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How decarbonisation, digitisation and circular solutions forge the sustainable European steel future?

ARTIFICIAL INTELLIGENCE GOVERNANCE, ECONOMICS, AND MANUFACTURING:

AN OVERVIEW

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AIMS

1. To clarify the differences among the Governance Systems of the 3 Key Players EU, US, and CHINA.

2. To gain insight into the general conditions influencing the direction and focus of AI-related expenditures / investments in the global manufacturing industry.

An insight about AI expenditures/investments into the Electrical Route (EAF) will be provided by breaking down the key application of AI.
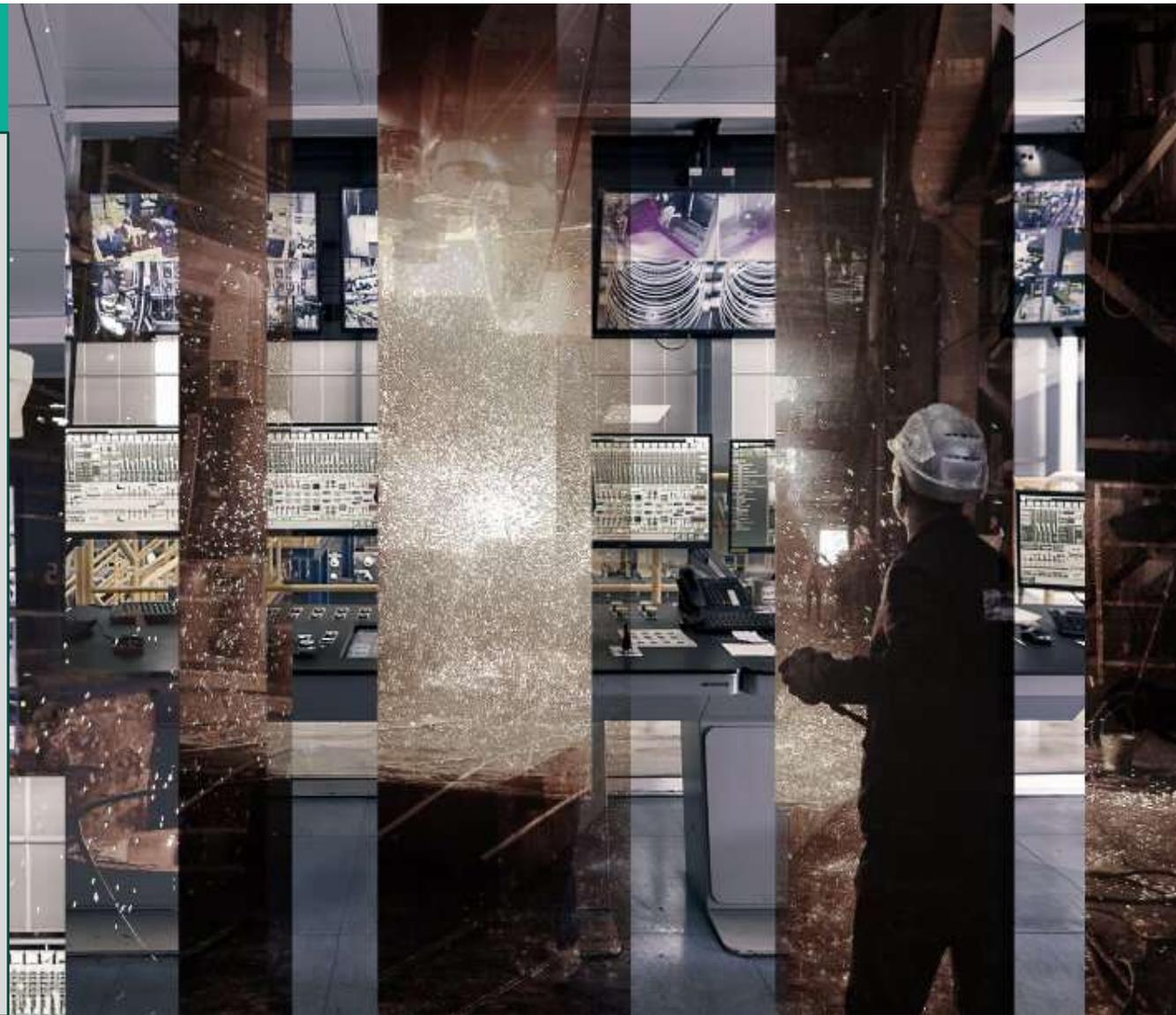
A paradigmatic statement

1. It is well known that AI is in the centre of public discussion to discriminate how it is and will be beneficial or detrimental for Society.

2. For sure, AI in all its declinations is perceived by People, Entrepreneurs, Sociologists, Scientists etc. and Politician as a "horse to ride" and, in the same time, a disruptive enabler in the largest possible extents, including the destruction of Humanity primacy.

3. To introduce the key aspect of the AI Governance, a paradigmatic sentence is:

   "The disruptive ability of AGI[1] ,and GenAI[2] in particular, are reputed to automate not only manual tasks but also cognitive functions"

4. It is paradigmatic because it allows us to introduce two antithetic concepts: FEAR and RISK as parts f the AI discussion.

Some introductive definitions upon which is not unanimously shared.

[1] *AGI - Artificial General Intelligence* refers to a hypothetical type of AI that can understand, learn, and apply knowledge across any domain much like a human being. This definition is a *paraphrased synthesis* of different definitions coming from different sources, *(proposed by ChatGPT5 and extensively modified by me).*

[2] *GenAI or Artificial generative Intelligence* is a branch of AI that can generate original outputs by using machine learning models, based on patterns learned from large datasets, especially Large Language Models (LLMs) and diffusion models.

[3]The distinction between "Fear of AI" and "Risk of AI" doesn't come from a single inventor or originator (although the suspect that it might be HAL 9000 seems to be credible). For sure, it is a conceptual distinction originated from the clash between AI and ethics, security and public perception.

Introducing AI Risks and Governance Systems

The issue of AI Risks is not the focal point. Despite many Tables are available such as the following one (based on 15 types of AI Risks*, the point of negligently manage such risks must be obligatorily contrasted and punished or not?

The Top 15 AI Risks*			
Ordinal Risk	Risk identification	Ordinal Risk	Risk identification
1.	Lack of Transparency	9.	Economic Inequality
2.	Bias and Discrimination	10.	Legal and Regulatory Challenges
3.	Privacy Concerns	11.	AI Arms Race
4.	Ethical Dilemmas	12.	Loss of Human Connection
5.	Cybersecurity Risks	13	Misinformation and Manipulation
6.	Concentration of Power	14.	Unintended Consequences
7.	Dependence on AI	15.	Existential Risks
8.	Job Displacement		

As a results of this preliminary work, *de facto*, Risk Analysis is now constituent part of Legislation Frameworks first and later of Governance Systems with some differences.

*Source: B. Marr, "The 15 Biggest Risks Of Artificial Intelligence", 2023/06/18, https://bernardmarr.com/the-15-biggest-risks-of-artificial-intelligence/

Analysis of what is hidden behind such statement

What is behind this statement?

Fear of ? ..

Risk of?

IRRATIONAL REACTION?

RATIONAL REACTION?

AI REJECTION

RISK ANALYSIS

The Top 15 AI Risks*			
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8.	Job Displacement		

... THEY SOUNDS DIFFERENTLY

…..job Killing

…..job Displacement
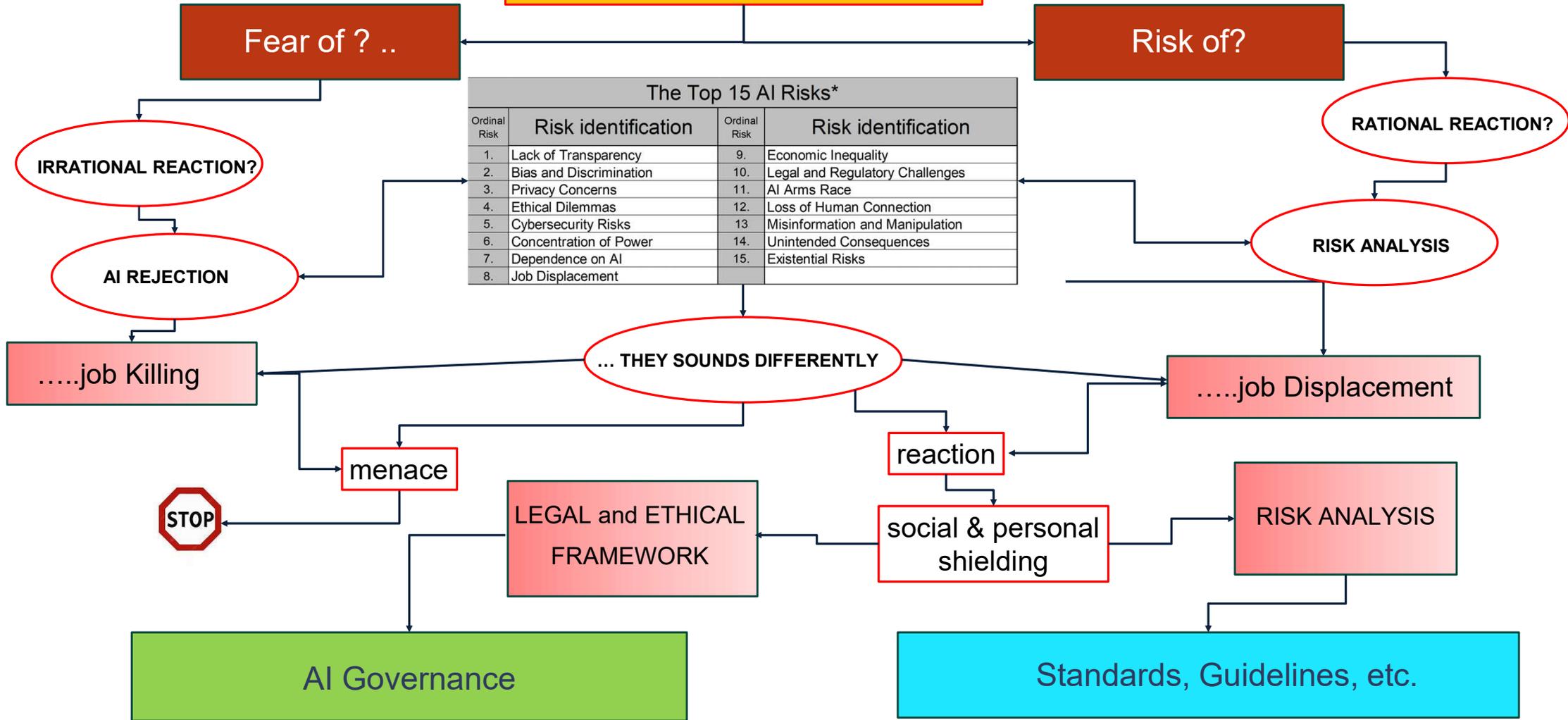
menace

reaction

STOP

LEGAL and ETHICAL FRAMEWORK

social & personal shielding

RISK ANALYSIS

AI Governance

Standards, Guidelines, etc.

What is an *AI Governance System**

In the previous slide, the AI Governance System was introduced as part of a shielding policy for weaker parties to the impact of AI. But ….. what is a Governance System?

An AI Governance System can be defined as

"… *a system of rules, practices, standards, processes, and technological tools aimed at ensuring an organization's use of AI technologies aligned with the organizational entity's strategies, objectives, and values. It fulfils legal requirements, and meets principles of ethical AI adopted by the entity …**"

- ✓ So, each national systems provided to its own Governance Systems. This obviously have led to an inhomogeneous landscape of approaches.
- ✓ In this scenario the only generalized Legislative Framework was developed by the EU (the EU AI Act).

In line with the aims of this presentation, the comparative analysis was carried out and the, relevant results on differences and commonalities are shown in the next slides.

*Source: Taken and updated from: Mäntymäki, M., Minkkinen, M., Birkstedt, T. et al., *Defining organizational AI governance*. AI Ethics 2, 603–609 (2022). https://doi.org/10.1007/s43681-022-00143-x

Comparison of the the three approaches. Synthesis.

Aspects	EU Approach [3]	US Approach [4]	Chinese Approach [5]
Ethics and Privacy	GDPR-driven, prioritising rights and privacy. The EU AI Act is the only defined Framework for developing, deploying and commercializing AI solutions.	Nothing similar to GDPR exits. Strong emphasis on civil-liberties principles and sectoral privacy laws.	Balances privacy with national security concerns
Risk Categorization	Risk-based AI classification	Voluntary adoption of sectorial standards and risk-management guidance	Licensing for systems on the "Negative List"
Innovation Focus	Regulatory balance between ethics and innovation	Focus on innovation and competitiveness. Strong pushing for safety/security and while preserving flexibility for industry.	Pragmatic focus on state-led economy gains
Human Oversight	Emphasis on human-centric principles and opt-outs	Very strong state support for rapid development and deployment of AI, and balancing AI alignment with national priorities.	Focuses on content control and alignment with socialist values

Reference Documents:

[3] The European Parliament, "EU AI Act: first regulation on artificial intelligence", 08-06-2023, https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence,

[4] National Institute if Standards and Technologies – NIST, "The AI Risk Management Framework", January 2023, https://doi.org/10.6028/NIST.AI.100-1 , https://www.nist.gov/itl/ai-risk-management-framework,

5] China Law Translate, "Interim Measures for the Management of Generative Artificial Intelligence Services.", Translated from Chinese to English on 2023/07/13, https://www.chinalawtranslate.com/en/generative-ai-interim/

1) EU generated an approach based on the idea of an obligatory **generalized AI Legislative Framework**, named the EU AI ACT. However, this may take the risk of "over-ruling everything".

2) US are oriented to leave free private entrepreneurs giving priority to business exigences with respect to individual consumers. Moreover, the US approach has the effect of emphasizing the use of **voluntary guidelines, innovation support, and separately considering AI ethics principles**.

3) China **privileged the primacy of the State control also by centrally establishing the priorities of AI**. This creates a bias on political exigences which and individual Ethical issues seems to be minor with respect to Collective policy.

The other face of the coin: the Economic Analysis, perspectives, players, and aims

The Economic Analysis is part of the answer to manage Risks. It is aimed at:

1. providing the forecast of economic size relevant to the AI deployment in the Manufacturing Sector in terms of breakdown of AI expenditures in the timespan 2024 – 2030*.

2. Breaking down the 2024 expenditure's size in AI in terms of significant manufacturing sectors.

3. Breaking down the forecasted expenditures/investments in terms of manufacturing product sectors in the timespan between 2024 and 2030

4. Gaining an idea on the prevailing sentiment of AI, the Rate of Return of investments is assessed**.

*To achieve these aims, data are gathered from most reputed observatory sources, validated by comparing different sources of the same information, and processed to obtain the information.
However, it must be underlined that the spread between different sources can be significantly high.

** The two economic indicators GMS and CAGR are used for obtaining information relevant to point 2. and 3.

The two economic indicator GSM and CAGR

The Global Market Size of Expenditures (GMS) on each Manufacturing Area technology (GMS) is yearly calculated by the formula [F1]:

$$GMS_j = \left(\sum_{1}^{NI} {}_i InvP_i \times EXP_{i,j} \right) \quad [F1]$$

- ❑ NI = Total Number of considered Players (fixed or variable),
- ❑ $InvP_i$ = i^{th} Player (with i = 1, NI).
- ❑ $EXP_{i,j}$ = Total Expenditures of ith Player on j^{th} Application Area.

The calculation of GMS considers the worldwide expenditures/investments. In the expenditures, there are also Services of any type.

The *Compound Annual Growth Rate (CAGR)* is "*the Rate of Return (RoR) that would be required for an investment to grow from its beginning to its ending balances, assuming the generated profits were reinvested at the end of each period of the investment's life span*".

CAGR indicates how much an investment is expected* to grow each year. The CAGR calculation formula F2 is:

$$CAGR = (V_{final} / V_{beginning})^{1/t} - 1 \quad [F2]$$

- ❑ V_{final} = the ending balance of investments at the end of the timespan.
- ❑ $V_{beginning}$ = the final balance of investments at the first year of the timespan.
- ❑ t = the considered timespan.

* In practice, the CAGR indicator gives an idea about the different expectations of AI' expenditures/investments from products and sectors

The reported results of the Economic Analysis are obtained considering two possible scenarios:

1. The Conservative Scenario A, where the baseline is based on the lowest Literature values of GMS and CAGR in 2024 i.e., the first year of the timespan[1].

2. The Aggressive Scenario B, where the highest values of the 2024 baseline taken from the Literature have been considered[2].

1. Global Market Insight Inc. through ChatGPT 5
2. MarketandMarkets through ChatGPT 5

Breakdown of AI GMS by products – the Conservative Scenario A


Scenario A - Conservative Assessment of GMS 2030
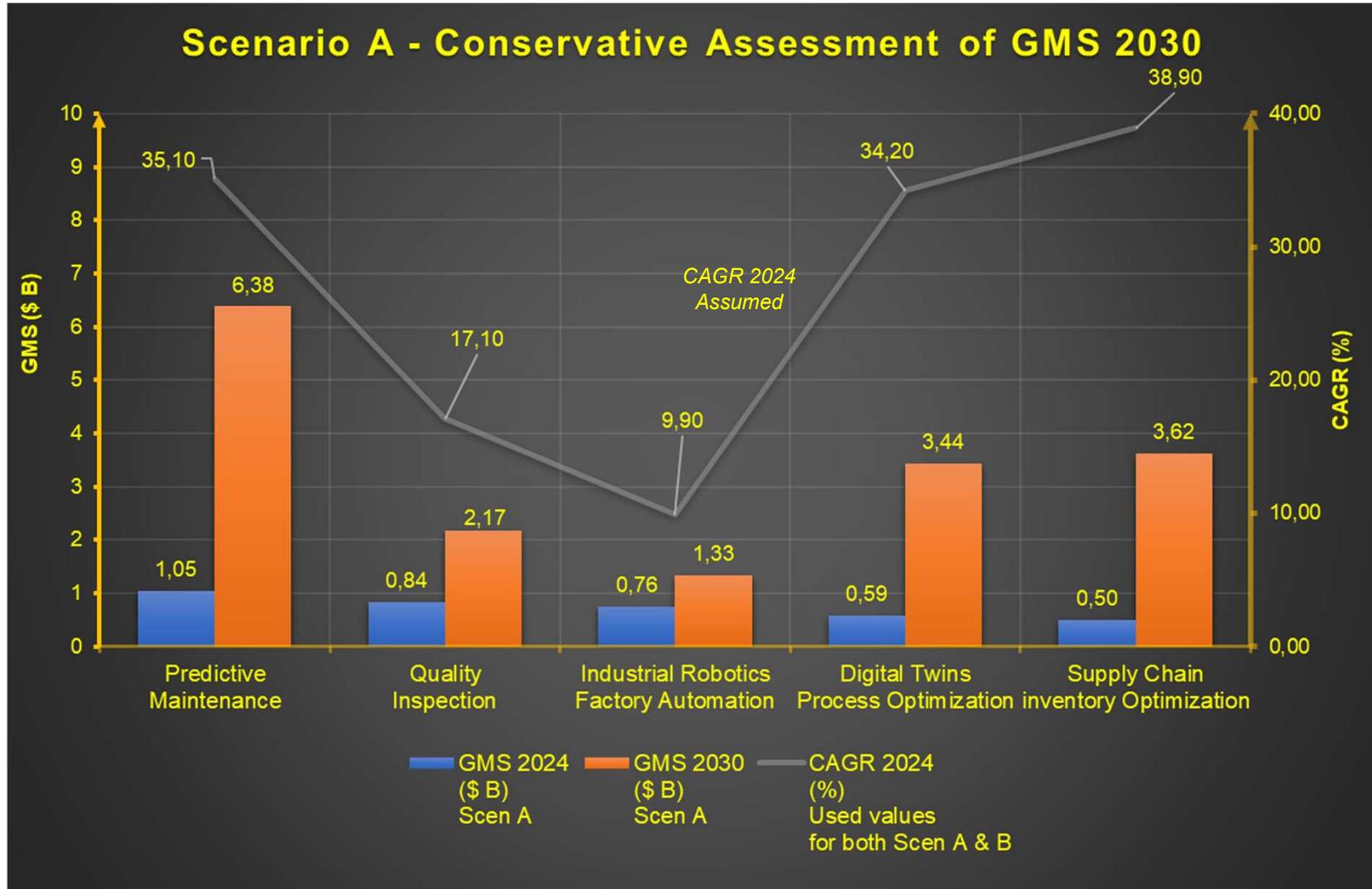
Breakdown of AI GMS and CAGR by products – the Aggressive Scenario

Scenario B - Aggressive Assessment of GMS 2030
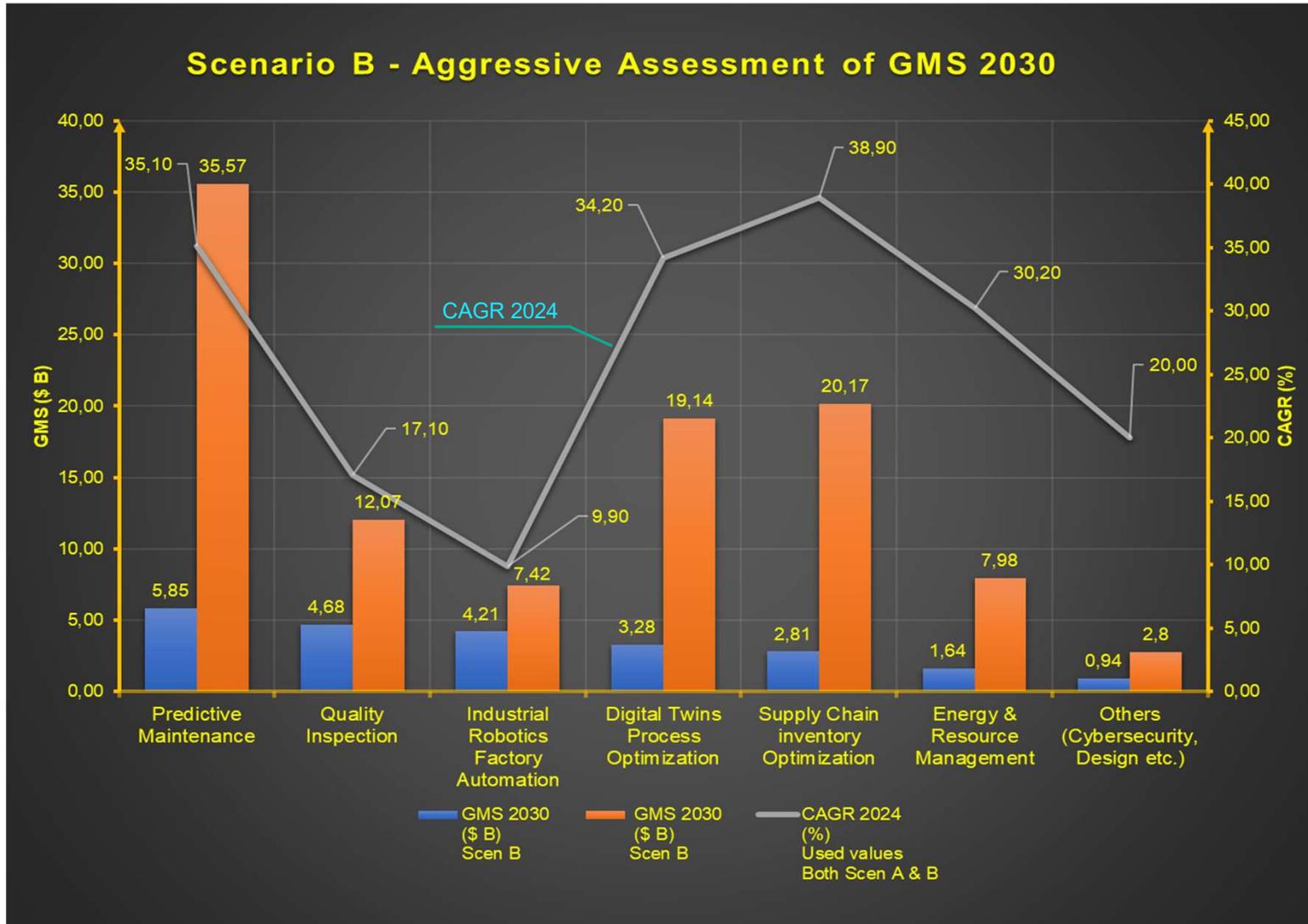
Comparison between the Scenario A, B, and Average

1. Looking to the aside radar diagram, the quantitative differences on AI expenditures/investments between Scenarios A and B are quite large but with similar shape. Of course, also the shape of the averaged values is similar as well.

2. Considering the poll-based methodology to project data to later time, the interviewed technicians by the Technological Observatories, they agree on the prevalence of expenditures in:

   ✓ Maintenance expenditures,

   ✓ Supply Chain optimization,

   ✓ Process Optimization supported by the Digital Twins.

3. These results open further scenarios of R&D&I's directions. Primarily, a dramatic evolution of the Computing Power for both GenAI and General – Narrow AI.

4. The performance of the Others' Group, suggests that AI could be considered as a specific approach to be case by case embraced however, it is also possible to imagine an AI-based Framework for the Automation of a Manufacturing Area.
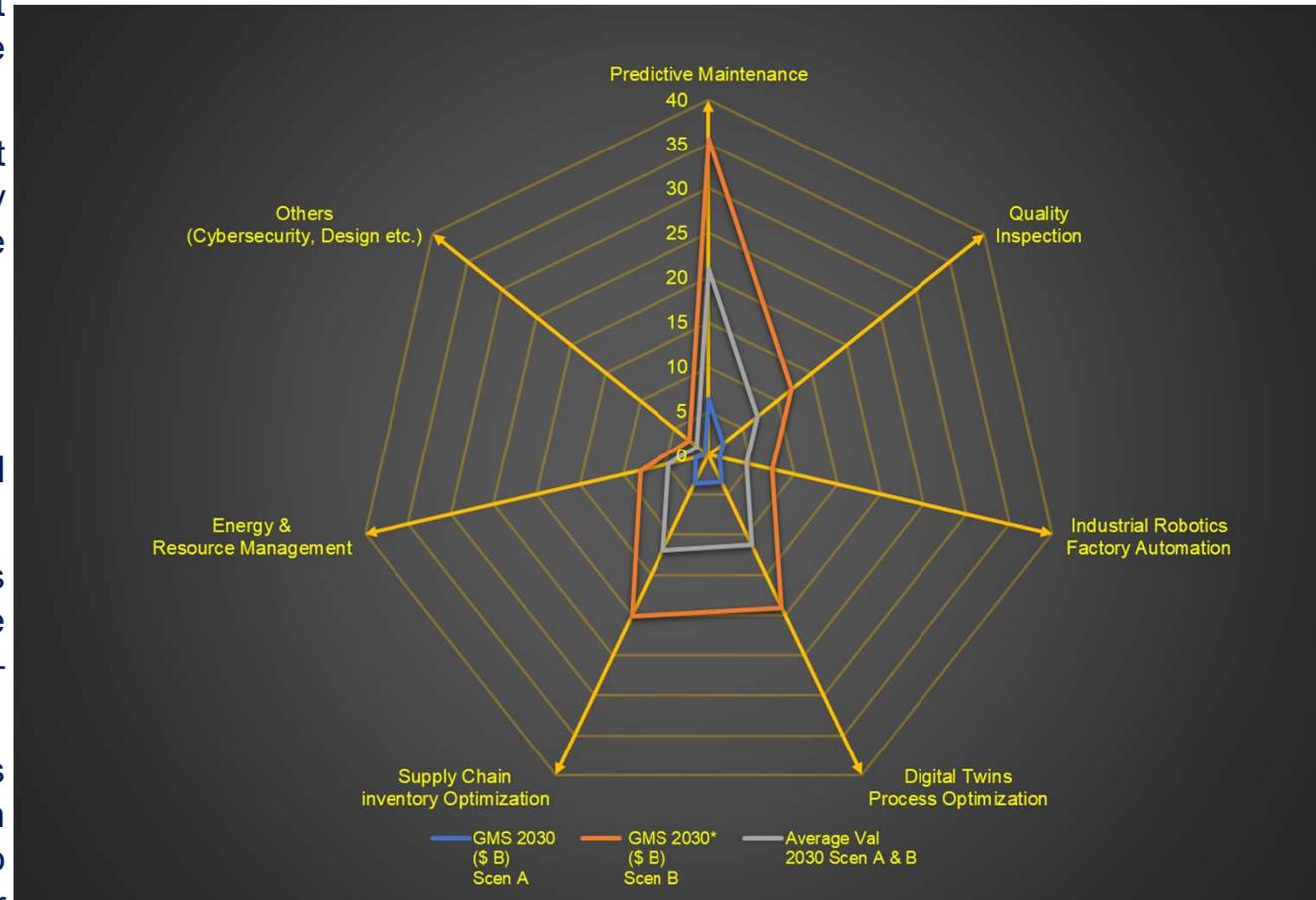
First set of Conclusion

A preliminary set of conclusion other than the prevalence of AI expenditures in Manufacturing (services or investments), the optimization of the Supply Chain, and the Process Optimization supported by the Digital Twins, includes the following sectorial considerations:

- ✓ The cluster defined "Others", which breakdown is not clearly defined in Literature except Cybersecurity, sems to be at the basis of AI expectations in terms of CAGR.

- ✓ In fact, a specific analysis to different sources drive to a total CAGR of Generalized AI between 2024 and 2030 rounds from 32,3% (TechSciResearch, July 2025) to 36,6% (GrandViewResearch, March 2025, leading to the average value of 33,5% in 2030.

- ✓ This very high value indicates the role "game changer" of AI is very high with respect to the assumptions of 20% for both scenarios A and B.

Honestly, I have some doubts about the reliability of such data. In my opinion average values might be the most reliable.
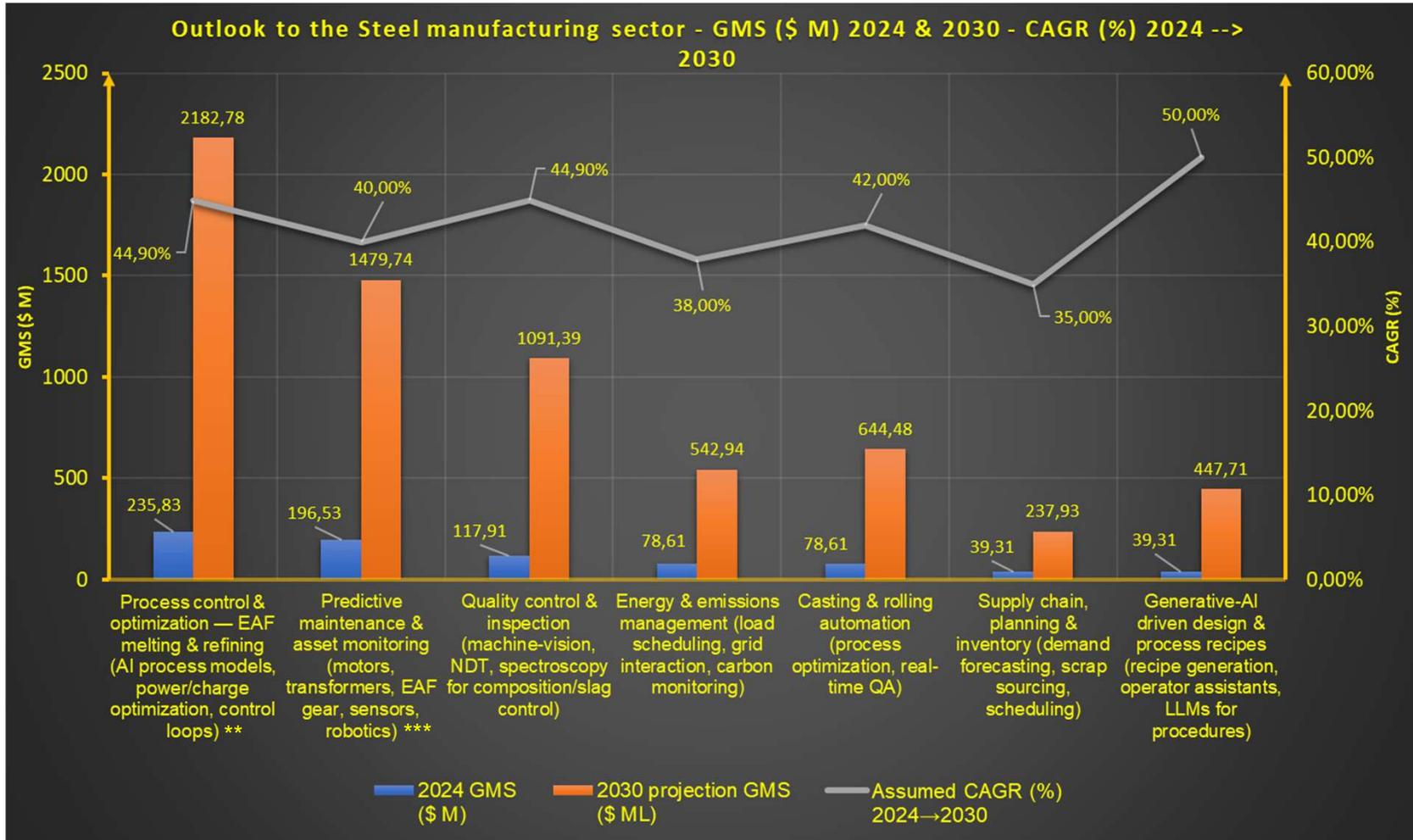
Let's look now to the GMS of AI in the Use Case of a modern Electrical Ruote

The considered Electrical Route" is composed by EAF + DRI/EAF workflows (scrap & DRI feedstock) → EAF melting → refining → continuous casting → rolling / finishing.

Breakdown by Applications of AI in the Electrical Route*

*MarketsAndMarkets https://www.marketsandmarkets.com/Market-Reports/artificial-intelligence-manufacturing-market-72679105, Grand View Research https://www.grandviewresearch.com/industry-analysis/generative-ai-market-report.

**Not casually these aspects are very related to the largest emissions in the such EAF Route.

*** Predictive Maintenance is confirmed as a very high topic of expenditures/investments.

Second set of Conclusions

✓ I open this second set of conclusion, telling you immediately that the values of CAGR of the different applications relevant to the Electrical Route, seem to be too high. If they would be true, I will run immediately to invest somewhere EAF + DRI are installed.

✓ Instead, GMS 2024 and 2030 are credible, due to my personal sensibility on the matter.

✓ The point of Predictive Maintenance expenditures is not comparable because we compare worldwide expenditures with EAF Route but, from the qualitative point of view, they almost agree on the relative position of such groups of data (see diagram in Slide 14).

✓ Regarding the point of GenAI, it is explicitly mentioned for Design, Operator Assistant, Recipe Generation and Procedure extraction and Formalization. What about the other kinds of application? Still an open question but solvable with a bit of imagination.

Another question: what about who will prevail between GenAI and AGI of Slide 17? Opinions seem to converge in a medium-long term towards GenAI. Who is still alive, will see.

THANK YOU FOR YOUR ATTENTION

Q & A

(IF YOU KINDLY WISH)