



Deep Tech Index

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Summary

- The large majority of leading Deep Tech companies are found in North America, with particular dominance in Quantum & Computing, Pharmaceuticals, and Artificial Intelligence.
- Santa Clara Valley is the world's leading Deep Tech cluster, followed by New York, Boston, and Los Angeles.
- Europe has particular strengths in Clean Tech, Biotechnology, and Robotics & Communication. Paris, Amsterdam, Berlin, and Stockholm are some of the dominant European hubs.
- Asia has strengths in Fintech, Space & Advanced Materials, and Clean Energy. Tel Aviv, New Delhi, Tokyo, Bengaluru, and Beijing are amongst Asia's primary innovation centres.

The study *Deep Tech Index* analyses where the leading companies involved in development and marketing of deep technologies are located. We live in a time of unprecedented technological change, at which significant advances are recorded in areas such as Artificial Intelligence (AI), Clean Energy, Clean Tech, Biotechnology, Photonic & Electronic, Robotics & Communication, Quantum & Computing, Pharmaceuticals, Fintech, as well as Space & Advanced Materials. By using Crunchbase, a leading international enterprise database, the study analyses the leading 50 companies in each field. The result is a database on the leading 500 Deep Tech companies globally. This Index outlines both where this innovation is taking place and how it differs between various technology areas. The result is a unique map of technological progress:

- **About 72 per cent of leading Deep Tech companies are based in North America.** While most are found in the US, Canada also houses a significant share. About 14 per cent are in Europe and 11 per cent in Asia. Africa, Oceania, and Latin America each host around 1 per cent of the leading Deep Tech firms.
- **North America dominates every field of Deep Tech development and performs notably well in Quantum & Computing, Pharmaceuticals, and AI.** In these three fields, about 80 per cent of the leading global firms are located in North America. Interestingly, in every Deep Tech area, beside Clean Tech, more than half of the leading 50 firms are based in the US. Canada, however, emerges strongly in Clean Tech, which means that North America (50%) maintains a significant role in this field, too. The share of the leading firms that are based in North America in Quantum & Computing, Pharmaceuticals, and AI stands at 90, 86 and 80 per cent, respectively.
- **Santa Clara Valley**, or Silicon Valley, is by a mile the leading Deep Tech hub globally. About 24 per cent of all the firms reside here. It is followed by **New York** (7,8%), **Boston** (6,8%), and **Los Angeles** (3,4%). Outside the US, the leading hubs are **London** (2,6%), **Tel Aviv** (1,8%), **New Delhi** (1,6%), **Toronto** (1,6%), **Paris** (1,2%), **Tokyo** (1,2%), **Bengaluru** (1,0%), **Amsterdam** (1,0%), **Berlin** (0,8%), **Stockholm** (0,8%), **Montreal** (0,8%), and **Dublin** (0,8%).
- **Europe is particularly strong Clean Tech, Biotechnology, and Robotics & Communication.** With about 28 per cent of the leading Clean Tech companies based here, it makes Environmental Technology the main relative strength of Europe. Biotechnology is another field in which Europe excels (20%). About 18 per cent of the leading Deep Tech companies are based in Europe, with London (2,6%) at the forefront of innovation. Paris, Amsterdam, Berlin, Stockholm, and Dublin are other influential clusters in Europe. Although being spread out more generally, these firms are also concentrated to Copenhagen and Cambridge.

- **Asia finds its relative strengths in Fintech, Space & Advanced Materials, and Clean Energy.** In these fields, about 20, 18, and 16 per cent of leading firms reside in Asia, respectively. India houses 22 of these companies and ranks third in the world, followed by China (11) in fifth and Israel (10) in sixth place. Relative to their populations and industrial production capabilities, both China and India disappoint. It is likely, however, that more and more Deep Tech firms will come from this region in the coming years. Hubs of prominence in Asia include Tel Aviv, New Delhi, Tokyo, Bengaluru, and Beijing.
- **The highest share of Deep Tech companies per million adults is found in Israel** (1.75), followed by the **US** (1.58), **Ireland** (1.2), **Estonia** (1.18), **Switzerland** (0.87), **Denmark** (0.8), **Canada** (0.79), **Sweden** (0.77), **Netherlands** (0.7), and the **UK** (0.54). While these are spread out in three continents, they are all part of a Western cultural group. Israel's Deep Tech innovation is linked to its military research. The US has both a large population and the second highest share, which explains its dominant position. By relying on low taxes and free markets, both Ireland and Estonia have both come from low levels of technological progress to become leading nations. The UK, Sweden, the Netherlands, and Denmark have long been important centres, but must introduce tax reforms to keep up with competing regions.
- **Having one more leading Deep Tech company per million adults, is linked to 1.26 percentage points lower unemployment.** Being on top of technological innovation allows for the creation of export-oriented jobs. Stimulating Deep Tech is thus a powerful tool to boost technological progress, prosperity, and jobs growth.
- **To boost Deep Tech, nations must promote school results such as PISA, foster top engineering & technology universities, lower taxes, and strengthen property rights.** The concentration of Deep Tech companies per million adults is compared to the number of top 100 universities in Engineering & Technology per million adults. The study finds that countries with high shares of leading universities also tend to house more leading Deep Tech firms.

Preface: Klas Tikkanen

Nordic Capital encourages academic research and has proudly supported the European Centre for Entrepreneurship and Policy Reform (ECEPR) since 2017. Our involvement in the Brain Business Jobs Index and the Superentrepreneurs Index has enabled us to meticulously examine and decode the geography of Europe's knowledge-intensive jobs, as well as the prevailing factors influencing the global distribution of so-called Superentrepreneurs.

Now, our attention shifts to Technology as well.

Technological advancement has been a key driver for human progression since the inception of civilisation. Although change is a constant throughout history, the current pace and breadth of development is unprecedented. Innovations within AI, FinTech, Advanced Materials, and BioTech are revolutionising our societies and significantly affecting our day-to-day lives. These transformative dynamics form the foundation of this study.

Studying Deep Tech innovation globally is crucial for manifold reasons. Not only does it offer a valuable metric for discerning key societal determinants and trajectories, but it also earmarks those nations at the vanguard for imminent rewards. The study reveals a correlation between efficient educational systems, low taxation, robust property rights, and the prevalence of leading tech firms. This is intrinsically tied to economic growth and low unemployment rates.

While the US takes the lead in Deep Tech sectors, Europe continues to wield significant influence, the study finds. Noteworthy hubs include the UK, Germany, France, and Sweden, to name a few. But today's landscape is by no means a given – it is both plausible and rather likely that other regions will eventually bridge this gap. A glimpse into the future can perhaps be inferred from looking at the top Engineering & Technology universities worldwide – with 27, 30, and 34 of which are in North America, Europe, and Asia respectively.

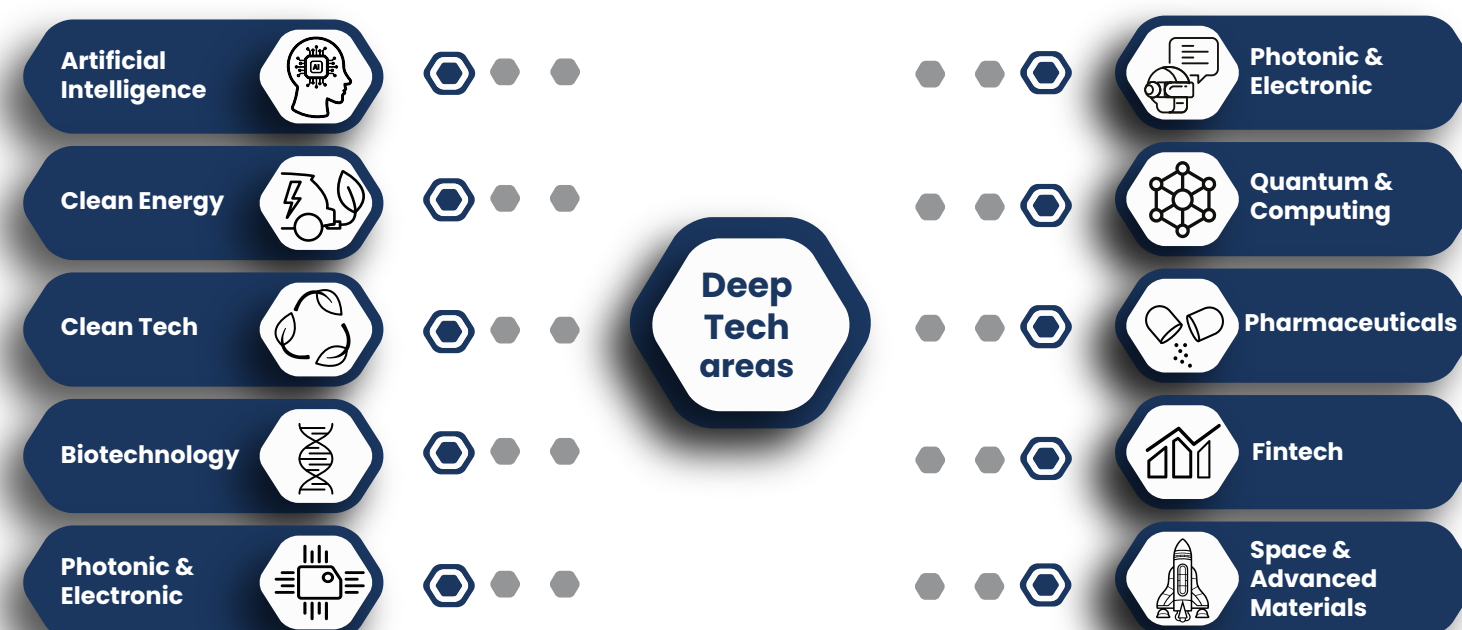
Europe is a close second to the US in terms of regions hosting the most prominent companies, exhibiting particular prowess in CleanTech, BioTech, and Robotics & Communication. Europe possesses the potential to climb even higher on this list, thereby reaping the associated benefits like reduced environmental impact and stimulated job growth and prosperity. Realising this potential necessitates the implementation of policies that foster and value knowledge and growth, underpinned by a readiness to evolve and invest in these sectors. Cultivating Deep Tech companies is tantamount to laying the groundwork for future economic progress.



- Klas Tikkanen, COO at Nordic Capital Advisors, has led the firm's transformation in the past decade, including the development of its strategy, governance, culture, and operations. As part of the management team, he serves on the Investment Review Committee, the Portfolio Review Committee, the Fair Value Committee, Operations Advisory Board, and the Value Portfolio Committee. Prior, Klas spent six years at McKinsey & Company as a Management Consultant and held several senior management functions, mostly as a CFO in PE- or bank-owned portfolio companies. Having throughout his career worked almost exclusively with turnarounds and complex carve-outs, Klas brought extensive experience from transforming and building high-performing organisations. He holds an MSc in Business Administration and Economics from Stockholm School of Economics.

Deep Tech Index

This novel index analyses where the leading companies involved in development and marketing of deep technologies are located. The study focuses on the following fields of Deep Tech development: Artificial Intelligence; Clean Energy; Clean Tech; Biotechnology; Photonic & Electronic; Robotic & Communication; Quantum & Computing; Pharmaceuticals; Fintech; Space & Advanced Materials.



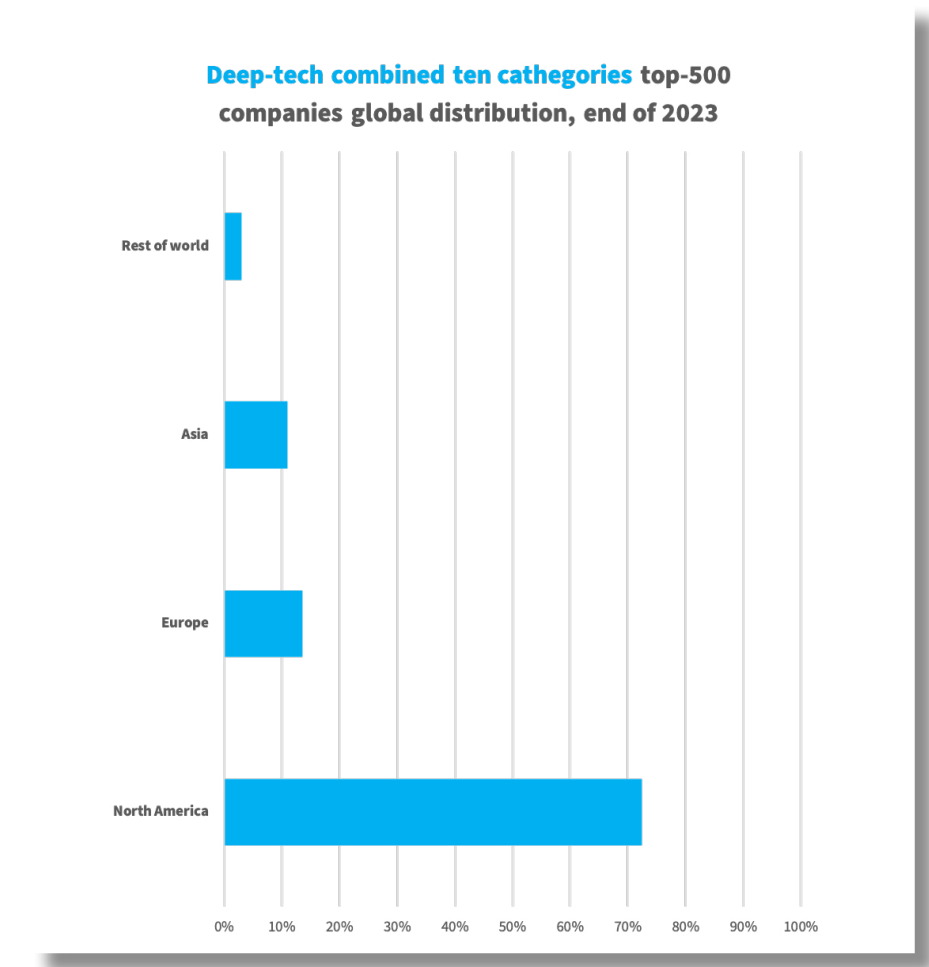
By using Crunchbase, a leading international enterprise database, the location of the leading 50 companies in each field is analysed. The result is a database on the 500 leading Deep Tech companies of the world. While Crunchbase is created mainly as a tool for investors and entrepreneurs, it has also gained considerable academic interest in recent years. For example, Jean-Michel Dalle, Matthijs den Besten, and Carlo Menoni published a study in 2017 for the OECD on the possibility to use Crunchbase for research in economics and management. The authors noted that Crunchbase is attracting interest from researchers in different fields since it contains unique data on the start-up eco-system.¹ Yuxian Eugene Liang and Soe-Tsyr Daphne Yuan have relied on Crunchbase for studying firm investments, with the motivation that Crunchbase is the largest global database with profiles for the included firms.² Ross Brown and Augusto Rocha have used the database in order to study the actions of investors during the uncertainty created by the COVID-19 pandemic.³

This unique index makes it possible to map out where the advanced tech development of the world is occurring, and how this differs for each area of technology. This results in a unique mapping of technological progress around the world.

72 percent of globally leading Deep Tech companies are situated in North America

The large majority of the leading Deep Tech companies of the world are based in USA, and a share are also situated in Canada. In total, fully, 72 percent of the leading Deep Tech companies of the world currently exist in North America.

Europe has the second highest share of global Deep Tech companies, as 14 percent of the top-500 companies are found in Europe. Out of the remaining, 11 percent are found in Asia. Africa, Oceania, and Latin America have in total the remaining 3 percent, approximately one percent in each of the latter three regions.



On a global level, the dominance of USA in Deep Tech is so significant, that it dwarfs any other single nation. While 68.4 percent of the globally leading Deep Tech companies are found in the USA, the share in the UK on second place is merely 4.6 percent. India has 4.4 percent of the Deep Tech companies, followed by Canada with 4.0 percent, and

¹ Dalle, Den Besten & Menon (2017).

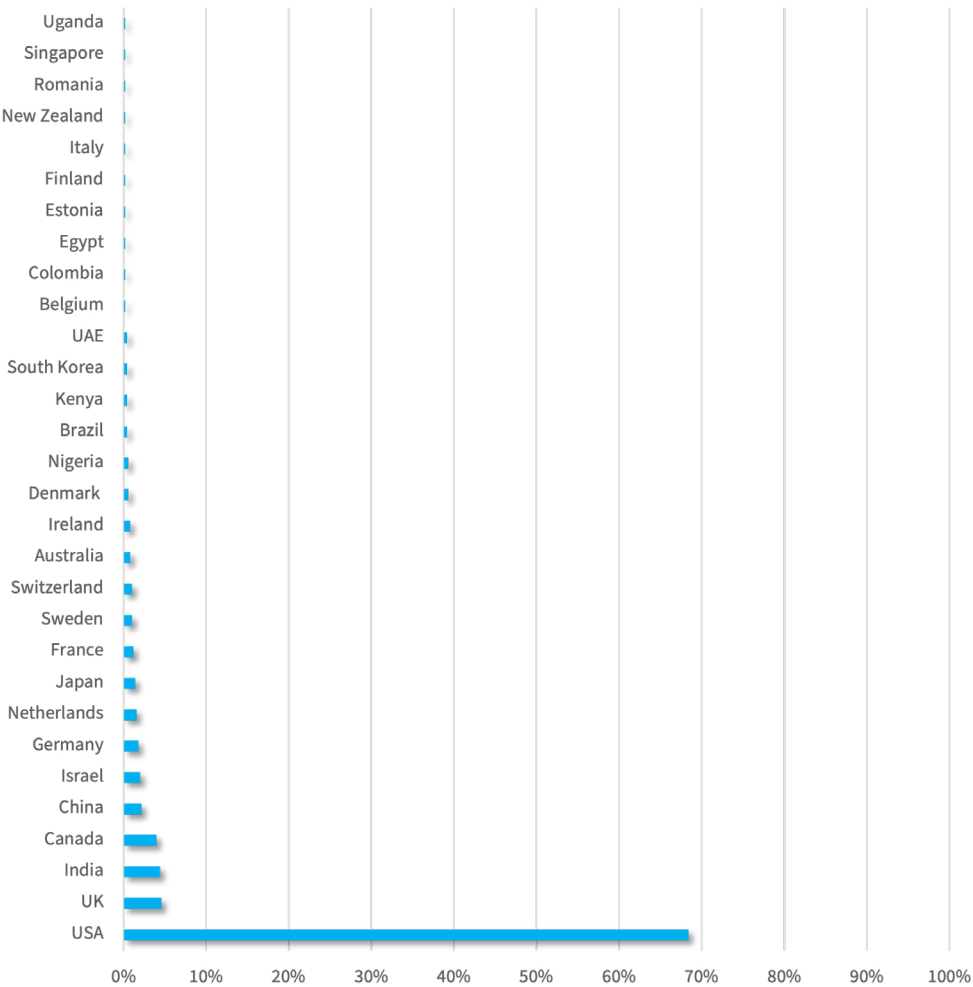
² Liang & Yuan (2016).

³ Brown & Rocha (2020).

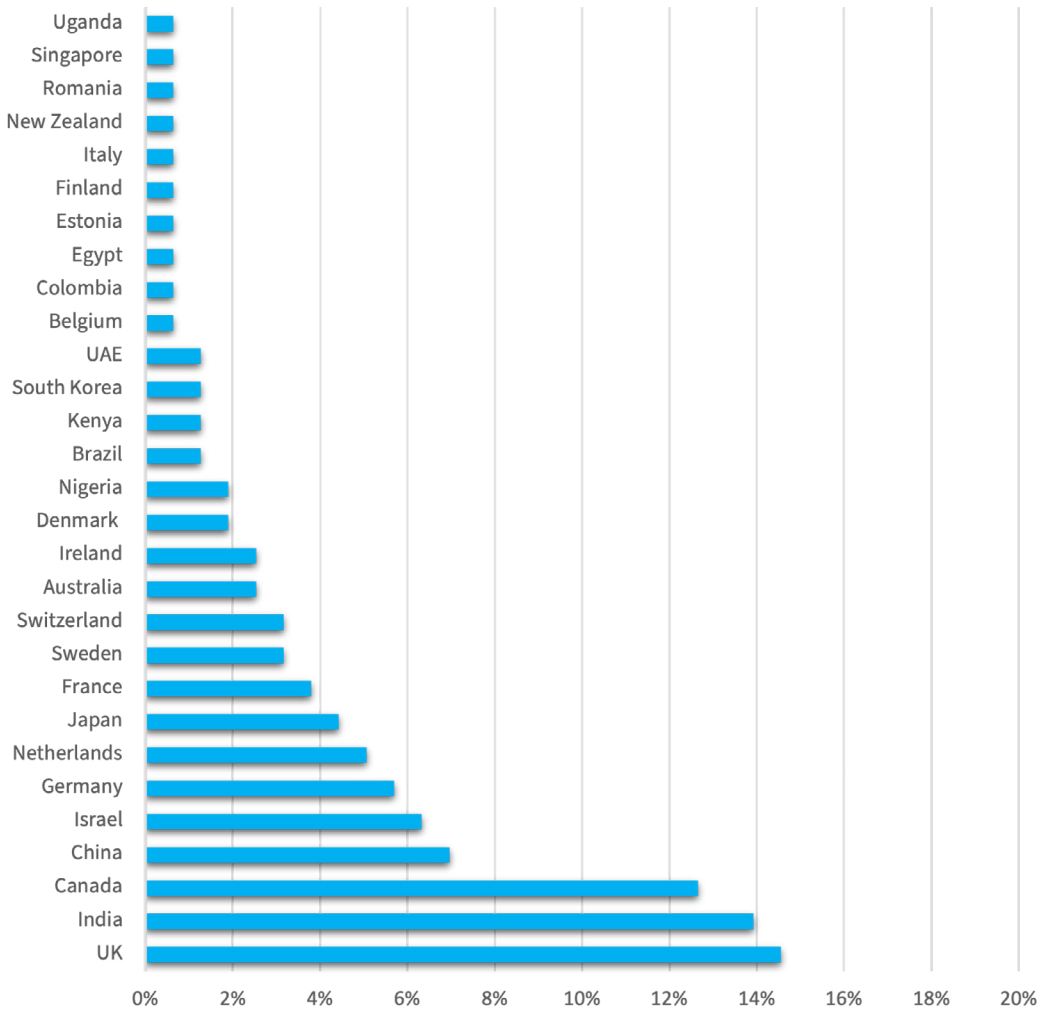
China with 2.2 percent. Particularly China, but also India, lag in Deep Tech development. These countries, with large industrial bases and large populations, are where significant investments for future Deep Tech progress is occurring. However, Deep Tech takes time to evolve and is very high on the value chain of the modern business world, so particularly China is still developing in this area.

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Deep-tech combined ten cathegories top-500 companies global distribution, end of 2023



Deep-tech combined ten cathegories (excluding the USA) top-500 companies global distribution, end of 2023



North America

North America has particularly strong dominance in the areas of Quantum & Computing, as well as in Pharmaceuticals and Artificial Intelligence. In these three Deep Tech fields, four out of five or more of the leading global firms are in North America, predominantly the USA. Quantum & Computing includes those companies that work on new quantum computers, as well as traditional computer technology. In this field, 44 out of the 50 leading global companies are found in the USA, and additionally one in Canada, which means that fully 90 percent are in North America. The Santa Clara Valley alone has a majority of 26 out of the 50 leading companies in Quantum & Computing.

In the field of Pharmaceuticals, 41 out of the 50 leading global companies are found in the USA, and additionally a couple in Canada, which means that 86 percent are localized in North America. The Boston urban region has fully 13 out of these companies, with a further 7 in New York, 3 in Santa Clara Valley, and 3 additionally in San Diego.

The third field with a particularly strong presence for North America is Artificial Intelligence. In this Deep Tech field, 37 out of the globally leading 50 companies are localized in the USA and a further 3 in Canada. Thus, 80 percent of the companies are found in North America. The majority of the leading Artificial Intelligence companies are found in the Santa Clara Valley, where 27 out of 50 are found, with New York hosting additionally 3.

Quantum & Computing	
North America	90%
Europe	4%
Asia	6%
Rest of world	0%

Pharmaceuticals	
North America	86%
Europe	8%
Asia	6%
Rest of world	0%

Artificial Intelligence	
North America	80%
Europe	10%
Asia	10%
Rest of world	0%

“Santa Clara Valley, often called Silicon Valley, is by wide margin the world’s leading Deep Tech centre. Fully 23.8 percent of all the globally leading Deep Tech companies are located here. The second, third and fourth leading urban regions for Deep Tech development also exist in the USA, namely New York, Boston, and Los Angeles.”

In fact, in all Deep Tech areas except Clean Tech, more than half of the leading top-50 firms of each field is located in the USA. Canada is however strong in Clean Tech, why even in this area half of the globally leading Deep Tech companies are located in North America. The share of North American Deep Tech companies is lowest for Clean Tech (50%) and highest for quantum and computing (90%).

Santa Clara Valley, often called Silicon Valley, is by wide margin the world’s leading Deep Tech centre. Fully 23.8 percent of all the globally leading Deep Tech companies are located here. The second, third and fourth leading urban regions for Deep Tech development also exist in the USA, namely New York (7.8 percent of all globally leading Deep Tech companies), Boston (6.8 percent), and Los Angeles (3.4 percent). The USA has many different urban regions which are strong in Deep Tech development, explaining the strong global dominance of this single nation.

Europe

Europe has particularly strong dominance in the areas of Clean Tech, as well as in Biotechnology and Robotics & Communication. Fully 28 percent of the leading Clean Tech companies of the world are situated in Europe, making environmental technology the main relative strength of Europe in a global Deep Tech analysis. In comparison, 50 percent of these firms are situated in North America. Europe does not outpace North America in any deep tech field, but the gap between the two is smallest in Clean Tech.

Biotechnology is another field in which Europe is strong, as 20 percent of the globally leading Deep Tech companies in this field are European. Nearly all other leading Biotechnology firms exist in the USA, with the exception of one in Canada and one in Japan. In Robotic & Communication, 18 percent of the world’s leading Deep Tech companies are located in Europe. This is nearly double the amount of Asia, but still significantly lagging North America. Photonic & Electronic Deep Tech development mainly occurs in North America, but 16 percent of the leading companies are found in Europe. Sweden, Netherlands, and the UK, have each a couple of the world’s leading Deep Tech companies in Photonic & Electronic.

London is the leading European hub of Deep Tech development, with 2.6 percent of all globally leading Deep Tech firms situated in this European centre for business and innovation. Paris, Amsterdam, Berlin, Stockholm, and Dublin are other leading European Deep Tech clusters. The Deep Tech companies of Europe are spread out in the continent, with Copenhagen and Cambridge also included amongst those cities which host more than a couple of the world’s leading Deep Tech companies.

North America	50%
Europe	28%
Asia	6%
Rest of the world	0%

Biotechnology	
North America	78%
Europe	20%
Asia	2%
Rest of the world	0%
Robotic and communication	
North America	68%
Europe	18%
Asia	10%
Rest of the world	4%
Photonic and electronic	
North America	68%
Europe	16%
Asia	14%
Rest of the world	2%

“London is the leading European hub of Deep Tech development, with 2.6 percent of all globally leading Deep Tech firms situated in this European centre for business and innovation. Paris, Amsterdam, Berlin, Stockholm, and Dublin are other leading European Deep Tech clusters.”

Asia

A relative strength of Asia is in the field of Fintech, as fully 20 percent of the leading developers of financial technology are found in Asia. India is particularly strong in Fintech development. Space & Advanced Materials is another relative strength of Asia, with 18 percent of the globally leading Deep Tech firms in this sector present in Asian countries. India, and Japan, are particularly strong in development of Space & Advanced Materials, with the United Arab Emirates, Israel, and Singapore, also having each one leading Deep Tech field in Space & Advanced Materials. Out of the Clean energy leading Deep Tech companies, 16 percent are found in Asia, considerably more than 10 percent in Europe. Also in this field, India is particularly strong.

Summing up all ten Deep Tech fields, India ranks third in the world in terms of number of globally leading Deep Tech companies. There are 22 such companies in India, followed by China on fifth place with 11, and Israel on sixth place with 10. Relative to their populations and industrial production, China in particular but also India is still behind in Deep Tech development. In the coming years, it is likely that an increasingly large share of the globally leading Deep Tech companies of the world will evolve in Asia, as particularly China amasses the investments needed to achieve this. Asian cities with a strong presence in Deep Tech development include Tel Aviv, New Delhi, Tokyo, Bengaluru, and Beijing.

Fintech	
North America	58%
Europe	12%
Asia	20%
Rest of the world	10%

Space and advanced materials	
North America	72%
Europe	10%
Asia	18%
Rest of the world	0%

Clean energy	
North America	72%
Europe	10%
Asia	16%
Rest of the world	0%

“In the coming years, it is likely that an increasingly large share of the globally leading Deep Tech companies of the world will evolve in Asia, as particularly China amasses the investments needed to achieve this. Asian cities with a strong presence in Deep Tech development include Tel Aviv, New Delhi, Tokyo, Bengaluru, and Beijing.”

Deep Tech per capita ranking

In total numbers, nearly seven out of ten Deep Tech companies are found in the USA. However, once population is accounted for, it is actually Israel that has most Deep Tech leading companies per capita. In Israel, there are 1.75 globally leading Deep Tech companies per million adults, ahead of 1.58 in the USA. Ireland (1.20), Estonia (1.18), Switzerland (0.87), are the other countries in the top-five. Denmark (0.80), Canada (0.79), Sweden (0.77), Netherland (0.70), and the UK (0.54) rank amongst the global top-10 list.

While the leading top-ten countries are spread over three continents, they are all part of the western cultural group. Israel’s Deep Tech progress is linked to its military research. The USA has both a large population and the second highest share of Deep Tech companies per adult, which explains its dominant global role. Ireland and Estonia both had relatively low levels of technological progress one generation ago and have evolved by relying on a combination of low taxes and free markets. The UK, Sweden, Netherlands, and Denmark have long been important centres of technological achievement. They need to introduce reforms in order to keep up the competition with lower tax regions such as Ireland, Estonia, and Switzerland.

Deep technologies are expensive to develop, and often require significant foreign direct investments. Favourable economic policy factors such as advantageous taxes are important for fostering Deep Tech progress, both for stimulating entrepreneurs and for gathering the resources.

“The UK, Sweden, Netherlands, and Denmark have long been important centres of technological achievement. They need to introduce reforms in order to keep up the competition with lower tax regions such as Ireland, Estonia, and Switzerland.”

Number of 500 globally leading Deep Tech companies per million adults	
Israel	1.75
USA	1.58
Ireland	1.20
Estonia	1.18
Switzerland	0.87
Denmark	0.80
Canada	0.79
Sweden	0.77
Netherlands	0.70
UK	0.54
New Zealand	0.30
Finland	0.29
UAE	0.26
Singapore	0.24
Australia	0.24
Germany	0.17
France	0.14
Belgium	0.13
Japan	0.10
Romania	0.08
Kenya	0.06
South Korea	0.05
Uganda	0.04
Colombia	0.03
Italy	0.03
Nigeria	0.03
India	0.02
Egypt	0.01
Brazil	0.01
China	0.01

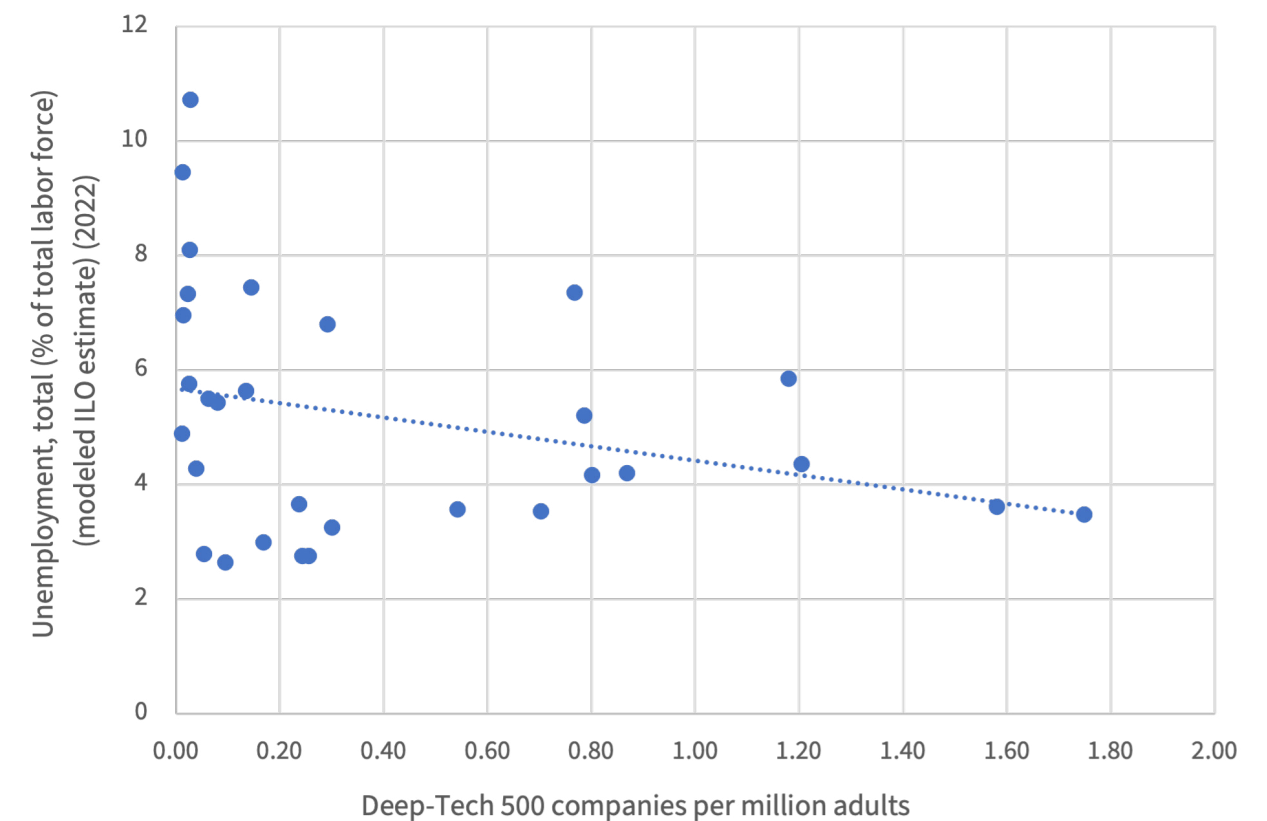
Deep Tech firms foster employment

Much of global economic development is currently linked to technological progress. Deep Tech companies are already today playing a key role in the economy and are further developing those technologies that will be market dominating in the coming generation. Companies high up in the business hierarchy tend to play an important role in attracting investments, stimulating exports, and job growth. While technologically advanced companies themselves do offer job opportunities, they also foster employment indirectly, through subcontractors, and by stimulating the local service economy. Deep Tech companies often sell their products and technologies to other companies in the same country, and thus promote the technological advancement of the overall economy.

These factors can explain why those countries that have more globally leading Deep Tech companies per million adults, also tend to have lower unemployment. One globally leading Deep Tech company more per million adults, is linked to 1.26 percentage points lower unemployment. This is the finding of a regression analysis of the countries in the world which host at least one globally dominant Deep Tech company. In a world driven by technological change, being on top of technological development allows for export-oriented jobs to grow, which in turn stimulates other forms of job growth in the local market, as demand is driven up. Stimulating Deep Tech is thus advantageous for national governments, in order to boost the technological progress of their respective countries, to further prosperity, but also to foster jobs growth.

“Stimulating Deep Tech is thus advantageous for national governments, in order to boost the technological progress of their respective countries, to further prosperity, but also to foster jobs growth.”

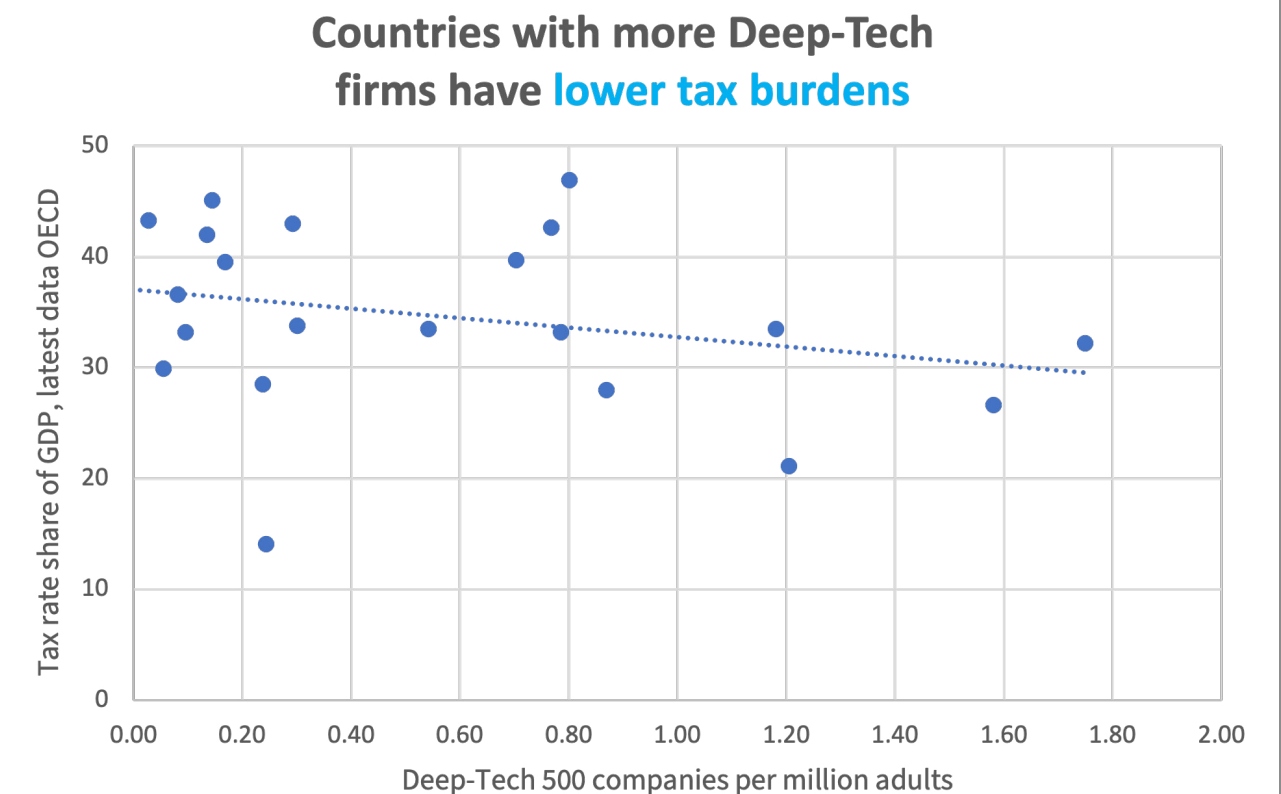
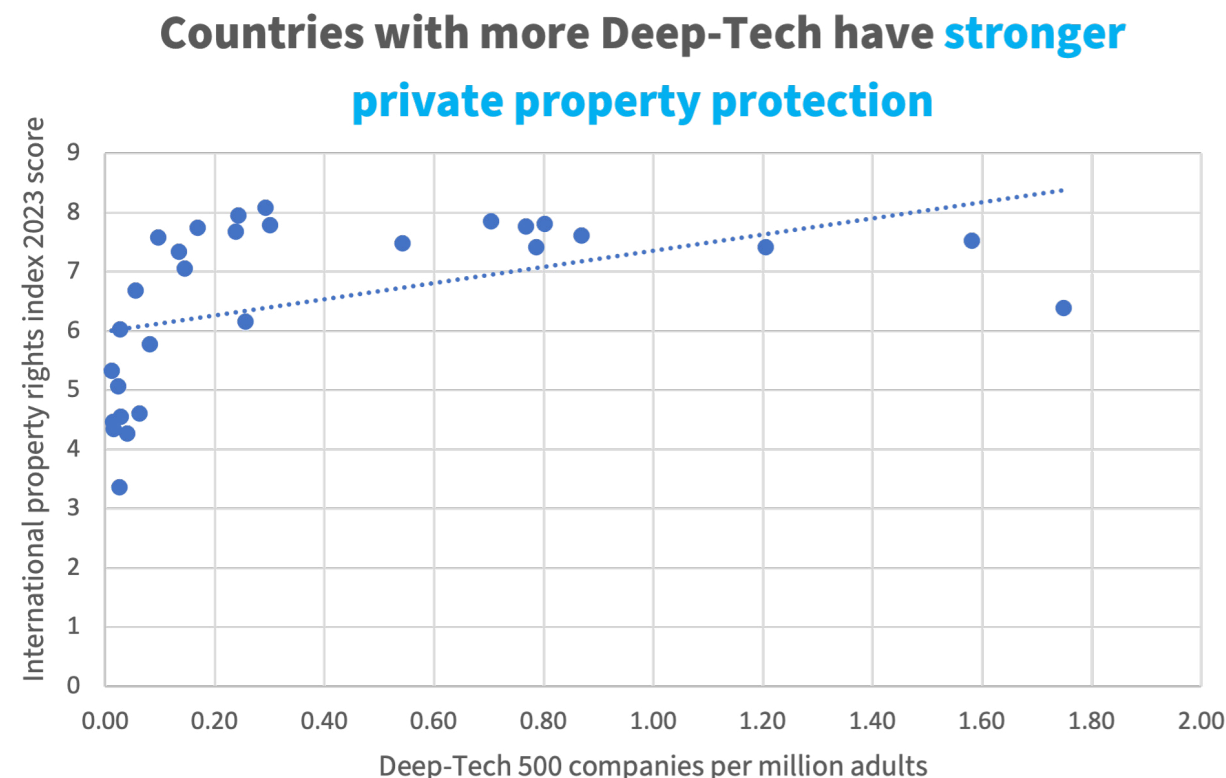
Countries with more Deep-Tech have lower unemployment



Deep Tech and policy

What sets apart those countries that have a high concentration of Deep Tech companies per million adults? To begin with, they tend to have strong private property protection. Deep Tech development requires significant investments, in immaterial and material goods, and these investments therefore tend to focus on those countries where the protection for private properties are strongest.

Another relevant policy field is taxes. While taxes are needed to fund basic research, infrastructure, welfare, rule of law, and other public goods, high taxes tend to crowd out economic activity. More precisely, countries with high taxes tend to also have high levels of public expenditure. High levels of public expenditure crowds out private expenditure, while high taxes crowd out private sector investments and activity. This can explain why those countries which have a lower tax burden tend to have a higher concentration of Deep Tech companies per million adults.

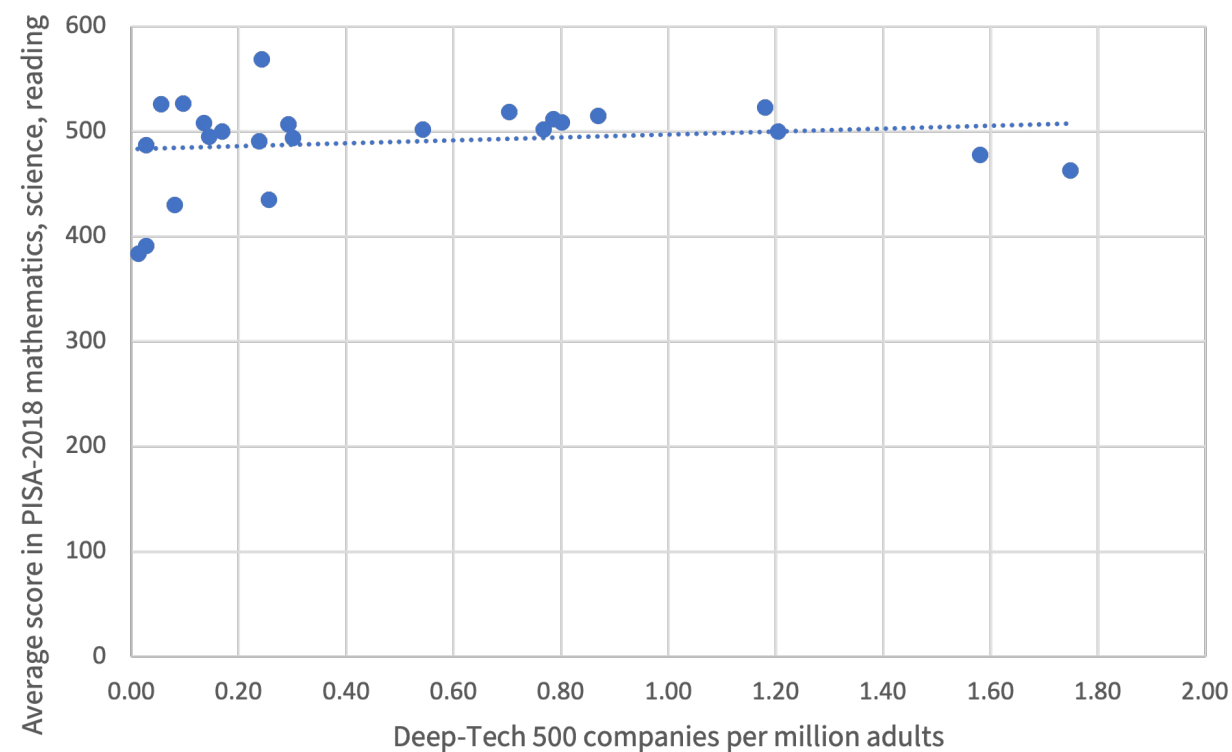


Knowledge plays a key role in technological development, why those countries that have a higher score in the international PISA-results, also tend to have a higher concentration of Deep Tech companies. Stimulating good school results, through teacher-led education with focus on mathematics, engineering, science, and technology, from early age, makes it possible to climb in PISA-results and particularly encourage those skills that are most relevant for Deep Tech development. While the quality basic education is important, elite universities also play a key role in Deep Tech development. The concentration of Deep Tech companies per million adults, is compared to the number of top-100 universities in engineering & technology per million adults. It is found that those countries which have a higher concentration of top universities in engineering & technology also tend to have more Deep Tech companies per capita.

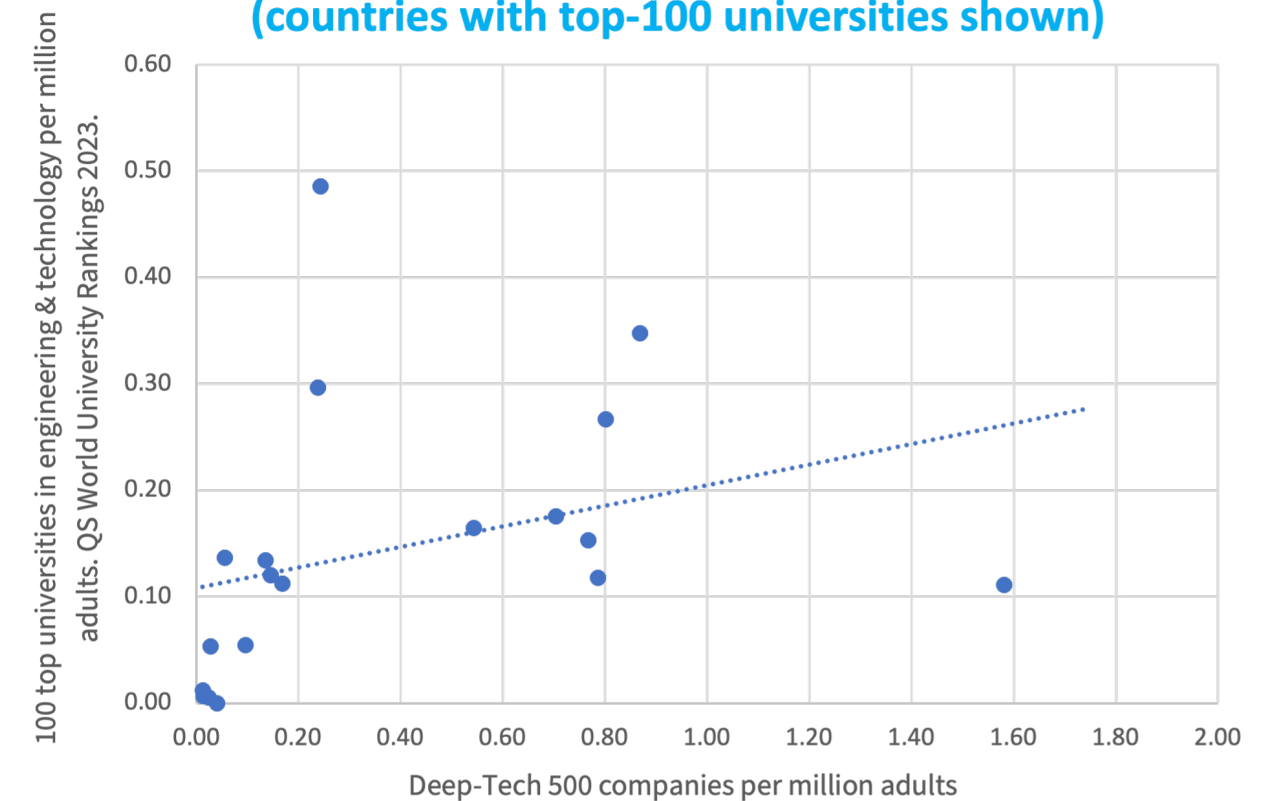
Fostering skills in schools, particularly in mathematics and technology, stimulating elite universities in engineering and technology, lowering the tax burden, and strengthening private protection, are policies that can boost the Deep Tech performance of individual countries.

“Fostering skills in schools, particularly in mathematics and technology, stimulating elite universities in engineering and technology, lowering the tax burden, and strengthening private protection, are policies that can boost the Deep Tech performance of individual countries.”

Countries with more Deep-Tech firms have higher average PISA score (average mathematics, science, reading)



Countries with more Deep-Tech firms have more top-100 universities in engineering and technology (countries with top-100 universities shown)



Artificial Intelligence

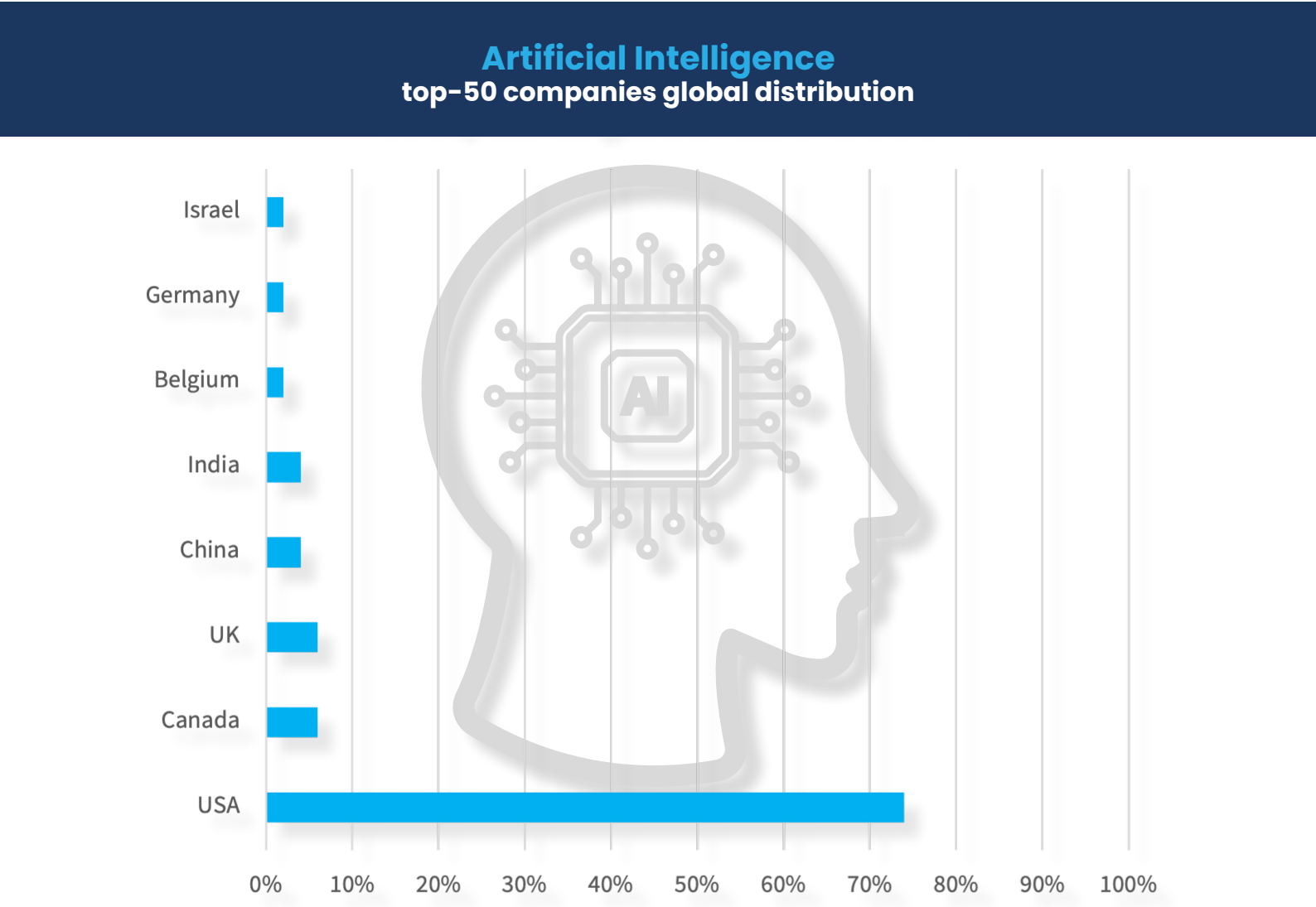
Artificial Intelligence development is about creating intelligence processes in computer systems and machines. Speech recognition, machine vision, and natural language processing are some applications of Artificial Intelligence. Out of the globally leading companies that are developing this deep technology, fully 80 percent are found in North America. The remaining leading technology companies in Artificial Intelligence are split evenly between 10 percent in Europe, and 10 percent in Asia.

Artificial Intelligence	
North America	80%
Europe	10%
Asia	10%
Rest of the world	0%

Fully 54 percent of the leading Artificial Intelligence development is occurring in Santa Clara Valley, popularly known as Silicon Valley. Thomas Edison founded the world’s first industrial innovation laboratory in this valley 150 years ago, and it has since become the most significant region for development of new technologies. In North America, Artificial Intelligence development is also focused to New York and Toronto. European centres of Artificial Intelligence development include London, Brussels, and Berlin. In Asia, the development of this deep technology is focused on Beijing, Shanghai, Tel Aviv, Bengaluru, and Mumbai.

Companies can already reduce costs, create more complex services and products, as well as reach new markets by utilizing Artificial Intelligence solutions. During the coming decades, Artificial Intelligence will become an increasingly dominant part of the economic system, around the world. Because of this, countries and regions which are the development centres of this deep technology face significant economic opportunities. The majority of Artificial Intelligence development is occurring in the USA, followed by Canada, the UK,

China, and India. The leading deep technology companies in Artificial Intelligence are all focused to North America, Europe, and Asia, with no leading centres of development in either Africa, South America, or Oceania.



Clean Energy

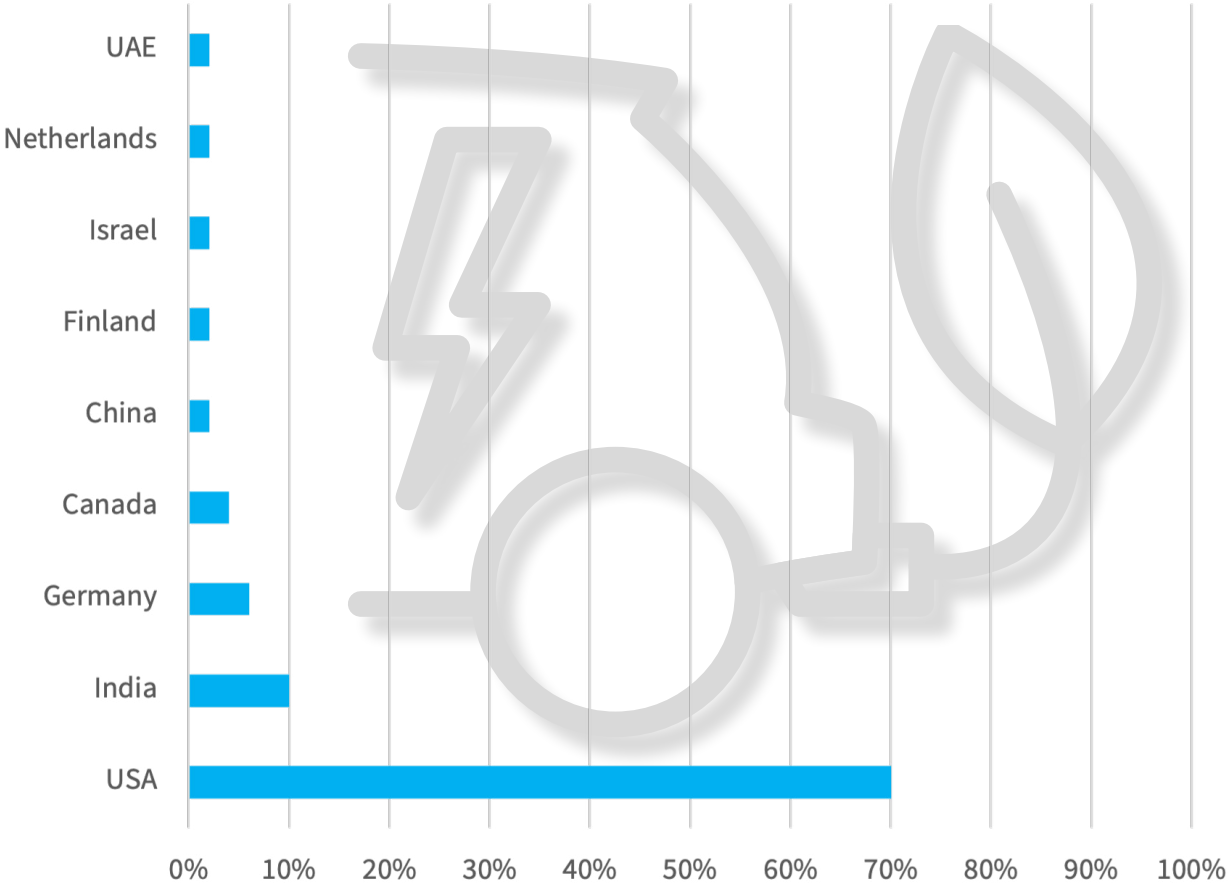
Clean energy solutions play a key part in the world economy, during a time when there is great demand for energy and a need to shift towards more environmentally sustainable energy production. Amongst those companies that develop this deep technology, 16 percent are found in Asia, a higher share than Europe, where 10 percent of the globally leading firms in Clean Energy are found. The remaining 74 percent are localized in North America.

Clean energy	
North America	74%
Europe	10%
Asia	16%
Rest of the world	0%

Asian centres of Clean Energy development include New Delhi, Ahmedabad, Bengaluru, Abu Dhabi, Tel Aviv in Israel, and Hong Kong. In North America, Clean Energy development is focused to the Santal Clara Valley, Boston, New York, and Chicago. European centres of Clean Energy development include Berlin, Munich, and Eindhoven.

As the world economy grows and move towards electrification, the demand for energy supply increases. At the same time, there is a strong political pressure to shift away from hydrocarbons due to environmental concerns of the greenhouse effect. Those countries that succeed most with developing Clean Energy solutions, will have the best opportunity to fuel their future economic growth. Because of this, those regions and countries which lead the development of Clean Energy, gain an economic boost. Often, globally leading companies build Clean Energy solutions also in other countries, creating substantial export revenues. The majority of Clean Energy development is occurring in the USA, followed by India, Germany, Canada, and China.

Clean Energy
top-50 companies global distribution



Clean Tech

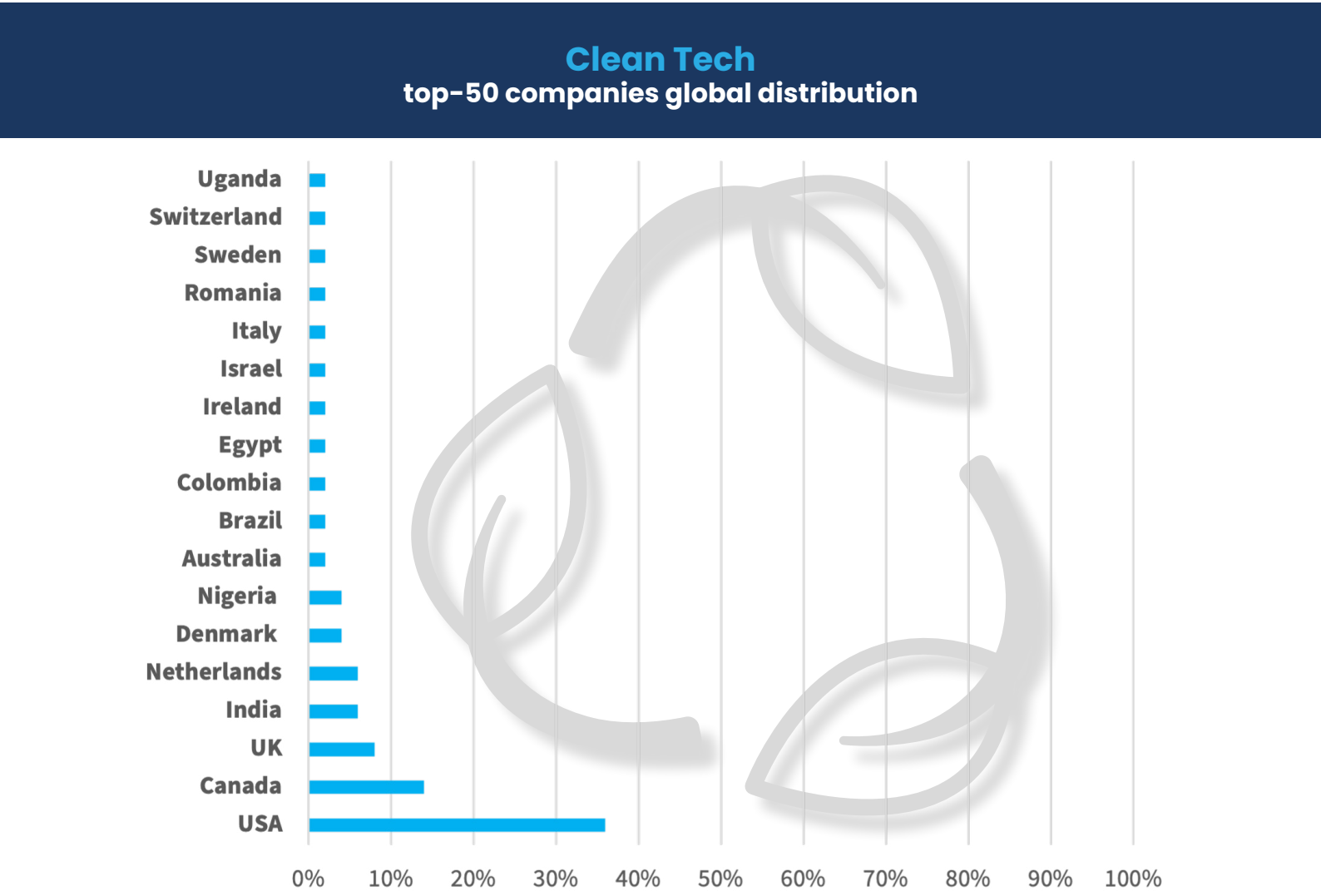
Internationally, there is growing public demand for environmental sustainability. An important part of this development occurs through Clean Tech solutions, which are about fostering a cyclical economic model where goods, components, and materials are increasingly recycled. Amongst those companies that develop this deep technology, 28 percent are found in Europe, a higher share than for any other form of deep technology. Additionally, 50 percent of the world’s leading technology companies in Clean Tech are found in North America, with the remaining 6 percent found in Asia.

Clean Tech	
North America	50%
Europe	28%
Asia	8%
Rest of the world	14%

European centres of clean-tech development include Copenhagen, London, Amsterdam, Bucharest, and Malmö. In Clean Tech North America, much of the progress is focused to New York, to the Santa Clara Valley, and to Toronto. In Asia, clean-tech development is focused to Hyderabad, Tel Aviv, and Jaipur. solutions are increasingly in demand. This is partially since the world’s population as well as consumption per capita is growing, creating greater need for recycling, and partially since environmental concerns are increasingly prioritized in policy around the world. Recycling is big business and people around the world are increasingly aware of the environmental impact of their consumption. Clean Tech solutions that are developed in one part of the world can be exported, creating a significant market opportunity.

The majority of Clean Energy development is occurring in the USA, followed by Canada, the UK, India, and the Netherlands. Much of the deep technology development of the world is limited to North America, Europe, and Asia. For Clean Energy however, some of the leading

companies are found in other parts of the world. This includes Abuja, Kampala, Lagos, and Cairo in Africa, as well as Bogota and Sao Paulo in South America. Some development also occurs in Mullumbimby, in Australia.



Biotechnology

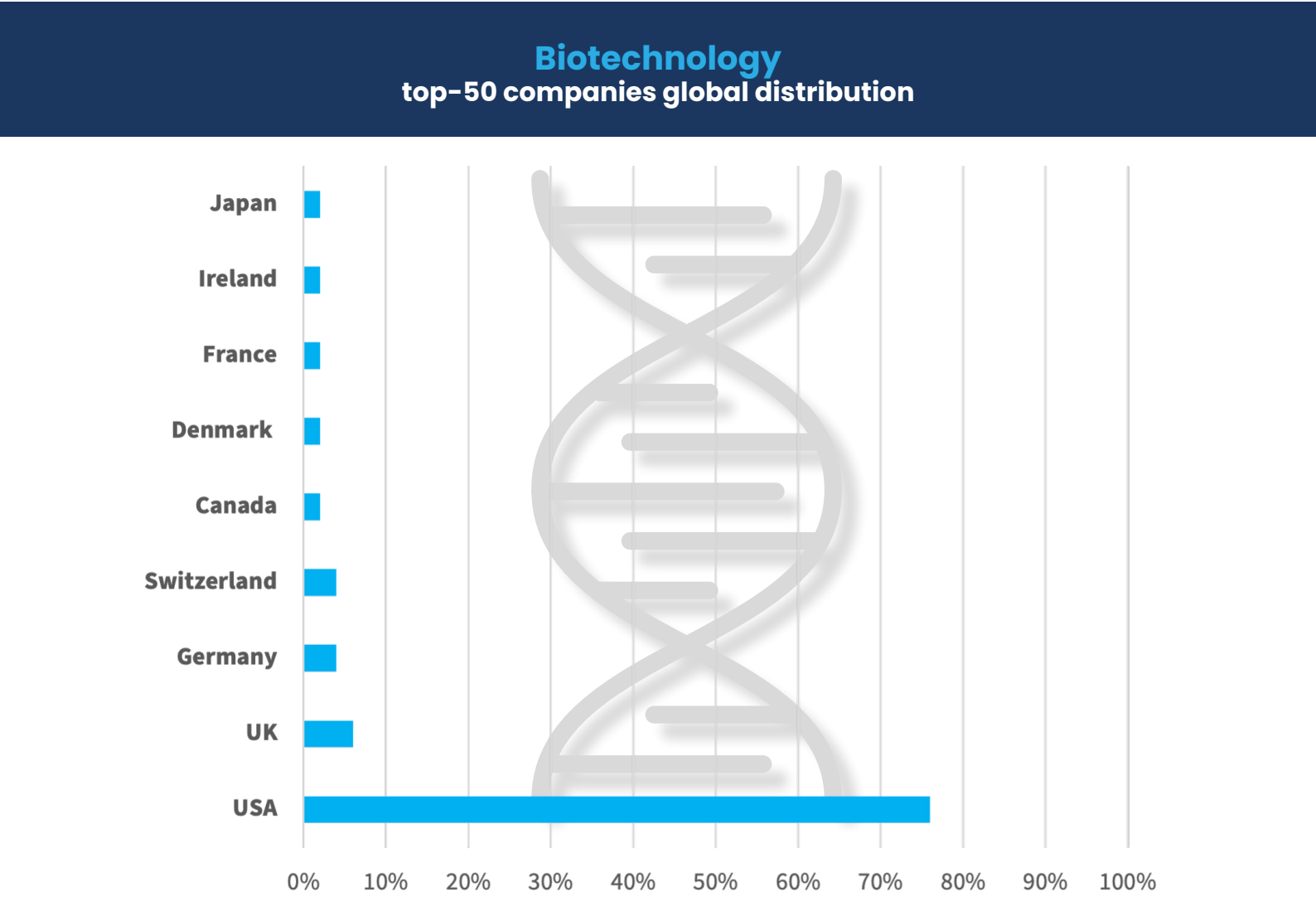
The progress of Biotechnology already offers many solutions for human health and longevity, with significant further progress on the way. For the first time in human history, scientists are able to understand the core foundation of ageing, leading to various Biotechnology solutions for longevity and health. Amongst those companies that develop this deep technology, 20 percent are found in Europe, a higher share than most areas of technology. Out of the remaining leading deep technology companies in Biotechnology, fully 78 percent are located in North America, while Asia has only one of the top-50 globally leading companies in biotechnology.

Biotechnology	
North America	78%
Europe	20%
Asia	2%
Rest of the world	0%

European centres of Biotechnology development include Basel, Cambridge, Copenhagen, Dublin, and Paris. Fully 26 percent of the leading Biotechnology development occurs in Santa Clara Valley, popularly known as Silicon Valley. Thomas Edison founded the world’s first industrial innovation laboratory in this valley 150 years ago, and it has since become the most significant region for development of new technologies. Outside of North America and Europe, Tokyo is the globally leading Asian centre for deep technology development of Biotechnology.

Biotechnology has many uses besides promoting longevity and human health. Biotechnology also has a key role in the global food industry, as well as in development of sustainable materials. Countries and regions that have a deep technology lead in Biotechnology can use this advantage to promote exports, and through that rising living standard. The majority

of Biotechnology development is occurring in the USA, followed by the UK, Germany, Switzerland, and Canada.



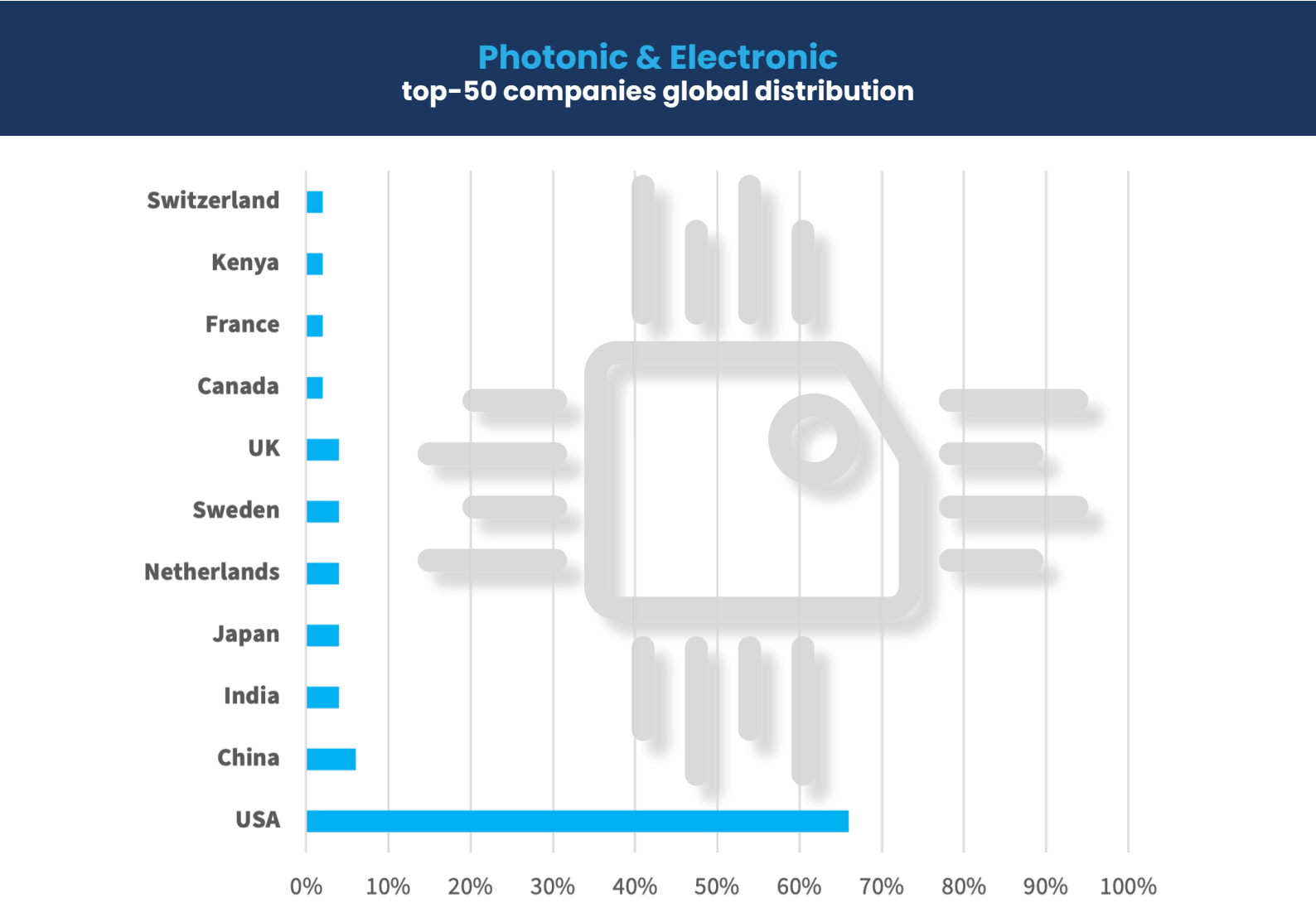
Photonic & Electronic

Photonic & Electronic are a couple of closely related fields of technology, which have significant impact on global development. While in an electronic chip, electron flux passes electrical components such as transistors and resistors, photonic chips are based on photon passing through optical components. Amongst those companies that develop this deep technology, 16 percent are found in Europe, a higher share than most other technology area. Additionally, 68 percent of the world’s leading deep technology companies in Clean Tech are found in North America. Out of the remaining, 14 percent are localized in Asia, and 2 percent in Africa.

Photonic & Electronic	
North America	68%
Europe	16%
Asia	14%
Rest of the world	2%

European centres of clean-tech development include Stockholm, Amsterdam, Cambridge, Paris, and Schaffhausen. In North America, much of the development is focused to The Santa Clara Valley, which is by wide margin the number one leading innovation region of the world. Fully 24 percent of the leading deep technology companies in Photonic & Electronic are found in this single region. Other North American centres for development of Photonic & Electronic include Boston, New York, and Los Angeles. Asian centres of development include Bengaluru, Guangzhou, Hangzhou, Hanoi, and Ho Chi Minh City, as well as Tokyo. Vietnam has a particularly strong presence in development of Photonic & Electronic, given that the country otherwise has limited deep technology development. Nairobi in Kenya is the only centre for globally leading development of Photonic & Electronic outside of North America, Europe, and Asia.

Photonics has applications in telecommunications and processing of information, as well as in lighting, robotics, biophotonics, holography, military technology including lasers, and spectroscopy. Much of technological development is related to photonics in some way, while electronic development continues to be a key part of technological progress. Countries and regions that are leading in development of Photonic & Electronic, therefore gain a significant economic advantage. The majority of Photonic & Electronic development is occurring in the USA, followed by China, India, and Japan. Sweden, The Netherlands, and the UK are also important countries for development of this deep technology.



Robotic & Communication

Robotics & Communication technology are significantly influencing the global economy. Robots have been a key part of industrial development for decades, and are becoming increasingly advanced, with even humanoid robots recently becoming a reality. That communication technology is changing the world is also apparent, in a time where many spend hours a day interacting through their smart phones. Amongst those companies that develop this deep technology, 18 percent are European, a higher share compared to other areas of technology. The majority of 68 percent of the world’s leading companies in Robotics & Communication development are found in North America. Out of the remaining, 10 percent are localized in Asia, and 4 percent in Africa and Oceania.

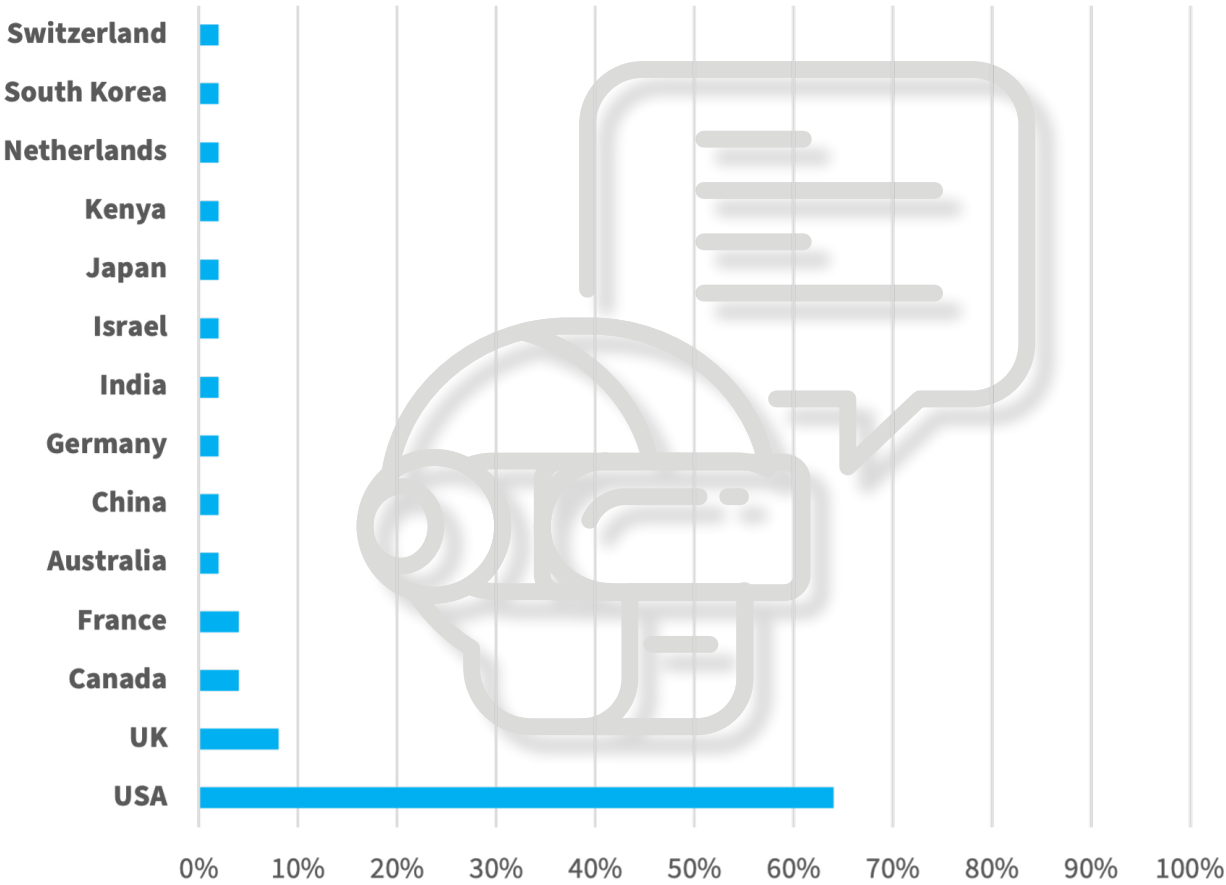
Robotic & Communication	
North America	68%
Europe	18%
Asia	10%
Rest of the world	4%

European centres of Robotics & Communication development include London, Paris, Amsterdam, and Berlin. In North America, much of the development is focused to The Santa Clara Valley, the number one leading innovation region of the world. Fully 20 percent of the leading deep technology companies in Robotics & Communication are found in this single region. Other North American centres for development include Austin, New York, Boston, and Seattle. In Asia, development of Robotics & Communication occurs in New Delhi, Seoul, Shenzhen, Tel Aviv, and Tokyo. Outside of North America, Europe, and Asia, there is also some development in Nairobi, Kenya, and Sydney, Australia.

Robotics & Communication technologies are fundamental for the future of manufacturing industries, but also services and communication. Those countries and regions that have

an edge in this field of technology are likely to significantly benefit from this. The majority Robotics & Communication development is occurring in the USA, followed by the UK, Canada, and France. China, India, Australia, and Germany are also important countries for development of this deep technology.

Robotic & Communication
top-50 companies global distribution



Quantum & Computing

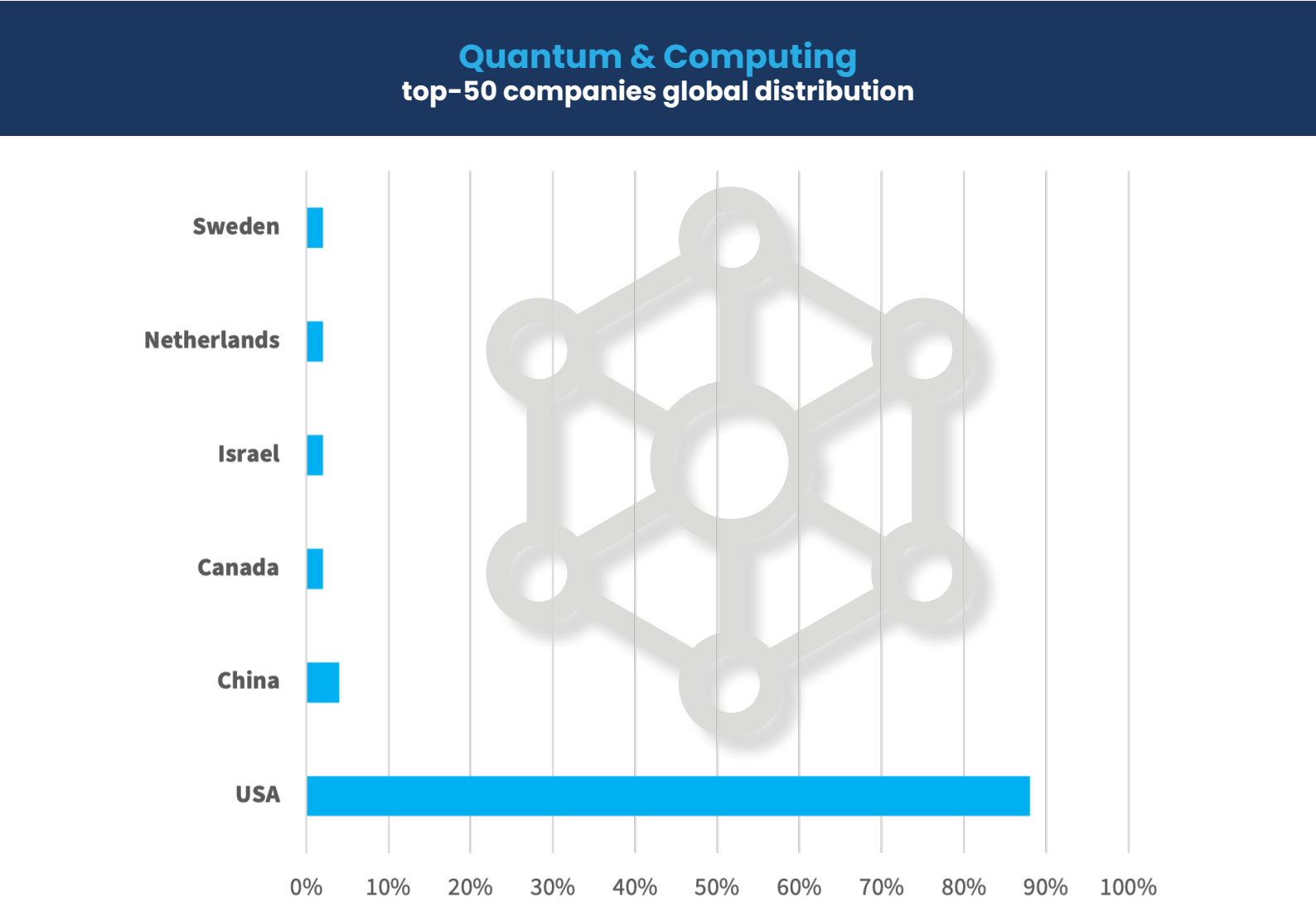
As recently as the 1960s, mechanical calculators were still used around the world. This is now a past memory since the development of electronic computing has revolutionized the world. Many people today have today stronger computing powers in their mobile phones, than the computers used for the first moon landing. While binary computer technology continues to evolve, it is now complemented by quantum computing, which relies on quantum bits instead of binary digits. Amongst those companies that develop this deep technology, fully 90 percent are found in North America. While North America dominated all areas of deep technology, the dominance is most clearly found in the area of Quantum & Computing. Out of the remaining firms, 6 percent are localized in Asia, with the remaining 4 percent in Europe.

Quantum & Computing	
North America	90%
Europe	4%
Asia	6%
Rest of the world	0%

A majority of 52 percent of the leading Quantum & Computing development is occurring in Santa Clara Valley, popularly known as Silicon Valley. Thomas Edison founded the world’s first industrial innovation laboratory in this valley 150 years ago, and it has since become the most significant region for development of new technologies. In North America, Quantum & Computing development is additionally focused to New York, Austin, and Boston. The few centres of globally leading Quantum & Computing development that are outside of North America include Stockholm and Amsterdam in Europe. In Asia, development centres include Tel Aviv, Beijing, and Hangzhou.

Quantum computing is ultimately a novel concept, capable of many parallel processes. Some problems can be solved significantly faster by quantum computing, particularly those

including complex relationships. Regions that have been the focus of traditional computers have thrived historically, and the same is likely to be the case for those regions that lead the future of Quantum & Computing. The USA by wide margin dominated development of quantum computers and classical computers, followed by China. Additional countries that contribute to this deep technology development include Sweden, the Netherlands, Israel, and Canada.



Pharmaceuticals

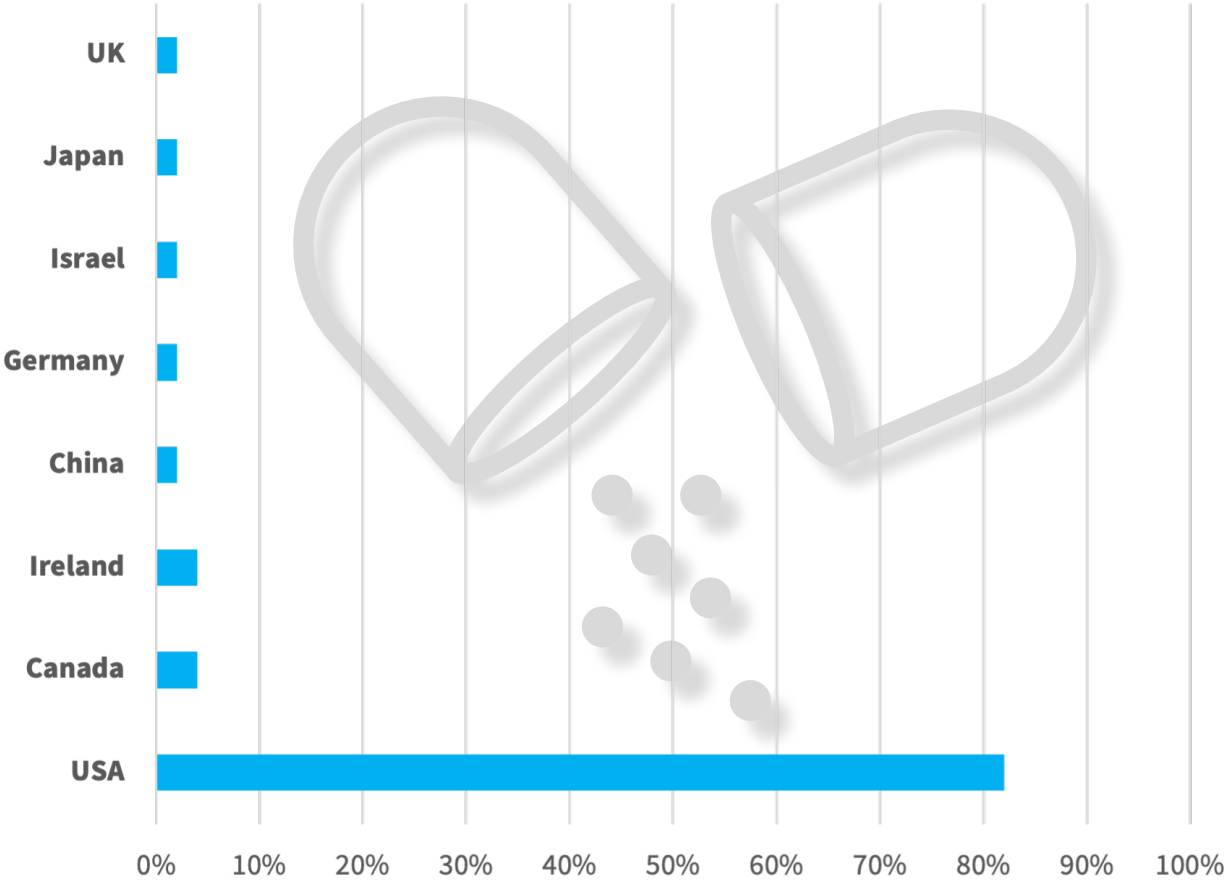
Throughout the world, there is a trend of increasing life span and more healthy years. This progress is linked to development of Pharmaceuticals. An increasingly large share of the world population is today elderly, pushing up the global demand for Pharmaceuticals. Amongst those companies that develop this deep technology, fully 86 percent are found in North America. While North America dominated all areas of deep technology, the concentration of leading Pharmaceuticals tech companies is unusually high. Out of the remaining firms, 8 percent are localized in Europe, with the remaining 6 percent in Asia.

Pharmaceuticals	
North America	86%
Europe	8%
Asia	6%
Rest of the world	0%

Fully 26 percent of the leading Pharmaceuticals development is occurring Boston. In North America, Pharmaceuticals development is additionally focused to New York, Los Angeles, San Diego, and the Santa Clara Valley. The few centres of globally leading Pharmaceuticals development that are outside of North America include Beijing, Tel Aviv, and Tokyo in Asia, as well as Dublin and Leverkusen in Europe.

Demand for Pharmaceuticals is rising, due to several factors. To begin with, the higher life span means an increasingly high need for Pharmaceuticals, as sickness increases with age. As living standards rise in the world, a higher share of incomes is directed to medicine. There is also a significant development of new medicines, based on genes, cells, and tissues. Those regions which are leading in development of Pharmaceuticals, are therefore likely to attract significant investments, and generate significant export revenues.

Pharmaceuticals
top-50 companies global distribution



Fintech

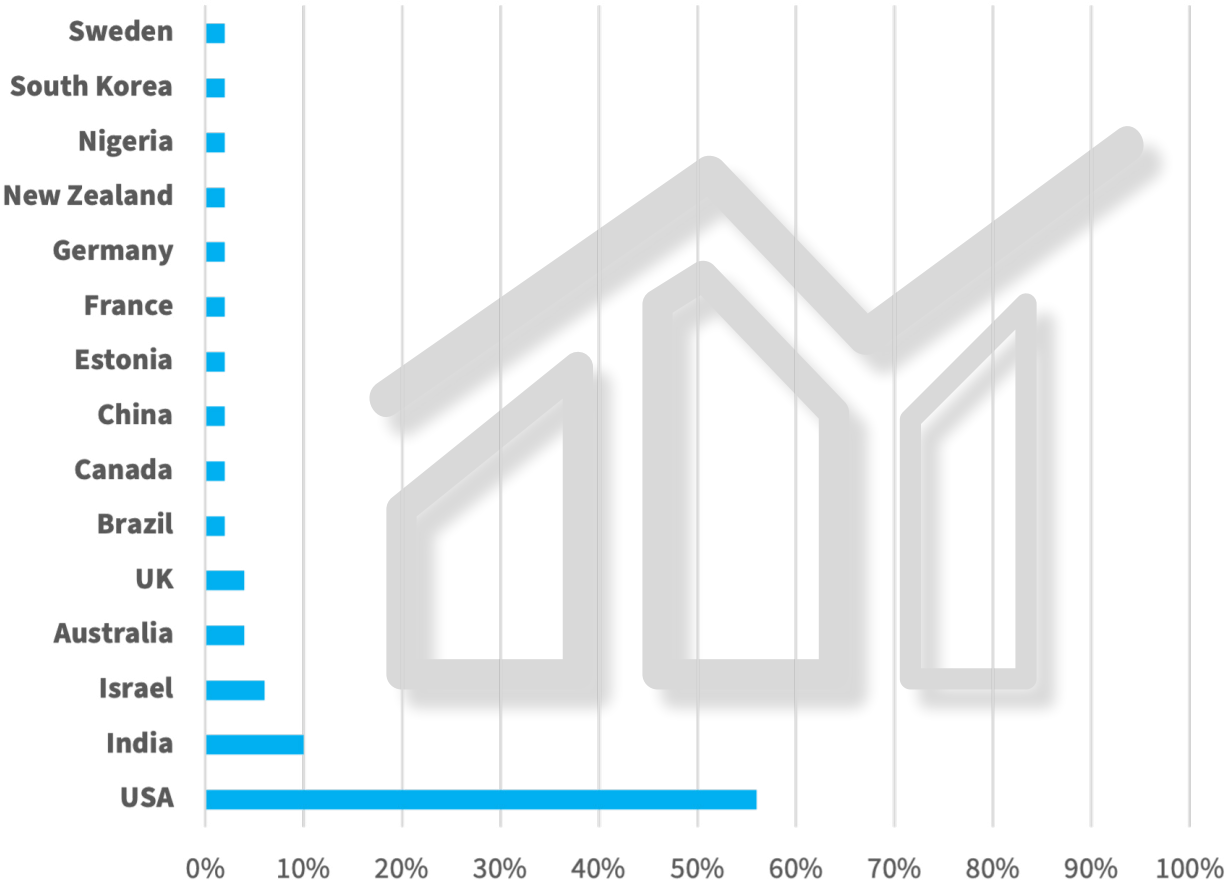
Financial technologies, or Fintech, play a key role in the world’s economy. Financial innovations, coupled to various digital solutions, promote investments and trade. Fintech solutions rely on specialized software on computers and phones, which promote safe and efficient financial transactions. Amongst those companies that develop this deep technology, 20 percent are found in Asia, a higher share than for any other area of deep technology. North America dominated all areas of deep technology and is the place where 58 percent of the globally leading Fintech companies are found. 20 percent are in Europe, with the remaining 10 percent spread out in Africa, South America, and Oceania.

Fintech	
North America	58%
Europe	12%
Asia	20%
Rest of the world	10%

Asian centres of Fintech development include New Delhi, Tel Aviv, Bombay, Hangzhou, and Hyderabad. Santa Clara Valley, often called Silicon Valley, has fully 26 percent of the world’s leading Fintech companies. In North America, other Fintech development centres include New York, and Atlanta. London, Berlin, Stockholm, Tallin, and Paris are amongst the European centres for Fintech development. Lagos is the Fintech hub of Africa, while São Paulo is that of Latin America. Melbourne, Sydney, and Wellington are Fintech centres of Oceania.

Finance is a driver for economic progress, why those regions that have strong Fintech presence have a significant advantage in terms of future growth potential. The majority of leading Fintech companies of the world are found in the USA, followed by India, Israel, Australia, and the UK.

Fintech
top-50 companies global distribution



Space & Advanced Materials

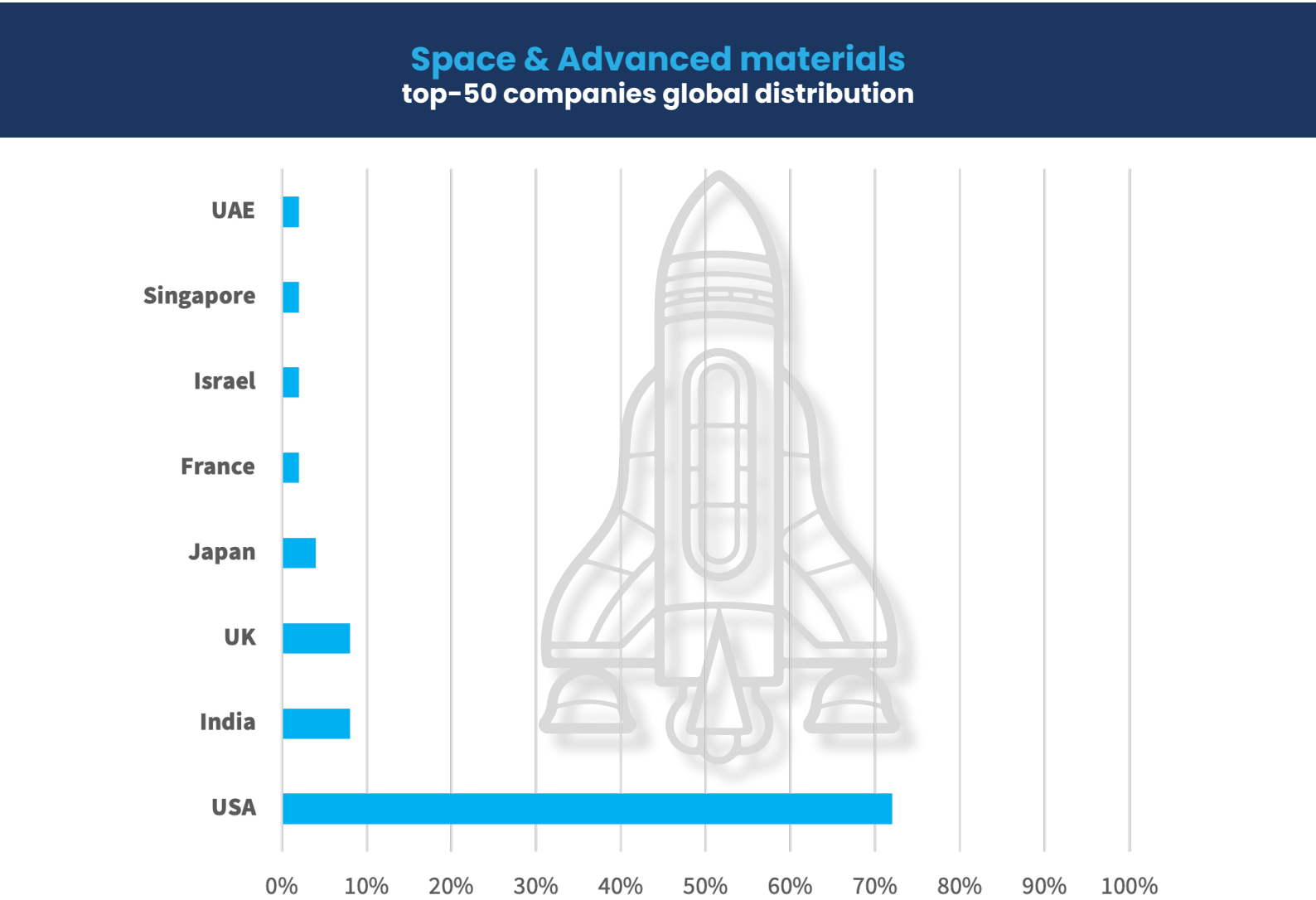
Space is in many ways the future of human progress. While space travel has been achieved for the past half century, it is only recently that private companies are able to overcome the technological and economical barriers to making space travel viable. Advanced material development is closely related since new materials are developed for space travel. Development of advanced materials also has many other industrial uses. Amongst those companies that develop deep technology of Space & Advanced Materials, 18 percent are found in Asia, a higher share than for any other area of deep technology except Fintech. North America, which dominated all areas of deep technology, is where 72 percent of the globally leading companies in Space & Advanced Materials are found. The remaining 10 percent of the leading technology companies in this field are European.

Space & advanced materials	
North America	72%
Europe	10%
Asia	18%
Rest of the world	0%

Asian centres of Space & Advanced Materials development include Tokyo, New Delhi, Abu Dhabi, Bengaluru, and Singapore. North American centres include Santa Clara Valley, Los Angeles, Washington DC, New York, as well as Austin. In Europe, the leading places Space & Advanced Materials development are London, Paris, Farnborough, and Harwell. Three out of the four European hotspots for Space & Advanced Materials are found in the UK.

Space in many ways is the final frontier for expansion, with massive opportunities to come in future decades. Advanced materials development is a key part of the space race, but also crucially important for industrial applications. Those regions that lead the race for Space & Advanced Materials, can attract significant economic opportunity. The vast majority of

development in this field of technology is occurring in the USA, followed by India and the UK. Japan, France, Israel, Singapore, and the United Arab Emirates, also have world leading Space & Advanced Materials companies.



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PWC, individual capital gain tax rate (typical cases, latest available estimate, or estimate based on own research).

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World Bank, world development indicators (wdi), unemployment, total (% of total labor force) (modeled ILO estimates).

World Bank, world development indicators (wdi), profit tax, % of commercial profits.

World Bank, world development indicators (wdi), population 15-64 years old.

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