate going forward – rising volatility, uncertainty and complexity

Achieving long-term sustainability, while ensuring resilience to volatility, uncertainty, climate change during the transition

The return of big governments

Major focus on decarbonisation, enabling infrastructure, strategic sectors

A continued gradual retreat from globalisation & rising importance of regional blocs

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Future of urban areas and the construction sector

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Urban areas at the center of global transformation

Cities represent

- ~55% of global population
- ~80% of global GDP
- ~75% of GHG emissions & energy consumption

Many major cities have ambitious climate action plans: sustainable & climate resilient

Urban population to continue to grow

Cities & urban resource use to grow

Digital age, smart city tech & transformation of urban mobility

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Densification through transit-oriented development

Build extensive public transportation networks & densify around transit hubs

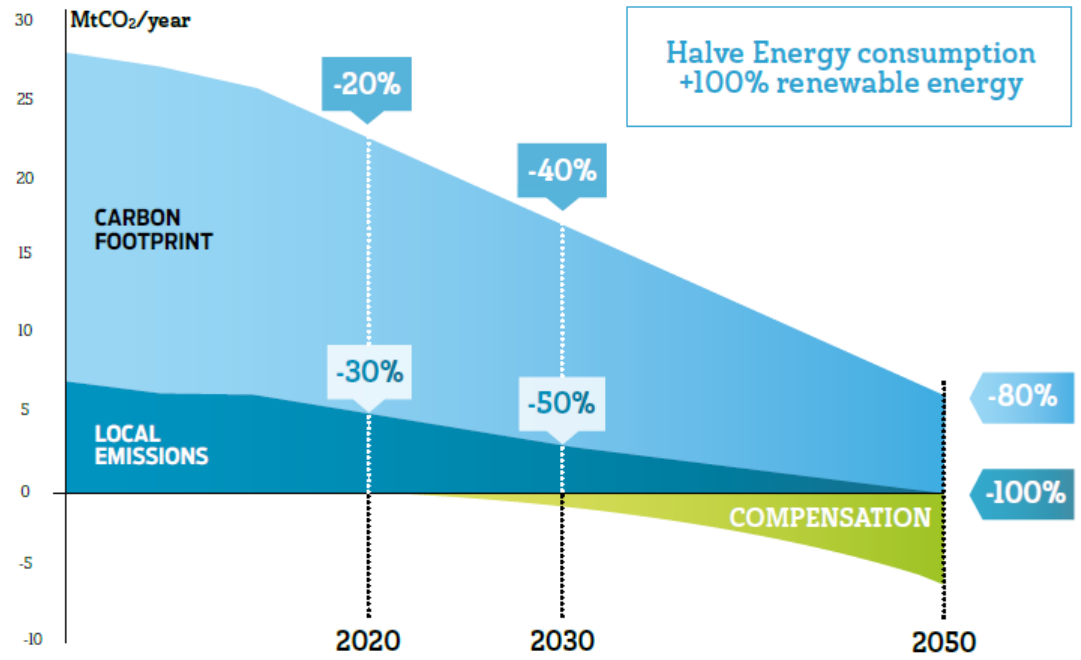
Paris' Grand Paris Express project aiming to transform the city's mobility infrastructure through establishing new neighborhoods within 800m radius of each new station

Higher Buildings: Paris' Clichy-Batignolles development allowed 50 m height for buildings (37 m height limit for Paris)

Transform energy system

From fossil-based to green, reduce energy demand, modernise and integrate

Paris' carbon neutrality plan targets halving energy consumption and 100% renewables by 2050



Source: Paris Climate Action Plan

- Reduce energy demand
  - Renovation of building stock & strict energy requirements for new buildings
  - Active, shared, electric mobility
- Renewable energy in buildings
- Renewable energy from wind/solar projects, but also large bioenergy and waste-to-energy plants
- Modernisation and integration of energy systems

Rapid advances in adoption of circular economy

Source: WEF White Paper, 2021, "Circular Economy in Cities"

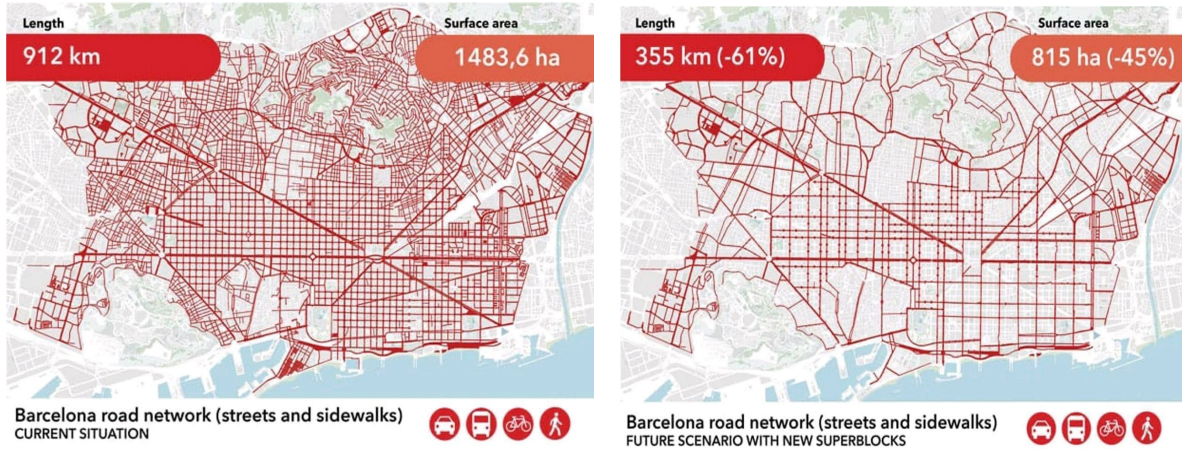
Governments exploring circularity strategies. Materials flows for cities are being mapped out. Some cities have announced ambitious materials use reduction targets (e.g., Amsterdam to halve the use of new raw materials by 2030)

Transform mobility

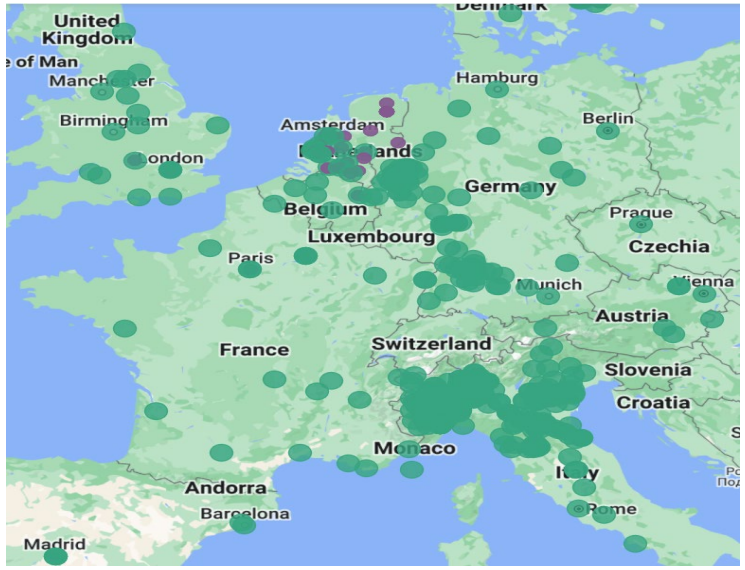
Regulate and reduce car traffic, encourage public transportation & active mobility

- Traffic and car use heavily regulated, limiting road space for driving and parking, increasing car ownership costs, establishing low speed/emissions zones & car bans
- Encourage active mobility, developing cycle/walking paths, and shared bicycle programmes
- Encourage distance working

Barcelona's superblocks reclaiming streets



Map of low/zero emissions areas in Europe



Source: Barcelona Urban Mobility Plan. The why and how is explained in this new documentary by @DeutscheWelle: https://youtu.be/RYuGWOjm26E. Right hand side chart from urbanaccessregulations.eu

Transform mobility

Encourage shared, seamless multi-modal mobility

- From ownership to shared on-demand mobility, subscription services and platforms integrating multiple payment and ticketing processes
- Adoption of automated vehicles and MaaS concepts bring new opportunities for efficiency gains & densification, such as repurposing of parking lots & garages

Key figures from Bremen's car sharing action plan that started in 2009

- 21,000+ active car sharing users (2022)
- 6,000 cars replaced - equivalent to 30 km of street space
- 400+ cars available for sharing in 135+ stations
- ~ 1/3 of car sharing users not using private car

Picture showing parking areas in a commercial district (in red)

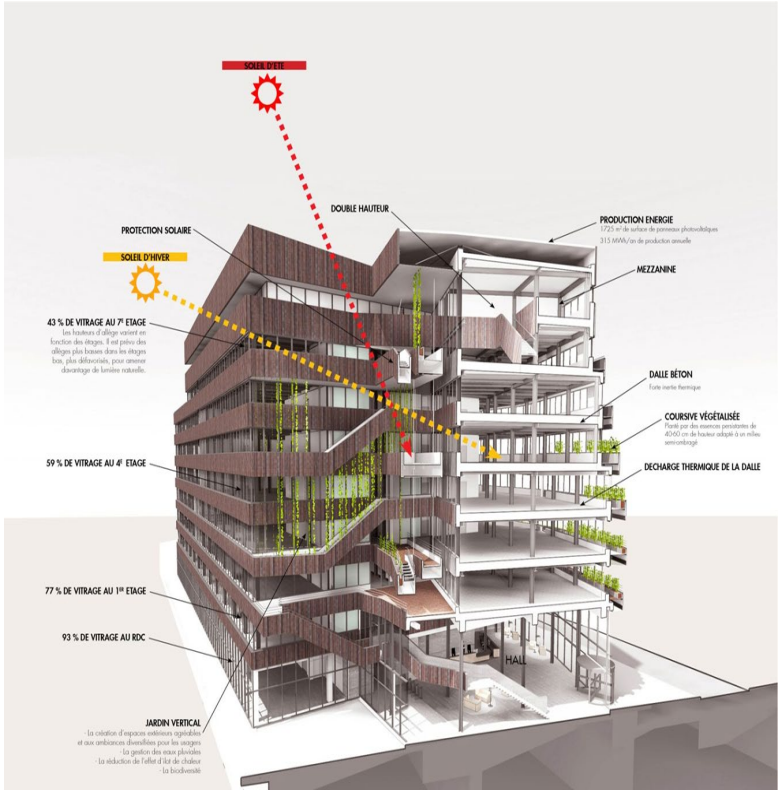
Source: Report from eumayors.eu dated June 2022 link

Buildings of future – Higher and high performance

70m-high social housing with vertical forest (125 trees and 5200 plants grown by sensors)

Futuristic skyscrapper design with solar walls, bladeless wind turbines and sky gardens

Bioclimatic design based on local climate and environmental conditions to minimize energy demand



Source: Left De Trudo Toren, which has 125 social housing rental apartments in S-Strip in Eindhoven, NL. Middle https://www.nationalgeographic.com/magazine/graphics/see-sustainable-future-city-designed-for-people-and-nature . Right An example of bioclimactic design from https://aasarchitecture.com/2018/01/lot-o7-office-building-batignolles-chartier-dalix-brenac-gonzalez.html/

Construction sector: Consolidated pressures should accelerate construction sector's transformation in digitalisation, integration, decarbonisation & circularity

As pressures consolidate over the 2020s

- Stagnating productivity
- Cost overruns
- Rising product & operation complexity
- Growing sustainability pressures

Construction sector to make strides in

- Digitalisation, automation & innovation
- Life-cycle impact & circular design
- Material efficiency and waste generation strategies
- High-performance durable, low carbon, recyclable materials
- Circularity ecosystem with establishment of standards, inventories, marketplaces

- Integration, prefabrication and modular construction to gain further market share, but will still be far away from being mainstream
- Main construction methods and materials will not see major changes. Demand for low carbon & higher recycled content steel & concrete, high-strength steel to surge

Outlook from megatrends window suggests strong infrastructure construction activity over the next 2-3 decades

The last 3-4 decades saw persistent underinvestment in infrastructure

New development strategies in major economies show major focus on infrastructure

Climate change: requiring an economic transformation of huge magnitude and scope

Shifts in the global geopolitical landscape and supply chain structure underpinning infrastructure investment

Technological progress: building the digital infrastructure for the smart era

Demographic trends also supporting growth in global infrastructure investment

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Trends in building design and construction points to increasing steel intensity

- Higher, flexible, scalable
- Energy generating / efficient / smart: fitted with energy generation capacity, various materials recycling / storage systems and sensors
- Prefabrication / modularity / digitalisation and industrialisation of construction processes
- More stringent environmental performance regulations
- Better understanding of materials flows and lifecycle impact, focus on circularity and durability, reuse and recycling characteristics might also be supporting steel intensity

Construction sector: the path to 2030

Construction expected to show relatively stronger growth in steel demand and grow its share in global total steel demand

Steel demand growth depending on construction growth and steel intensity

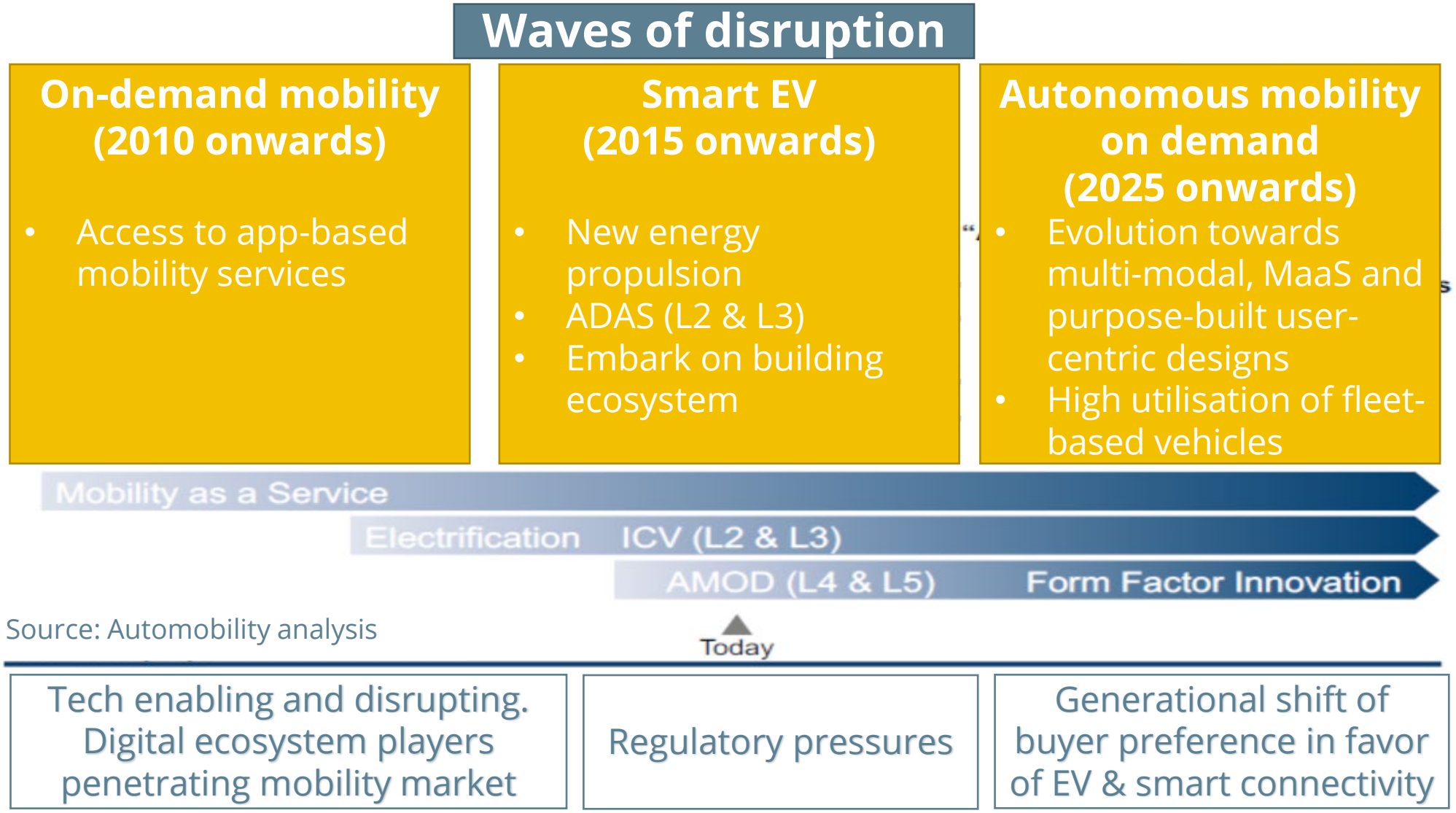
(vs. average)	Residential	Non-residential	Infra.	Plant
Steel intensity	Low	High	High	High
Construction growth	Low	Mid	High	Low
Steel demand growth	Low	Mid	High	Low

Source: worldsteel Megatrends Evaluation Study

- Strong infrastructure investment, continued non-residential building growth
- Trends in construction, such as increasing height, durability, flexibility, modular building design, circularity, are in general pointing to increasing steel intensity

Future of the automotive sector

Automotive sector stands at the inflection point of a once-in-a-century paradigm shift…



Source: Automobility analysis

From mobility as a product to mobility as a service

Massive scale of cities & low motorisation in developing world, shift of preference towards MaaS, regulatory push towards shared mobility, aggressive push from digital ecosystem players

Mobility as a Product with Modern Auto

- Ownership
- Product optimisation
- Over-engineered vehicles for urban mobility

Mobility as a Service

- MoD and eventually AMOD, subscription services and multi-modal platforms
- Service optimisation (monetisation of big data)
- Purpose-built vehicles designed specifically for city use

Implications on vehicle design and bill of materials

Peak in global car demand:
91 mn units in 2017

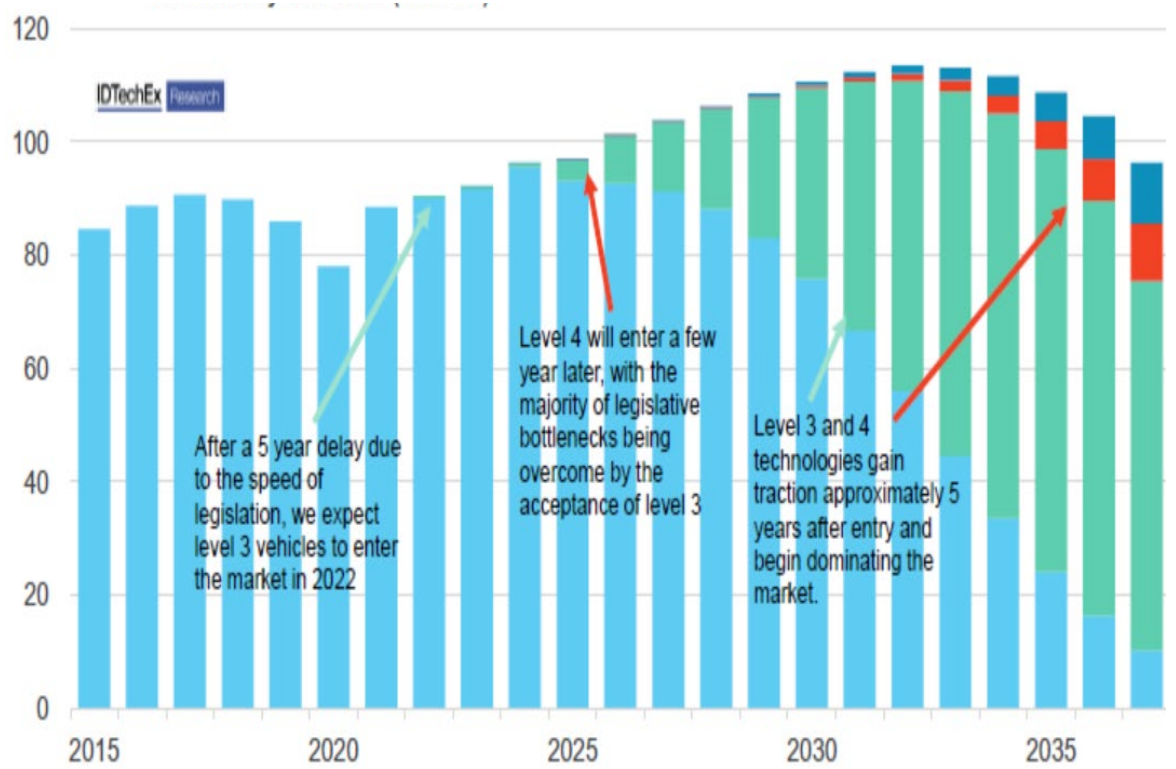
Implications on passenger vehicle demand

Future passenger vehicle demand?

Source: Toyota Corolla and WorldAutoSteel, MOD stands for Mobility on demand and AMOD stands for autonomous mobility in demand

Future of autonomy and mobility services

IDTechEx New Passenger Vehicle Sales by SAE* level (millions)



Source: IDTechEx Autonomous Cars, Robotaxis & Sensors 2022-2042 Report

Current projections suggest a wide range of possibilities for AV adoption even for 2030…

**The Society of Automotive Engineers (SAE) defines 6 levels of driving automation ranging from 0 (fully manual) to 5 (fully autonomous)*

Vision and agenda for a sustainable and resilient global steel industry

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Vision and agenda for a sustainable and resilient global steel industry

Sustainable & Resilient Steel Industry

	Market	Products	Smart Mfg. [Steel Making]	Decarbonisation [Ecosystem]
1 ***Vision*** *"where should we go?"*	**Growing along the market**	**Material solution provider**	**Smart & digital manufacturer**	**Carbon neutral ecosystem**
2 ***Agenda*** *"How can we get there?"*	• **Develop construct., auto, and energy steel demand** along the evolving future city archetypes • **Appeal the market with steel's superior performance** – lightness, high-strength with low-carbon footprint • **Digitally driven customised market-oriented technology solutions** • **Meet the changing standards of the market** of fair competition and innovation	• Diverse and competitive **material solutions to meet customers' needs** in the future • **Partnering with** construction, auto, energy vendors to develop products • Providing **multi-material solutions** as joining and process technology evolves • **R&D with newly-emerging polymers** industries towards future product development	• **Expand smart factory capabilities** - Smart safety devices, AI-based customised production, V/C integration • **Building digital ecosystem** by data sharing with business partners and applying open & transparent technology • **Applying meta-verse tools** to develop new solutions, enhance processes and measure carbon footprint	• Intra- and inter-industry open networking data platform towards green steelmaking • **Build up green steel value chains from upstream** (scrap, DRI, renewable energy, hydrogen) **to downstream in a circular economy** • **Promote dialogue** over decarbonisation **btw. private and public sectors** to cross-border over regional blocs

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