LAKE STAR

TOWARDS A RESILIENT EUROPE: INNOVATIONS IN DEFENCE AND SECURITY

November 2024

The case for investing in European Defence Capabilities

Europe is facing its **biggest threat in decades** – Observers estimate it will take Russia **2-8 years to rebuild its army** to the point where it could dare to attack

However, European NATO allies are by far not doing enough to build a credible deterrence position and have **scaled back defence spending by 30%** since the 1990s

Meanwhile, industry's current production & imports are **only a fraction** of stock levels – meaning it would take substantial time for new equipment to be delivered

Also, the military capabilities needed in the future are changing (e.g., drones, direct-energy weapons), yet European **investment in R&D is only 1/10 of the spend in the US**

Going forward, if **German defence spend were to increase to a minimum of ~3.5% of GDP, i.e., >€150bn p.a.,** a more credible deterrence position would be developed

If deployed well, defence investments can also bring significant economic benefits, e.g., increasing GDP by **~€70-180bn,** which may justify a (temporary) debt increase

To ensure that the additional funding also drives innovation, a virtuous cycle within a European defence innovation ecosystem needs to be developed, reflecting the needs and requirements of the most important stakeholders: **armed forces**, the **defence industry**, **entrepreneurs**, **investors**, and **society at large**

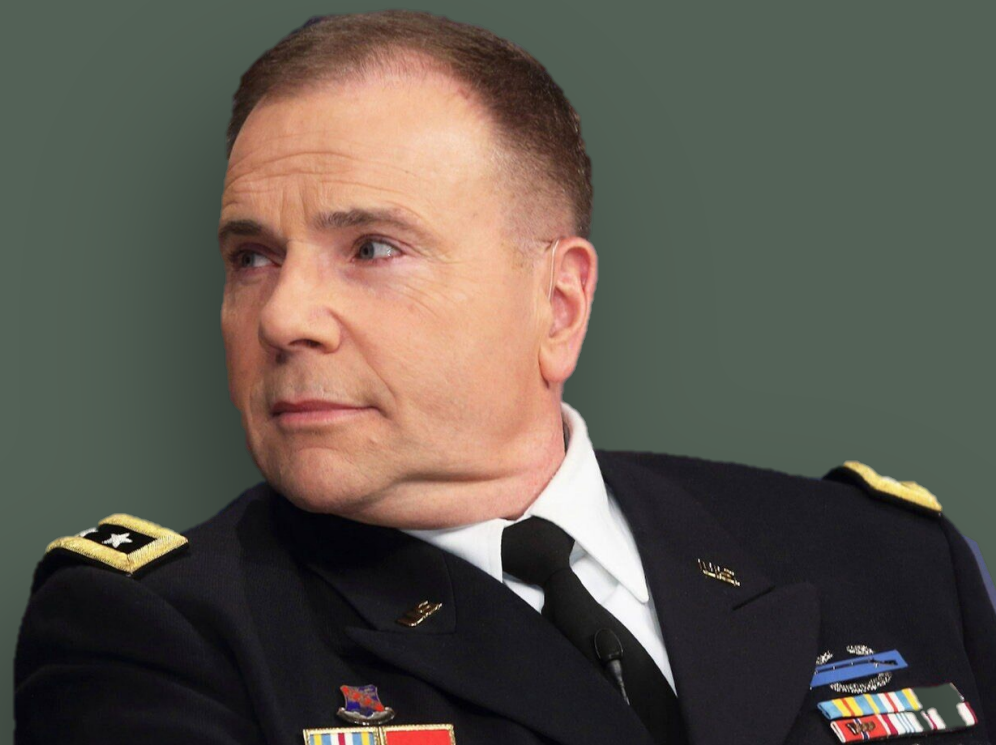
INTRODUCTION

„ In Central and Western Europe, we could not protect all of the key cities, seaports, airports, and transportation infrastructure [against Russia].

We absolutely don't have enough to be able to do that."

LT. GEN. (RET.) BEN HODGES
FORMER COMMANDING GENERAL OF US ARMY EUROPE

JUNE 2024



Russia's threatening stance toward Europe is becoming more obvious …

Military Force Structure

2-8 years

for Russia to "re-build its army to the point where it could dare to attack NATO"

280,000 recruits

p.a. training capacity in Russia

Funding

€430 billion

estimated military spend in 2023[1], which is …

… ~2 times

more than 2014

Industrial Depth

3 million units

p.a. domestic production capacity for artillery **ammunition** – "more than all NATO members combined"[2]

1,500 units

Main Battle **Tanks** delivered or refurbished in 2023 by Russia's industry

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1) Purchasing power adjusted; 2) Testimony of General Christopher Cavoli, Commander of the US European Command, before the US Congress House Armed Services Committee
Source: NATO reporting, SIPRI, militaryppp.com, The International Institute for Strategic Studies (IISS) – The Military Balance, government websites, expert assessment, German Council on Foreign Relations (2023): "Preventing the Next War Germany and NATO Are in a Race Against Time"

… yet Europe is struggling to develop a meaningful response

Military Force Structure

25% vs 1992

Main Battle Tanks in NATO Europe today vs. 1992

70% vs 1994

Military personnel in NATO Europe today vs. 1994

Funding

€1.6 trillion

gap vs. 2% goal in NATO Europe since 1992 (“peace dividend”)

<2% GDP

GDP spent on defence in Germany in 2023

Industrial Depth

~100 units

Main Battle Tanks annual production capacity in Germany

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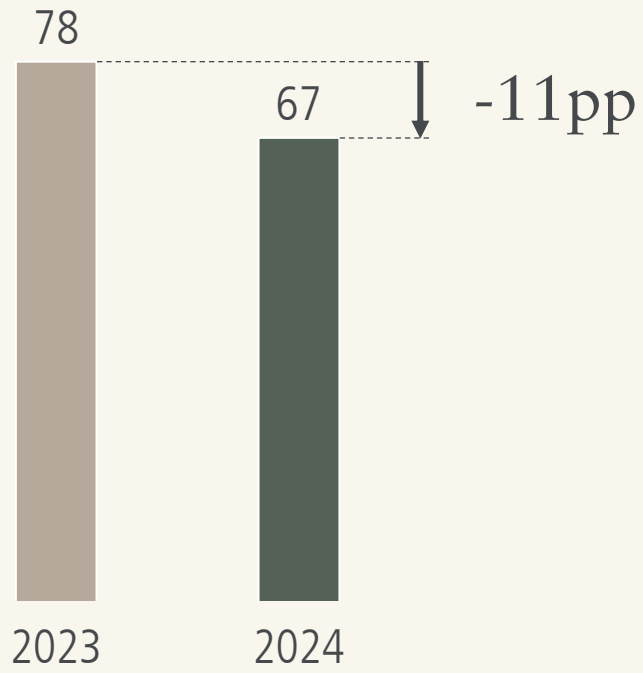
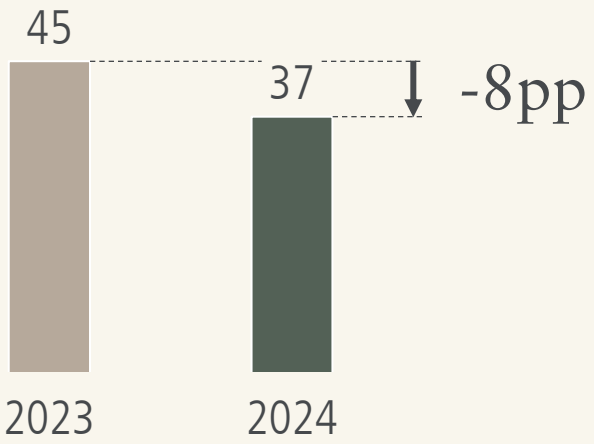
Source: NATO reporting, SIPRI, The International Institute for Strategic Studies (IISS) – The Military Balance, government websites, expert assessment

In addition, public risk perception and support for joint defence in NATO Europe are declining – *Example from Germany*

Perceived risk from Russia
in Germany, indexed to 100[1]



Support for joint defence
in Germany, %[2]

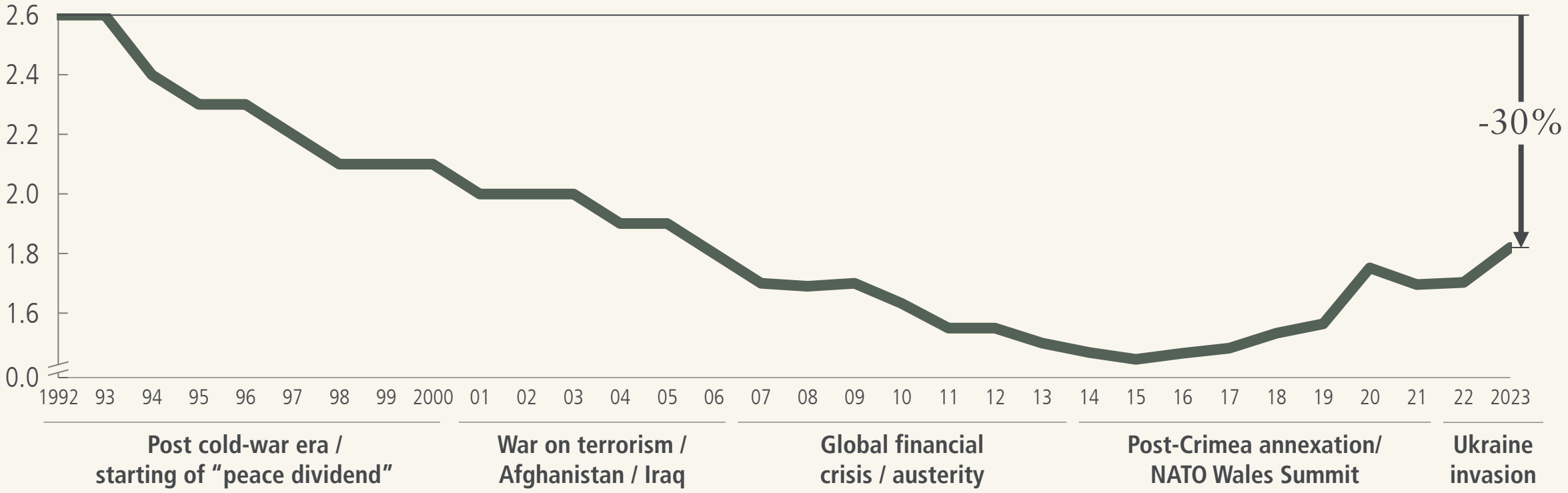


1) Kekst CNC, commissioned by the Munich Security Conference, based on the aggregate of respondents' rating from 0 (lowest) to 10 (highest) of overall risk, risk trajectory, risk severity, risk imminence, and preparedness scaled to 100
2) Question: "Should Germany participate in a military campaign to defend another NATO member state when attacked?"; Centrum für Strategie & Höhere Führung and IfD Allensbach: Sicherheitsreport
Source: Kekst CNC, commissioned by the Munich Security Conference, Centrum für Strategie & Höhere Führung and IfD Allensbach

THE STATE OF EUROPEAN DEFENCE

Defence spending of European NATO partners as share of GDP is 30% below 1992 levels, despite some uptick after 2014

Development of defence budgets in NATO Europe[1],
1992-2024, as share of GDP



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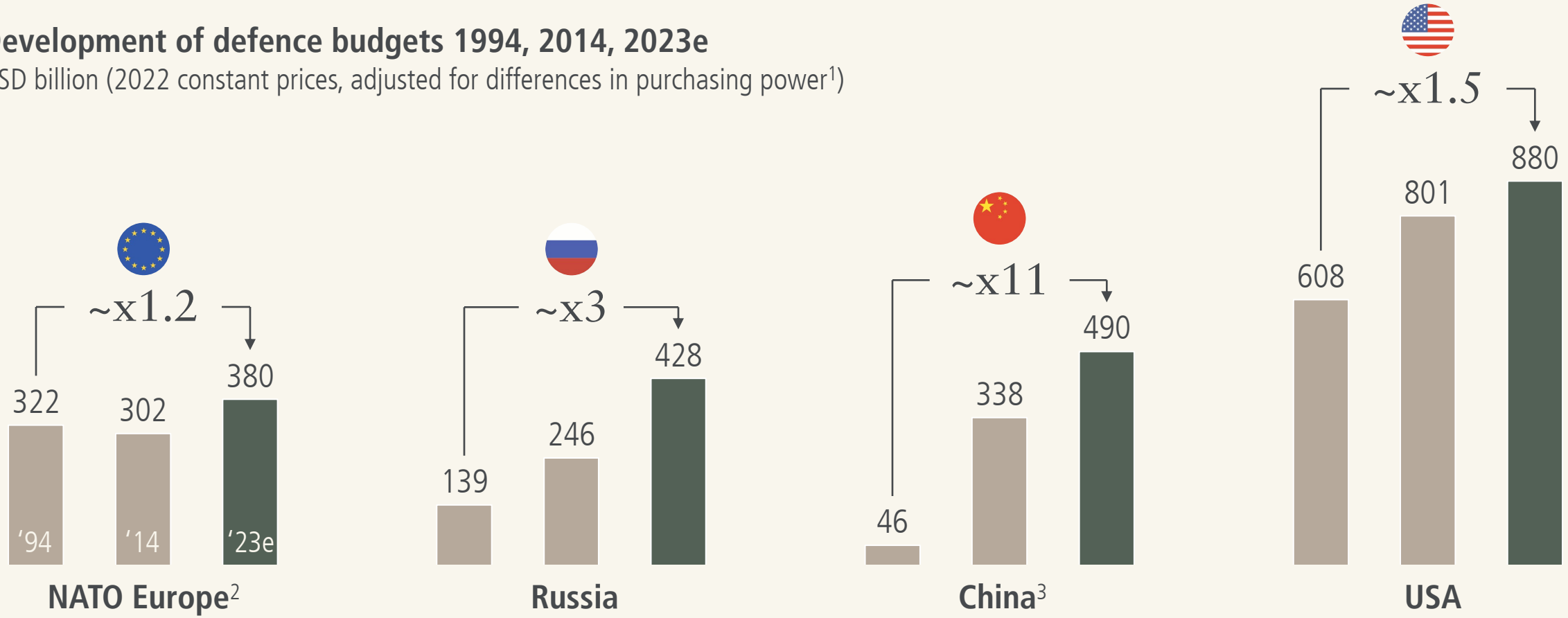
1) Figures as reported by NATO (1992-2007: current prices, 2008-2011: based on 2010 prices, 2012-2024: based on 2015 prices - methodological differences account for <.1% of variation); NATO excluding Canada, United State, and Turkey
Source: NATO reporting

In absolute terms, NATO Europe's defence budget remained largely unchanged, while other nations significantly increased theirs

Development of defence budgets 1994, 2014, 2023e

USD billion (2022 constant prices, adjusted for differences in purchasing power[1])

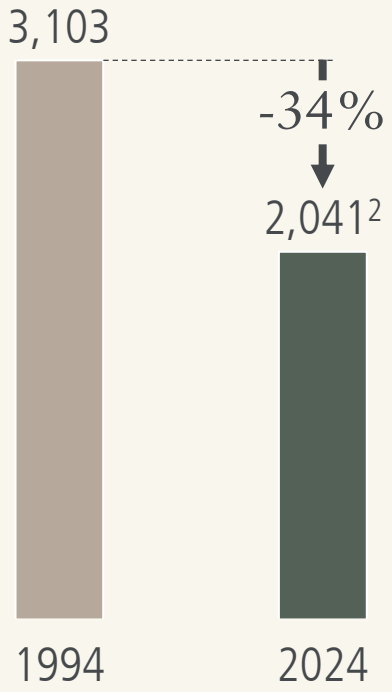


1) Following multiples reported by militaryppp.com; 2) Based on 1994 NATO members excl. Canada, United States and Turkey; 3) Based on officially collected figures from SIPRI, may potentially be higher e.g., as estimated by American Enterprise Institute
Source: SIPRI, militaryppp.com

The effects of low defence spending can be felt across personnel and equipment

Military personnel in NATO Europe[1]

Thousand



Development of capital stock in NATO Europe[3]

USD billion

Capital stock shrinkage likely underestimated due to decommissioning & sales

SELECT EXAMPLES GERMANY

2010-2020: Decommissioning of all remaining 57 air-defence systems "Gepard"
2010-2019: Sale of 164 Leopard 2 A4 MBT to Singapore
2013-2017: Sale of 103 Leopard 2 A4 MBT and 42 armored vehicles to Indonesia

1) European NATO members in respective year excluding Turkey. Note that figures for later years include additional members as compared to 1994, otherwise the decline of forces would have been even more substantial; 2) Estimates for 2023 and 2024; 3) Excluding new NATO members post eastward extension to ensure like-for-like comparison for entire time frame; 4) Calculated based on 30-year depreciation schedule applied to capital stock modeled based on equipment spend post 1964, excluding donations & sale of military equipment to 3rd party countries (see Appendix for details); 5) Inflation adjusted to 1994 values
Source: NATO reporting, capital stock modeling, IMF (inflation rates), SIPRI (examples)

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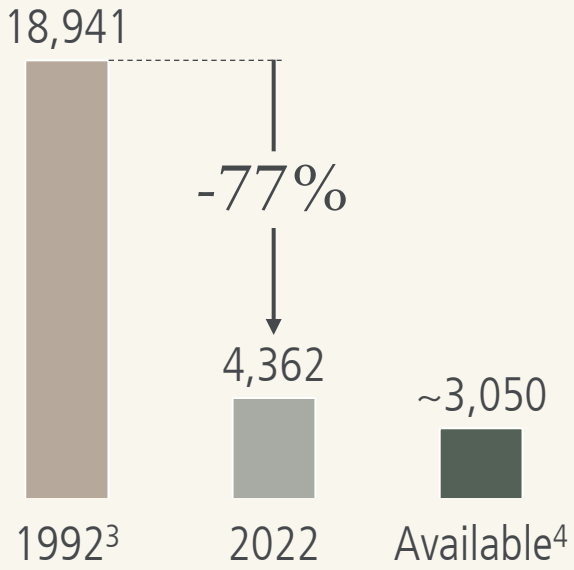
As a result, inventory levels of key equipment are far below 1990s levels – with some capabilities given up completely

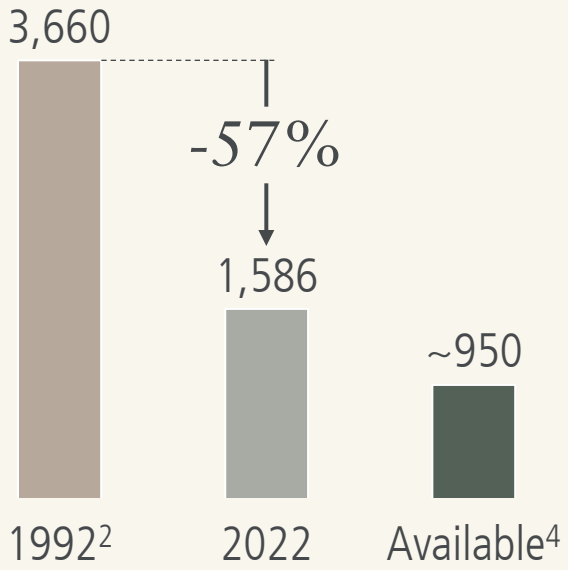
Equipment holding for selected European countries[1]

of units

Main Battle Tank



Fighter/Ground Attack[2]



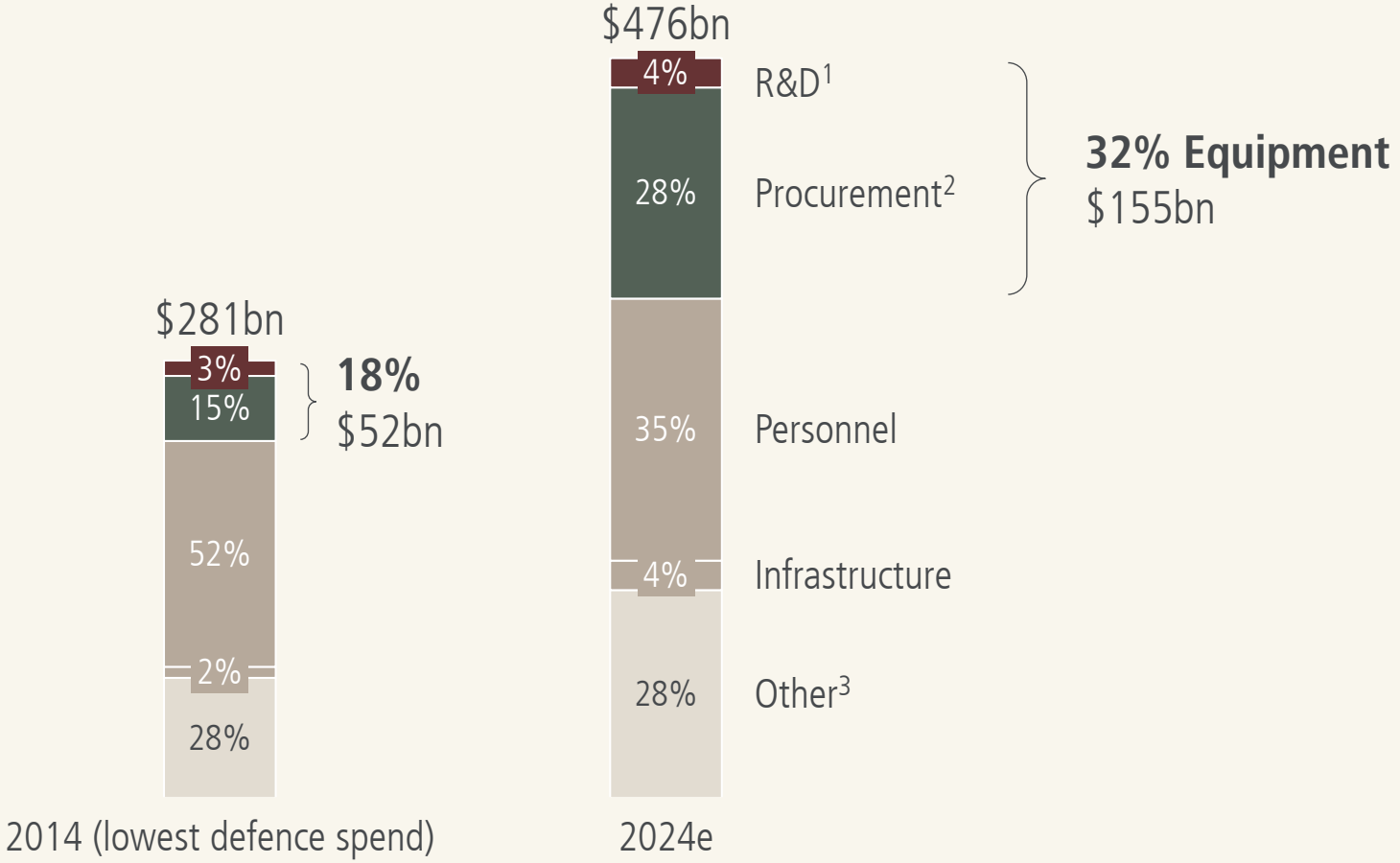
Armored Air Defence

Given up completely in some countries, e.g., air defence systems "Gepard" in Germany

1) Countries included: France, Italy, Norway, Spain, UK, Germany, Netherlands, Poland, Turkey; 2) Fighter jets and ground attack / fighter bombers
3) Selected as it was the year of the KSE treaty entering into force; 4) Ready to be used, i.e., not under repair or being revised
Source: The International Institute for Strategic Studies (IISS) – The Military Balance, government websites, expert assessment

Equipment is the focus of increased European defence spending

Defence spend per category for NATO Europe
USD billion (current values per year) and share of total defence spend



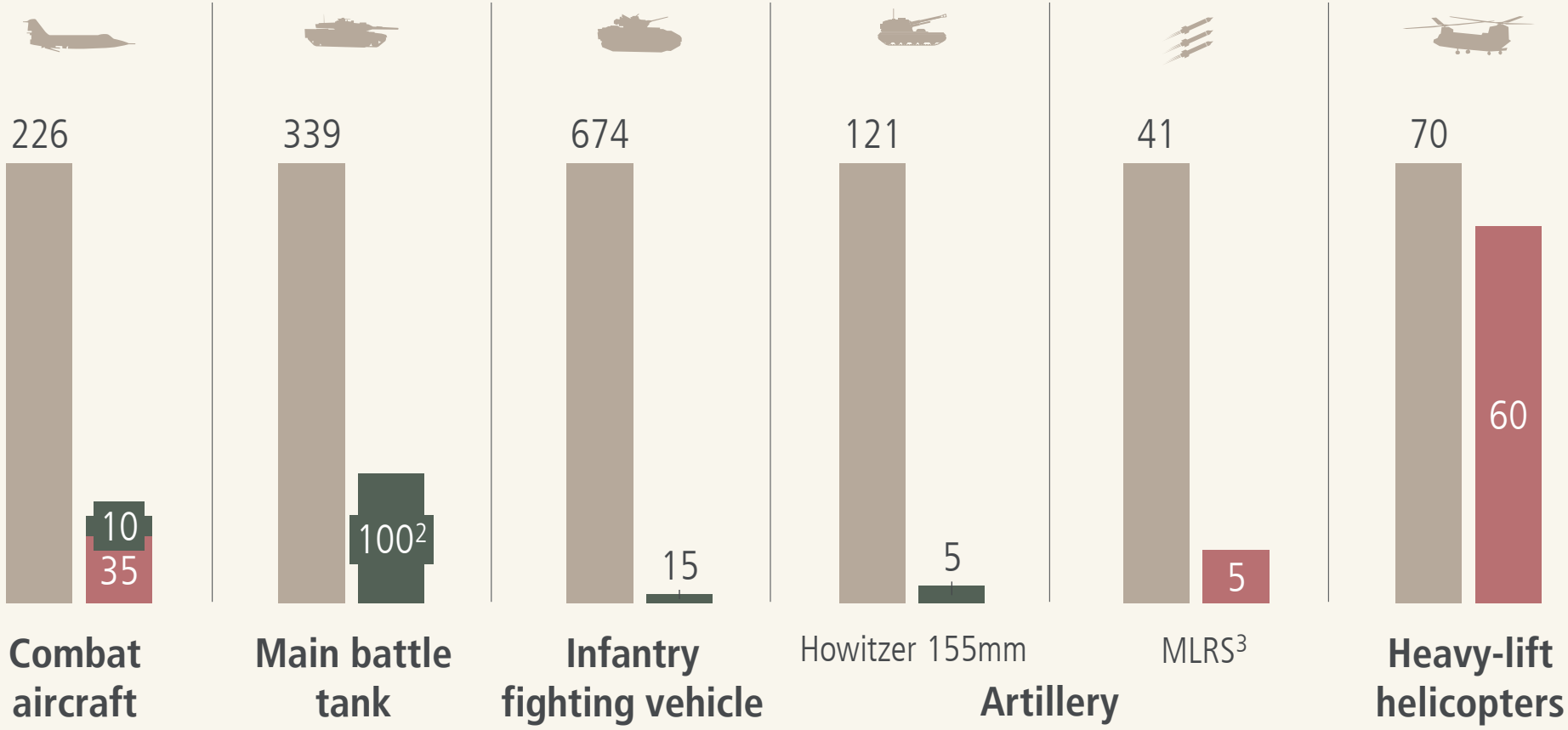
1) Approximated based on R&D share reported by EDA; 2) Excluding R&D; 3) Includes Operations & Maintenance, other R&D, and not allocated expenditure
Source: NATO, EDA Reporting (R&D share)

Low industrial production in Europe forces imports, but even combined, they cannot sufficiently boost stock levels

Example Germany
2021 Stock levels
# of units

Annual national production rate[1]

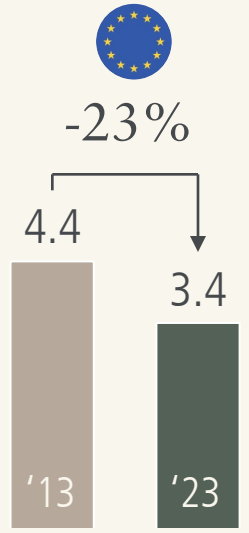
Planned imports in next years



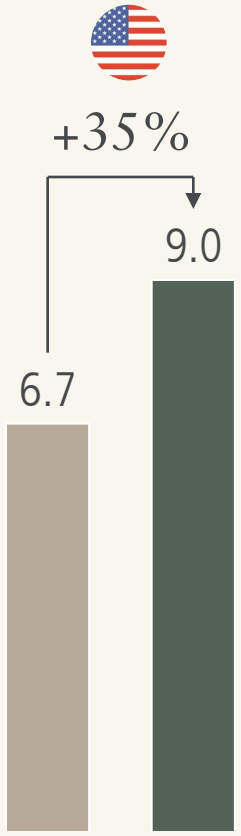
1) Outside-in estimates / 2nd hand sources not considering potential future production upgrades; 2) Currently 48, capacity expansion to 100 planned; 3 Multiple Launch Rocket Systems
Source: Kiel Institute for the World Economy; public reports; United Nations Register of Conventional Arms (UNROCA, for import figures); Bundeswehr.de; Hartpunkt.de

Net weapon exports for key regions indicate significant shifts between 2013 and 2023

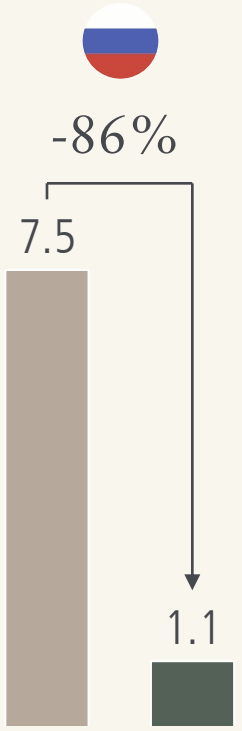
Net weapons exports[1]
TIV[2] million



NATO Europe[3]



USA



Russia

While Russia's net exports even exceeded the US in 2013, **they have since dropped strongly**, as both exports & imports shrank

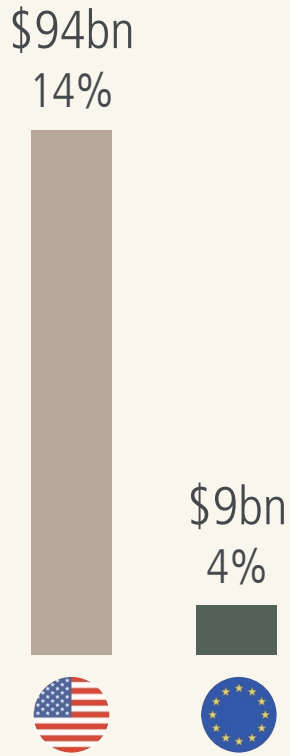
Ranking below the US and Russia, **Europe's net exports declined further, driven by ~4x higher imports**; although exports grew by ~20% this could not compensate the higher imports; nevertheless, **Europe is still a net exporter**

US growth was driven by higher exports, while imports remained largely stable

1) Total exports less imports); 2) SIPRI trend-indicator values; 3) NATO Europe (excl. Turkey) + Austria & Switzerland
Source: Information from the Stockholm International Peace Research Institute (SIPRI), arms transfer database

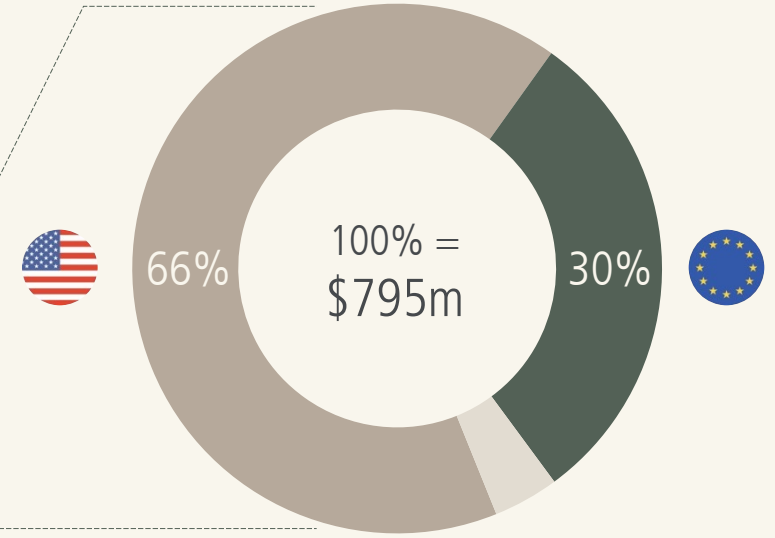
The US military started to heavily invest in defence innovation, while Europe's military did not

Defence R&D spend, 2022[1]
Share of total defence spend in %



VC Defence Tech funding, 2024[2]

European VC Defence Tech funding by Investor HQ



Necessity for European Sovereignty financing

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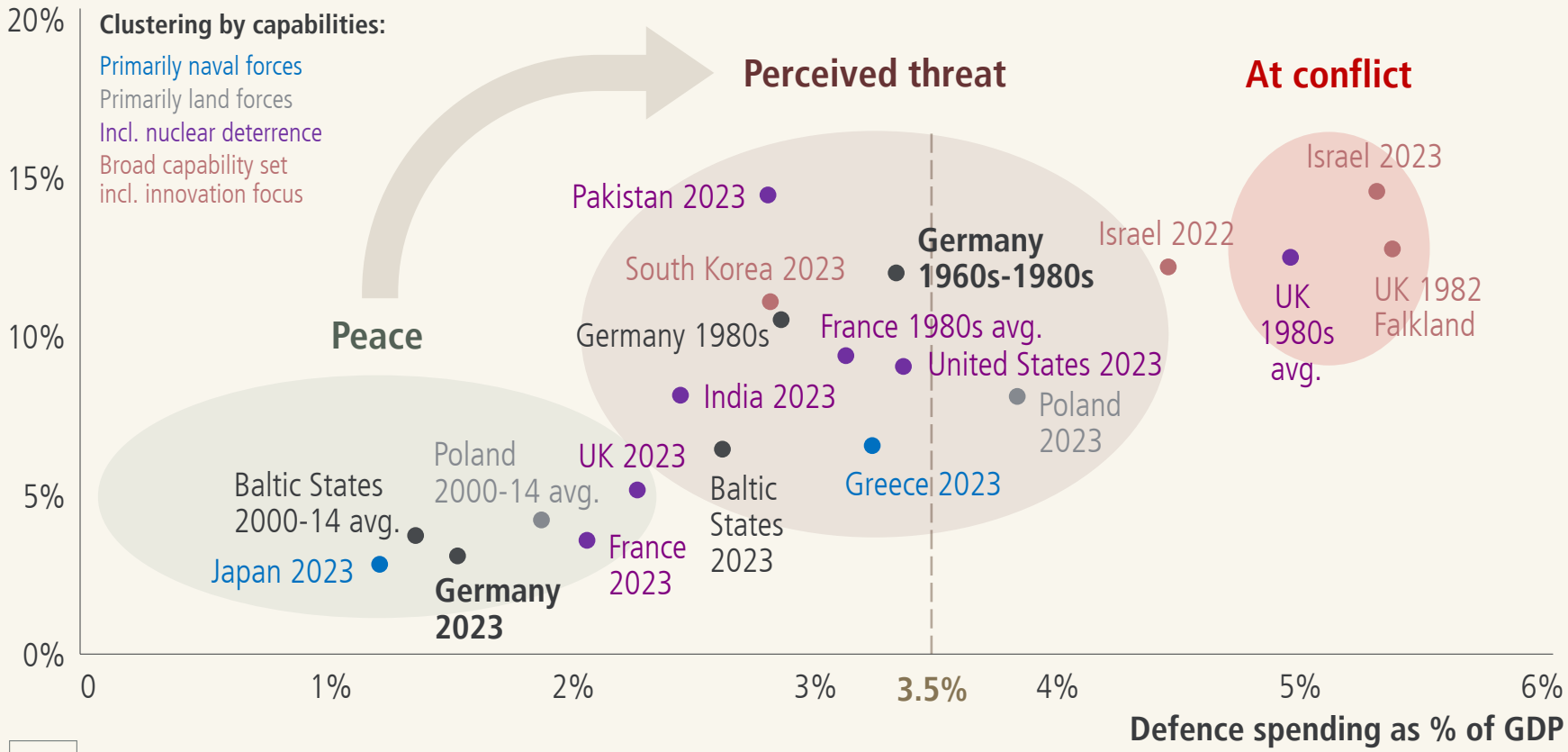
1) Source: European Parliament report based on EDA data; US DoD Greenbook; Eurostat; European Commission; 2) Source: Dealroom

FUNDING NEED FOR CREDIBLE DETERRENCE

Countries under a perceived threat tend to spend more on defence – for Germany, this could be ~3.5%

Defence spending as % of government spending



Today, Western European nations spend a **lower share of GDP than Eastern European nations,** likely due to different threat perception

Historic spend during **periods of perceived threats** was in a comparable range to today

Higher spend ("perceived threat") may be seen as an **"insurance premium"** to the cost of direct conflict

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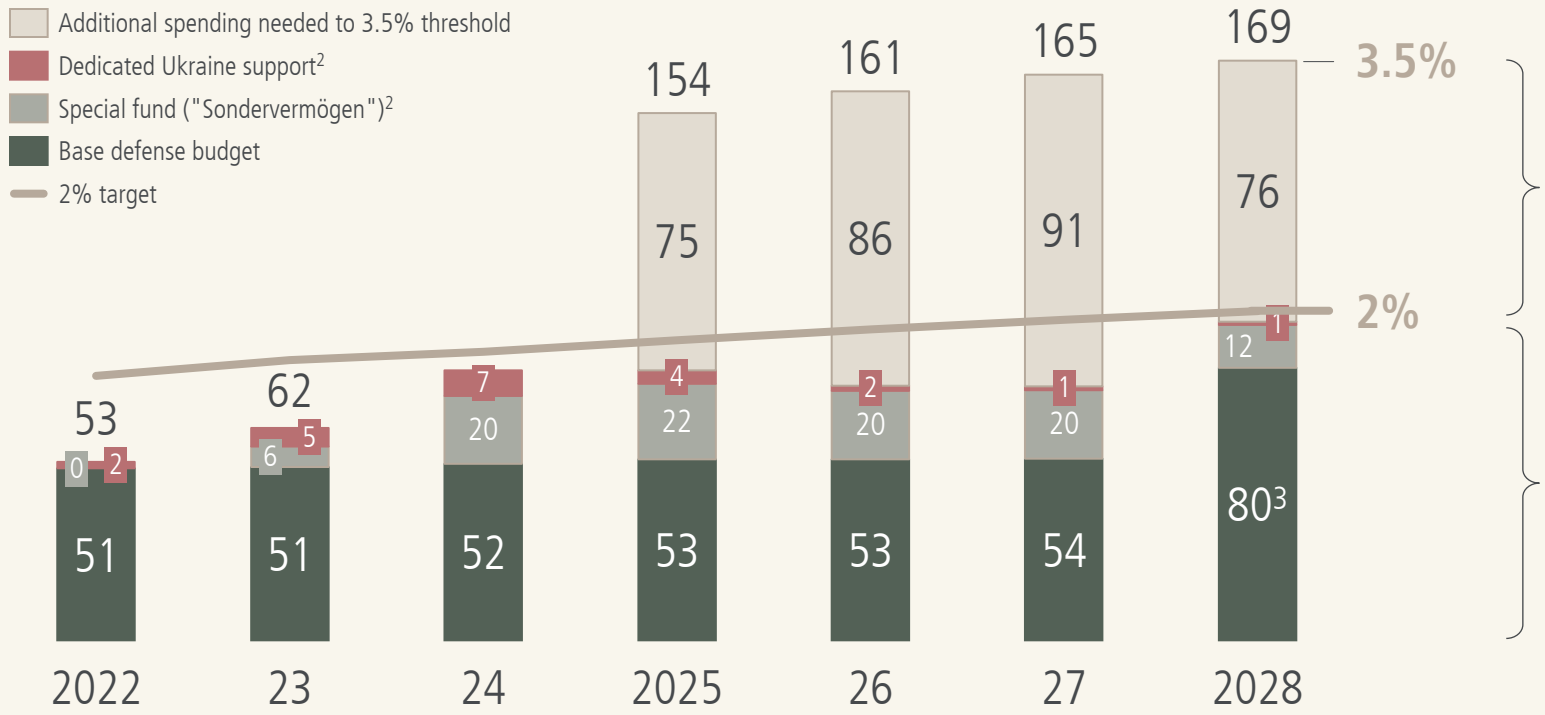
1) Average of German defence spend share of GDP 1960-1989 ~3.3%
Source: NATO reporting, World Bank, expert interviews

For Germany to reach the 3.5% level, >€150bn in defence spend per year would be required from 2025 onwards

Defence budget plans for Germany[1] and additional spending need identified

€ billion (current year)



~€330bn total additional spend vs. planned budgets

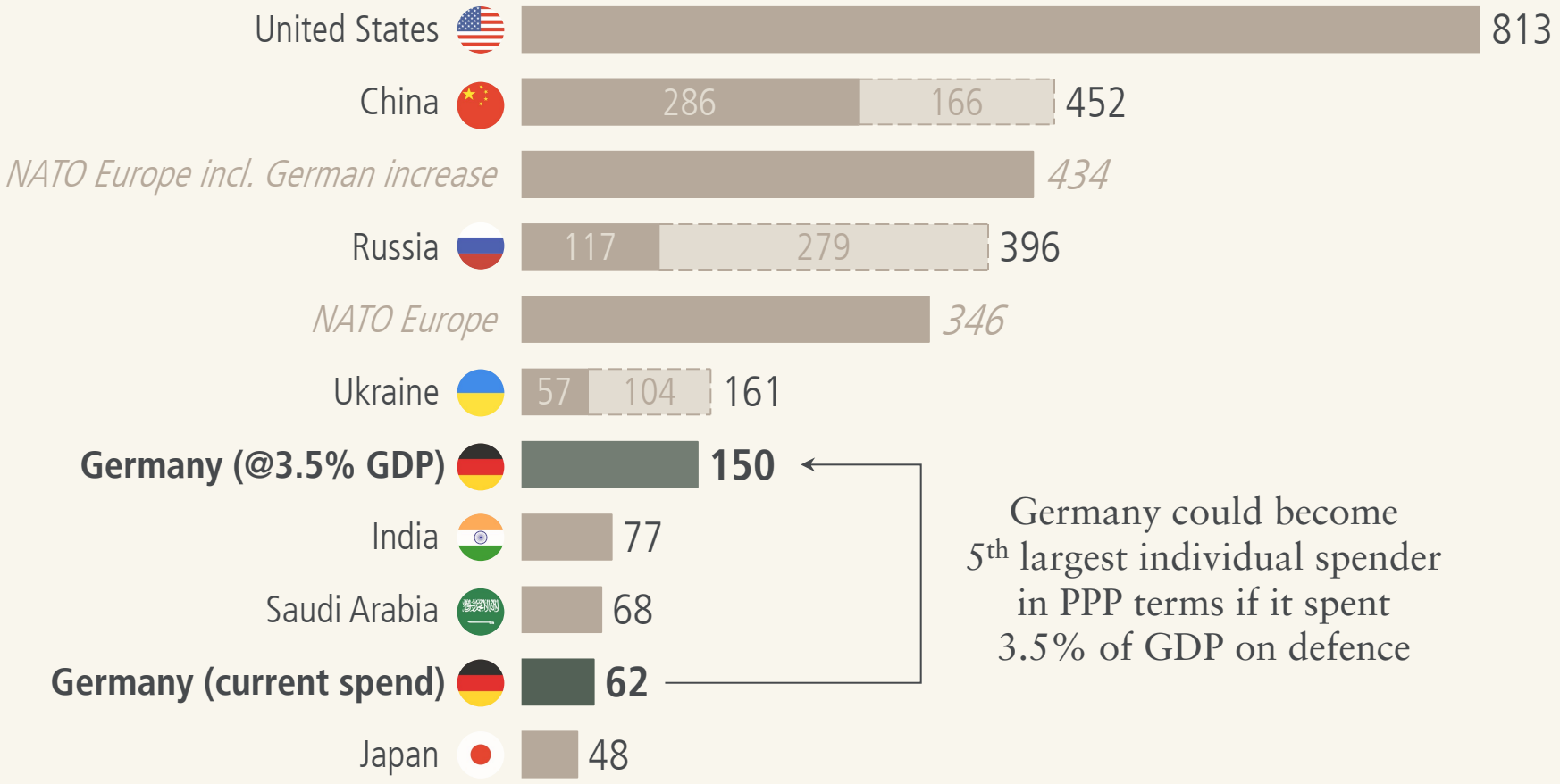
Currently planned defence budget for Germany is materially **lower than 3.5% threshold and largely flat until 2028**

1) Including base budget (Einzelplan 14), extra funding ("Sondervermögen") and Ukraine support (Einzelplan 60), excluding "additional defence spending" reported by German government not directly related to defence (e.g., interest payments)
2) Actual spending for 2022/23; planned spending for 2024/25; estimated spending for 2026-28; 3) Source of funding of significant increases compared to prior years currently not confirmed
Source: German MoD Budget Documentation; German MoD budget draft 2025; German Federal Statistics Office; IHS; IMF (GDP projections)

With €150bn of annual defence spend, Germany would reach the global top 5 in PPP terms

Annual defence spend 2023
€ billion[1]

Additional defence spending based on PPP & expert estimates

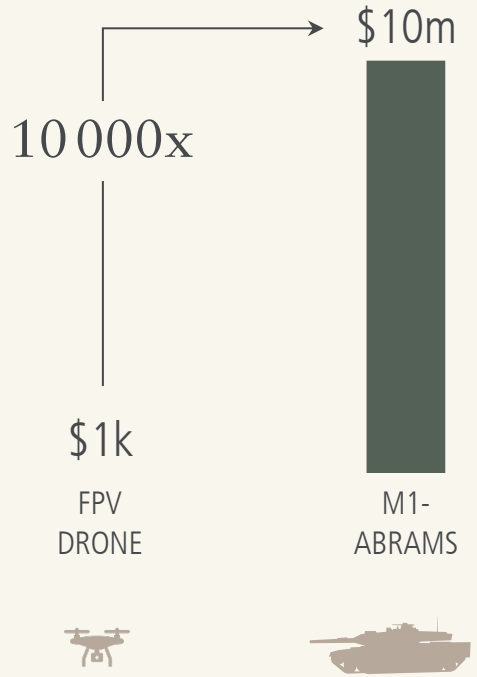


Germany could become 5th largest individual spender in PPP terms if it spent 3.5% of GDP on defence

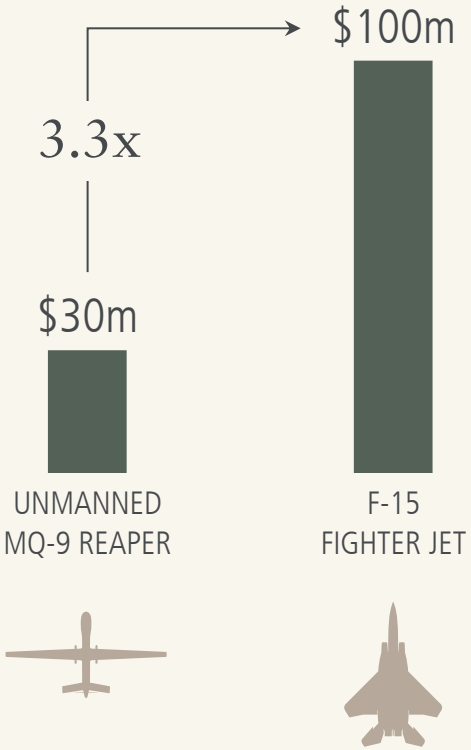
1) Defence spend for China, Russia and Ukraine (50%) in PPP terms (based on 2022 constant prices)
Source: SIPRI, Bundeshaushalt, NATO, militaryppp.com

When spending the €150bn defence spend, the cost asymmetry of new and established weapon systems drives allocation to tech solutions

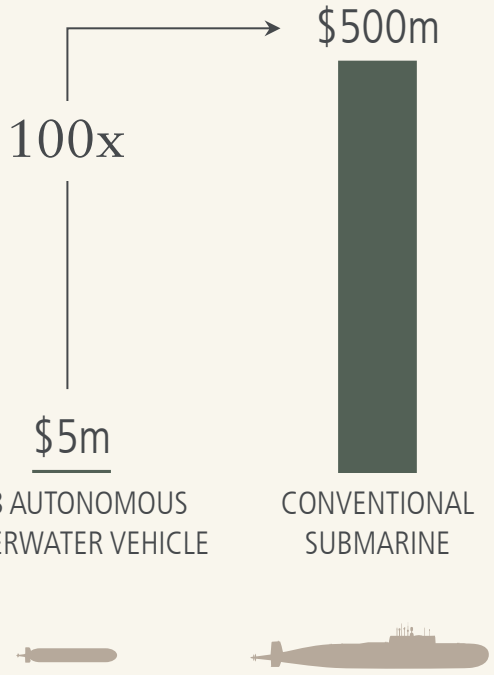
One $1k-FPV-Drone can destroy a $10m-Tank[1]



MQ-9 Reaper Drone costs a fraction of a Fighter Jet[2]



New AUVs are cheap and operate without staff[3]



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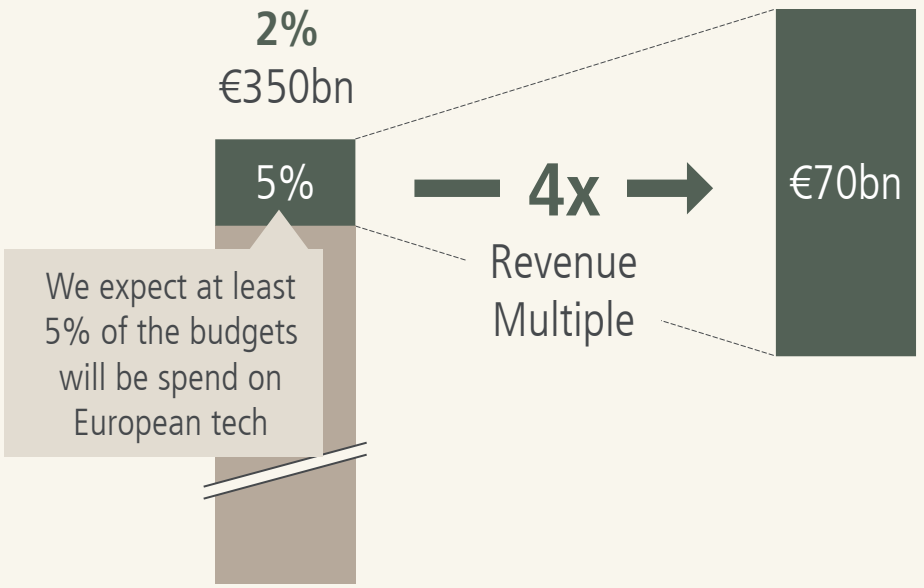
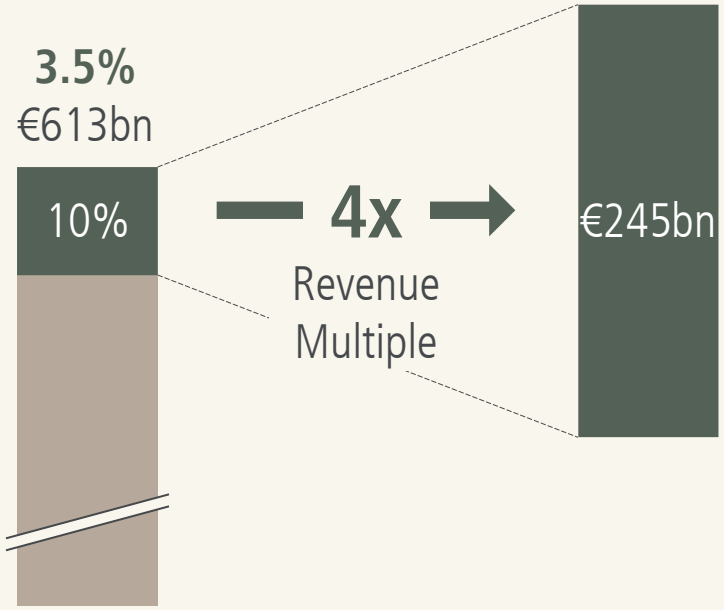
1) Source: The Telegraph; 2) Source: defencetalks.com; 3) Source: MarketsandMarkets

We expect European defence budgets to rise significantly, creating an annual market cap opportunity of up to €245bn for European tech

TODAY:
NATO Europe spends 2% of GDP



POTENTIAL FUTURE SCENARIO:
NATO Europe spends 3.5% of GDP



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Sources: 2024 Defence Spend – NATO Press Release (2024); Own Calculation

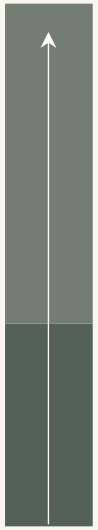
ECONOMIC BENEFITS & FINANCING ADDITIONAL SPENDING

If deployed in the right way, the defence spend of >€150bn could also bring significant economic benefits, justifying a temporary debt increase

Estimated implied economic impact of ~€90bn local defence investment[1]

Additional GDP

70-180bn



Additional tax revenues

20-35bn

Additional household income

40-60bn

Non-quantifiable benefits

Increased competitiveness & resilience of new & traditional local industry through **accelerated build-up of capabilities**

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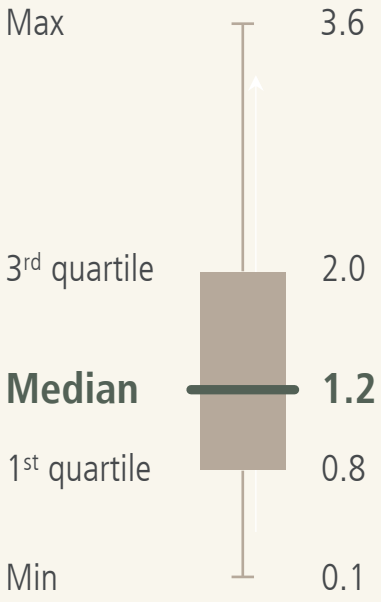
1) Considering ~53% investment share (equipment, infrastructure and 50% of operations & maintenance) of total additional defence spend of ~€330bn over 4 years of which 50% are invested locally
Source: Own calculation based on consensus estimates of economic impact of defence investment (background see next page)

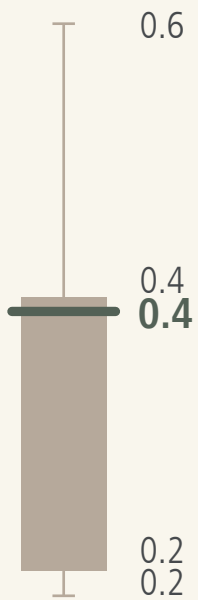
Background:
The impact of additional defence investments on the broader economy has been well-documented across multiple different instances

Impact of defence investments on broader economy, multiplier unless indicated

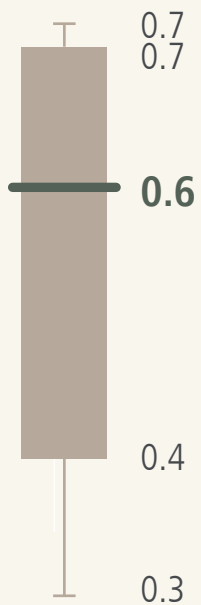
€70-180bn added GDP



€20-35bn added taxes



€40-60bn added household income



Non-quantifiable benefits

Increase economic competitiveness based on fostering of innovation and attraction of private funding for start-ups & established industry

Development of talents through capability development, research & education build-up

More agile processes and **scaling** of industry & administration

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Source: Oxford Economics, RAND, EDA, Case studies

Investment in European Defence Ecosystem paramount for economic upside

Economic benefits of defence spend require **investment in Europe to materialize locally**

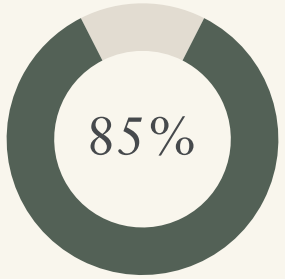
Some countries already spend mostly in Europe

To capture economic benefits locally a **target ratio >50%** should be attained & is thus reflected in the benefit model

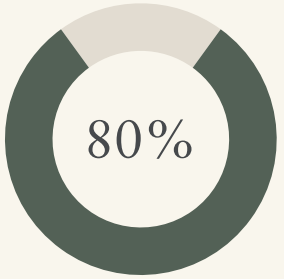
OUTSIDE-IN ASSESSMENT

Share of European defence spend on equipment with European recipients

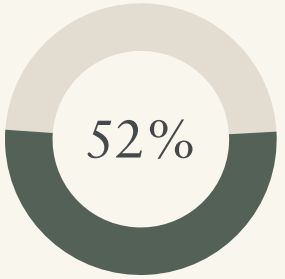
Italian defence programmes



German special fund

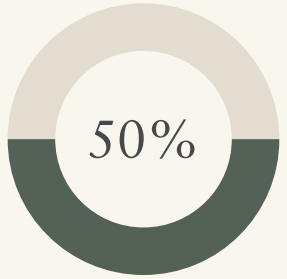


EU defence spend



Potential target

Used for economic benefit modeling



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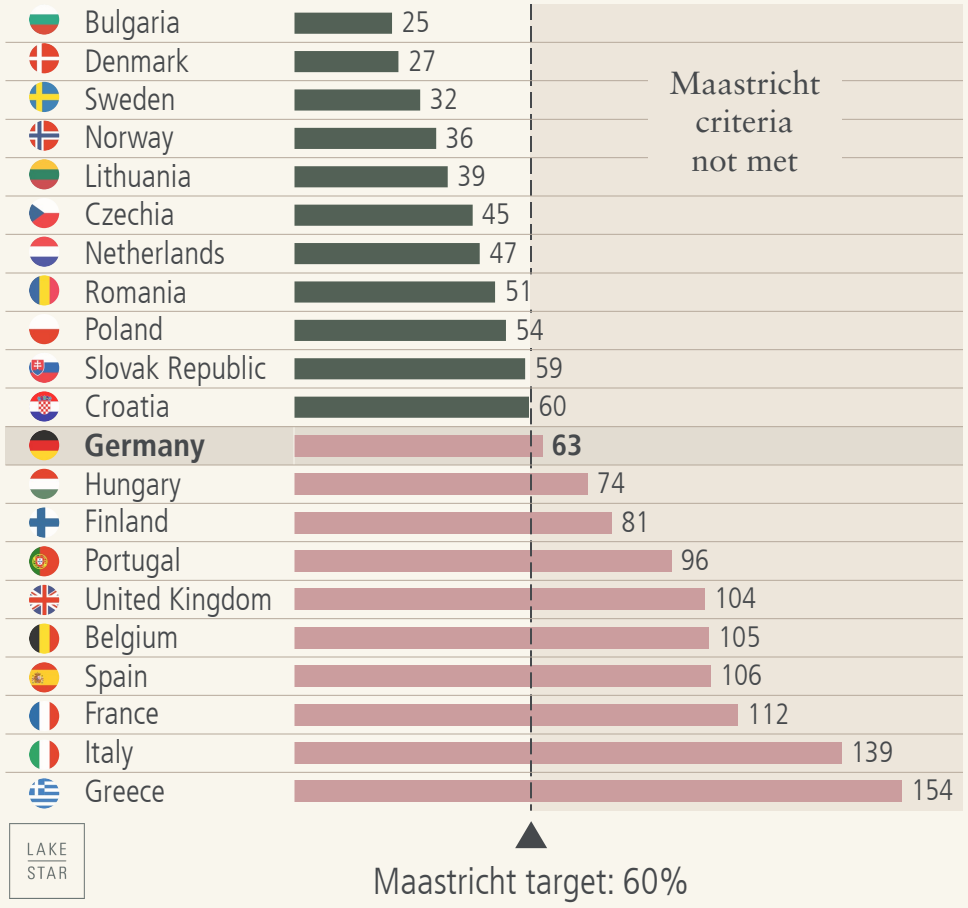
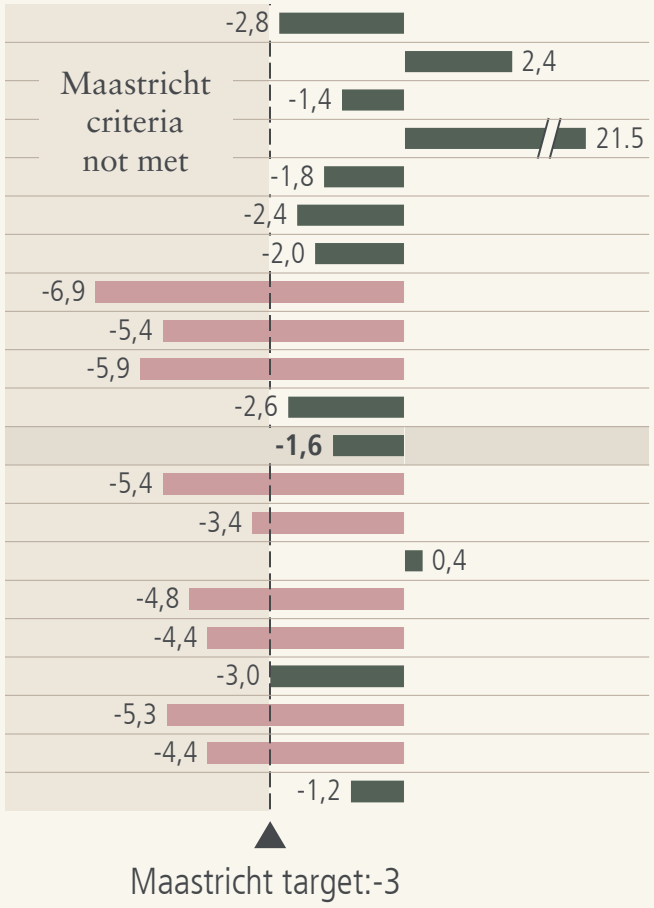
Source: Institute of Strategy Studies (2024); German Defence Budget Draft for 2025; Italian DPP 2024-26

Considering the severity of the situation, there is still room to borrow for countries like Germany

Public debt 2024[1], % of GDP



Budget deficit 2024[1], % of GDP



Using debt for funding more defence spend is limited by the European Union's Maastricht criteria for financial stability

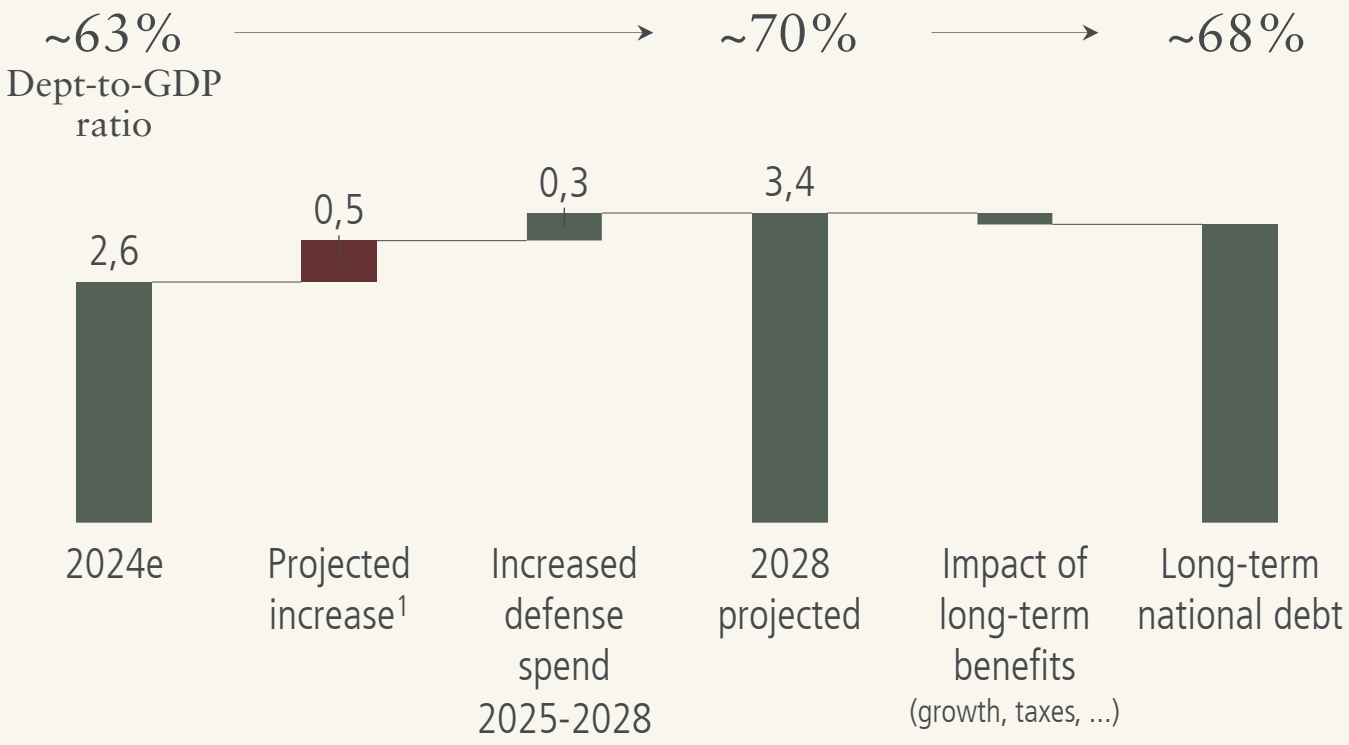
Even today, most European NATO countries violate one or both criteria, **only 8 countries meet both targets**

Key countries such as Germany, France, Italy, or the UK **do currently not meet the criteria.**

1) European NATO members with largest defence spending
Source: German Federal Ministry of Finance

If temporary debt increases can be compensated by GDP growth, debt-to-GDP ratio would only rise moderately to ~68% in the long term

German national debt, € trillion



Key considerations:

A moderate[2] and **temporary – not structural** – debt increase could be justified by long-term economic benefits

Requires that labor / **resource supply is not constrained** (otherwise only inflation rises). Given the **transformation in the German auto industry**, such supply may be available

Modeling of economic benefits assumes **~50% of the defence investment is local**

A temporary increase in debt would require a **constitutional change** to allow additional debt

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1) Conservative estimate assuming constant debt-to-GDP ratio of ~63%, dependent on future policy decisions, currently planned increase amounts to ~0.2 bn EUR
2) For comparison: In 2010 after Financial & Euro crisis the German debt-to-GDP ratio was 82%; the US debt-to-GDP ratio in 2023 was about 123%
3) Source: Own calculations based on data by Deutsche Bundesbank (debt level), the IMF (GDP projection), the German Federal Ministry of Finance, and economic impact models (see prior pages)

ADVANCING DEFENCE INNOVATION

Using €150 billion defence spend constructively requires a joint ecosystem with mutual trust

Joint ecosystem

€150 billion defence spend will create benefits across stakeholders when spent constructively

ARMED FORCES

Faster delivery & more innovative equipment through simplification of procurement, harmonized requirements & acceptance of non-national European equipment

INDUSTRY

Predictable long-term demand signals and support to decrease 2-4x higher fragmentation[1] through **aligned industrial agenda**

ENTREPRENEURS

Successful "stars" compensating for **5-year deal time lag** of Europe vs. US[2] & **innovation hubs** to bring together public & private spaces

INVESTORS

Upside revenue & valuation potential from defence deep tech customers; however, **adjustments to ESG taxonomy** and increased focus on **European sovereignty** required

BROADER SOCIETY

Improved national security and economic benefits from GDP growth & spillover effects

LAKE STAR

1) In the European defence industry compared to the United States (i.e., number of leading defence primes per platform segment); 2) Based on number of deals

Industry would benefit from a coordinated defence agenda given 2-4x higher fragmentation of European defence industry

Europe[1] vs. US defence industry fragmentation

Number of prime contractors by major platform (examples)

	Europe		US	
Combat aircraft[2]	6	LEONARDO, AIRBUS, DASSAULT AVIATION, BAE SYSTEMS, Aero Vodochody, SAAB	x1.5	4	LOCKHEED MARTIN, TEXTRON, BOEING, NORTHROP GRUMMAN
Main battle tanks	8	GENERAL DYNAMICS, CIO, RHEINMETALL, KNDS, BAE SYSTEMS, PGZ, UkrOboronProm	x4	2	BAE SYSTEMS, GENERAL DYNAMICS
Large surface combatants	8	Navantia, NAVAL GROUP, babcock, FINCANTIERI, BAE SYSTEMS, LÜRSSEN, DAMEN, thyssenkrupp	x2	4	HII, FINCANTIERI MARINETTE MARINE, AUSTAL, GENERAL DYNAMICS

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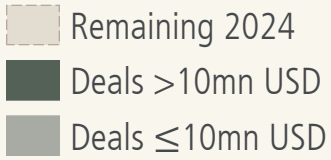
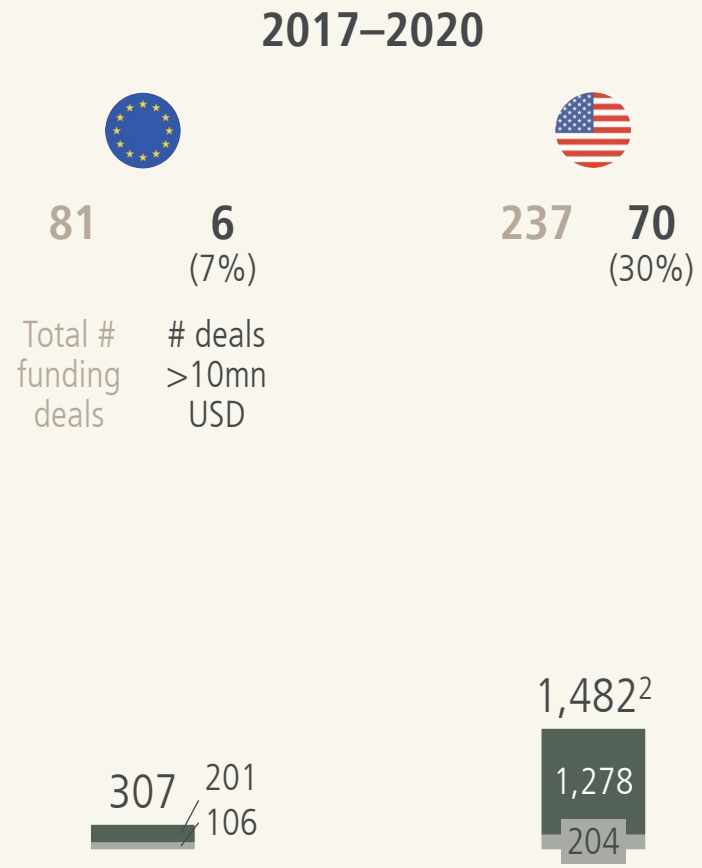
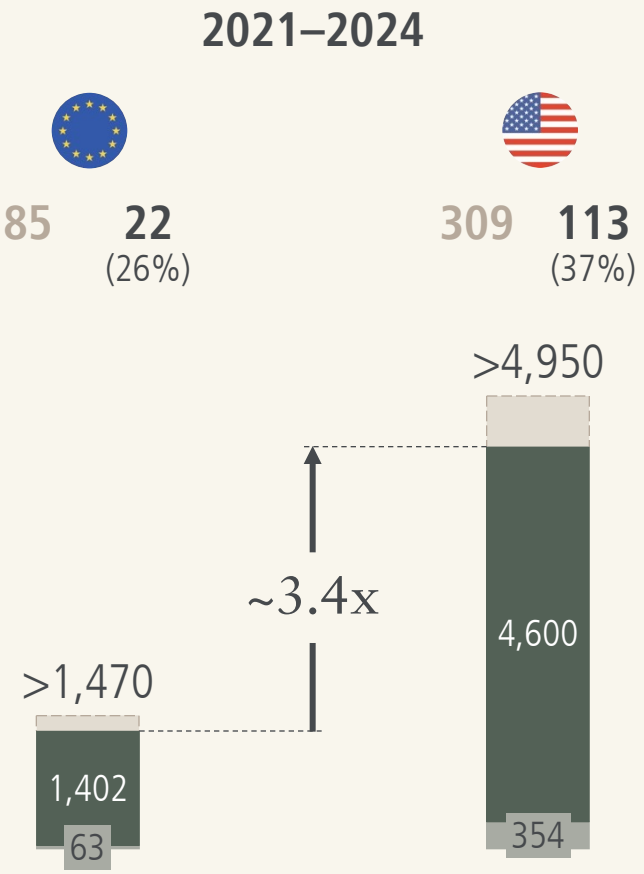
1) All European countries including Ukraine but excluding Turkey; 2 Jet powered combat aircraft including light attack aircraft
Source: TEAL Group, Jane's All the World's Aircraft; armyrecognition.com; army-technology.com; Weyers Flottentaschenbuch, IndustriALL, Europäische Strategie und Technik

Defence Tech startups benefitted from growing deal volume 2021-24. Still, ~5yr time lag of US & Europe shows further growth opportunities

Total deal volume for Defence Tech startups in Europe and the US[1]
USD million







BASED ON PUBLICLY-AVAILABLE DATA

1) Incl. VC, Incubators, Business Angels and other venture funding; excl. PE & Corporate funding; 2) 2018-2020
Source: Pitchbook (June 2024)

Adding defence as customer set for deep tech startups may increase demand and create valuation upsides

Defence as an **additional customer set** for deep tech startups may increase demand and create valuation upsides when part of **~€120bn annual defence procurement spend** in NATO Europe is captured by startups

Current and future pillar of the European ecosystem

Key partner for **NATO defence modernization** by deploying AI for decision support and threat analysis

BASED

Official Security & Defence Hub of the Digital Hub initiative of the Federal Ministry for Economic Affairs[3]

isar aerospace

Accessed ~36 times private funding per Euro of public orders received[2]

Auterion

Addresses a $300 bn market and is already the common OS for the US DoD to standardize on[3]

LAKE STAR

1) Based on reported 2023 revenues of ~37 mn EUR and a latest valuation of 4.95 bn EUR
2) Based on statements made by the CEO in public: "With 11 million Euro of public orders we have collected 400 million Euro of funding from private investors."; 3) Based on company reports
Source: Company statements as disclosed above

Recap

Acting now on Germany's defence spend would help address the security situation, capture economic benefits, and ignite the innovation ecosystem

While Europe is facing its **biggest threat in decades** it is currently **falling short along all dimensions of the defence equation:** Funding, military equipment & personnel, industrial depth, and innovation

Going forward, if **German defence spend were to increase to ~3.5% of GDP, i.e., >€150bn p.a.,** a more credible deterrence position would be developed

Higher defence investments could bring **significant economic benefits** (e.g., increasing GDP by **~€70-180bn)** and may warrant a (temporary) debt increase

To establish a virtuous cycle within a European defence innovation system, the needs and requirements of the most important stakeholders must be met: **armed forces**, the **defence industry**, **entrepreneurs**, **investors**, and **society at large**

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