

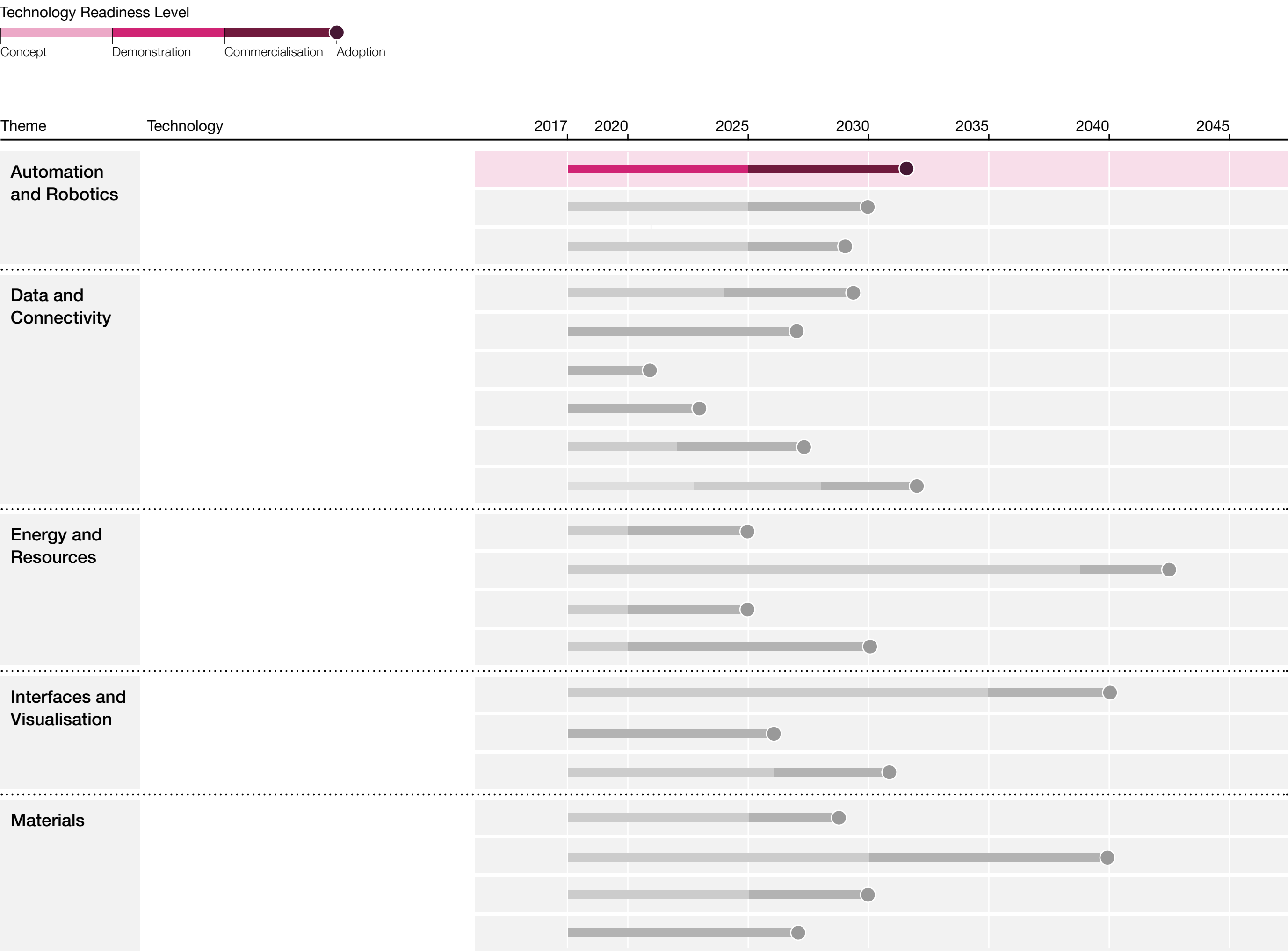
ARUP

emerging technology timeline

20 emergent technologies
likely to disrupt our sector



Timeline



Augmented intelligence

Definition

Augmented intelligence describes the use by people of intelligent tools that are designed to enhance the human brain’s capacity to calculate, assess, prioritise and create. It builds on advances in artificial intelligence (AI) and machine learning that have radically optimised how machines are trained, and which result in very high degrees of speed and accuracy. As such, augmented intelligence is moving from everyday applications such as autocorrect to more specialised use, including real-time translation and live visualisation. This has also led to more advanced hardware capable of managing increasingly complex tasks, for example Nvidia’s custom-made DriveX chip (see Autonomous Vehicles).

Relevance

Augmented intelligence will help engineers, designers and consultants to make better informed decisions at quicker intervals. Users will be able to transcend traditional cognitive constraints, to more effectively assess insights generated through advanced data analytics through the aid of non-linear processing capabilities. This will enable individuals to develop a deeper understanding of complex systems, and to make optimised decisions in relation to any given intervention or series of interventions.

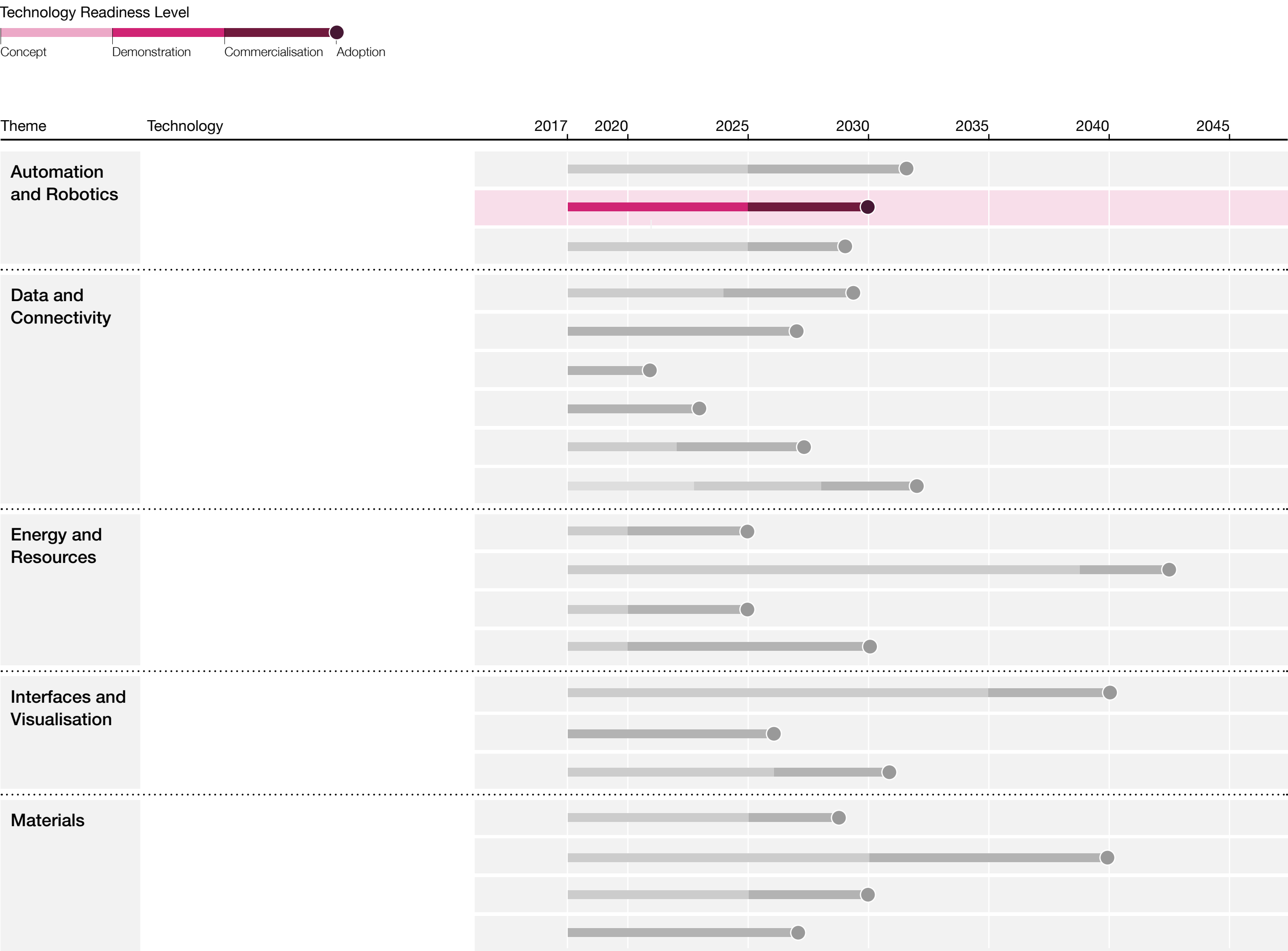
Case Study

Google’s Neural Machine Translation (GNMT) system has used machine learning to enhance the speed and accuracy of translation. Research carried out by teams from Google Brain and Google Translate in late 2016 shows how GNMT began to perform “translation between language pairs never seen explicitly by the system” by creating its own interlingua informed by its own learning. GNMT used in Google Translate has resulted in higher quality and simplified production architecture.

Links

- economist.com
- research.googleblog.com
- technologyreview.com
- theatlantic.com
- theguardian.com
- theguardian.com
- wikimedia.org

Timeline



Autonomous Vehicles

Definition

Autonomous vehicles (AVs) are cars or other vehicle types that take users from one point to another without any human control. Safer and more fuel-efficient than conventional vehicles, AVs rely on GPS and sensory observation of their surrounding environment in order to navigate. By 2035, the widespread use of autonomous vehicles is expected to reduce the need for parking space in the US by 5.7 billion m² and will free up nearly 50 minutes a day for users. As well as improving land use, the mass adoption of AVs promises to lower accident rates, reduce carbon emissions and improve mobility access.

Relevance

Cities and urban spaces will dramatically change as a result of AVs, with the design of roads, neighbourhoods, public transport and freight systems all affected. Current infrastructure will need to be retrofitted or reused as part of the transition to a fully autonomous future.

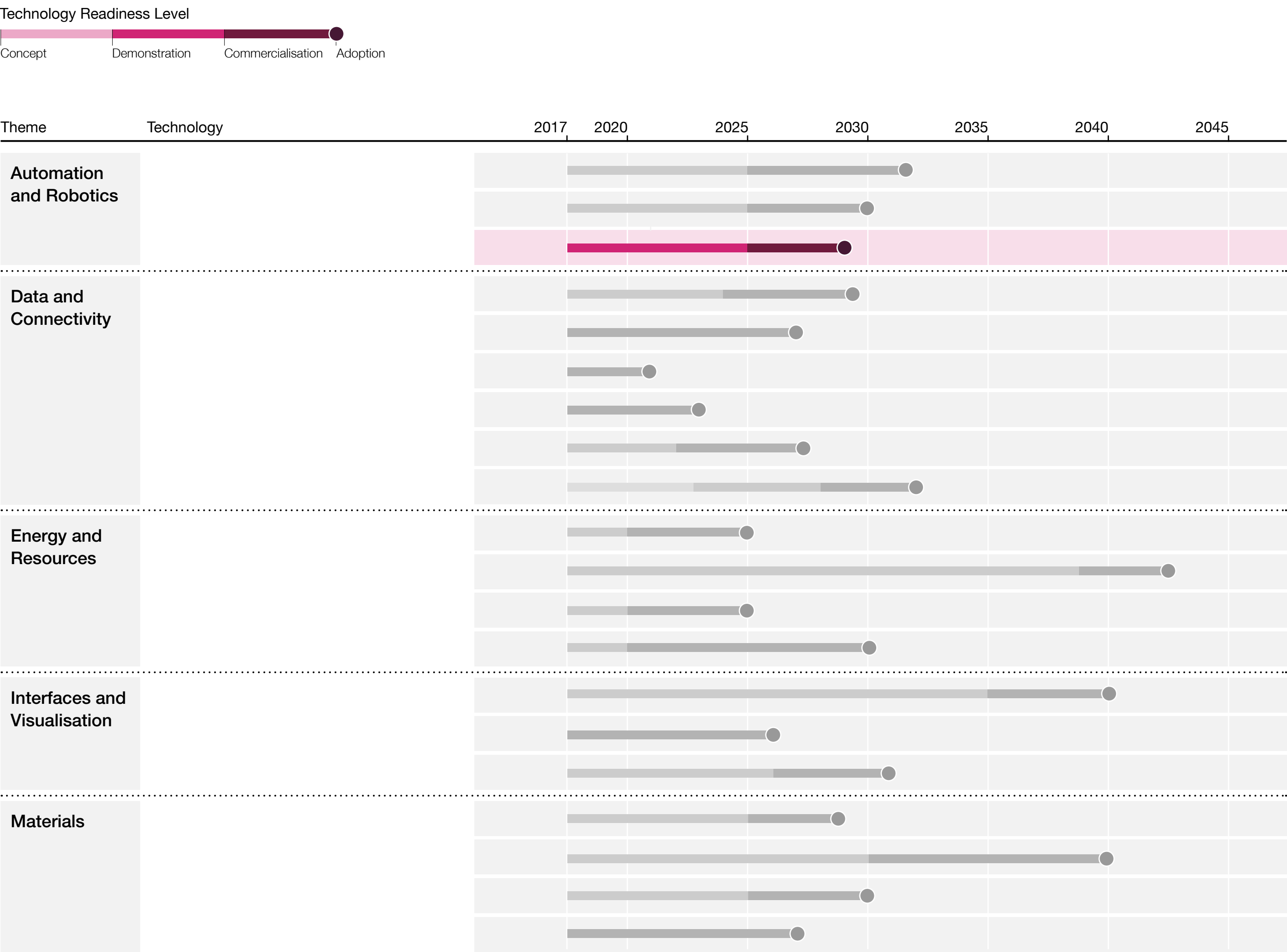
Case Study

Nvidia’s self-driving car uses machine learning as a basis for autonomous operation, rather than pre-determined algorithms. The system analyses footage taken from cameras mounted on human-driven vehicles, using AI to learn and replicate observed behaviours. The benefits of this approach include the system’s ability to tackle adverse weather conditions, imperfect road markings and night-time driving.

Links

- dezeen.com
- mckinsey.com
- nvidia.com
- rand.org
- theguardian.com
- theguardian.com

Timeline



Passenger Drones

Definition

Passenger drones are a mode of aerial transport carried out by an autonomous vehicle capable of delivering individuals or small groups of passengers to a desired destination. Various concepts and prototypes are in development for use in high-density urban environments, where they are seen as a complementary mode of transport that would be far faster than ground-based modes. If practical and deployed at scale, passenger drones could compliment the human-operated helicopter to become a viable mode of autonomous transport in cities within the next 10-15 years.

Relevance

Increasing urban density relies on the growth of multimodal transport systems. Beyond the development of connectivity and autonomy in ground vehicles, aerial transport – if feasible – would appear to be the next logical step. This would affect the design of buildings, public spaces and power systems, as well as transport infrastructure. Dubai has already begun trials of a passenger drone service.

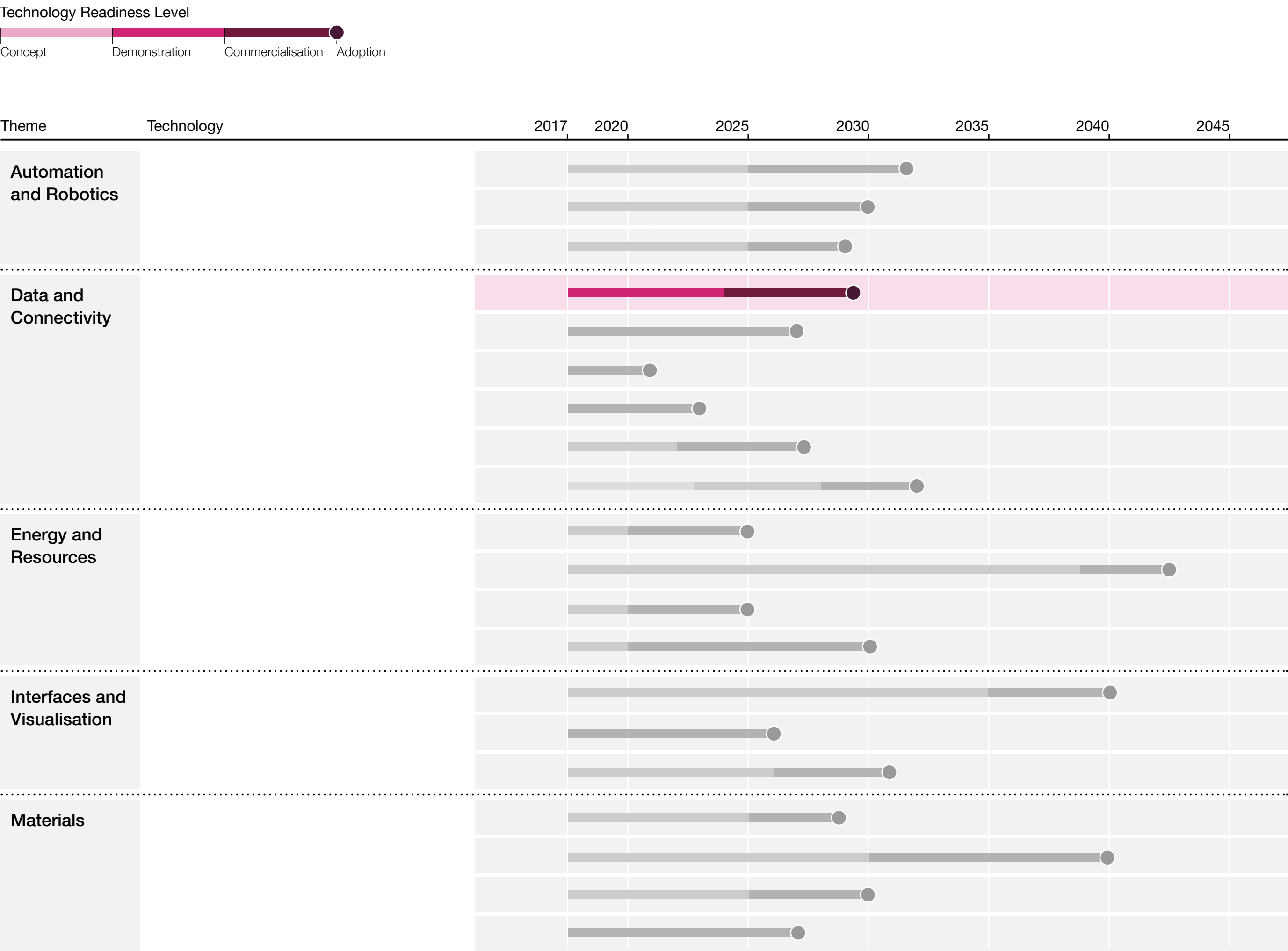
Case Study

In collaboration with ItalDesign, Airbus is developing a hybrid car concept called Pop.Up. It would operate on the ground as a drivable smart vehicle, while its core passenger pod could be detached and picked up by a large quadcopter to fly over traffic. The project is being developed in response to rising urban density and traffic congestion by providing a new multimodal transport solution.

Links

- engadget.com
- futurism.com
- mashable.com
- theguardian.com
- wired.com

Timeline



5G Mobile Internet

Definition

Global mobile data use has grown exponentially in recent years, increasing by 74% alone in 2015. Next-generation mobile internet, called 5G, is expected to handle much more data, connect more devices, reduce latency and provide increased network reliability. 5G is being seen as a transformational technology that will likely have a major impact on our sector and a wide range of industries including energy, transport and healthcare. It will be a key enabler for the Internet of Things as well as for the development of artificial intelligence.

Relevance

5G will be key to unlocking the ‘fourth industrial revolution’, underpinning the development of smart homes and cities, cloud computing, machine-to-machine communications and the Internet of Things. Sensor networks and high-speed connectivity will enable real-time monitoring of buildings and structures, helping to better understand operational aspects and post-occupancy performance. It will facilitate developments in autonomous vehicles and ‘mobility as a service’ models. 5G connectivity will also enable a range of other data-rich technologies, such as virtual and augmented reality (see Mixed Reality).

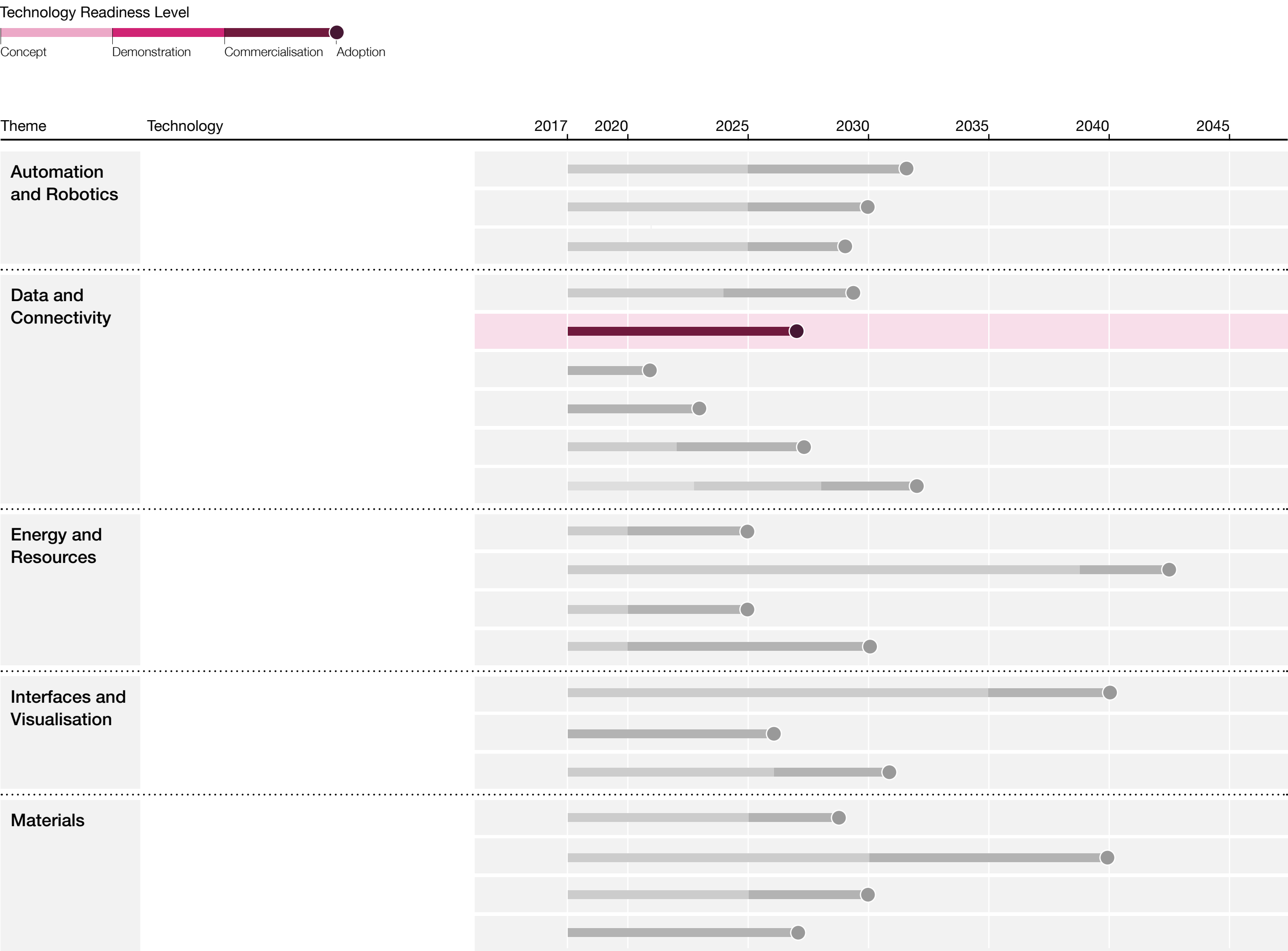
Case Study

China’s Ministry of Industry and Information Technology (MIIT) has established the world’s largest 5G test field at an outdoor site in Beijing. Here, the MIIT and industry partners including Huawei and Samsung have established the feasibility of the technology, with further trials now planned in cities across the country. China aims to be at the forefront of the development and commercialisation of 5G technology.

Links

- elenaneira.com
- ericsson.com
- gizmodo.com
- trustedreviews.com

Timeline



Blockchain

Definition

A blockchain is a fraud-proof, distributed digital ledger that records transactions in a peer-to-peer network. Transactions are permanently recorded in the form of ‘blocks’, with each one ‘chained’ together, from the very first to the latest block. The blockchain itself is recorded by a distributed network of users known as ‘miners’ performing a computational review on each block. The benefits of this system include a very high degree of security, redundancy of intermediaries, reductions in transaction cost and time, and global accessibility for all users.

Relevance

Blockchain could affect the building industry through smart asset management, where a single distributed ledger would provide improved security and efficiency for the large number of assets and stakeholders involved. Blockchain could also speed up the adoption of smart grids with its ability to validate the authenticity and source of transactions, thereby helping users to better choose their suppliers. For large organisations, blockchain could substantially reduce the cost and time of transactions and ease international contracts.

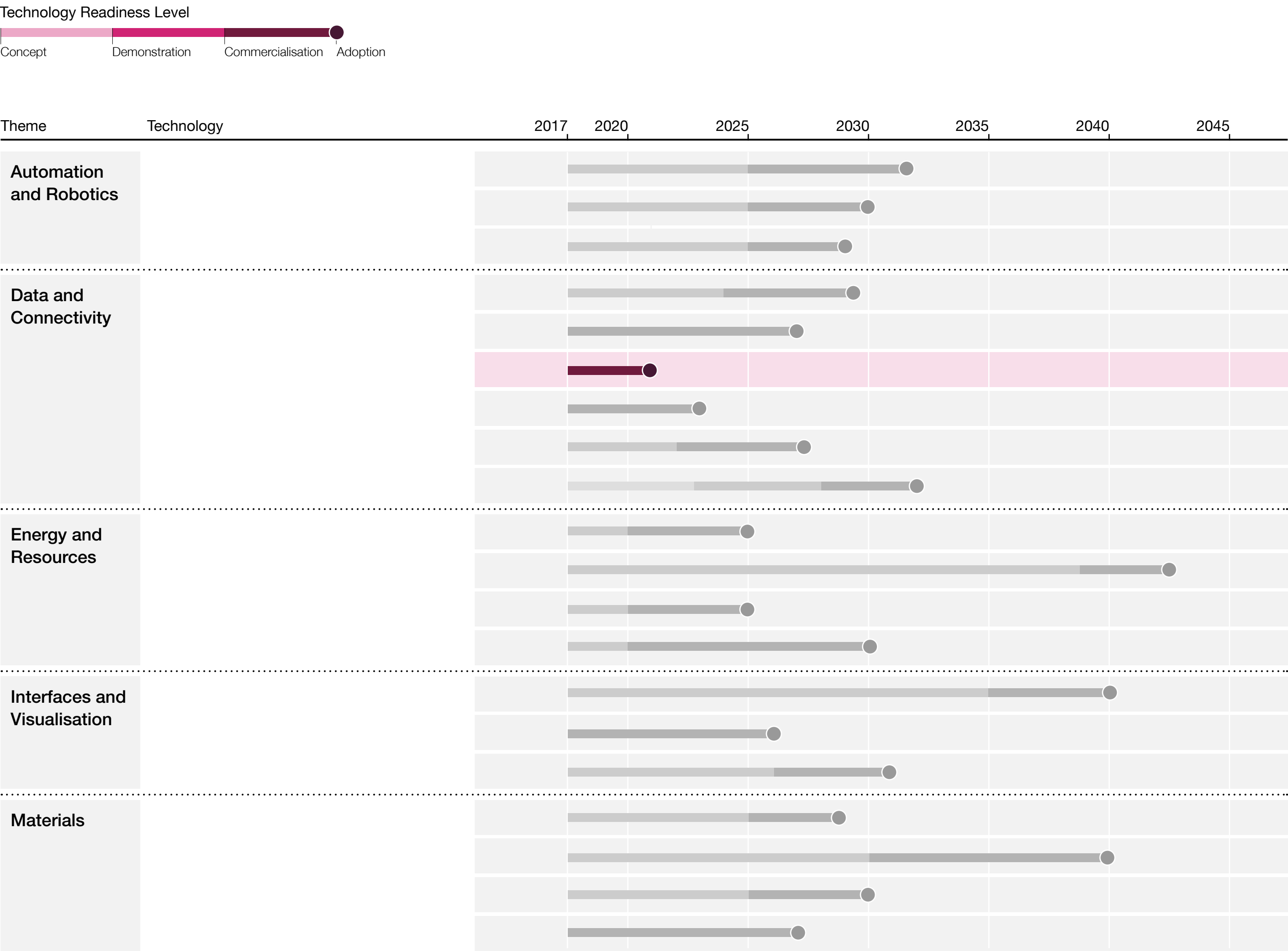
Case Study

FOAM is a prototype demand-driven marketplace that connects investors to a physical asset. Built with blockchain and smart contracts on Ethereum – the second most popular cryptocurrency after Bitcoin – this platform would allow fractional ownership of urban developments on a variety of scales from concept to built asset.

Links

- foam.space
- ibm.com
- joi.ito.com
- medium.com
- uk.reuters.com

Timeline



Bluetooth 5.0

Definition

By 2021 there will be nearly 48 billion connected devices worldwide, and Bluetooth 5.0 is the wireless connection standard through which many of these devices will communicate. Offering an 800% increase in data broadcasting capacity, Bluetooth 5.0 doubles the speed and quadruples the range of its predecessor, while its power consumption remains very low. The technology is expected to underpin the consumer adoption of the Internet of Things, support industrial automation, and pave the way for the proliferation of dense sensor networks (see Smart Dust).

Relevance

Bluetooth 5.0 will improve the ability of sensors to exchange data, helping the industry to better monitor everything from noise volumes on construction projects to ongoing corrosion levels. Its increased range – from single room to whole building coverage – will support the improved performance and incorporation of smart devices in both the home and the workplace, helping to enhance building and system efficiency.

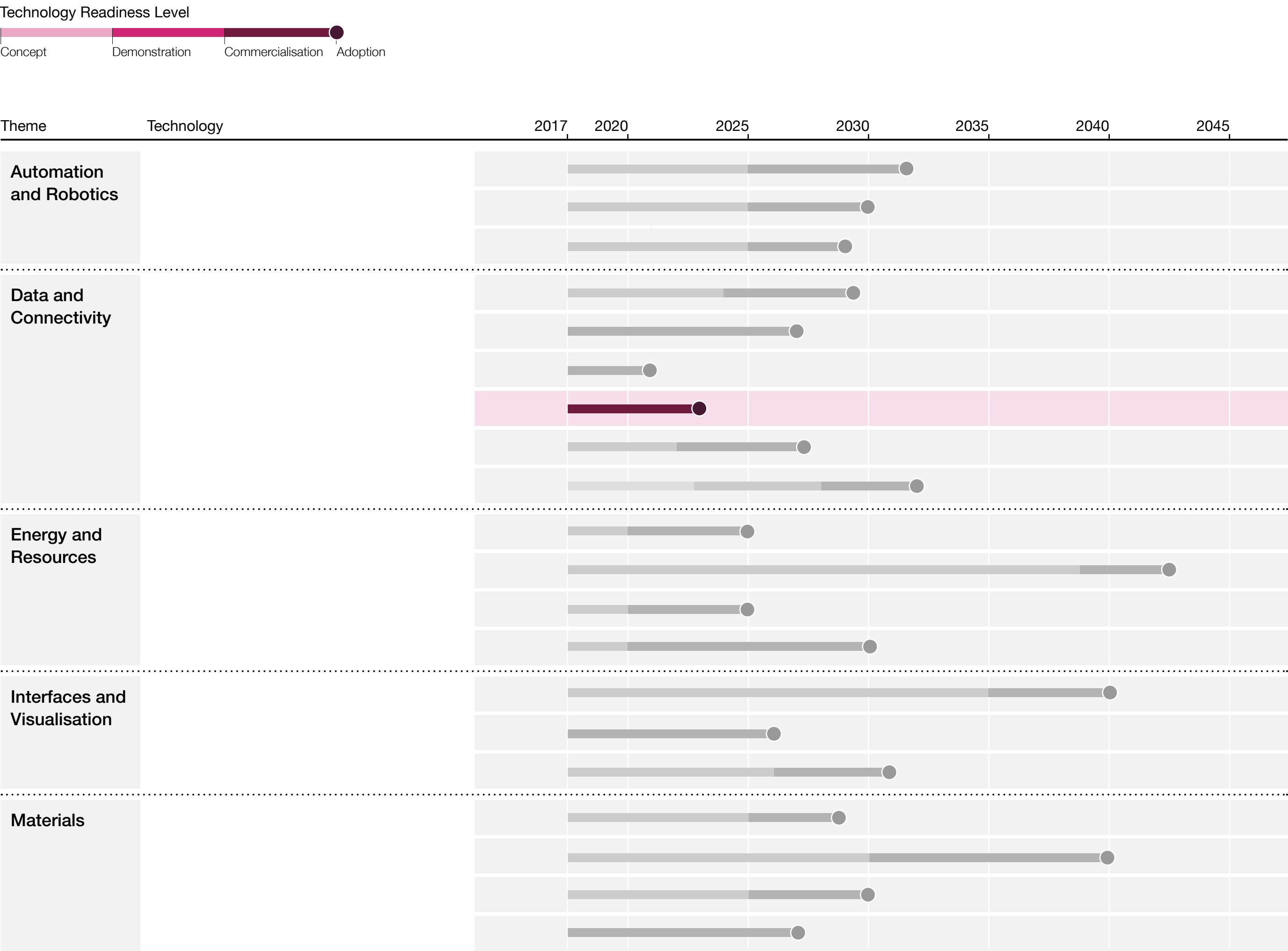
Case Study

An ongoing study by Propeller Health in Louisville, Kentucky, uses Bluetooth-enabled asthma inhalers to generate a living map of the city’s air quality. The anonymised data on inhaler use is then used by health professionals and city planners to inform medical treatment and air pollution reduction strategies.

Links

- bluetooth.com
- engadget.com
- inspire.driversofchange.com
- luxinsights.com
- readwrite.com
- t3.com
- telegraph.co.uk

Timeline



Li-Fi

Definition

Light fidelity or Li-Fi is a form of Visible Light Communication (VLC) that uses LED lighting to provide local wireless communications at very high speeds via the visible light portion of the electromagnetic spectrum. The visible light spectrum is 10,000 times larger than the radio waves used for conventional Wi-Fi. It is estimated that the technology could achieve internet speeds of up to 224GB per second, far faster than standard Wi-Fi. As light cannot pass through walls, it makes the transfer of data more secure than conventional Wi-Fi. This also ensures that there is less interference between multiple devices.

Relevance

Li-Fi could allow for a much greater take up of the Internet of Things, unlocking new opportunities for businesses, industries and cities. Retailers, for example, could transmit data to multiple customers’ mobile devices quickly and securely. Other applications could be found in transportation (traffic management, vehicle-to-vehicle communications and in-flight connectivity), hospitals (medical instruments) and in urban environments (free connectivity at specified access points to provide internet, audio and video streaming).

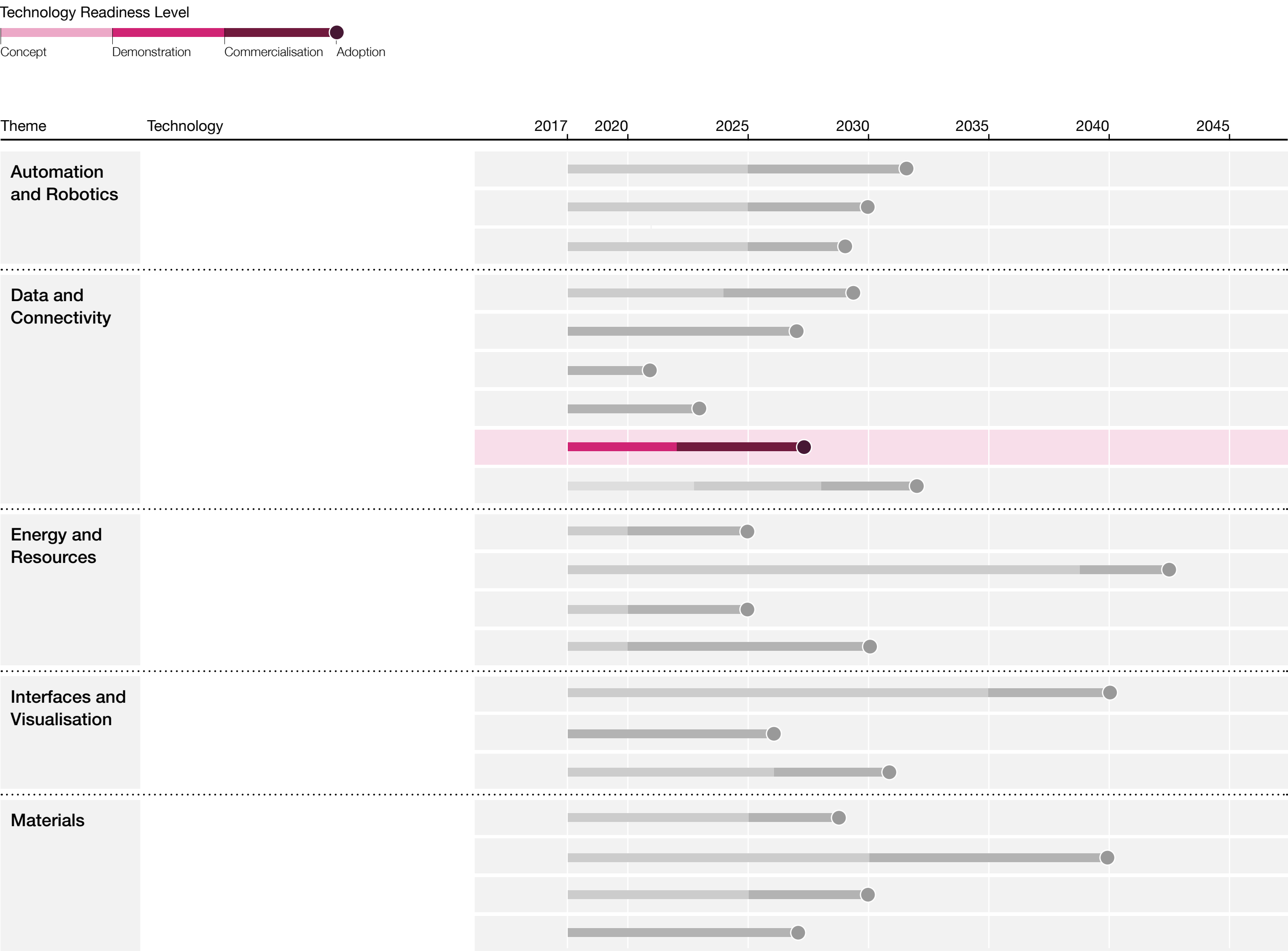
Case Study

Estonian tech company Velmenni develops smart lighting solutions for workplace environments that provide users with access to the internet through light. The company has trialled Li-Fi in both an office and an industrial site in Tallinn, reporting that they have achieved data transmission speeds of 1GB per second.

Links

- bbc.co.uk
- sciencealert.com
- swemorph.com
- techworld.com
- youtu.be

Timeline



Quantum Computing

Definition

Quantum computing uses subatomic particles to store information. As subatomic particles can exist in more than one state simultaneously, quantum computers have a processing power many times faster than classical computers based on binary logic. Quantum processors operate in a super-cooled, high-vacuum environment, and future widespread access is likely to be facilitated through cloud services. The huge increase in computational power, energy-efficiency and speed offered by quantum computing promises to have a significant impact on data-rich or digital-intensive industries, including financial services, logistics and healthcare.

Relevance

Complex problems and geometries will become easier to calculate through the use of quantum computing, opening up new possibilities for design and construction. By supporting the development of more advanced artificial intelligence with machine leaning, quantum computing could also underpin the next generation of transport or logistics automation and remote sensor management. In addition, the technology could help to tackle complex construction challenges, including logistics, risk management and the modelling of innovative new materials and structures.

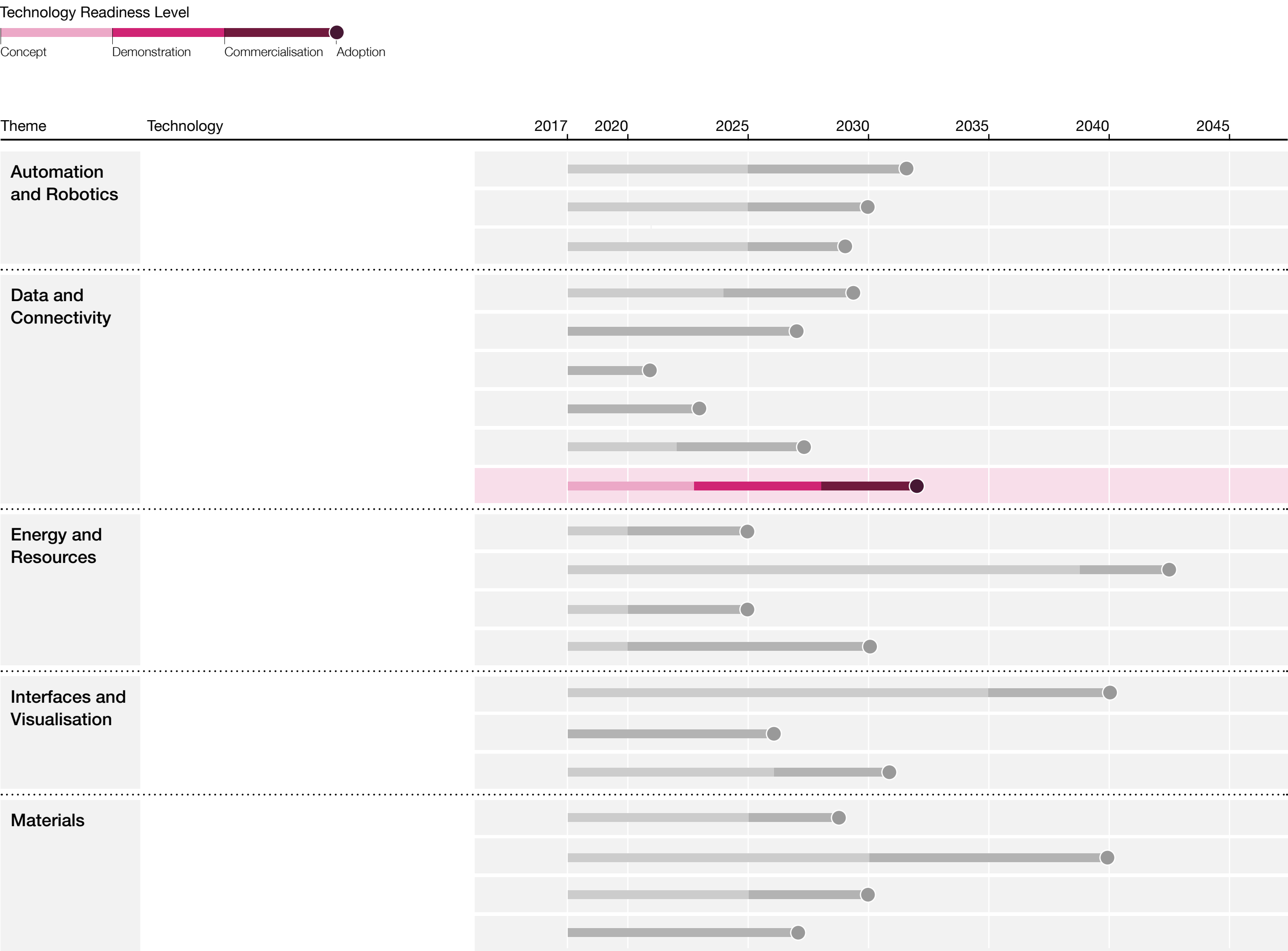
Case Study

Lockheed Martin, one of the largest defence contractors in the world, has an ongoing relationship with quantum computing developer D-Wave. Its 1152-qubit D-Wave 2X will help to verify and validate aeronautics systems, design lifesaving drugs and debug millions of lines of code.

Links

- [dwavesys.com](#)
- [link.springer.com](#)
- [nature.com](#)

Timeline



Smart Dust

Definition

Smart dust will enable the wireless, real-time collection of data via miniaturised low-power sensors, transforming our understanding of structures, systems and the environment. An evolution of wireless sensor networks, the advent of smart dust will see the distribution of billions or trillions of devices, each capable of transmitting specific feedback, including data on vibrations, sound, temperature, pressure or chemistry. Powered by battery or kinetic energy and measuring just one cubic millimetre, smart dust could be deployed across vast or hard-to-reach areas, monitoring water use in agriculture, mechanical performance in factories or even neural activity inside the human brain.

Relevance

Used as a new instrument for survey work and quality control of sites and construction programmes, smart dust would allow continuous real-time monitoring of projects and structures. In addition, environmental monitoring via smart dust would inform new approaches to urban resilience, while wireless seismometers spread over large areas could give advanced warning of earthquakes.

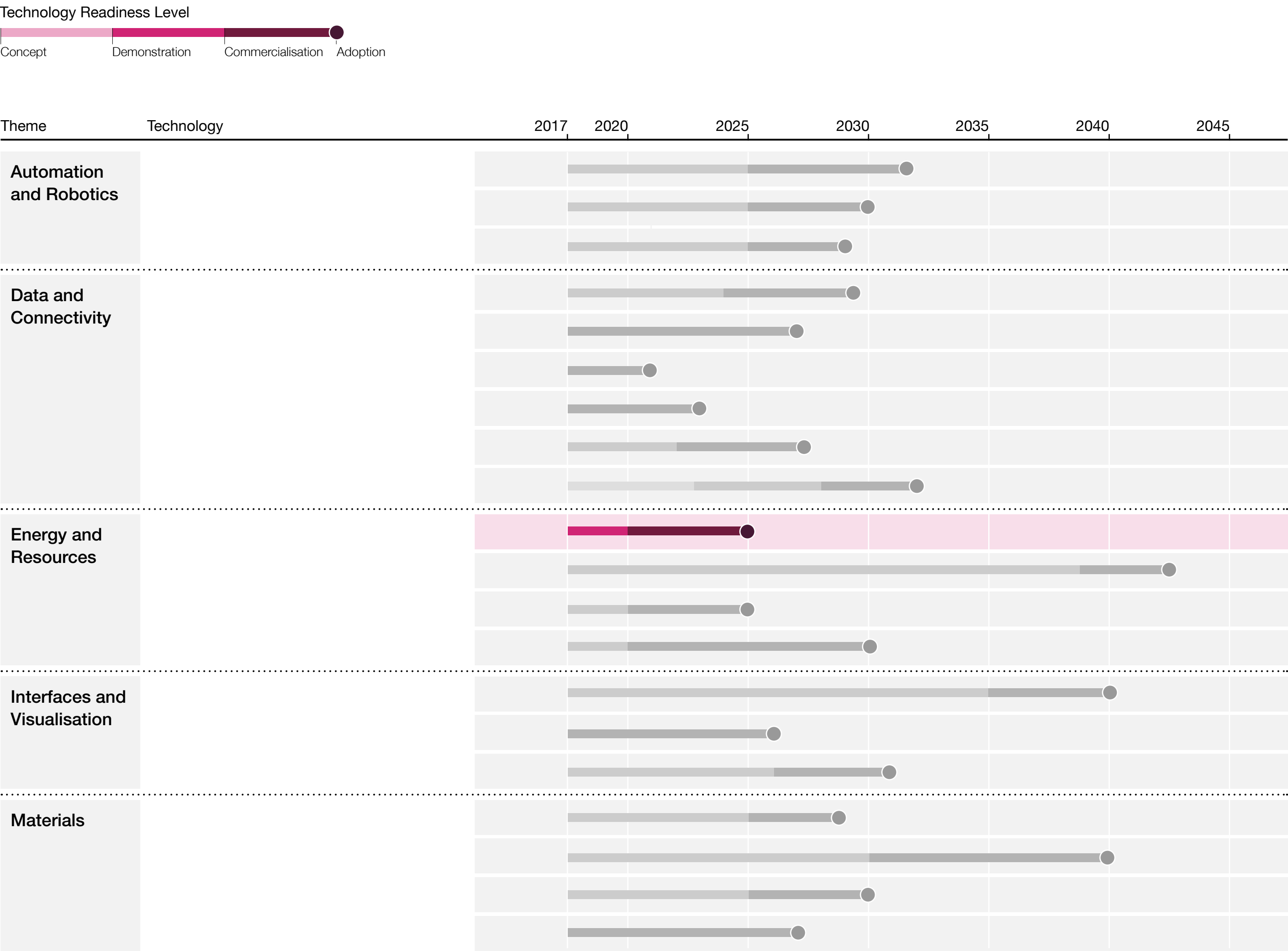
Case Study

HP Labs’ Central Nervous System for the Earth (CeNSE) is researching the development of a global sensing network using billions of nanoscale sensors. The data gathered on environmental, biological and structural changes could help to improve the efficiency of global resource use. The programme is currently working with sensors embedded within buildings and bridges in order to extend their lifespan.

Links

- edition.cnn.com
- newengineeringjournal.in
- forbes.com
- theengineer.co.uk

Timeline



Foam Batteries

Definition

Conventional battery surfaces are typically two-dimensional (2D), which limits the speed and direction in which energy can flow. As a result they can take a long time to charge, lose energy quickly and need to be replaced often. The unique 3D architecture of foam batteries however, would allow for increased energy and power density by using high surface-area substrates such as copper or carbon foam together with thin film electrodes. 3D foam batteries promise to be cost effective to manufacture, faster to charge, smaller and more lightweight, as well as being safer and less toxic than traditional 2D batteries.

Relevance

3D foam batteries could lead to entirely new energy storage applications on account of being flexible, lightweight and available in an almost limitless variety of physical shapes. Over time, the technology could develop to provide energy storage solutions for building- or grid-scale use, and for new applications in consumer electronics, transportation and industry.

Case Study

Prieto Battery, a startup backed by Colorado State University, has developed what it claims is the world’s first 3D solid-state battery that can hold and discharge power. The approach tackles the slow diffusion of lithium-ions that constrains conventional 2D battery design by using a copper foam substrate. The copper foam increases the internal surface area six-fold, reducing the distance that ions need to travel. The foam is electroplated with copper antimonide (the anode), while the cathode takes the form of black ‘slurry’ coating. This approach is expected to result in power densities of up to 14,000 W/L, and energy densities of 650 Wh/L. As well holding more power and charging more quickly, the use of low-cost materials makes it cheaper to produce than conventional batteries. The company is continuing to research and refine its battery design, and is collaborating with Intel to bring the battery to market.

Links

- energyharvestingjournal.com
- technologyreview.com
- magazine.colostate.edu

Timeline



Fusion Reactors

Definition

Fusion is the process by which a gas is heated up and separated into its ions and electrons. When the ions get hot enough, they can overcome their mutual repulsion and collide, fusing together. This ‘fusion’ releases massive amounts of energy – about one million times more powerful than a chemical reaction, and 3-4 times more powerful than a fission reaction. Fusion reactors have the potential to provide safe, clean energy with no long-lasting radioactive waste, helping to pave the way for a future without fossil fuels.

Relevance

Fusion power could revolutionise established models of energy generation and distribution. The vast amount of energy which could be produced by fusion reactors would transform the transport landscape and other energy-intensive industries, but would also power increased material consumption and resource use. This in turn would lead to new challenges for the built environment and new climate change mitigation strategies.

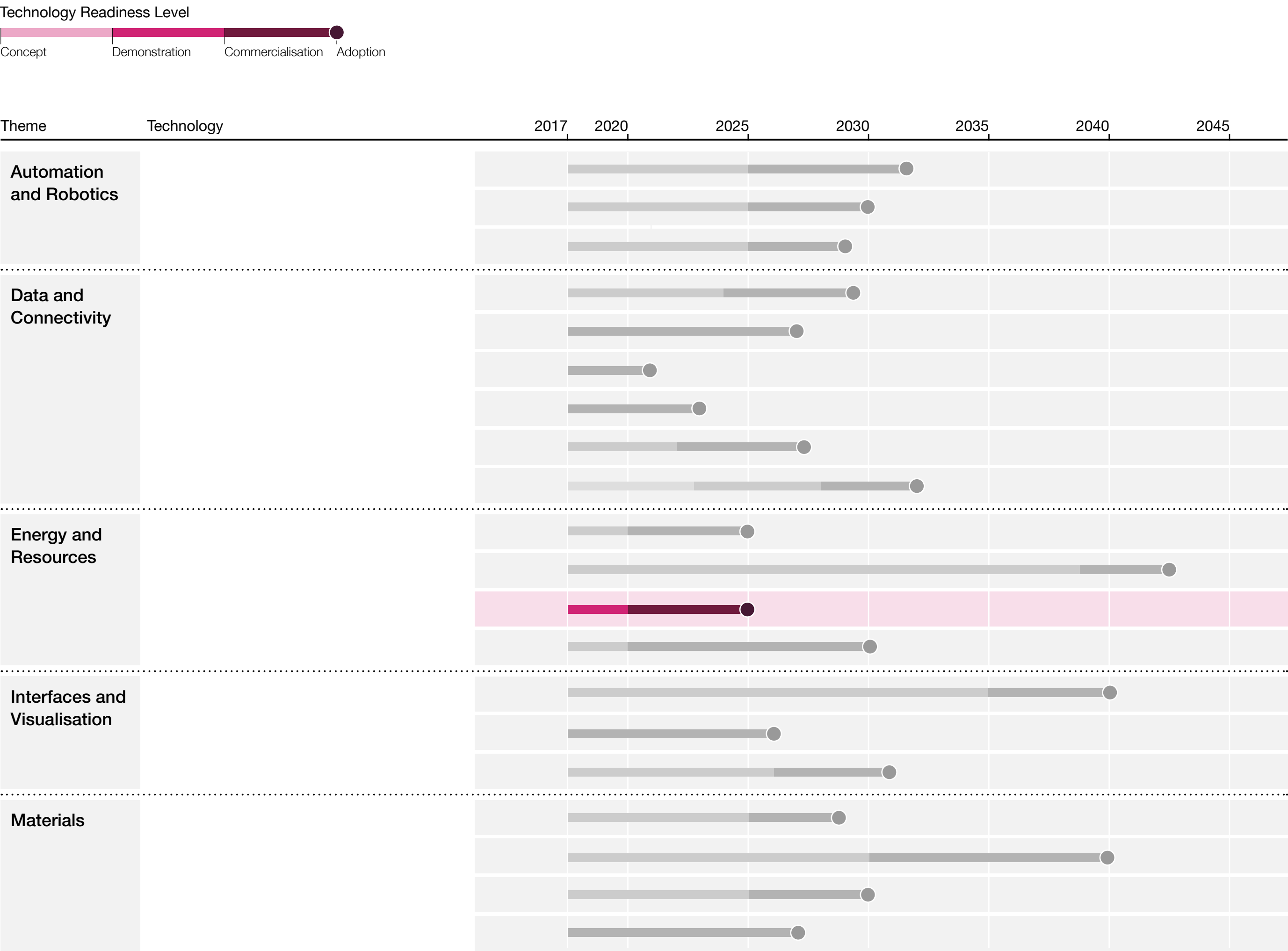
Case Study

Lockheed Martin’s Compact Fusion concept proposes the use of magnetic field pressure to make a fusion reactor that is 10-times smaller than other prototypes. By creating a magnetic ‘bottle’ capable of handling extremely high temperatures, the contained fusion reaction could be released as heat energy. This could then replace conventional combustion chambers in turbine generators, for example, which in turn could produce electricity or propulsive power for a number of applications.

Links

- fusionforenergy.europa.eu
- lockheedmartin.co.uk
- sciencealert.com
- thoughts.arup.com
- youtu.be
- youtu.be

Timeline



Transparent Solar Panels

Definition

Transparent solar panels use organic salts to absorb light wavelengths that are invisible to the human eye. This enables the panels to be fully transparent, compared to the current generation of translucent photovoltaics, and as such could replace conventional window glass. Although the cost of manufacturing remains high and the energy output is still limited, their potential widespread application is attracting both scientists and investors.

Relevance

The main obstacle to the increased use of conventional photovoltaic panels is their appearance. Transparent panels, however, have the potential for mass adoption and could transform any surface into an energy harvesting system. Their clear appearance provides designers and engineers with a huge range of potential applications from tall buildings to acoustic barriers.

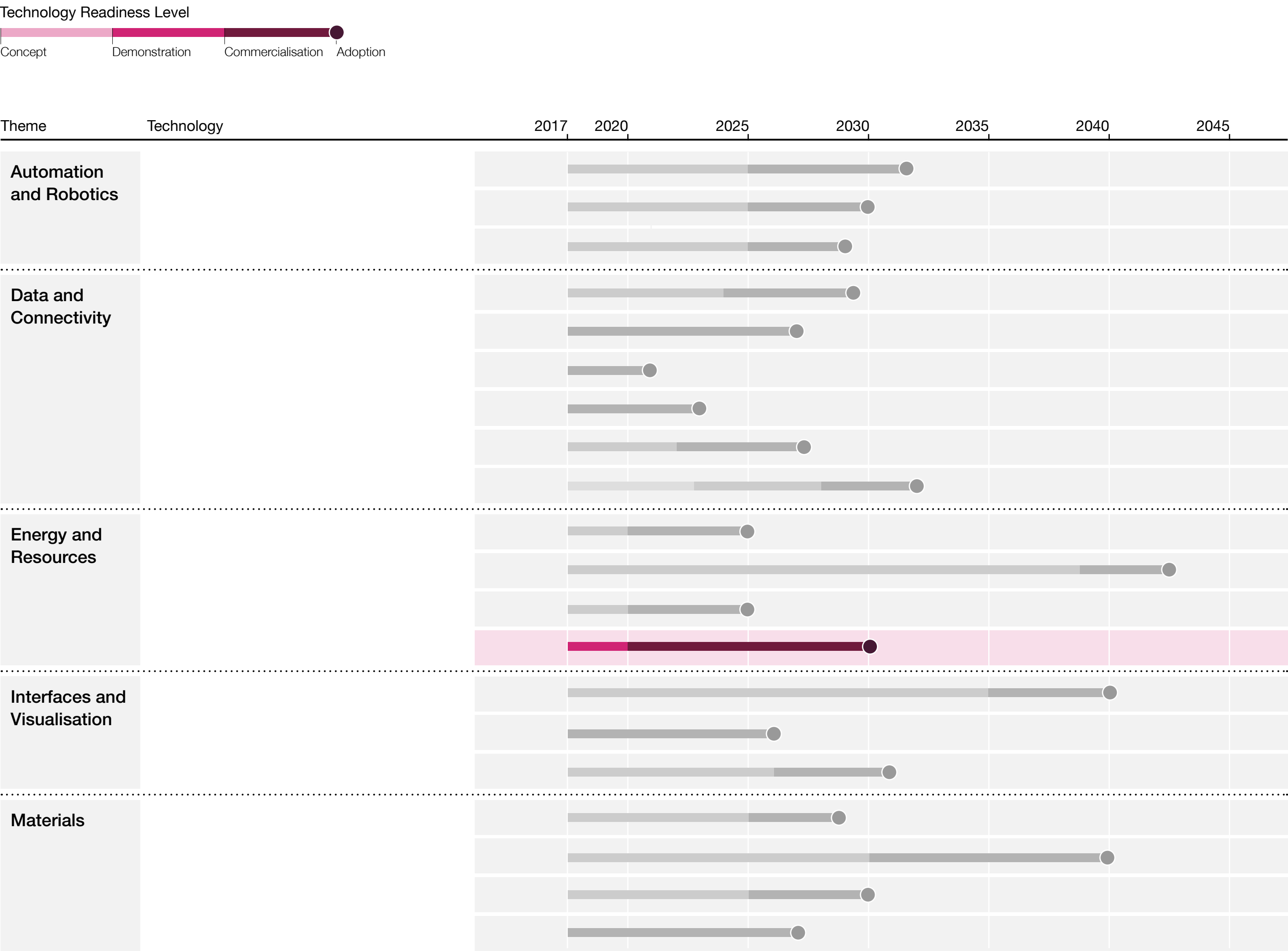
Case Study

The MIT start-up Ubiquitous Energy has created a truly transparent solar panel. The transparent luminescent solar concentrator (TLSC) absorbs ultraviolet and infrared wavelengths to produce energy. Although the prototype can only achieve a 1% efficiency rate, it is anticipated that the design could achieve up to 5% efficiency, comparable to the 7% achieved by semi-transparent panels.

Links

- digitaltrends.com
- energy.mit.edu
- extremetech.com
- wired.co.uk
- zmescience.com

Timeline



Pollution Digesters

Definition

Incorporated into the urban fabric, pollutant digesters are capable of removing, filtering or transforming harmful airborne contaminants in order to improve air quality. Various different approaches have been developed to achieve this, including large-scale air ionizers and photocatalytically active substances. If used within building facades, hard surfaces or installed as standalone mechanisms across the city, these could help combat air pollution on an urban scale. There is a growing political interest in initiatives to tackle air pollution, with global air quality targets set for 2030 and 2050 helping to boost the innovation and adoption of high impact technologies.

Relevance

The dangers of urban air pollution are increasingly apparent. With growing levels of urbanisation globally, the reduction and removal of airborne pollutants is becoming a critical challenge for national governments and city authorities. Designers and engineers will need to have an awareness of the role that pollutant digesters could play in improving air quality and human health, and help to overcome associated cost and design challenges.

Case Study

Added during concrete manufacture, Photoment can turn large areas of concrete paving into surfaces that actively reduce the amount of airborne pollutants. The powder-like substance is photocatalytically active and reacts with sunlight to break down toxic airborne nitrous oxide (NOx) into non-toxic nitrates (NO3). The small quantity of nitrates produced poses no threat to the environment or human health, and is easily washed away by rain.

Links

- [airocide.com](#)
- [eea.europa.eu](#)
- [kickstarter.com](#)
- [photoment.com](#)
- [spinoff.nasa.gov](#)
- [theguardian.com](#)
- [youtube.com](#)

Timeline



Deep Mapping

Definition

Deep mapping is the layering of multiple types of geo-tagged data within a GIS environment. Data is compiled from multiple sources, including remote sensor networks, aerial and satellite imagery, active and passive crowd-sourcing, smartphones and on-site mapping vehicles. The localised data sits ‘behind’ the map, showing a range of information including driving restrictions, air quality, light and noise levels or pedestrian activity. A form of integrated cross-platform surveillance, deep mapping relies on the accurate integration and visualisation of the data to provide a far richer understanding of places and structures.

Relevance

With its synthesis of various datasets – for example BIM or sensor data – into a single interface, deep mapping will support integrated design approaches and enhance visual analysis. The layering of information, both historic and real-time, will also improve decision-making, helping to reduce construction and maintenance costs.

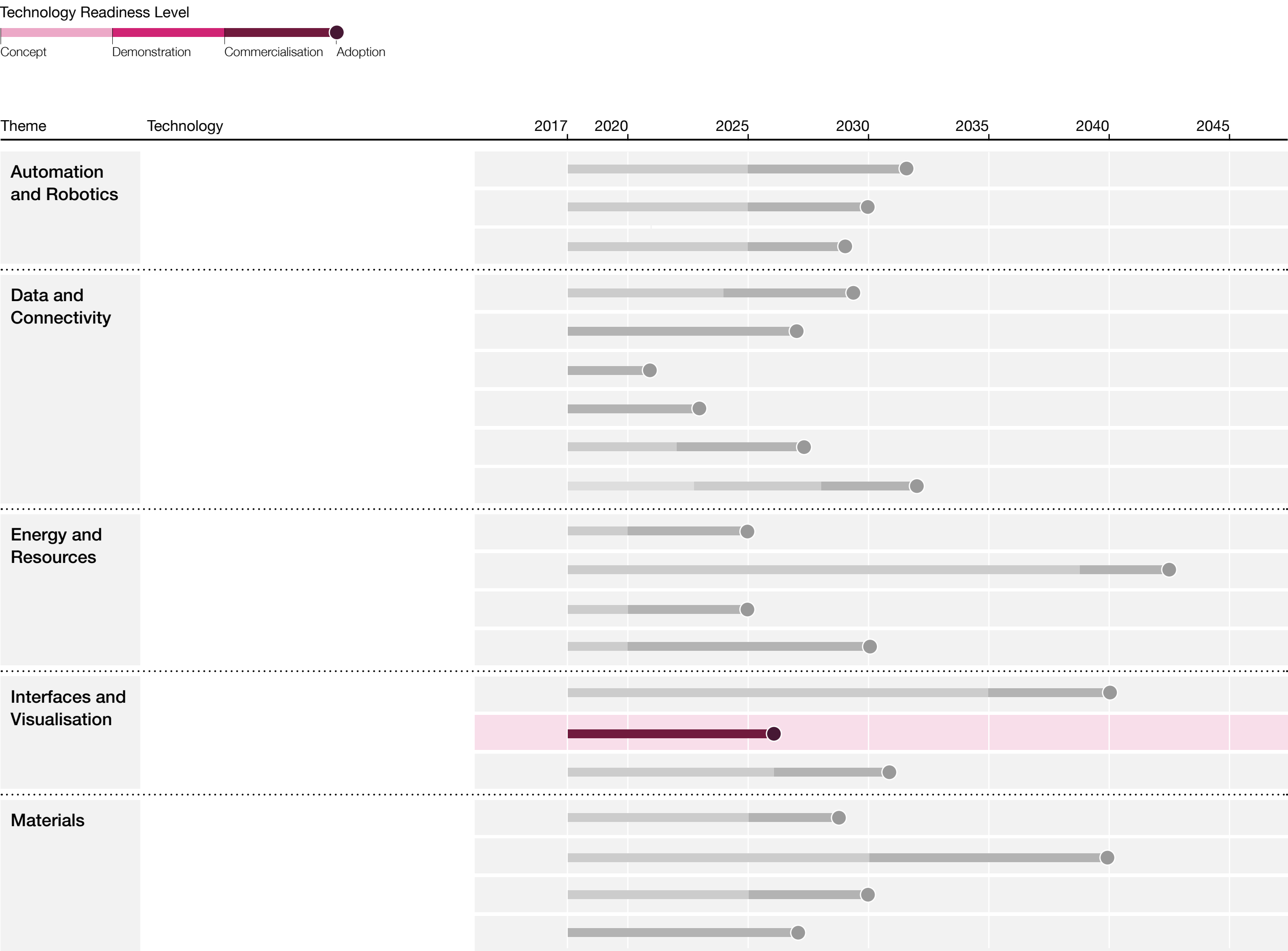
Case Study

Google’s Ground Truth data acquisition project combines aerial and satellite imagery with data collected via its fleet of Street View cars and its other sources of data. The mapping process begins with extracting information available at the street level, including street numbers, local business names, traffic restrictions, building dimensions and photographs. These geo-tagged datasets are then combined and merged with satellite images, crowd-sourced and open source geo-tagged data to generate a virtual replica of the mapped areas.

Links

- google.com
- venturebeat.com
- wired.com

Timeline



Mixed Reality

Definition

Mixed reality is the integration of digital information into a real-world environment, allowing live interaction and feedback. Unlike the complete immersion provided by virtual reality, or the overlaying of content onto the real world achieved by augmented reality, mixed reality uses transparent lenses to make virtual objects both appear and interact with real ones. This ‘hybrid reality’ is made possible by advances in sensors, eye tracking, spatialised sound, optics and mobile network capacity (see 5G Mobile Internet). The integration of haptic technology will also provide virtual objects with a realistic sense of touch. As well as underpinning new computing interfaces, mixed reality promises to transform how people access information, share experiences and provide feedback.

Relevance

An inherently spatial technology, mixed reality will drastically impact design, construction and maintenance of projects across all sectors. New tools and interfaces will overlay images and information, for example BIM, onto building facades or construction sites. This will allow on-site evaluation and real-time design variation, reducing inefficiency and costs.

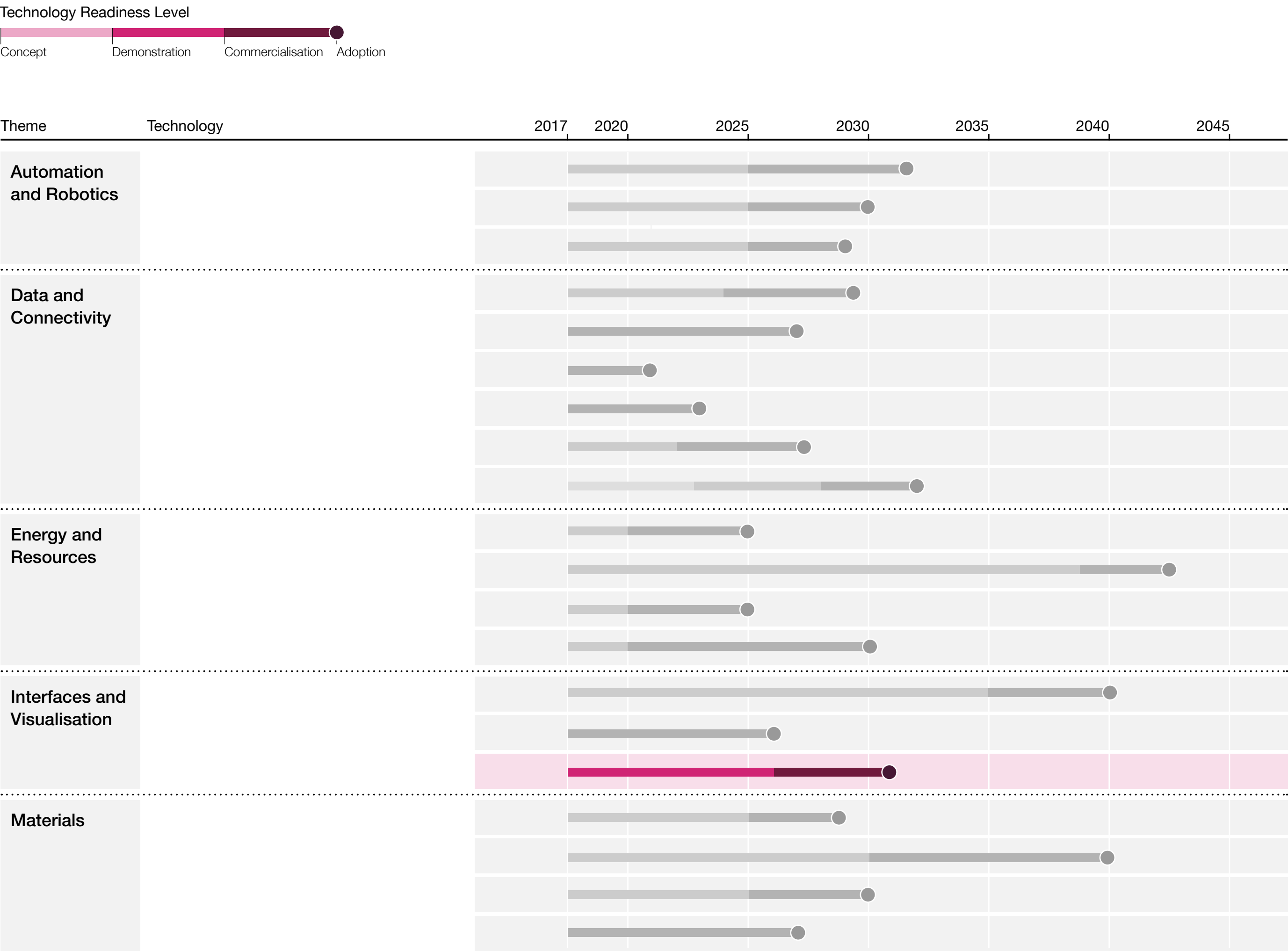
Case Study

Microsoft’s HoloLens is a head-mounted display unit that allows users to view and interact with scalable, photorealistic and responsive 3D holograms overlaid on the user’s visual field. US construction firm Gilbane is using HoloLens to inspect 3D renderings of site plans to identify potential design issues prior to construction.

Links

- engadget.com
- microsoft.com
- technologyreview.com
- tekla.com
- theguardian.com

Timeline



Multi-Sensory Interfaces

Definition

Multi-sensory interfaces enable communication between humans and machines through physical gesture and speech. They are set to replace conventional computer control systems by allowing humans to interact with digital interfaces using eye movement or movement generated by our hands and fingers. Conversational interfaces are also being enhanced to combine voice recognition and natural language cognition to create more effective speech-driven interfaces. These pave the way for real-time cross-language communications (see also Augmented Intelligence). Current constraints include limited processing power, complex input methods and comprehensive joint and movement recognition.

Relevance

Developments in digitally-enhanced environments (see Mixed Reality) will require a new generation of user interfaces and experiences. Multi-sensory interfaces will form a key part of this, fundamentally altering our experience of human-machine communication. In the near term, these changes will influence design tools and experiential interfaces, with the potential to affect design processes, and construction or building operations.

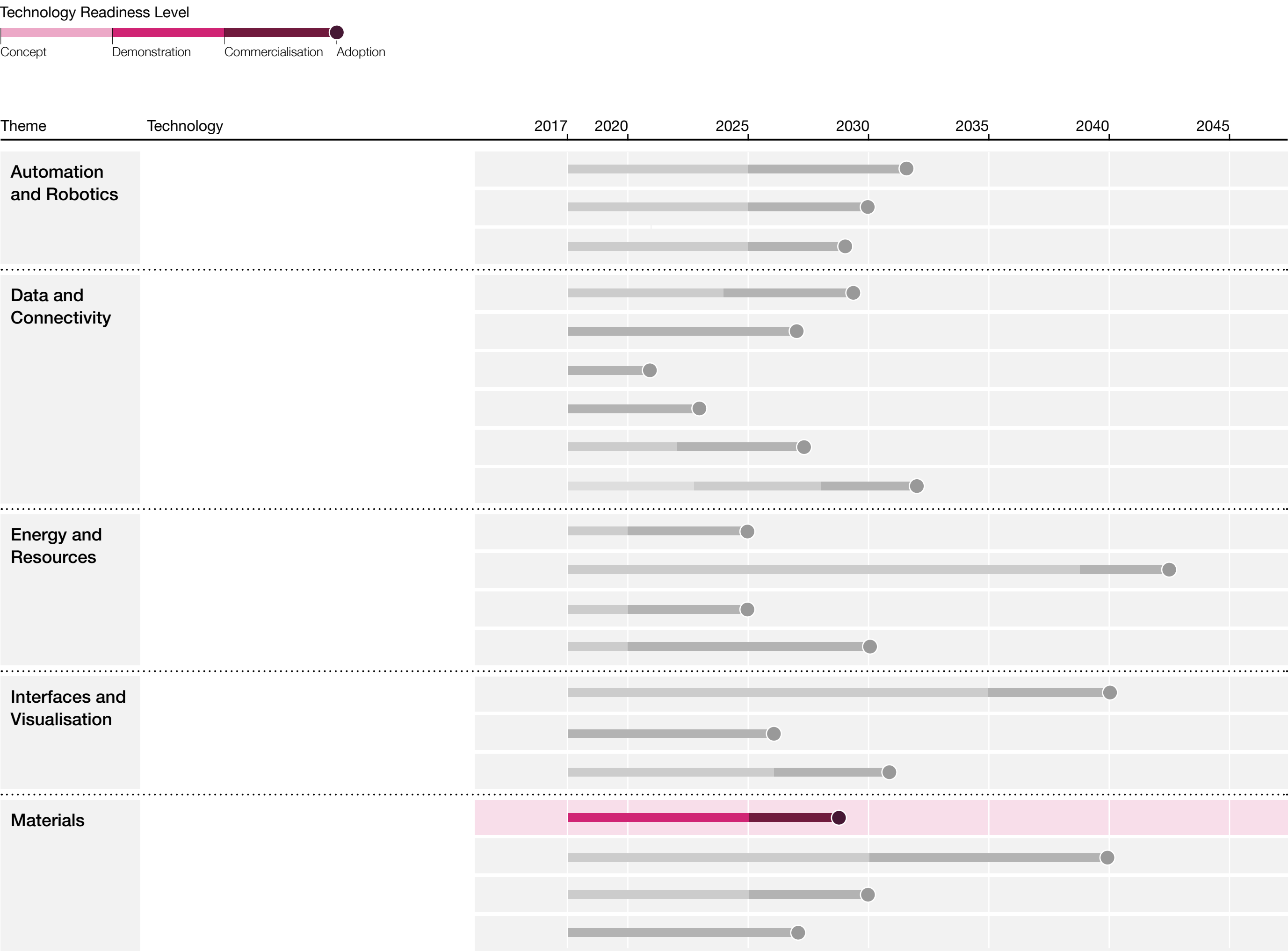
Case Study

A patent filed by Samsung in South Korea details a blink-detecting contact lens, equipped with a display, camera, antenna and movement sensors. If realised, this lens could transform how humans interact with virtual and augmented environments. By projecting an image directly onto the retina, the technology could achieve higher resolution while minimising physical impact.

Links

- bloomberg.com
- engadget.com
- fastcodesign.com
- sammobile.com
- sciencedirect.com
- techcrunch.com
- technologyreview.com
- techrepublic.com

Timeline



Nanomaterials

Definition

Nanomaterials are a group of materials defined as being smaller than 100 nanometres in any of their dimensions and include nanotubes, quantum dots, aerogels and graphene. As well as strength and conductivity, they have been shown to demonstrate a huge range of useful properties including self-lubrication, creep resistance and self-organisation. Nanomaterials need to be used in composition with other materials in order to be applied. Flexible, incredibly strong and ultra-lightweight, Graphene is composed of a two-dimensional hexagonal lattice of carbon atoms. It works as an excellent thermal and electrical conductor, and can act as a barrier with liquids or gases unable to pass through.

Relevance

There are many potential use cases for nanomaterials in the built environment due to their inherent strength, light weight and insulating properties. Additional applications under development include corrosion-free steel, low-energy LEDs and ultra-thin PV cells. Applied as a membrane, nanomaterials such as graphene could also underpin the next generation of water purification technology, improving access to clean drinking water globally.

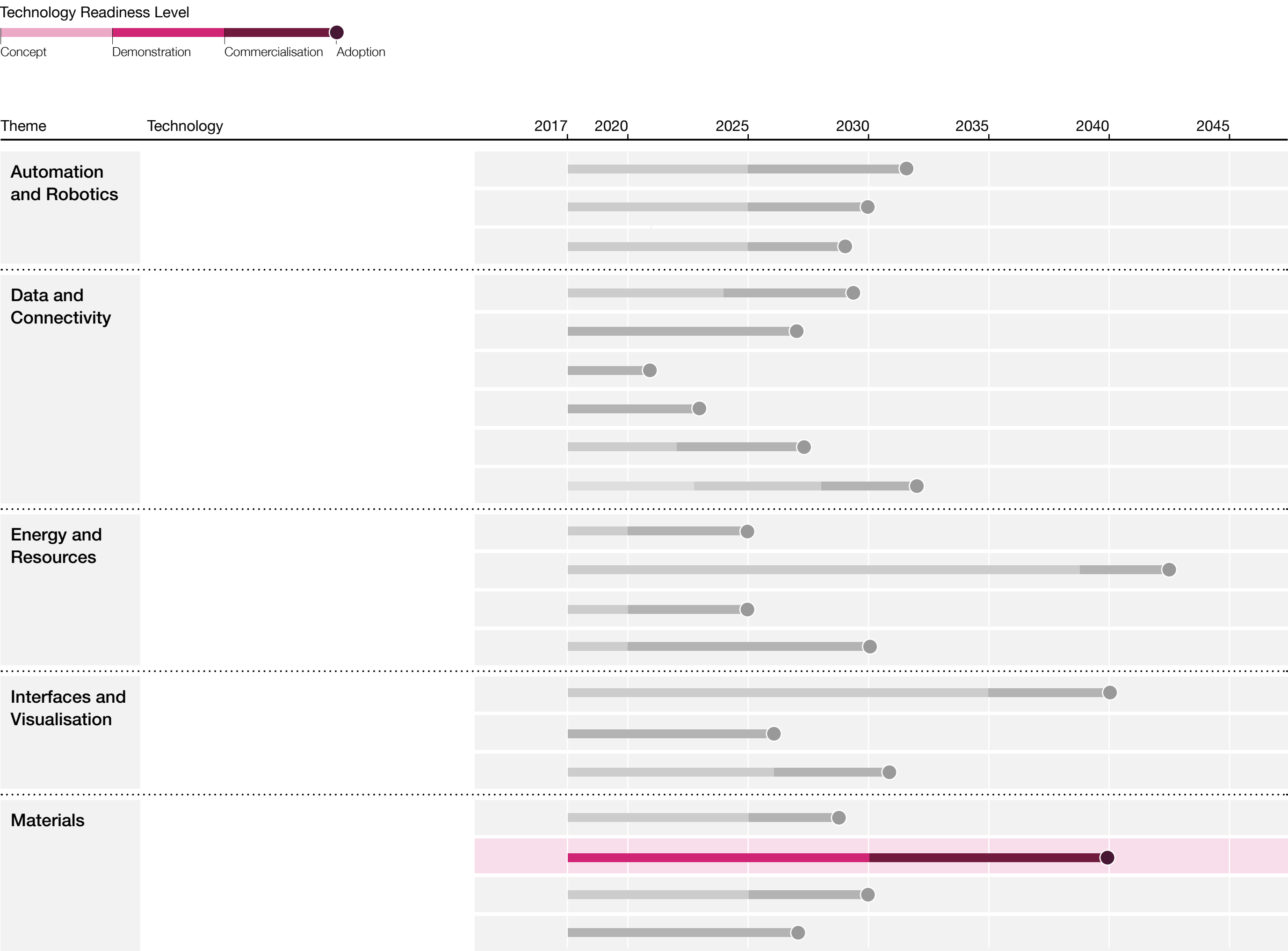
Case Study

Zenyatta, a mineral exploration company, has partnered with concrete producer Larisplast to develop graphene-infused concrete. As well as preventing premature failure, anticipated benefits include faster curing times, improved mechanical performance with smaller volumes, and the ability to withstand large forces, for example during earthquakes.

Links

- bbc.co.uk
- cobaltrecruitment.com
- constructionmanagemagazine.com
- constructionmanagemagazine.com
- graphene.manchester.ac.uk
- nature.com
- research.arup.com
- theguardian.com
- ultrawire.eu

Timeline



High Performance Materials

Definition

A range of high performance materials are being actively evolved, driven by application-specific demand. Generally, high performance materials maintain their essential properties while providing additional capabilities such as enhanced durability, lightness, strength, tensility, conductivity, insulation, roughness, or resistance to high radiation and temperatures. Examples include titanium foam and transparent wood.

Relevance

High performance materials offer enhanced properties that help to improve performance in specific contexts. In recent years industry has had some success in developing advanced performance materials, including in the construction sector. For example, high performance materials are driving new opportunities for insulation with products including aerogel and vacuum insulation panels offering improved applications. Other sectors using such materials include aerospace, automotive and the nuclear industry.

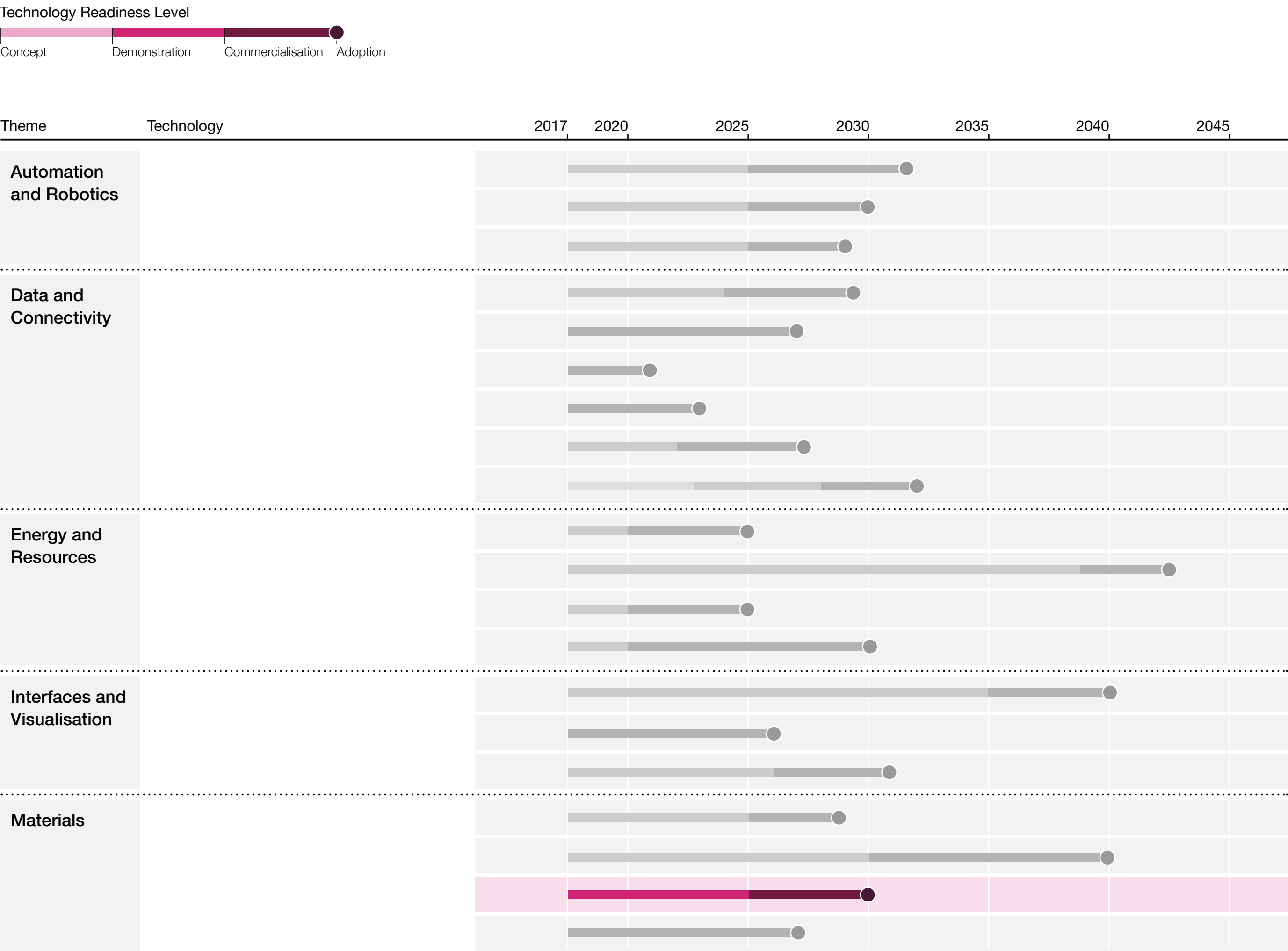
Case Study

Developed by Cabot, ThermalWrap uses aerogel particles as part of flexible nonwoven fabric with highly insulating properties. These aerogel blankets are ultra-thin and can be easily cut and shaped for insulating buildings. They can also transmit and diffuse light while being water-repellent and low-dusting.

Links

- architizer.com
- cabotcorp.com
- saint-gobain.com
- sciencealert.com
- sciencenewsforstudents.org
- scitechdaily.com
- vacuum-panels.co.uk

Timeline



Programmable Materials

Definition

Programmable materials are materials that are formed and pre-programmed to transform into engineered geometries. In essence, physical objects are able to change their shape due to a combination of specific material properties, the programmed geometry, and a change in their environment, for example temperature, moisture or movement.

Relevance

Applications of programmable materials spread across infrastructure, production lines, construction and asset operation. In the near term, engineers will be able to design new operational behaviour for products, and improve the efficiency of assembly processes. Advances in the scale and complexity of our ability to program materials could eventually support a new generation of structures that respond dynamically and automatically to their environment.

Case Study

A project developed by the Self-Assembly Lab at MIT is using shape-shifting carbon fibre in a racing car spoiler. The spoiler reacts to environmental change, morphing into its most efficient shape and improving the car’s aerodynamic performance.

Links

- selfassemblylab.net
- smithsonianmag.com
- wired.com

Timeline



Bio-based Materials

Definition

Bio-based materials contain substances derived from plant-based or other renewable sources and include bioplastics, bioconcrete and resin-free biofabricated wood. With their reduced environmental impact these materials have a broad range of future applications, for example those currently dominated by fossil-based plastics. The market for bio-based materials is expected to grow by around 300% over the next four years. Obstacles to the large-scale adoption of bio-materials in the building industry include limited strength and vulnerability to fire.

Relevance

With increasingly ambitious carbon reduction targets and a growing interest in the use of organic waste as a resource, bio-based solutions could provide a valuable and sustainable alternative to conventional materials. Already a significant trend in the packaging and furniture industries, the building sector will soon be affected through tighter environmental legislation. Likewise, growth in the circular economy and greater awareness among designers and engineers will help to accelerate innovation and the practical adoption of bio-based building materials.

Case Study

Designed by The Living architecture studio, Hy-Fi was a 13m-high cluster of towers built from 10,000 compostable bricks and installed in summer 2014. The zero-carbon bricks were created from corn stalks and mushroom mycelium, and coated with a light-refracting film to naturally light up the interior of the towers. Once disassembled, the bricks were composted and the soil returned to local community gardens.

Links

- designboom.com
- ec.europa.eu
- lafargeholcim-foundation.org
- nytimes.com

About

The Technology Timeline 2017 showcases 20 emerging and future technologies with a high disruption potential for the engineering and construction sector.

While the scale and maturation rate at which technological change will happen is fraught with complexity and uncertainty, we can make some assumptions about the pace of change and likely impacts across the breadth of the sector. This analysis has enabled us to indicate what we might expect to see in the rapidly evolving realm of new technology.

This interactive report looks at the attributes and possible applications for each of the technologies identified. The timeline offers insight into likely timescales in terms of any given technology’s development, from concept through to commercialisation and adoption at scale, using the following technology readiness levels:

- 1. Concept
- 2. Demonstration
- 3. Commercialisation
- 4. Adoption

The aim of this project has been to enable a wide audience, both internally within Arup and externally, to consider what emergent technologies might start to impact our operating environment in the coming years and decades.

This report is a product of a collaboration between Arup Foresight, Research and Innovation, and subject matter experts across Arup. We would like to thank all contributors for their guidance and insight.

Foresight, Research and Innovation is Arup’s internal think-tank and consultancy which focuses on the future of the built environment and society at large. We help organisations understand trends, explore new ideas, and radically rethink the future of their businesses.

We developed the concept of ‘foresight by design’, which uses innovative design tools and techniques in order to bring new ideas to life, and to engage all stakeholders in meaningful conversations about change.

For more information, please email foresight@arup.com or visit driversofchange.com