



Google's Economic Impact in the EU 2023

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Public First is a global strategic consultancy that works to help organisations better understand public opinion, analyse economic trends and craft new policy proposals.

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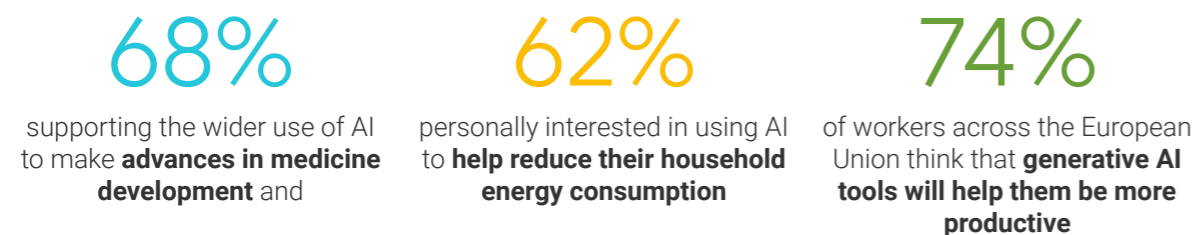
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Executive Summary

To take full advantage of the potential of digital technology, the European Commission has created a series of Digital Decade targets for 2030 based on four areas: skills, infrastructure, business and government. Meeting these goals could help unlock trillions of economic value for the EU economy, close the digitalisation gap with other advanced economies and boost the long-term competitiveness of the European economy.

In the next few years, the economic opportunity from digital technology is likely to grow further as the economic potential of Artificial Intelligence (AI) comes fully online. The latest generation of AI systems is already helping us develop new medicines, improving energy efficiency, and significantly improving worker productivity. A majority of Europeans (52%) told us that AI was developing faster than they expected, with:



AI provides an opportunity for the EU to help boost its long-term competitiveness, allowing it to create new types of business and enhance performance in the EU's existing world-leading companies in industries such as automotive or pharmaceuticals. Taking full advantage of this opportunity will require having the right underlying infrastructure, skills base and a supportive regulatory framework in place.

Google's mission is to organise the world's information and make it universally accessible and useful. This mission is more relevant than it's ever been, with AI providing one of the most profound new opportunities to unlock the power of information.

Google is a major contributor to the EU's economy, providing key tools, platforms and ways for businesses to connect with customers. **In total, we estimate that Google's products, platforms and tools, including Search, Ads, Maps, Workspace, YouTube, Cloud, Play and Android, will help provide an estimated €179 billion in economic activity in 2023 across the European Union, allowing businesses to employ over 3 million people.**

In this report, we explore Google's economic impact across the EU and its potential to grow in the future, supporting the EU in achieving its Digital Decade goals, boosting economic competitiveness and taking advantage of the opportunities of AI.

As part of our research, we conducted extensive new polling of over 12,000 individuals and 7,500 senior business leaders across the European Union, exploring how Google products were helping them and their interest in unlocking the potential of AI.

Key Findings

The Potential of AI

Google describes itself as an AI-first company, with the technology currently playing a crucial role in many of its leading products, including Search, Maps and YouTube. In 2017, the company pioneered the Transformer machine learning model, leading to the current wave of new generative AI applications that are transforming the wider tech industry. In the next few decades, AI is likely to be the most significant general-purpose technology, helping boost economic growth and giving us new solutions for long-term societal challenges.



Generative AI could increase **the size of GVA in the European Union by €1.2 trillion**, while generative AI tools could save the average worker over **70 hours** a year.



Over half of European businesses plan to invest in AI-based automation in the next five years. Of those, **79%** said that they are likely to use the freed-up time for workers to give them **other more valuable tasks**.



Google is one of the world's single largest contributors to AI research, with **30% of the top 100 most cited AI scientific publications** coming from the company's researchers.

Supporting European Innovation

Google is also playing an important role in helping the EU accelerate its digital transformation and achieve its Digital Decade goals.

The EU is one of Google's most important engineering and development hubs, **with 30 offices located across 19 countries.**



 **11**

Google Cloud has launched **11 cloud regions** in the EU since 2015, helping European businesses run mission-critical services with reduced latency, meet local data-residency rules, enact digital transformation and stay in control of their data.

 **\$519m**

In 2022, Google for Startups Community startups **raised over \$519 million**, creating over 5,000 jobs.

Businesses

Google's products are helping support the growth and competitiveness of European companies, enabling businesses of all sizes to compete and reach customers across the world, providing new platforms for independent creators to earn a living through, and supporting innovation in some of Europe's most dynamic firms.

73% of larger businesses told us that paid search advertising was one of the most important ways they reached new customers, while for SMEs, online search was second in importance behind only word of mouth.

 **66%**

66% of the fastest-growing European businesses say Google products have helped **accelerate their growth.**

 **64%**

64% of new businesses agreed that **the costs of starting a business have reduced substantially or dramatically** because of internet tools such as Google Search, Gmail, Google Docs, Google Workspace, or Google Business Profile.



Workers and Skills

Increasing the supply of digital skills is one of the most important stepping stones to achieving the Digital Decade goals. From primary school to on-the-job skills training, Google's products and services have created new ways for people to learn and build new skills throughout their lives.

Every year, digital skills people teach themselves online through Google Search. Skills such as programming, design or digital marketing, **which boost the EU economy by over €152 billion.**



 **€560bn**

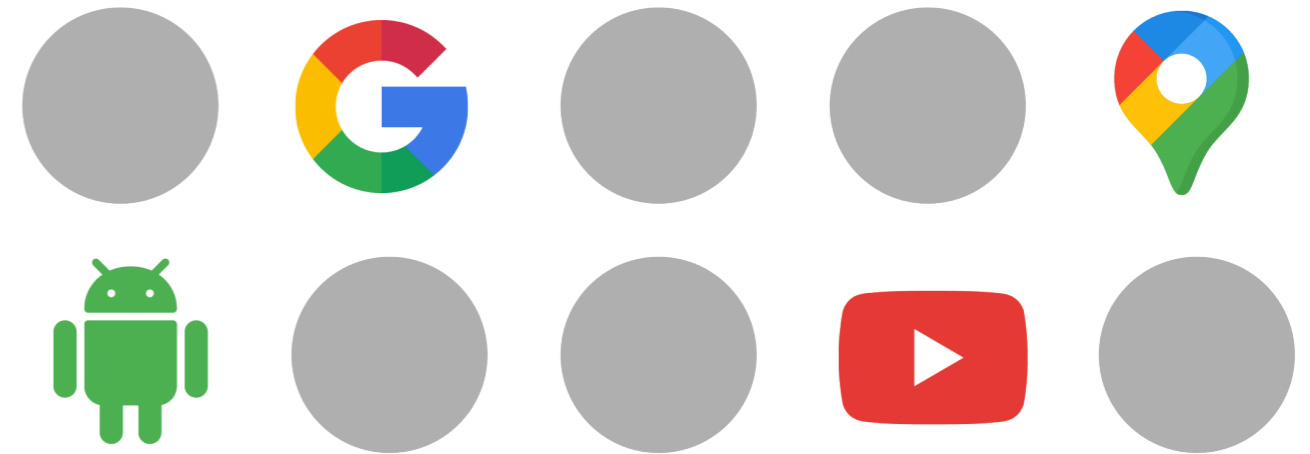
Based on the time saved for the average worker by Google Search and Google Workspace, we estimate that in a given year, Google services are producing a **€560 billion improvement in worker productivity for the economy of the European Union.**

 **9m**

Since 2015, Grow with Google has trained **over nine million people** in the EU-27 on key new digital skills such as digital marketing or best practices in cybersecurity.

Consumer

Through steady investments in innovation, Google's core products have continued to evolve and improve, saving time and money for people. By providing more affordable and open options, Google helps create greater choice and increases digital inclusion.



Google's products **Google Search, Google Maps, Android, and YouTube** were named among the **ten most helpful innovations** of the last thirty years, as judged by the general public across the European Union.

 **46bn**

In total, we estimate that Google Search and Google Assistant together **free up over 46 billion hours of leisure time** every year across the European Union.

 **1.2m**

Fuel-efficient routing in Google Maps is estimated to have **helped prevent more than 1.2 million metric tons of CO2e globally since launch through the end of 2022—the equivalent of taking approximately 250,000 fuel-based cars off the road for a year.**

Foreword

AI is the buzzword of the year. But intelligent machines have been around for decades, helping people get things done and improving some of our most used tools. You've probably been using it for a long time without even realising - it's used in autopilot systems for planes, in antilock braking technology - and in Google Maps, Translate and Search.

Over the last few years, the pace of AI development has increased exponentially, creating smarter tools, new opportunities and new interests. It's no understatement to say that AI will transform the lives and businesses of people right across Europe. And it will transform the EU economy and its ability to achieve its bold ambition of a sustainable future.

To look at the real impact of this opportunity, we have commissioned new research by Public First. This shows that generative AI could increase the size of the EU economy by 1.2 trillion Euros and save the average worker over 70 hours a year - the equivalent to about two weeks of work.

In fact, no current technology has more potential to boost the EU's competitiveness than AI. By helping everyone across the EU focus on more productive and creative tasks, AI can accelerate economic growth and in turn make progress on social challenges.

Yet for AI to benefit everyone across the EU, we must work together.

Europeans have achieved a high quality of life, marked by shorter working hours, paid vacations, strong labour laws, universal healthcare, and generous social welfare states. Technology has played its part in this, and will continue. Europe's Digital Decade is in full force.

Despite that, our way of life has changed. Increasingly, people are feeling the weight of social, political and growing economic challenges. We're not meeting enough of the commitments needed to beat the climate crisis, we are all witnesses of a growing political polarisation, the fight against high inflation is not done, energy dependence is yet to be resolved, and of course the ongoing horrific Russian war on Ukraine.

These factors are creating significant social and economic challenges - and the EU is at risk of falling behind its international competitors due to lacklustre productivity growth.

AI can be a driving force in helping the EU address some of these challenges. Creating an environment that prioritises innovation and research will help people and businesses adopt and benefit from AI. And it'll lead to smarter tools for everyone

One of the ways Google can help is by providing helpful and innovative tools. This report estimates that Google's products, platforms and tools will help provide an estimated €179 billion in economic activity in 2023 across the European Union, allowing businesses to employ over three million people.

Of course, AI brings both opportunities and risks. If used irresponsibly, AI could amplify current societal issues - like misinformation and discrimination. Tackling these challenges will require fundamental research, common standards, and aligned regulation based on shared democratic values. At Google, we have developed a set of AI principles to guide our development of new technologies. We also need to work together to prepare the workforce for the AI-driven job transition. That's why Google has trained over 9 million people across the EU in digital skills.

As the EU progresses towards its Digital Decade goals, this report looks at how AI can boost the EU's economic competitiveness and in turn, address broader challenges. The report also looks at the impact Google is having on the EU's economies. We're committed to playing our part in helping the EU realise its digital and AI-driven future. Read on.



Matt Brittin

President,
Google Europe, Middle East & Africa

Introduction

Europe's Digital Opportunity

Over the next decade, the European Union's economy faces a once-in-a-generation opportunity to accelerate economic growth and make new progress on social challenges. Advanced technologies like AI, the cloud and the Internet of Things can help radically improve worker productivity, discover new medicines, support the transition to a green economy and save billions for public services.

The EU has many of the world's leading companies in industries including pharmaceuticals, automobiles, and retail. However, the region has also struggled with lower long-term economic competitiveness compared to other advanced economies. On average, European GDP per capita remains around only 70% of that in the US—a gap that has not closed in over forty years.¹

In March 2023, the leaders of 10 European Member states wrote a letter calling for “a strategy on long-term competitiveness to keep up with our main global competitors in terms of economic output and productivity... [they urged to] give due consideration to securing the long-term economic growth needed for the future wellbeing of citizens, for the creation of more and better jobs, for the green and digital transitions and open strategic autonomy.”²

At the same time, many existing European enterprises have also not taken advantage of the potential of digital transformation. While the EU contains many of the world's leading digital countries, this progress is not uniform. If it was measured as a single country, the EU would only come 17th in IMD's World Digital Competitiveness Index.³ In 2020, the European Investment Bank found that only 63% of EU firms had adopted advanced digital technology, compared to 73% of firms in the US.⁴

Recent research by the McKinsey Global Institute estimates that between 2014 and 2019, large European companies' revenues increased 40% more slowly than those in the US, with these companies spending 40% less on research and development.⁵ This gap is disproportionately concentrated in the IT and pharmaceutical industries. Across ten key current emerging technologies, McKinsey estimates that the EU is behind on eight out of the ten.⁶

Fortunately, the EU also has the potential for significant medium-term improvement in its economic competitiveness, allowing it to protect and advance the standard of living of its citizens.

Many of the current waves of new technology, such as generative AI or IoT, are likely to have a significant impact in areas where the EU already has a strong comparative advantage, such as manufacturing or pharmaceuticals. Some parts of the EU already see some of the highest levels of adoption for core business digital technologies, and learning from their example could see rapid catch-up elsewhere.

However, to take full advantage will require having the right underlying infrastructure, skills base and a supportive regulatory framework in place. In June 2023, an open letter from 150 European businesses argued that “Like the invention of the internet or the breakthrough of silicon chips, generative AI is the kind of technology that will be decisive for the performance capacity and therefore the significance of different regions” and that the EU needs to “agree on a proportionate, forward-looking legislation which will contribute to European competitiveness while protecting our society.”⁷

1 <https://ecipe.org/publications/comparing-economic-growth-between-eu-and-us-states/>

2 <https://valtioneuvosto.fi/documents/10616/146554548/Joint+Letter+on+Competitiveness.pdf/b7e78afe-7323-4d8f-6bbd-5ad8a420b-f6c/Joint+Letter+on+Competitiveness.pdf?t=1677680257471>

3 Public First calculation

4 https://www.eib.org/attachments/efs/digitalisation_in_europe_2020_2021_en.pdf

5 <https://www.mckinsey.com/mgi/overview/in-the-news/addressing-europes-corporate-technology-gap>

6 <https://www.mckinsey.com/mgi/overview/in-the-news/addressing-europes-corporate-technology-gap>

7 <https://www.igizmo.it/wp-content/uploads/2023/06/Open-Letter-EU-AI-Act-and-Signatories.pdf>

To take full advantage of the potential of digital technology to support economic growth, the European Commission has created a series of Digital Decade targets for 2030 based on four areas: skills, infrastructure, business, and government.⁸ In total, previous research by Public First estimates that meeting the Digital Decade goals could create €2.8 trillion in economic value by 2030.⁹

Meeting these goals and ensuring the responsible deployment of new technology will require collaboration from citizens, governments and businesses, both European and international. As Thierry Breton, the Commissioner for the Internal Market, has argued, "By working together, we will be able to take full advantage of the possibilities offered by digital technologies in our daily and professional lives from here to 2030."¹⁰

The EU's Digital Decade Goals¹¹

Skills

Target	Current Progress:
80% At least 80% of adults with basic digital skills	54% of adults with basic digital skills
20m 20 million ICT specialists with gender balance	9m 9 million ICT specialists

Infrastructure

Target	Current Progress:
100% of households with gigabit network coverage	73% of households with gigabit network coverage
100% of populated areas with high-speed mobile coverage	81% of populated areas with high-speed mobile coverage
20% of world semiconductor production by value	10% of world semiconductor production by value
10,000 Deploy 10,000 edge nodes	N/A
2025 By 2025, the first EU computer with quantum acceleration	N/A

Business

Target	Current Progress:
75% of businesses using cloud computing	34% of businesses using cloud computing
75% of businesses using big data	14% of businesses using big data
75% of businesses using artificial intelligence	8% of businesses using artificial intelligence
80% of SMEs with at least a basic level of digital intensity	69% of SMEs with at least a basic level of digital intensity
x2 Double the number of unicorn startups	249 249 unicorns

Government

Target	Current Progress:
100% of citizens have online access to key public services	77% of citizens have online access to key public services
100% of businesses have online access to key public services	84% of businesses have online access to key public services
100% of citizens have access to medical records online	72% of citizens have access to medical records online
100% of citizens have access to eID	N/A

8 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

9 <https://awsdigitaldecade.publicfirst.co/>

10 <https://digital-strategy.ec.europa.eu/en/news/2030-digital-decade-commission-adopts-indicators-monitor-europes-digital-transformation-and-issues>

11 <https://digital-strategy.ec.europa.eu/en/library/policy-programme-path-digital-decade-factsheet>

How Google Is Supporting the EU's Digital Transformation

Over the 25 years since its foundation, Google has been a major contributor to the EU's economy, providing key new tools, platforms and ways for businesses to connect with customers.

As the economy becomes increasingly digitised, this impact is likely to become even more important. **In total, we estimate that Google's products, platforms and tools, including Search, Ads, Maps, Workspace, Cloud, Play and Android, help** provide over €179 billion in economic activity in 2023 for businesses across the European Union, allowing them to employ over three million workers.

In this report, Google commissioned us to explore Google's economic impact across the EU, how it supports economic competitiveness, can help the EU achieve its Digital Decade goals and the specific opportunities from AI.

We look at



How Google is supporting European innovation and digital technology.



How Google's platforms are helping businesses gain new customers or increase their competitiveness.



How Google's tools help workers get more done or learn new skills.



The ways Google's innovations have transformed ordinary life for Europeans.

How we quantified Google's impact in the EU

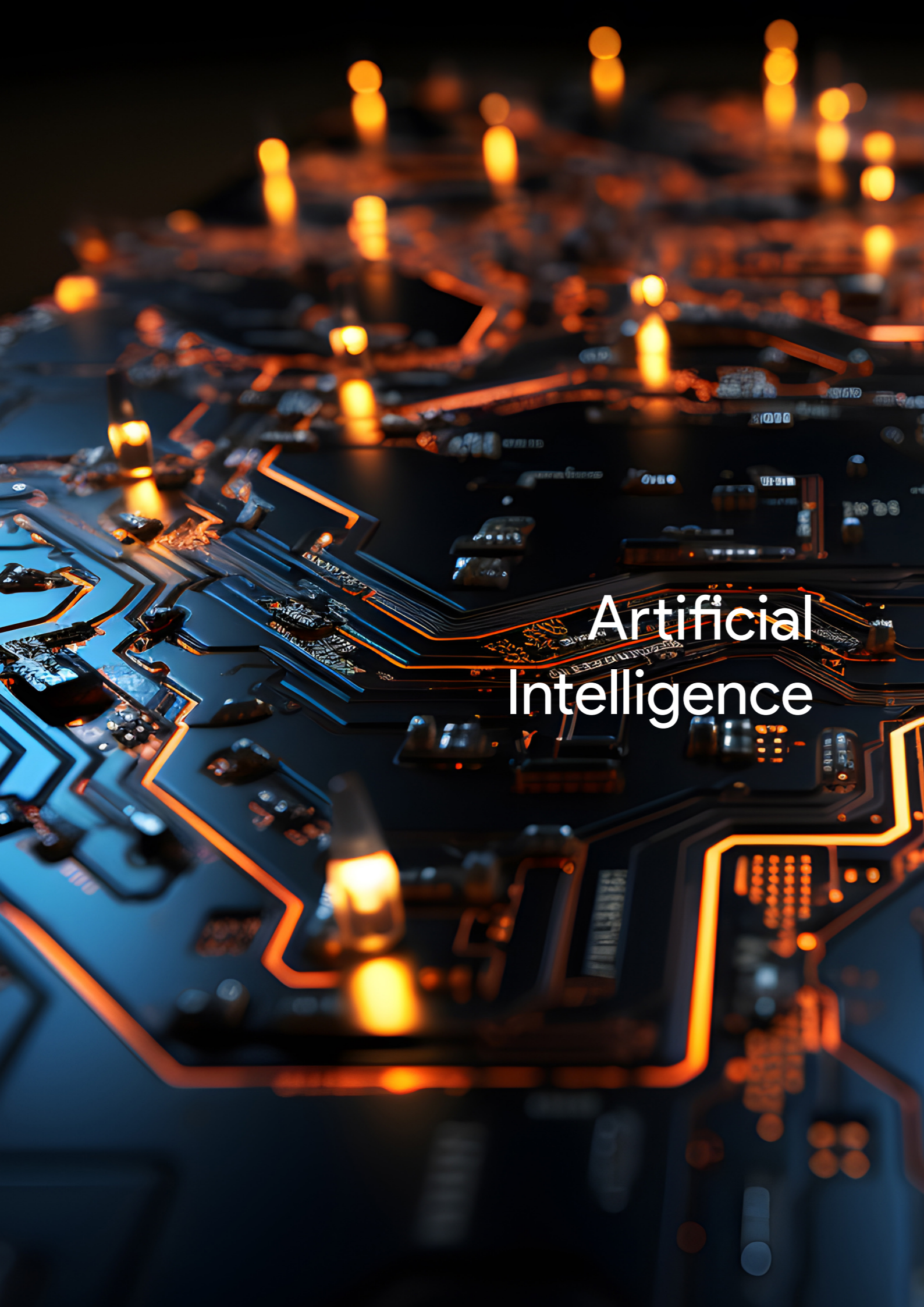
In this paper, we used a range of different methods to quantify the economic impact and helpfulness of Google Search, YouTube, Android and other Google products:

- Building on the precedent of previous Google impact reports from markets including **Europe**, the **United States** and the **UK**, we used traditional economic modelling built upon third-party estimates of Google market size in the EU and standard returns on investment (ROI) to measure the economic activity driven by Google's core products.
- Working with independent providers Dynata, we conducted extensive polling of a representative sample of over 12,000 individuals across the European Union.
- At the same time, we polled over 7,500 senior business leaders from small, medium and large businesses representing a range of different industries.

To learn more about our modelling approach, please see the Methodology section in the report's appendix.

Public First is a member of the Market Research Society. The full tables for all the data used in this report are available to download from our website.

While Google commissioned this report, all information in this report is derived or estimated by Public First analysis using non-Google proprietary and publicly available information. Google has not supplied any additional data, nor does it endorse any estimates made in the report. Where information has been obtained from third-party sources and proprietary research, this is clearly referenced in the footnotes. All numbers are Public First's best estimates as of September 2023 and have not been revisited since.



Artificial Intelligence

The Rise of AI

Ever since the invention of the computer, scientists have been working on developing artificial intelligence. For much of the twentieth century, progress was relatively limited, with AIs only able to handle very specific tasks and struggling to generalise or match a human's ability to recognise patterns or combine different ideas.

Starting around the early 2010s, AI saw a significant leap forward. The combination of more powerful processors, advances in underlying algorithms, and the diverse range of publicly available training information available through the open internet created a new deep-learning revolution in AI. Companies like DeepMind created new AI technologies that were able to teach themselves human-level performance on a wide range of games. AI algorithms were integrated into some of the world's most important technology products, including Google's: helping Google Search understand better the context of a query, Google Translate to create more accurate translations, or Google Photos automatically identify different people or types of objects.

In 2017, researchers at Google introduced the Transformer, a new type of deep-learning architecture. Compared to previous architectures, the Transformer's structure made it much easier to train far larger models. At the same time, the attention mechanism built into the Transformer model allowed it to keep track of longer-term context, allowing it to understand increasingly complicated concepts across a wide range of fields.

Building on the transformer architecture, the tech industry is currently introducing a range of new generative AI products to help humans write text, research information, create images or generate code. In recent months, experiments using these tools have shown that generative AI tools are able to help humans significantly reduce the amount of time taken to complete mid-level professional writing tasks,¹² deal with customer support cases,¹³ or develop new programs.¹⁴

The advances in AI have been widely noticed—and not just by people in the tech industry. **A majority of Europeans (52%) told us that AI was developing faster than they expected, with just 8% saying it was developing slower.** In our polling, we saw significant interest in taking advantage of a wider range of AI-powered features:



65% said they would be personally interested in using AI to **help protect them online.**



62% said they would be personally interested in using AI to **help reduce their household energy consumption.**



50% said they would be personally interested in using AI to **eliminate mindless or repetitive tasks at work.**



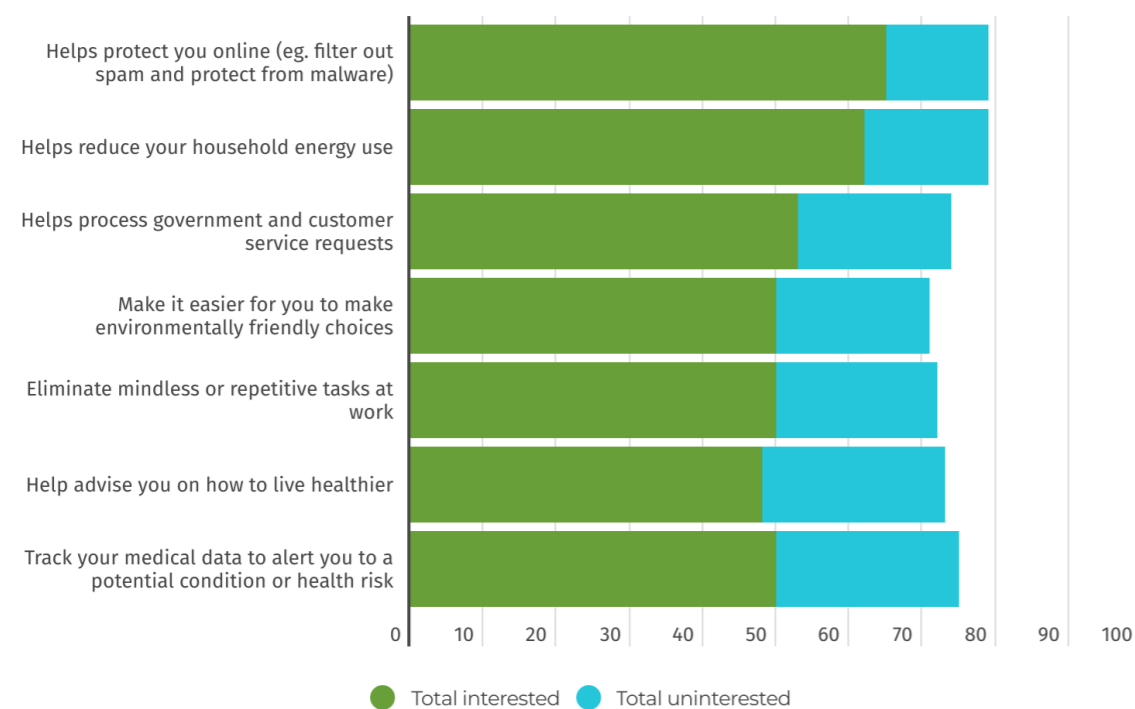
50% said they would be personally interested in using AI to **track their medical data to alert them of a potential condition or health risk.**

¹² https://economics.mit.edu/sites/default/files/inline-files/Noy_Zhang_1.pdf

¹³ https://www.nber.org/system/files/working_papers/w31161/w31161.pdf

¹⁴ <https://github.blog/2022-09-07-research-quantifying-github-copilots-impact-on-developer-productivity-and-happiness/>

How interested, if at all, would you be personally in using AI to do the following?



The Economic Potential of AI

Over the last few decades, the personal computer, internet and smartphones have created successive waves of new opportunities for businesses. Together, digital technology has been responsible for around half of the fundamental productivity growth in advanced economies.¹⁵

In the next few decades, AI is likely to further increase economic growth, business productivity and innovation in many ways: enabling new types of products, allowing workers to get their jobs done faster and reducing waste or efficiency.

There remain many unknowns about the potential speed and scale of the economic impact of generative AI (see box). Based upon Goldman Sachs' identification of the types of tasks exposed to automation by generative AI,¹⁶ we produced new estimates of the potential improvement in labour productivity.



Following Goldman Sachs' methodology, we estimate that generative AI could increase the economy of the EU by €1.2 trillion, or the equivalent of 8% of GDP.¹⁷

15 <https://www.oecd.org/economy/growth/ICT-investments-and-productivity-measuring-the-contribution-of-ICTS-to-growth.pdf>
 16 <https://www.goldmansachs.com/intelligence/pages/generative-ai-could-raise-global-gdp-by-7-percent.html>
 17 Following the methodology of Goldman Sachs, we assumed no productivity improvements to types of tasks other than those identified by them. In addition, we assume capital intensity remains constant.

What do we know about the economic impact of AI?

There remain many unknowns about the potential scale and speed of the economic impact of AI, including:

- **How fast will AI models continue to improve?** Today's technology is already capable of automating many tasks, but more progress will be needed to ensure their reliability for longer-term, more complex or sensitive tasks.
- **How long will it take businesses to adopt AI technologies and adapt the rest of their business model?** For past General Purpose Technologies (GPTs), it has often taken decades for businesses to work out how to best take advantage of new technology, redesign jobs or develop supporting systems.
- **What other bottlenecks could hold back progress?** A shortage of skilled workers, other digital infrastructure or badly designed regulation, could slow the adoption and deployment of AI technology.

Despite these uncertainties, there is widespread consensus that AI has the capability to create at least as much economic benefit as previous foundational technologies, such as the steam engine or personal computer.

A wide range of recent estimates suggest that AI could have a significant impact on growth:

- **McKinsey**¹⁸ estimates that generative AI could lead to \$2.6 trillion to \$4.4 trillion annually in additional economic growth, or the equivalent of 0.6-0.7 pp higher annual productivity growth for advanced economies such as France or Germany.
- **Public First**¹⁹ finds that generative AI could lead to the equivalent of an additional £400 billion in GDP for the UK by 2030.
- **OpenAI**²⁰ estimates that tools built on top of generative AI could help between 47% and 56% of all worker tasks completed in the US be done significantly faster.
- **Goldman Sachs**²¹ estimates that generative AI could increase global GDP by 7% over 10 years, increasing productivity growth by 1.5 percentage points.

18 <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#key-insights>
 19 <https://googlesukimpact2023.publicfirst.co.uk/#c7>
 20 <https://arxiv.org/abs/2303.10130>
 21 <https://www.goldmansachs.com/intelligence/pages/generative-ai-could-raise-global-gdp-by-7-percent.html>

As part of its Digital Decade plan, the European Commission has set a goal for 75% of EU businesses to be using AI, cloud and big data by 2030. In our business poll, we saw that a significant minority of European businesses were already using some kind of AI technology, including:²²



20% of EU businesses said that they were using AI for **data analysis**.

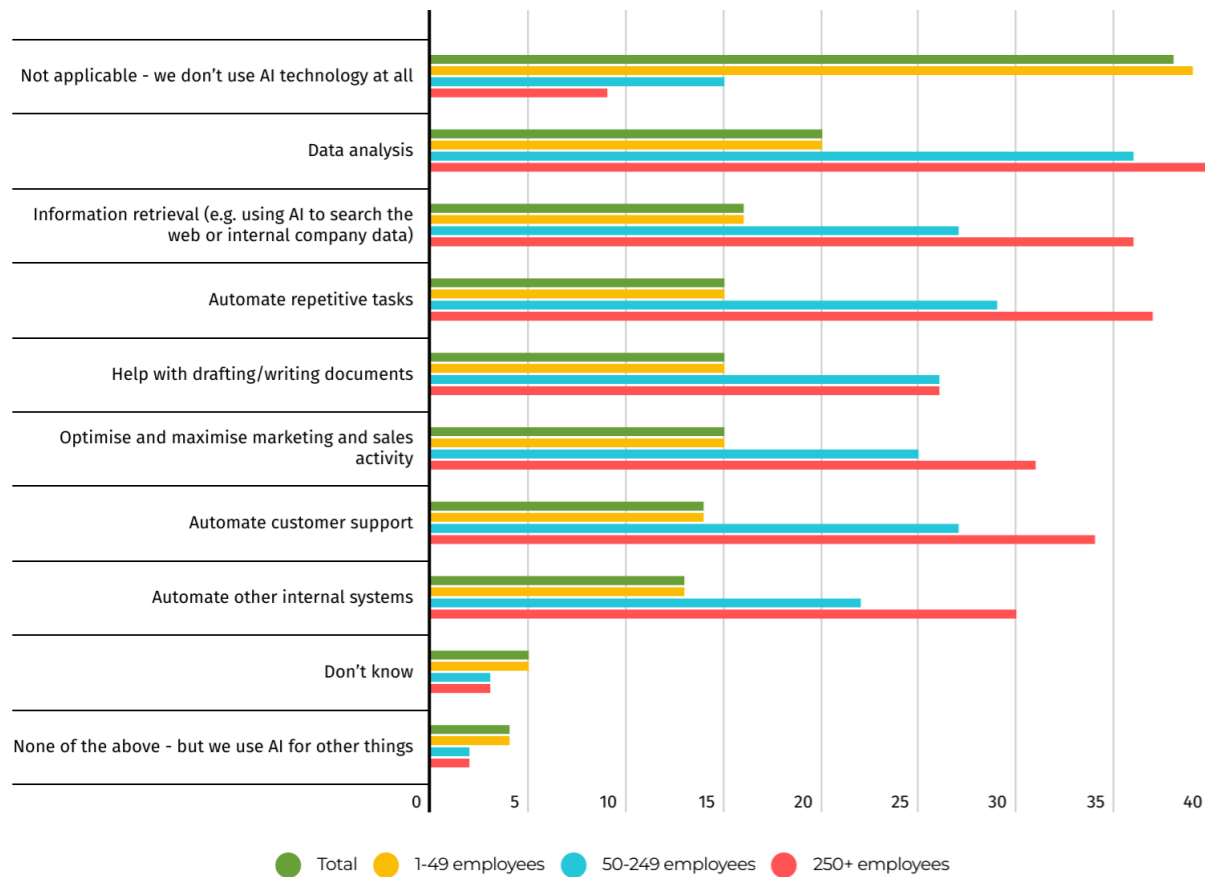


16% of EU businesses said that they were using AI for **information retrieval**.



15% of EU businesses said that they were using AI for **help with drafting or writing documents**.

Does your business currently use AI to do the following?



²² The proportion of businesses using AI is very dependent on how exactly Artificial Intelligence is defined, which businesses are surveyed and whether businesses are weighted purely based on their number or their wider share of employment. From one perspective, almost all businesses today are using AI indirectly through tools such as Google Search, although most will not be aware of this. By contrast, the EU's most recent data for 2021 finds that just 7% of businesses are currently using AI technologies. This is based on non-financial enterprises with 10 employees or more who reported using one of the following AI technologies: analysis of written language, converting spoken language into machine-readable format, generating written or spoken language, identifying objects or persons based on images, machine learning (e.g. deep learning), automating different workflows or assisting in decision making or enabling physical movement of machines via autonomous decisions based on observation of surrounding.n

In the next few years, generative AI is set to create a whole generation of digital tools, with the potential of this already recognised by larger businesses. 75% of larger businesses with greater than 250 employees told us that they expected generative AI to significantly improve the productivity of their business in the next five years and:



54% of larger businesses told us that they expect to use generative AI in the next five years for **data analysis**.



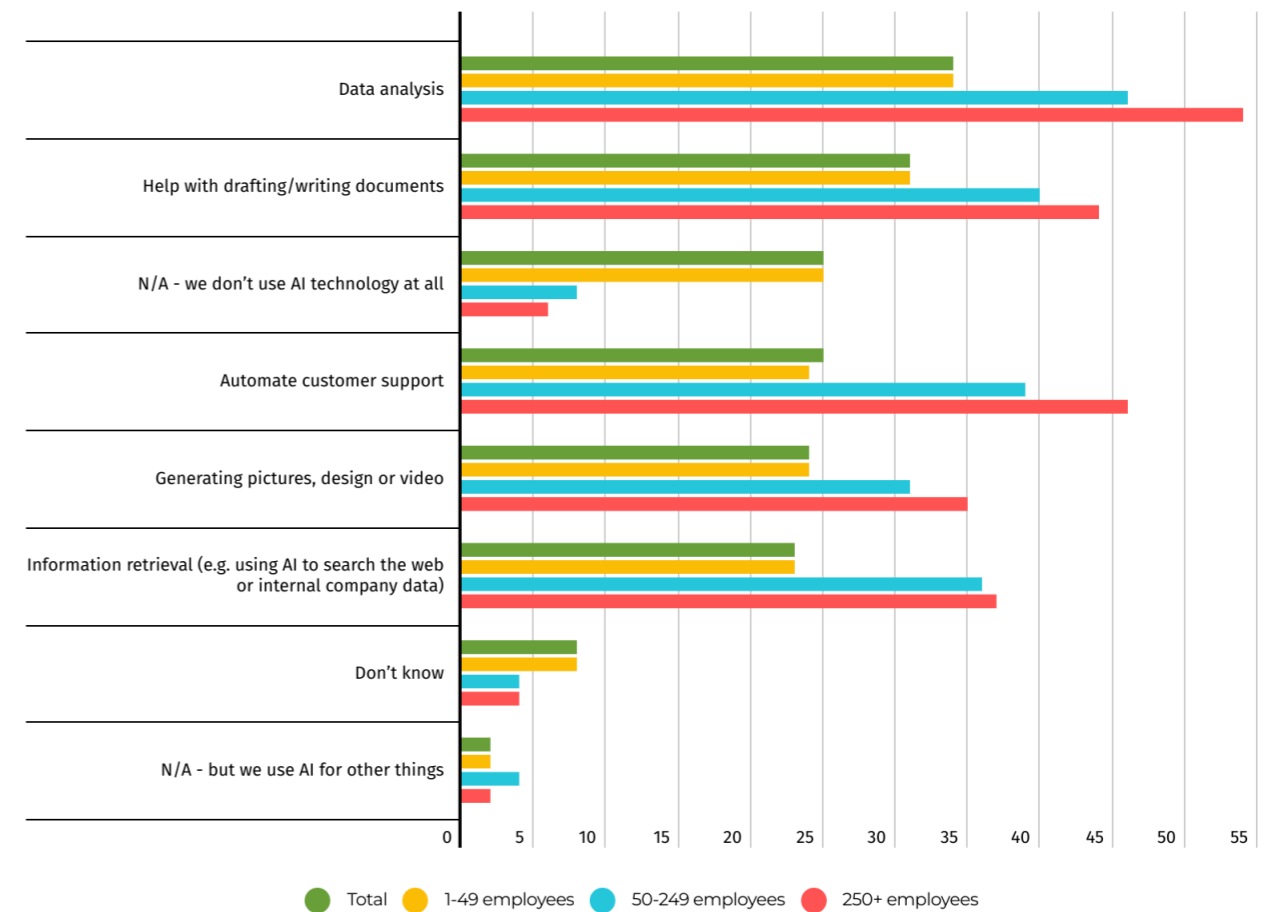
44% of larger businesses told us that they expect to use generative AI in the next five years for **help with drafting or writing documents**.



46% of larger businesses told us that they expect to use generative AI in the next five years to help them process **customer support**.

By contrast, smaller businesses were less aware of the potential benefits of generative AI. For example, businesses with fewer than 50 employees were only half as likely to say that they were already using generative AI for help with writing and drafting documents in the next five years as those with more than 250 employees. In the next five years, just 31% thought they would likely use it.

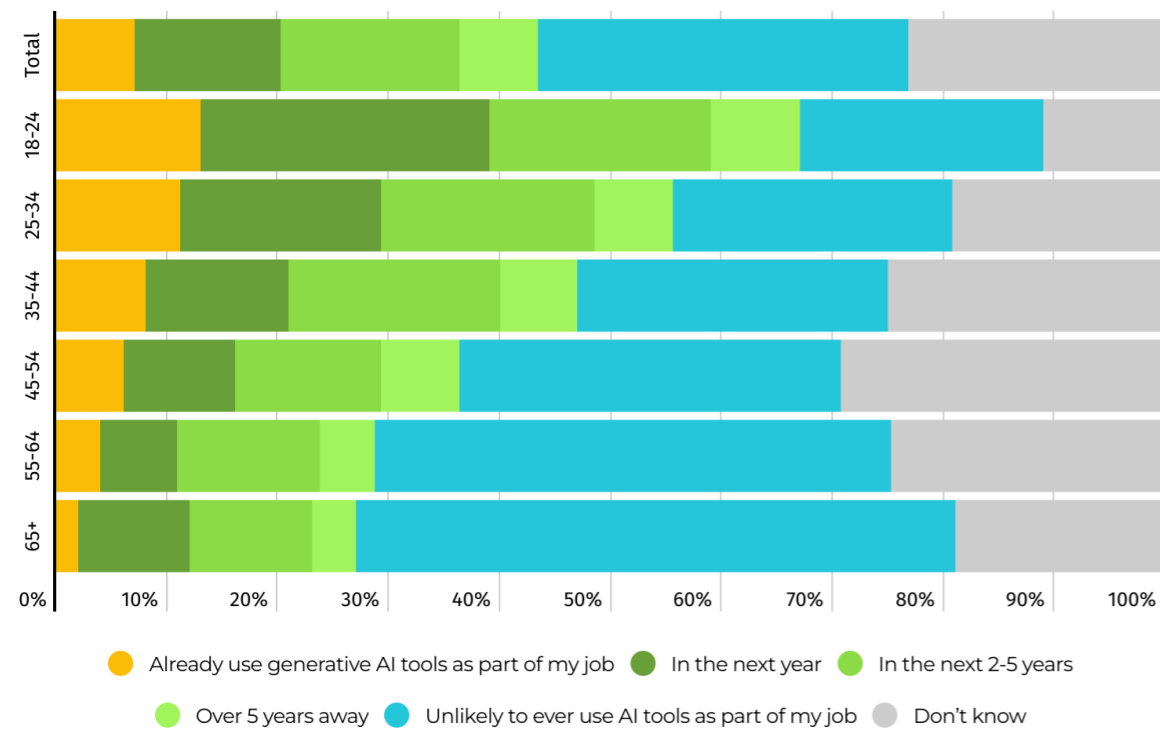
And which of the same list of tasks do you expect to use generative AI technology to do in the next 5 years?



Just as with businesses, in the next few years, generative AI tools have the potential to significantly boost the productivity of individual workers. **On average, we estimate that generative AI tools could save individual workers over 70 hours a year by 2030.**

Just over half of full-time workers (52%) told us that they expected to explore more AI-powered tools in the next year, and 39% said that they expected to use generative AI tools as part of their jobs within the next five years. This was particularly true for younger workers, with over half of those under 35 expecting to use generative AI tools as part of their work in the next five years.

When, if ever, do you plan to use generative AI tools as part of your job?



On average, senior business decision-makers told us they expected to invest in AI tools to automate current business tasks in the next two to five years. While there were business leaders who were considering reducing their workforce, the majority (**79%**) said they were likely to **reallocate employees' freed-up time to other more valuable tasks**. At the same time, 66% said they were likely to reskill existing employees, and 61% were likely to **hire new people to support the deployment of AI technology**.

How AI Can Help Tackle Societal Challenges

Over the last thirty years, the internet has been one of the most important drivers of higher economic productivity and competitiveness. As important as the new industries and jobs it has created, however, have been the ways it transformed our daily lives: changing how we learn, communicate, relax or date.

In the same way, the impacts of AI are as likely to be as significant in our personal lives or for wider society as in the workplace.

In the next few decades, AI tools could help us:



Accelerate medical research. At the moment, much drug development relies on a slow and increasingly expensive process of trial and error to find new candidates for potential medicines. In the future, AI systems will make it much easier for pharmaceutical companies to find, design and select new options for drug development.



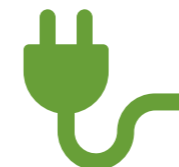
Make it easier to learn or gain new skills throughout your life. One-to-one personal tutoring is one of the most effective means of teaching we know of. At the moment, it is too expensive to roll out to every pupil, while many people later in life cannot commit to a full-time education. In the future, AI will allow every pupil or worker to have a tutor customised to their preferences and existing level of knowledge, helping motivate them to learn more.



Diagnose and treat emerging health conditions earlier. The earlier an emerging disease is identified, the more likely we are to be able to implement effective treatment.



Reduce cost pressures in public services. Beyond its impact on health and education, AI systems could also help public services work more efficiently, automating back-end operations and reducing waste. This could make a significant difference in the sustainability of public finances, freeing up resources that can be deployed elsewhere.



Improve energy efficiency and sustainability. Across the economy, AI systems can help identify and reduce unnecessary energy usage or greenhouse gas emissions. According to one recent estimate by PWC, the application of AI levers could help reduce worldwide greenhouse gas (GHG) emissions by 4% in 2030.²³



Improve safety and reduce traffic accidents. In 2021, around 20,000 people were killed in road traffic accidents in the EU.²⁴ Autonomous vehicles such as those being developed and deployed by Google's sister company, Waymo (formerly the Google Self-Driving Car Project), are already improving road safety by reducing the number of traffic injuries and fatalities in areas of the US where they operate.

23 <https://www.pwc.co.uk/services/sustainability-climate-change/insights/how-ai-future-can-enable-sustainable-future.html>
 24 https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Road_accident_fatalities_-_statistics_by_type_of_vehicle

In our polling, we saw widespread support among Europeans for the greater use of AI to help with wider societal challenges:



68% supported the wider use of AI to **make advances in medicine development.**

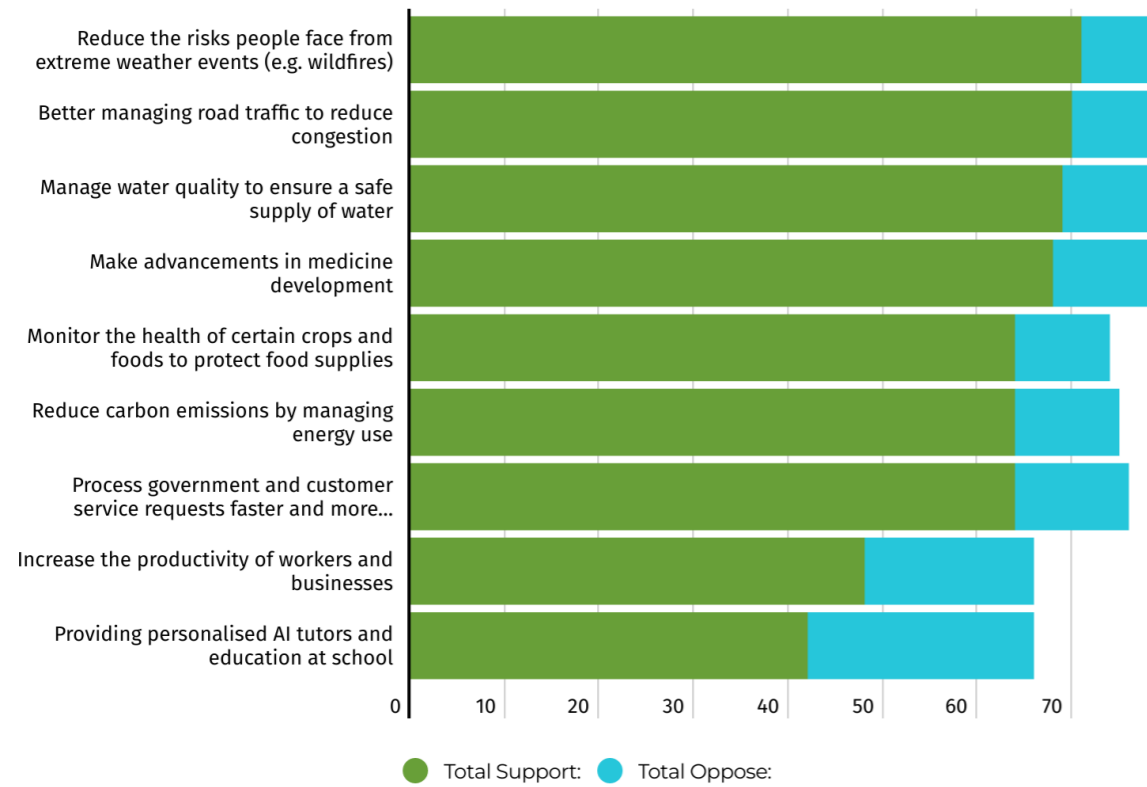


64% supported the wider use of AI to **process government and customer support requests faster and more efficiently.**



64% supported the wider use of AI to **reduce carbon emissions by managing energy use.**

Would you support or oppose AI being used more widely in society to do the following?



Google's Contributions to AI

For over twenty years, Google products and services have been taking advantage of AI technology to create more powerful products and features. The first AI feature in Google Search was first introduced in 2001 to support better spell check. Despite this, in our polling, only around half of EU adults were aware that Google Search already draws on AI features.

In 2016, Google's CEO Sundar Pichai announced that it would now be an "AI-first company." Following up on this, the company has pledged to follow a "both bold and responsible"²⁵ approach to AI and published a set of AI principles on how it will respond to new challenges created by the technology.²⁶

Today, AI is being used:



In **Search**, AI enables Google to better understand the context of the kind of information you are likely to be looking for or lets you search in different ways, such as through your camera or even humming a tune.



In **Maps**, AI provides up-to-date traffic information and helps keep data such as business hours always up to date.



In **YouTube**, AI helps automatically generate captions or recommend new and upcoming creators for you to watch.



In **Photos**, AI helps automatically categorise your pictures by who or what is in them, making it far easier to surface old memories.

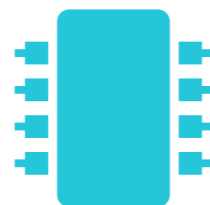
²⁵ <https://blog.google/technology/ai/google-responsible-ai-io-2023/>
²⁶ <https://ai.google/responsibility/principles/>

Looking forward, the use of AI is likely to become significantly more visible to the end user, as generative AI helps them directly research, create documents and edit images. In 2023, Google announced a wide range of new generative AI features. Already available is Bard, an experimental chatbot tool that can help answer a wide variety of questions. In the US, Japan and India, Google is experimenting with generative AI in Search to help people better understand topics faster. A new set of features in Workspace called Duet AI will be able to help you produce the first draft of a document, email or slide deck, while Magic Editor in Photos will allow you to organically edit different aspects of a photo, such as where a relative is sat, or how overcast the sky is.

Beyond its own products, Google is one of the leading creators of AI tools, APIs and datasets for other companies, including:



TensorFlow. In 2015, Google released TensorFlow, an open-source software library that has become popular among AI researchers and developers and is used for a variety of tasks, including image recognition, natural language processing, and machine translation. TensorFlow has become a critical tool for creating and deploying machine learning models, with more than 200,000 users and over \$17 billion in economic impact globally.²⁷



Hardware. One of the most important current bottlenecks to the faster development of AI is a shortage of the advanced chips that are needed to train or run today's leading models. Google's Tensor Processing Units (TPUs) are custom-developed chips specially designed for the matrix calculations needed for AI neural networks. Alongside being used to train Google's own models, they are available for other companies to hire through Google Cloud.



Datasets. Google has published over 90 open datasets for other researchers and smaller organisations to learn from, including COVID-19 open data and Open Images.



PaLM 2. In 2023, Google announced PaLM 2, a next-generation large language model. PaLM 2 is used by Google to power its own generative AI tools, such as Bard, and will soon be available for other developers to build on top of through a new API. PaLM 2 can manage complex reasoning tasks, handle instructions in many languages simultaneously, and is better optimised to support coding-related tasks.

Case Study: Lufthansa

In the past few years, the airline industry has announced its commitment to achieving net-zero carbon emissions in the next 30 years. Meeting this target will largely depend on the industry's ability to access sustainable fuel, acquire the latest carbon-friendly aircraft technology, and develop optimisation strategies for efficient operations in the air and on the ground.

The Lufthansa Group recognised that this increasingly complex environment required a new approach to data management. The airline partnered with Google Cloud to develop a platform that facilitates better planning and steering of the airline's daily flight operations.

Flight rotation involves choosing an aircraft that will increase efficiencies for a particular flight based on a variety of factors, including the aircraft's passenger capacity, weight, maintenance schedules, and fuel burn. The amount of fuel consumed during flight varies from plane to plane, depending mainly on the trajectory of the aircraft and the type of engine.

For example, an Airbus A321neo, which stands for "new engine option", would be 15% to 20% more efficient than a standard Airbus A321 on a four-hour trip to the Canary Islands. How does the team know this? The scenario-planning capabilities enabled by Google Cloud help controllers determine which aircraft is ideal for a particular route, considering all available live data. The efficiencies gained from these decisions, even in small numbers, add up to significant savings.

Within 18 months of working with Google Cloud on these initiatives, the Lufthansa airline SWISS has already optimised at least half the flights in the SWISS network, and they reported to have cut CO2 emissions by an estimated 7,400 tons per year—the equivalent of 18 Boeing 777 roundtrip flights between Zurich and New York City or 370 rotations between London and Zurich.

²⁷ <https://www.google.com/search?q=tensorflow+has+become+a+critical+tool+for+creating+and+deploying+machine+learning+models%2C+with+more+than+200%2C000+users+and+over+%2417+billion+in+economic+impact+globally.&oq=tensorflow&aqs=chrome.0.69i59l2j69i57j0i67i650l2j69i60l3.3527j0j7&sourceid=chrome&ie=UTF-8>

AI Research

Across the world, Google is one of the most significant contributors to AI research, publishing more than **2,700 research papers** in the last three years. Over the last five years, Alphabet, Google's parent company, has invested over \$145 billion globally in R&D.²⁸

This research is behind many of the most important developments in the field, with over 30% of the top 100 most cited AI papers in recent years coming from the company's researchers.²⁹

Among its most important creations are:

- **The Transformer architecture.** In the 2017 paper "**Attention Is All You Need**" by Vaswani et al., Google researchers introduced the Transformer model, which drives many of the advancements in generative AI we experience today. This breakthrough architecture addressed the limitations of previous models, which struggled with long-range context and parallelisation, making it significantly easier to train larger deep-learning models. Transformer models are at the heart of many of today's leading generative AI models, including Bard, Stable Diffusion, ChatGPT and MidJourney.
- There are over 200 million known proteins, each with a unique 3D shape that determines how they work. Google DeepMind's **AlphaFold** was recognised as a solution to the 50-year "protein-folding problem", enabling us to better predict what a protein will do from its underlying amino acids. **AlphaFold** can accurately predict 3D models of protein structures, accelerating research across medicine and biology. The AlphaFold Protein Structure Database, created in partnership with the European Bioinformatics Institute, allows scientists to access information on over 200 million predicted structures, including all the 20,000 known proteins that make up the human body.³⁰ By reducing the need for slow and expensive experiments, Google DeepMind estimates that AlphaFold potentially gave the research world up to one billion years of progress and saved trillions of dollars. Since its launch, the AlphaFold Protein Structure Database has been accessed by over 280,000 users across the EU. 3660 papers co-authored by researchers affiliated with EU-27 institutions have cited AlphaFold.

Across Europe, Google works with many academic and research institutions, including:

- The **Max Planck Institute for Informatics in Saarbrücken** (Germany) and Google have started a strategic partnership to establish the Saarbrücken Research Center for Visual Computing, Interaction and Artificial Intelligence (VIA) at the MPI for Informatics. The centre will conduct basic research in frontier areas of computer graphics, computer vision, and human-machine interaction.
- Google is supporting **INSAIT (Institute for Computer Science, AI and Technology)**, a new Computer Science AI Institute based in Bulgaria. INSAIT's mission is to establish itself as the first world-class computer science and AI research institute in Eastern Europe.
- Google is supporting **PRAIRIE** (Paris Artificial Intelligence Research Institute) in France. This is one of the four French Institutes of Artificial Intelligence, which were created as part of the national French initiative on AI announced by President Emmanuel Macron on May 29, 2018. Google is planning to support PRAIRIE for three years (2020 - 2023).

Case Study - Google.org Social Innovation Fund on AI

From tracking real-time global carbon emissions to predicting disease outbreaks to helping communities unlock their potential, AI can transform how we tackle social and environmental challenges here in Europe and globally. To help entrepreneurs share in this opportunity, Google.org provided €10 million in funding, as well as mentoring and support, to help social entrepreneurs from underserved backgrounds develop transformative AI solutions and apply them to the issues they're tackling on a daily basis. The fund will focus on:

- **Providing capital:** Through a grant to INCO, the fund supports the expansion of Social Tides, a bespoke accelerator program funded by Google.org, that will provide cash grants of up to \$250K, dedicated support and AI expertise for underserved social entrepreneurs.
- **Sharing expertise:** The Google for Startups Accelerator team will be providing INCO with best-in-class mentoring and technical support from AI experts, as well as training on how to develop AI responsibly.
- **Growing the AI ecosystem:** Supporting non-profits in Europe with grants to provide and grow access to training and support to underserved social entrepreneurs on how to develop and deploy AI solutions.

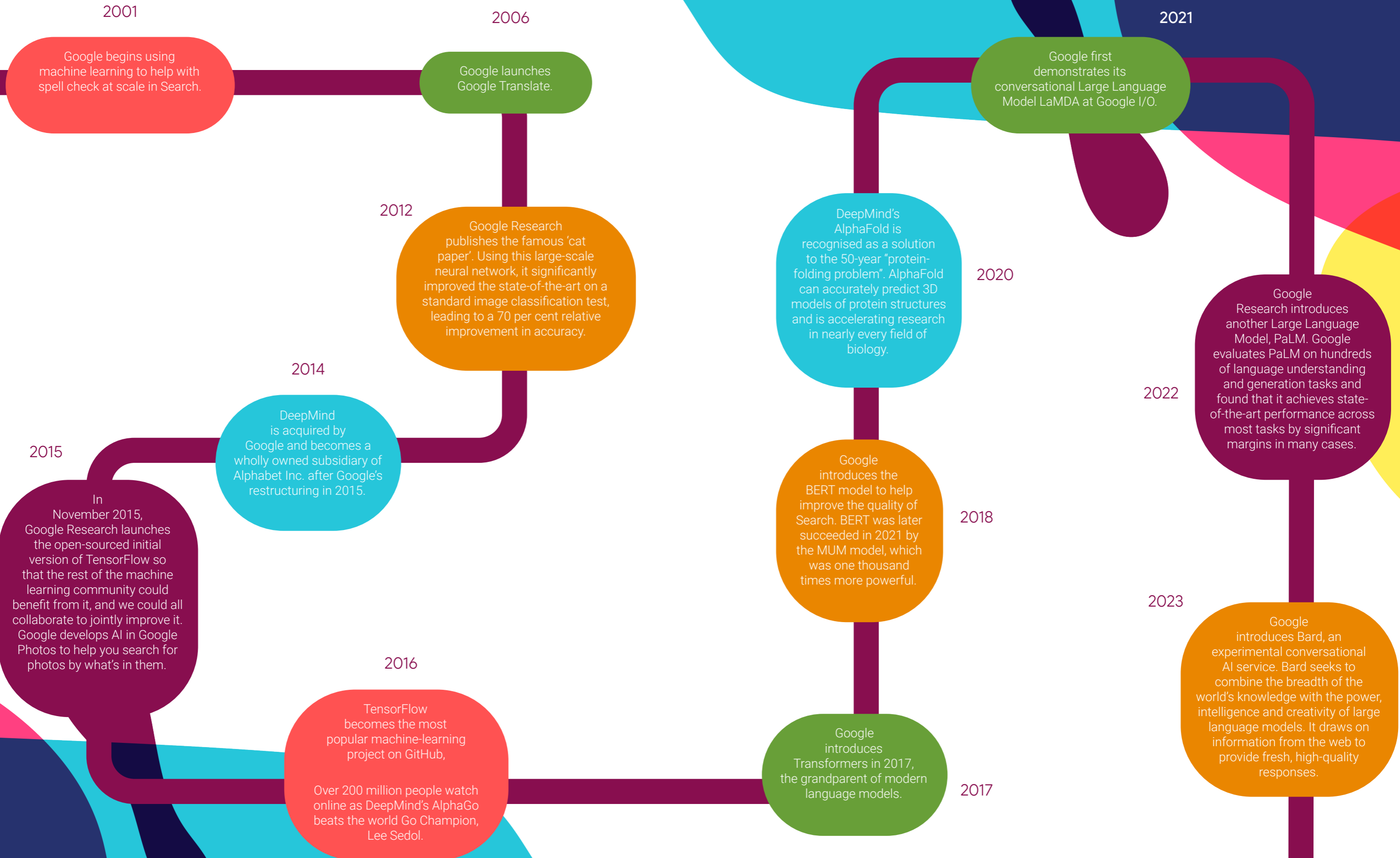
Launched in March 2023, this new fund builds on the €20 million Google.org Social Innovation Fund, which, after launching in 2021, has so far supported over 260+ European social entrepreneurs. Among the participants, 62% are women, and 84% represent individuals from underserved communities. By participating in the program, they have been enabled to test and prototype their idea, establish an enterprise, consolidate their business model and brand identity, raise funds and generate their first revenues. One such beneficiary is George Koureas, who heads up the social enterprise Promilist in Greece: "*With an increasing amount of openly available data and a decrease in computational costs, AI can enable small teams to create measurable value both for their immediate communities as well as the global economy*".

28 <https://googlesukimpact2023.publicfirst.co.uk/>

29 <https://www.zeta-alpha.com/post/must-read-the-100-most-cited-ai-papers-in-2022>

30 <https://www.deepmind.com/research/highlighted-research/alphafold>

Google's Advances in AI



Google's AI Policy Recommendations

To help Europe take full advantage of the potential of AI, Google suggests:³¹

Today, Europe faces a once-in-a-generation opportunity to accelerate economic growth and make progress on social challenges. The ability to deploy AI and innovate with it at scale will most likely define Europe's competitiveness in the coming decade. To capture these opportunities, European policymakers need to strike the right balance between leveraging AI's benefits and minimising its risks. This requires responsible regulation—but it also needs a broader vision of technology leadership that prioritises new ways to spur private sector innovation and promote the adoption of AI and emerging technologies. In order to do this, Google recommends that the EU:

1 Increase investments in AI research and development: The EU and its nations should significantly increase investments in fundamental and applied AI research, both through its own investment goals and through incentivising private sector research. This should include research into better understanding AI's benefits and risks and how to manage them (such as the development and deployment of new technical innovations for responsible AI) and research into applying AI for societal benefit (such as in health, manufacturing and agriculture). At present, the US spends more than twice as much as the EU per capita on AI R&D.³²

Recommendation: The EU should review its own investment goals and allocate more funding towards this research—as well as further incentivising private sector R&D.

2 Aim for international alignment, including a balanced AI regulatory framework: A consistent set of rules for AI will help instil trust and confidence, create a healthy competitive EU market, and give citizens, researchers and businesses the guidelines they need to use, develop and deploy AI. Whether creating new regulations or deploying existing rules, the EU needs to ensure that there's consistency across all EU countries and avoid duplication or conflict. Beyond that, the EU single market would be even more beneficial if coupled with an ambitious trade policy and alignment on AI governance. We need common risk-based policy approaches that regulate the uses of AI, rather than the technology itself, with like-minded partners that reflect democratic values and avoid fragmentation on an international level.

Recommendation: Harmonise existing EU digital regulation, ensuring that there's consistency across all EU countries and avoiding duplication or conflict. Seek international cooperation and alignment on AI policy and regulation in international fora, like the G7.

3

Understand and prevent malicious use of AI across the internet: AI has important implications for global security and stability. Whether it is good or bad depends entirely on how it is used; it can be used to create or to combat misinformation and disinformation or to drive increasingly sophisticated cyber defences or attacks. Progress in this space will require cooperation in the form of joint research, adoption of best-in-class data governance, and public-private partnerships to share information on AI security vulnerabilities and more.

Recommendation: Form networks and cooperation between academia, civil society and private companies to better understand the security and safety risks of AI systems and how to align them with human values. Expand international and private-public partnerships to share information on AI security vulnerabilities and issues (such as disinformation campaigns), aligning on next-generation trade control policies for specific applications of AI-powered software.

4

Prepare workforces for the AI-driven job transition: Recent studies suggest that up to 30% of hours worked could be impacted by generative AI by 2030, with the majority of jobs transitioning to new tasks rather than becoming redundant. Despite extensive EU and Member State efforts, the digital skills gap and the scarcity of STEM talent remain the most significant barriers to the digital transition and innovation made in Europe. Closing that gap in Europe and preparing the workforce for an AI-driven transition will be essential to capitalising on AI's economic and societal benefits. Governments and industry need to double down on their efforts to upskill and reskill workers and support businesses, in particular SMEs, to meet changing demands and utilise new ways of producing goods and services. Extra focus should be given to vulnerable groups so as to ensure that this transition is inclusive and accessible to all.

Recommendation: Make basic computer science and AI training a mandatory part of school curriculums across Europe and explore using generative AI as a tool to advance formal education in schools and universities. Leverage public-private partnerships (like the European Pact for Skills) in order to align on common standards and effective programs for upskilling and reskilling workers, including life-long learning, for an AI-driven economy. Finally, the European STEM talent base must be grown and made more inclusive by diversifying computer science education, nurturing talent and easing immigration policies for non-EU STEM students and professionals.

5

Advance High-Performance Computing (HPC) technologies. To be a world leader in science and innovation, the EU needs to increase its large-scale computing capacity and public access to it. HPC technologies can tackle problems that would be impossible to solve with traditional computing models—enabling AI breakthroughs (like AlphaFold) that can tackle climate change or disease. To implement the EU Digital Decade target of 75% cloud/AI use in firms, governments will need to support a combination of public and private investments in HPC.

Recommendation: As part of the High-Performance Computing Joint Undertaking, the EU should assess whether the future demand for AI computer research, development, and deployment requires new types of investments (for example, to become more flexible by supporting HPC in the cloud).

³¹ These policy recommendations have been provided and developed by Google.

³² https://ai-watch.ec.europa.eu/document/download/dc51ed64-e3f7-4cd2-8c91-919b034ad797_en (This figure exclude investment in Skills).

Innovation

Supporting European Innovation

The EU is one of Google's most important engineering and development hubs, with 30 offices located across 19 countries.³³ The EU is also home to four R&D sites in Europe: Amsterdam, Berlin, Munich and Paris.

Beyond helping develop its own products and services, Google is also a key contributor to the wider European innovation ecosystem:



Google is a key supporter of global and European research, particularly in the areas of AI and cybersecurity.



Google is a significant investor in digital infrastructure, such as data centres or content delivery systems.



Google provides multiple open-source software frameworks that many European businesses build on, including Android, Firebase, Kubernetes and TensorFlow.



Google directly supports many European startups, both in programs such as its Google for Startups Accelerator and through venture investment from Google Ventures.

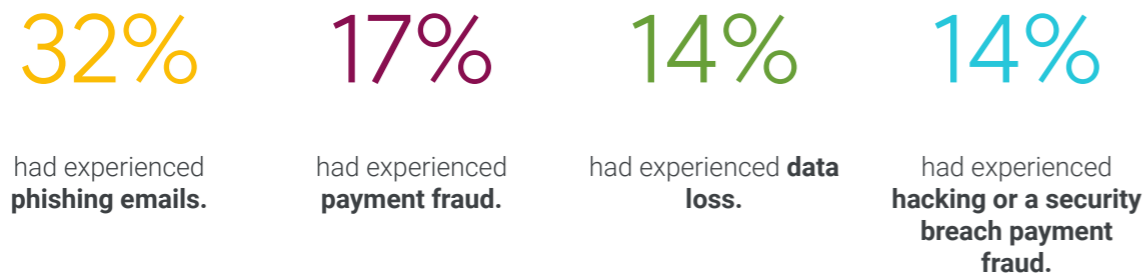
In this chapter, we look in more detail at some of the different ways Google is helping to drive European innovation.



Cybersecurity

Europe is home to three of Google's global hubs for privacy and security engineering, developing tools that help keep billions of people safe online. Globally, Google has committed over \$10 billion to strengthen cybersecurity, including expanding zero-trust programs, helping secure the software supply chain, and enhancing open-source security. At the same time, increasingly sophisticated protections continue to be added to core products: Gmail, for example, protects its users from nearly 15 billion unwanted messages a day, blocking more than 99.9% of spam, phishing, and malware.

Businesses and governments face increasingly sophisticated online threats, which carry significant financial, operational and reputational risks. Global cyberattacks increased by nearly 40% in 2022, and this trend is likely to continue over the years to come.³⁴ According to our business polling, **58% of businesses experienced some kind of digital security threat in the past five years.** Of the businesses we spoke to:



Google Cloud continues to invest in the key technologies that will make strong security pervasive and simple for everyone. Recent advancements in AI—such as Google's Security AI Workbench—will accelerate Google's ability to help businesses and governments stay safe. These new models not only give people a more natural way to manage security, but they also give people access to AI-powered expertise to go beyond what they could do alone.

By deploying AI across businesses to help with pre-emptive risk monitoring and upskilling workers in cybersecurity, we estimate that the EU could mitigate over €19 billion worth of cybersecurity risks.

Google is also supporting cybersecurity training for businesses to ensure their workers have the skills they need. This includes a Google Cybersecurity Certificate, where individuals can learn from Google's experts at their own pace, gaining critical skills like identifying common risks, threats, and vulnerabilities and the techniques to help mitigate them.

Case Study: Google Safety Engineering Centres (GSEC)

GSEC Munich is Google's global hub of privacy and security engineering. Established in 2019, it's where 300 dedicated engineers work to make best-in-class privacy and security equally available to all, such as:

- the Google Account, featuring transparency and controls over data collected across Google services, as well as easy-to-use tools like Privacy checkups or Security checkups;
- Google's Password Manager, built directly into Chrome and Android, ensures that saved passwords are protected 24/7 by Google's automated defences.

At the same time, Google is providing the Technical University of Munich (TUM) University Foundation with a total of 1.2 million US dollars for scientific research in the areas of Privacy, Safety and Security. Google has been a TUM "Partner of Excellence" since 2018. The donation will finance a new TUM Innovation Network led by Prof. Claudia Eckert and will focus on the topic of cybersecurity.

Google also operates a second Google Safety Engineering Center in Dublin, acting as a regional hub for Google experts working to tackle the spread of illegal and harmful content. Dublin is already a hub for Google's Trust and Safety teams in the region, comprising many different policy experts, specialists and engineers working to keep people safe online by using the latest technology and artificial intelligence. The new GSEC will provide additional transparency into this work and allow regulators to access more information about how Google's content moderation systems and other technologies work in practice.

In the second half of 2023, a new Google Safety Engineering Centre with a focus on cybersecurity is set to open in Málaga, Spain, to act as an additional analyst centre and hub for collaboration.

34 <https://blog.checkpoint.com/2023/01/05/38-increase-in-2022-global-cyberattacks/>

Infrastructure

Training, deploying and fine-tuning today's leading AI models requires significant investment in supporting digital infrastructure, such as cloud, connectivity and underlying computing power. As part of its Digital Decade goals, the European Commission has called for the EU to achieve 100% coverage for high-speed internet, alongside the deployment of at least 10,000 edge climate-neutral and secure edge nodes to enable low-latency computing applications.



100% coverage for high-speed internet, alongside the deployment of



at least 10,000 edge climate-neutral and secure edge nodes to enable low-latency computing applications

Building on top of common digital infrastructure, such as that invested in by Google, allows European companies to take advantage of much greater economies of scale: reducing their costs, giving fast access to the latest advances and increasing energy sustainability. In 2022, Alphabet invested over €28 billion globally in capital expenditure, the vast majority of which is infrastructure such as data centres, content delivery systems and over 20 subsea cables, including the Danat cable connecting the US and mainland Europe³⁵ or the Grace Hopper subsea cable linking Spain, the US and UK.³⁶ The Google Global Cache works with over 1600 ISPs globally to help deliver internet traffic worldwide,³⁷ with Google's infrastructure carrying traffic over 99% of the way to the end user. Google also designs services and products in a way that supports ISPs to effectively manage their network and reduce costs. For example, YouTube compresses video so it can be efficiently transmitted over the Internet.

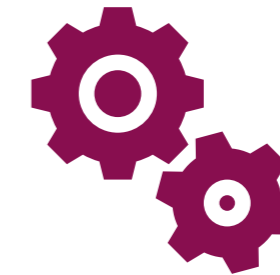
35 <https://cloud.google.com/blog/products/infrastructure/googles-dunant-subsea-cable-is-now-ready-for-service>
 36 <https://cloud.google.com/blog/products/infrastructure/announcing-googles-grace-hopper-subsea-cable-system>
 37 <https://storage.googleapis.com/gweb-uniblog-publish-prod/documents/Future-of-EC.pdf>

Google owns and operates seven data centres located in the EU in Ireland, the Netherlands, Denmark, Finland and Belgium.³⁸ Since 2015, Google Cloud has launched 11 cloud regions in the EU, giving European businesses better performance and more control over where their data is stored.

Google Cloud is designed to ensure three pillars of sovereignty:³⁹



Data sovereignty provides customers with a mechanism to prevent the provider from accessing their data, approving access only for specific provider behaviours that customers think are necessary.



Operational sovereignty provides customers with assurances that the people working at a cloud provider cannot compromise customer workloads.



Software sovereignty provides customers with assurances that they can control the availability of their workloads and run them wherever they want without being dependent on or locked into a single cloud provider.

Beyond cost savings, cloud solutions like those offered by Google Cloud can make it possible to significantly reduce energy usage and carbon emissions compared to traditional on-premises servers. On average, Google-owned and operated data centres are more than 1.5x as energy efficient as a typical enterprise data centre⁴⁰ and deliver approximately 3x more computing power today for the same amount of electrical power that they used five years ago.⁴¹ In 2022, the average annual power usage effectiveness (PUE)⁴² for Google's global fleet of data centres was 1.10, compared with the industry average of 1.55—meaning that Google data centres use about 5.5 times less overhead energy for every unit of IT equipment energy.⁴³⁴⁴

38 <https://www.google.com/about/datacenters/locations/>
 39 <https://cloud.google.com/blog/products/identity-security/how-google-cloud-is-addressing-data-sovereignty-in-europe-2020>
 40 According to Google's own analysis of its more efficient servers, power infrastructure, and cooling systems, compared with data centre industry averages.
 41 According to Google's platform-neutral measurement for central processing unit (CPU) resources analysed over a five-year period.
 42 PUE is a standard industry ratio that compares the amount of non-computing overhead energy (used for things like cooling and power distribution) to the amount of energy used to power IT equipment. A PUE of 2.0 means that for every watt of IT power, an additional watt is consumed to cool and distribute power to the IT equipment. A PUE closer to 1.0 means nearly all the energy is used for computing.
 43 According to the Uptime Institute's 2022 Data Center Survey, the global average PUE of respondents' data centres was around 1.55.
 44 <https://www.gstatic.com/gumdrop/sustainability/google-2023-environmental-report.pdf>

Creating the Next Generation of Tech Leaders in Startups

As one of its Digital Decade goals, the EU has set a target to double the current number of EU unicorns by 2030. At present, the number of unicorns in the EU per million population remains significantly lower than in other tech hubs such as the US, Israel or Canada.

Google is helping support the wider European tech ecosystem in multiple ways, from creating key open software tools to helping anchor the market for tech skills to providing direct capital. GV, the venture capital firm owned by Google's parent company, Alphabet, has invested over \$500 million across 40 European startups since opening in 2014.

Beyond this, Google for Startups is also offering direct support to help nurture European startups. Since its creation in 2015, Google for Startups has helped startups globally raise over €8 billion and create more than 54,000 jobs.⁴⁵ Two of the six dedicated campuses worldwide are based in the EU in Madrid and Warsaw.

Google for Startups offers a wide variety of programs and initiatives to help connect startups to the right people, training, networking opportunities and best practices they need to grow and scale:



Accelerator: AI First

A 10-week, equity-free hybrid program for Seed to Series A, AI-first startups. Alumni of the Accelerator program include:

Born Digital (Czech Republic): A platform to help companies understand why companies contact them and use this data to improve their products.



Growth Academy: Cybersecurity

Google for Startups worked with 15 selected startups across Europe and the UK, focussing on digital security. Alumni of this program include:

Astran (France): A Paris-based confidential data cloud solution that enables companies to unlock cloud adoption without encryption keys.



Accelerator Climate Change

A 10-week equity-free accelerator program for climate change and clean technology innovators who leverage AI and deep tech to ensure a better, cleaner world. Alumni of this program include:

Dayrize (Netherlands): Enables companies with large product ranges to rapidly measure the environmental impact of their entire product ranges, solving the issue around data, cost and speed.



Growth Academy: AI for Health

A three-month program dedicated to supporting high-potential startups using AI technology to grow and innovate responsibly in the healthcare and wellbeing industry. Alumni of previous Google for Startups programs focused on health include:

Infermedica (Poland): A digital health company specialising in AI-powered solutions for preliminary diagnosis and patient triage.

In total in 2022:⁴⁶



Google for Startups Community startups raised **over \$519 million**, creating over 5,000 jobs.



Google for Startups Alumni startups raised **over \$177 million** and hired over 1,000 new people.

⁴⁶ Impact survey (Jan-Mar 23) - All self-reporting figures in this report were provided by the Founder recipients. Google has not supplied any additional data points, nor does it endorse self-reported figures from third parties.

⁴⁵ https://drive.google.com/file/d/1qxcsrHN0XmMyOfsl6iq-qw6dHBwU_nco/view

Google for Startups has created many successful European companies, including:

Gorillas: The on-demand delivery service. Since its founding in Berlin in May 2020, the startup has grown rapidly, expanding to more than 60 cities globally and establishing more than 230 micro-fulfillment centres in nine countries. After just nine months, the startup achieved Unicorn status faster than any other German company before.⁴⁷

Idoven: The world's first cardiology-as-a-service platform powered by artificial intelligence. With origins at the National Cardiovascular Research Centre in Madrid (CNIC), Idovent was co-founded in 2018 by sports cardiologist Manuel Marina Breysse and machine learning scientist Jose María Lillo Castellano, who sought a way to leverage machine learning to prevent and predict heart disease. The Spanish startup, which launched and grew from the Google for Startups Campus Madrid, worked closely with the Google Cloud team to build out their software, and today, Idovent's cardiac AI can analyse 50,000 heartbeats in 60 seconds.

femantasy: The first audio-only streaming platform for female-centric erotica. Operating at the intersection of self-care, podcasting, and sexual wellness, the subscription-based femantasy platform offers over 2,000 high-quality audio stories, real sex sounds and sensual audios from male, female, and non-binary voice actors, ranging in content, theme, vibe and duration. femantasy has won the hearts of hundreds of thousands of users as well as awards, including Forbes' "30 under 30" and Bits & Pretzels' "Best Startup in Health & Wellness". Nina Julie Lepique, co-founder of femantasy, took part in the Immersion: Women Founders program in 2020 and credits its 1:1 business coaching for helping push the business forward.



Businesses

Supporting Business Competitiveness

Over the last two decades, the internet has enabled new types of digital tools, helping many businesses boost worker productivity, transform their business models and reach customers around the world. Recent research by the OECD based on EU data has found, for example, that increasing the adoption of digital tools such as Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM) can boost the productivity of the average firm by over 10%.⁴⁸

As part of its Digital Decade agenda, the EU has set a target for over 90% of SMEs to reach at least a basic level of digital intensity, taking advantage of digital options such as AI, CRM, ERP, cloud, e-commerce or social media.⁴⁹ According to the most recent data, just over half of EU SMEs currently reach this level.

Many of the most important digital tools in recent years used by both SMEs and larger enterprises have been developed by Google:



Google Ads, Google Business Profile and Google Maps have made it far easier for businesses of all sizes to connect with new customers around the world.



Tools like Google Workspace or Gmail make it easier for teams of all sizes to collaborate and communicate.



Services like Google Cloud or TensorFlow help businesses accelerate their digital transformation or adopt customised AI solutions.



New platforms like YouTube or Google Play have created new markets, enabling creators and developers to more easily distribute their content and services.

In our business poll:



55% of all businesses agreed that Google's tools and services had helped to **accelerate their growth**.



64% of new businesses agreed that **the costs of starting a business have reduced substantially or dramatically** because of internet tools such as Google Search, Gmail, Google Docs, Google Workspace, or Google Business Profile.⁵⁰

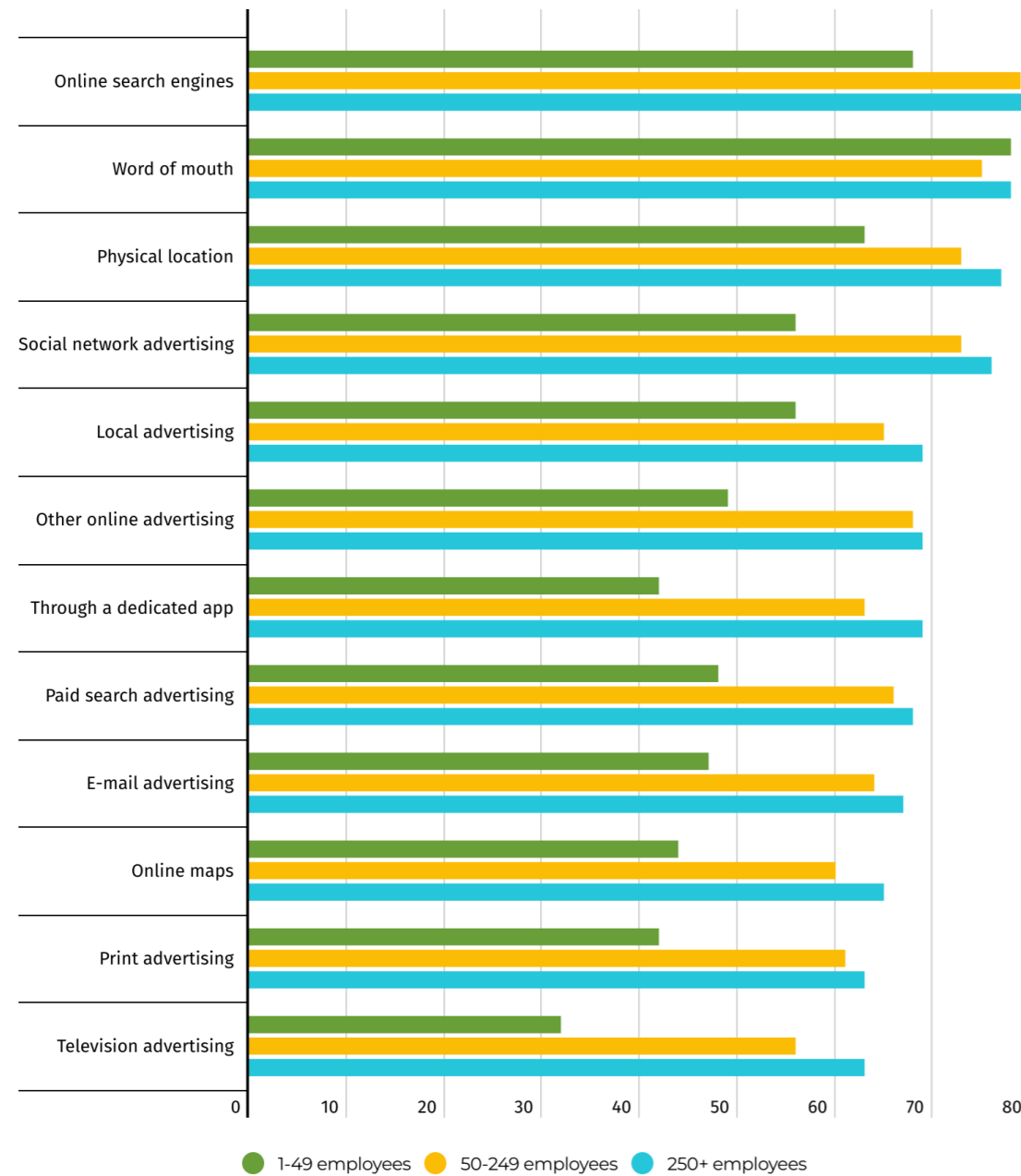
48 https://www.oecd-ilibrary.org/economics/digitalisation-and-productivity-in-search-of-the-holy-grail-firm-level-empirical-evidence-from-eu-countries_5080f4b6-en
49 <https://circabc.europa.eu/sd/a/85e9f133-c930-4453-84d0-2161469b1695/DIGITAL%20INTENSITY%20INDEX.pdf>
50 Defined as business under 2 years old

Connecting with Customers

The internet has transformed the way customers and businesses find and communicate with each other.

For medium and large businesses, online search is now the most important way customers find them. (Smaller businesses said that it came second behind word of mouth.)

How important would you say each of the following are as ways customers or clients find your business?



Today, 70% of EU businesses report using some form of paid online advertising to reach their customers—with over a third (35%) specifically using Google Ads to boost their visibility. Over half (53%) of EU businesses attributed more than 1 in 10 of their customer base to online search and/or paid search advertising. **73% of larger businesses told us that paid search advertising was one of the most important ways they reached new customers.**⁵¹

Historically, it has been challenging for a business to understand the true return on investment of any advertising spend. Without clear data on how many people had taken action in response to an ad, it is difficult to implement bespoke marketing campaigns or to understand whether an advert was actually performing effectively. Meanwhile, large-scale campaigns demand big budgets—often out of reach of smaller businesses or startups—with no guarantees of success.

By contrast, Google Ads’ auction “pay-per-click” model means that businesses only have to pay for adverts that are working. This is more accessible for new businesses as they grow their customer base and allows businesses of all sizes to compete fairly for customer attention. **On average, Google estimates that for every €1 a business spends on Google Ads, it receives €8 back in profit through Google Search and Ads.**⁵²

51 Unless otherwise specified, these numbers cover all search engines, not just Google Search.
 52 <https://economicimpact.google/methodology/>

Case study: Rifò

Rifò is a circular fashion brand based in Prato, near Florence. After realising the extent of overproduction and overconsumption present in the fashion industry, Niccolò Cipriani founded the startup in 2017—calling it after the Tuscan expression for “remake”.

As e-commerce surged in 2021, Rifò needed an advertising solution that would attract new customers, spread awareness and boost conversions. The startup was particularly hoping to capture traffic from consumers interested in sustainable fashion: Rifò collects clothing and textile waste, shreds it by fibre, and then spins a new yarn that can be made into a new garment.

Since using Google Ads, Rifò has seen a great increase in ROAS—reaching 831% across all markets in December 2022—and a 980% ROAS in Italy. Google Ads has also played a huge role in Rifò’s expansion into new markets, increasing sales across Europe with a 420% ROAS year-over-year in December 2022.

“We decided to invest in Google because it was easy to attract new customers”, says Niccolò. “Google Ads became a way we could spread awareness regarding our product and philosophy and attract customers searching for sustainable clothing.”

Beyond paid advertising, many of Google’s most powerful options for business, such as organic search, Maps, Shopping or Google Business Profile, are offered free of charge. **For every click on a paid ad on Google Search, businesses, on average, receive five clicks from organic search results.**⁵³

Google Maps is one of the most important channels through which European businesses reach customers local to them:

61%

of Google Maps users had used it in the last month to **find a local business.**

68%

of Google Maps users had used it in the last month to **find out if a local shop or business was open.**

YouTube has made it possible for businesses of any size to use video to communicate with their customer base. Recent polling by Oxford Economics found that:

76%

of SMBs with a YouTube channel agree that **YouTube played a role in helping them grow their customer base by reaching new audiences.**

73%

of businesses with a YouTube channel agree that **YouTube has helped them develop a following in their local area.**

66%

of SMBs with a YouTube channel agree that **YouTube played a role in helping them grow their revenue.**

63%

of SMBs who use YouTube agree that YouTube is **essential to their business growth.**

Equally, however, Google Search and Ads are also helpful tools for reaching customers globally. 49% of businesses agreed that Google had made it easier to sell to international customers. In total, we estimate that Google Search and Ads have supported over €38 billion in exports for the EU economy in the last year.

Cloud

The cloud is one of the most important enabling layers for digital transformation, supporting higher business competitiveness, improved reliability and more rapid adoption of key technologies such as AI. Recent work by the OECD estimates that in the EU, every 10% increase in the business adoption of cloud is associated with a 3% higher average productivity level for businesses.⁵⁴

Google Cloud is one of the leading cloud infrastructure providers for European companies, used by leading European companies including Deutsche Bank, L’Oreal and Spotify. More than half of all funded gen AI startups are Google Cloud customers, including 70% of gen AI “unicorns”, or those valued at more than \$1 billion.⁵⁵

Previous research by Deloitte for Google Cloud found an average net return on investment of up to €2.5 for every €1 invested in cloud services, with some of the most successful Google Cloud users seeing net returns of €10 for every €1 invested.⁵⁶

In the next few years, the cloud is likely to be an important prerequisite for developing AI workflows and solutions, allowing businesses to fine-tune AI models on their own proprietary datasets while taking advantage of the massive investment it takes to train a foundation model. For the most advanced models today, this cost can reach over \$100 million.⁵⁷

54 Based on the improvement in the productivity of the average company after five years. See https://www.oecd-ilibrary.org/economics/digitalisation-and-productivity-in-search-of-the-holy-grail-firm-level-empirical-evidence-from-eu-countries_5080f4b6-en

55 <https://cloud.google.com/blog/topics/startups/generative-ai-startups-choose-google-cloud>

56 https://www2.deloitte.com/content/dam/Deloitte/es/Documents/tecnologia/Deloitte_ES_tecnologia_economic-and-social-impacts-of-google-cloud.pdf

57 <https://www.wired.com/story/openai-ceo-sam-altman-the-age-of-giant-ai-models-is-already-over/>

In the last year, Google Cloud has announced multiple tools to help businesses take better advantage of AI, including:

Google Data and AI Cloud help organisations combine data and AI to quickly and efficiently do things like reduce call volumes, improve customer experiences, prevent fraud, and increase manufacturing efficiency.

Duet AI for Google Workspace⁵⁸, which can help workers draft documents, classify data, automate workflows, take meeting notes or catch up with chats.

AI assistance from **Duet AI in Google Cloud**⁵⁹, an always-on AI collaborator that helps Google Cloud users of all skill levels build cloud applications quickly and easily.

Vertex AI⁶⁰ allows companies to build, deploy or scale their pre-trained AI models, making it faster to develop their own generative AI applications or manage machine learning projects. Through Model Garden, companies have access to Google’s leading models, models designed for specific purposes such as cybersecurity or health, or existing third-party or open-source models.

SynthID⁶¹ is a tool for watermarking and identifying AI-generated images. This technology embeds a digital watermark directly into the pixels of an image, making it imperceptible to the human eye but detectable for identification. Being able to identify AI-generated content can help ensure people always know when they’re interacting with generated media and help prevent the spread of misinformation.

58 <https://workspace.google.com/blog/product-announcements/duet-ai>

59 <https://cloud.google.com/blog/products/application-modernization/introducing-duet-ai-for-google-cloud>

60 <https://cloud.google.com/vertex-ai#section-1>

61 <https://www.deepmind.com/blog/identifying-ai-generated-images-with-synthid>

The use of cloud and AI together is already leading to significant real-world productivity impacts for businesses:

397%

A recent study by Forrester Consulting based on interviewed Vertex AI customers found that it could lead **to a 397% ROI** through improved machine learning insights, helping retire legacy solutions and improving efficiency.⁶²

\$3.7m

Call centre teams using Google Cloud's CCAI Agent Assist for Chat are able to manage up to 28% more conversations concurrently, responding 15% faster to customer inquiries and increasing customer satisfaction by 10%. In total, it is estimated that contact centres can **save between \$1.3 million and \$3.7 million** by improving agent productivity and reducing call times.⁶³

For developers, Google Cloud supports training through comprehensive labs and courses, a certification program, and in-product tutorials. Developers can explore best practices through the Architecture Center and quickly deploy sample applications with Jump Start Solutions. The Google Cloud Innovators programme also offers interactive events, a weekly newsletter, a paid tier of premium benefits, and an invite-only tier for top community contributors.

Developers

Google Play provides European developers with an effective, safe and scalable distribution platform for their apps, making it easy to deploy apps or games to billions of users worldwide at once. More than 110 billion apps were downloaded from the platform worldwide in 2022 alone.⁶⁴

In 2023, we estimate that Play generated over €3 billion in revenue for developers in Europe. Alongside revenue generated from distributing apps through Google Play, developers also receive a significant income from contract work developing apps for businesses and brands.

Moreover, there are further time and cost savings for developers owing to Android's free-to-use open-source model. Android has been widely adopted by the vast majority of Original Equipment Manufacturers (OEMs), with over 1000 companies building devices using Android globally. As a result, developers do not need to remake their applications for a new operating system for every smartphone manufacturer. In total, we estimate that Android has saved developers in the EU over 8 million development days—the equivalent of €1.5 billion in reduced development costs.

62 <https://cloud.google.com/resources/forrester-tei-of-vertex-ai-report>

63 https://services.google.com/fh/files/misc/forrester_te_i_contact_center_ai_report_2020_google_cloud.pdf

64 <https://www.statista.com/statistics/734332/google-play-app-installs-per-year/>

Case Study: Gronda

With hotelier and restaurateur parents, Valentin grew up learning about the challenges of the hospitality sector. As he was a better programmer than a cook, he decided not to join the industry. But at 22—whilst successfully working abroad—he felt his life was lacking purpose. Valentin went back to his hometown and, after hearing his parents had trouble with hiring, created a hospitality recruitment app with co-founders Tobias and Juan. However, when Covid hit, Gronda transformed into a platform for chefs to share and monetise their recipes, inspiring other culinary lovers. Next, Gronda wants to help ambitious chefs worldwide unleash their full potential.

"Today, we have around two million chefs sharing recipes of their dishes. And it's a place where chefs inspire each other, and Google Play played a massive role here. From idea to app, it's so easy and fast. And now, since we launched, we have around 40 employees in two continents."

Creators⁶⁵

Every day, over one billion hours of video content are watched on YouTube,⁶⁶ and over 720,000 hours of content are uploaded.⁶⁷ If you tried to watch just that new content back to back, it would take you over 80 years—a whole human lifetime.

YouTube has helped a new generation of thousands of European creative entrepreneurs build their own media businesses, earning real revenue and employing other members of their team. **78%** of creators who earn money from YouTube told Oxford Economics that YouTube **provides an opportunity to create content and earn money that they wouldn't get from traditional media.** YouTube allows anyone who has something interesting to say to reach an audience and start earning real income—both directly through the platform and through off-platform opportunities such as sponsorship, live appearances or creating their own products.

By helping bring together a long tail of different hobbies, passions and industries, YouTube has made it financially sustainable to earn a living producing different types of content that are not a natural fit for traditional TV, from make-up tutorials to revision videos, game live streams to vlogs.

Before the existence of tools like YouTube, it could be cost-prohibitive for independent creators to distribute their content. Today, YouTube is helping make it possible for anyone to reach a worldwide audience:

73%

of creators who earn money from YouTube agree that YouTube is an **essential platform to earn a global presence.**

71%

of creators who earn money from YouTube agree that YouTube helps them **export their content to international audiences they wouldn't otherwise have access to.**

65 All survey data points in this section are taken from research by Oxford Economics
66 <https://blog.youtube/news-and-events/you-know-whats-cool-billion-hours/>
67 Based on 500+ hours of content uploaded every minute from <https://blog.youtube/press/>

The vast amount of content available on YouTube means that it can serve every community and taste. According to polling by Oxford Economics, **84% of users agree that with YouTube, they can hear from diverse communities and/or cultures from around the world.** Similarly, 79% of users agree that they can easily find content on YouTube in their preferred language.

Beyond supporting this new generation of creators, YouTube is also an increasingly important tool for traditional media channels looking to find new ways to reach their audiences:

90%

of media and music companies with a YouTube channel agree that **YouTube is critical to breaking new artists and/or music.**

72%

of media and music companies with a YouTube channel agree that **YouTube has increased the supply of creative talent in the industry.**

68%

of media companies with a YouTube channel agree that **YouTube is an important source of revenue for their company.**



Workers & Skills

Helping People Collaborate

For many, Google's products are now indispensable tools for their work:



72% of workers told us that as part of their job, they regularly use **Google Search**.



55% of workers told us that as part of their job, they regularly use **Gmail**.



51% of workers told us that as part of their job, they regularly use **Google Maps**.



47% of workers told us that as part of their job, they regularly use **Google Translate**.



27% of workers told us that as part of their job, they regularly use **Google Workspace**.

A Forrester Consulting study estimated that the deployment of Google Workspace, including tools like Gmail, Drive, Calendar, Meet, Docs, Sheets and Slides, had the potential to save employees between 15 minutes to two hours per week at work in more efficient collaboration.⁶⁸

On average, workers told us that they use Google Search over five times a day for their job, with around a third saying that not being able to use a search engine would have a major impact on their jobs. Similarly, around a third of Workspace users told us that it would have a major impact on their jobs if they were unable to use it. Together, we estimate that Google Search and Workspace are producing the equivalent of a €560 billion improvement in productivity for the EU economy.

Just as with businesses, in the next few years, generative AI tools have the potential to significantly boost the productivity of individual workers. Google already estimates that AI-powered Smart Compose features have been used in Google Workspace over 180 billion times in the past year alone.⁶⁹



By 2030, on average, we estimate that generative AI tools could save individual workers over 70 hours a year.

Just over half of full-time workers (52%) told us that they expected to explore more AI-powered tools in the next year, and 39% said that they expected to use generative AI tools as part of their jobs within the next five years. This was particularly true for younger workers, with over half of those under 35 expecting to use generative AI tools as part of their work in the next five years.

68
69

https://services.google.com/fh/files/misc/the_total_economic_impact_of_google_workspace.pdf
<https://blog.google/intl/en-africa/company-news/google-io-2023-making-ai-more-helpful-for-everyone/>

Learning New Skills

Expanding the supply of digital skills is an essential prerequisite for the wider digital transformation of the EU. In recent polling by Public First, 40% of highly digital-intensive businesses in the EU said that a shortage of digital skills had slowed their growth. On current trends, which have only seen slow rates of improvement, only 61% of the EU population is projected to have basic digital skills by 2030, compared to the EU's Digital Decade target of 80%.⁷⁰

Today, Google's tools, such as Search and YouTube, are some of the most important platforms that workers use to learn new skills or retrain throughout their careers. **Over half of employed Google Search users said they used it regularly to learn a new technical or digital skill for their work.**

Google Search is often particularly important for those seeking to learn new digital skills at work. Based on our polling, we estimate that:



17 million workers have used Google Search to help them learn **basic digital skills**.



18 million workers have used Google Search to help them learn **advanced word processing, spreadsheet or presentation software skills**.



19 million workers have used Google Search to help them learn **design and other creative tools**.



12 million workers have used Google Search to help them learn **programming**.



10 million workers have used Google Search to help them learn **data science and analysis**.

In total, we estimate the new digital skills learned through Google Search **have increased the productivity of the EU economy by over €152 billion.**

Beyond the direct impact of its products, Google's Grow with Google program has helped over nine million people in the EU-27 learn key digital skills such as digital marketing or best practices in cybersecurity.

Case Study: Grow with Google

Since 2015, Grow with Google has helped millions of people across Europe to adapt and grow their careers or businesses with digital tools and training. Grow with Google regularly partners with governments, industry experts and local organisations to understand where the greatest needs lie and tailor training to meet them.

Google Career Certificates are flexible online training programmes designed to help people learn job-ready skills in high-growth career fields, including Cybersecurity, Data Analytics, Digital Marketing & E-commerce, IT Support, Project Management and UX Design. The online programmes allow learners to get job-ready skills, with no degree or relevant experience required.

At age 47, Pasquale Vadalà, an Italian post-producer of cinema advertising campaigns, signed up for a Data Analytics course as part of the Google Career Certificates program to update his skills during the pandemic. *"Six months spent studying the theory, which was clearly explained, and lots of practical work to test what I had just learned: the Data Analytics course in the Google Career Certificates program was extremely useful to me. At work, I was able to put my data analysis skills into practice right away, especially SQL and Spreadsheet, which is what enabled me to make that big quality stride forward"*.

70 <https://awsdigitaldecade.publicfirst.co/#c5>

Case Study: Boosting Inclusion

One of the European Commission's key aims for the Digital Decade is to boost inclusion in the ICT industry, with a goal for men and women representing equal proportions of the workforce by 2030. Meeting this goal is likely to need significantly more effort, with progress so far relatively limited—just 19% of ICT specialists in the EU are currently female, and this metric has only increased by two percentage points over the last five years.⁷¹

Google has multiple initiatives underway to try and increase inclusion in the sector, including:

- To mark International Women in Engineering Day, Google launched new research on the barriers preventing girls from choosing computer science in Europe, with insights from interviews and surveys with over 3,000 students and education leaders.
- With support from Google.org, Women Go Tech and Riga Tech Girls have reached over 20,000 women across Lithuania and Latvia with their Discover Tech program. The programme, coupled with mentorship, provided participants with an introduction to the tech industry with insights into tech roles.





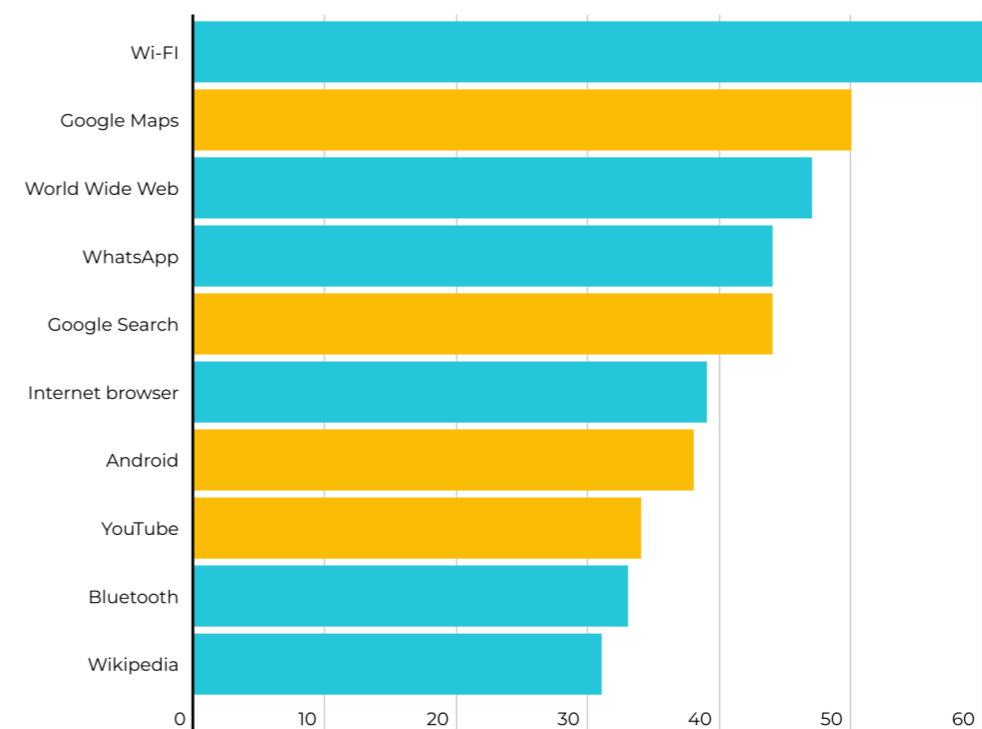
Consumers

Helping People

Where do you go if you want to find out how to complete a DIY chore or learn a new recipe? Share a video with your family? Find the directions to a new restaurant or local business to try?

Before the internet—and before Google—the answers to these questions tended to be very different. Google did not invent online search, video sharing, maps or the smartphone. But by making them more powerful, easy to use, and fast, they helped radically unlock the potential of the internet. In our survey, Europeans said that **Google Search, Google Maps, Android, and YouTube** were among the **ten most helpful innovations of the last thirty years**.

Which, if any, of the following products do you think have been the most helpful innovations of the last thirty years?



In our consumer survey:

92%

of Europeans agreed that the results of Google Search are **helpful**.

79%

of Europeans agreed that the results of Google Search are **relevant**.

78%

of Europeans agreed that the results of Google Search are **reliable**.

73%

of Europeans agreed that the results of Google Search are **trustworthy**.

Based on the results from our polling, you would have to compensate the average European adult at least €160 a month to make it up to them if they lost access to Google's services.



PageRank was a groundbreaking algorithm developed by Google's co-founders, Larry Page and Sergey Brin, that ranked web pages based on the number and quality of links pointing to them, enabling the new **Google Search** to deliver more relevant and useful search results.



Threaded online email, as introduced by **Gmail**, transformed email communication by organising related messages into easily accessible conversations while providing an order of magnitude more storage.



Having access to **Google Maps**, wherever you are, changed the way people travel and explore the world, making it easier for users to find locations, businesses, and directions without the need for physical maps or expensive sat nav systems.



Online video streaming, exemplified by Google's **YouTube** platform, revolutionised the way people consume and share media content by allowing users to easily upload, store, and share videos with a global audience, democratising content creation and distribution.



Online productivity suites such as Google **Workspace—Docs, Sheets and Slides**—transformed the way people collaborate on documents, spreadsheets, and presentations, allowing real-time editing and sharing.



The open-source **Android** operating system provided a customisable and adaptable operating system for mobile devices and made sure every phone manufacturer could take advantage of the latest in mobile technology. Today, there are over 1,000 different companies that make devices that run on Android.

Saving Time and Money

The time saved by Google's services adds up. In total, we estimate that Google Search and Google Assistant together **free up over 46 billion hours of leisure time** every year across the European Union. 88% of Europeans agree that Google Search helps save them time.

Alongside time, Google's services have also played an important role in helping European consumers make more informed choices, save money and take advantage of more affordable options. This has been particularly important in the last couple of years, as Europeans have struggled with the rising cost of living.

Google Search and Maps are some of the most important channels through which consumers find other local businesses, with 61% of European Search users telling us they had done this in the last month and 64% that they had looked for deals or discounts. 70% of Google Shopping or Search users say they regularly use them to compare the prices of products and services, with over 9 in 10 of these saying they find this helpful. In total, **we estimate that Google Search and Google Maps alone help save the average European €110 every year.**

At the same time, Google's products themselves also often help consumers directly save money by offering consumers an affordable alternative. Many of Google's most important services, such as Search, Maps, YouTube, or Gmail, can be used free of charge.

Android is the most widely used mobile operating system in the European Union⁷², while Chromebooks are a common sight in European homes and workplaces.⁷³ The affordability of these products is an important factor in why people buy them, with affordability being the second most important reason people gave us for why they had chosen an Android phone behind ease of use.

72 <https://www.statista.com/statistics/639928/market-share-mobile-operating-systems-eu/>
73 <https://www.statista.com/statistics/749890/worldwide-chromebook-unit-shipments/>

Supporting More Sustainable Choices

Reducing carbon emissions and achieving a more sustainable economy will require urgent actions by governments, companies—and, importantly, by ordinary people and families, too. On average, households are directly responsible for around 20% of greenhouse gas emissions in the EU.⁷⁴

Google provides multiple tools to help Europeans reduce their energy use and make more sustainable choices. For example:

- In 2022, Nest thermostats helped customers save over 26 billion kWh of energy globally, more energy than Google used in the same year.⁷⁵
- Google Maps provides, on average, over two billion kilometres of public transport results per day, while its fuel-efficient routing option leverages Google's AI tools and insights from the US Department of Energy's National Renewable Energy Laboratory and data from the European Environment Agency to optimise fuel-efficient route choices. Fuel-efficient routing is available in nearly 40 European countries, the US, Canada, and Egypt. **It is already estimated to have helped prevent more than 1.2 million metric tons of CO2e globally since launch through the end of 2022—the equivalent of taking approximately 250,000 fuel-based cars off the road for a year.**⁷⁶

In our poll of consumers, over one-third of Europeans said that they were aware of fuel-efficient routing on Google Maps and over half of Europeans (58%) said that Google's products, such as fuel-efficient routing or eco-certified labels for hotels on Google Maps, makes it easier to make informed and sustainable choices.

74 https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Greenhouse_gas_emission_statistics_-_air_emissions_accounts#Analysis_by_economic_activity

75 Estimated energy savings are calculated based on the typical percentage of heating and cooling savings found in real-world studies of the Nest Learning Thermostat. To calculate the total Nest savings, Google applies these savings percentages to the actual heating and cooling hours of all Nest thermostats.

76 Google uses a high-quality ML prediction model to estimate the expected fuel or energy consumption for each route option when users request driving directions. They then identify the route that we predict will consume the least amount of fuel or energy. If this route isn't already the fastest one and it offers meaningful energy and fuel savings with only a small increase in driving time, they recommend it to the user. To calculate enabled emissions reductions, Google tallies the fuel usage from the chosen fuel-efficient routes and subtracts it from the predicted fuel consumption that would have occurred on the fastest route without eco-friendly routing and applies adjustments for factors such as: CO2e factors, fleet factors, well-to-wheels factors, and powertrain mismatch factors. They then input the estimated prevented emissions into the EPA's Greenhouse Gas Equivalencies Calculator to calculate equivalent cars off the road for a year. The 2022 figure covers estimated emissions prevented after eco-friendly routing was launched from October 2021 through December 2022. Enabled emissions reduction estimates include inherent uncertainty due to factors that include the lack of primary data and precise information about real-world actions and their effects. These factors contribute to a range of possible outcomes, within which they then report a central value.

Case Study - Energy Crisis Alerts

In times of uncertainty, people turn to Google for help and information. Due to the energy crisis in Europe, people looked for new ways to stay on top of their energy consumption and keep costs manageable. In 2022, Google launched a new feature in 29 countries and 22 languages across Europe to enable people to find relevant and actionable information to help them navigate this crisis and save energy.

When people searched for information on the energy landscape in Europe, they saw dedicated features with helpful and reliable information. For example, when you searched for things like 'Europe energy crisis' and 'energy price', you saw news articles, local information including financial assistance that may be available, and recommended actions from the International Energy Agency to help conserve energy. Whether it's turning down the heat or adjusting the settings of your boiler, you can see, at a glance, information about saving energy in your home. These information panels surfaced alongside other relevant results from the open web.

Appendix

Methodology

Economic Impact

Google Ads

Following the precedent of past Google impact reports, we use third-party data to estimate the total size of the EU-27 Google Ads market, combining PWC and Statista data on the total EU-27 paid search market with Statcounter estimates of Google's market share.

Following the methodology of the US [Google Economic Impact Report](#), we then scale this revenue by an assumed Return on Investment (ROI) factor of 8, from:

- [Varian \(2009\)](#) estimates that businesses make, on average, \$2 for every \$1 they spend on AdWords.
- [Jansen and Spink \(2009\)](#) estimate that businesses receive five clicks on their search results for every one click on their ads.
- Google estimates that search clicks are about 70% as valuable as ad clicks.
- Total ROI is then $2 * \text{spend} + 70\% * 5 * 2 * \text{spend} - \text{spend} = 8 (\text{spend})$.

This growth is similarly scaled by the ROI factor of 8 and divided by GDP.

More information on this methodology is available at <https://economicimpact.google.com/methodology/>

AdSense

To estimate total EU-27 AdSense revenues, we combined:

- Google's published 2022 Network Revenue;
- An assumption of Traffic Acquisition Costs as a % of Network Revenue, based on past published TAC data;
- EU-27's share of non-video display spending and growth in overall market since 2022, derived from PWC and Statista data.

Cloud

To estimate the total productivity impact of Google Cloud in EU-27, we combine:

- Statista data on total public cloud revenue in EU-27 in 2023;
- An assumption that every dollar invested in Cloud services by users generates a net return.

Android

We draw on:

- [Deloitte](#) data on the overall size of app store and contract revenue in Europe;
- Statcounter data on Android market share;
- [PPI data](#) on the number of jobs supported in EU-27 by Android.

This allowed us to estimate Google Play revenues for developers in EU-27.

To calculate the overall cost and time savings for developers, we:

- Use [42Matters](#) data to estimate total number of Android apps offered by EU-27 developers;
- Apply [AlphaBeta estimates](#) of average developer daytime savings created by Android;
- Glassdoor data on average developer salary in EU-27.

Consumer Benefits

Consumer Surplus

As part of our polling, we asked participants the following single discrete binary choice questions:

“Imagine you had to choose between the following options. Would you prefer to keep access to GOOGLE PRODUCT or go without access to GOOGLE PRODUCT for one month and get paid PRICE?”

The price offered was randomised between 1.25, 2.50, 5, 10, 20, 50, 100, 200 and 500 euros, and we asked variants of this question for Google Search, Google Maps, YouTube, Gmail and Google Workspace.

We then regressed the results of this poll to derive a demand curve and used this to calculate the median consumer surplus per user per product.

Cost Savings from Google Maps and Search

The cost savings for Google Maps were estimated using our consumer survey data on Google Maps usage in EU-27, estimates from TomTom on time savings from using GPS devices and statistics on car ownership rates and average distances travelled by car per year. This allowed us to estimate the reduction in distance travelled from using Google Maps. Combining that with vehicle fuel economy and fuel price data allowed us to estimate the cost savings from this.

Cost savings from Google Search drew on our survey data on the use of Google to compare prices and statistics on the size of the e-commerce market in EU-27. For those who said that they found Google “very helpful” for comparing prices, we assumed savings of 10%, and for those saying it was “somewhat helpful”, we assumed savings of 5%.

Skills and Productivity

Digital Skills learned through search

To do this, we:

- Undertook a review of estimates of the wage premiums associated with digital skills. Drawing on this, our calculations assumed:
 - A 6% wage premium from acquiring basic digital skills
 - A 15% wage premium from acquiring more advanced digital skills.
- Asked adults, through our consumer survey, whether they had used self-directed internet research to learn a range of digital skills from scratch (e.g. advanced spreadsheet skills, programming, computer-aided design, etc.)
- For those who had done so, we asked them whether Google played an important role in this self-directed research.
- This allowed us to estimate the share of adults in work who had used self-directed internet research through Google to learn digital skills.

Combining this with our estimates of the wage premium (and Eurostat data on wages) allowed us to arrive at a salary uplift across the whole economy.

Workplace time savings and productivity gains

Using the [approach of Hal Varian](#) and estimates of Google Search usage in EU-27 from our survey, we quantified the aggregate working time saved from Google Search being used to answer questions. Eurostat data on hourly labour costs allowed us to express the value of these time savings in monetary form.

We also used data from our survey on Google Workspace usage and [Forrester estimates](#) of productivity gains to estimate the impact of greater collaboration and efficiency through Google Workspace.

AI

Potential Economic Impact of Generative AI

To do this, we:

- Drew on the US O*Net occupation database, which contains information on 51 different types of work activity for around ~800 types of occupation.
- Based upon Goldman Sachs' [identification](#) of the types of tasks exposed to automation by generative AI, we classified the proportions of tasks in each occupation that were susceptible to automation.
- We aggregated this into broader economic categories based on their overall share of US employment and average wage bill and then created our own crosswalk to convert the results from each occupation to the corresponding occupation in ISCO-08.
- Aggregate by wage bill, occupation and sector to produce an estimate of the total possible improvement in labour productivity.
- Assumed capital intensity remained constant and converted this labour productivity improvement into an overall improvement in GVA.

AI Cybersecurity Savings

To assess the potential savings derived from AI cybersecurity, we asked businesses questions on whether they had experienced a cyber attack as well as on their current utilisation of AI-based cybersecurity solutions. We also drew on data from the Global Cyber Security Index, Hiscox and Norton on cybersecurity risk, costs and awareness of how to protect from cybercrime.

We drew on IBM's Cost of a Data Breach Report 2022 to obtain the average percentage savings achieved through the implementation of AI in cybersecurity practices.

By combining these multiple data points with Eurostat data on the number of businesses, we constructed a model that estimated the potential savings that could be attained if non-adopters of AI cybersecurity were to implement such solutions.



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