# INDEX MONITOR OF THE INTERNET INDUSTRY: INFLUENCE OF ARTIFICIAL INTELLIGENCE

Updated Report 2023

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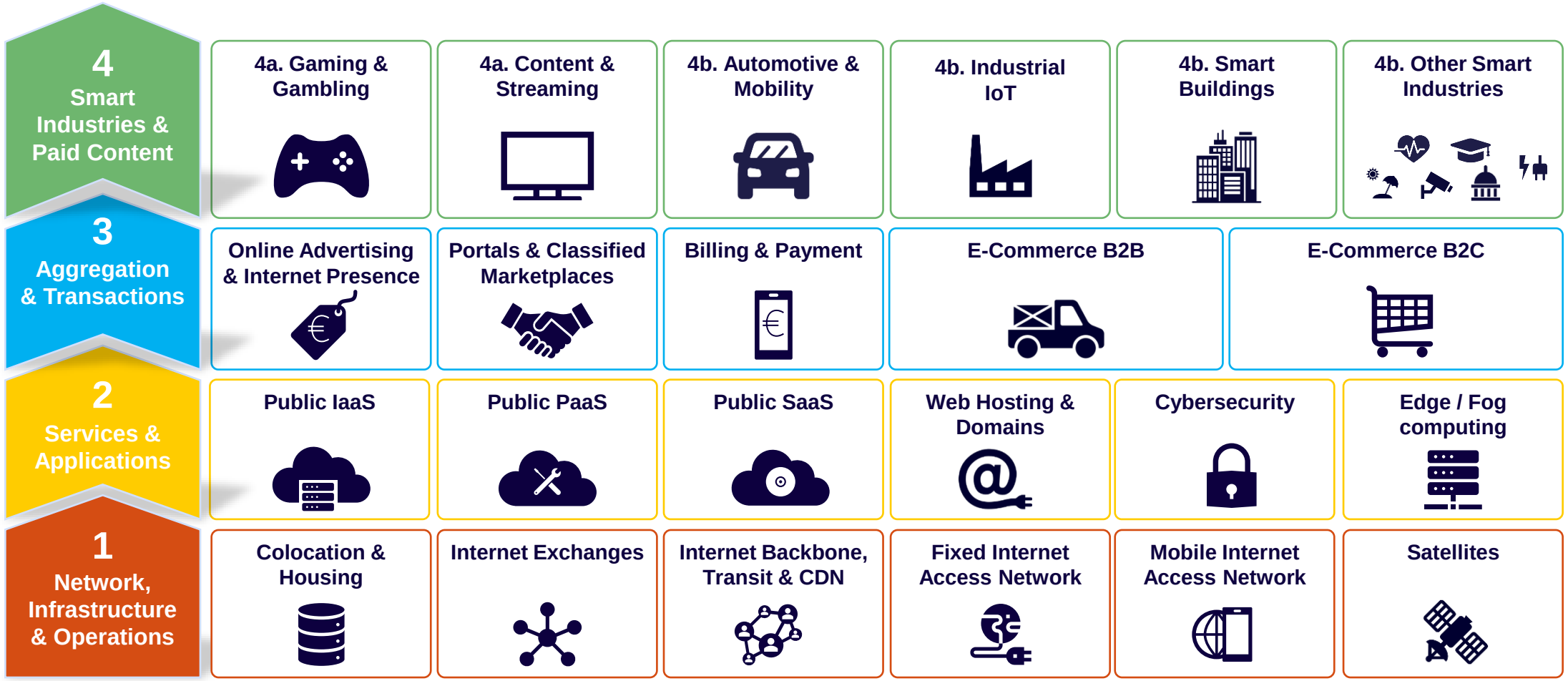
eco ASSOCIATION OF THE INTERNET INDUSTRY

ARTHUR D LITTLE

# eco Association & Arthur D. Little have compiled an update of the study on the Internet industry in Germany for 2023-2025, with a special focus on AI




**The eco / Arthur D. Little layer model for mapping the Internet industry continues to serve as the basis for the eco Index**

Source: Arthur D. Little & eco

# Incidents such as the Covid-19 pandemic, inflation, the Ukraine crisis and AI development have impacted the Internet industry

## Macro Factors 2020 et seq.

### 1 Covid-19 pandemic

- Covid-19 led to an **upswing** in TMT sector **revenues**, primarily due to **work from home** and, consequently, increased spending on TMT services by the population
- A €750 billion Covid economic stimulus package was introduced for the German economy, covering all sectors and partially financing the expansion of TMT

### 2 Inflation

- Acceleration of total revenues across all four levels of the TMT sector, due to inflation and **unit price increases**
- Expectation that the phase of high **growth** and inflation will be followed by a **corrective phase** in the short term
- The Federal Reserve increased the **interest rate** from ~0% to 4.75-5.50% (Q1 2022 to Q3 2023), while the EU raised **interest rates** from 0% to 4.50% (Q1 2022 to Q3 2023), resulting in higher **borrowing costs** for the TMT industry

### 3 Ukraine-Russia war

- **Energy price spikes ($60/bbl** → $130/bbl 2021-2022) due to sanctions against Russia, which supplied 42% of European gas and 30-50% of European oil, also leading to TMT price increases
- **Raw material and labour shortages** causing delays and price increases in TMT projects

## Artificial Intelligence

### 4 Economic recovery & AI developments

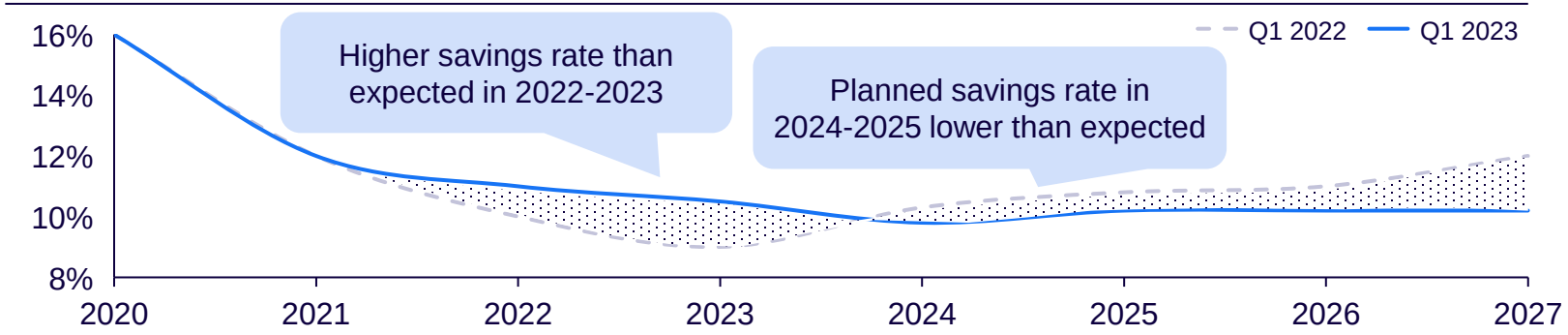
- Recovery of **German economy** could begin end of 2023
- **AI take-off anticipated** as governments and companies invest in advancing AI capabilities
- Advanced language models that utilise **artificial, neural networks** for text generation (e.g. ChatGPT)
- Enhanced **AI Regulation** in the EU to ensure unified and ethical usage

Source: Arthur D. Little & eco

# We anticipate an advanced economic recovery, due to an atmosphere of optimism and a rise in consumer spending

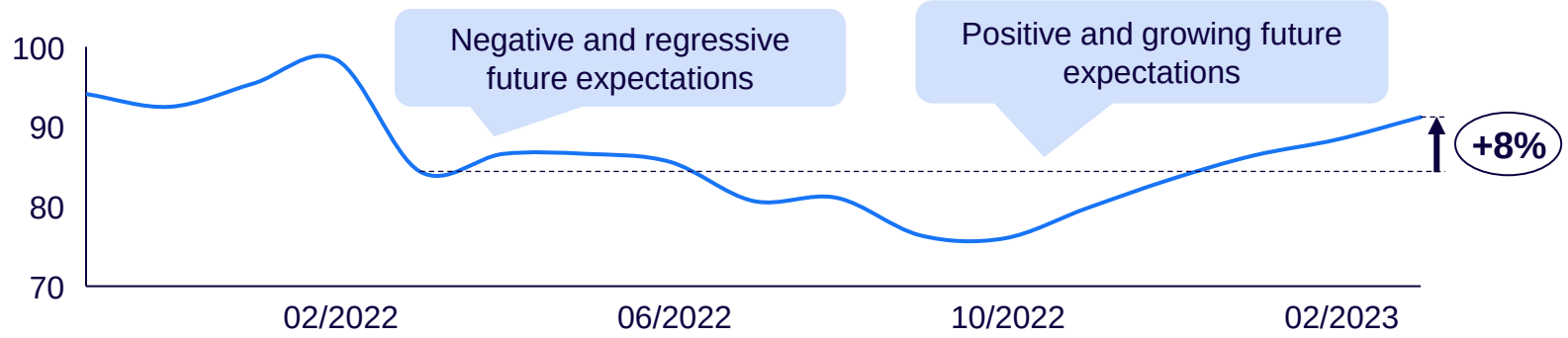
## Savings Rate

% of disposable income




## ifo Business Climate Index[1]

Index, 2015 = 100, monthly release




### Observations

- Q1 2023 shows **higher** 2022-2023 **savings rates** and **lower** expected 2024-2025 savings rates compared to Q1 2022
- Economic **recovery** in the Euro zone **exceeds** forecasts for Q1 2022, driven by the **services sector**
- The ifo Business Climate Index for Q1 2023 shows an **increase** of 8% compared to the previous year and thus an **upward trend**, indicating a **revival** of **economic activity** from Q3 2023 onwards

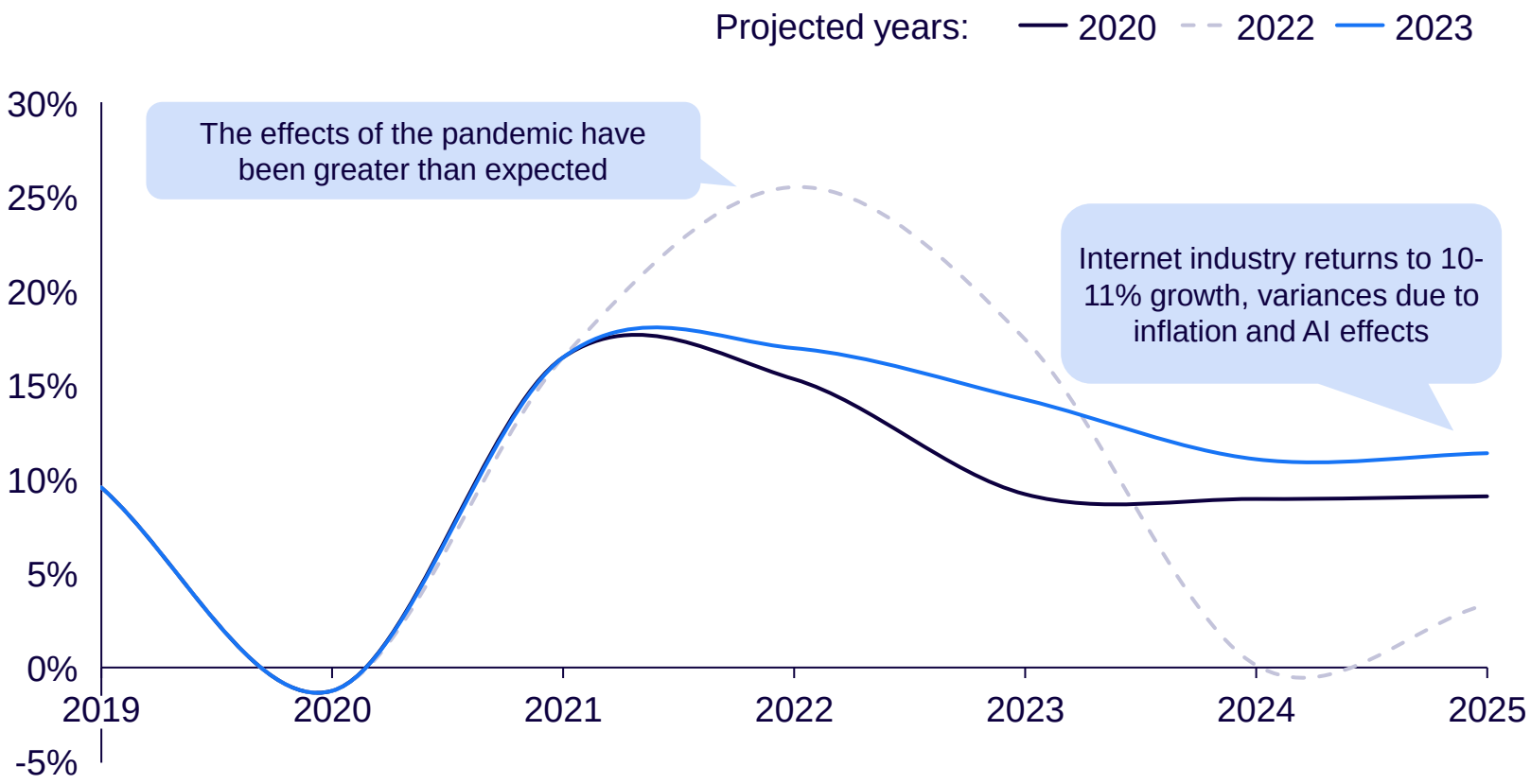
Source: Deutsche Bundesbank, Arthur D. Little & eco

Note: 1) The ifo Business Climate Index is based on approx. 9,000 monthly responses from the German business community. The companies are asked about their assessment of the current business situation and their expectations for the next six months; the net figures of the was calculated by getting the difference between the percentages of the responses "rather favorable" and "unfavorable."

# Current forecasts predict a return to similar Internet industry growth rates of 10-11% by 2024

## Growth Rates of the German Internet Industry

% from year to year, for the 2020, 2022 and 2023 projected years




## Observations

- **Growth rates** for 2022-2023 revised downwards as **inflation** has lasted longer and **economic** recovery has been delayed until the end of 2023
- As a result of the adjustment to the new conditions, we expect a return to **growth rates** of 10-11% in 2024-2025, driven by a favourable business atmosphere and an expected increase in **consumer spending** and real wages

Source: Arthur D. Little & eco

# In the short term, growth is fueled by inflation – In the medium term, we expect a higher organic growth rate of 9-11%

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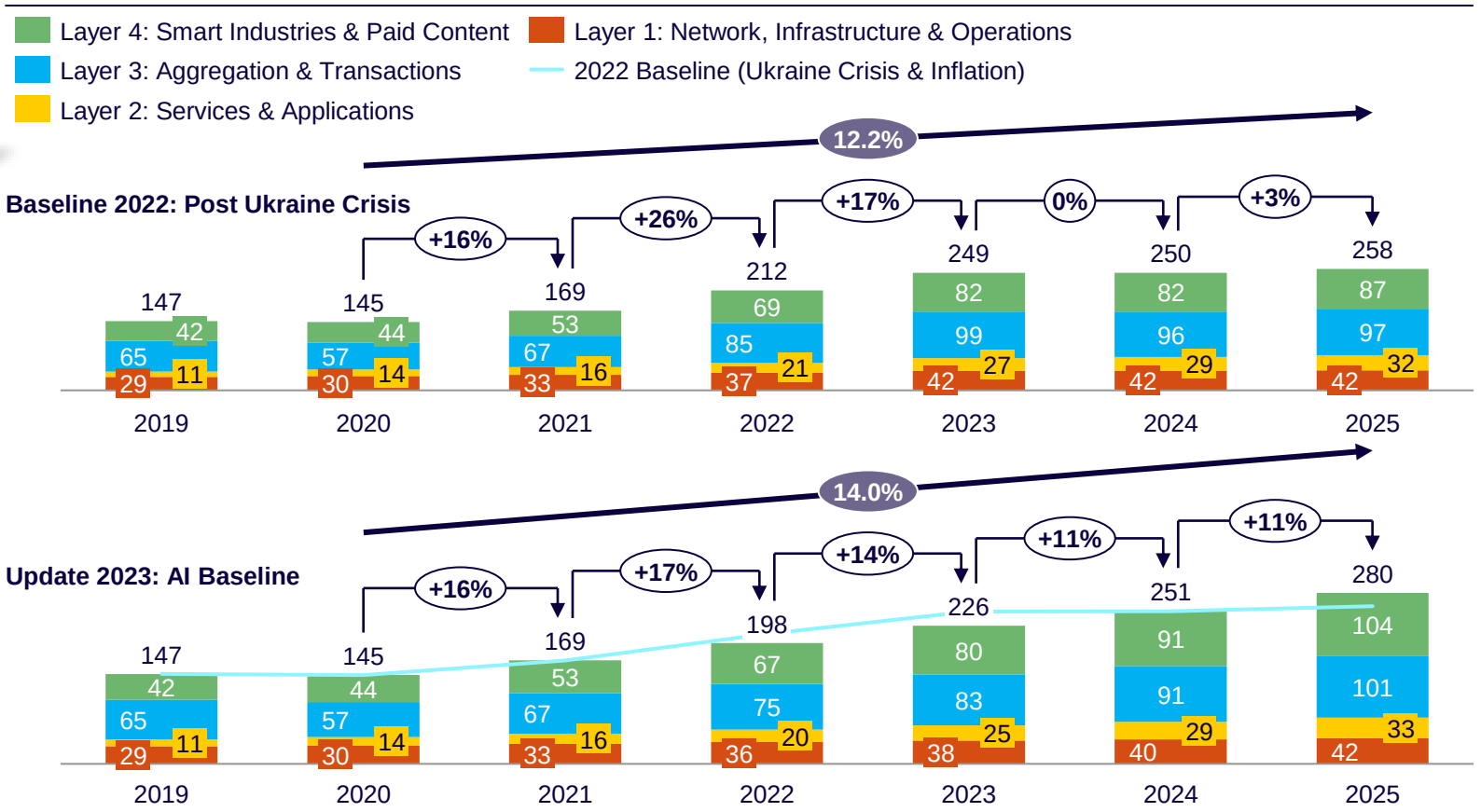
## Revenues of the Internet industry in Germany

EUR bn 2020-25




## CAGR of the Layers

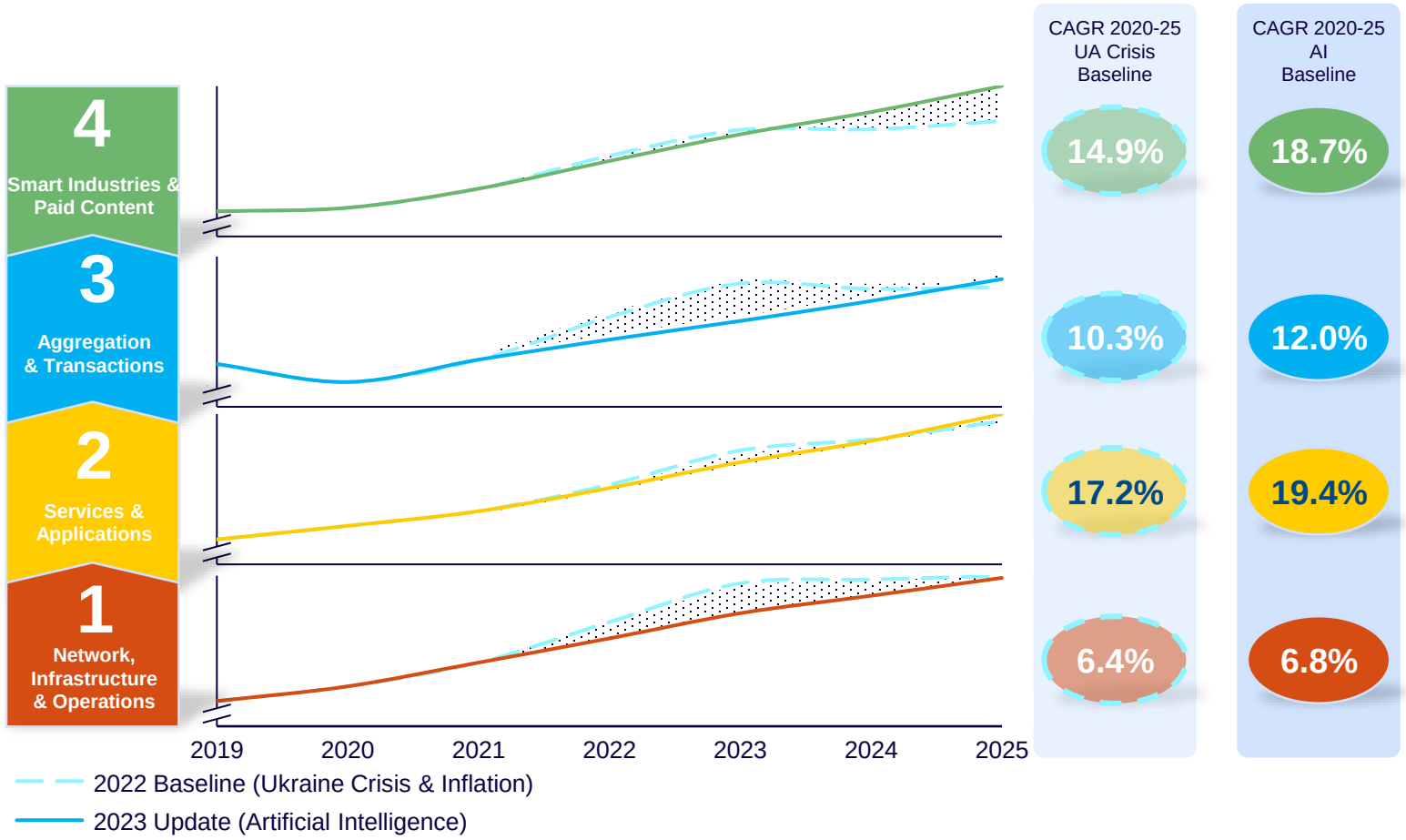
| | CAGR 2020-25 UA Crisis Baseline | CAGR 2020-25 AI Baseline |
|---|---|---|
| Layer 4 | 12.2% | 14.0% |
| Layer 3 | 14.9% | 18.7% |
| Layer 2 | 10.3% | 12.0% |
| Layer 1 | 17.2% | 19.4% |
| Layer 1 | 6.4% | 6.8% |

Source: Arthur D. Little & eco

# Based on positive signals on Germany's economic recovery and the implementation of AI, we anticipate a moderate increase in CAGR

## Effects on the individual layers of the Internet industry

EUR bn revenue 2020-25




## Observations

Revenues will increase due to **higher vendor pricing** and **growth** in the **smart buildings** and **healthcare** segments

**Acceleration of growth** through enhanced **economic recovery** in 2024-2025, supplemented by **AI-enabled adjustments**

IaaS/PaaS revenues will increase due to **rising prices** and the ongoing momentum towards **digitalisation** and **teleworking**

**Revenue growth** will stem from an increase in **traffic volume** and **price rises**, in order to offset rising **network investment costs**

Source: Arthur D. Little & eco, Short term = 2023-24, Medium term = 2025.

# Adjustment of the previous forecast for 2023, based on a more conservative assessment of inflation and demand effects

## 1 Network, Infrastructure & Operations

- **11% increase in revenue of Internet Exchanges** due to a 25% increase in German **data traffic** in 2022
- DE-CIX plans to expand its **Internet backbone** by 1,500 km in **2023**, representing a **5%** increase by the **end of 2023**

## 2 Services & Applications

- Edge and fog computing: **35%** growth expected **by end of 2023**
- Moderate demand for public PaaS and SaaS due to high **inflation** and interest rates, as well as **reduction** of **capital costs** for own infrastructure

## 3 Aggregation & Transactions

- Due to high **interest rates**, citizens will shop **less** online than envisaged, resulting in **lower** e-commerce **revenues**
- Decline in **e-commerce consumption** will impact related areas such as **payment transactions**, portals and marketplaces

## 4 Smart Industries & Paid Content

- Stronger focus on the **medical & healthcare** sector due to ageing population
- High **energy prices** will lead to ~23% growth in smart buildings via **energy-saving measures**

2023 Growth Forecast (Index 2022 vs Index 2023)


Source: Arthur D. Little & eco

# Adjustment of our previous forecast for 2024-2025, given the expected recovery of the economy and the gradual adoption of AI layers

## 1 Network, Infrastructure & Operations

- **Main drivers**: Mobile and fixed Internet access, with **price increases** by operators
- **Modern mobile and digital** applications require a higher level of data traffic
- An expected incremental **adoption** of **AI** (e.g. in customer service)

## 2 Services & Applications

- Public **PaaS and IaaS services** poised for rapid growth (~20%) as the economy recovers
- Higher deployment of AI in these **tech-savvy**, **flexible** companies

## 3 Aggregation & Transactions

- Forecast of an **upturn** from Q3 2023 onwards as growth in **international** trade impacts B2B e-commerce
- Growth in **B2C e-commerce** and **marketplaces** due to rising **wages** and household **expenditure**

## 4 Smart Industries & Paid Content

- Growth rate of **10-15%** for paid content **providers** due to **economic recovery**
- **Growth** in **smart buildings** layer, as is the case in the **USA**
- Significant **growth** in **AI-enabled biotech start-ups**

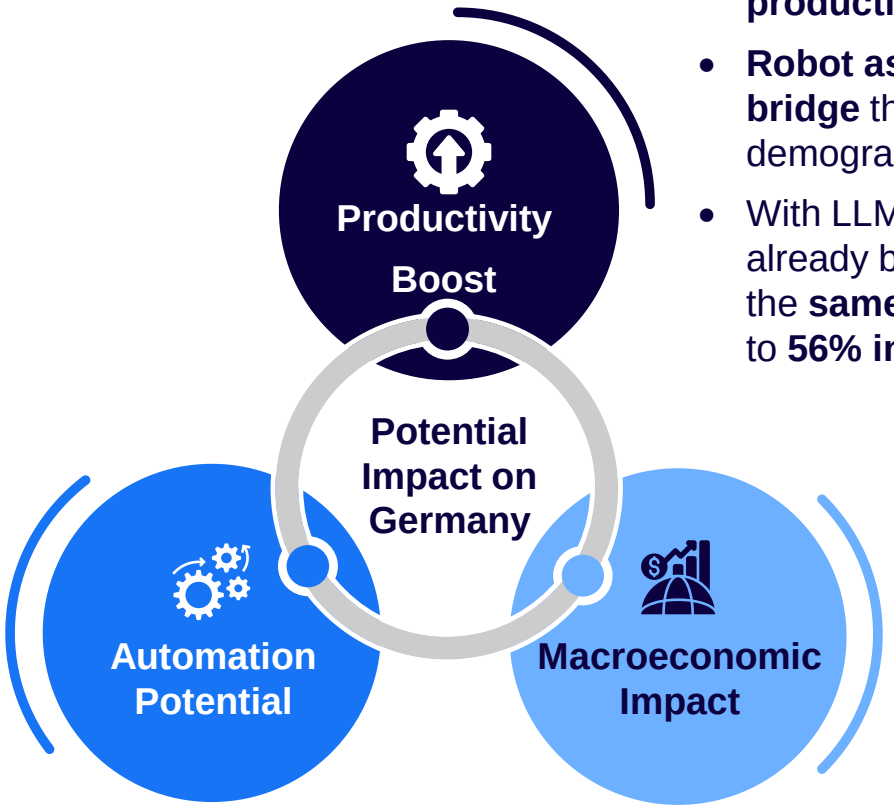
2024-2025 Average Growth Forecast (Index 2022 vs Index 2023)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.0% | vs | 4.9% | 9.1% | vs | 15.7% | -0.8% | vs | 10.1% | 2.6% | vs | 13.9% |

Source: Arthur D. Little & eco

# Small impact by AI on the Internet industry's revenue in the short-term – we expect increased effects in the medium-, and significant growth contribution in the long-term

- Bot programs that can **operate independently of humans** (self-learning capability)
- **Applications** with the highest **automation potential**: process automation, virtual agents, data visualisation, recommendation systems, language analysis
- The decisive factor will be how AI can be used to automate and **release capacities** for value-added **growth**



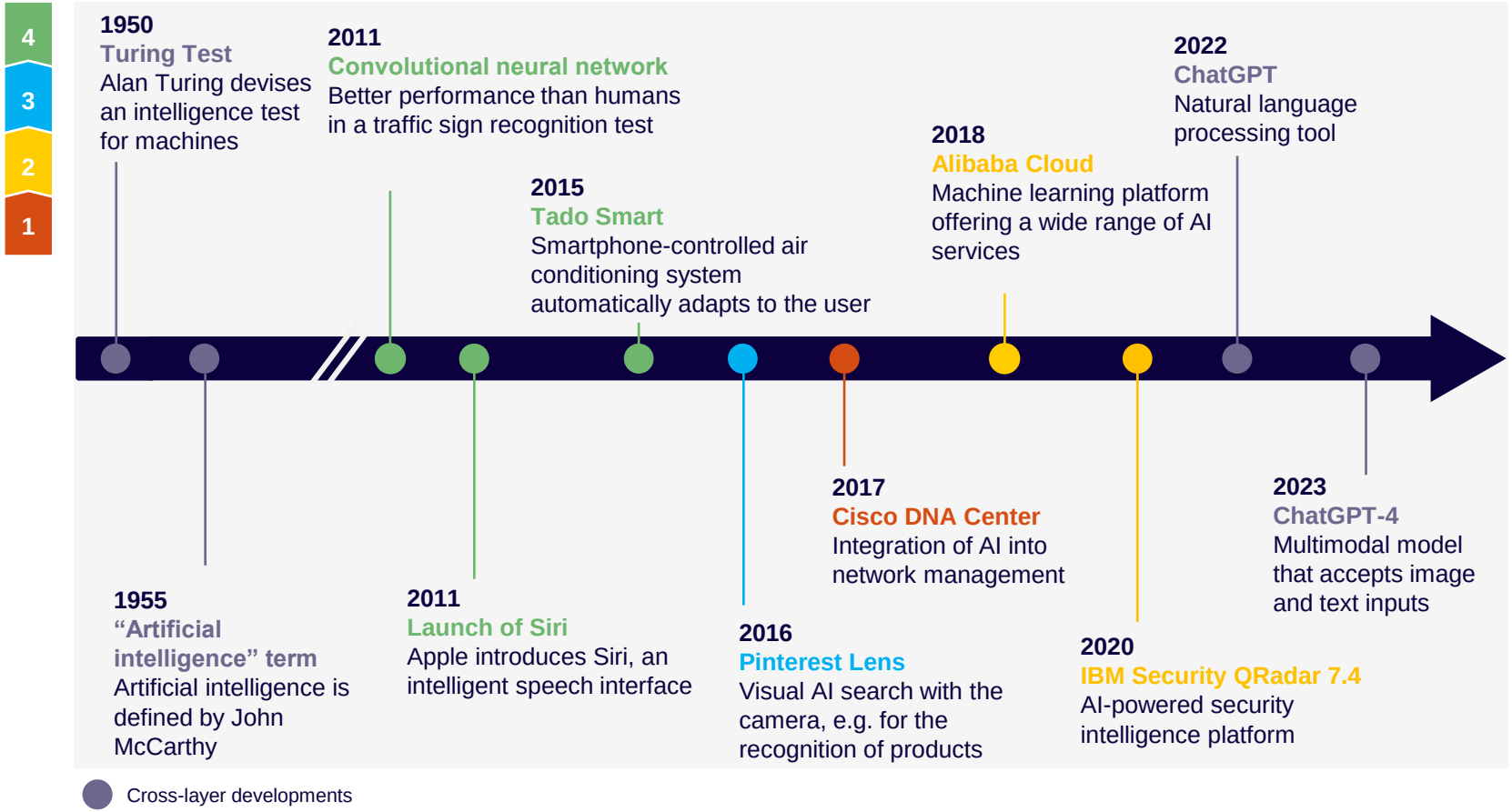

- In Germany, AI-supported work may increase **productivity** annually by **0.8-1.4%**
- **Robot assistants** serve as a **means** to **bridge** the **age gap**, resulting from demographic transition
- With LLMs, **15% of all work tasks** could already be completed more quickly and with the **same quality** today; this share could grow to **56% in the future**

- Rapid **AI implementation** ensures long-term **competitiveness** in **international comparison** and helps achieve **growth targets**
- AI can impact **sustainability goals** by focusing on **sustainable data sources** and **infrastructures**

LLM = Large Language Model
Source: 'InData Labs Latest Development of Artificial Intelligence' report, 'GPTs are GPTs: An Early Look at the Labour Market Impact Potential of Large Language Models', Arthur D. Little & eco

# The development of artificial intelligence (AI) has been evolving for decades and is increasingly taking on a transformative role in a wide range of areas

## Overview of Major AI Developments




## Future Outlook

- AI has reached another **milestone** and has already begun to significantly **transform** most industries
- Public and private **investment** in AI will **increase**, in order to accelerate **innovation**
- Further development of **AI regulations** and **guidelines** for the appropriate use of AI, in order to **complement** human intelligence and skills
- Increased use of AI in various **countries** and **industries**
- Defining **ethics** and **morality** in AI advancements

Source: Arthur D. Little & eco

# AI promises significant growth across all layers of the Internet industry in the short, medium and long term (1/2)

| | Short term (0-2 years) | Medium term (2-5 years) | Long term (5+ years) |
|---|---|---|---|
| 4 Smart Industries & Paid Content | • Boost of AI-driven voice assistants like Amazon Alexa, Siri, Google Home... | • Performance of a medical image analysis for disease diagnosis and treatment planning | • Facilitation of predictive maintenance in manufacturing and healthcare |
| 3 Aggregation & Transactions | • Provision of personalised product recommendations and optimised pricing strategies | • Provision of AI-assisted virtual shopping assistants and upgraded product tips | • AI-assisted virtual try-on and augmented reality shopping experiences |
| 2 Services & Applications | • Provision of real-time threat data and security analyses | • Optimisation of cloud computing environments to ensure efficient use of resources | • Development of fully autonomous AI-driven cybersecurity systems |
| 1 Network, Infrastructure & Operations | • Optimisation of network traffic and enhancement of network performance | • Network operations automation such as configuration management, device provisioning and software upgrades | • Development of cognitive network systems that can learn from data and make intelligent decisions |

Source: Arthur D. Little & eco

# AI promises significant growth across all layers of the Internet industry in the short, medium and long term (2/2)

## 1. Network, Infrastructure & Operations

- Network optimisation
- Network maintenance
- Network design
- Network traffic routing
- Capacity planning
- Satellite operations
- Predictive maintenance
- Network anomaly detection
- Network automation
- Service quality improvement
- Network analysis
- Network performance monitoring
- Infrastructure planning
- Disaster control

## 2. Services & Applications

- Resource consumption
- Application deployment
- Bottleneck identification
- Application performance
- User experience
- Customer support
- Website performance
- Website traffic
- Security threat detection
- User behaviour
- Latency reduction
- Data processing
- Data storage
- Cybersecurity

## 3. Aggregation & Transactions

- Marketing campaigns
- Customer selection
- Experiential personalisation
- Website design
- Website content
- Search functions
- Discovery features
- Content moderation
- Fraud detection
- Automated payment
- Payment personalisation
- Payment suggestions
- Product recommendation
- Pricing strategies

## 4. Smart Industries & Paid Content

- AI game characters
- Game design
- Content recommendation
- Content creation
- Content moderation
- Autonomous driving
- Behaviour predictions
- Predictive maintenance
- Personalised driving
- Quality control
- Supply chain optimisation
- Energy management
- Facility management
- System security

Source: Arthur D. Little & eco

# Layer 1 revenue will regain the growth trajectory of ~ 7% in line with the general economic recovery (1/2)

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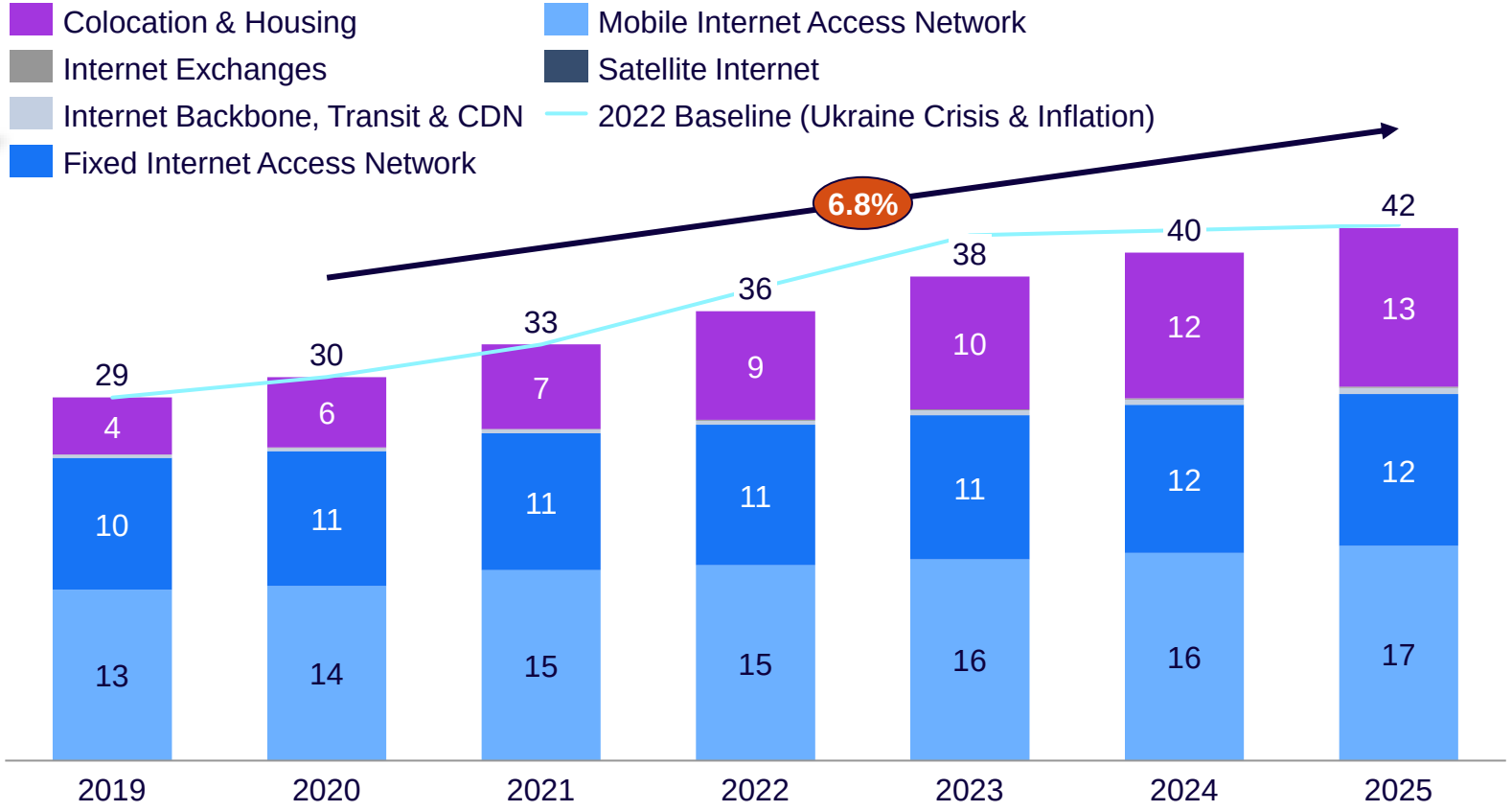
## Layer 1: Network, Infrastructure, & Operations

EUR bn revenue 2020-25




## Observations

- Inflation has led all major German telecom providers (and others in Europe) to increase prices for fixed and mobile services by **5-10%**, leading to **2-3% revenue growth** in 2023 and beyond
- Despite high **energy prices**, a strong **demand** for cloud storage and data centres persists, as **digitalisation plans** continue to grow, and **remote work** becomes more consolidated
- AI will only have a **marginal** impact on telco revenue (~0.2% additional year-on-year increase), due to a reshaping of operational models to reap the benefits (better personalisation, etc.)

Source: Arthur D. Little & eco

# Layer 1 revenue will regain the growth trajectory of ~ 7% in line with the general economic recovery (2/2)

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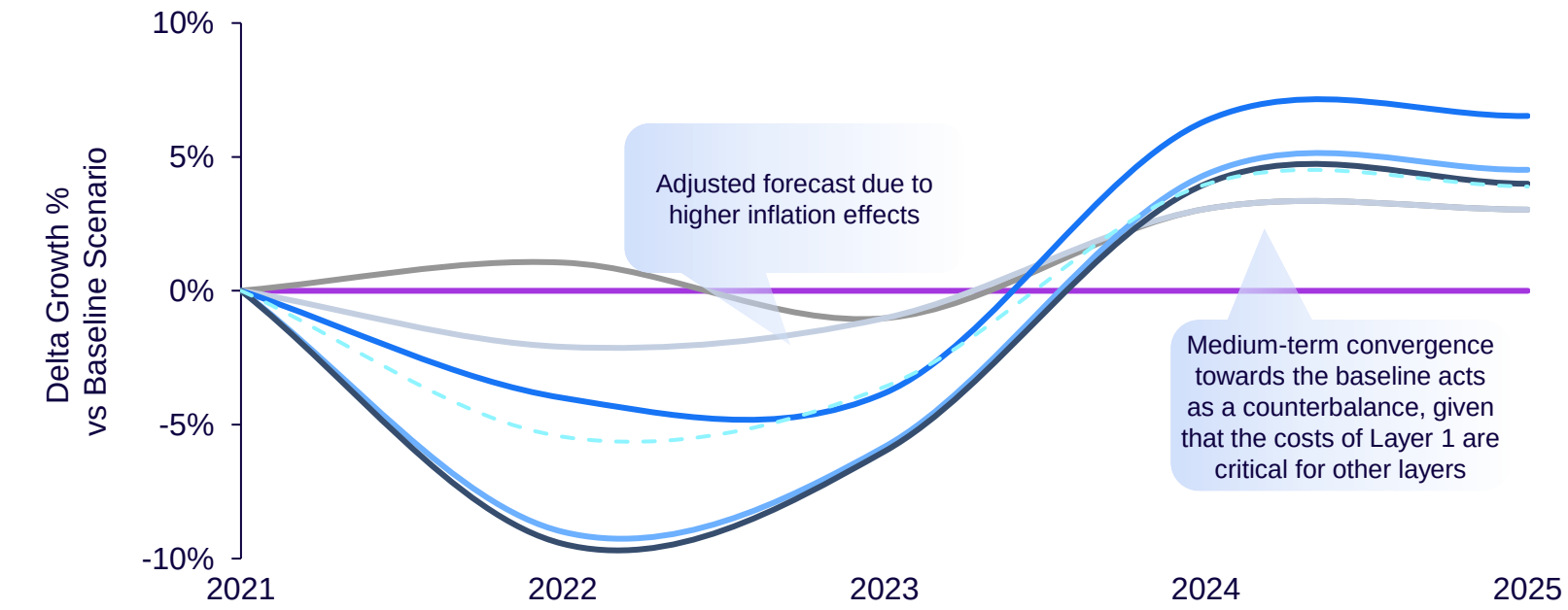
## Layer 1: Network, Infrastructure, & Operations

delta % points vs baseline (AI) growth




## Observations

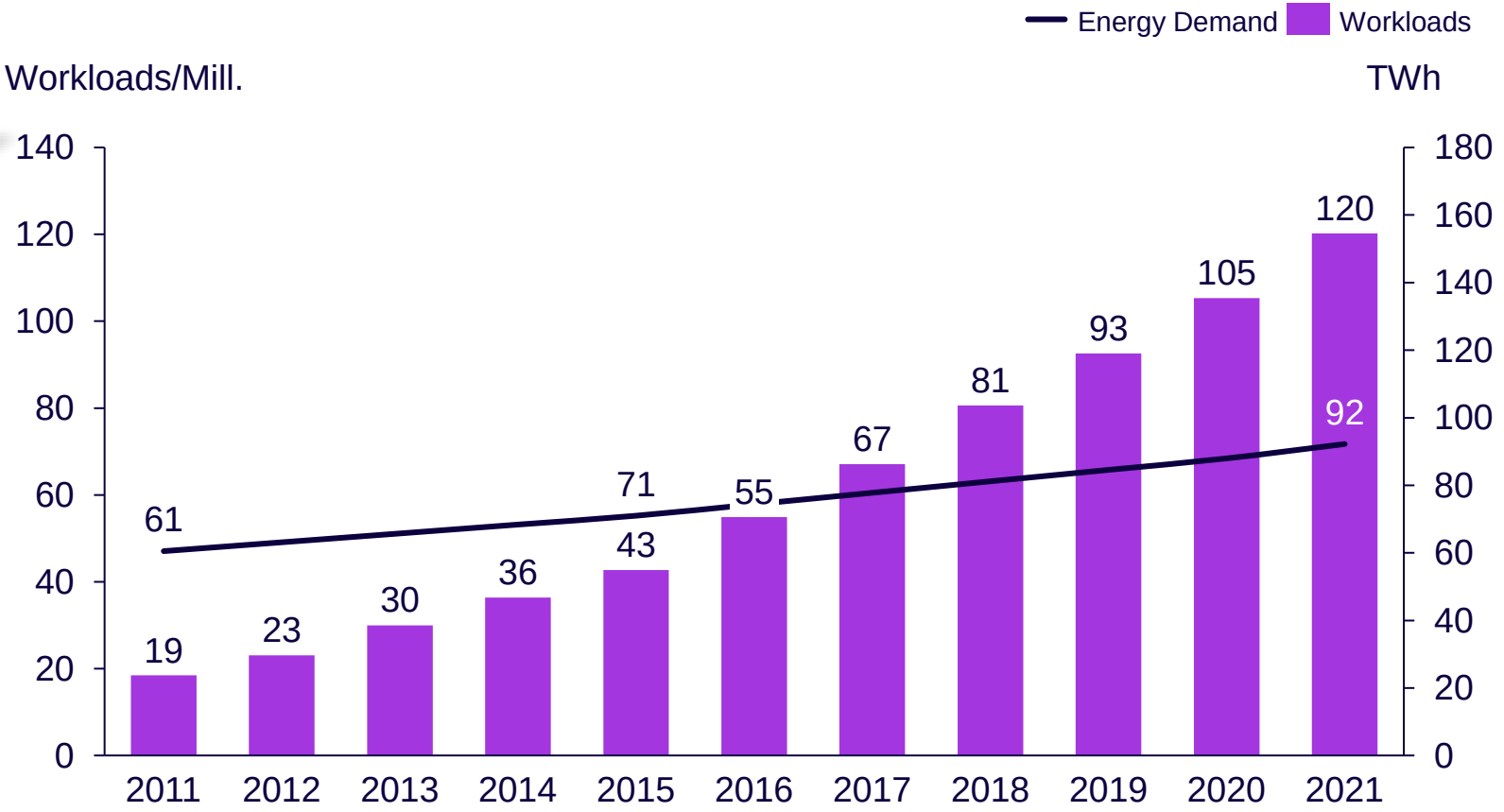
- In the **medium term**, Layer 1 revenues are expected to move towards **baseline trends**, as the layers represent a **critical cost component** for the services of Layers 2, 3 and 4; in turn, this results in a **counterbalancing** measure

Source: Arthur D. Little & eco

# Data centres are steadily becoming more efficient and sustainable

## Energy Demand and Workloads of Data Centres in Europe

2011 - 2021, European energy demand from data centres in TWh, workloads in millions




### Observations

- The bulk of the energy in data centres is used to power the IT components. Approx. 30 per cent relates to the supply infrastructure
- Data centres are steadily becoming more efficient. This is clearly evident in the 10-year comparison, from 2011 to 2021: **6.5-fold** increase in workloads with only a **1.5-fold** increase in energy demand
- Newly constructed data centres will **accelerate this trend**, as they require even less **energy** per **workload**

Workload: Set of computer resources required to perform a particular task, including data storage

Source: 'Cisco Global Cloud Index: Forecast and Methodology, 2011–2021', 'Data Centres in Europe – Opportunities for Sustainable Digitalisation', Arthur D. Little & eco

# Sustainable digitalisation: How data centre operators can fulfil their responsibility

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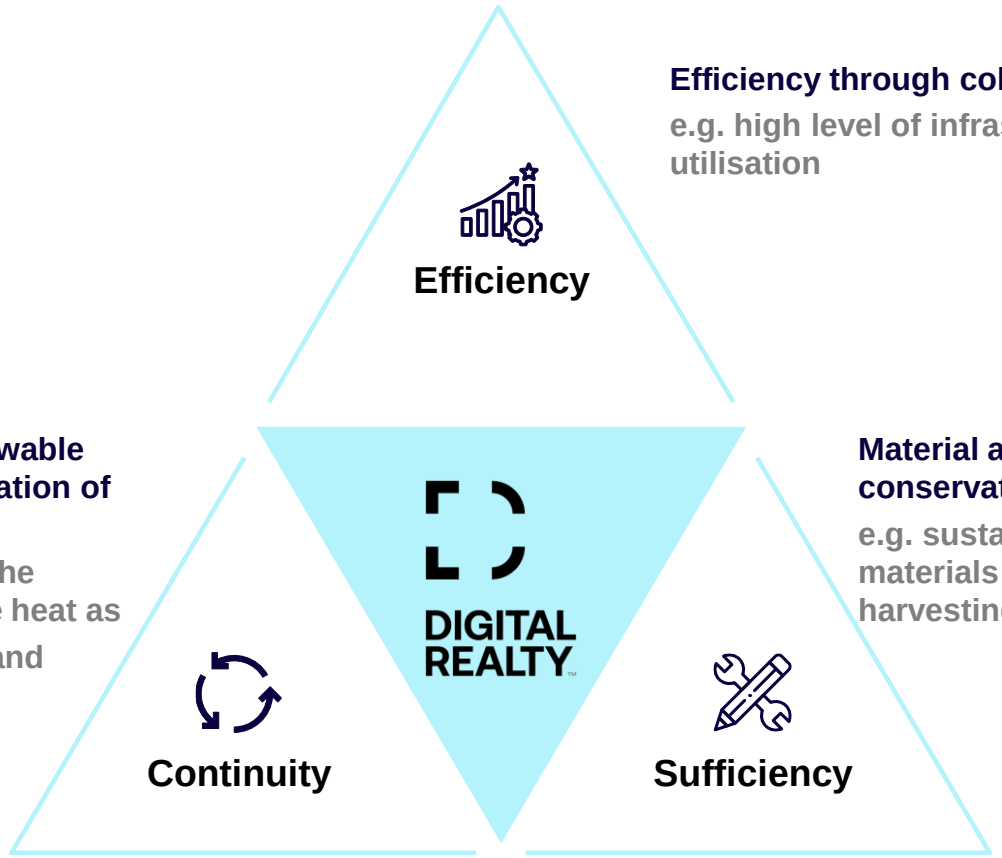
## Digital Realty Case Study: Portfolio of Sustainable Data Centres' Measures




**Efficiency through colocation**

e.g. high level of infrastructure utilisation

**Integration of renewable energies and utilisation of waste heat**

e.g. via PPAs and the utilisation of waste heat as a source for local and district heating

**Material and energy conservation**

e.g. sustainable building materials and rainwater harvesting

## Challenges

- Data centres are an essential component of critical infrastructure
- Finding well-networked **surfaces** and making them quickly usable
- Finding suitable **skilled workers**
- Energy costs: Maintaining **competitiveness** and offering added value to international customers

## Measures

- **Waste heat** utilisation
- Electricity from **renewable energy sources**
- Enhancement of **biodiversity** (species protection, new plantations)
- **Measurement** of the three **sustainability pillars** using intelligent data points, metrics and meaningful indicators
- **Exchange** between operators, partners, the public and policymakers

# Layer 2 revenue increase forecasted due to inflation, energy prices, human resource challenges and digitalisation in the coming years (1/2)

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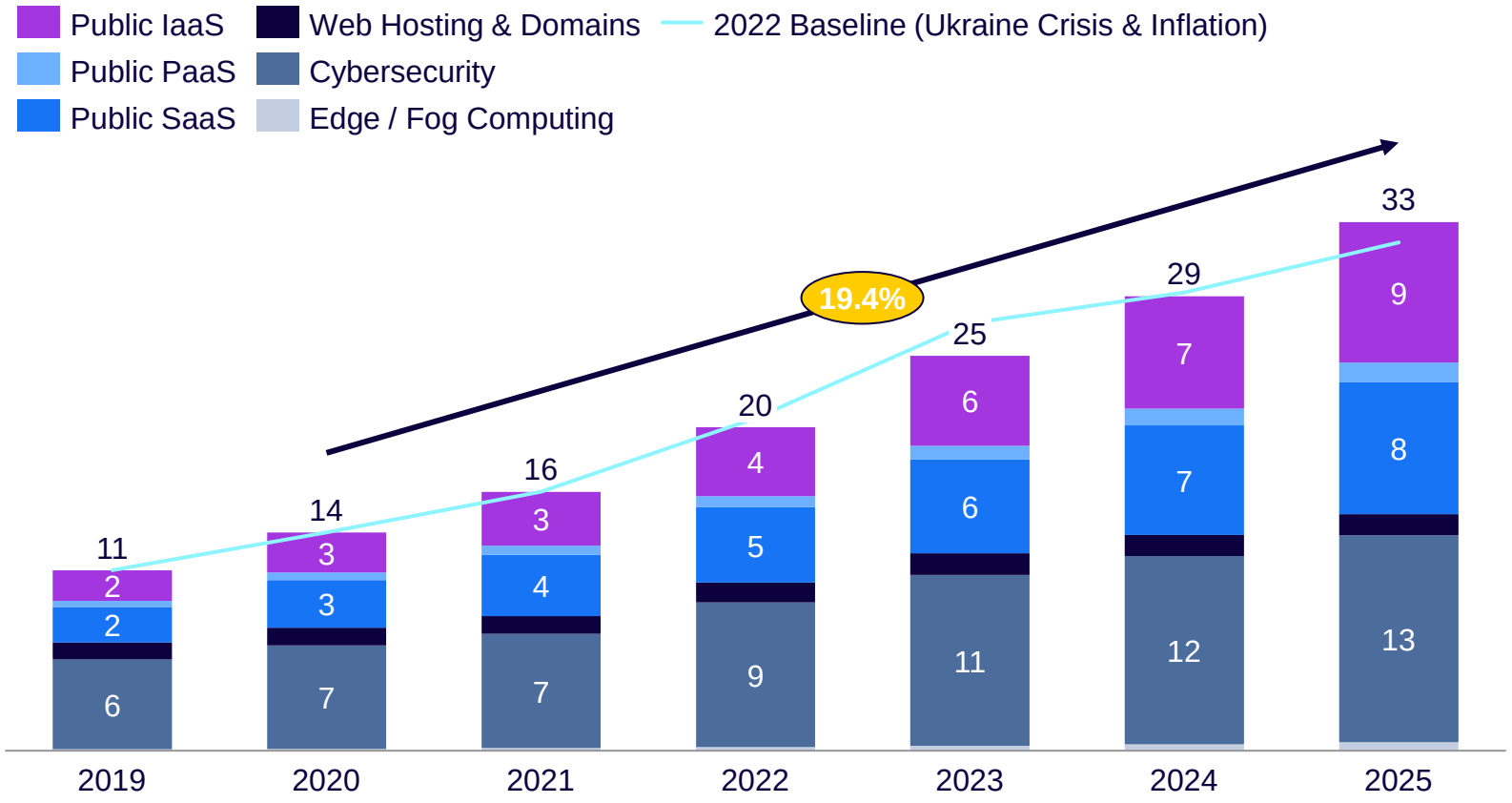
## Layer 2: Services & Applications

EUR bn revenue 2020-25




## Observations

- Accelerated **adoption of AI by PaaS and SaaS companies**, **driving** medium-term and long-term **revenue growth**
- Higher **growth rates** forecasted for 2024 and 2025 due to **price increases** and **advancing** digitalisation
- Companies **prefer public cloud services** and are switching expenses from **capital** to **operating costs**
- AI often offered in the **Public PaaS**, **SaaS** and in the **cybersecurity segments**
- Long-term **revenue effect** expected, but **no abrupt transition** (e.g. not all call centre employees will be replaced by AI-based virtual agents in the short term)

Source: Arthur D. Little & eco

# Layer 2 revenue increase forecasted due to inflation, energy prices, human resource challenges and digitalisation in the coming years (2/2)

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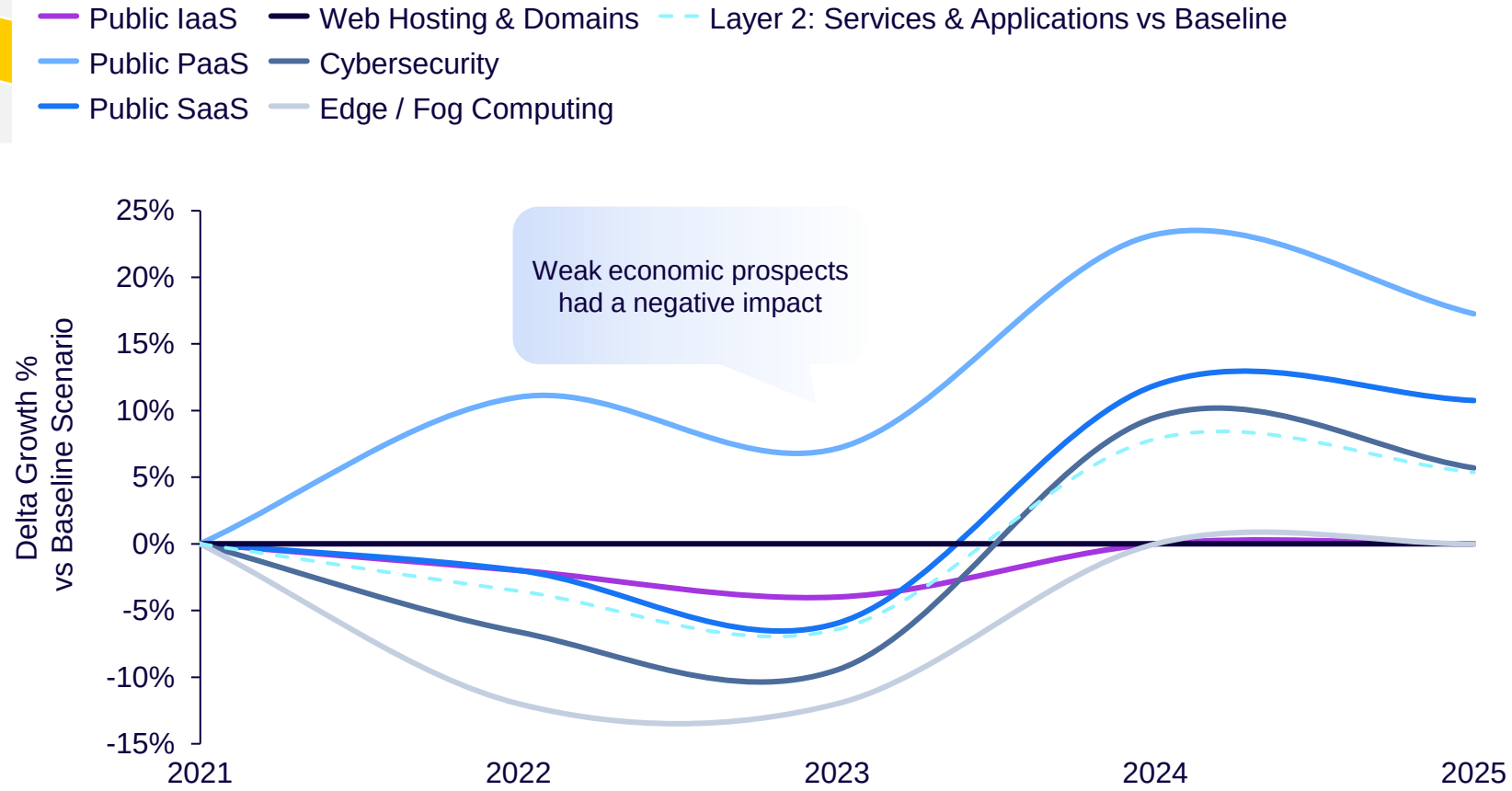
## Layer 2: Services & Applications

delta % points vs baseline (AI) growth




## Observations

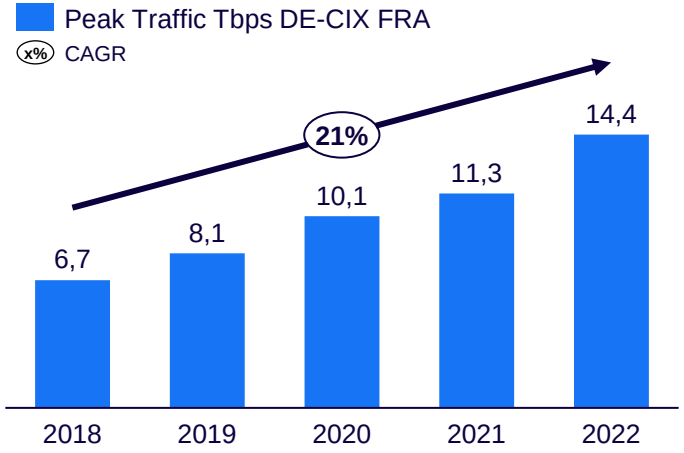
- PaaS and SaaS firms are rapidly adopting AI, driven by **staffing issues** and **margin protection**, maintaining **growth rates** of 10-30% in the short term
- IaaS prices are rising by 15-100% due to **energy costs** and **chip shortages** (Google Storage PD Snapshot in Frankfurt experiencing a 90% price increase)
- Layer 2: Revenues are rising as **cloud usage** expands, with Layers 3 and 4 services relying on this
- **Cybersecurity** is anticipated to be a **driving force** in Layer 2 from mid-2023, with **growth rates** of up to **10%**

Source: Arthur D. Little & eco

# The data from Germany's largest Internet Exchange shows a significant increase in data traffic, which has intensified during the current crisis

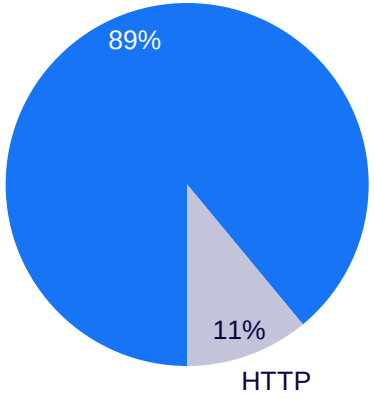


## The volume of Internet data traffic is rising steadily




- Peak (and average) Internet traffic at the DE-CIX Internet Exchange in Frankfurt is increasing at an average annual growth rate of approx. 21%
- Peak Internet traffic reached 14.4 Tbps on 14.12.2022

## Utilisation of secure Internet protocols is reaching new highs




- Use of HTTPS already accounts for 89% of PC-based and 85% of mobile Internet traffic – an indicator of a major need to implement IT security on the part of the Internet infrastructure
- Adoption of advanced TLS 1.3 encryption methods is at 66% with HTTP/2+ – 34% with HTTP/1.1

## Percentage of website tracking by third parties

| Top 10 Third-Party Tracking | Traffic Share % |
|---|---|
| Google analytics (site analytics) | 65% |
| Google (advertising) | 51% |
| Doubleclick (advertising) | 50% |
| Facebook (advertising) | 30% |
| Google adservices (advertising) | 23% |
| Google syndication (advertising) | 12% |
| Wordpress stats (site analytics) | 6% |
| Twitter (social media) | 6% |
| Adobe audience manager (advertising) | 5% |
| Rubicon (advertising) | 5% |

- Google dominates third-party website tracking, occupying four out of the top six positions
- However, such dominance raises concerns about competition and privacy, as Google has been accused of anti-competitive behaviour and misuse of its access to user data

**As AI use increases, website tracking data will play an increasingly important role – usage parameters continue to trend upwards**

Source: DE-CIX, Arthur D. Little & eco

# Artificial intelligence – a double-edged sword in digital threat protection: on the one hand, support for cybersecurity; on the other hand, a driver for cyber attacks in Germany

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1

**20,174**

vulnerabilities in software products (13% critical), 10% more than the previous year

**116.6 million**

new malware variants

**207 days**

digital disaster in the Anhalt-Bitterfeld district, disrupting the provision of parental benefits, unemployment benefits and other services

- Enhanced **detection and response capabilities**
- Advanced threat prediction and assessment through data analysis
- **Reduced workload** for human analysts (currently about 80,000 positions remain unfilled)
- More accurate risk assessment by identifying **vulnerabilities**

VS.

- Increased efficiency in **network scans** and **vulnerability tests**
- Enhanced targeting through **tailor-made attacks**
- **Greater inconspicuousness** by evading hacker detection
- **ChatGPT** as an enabling **malicious tool:**
  - Improved **"social engineering"** through more convincing **phishing emails**
  - **Polymorphic malware** (lower detection rate)
  - **Confidential information** as an input (further attack surface)
  - More spreading of **false information**

Source: Federal Office for Information Security (BSI), Arthur D. Little & eco

# Layer 3 services will regain their normal growth rate of 10%, supported by higher spending and the resumption of global trade (1/2)

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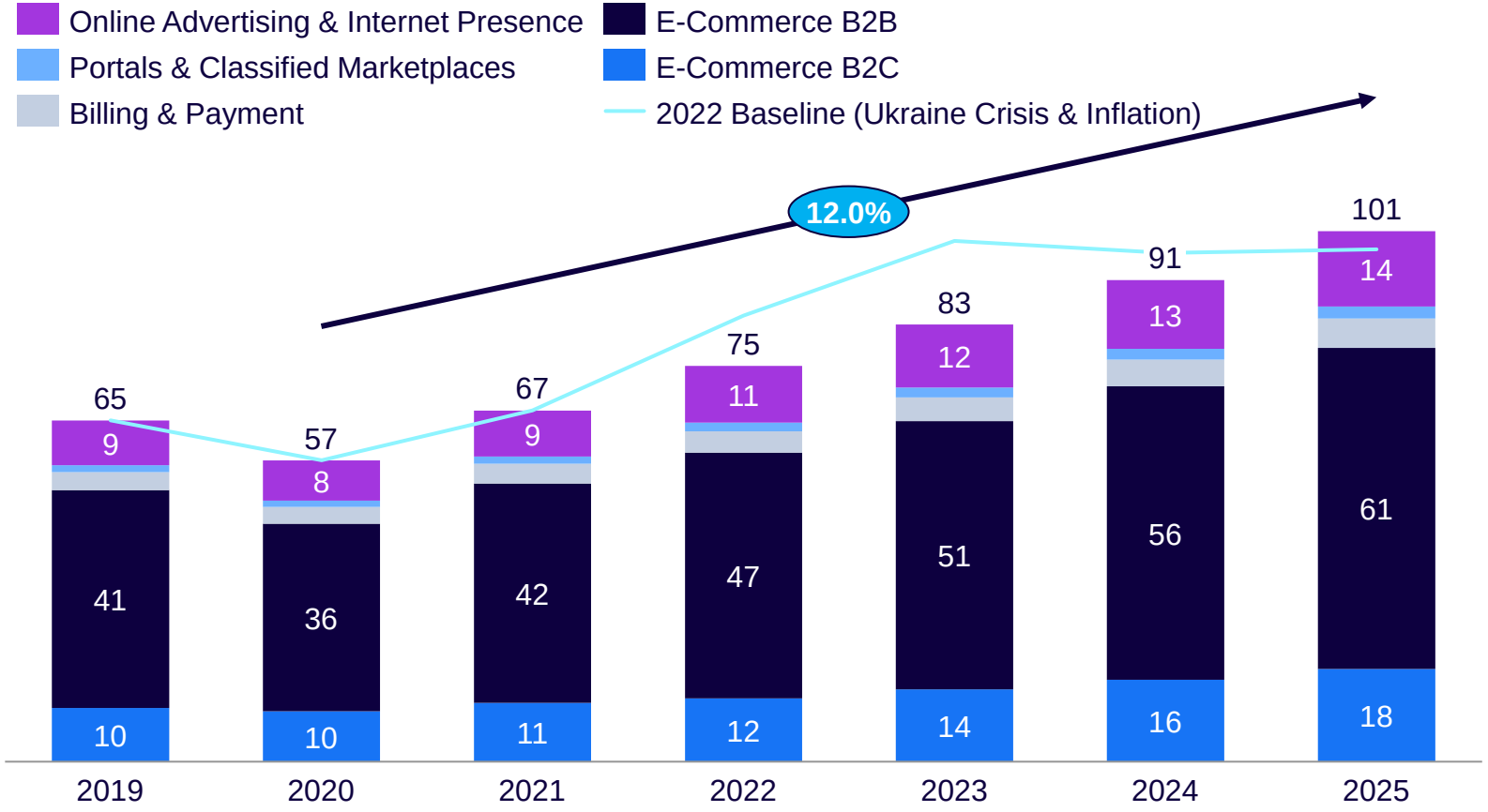
## Layer 3: Aggregation & Transaction

EUR bn revenue 2020-25




## Observations

- Layer 3 **services** will be more affected by inflation and **macroeconomic** factors than the services of Layers 1 and 2
- **Inflation** will have **longer-lasting effects** beyond 2023, although the magnitude of these effects is expected to **diminish** over time
- Our assumption is that **advertising**, **portals** and **marketplace prices** will rise in line with inflation
- Through **enhanced personalisation**, AI is expected to contribute an additional growth of 1-2% in online advertising, e-commerce and marketplaces

Source: Arthur D. Little & eco

# Layer 3 services will regain their normal growth rate of 10%, supported by higher spending and the resumption of global trade (2/2)

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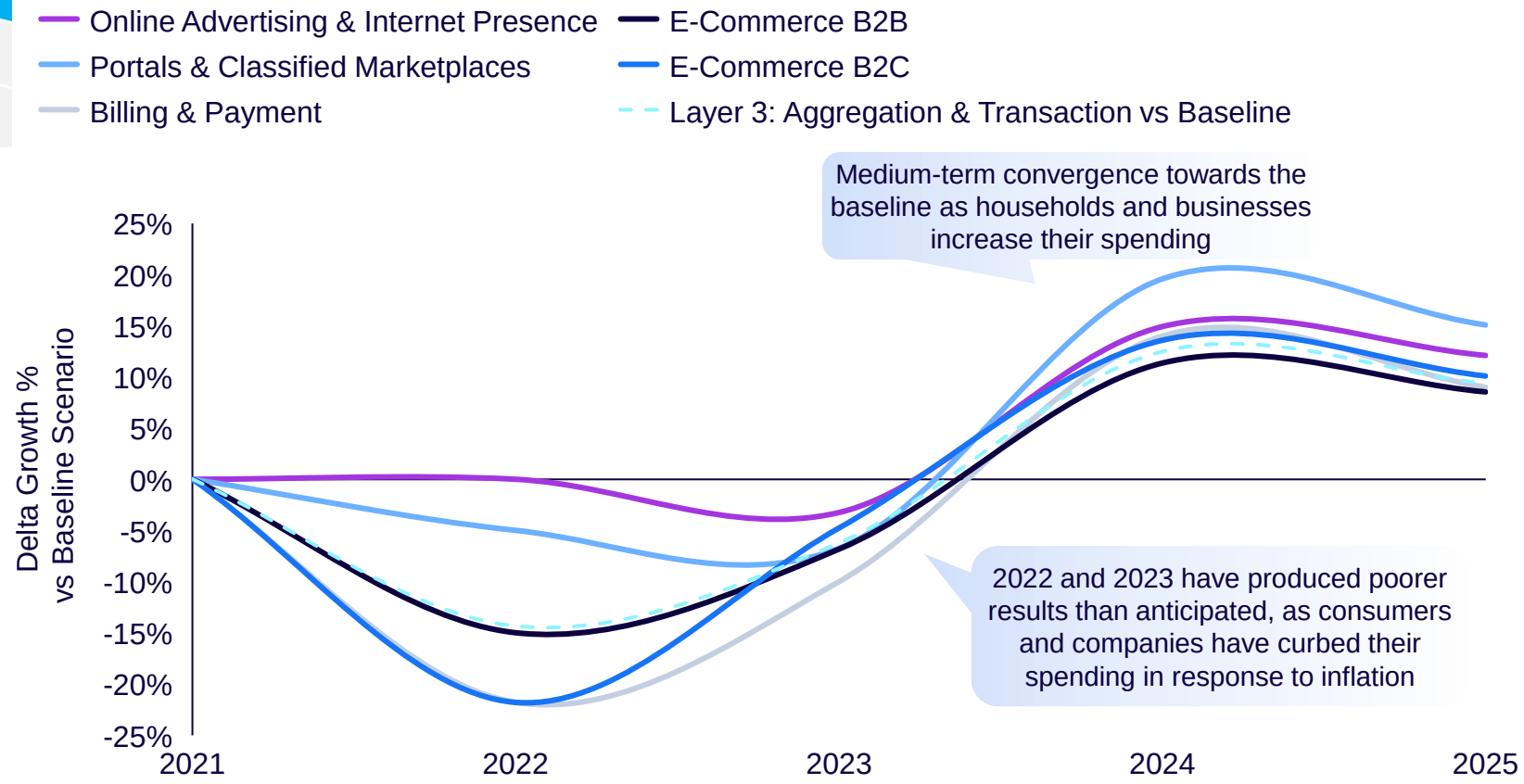
## Layer 3: Aggregation & Transaction

delta % points vs baseline (AI) growth




## Observations

- **Aggregate and transaction price inflation** is projected to remain at **lower levels** (7-8% in 2023 compared to 9-11% in 2022), given that higher **energy and transport costs** are added to **retail prices** and the demand for services grows
- A significant **slowdown** in **inflation** is forecast for 2024 (3.5%) and 2025 (2.6%) as the **economy** recovers and as **business activities** rise due to growing confidence in the future

Source: Arthur D. Little & eco

# Layer 4a content services will face a strong inflation-driven increase in the short term before inflation levels off in the medium term (1/2)

4
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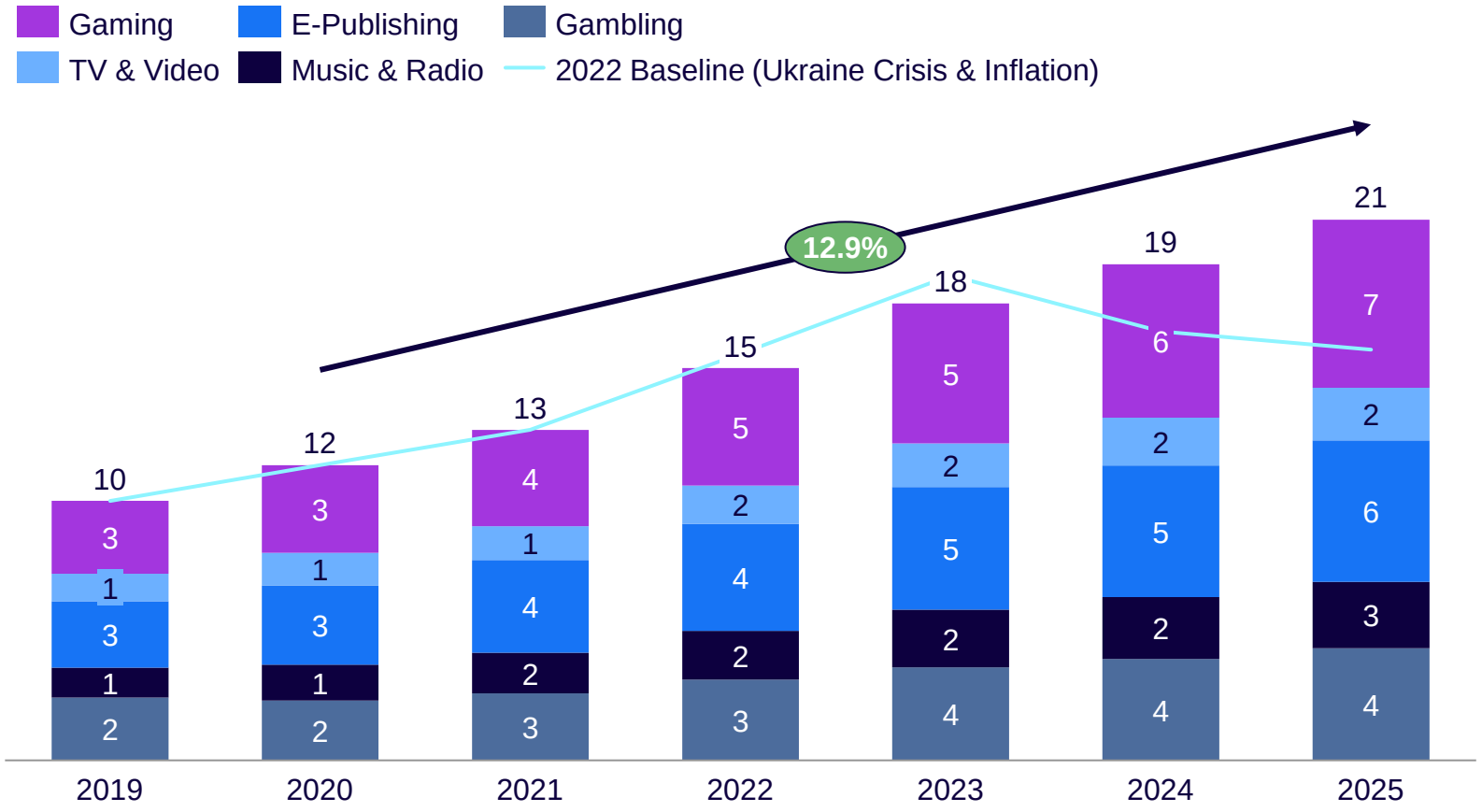
## Layer 4a: Paid Content

EUR bn revenue 2020-25




## Observations

- Layer 4 is most **heavily** influenced by **inflation** and **macroeconomic** factors
- It is expected that AI will be able to analyse **customer data and preferences** more effectively, thereby providing improved **personalised recommendations** for the entire industry
- Projections for 2024 and 2025 exceed the 2022 baseline, as **inflationary pressures** from price increases become evident across the **paid content** segment (*e.g. Netflix's new price segments and price increase, and Sony's price increase for the PS5 Digital Edition in Europe from €400 to €450*)

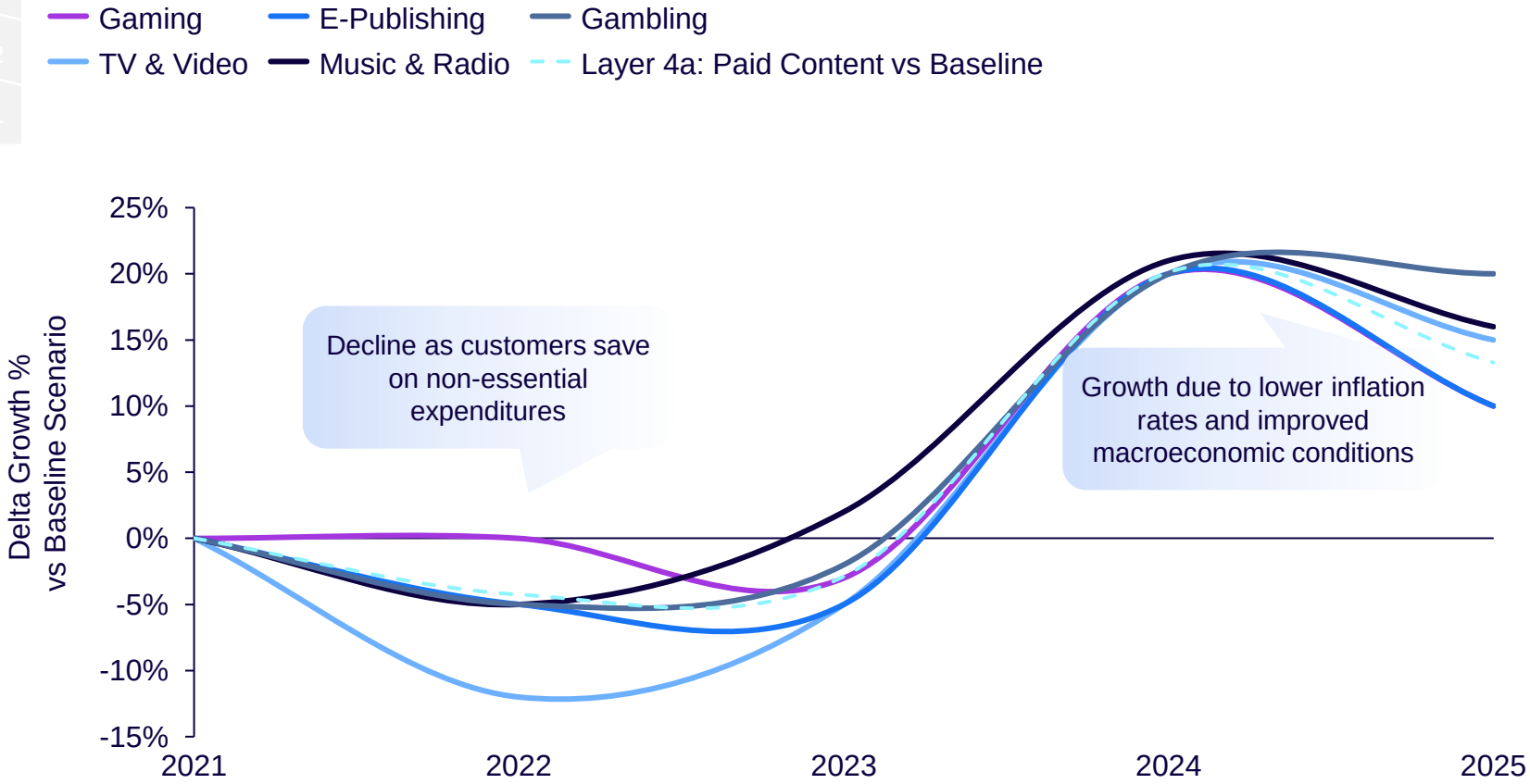
Source: Arthur D. Little & eco

# Layer 4a content services will face a strong inflation-driven increase in the short term before inflation levels off in the medium term (2/2)

4
3
2
1

## Layer 4a: Paid Content

delta % points vs baseline (AI) growth




## Observations

- **Downward pressure** due to inflation-related cost increases (not only for basic services but also for content providers), resulting in price increases, forcing customers to **cut back** on non-essential spending, e.g. for paid content or for subscriptions to multiple providers
- In the **short term**, there could be mildly **positive effects** from the development of AI innovations, as AI-powered systems analyse **customer data more efficiently** and are used to improve content recommendations, especially in sectors such as gaming, TV, video, music and radio.

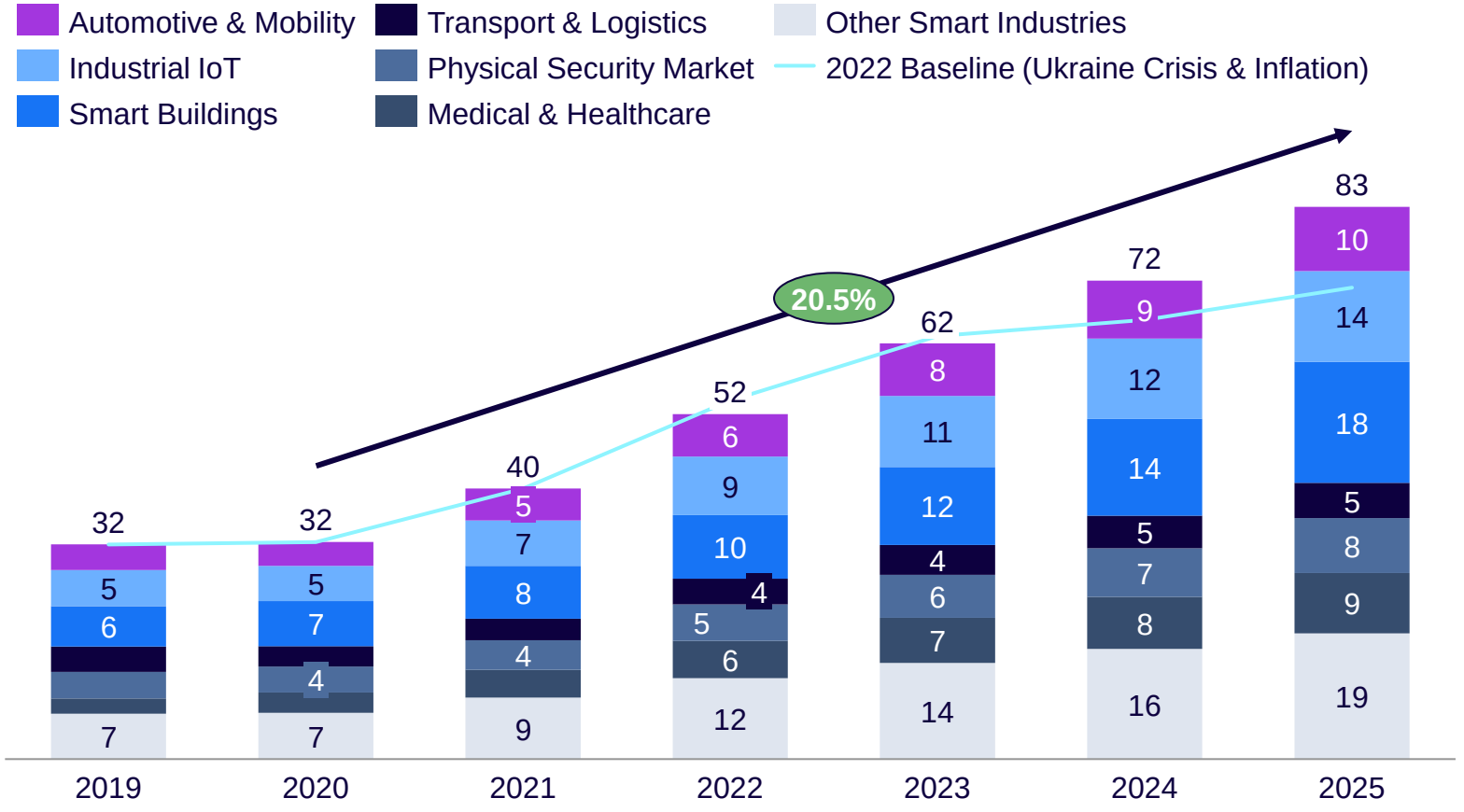
Source: Arthur D. Little & eco

# Layer 4b smart industries are expected to grow due to the trend of cost saving in the short and medium term (“smartify-to-save”) (1/2)

4
3
2
1

## Layer 4b: Smart Industries

EUR bn revenue 2020-25




## Observations

- Layer 4 is the layer **most strongly** influenced by inflation and **macroeconomic** factors
- The rise in underlying **energy prices** is accelerating the shift to smart devices, especially for **optimising energy consumption**; industrial customers/ cities/municipalities aim to make their networks **smarter** in order to reduce energy and raw material costs
- The expectation is that the **shift** towards “**smart industries**” will continue via AI, as AI-based systems are gaining **traction** and prevalence

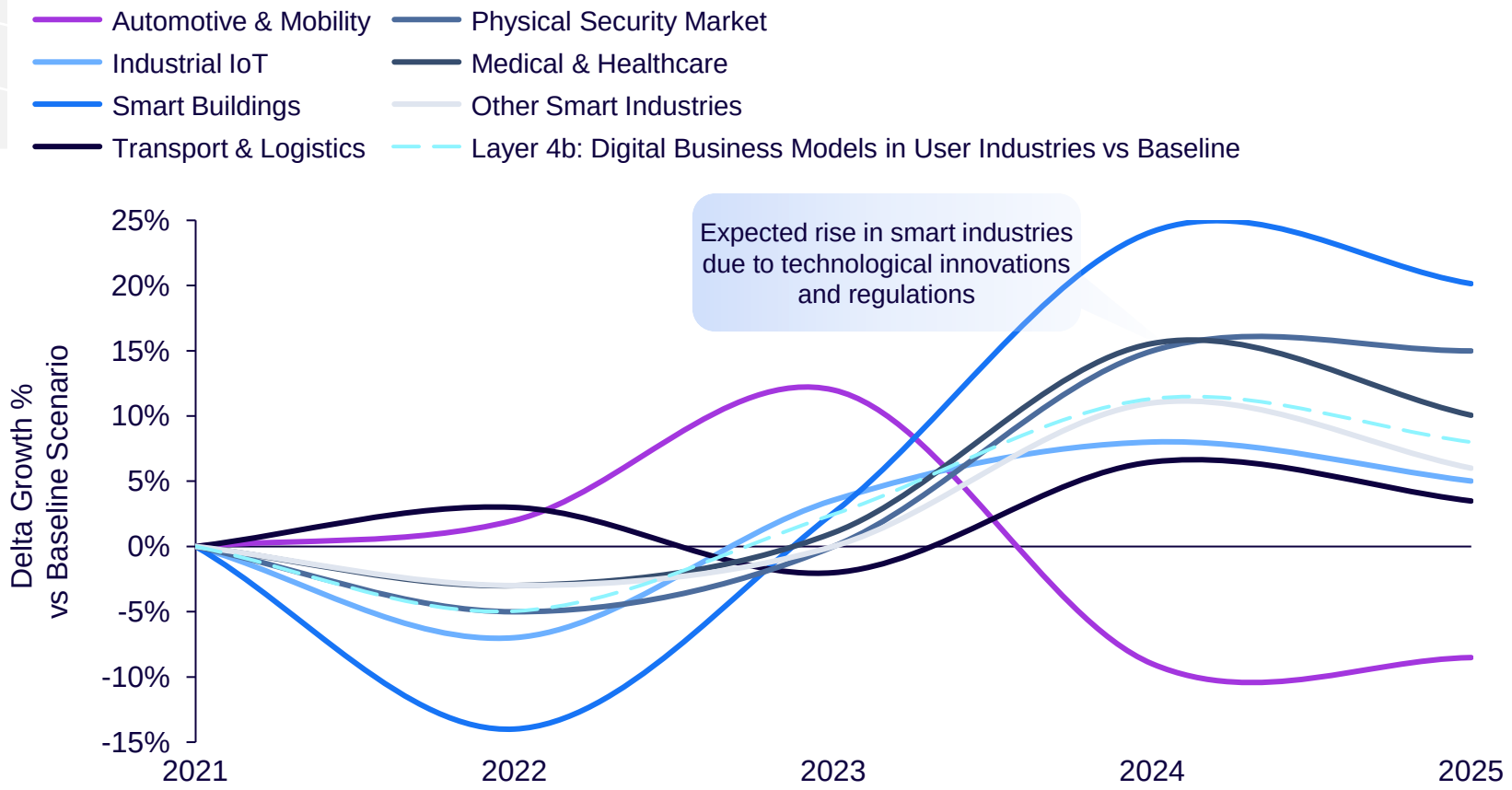
Source: Arthur D. Little & eco

# Layer 4b smart industries are expected to grow due to the trend of cost saving in the short and medium term (“smartify-to-save”) (2/2)

4
3
2
1

## Layer 4b: Smart Industries

delta % points vs baseline (AI) growth




## Observations

- Smart solution providers are **shifting** their revenues from **one-off** product sales to **recurring** services (e.g. €5/month for a smart thermostat that saves 30% energy)
- Furthermore, we anticipate that the EU will enact a similar **incentive** to the $369 billion US **Inflation Reduction Act**, which encourages the adoption of more sustainable building practices for **energy security** and climate change
- The automotive and mobility sectors experienced a sharp increase due to **inflation** and **raw material shortages** – growth is forecast to **level out** in the short term

Source: Arthur D. Little & eco

# Short-term growth followed by medium-term expansion, driven by economic recovery, investments, and the implementation of AI in all industries

**Outcome**

- In the short term (2023-2024), there will be a **lower revenue** than **projected in the 2022 index**, due to **high interest rates** and customers' increased **propensity to save**, amid **stagnating real wages**
- **Little to no** direct **effects** expected from AI in the short term, with **tech-savvy** and **personalisation-oriented** industries likely to reap greater benefits
- In the medium term (2025), a "**soft landing**" is forecasted; **growth at all levels** driven by increased demand, inflation, real wage increases, investor interest and international trade
- In the long term, AI will **reshape** the world of work in a sustainable manner and present companies with the **choice** to either **embrace change** or take the risk of falling behind

Source: Arthur D. Little & eco, DE-CIX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