wbcsd

Innovations that could shape and transform 2020-2030.

Vision 2050 issue brief

Contents

1 Context

In 2010, the World Business Council for Sustainable Development (WBCSD) released Vision 2050, a landmark piece of work that laid out a pathway to a world in which nine billion people are able to live well, within planetary boundaries, by mid-century.

In 2019, WBCSD decided to revisit Vision 2050 – not enough progress towards the Vision had been made, nor was there yet a clear route to bringing about transformation at the rate and scale required.

WBCSD has worked together with 40 member companies to reflect some of the great changes that have unfolded since 2010, to align the pathway with the Sustainable Development Goals (SDGs), and to prioritize the critical actions that business can take to unlock the progress required for the kinds for transformations that our Vision 2050 demands.

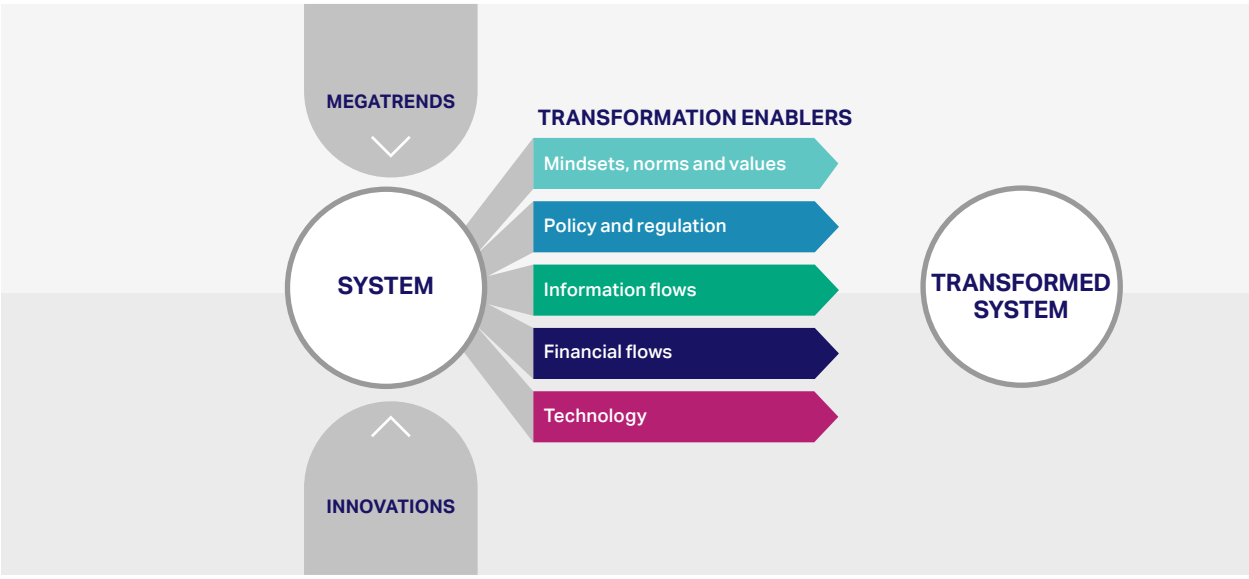
INNOVATION: AN ESSENTIAL INGREDIENT FOR SYSTEMS TRANSFORMATION

Achieving our Vision 2050 demands transformation – incremental impact reduction efforts will not bring about the shifts required if 9+ billion people are to live well, within planetary boundaries by mid-century.

But how to unlock transformation? We started by looking into the ways in which transformation takes place and the extent to which business can drive, rather than react to it.

Systems move from one state to another as a result of a combination of factors. Other than extreme shocks, (e.g. COVID-19) which can rapidly shift a system from one state to another, there are three key factors to systems transformation: macrotrends affecting a system's environment; new innovations that can influence the functioning, capabilities and outcomes of a system, and; enablers that oil transformation from one state to the next (e.g. behaviors, policies, finance). Our Vision 2050 issue brief on Unlocking Systems Transformation lays out a common framework and vocabulary for business, describing what a system is, what systems transformation is, and how systems transformation happens.

Figure 1: Megatrends, innovations and enablers combine to bring about transformation of systems



Building on this understanding of how systems transform, we have taken a closer look at the factors that will influence how the next 10 years unfold: the macrotrends, the disruptions and the innovations that will shape the decade to come. We understood that we needed to look beyond sustainability challenges – we needed to explore more generally how the world could change, what it would look like, and consider how that would affect business' ability to operate successfully (so that it could also operate sustainably). The COVID-19 pandemic forced us to revisit and recalibrate that outlook in light of the ways the pandemic could affect the trends.

Our analysis can be explored in our Vision 2050 issue briefs "Macrotrends & Disruptions shaping 2020-2030" and "The consequences of COVID-19 on the decade ahead".

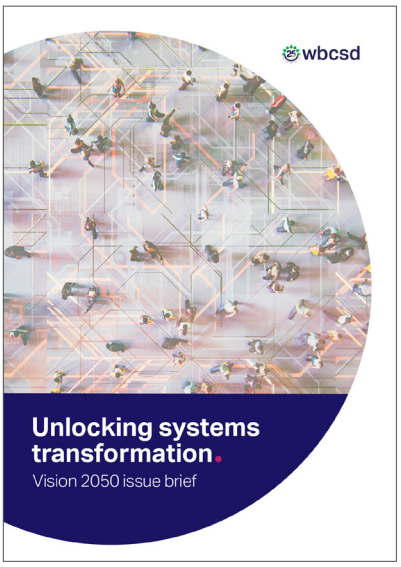
INNOVATION WILL SHAPE THE DECADE TO COME

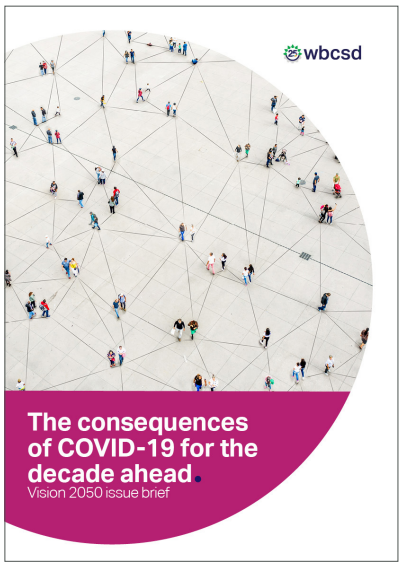
This issue brief "Innovations shaping 2020-2030" offers a high-level overview of the innovations that could influence the way in which the next 10 years unfold. It is intended to complement the our exploration of macrotrends, disruptions and COVID-19.

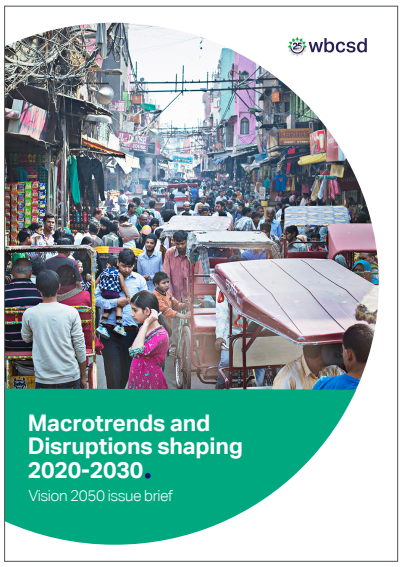
As with our work on macrotrends and disruptions, we have sought to take a step back from sustainability challenges, asking simply what innovations will shape the next decade, regardless of whether they support or hinder efforts for the world to become more sustainable.

We worked with the Zürich-based think tank W.I.R.E. to compile a list of business model shifts, emerging technologies and social innovations that could shape the next decade. In this issue brief you will find brief overviews of **5 business model shifts, 12 emerging technologies and 8 social innovations** that we feel could strongly influence the next 10 years.

As with any look into the future, caveats are required. This issue brief is not a forecast or a prediction, and neither is it complete – it's a highly condensed view and, inevitably, we will have missed relevant topics and/or local perspectives. Neither have we sought to highlight innovations emerging directly as a result of COVID-19 – the innovations that will shape the next decade were probably already sufficiently mature to have existed prior to the pandemic. This selection seeks to provide business with a useful range of influential innovations to factor into strategic plans, leveraging them to support and accelerate transformation towards our Vision 2050.







UNDERSTANDING THE FUTURE BY LOOKING AT THE PAST

> We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don't let yourself be lulled into inaction.
>
> **Bill Gates**

Certain innovations always seem to be on the verge of becoming reality. Flying cars have been on the verge of launch since the 1950s for instance. Over the last 10 years it's been the smart fridge, the folding touch screen and blockchain. Not all innovations will succeed, nor will we necessarily spot the ones that will successfully transform our world.

Transformative innovations are rarely the result of a single technology - more often they happen when multiple technologies and societal conditions align and combine to create something that changes the way we live. Clearly the world has changed enormously over the last 10 years. As the original Vision report was being released, internet connectivity was surpassing 2 billion users. But it was the convergence of numerous innovations and technologies, all reaching maturity just at the right time, that really unleashed the power of the internet as we know it today. The internet got into our pockets and went mobile, driving systemic cultural and market shifts, transforming the nature of news, transport, arts and entertainment, politics, commerce, advertising, holidays, friendship, dating and more all around the world. And, at the scale of billions, use and serendipity inevitably drives further innovation: transformational innovations have a cascading effect that is hard to imagine when they first enter society. Tablet computers (the iPad was launched in 2010) have gone from gimmicks to transformative devices that can now be found running bars and restaurants and helping pilots to fly across oceans and continents.

The point is, to adapt William Gibson's line, the future is already here, we just don't know it yet. And the reason we don't know it, is because even though the technologies will already exist, we haven't understood their use or potential yet: we haven't yet imagined how innovations will converge and interact with other innovations that together have transformational potential.

THE INNOVATION ENVIRONMENT

The technological disruption of the past decade continues to blur traditionally distinct sectors. Companies have challenged traditional industry conventions by entering seemingly unrelated industries. This isn't limited to big tech incursions into, for instance, media, mobility, retail, finance and healthcare. Companies have pushed into new markets and sectors through M&A activities, partnerships or organically growing their operations, often in order to place customer needs at the center of the business model, increasingly turning away from a traditional product-centric mindset. This is the kind of thinking that drives a company that makes laundry detergent to enter the launderette and washing machine markets. Mobile and digital technologies have enabled companies to directly interact with their customers, gain customer insights and design frictionless customer journeys across various industries. This sectoral blurring will likely continue, emboldening disruptors to continue their search for ways of improving incumbent offers.

COVID-19 has given rise to a rethinking of where innovation and development is essential, for example: biomedical research to combat the pandemic; digital infrastructure as a fundamental underlying framework of the future in the same way as railroads and roads were in the past; centralized diagnostics; decentralized supply chains; smarter logistics; an explosion in virtual and remote tools that enable social distancing across a wide range of situations. Successfully bringing about many of these developments will depend on combinations of innovations being brought together to transform current systems.

In addition, increased online presence and activity will support the existing shift towards more and more customized products, services and marketing experiences. In this environment, controlling the interface between customers and their experiences means controlling access to customer data and therefore understanding customers better and better.

It would appear that COVID-19 is accelerating the shift towards the digitization of everything. However, the next decade may also bring about a more cautious approach to investment and the potential of tech. As money becomes tighter in the aftermath of the pandemic, risky bets will be harder to make and start ups will need to do a better job of proving their business model actually delivers value. Value in the financial sense (avoiding overly-optimistic large-scale growth business plans), but also in the social and environmental sense (better addressing unintended consequences from new technology offerings such as increased car usage, traffic and emissions resulting from ride-hailing services). This goes far beyond the debate on tech governance and competition. The causes of, and inequities tragically exposed by, the pandemic, together with the subsequent global social unrest, have only increased societal expectations that companies more explicitly focus on serving society and addressing social and environmental damages that have been caused.

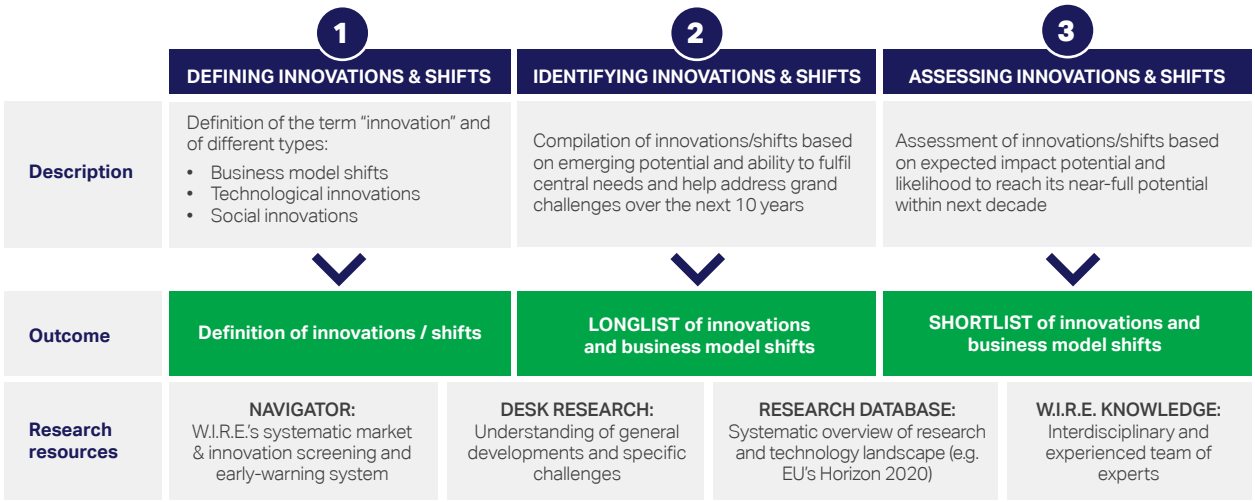
There is no question that innovation, including and also beyond digital technologies, is essential if Vision 2050 is to be achieved. Essential systems transformations will depend on innovation: in decarbonization technologies, transport technologies, in preventative healthcare and in gene technologies, materials and materials reuse, in building design and use and reuse, in sanitation and in the sanitation economy, in agricultural practices and food storage technologies and more.

The innovations outlined in this document will not automatically contribute to a more sustainable future. Indeed, some of the innovations that we think we absolutely need to deliver on our Vision of 9+ billion people, living well, within planetary boundaries, are missing from our shortlist of innovations that will shape the decade to come. But that's the point – this list is here to help us think about the innovations that we can leverage in service of our Vision, and those that we need to work harder to bring about. And it's a reminder that there will *not* be linear causality between one innovation and one challenge solved – everything is interrelated.

2 Methodology

2 Methodology

We followed a three-step approach to develop a shortlist of innovations, emerging technologies and business model shifts that might shape the next decade.



STEP 1. DEFINING INNOVATION AND SHIFTS

An innovation is a deliberate and targeted process of change towards something "new". An idea turns into an innovation when it is transformed into actual products, services or processes; in Schumpeter's words, the "doing of new things or the doing of things that are already done, in a new way".

We have focused on the following three types of innovations, defined as:

- **A BUSINESS MODEL SHIFT** is the change in key aspects of the contemporary approach of business-making (value creation, value delivery or value capturing).
- **AN EMERGING TECHNOLOGY** is a device, contrivance or process originating from research developments or technical knowledge to make an impact in the market or society.
- **A SOCIAL INNOVATION** is the altering of social systems to overcome one or several challenges to society, thereby also potentially generating economic added value for organizations.

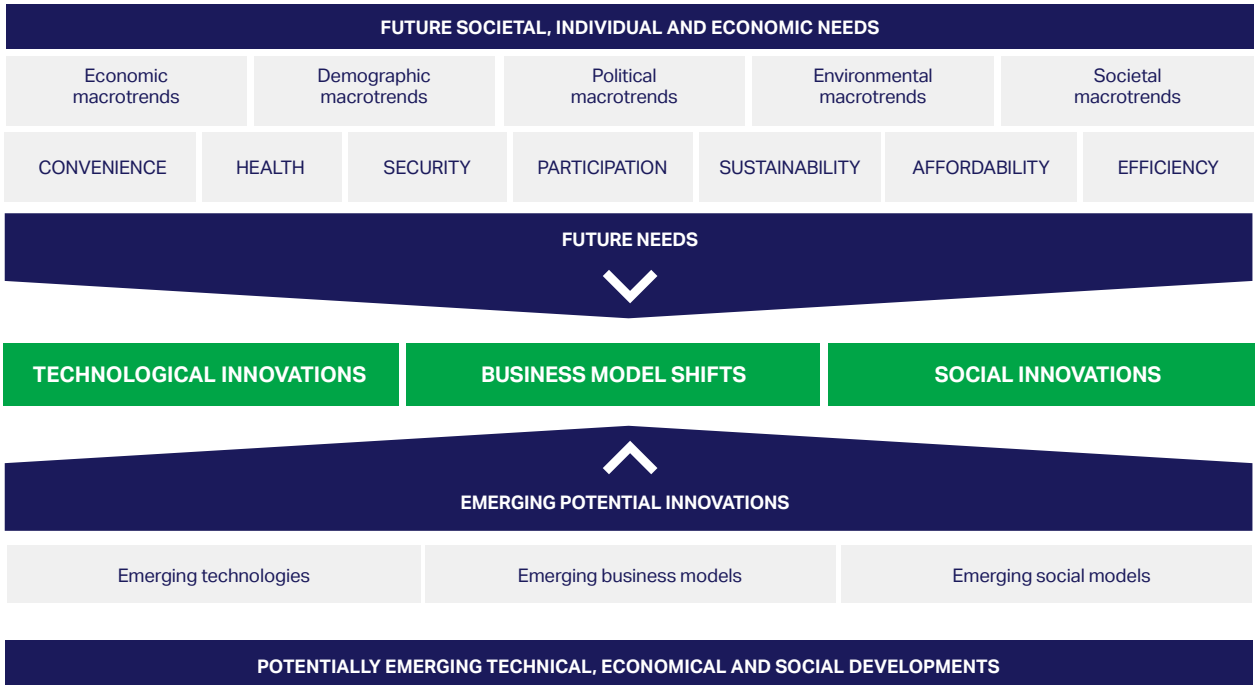
STEP 2. IDENTIFICATION OF INNOVATIONS & SHIFTS

"Grand challenges" that technology has yet to solve inform the future societal, individual and economic needs and give an indication of where innovation focus, effort and resources is being (and will continue to be) directed. A number of globally respected institutions compile lists of breakthrough technologies (eg. MIT Technology Review's annual list of *Breakthrough Technologies*) as well as the big global challenges that technology could solve: for an example, see MIT Technology Review's 2019 "Ten big challenges technology could solve", which included:

- **Carbon sequestration**: recycle and store carbon dioxide cheaply
- **Grid-scale energy storage**: balance irregular electricity generation from renewable energy sources at scale

- **Universal flu vaccine**: protection against all variants of virus strains
- **Dementia treatment**: slow or eliminate devastating effects of dementia / Alzheimer's disease
- **Ocean clean-up:** solution to collect billions of tiny pieces of plastics diffused on oceans, coasts, and waterways
- **Energy-efficient desalination**: gaining fresh water from the ocean
- **Safe driverless car**: safely handling chaotic traffic and difficult weather conditions
- **Embodied AI**: relation of internal computational processes to real things in the physical world as an important milestone towards general artificial intelligence
- **Earthquake prediction:** reliably predicting earthquakes and tsunamis to evacuate unsafe areas
- **Brain decoding**: understanding the way the brain stores and communicates thoughts could lead to breakthroughs in treatment of mental disorders and direct interfaces.

Our identified innovations and shifts were derived by analyzing and coupling future needs with an understanding of technically, economically and socially feasible potential developments based on the latest research and technology landscape.



STEP 3. ASSESSING INNOVATIONS & SHIFTS

We then allocated our identified innovations and shifts to one of four phases corresponding to their maturity level (readiness). In addition, we performed a qualitative assessment of the innovations and shifts based on their expected impact on business and society.

SUB-STEP 1: ALLOCATING INNOVATIONS / SHIFTS IN PHASES (QUALITATIVE ASSESSMENT)

PILOT-PHASE
- Innovation still being developed and tested in private or public research institutions including few real-life pilot projects.
- Very low likelihood that impact of innovation over next 10 years is approaching its full potential.

INTRODUCTION-PHASE
- Innovation introduced to market, but still with limited performance and applications and therefore not yet extensively used in any sector.
- Low likelihood that impact of innovation over next 10 years is approaching its full potential.

GROWTH-PHASE
- Innovation increasingly used in one or several sectors.
- Medium likelihood that impact of innovation over next 10 years is approaching its full potential.

MATURITY-PHASE
- Innovation already extensively used in one or more sectors.
- High likelihood that impact of innovation over next 10 years is approaching its full potential.

SUB-STEP 2: ESTIMATING POTENTIAL IMPACT OF INNOVATIONS / SHIFTS (QUALITATIVE ASSESSMENT)

PERCEPTIBLE EXPECTED IMPACT (+)
Innovation will alter existing systems slightly but the central elements of the system remain intact and practically unchanged.

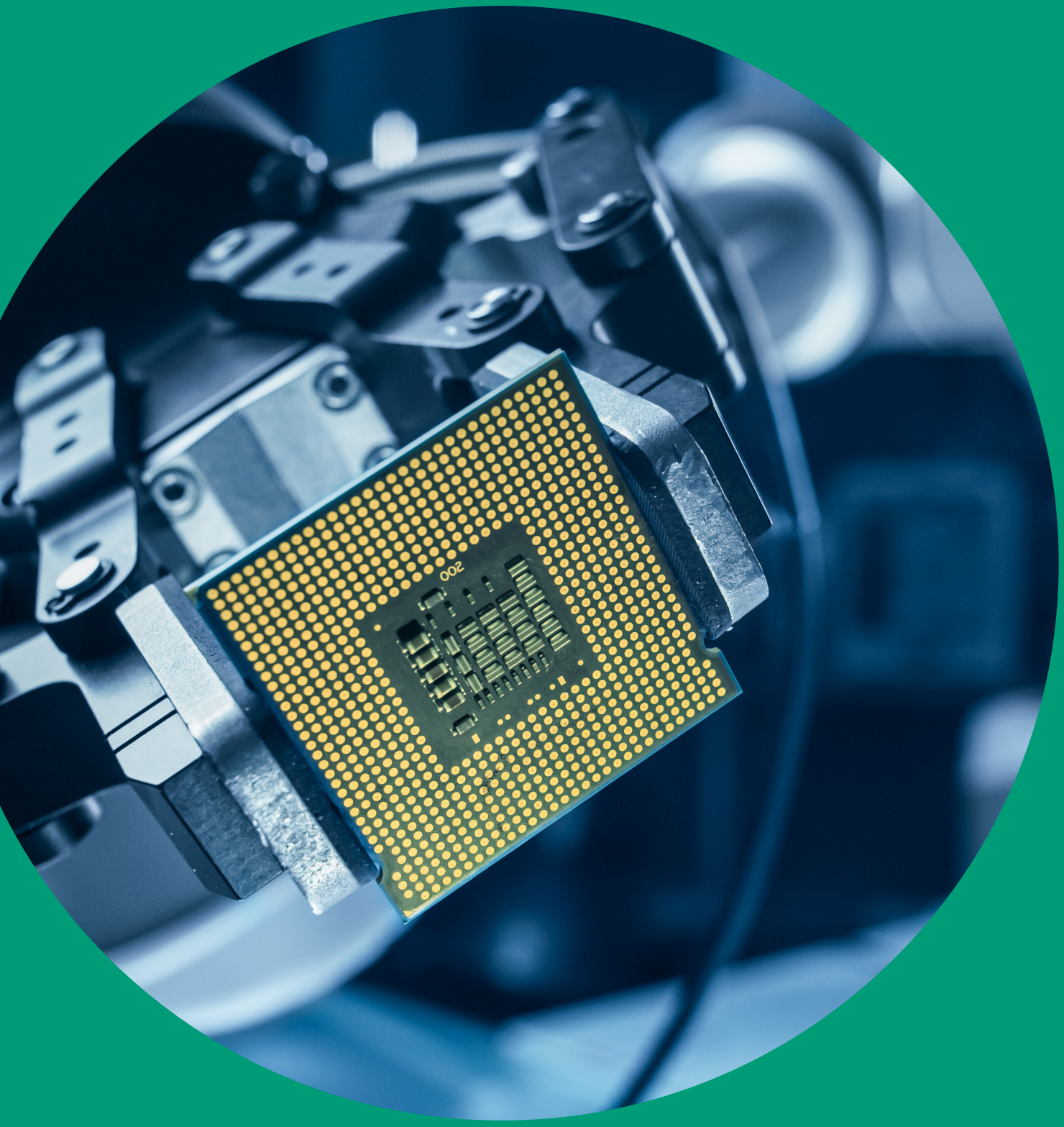
SIGNIFICANT EXPECTED IMPACT(++)
Innovation will alter existing systems substantially by enhancing, replacing or adding new elements to the system.

TRANSFORMATIVE EXPECTED IMPACT (+++)
Innovation will fundamentally change the way how society works. This can be limited to one aspect, but often impacts several aspects of society.

We set the following criteria for the innovations to be shortlisted:
Introduction-Phase with potential impact level +++, or Growth-Phase with potential impact level +++ or Maturity-Phase with potential impact level ++ or +++. Below, you can see all the identified innovations and shifts allocated to a development phase and qualitatively assessed based on the expected impact potential. Those innovations and shifts that we shortlisted are highlighted in **bold.**

	PILOT-PHASE	INTRODUCTION-PHASE	GROWTH-PHASE	MATURITY-PHASE
Business model shifts		• **Circular / Regenerative (+++)** • Outcome-based (++)	• **Business Ecosystems (+++)** • **Crowd-based (+++)** • Omni-channel (++)	• **Platform (+++)** • **Subscription (++)**
Technological innovations / emerging technologies	• Brain-Computer Interface (+++) • Nanomedicines (+++) • Programmable Matter (+++) • Quantum Computing (+++)	• **Digital Money (+++)** • **Distributed Ledger Technology (+++)** • **Edge Computing (+++)** • **Energy Harvesting (+++)** • **3D Printing (+++)** • Biosensors (++) • Small Modular Reactor (++)	• **Artificial Intelligence (+++)** • **Connected Infrastructure (+++)** • **Digital Twin (+++)** • **Electric Vehicles (+++)** • **Genetic Engineering (+++)** • **Next-Generation Robotics (+++)** • **Plant-based Meat (+++)** • Healthy Architecture (++) • Unmanned Aerial Vehicle (++)	
Social innovations	• Universal Basic Income (+++) • Universal Fund (++) • Time Banks (+++)	• **CrowdLaw (+++)** • **Participatory Budgeting (+++)** • **Self-sustaining Neighbourhoods (+++)** • Local Currency (++) • Multi-generational Living (++)	• **Citizen Science (+++)** • **Digital Deliberative Democracy (+++)** • **Open Government Data (+++)**	• **Open Source Software (+++)** • **Open Education (+++)**

3 Innovations



3 Innovations

3.1 OVERVIEW OF INNOVATIONS

3.1.1 Business model shifts

Business model shifts are defined as the change in aspects of the contemporary approach of business-making (value creation, delivery or capturing). We considered the following shifts:

Business model shift	Description
Business ecosystem	The business is part of or even the orchestrator at the center of a network of companies. Jointly, these companies strive to create an aligned value proposition for their customers, which exceeds the sum of the added value generated by each company individually, e.g. using common platforms.
Circular / Regenerative	The business strives to minimize the resources used in the creation of a product or service, as well as extending and closing a product's life cycle. Regenerative goods and/or services are those that not only benefit the individual customer but also provide a benefit to the whole of society.
Crowd-based	The business brings together resources from larger, external groups to create monetizable value. These groups' contributions improve or even fully supplement internal business-making processes (e.g. creation of media content, crowd-based traffic and navigation).
Omni-channel	The business provides an integrated customer experience in both the virtual and physical world. Its various interaction channels allow for the seamless bridging of business-making online and offline.
Outcome-based	The business sells and markets products and services based on the valuable outcome they deliver, not on their objective value. All business activities are aligned to improve the outcome (e.g. pricing of service is based on measurable cost or revenue impact delivered).
Platform	The business facilitates value-adding interactions by matching providers and consumers across a large number of participants. It does so by providing the structure, governance and standards for such interactions.
Subscription	By paying a recurring price at regular intervals, customers of subscription businesses are either provided with a regular service or get free or discounted access to the company's products and services for a certain period.

The following **business model shifts** were **not shortlisted**. They might still emerge and drive consequential shifts in business and society – but were considered as likely less impactful that our selected shifts.

Business model shift	Rational for not being short-listed
Omni-channel	The shift to outcome-based business models is difficult and often complex since it requires the ability to anticipate long-term risks as well as the possibility to measure the outcome (e.g. enabled through the Internet of Things).
Outcome-based	The business sells and markets products and services based on the valuable outcome they deliver, not on their objective value. All business activities are aligned to improve the outcome (e.g. pricing of service is based on measurable cost or revenue impact delivered).

3.1.2 Technological innovations are defined as (new) inventions resulting from research developments or technical knowledge and making an impact in markets or society. We considered the following innovations:

Techonology	Description
Artificial intelligence	Artificial intelligence (AI), is the application of fast data processing, machine learning, predictive analysis and automation to simulate intelligent behavior and problem-solving capabilities with machines and software.
Biosensors	Biosensors allow biological systems to interact with a specific substance sample or measured quantity, triggering physical or chemical reactions, which are then detected by the sensors and signalled to the outside.
Brain-computer interface	A brain-computer interface is a direct communication pathway between an enhanced or wired brain and an external device. Signals derived from correlations between planned behavior and brain activity can be used to control electronic devices or operate software.
Connected infrastructure	A system, of interconnected computer devices, mechanical and digital machines and other objects, which has the ability to transmit data over a network, autonomously and without human involvement.
Digital money	Digital Money is a digital representation of value, which can, but does not necessarily have to, be issued by a central bank or a credit institution and thus might have no geographical or political boundaries.
Digital twin	Digital Twin refers to a digital replica of an actual (or potential) physical entity. The digital representation provides exact simulations of both the elements and the dynamics of how the physical object functions and lives throughout its life cycle.
Distributed ledger	Distributed Ledger technology is a database system characterized by the storage of data blocks in peer-to-peer networks and the continuous cryptographic chaining of data (e.g. Blockchain).
Edge computing	Edge Computing describes a procedure that shifts the processing of data and specific processes away from the central nodes to the edges of networked IT infrastructure.

Electric vehicle	An vehicle for the transport of passengers or goods with an electric drivetrain. Electricity for the drivetrain can be drawn from accumulators, capacitors, fuel cells or overhead lines, or generated by combustion engines or flywheel storage systems.
Energy harvesting	The extraction of small amounts of electrical energy from sources such as ambient temperature, vibrations or air-currents in the immediate vicinity of a terminal device, which can then be stored or directly supplied for use for instance in low-power mobile devices.
Genetic engineering	Genetic engineering is the direct manipulation of the genes of an organism with the help of biotechnology. Types of manipulation include the transfer of genes within and across species or the recombination or artificial synthesis of DNA strands.
Healthy architecture	Buildings that are designed to not only to minimize harm for the people living inside them but to improve people's health and to encourage them to live a healthy lifestyle. In the same vein, architecture that is increasingly climate-adaptive.
Nanomedicines	The medical application of nanotechnology, which refers to the manipulation of matter at atomic, molecular and supramolecular level.
Next-gen robotics	Intelligent machines that can replace and support people at work and in everyday life in an increasingly sophisticated way. These machines are capable of working safely alongside humans, adapting their functions to new environments and coordinating among each other.
Plant-based meat	Plant-based meat products are produced to mimic the characteristics of natural meat and are considered to be meat substitutes. The main ingredients of plant-based meat substitutes are usually soybeans, wheat gluten, lentils and tofu, tempeh and a variety of nuts.
Programmable matter	Programmable matter is matter that has the ability to change its physical properties, such as shape, density, conductivity, optical properties, etc. It does so by reprogramming the individual particles of which it is composed, based on user input or autonomous sensing.
Quantum computing	Quantum-mechanical phenomena such as superposition and entanglement can be used to enormously improve the capabilities of computer systems, such as their computational power and the security of transferred information.
Small modular reactor	Nuclear fusion reactors that are smaller than conventional reactors and can be manufactured in a factory, then moved to an assembly site.
Unmanned aerial vehicle	An aircraft which can be operated and navigated autonomously by a computer or from the ground by remote control without an on-board crew.
3D-Printing	A process of building a three-dimensional object from a computer-aided design model, usually by adding material layer by layer.

The following **technological innovations** were **not shortlisted**. They might still emerge and drive consequential shifts in business and society but were considered as likely less impactful in comparison to those on our shortlist.

Techonology	Rational for not being short-listed
Biosensors	Biosensors have a wide range of applications ranging from healthcare (monitoring, disease screening), food processing and agriculture. The ubiquitous data generation will advance various fields but hardly lead to fundamental change in how society works.
Brain-computer interface	Brain-Computer Interfaces have the potential to be transformative. Their development is however still at a very early stage, with applications not having yet reached broad market viability.
Healthy architecture	The orientation of architecture to actively improve inhabitants' health and wellbeing is a highly beneficial development. It is however likely that it will not fundamentally change the way people live but generally improve existing structures.
Nanomedicines	Nanomedicine applications can substantially improve existing medical practices. Potentially transformative applications of nanomedicine, for instance molecular assemblers, are still in the early-research phase and are to an extent still speculative.
Programmable matter	While the application of programmable matter is of a potentially transformative nature, the current approaches have so far been primarily implemented in a testing environment for research purposes.
Quantum computing	Quantum Computing could enhance system's computational capabilities, but there are currently still limitations, such as costs and especially the problem of quantum decoherence, that hinder the technology's introduction into the market.
Small modular reactor	SMRs allow for a more decentralized, safe generation of power. However, SMRs currently have several disadvantages, especially to other sustainable energy sources, for example the risks associated with monitoring dispersed radioactive material and the safety of transportation. These obstacles throw doubt on the potential of SMRs as a transformative technology and its probability of realisation.
Unmanned aerial vehicle	Unmanned aerial vehicles, especially cargo and surveillance drones, will make certain tasks more efficient and effective. Current limitations , for example regarding regulation on privacy and air space, however put into question the extent to which these applications will find their way into everyday use.

3.1.3 Social innovations are defined as the overcoming of one or several challenges to society by altering social systems. In so doing, they may also generate economic added value. We considered the following innovations:

Category		Selected social innovation	
Alternative exchange systems	Mediums of exchange to complement or replace an existing currency based on a mutual agreement between the parties involved, typically to promote a non-monetary valuation of goods and services.	**Local currency**	A currency that can be spent in a particular geographical area at participating organizations.
		Time bank	A time-based exchange system, where people exchange services for hourly time credits rather than money.
Collaborative communities	Groups of people organised around particular interest-based relationships or sharing concepts to strengthen social cohesion and collaboration.	**Multi-generational living**	A household or housing situation where multiple different generations live and/or work together.
		Self-sustaining neighbourhood	A geographically defined community that strives to achieve some level of economic independence or self-sufficiency.
Crowdsourcing	Sourcing models whereby goods and services are created through the collaborative efforts of a group of participants.	**Citizen science**	Scientific research activities conducted by members of the general public.
		CrowdLaw	Law-making processes, which enable participation by individuals and groups.
Open source	Initiatives that promote the free availability, usage, modification and distribution of information, without restrictions from copyright, patents or other mechanisms of control.	**Open education**	Free and open access to educational resources that are traditionally offered through formal education systems.
		Open government data	Free and open access to governmental documents and proceedings to promote effective public oversight.
		Time bank	Software, the source code of which can be viewed, changed and used publicly and by third parties, often for free.
Participative decision-making	Instruments to enable or promote the empowerment and participation of relevant stakeholders in a decision-making process through deliberation, appointment or representation.	**Digital deliberative democracy**	The use of digital tools to promote political deliberation.
		Participatory budgeting	A process in which citizens decide how to allocate part of a municipal or public budget.
Social income	Public arrangement for the (re)distribution of wealth.	**Universal basic income**	The unconditional provision of an amount of money on a regular basis to all citizens.
		Universal fund	A shareholder model, which provides all citizens shares from a portfolio of stocks in different corporations.

The following **social innovations** were **not shortlisted**. They might still emerge and drive consequential shifts in business and society but were considered as likely less impactful in comparison to our selection.

Social Innovation	Rational for not being short-listed
Local currency	Despite local currencies gaining potential importance due to the rise of large monopolies, ecosystems and new communities, where institutions or organisations might benefit from introducing their own currency, restricted usability and potentially difficult convertibility of local currency result in increased user inconvenience, limiting their potential for dispersion.
Multi-generational living	While trends such as urbanization, ageing populations and socio-economic inequality will make multi-generational living concepts more attractive to many people, more individualised lifestyles remain the dominant aspiration and social trend for now (particularly in emerging economies). This could diminish over the next decade.
Time bank	Exchanging labour-time instead of money can have transformative impact on how smaller-scale communities interact with each other and could lead to the provision of services that in the money-based economy would not be provided. However, the system is still used only by a few, due to, among other things, limited network externalities and the challenge of valuing services appropriate to their utility and not just time effort
Universal basic income & universal fund	Both social innovations would fundamentally change how money is (re)distributed. Depending on the amount of money distributed to each citizen/ inhabitant, new types of jobs with more difficult monetization potential could emerge. These ideas of social income, have so far only been tested in temporary pilot projects, as political opposition and economic concerns hinder dispersion. The idea would probably only be able to advance alongside a fundamental change in the rules and objectives of today's economic systems, which are set up to generate growth.

In the following three sub-sections we will look at the shortlisted innovations in a bit more detail. It's important to note that many of the innovations listed will depend on a degree of "foundational infrastructure". The quality of physical, social, technical, legal and economic infrastructure (for instance property rights or public trust) will be an essential element for the innovations to unleash the full extent of their transformational potential.

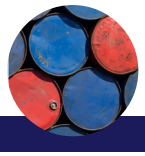
Furthermore, it may appear that we are listing innovations that already exist. We have done this where an innovation appears to be moving from niche into the mainstream, with the potential to change entire systems around it. An example of this is electric vehicles (EVs) where a significant increase in market share is predicted, driving changes in linked industries such as maintenance and charging infrastructure.

Finally, for each innovation we have offered examples of current applications. That is deliberate: the applications are there to illustrate existing manifestations of business model shifts, emerging technologies and social innovations. There will be exceptions, but for an innovation to significantly affect the next 10 years it will already be mature enough to have sufficiently established applications present in society today. As stated, we are not attempting to predict the future – simply to sketch out current possibilities and provide an overview of the business model shifts, emerging technologies and social innovations that will combine and morph to shape the future.

3.2 BUSINESS MODEL SHIFTS

BUSINESS ECOSYSTEM

Description	Ecosystem businesses are part of, or the orchestrators at the center of, a network of companies. Jointly, companies in the same business ecosystem strive to create an aligned value proposition for the ecosystem's customers, which exceeds the sum of the added value generated by each company individually.
Selected Applications	**Finance:** Ecosystem solutions can improve user convenience through a mutually agreed simplification of processes. In the financial services sector, banks and other financial providers can form an ecosystem allowing users to conveniently transfer money among each other in very few steps and through one shared medium, such as a smartphone app. **Mobility:** Companies in ecosystems can achieve higher customer value by centralizing access to a range of different services. Ecosystems in the mobility sector can give customers simple access and settlement to various mobility services offered by independent providers within the ecosystem.
Opportunities & Risks	+ Business ecosystems increase convenience for customers through one-stop solutions + Cross-industrial business ecosystems can create new added value thanks to synergy effects - Systematic coordination and cooperation among members of the same industry increases the risk of monopolies of ecosystems - Effective coordination can become very complex and therefore costly to manage for members of the ecosystem



CIRCULAR & REGENERATIVE MODEL

Description	Circular and regenerative businesses strive to minimize the resources used in the creation of a product or service, as well as extending and closing a product's life cycle. Regenerative goods and/or services are those that not only benefit the individual customer but also provide a benefit to the whole of society.
Selected applications	**Clothing & Fashion:** One strategy for companies pursuing a circular business model is the setup of a "closed" service chain. A circular model for clothing companies, for example, would involve not only selling clothes but also taking them back once customers want to change them. After cleaning, and if needed repairing, clothes, they are ready to be sold again to new customers. In other models, materials are re-used to create new clothes. In any case, the customers' possession become temporary. **Health & Food:** Another approach for companies to position themselves in a circular economic system is to specialize in buying industrial or biological waste to process and refine it using various technologies to recover nutrients and water and/or create value-adding products such as renewable energy, organic fertilizers or protein-rich materials.
Opportunities & Risks	+ Reduced input of virgin material and energy, less waste and emissions, reduced costs and environmental impacts (in theory) + Increased sense of community and cooperation through the more circular models of consumption, such as the "sharing economy" + Increased societal legitimacy of economic system due to added value provided to society by regenerative businesses - Over-focusing on ecological factors could lead to diminished growth and economic prosperity

CROWD-BASED MODEL

Description	Crowd-based businesses bring together resources from larger, external groups to create monetizable value. These groups' contributions are intended to improve or even fully supplement internal business-making processes.
Selected applications	**Marketing:** Companies integrating the broader public (the crowd) into their business-making process can draw on user-generated content for their marketing campaigns, especially on social media. By helping to generate content that includes their products, they can use the dynamics of social media behavior to raise brand or product awareness. **Education:** Some information-based educational organizations rely on the contribution of crowds to provide valuable (written) information and perform quality auditing. This can range from the revision of an article in an online encyclopedia to the creation of a complete online education course.
Opportunities & Risks	+ The inclusion of diverse perspectives into innovation processes can mitigate the risk of the occurrence of discriminatory practices and outcomes thereby improving the legitimacy of businesses and the economic system as a whole. + The effective and efficient involvement of consumers and users in the business-making process improves outcomes, accelerates the shift of consumers becoming producers of their own goods and services. - A large group of contributors can add cost and time to the coordination of activities and managing the quality of content. - Relying on workers who are not legally/contractually integrated into the corporate structure, allows companies to avoid responsibilities towards their workforce.

PLATFORM

Description	Platform businesses facilitate value-adding interactions by matching providers and consumers across a large number of participants. The platform provides the structure, standards and governance for such interactions. These businesses are generally built around a digital infrastructure that improves accessibility and ensure scalability of the business.
Selected applications	**Marketing:** Platforms can connect companies with external experts in the innovation process. Faced with an engineering challenge, a company can use platforms to access a broad range of engineering experts from various sectors, recruiting experts for projects or soliciting solutions from multiple experts for single, posed challenges (e.g. as part of a contest). **Real estate:** Platforms can function as an online marketplace and match (temporarily) available accommodations with interested individuals. For many, this a cheaper and more convenient option than checking into a hotel or renting an accommodation. These platforms also provide accommodation owners or tenants with an additional income, when they are not using the accommodation.
Opportunities & Risks	+ Platforms empower individuals to gain personal independence and flexibility as their own services and goods can be offered and traded easily + Platforms allow for more effective and efficient matching of suppliers and demanders of goods and services at scale - Tendency for oligopoly or even monopoly structures as network effects ensure that power concentrates quickly on a few dominant actors - Individuals offering their services/products on platforms usually are at the mercy of the platforms: power between the platform and the individual is unequally distributed - Dominance and dependence on emerging super platforms combining a variety of services (e.g. social media, media, e-commerce, entertainment, education, banking, healthcare)

SUBSCRIPTION MODEL

Description	By paying a recurring price at regular intervals, customers of subscription businesses are either provided with a regular service or get free or discounted access to a company's products and services for a certain period.
Selected applications	**Tourism:** For the payment of a regular fee, customers can regularly receive curated goods and services, such as travel itineraries. The regular contact due to the subscription model allows companies to progressively gather more information on customers , thereby improving the curation process and customer engagement. This type of service is attractive for customers, as they gain both convenience and an element of surprise. **Food:** Customers can buy subscriptions from food delivery companies to get access to exclusive products and services. This type of subscription is often marketed as a membership, seeking to encourage a community feeling and as a result customer loyalty.
Opportunities & Risks	+ Regular payments lead to more predictable cash flows and can therefore encourage investments + Continuous contact and exchange with customers generates data that helps to create more personalized services + A shift away from ownership to usage might result in a more efficient distribution of resources (e.g. cars) - While subscription models potentially increase convenience, regular automated payment flow increases risk of unnecessary spending for customers - Risk of overconsumption due to flat-rate models

3.3 TECHNOLOGICAL INNOVATIONS / EMERGING TECHNOLOGIES

ARTIFICIAL INTELLIGENCE

Description	Artificial intelligence (AI), is the application of fast data processing, machine learning, predictive analysis and automation to simulate intelligent behavior and problem-solving capabilities with machines and software.
Selected applications	**Healthcare:** AI has the potential to radically improve the process of medical diagnosis. For instance, by analyzing a patient's heart structure, it could indicate their risk of cardiovascular disease. It could be used to detect abnormalities in common medical tests, such as chest X-rays, leading to quicker risk detection and fewer misdiagnoses. **Voice interfaces:** Driven by advances in conversational AI, voice assistants are becoming increasingly potent system interfaces, for example in consumer electronics in the context of smart homes. Voice assistants can replace human employees in jobs that entail relatively short, and standardized conversations with clients, meaning that they could begin to do so much more than they currently do, creating efficiencies in a broad range of societal services, from government to education to fitness.
Opportunities & Risks	+ Artificially intelligent systems can help make humans to make decisions more efficiently and effectively, enhancing human being's natural abilities + AI's potential for automation of repetitive and standardized tasks can free up human resources for more complex and social tasks - AI systems have the potential to accelerate the technology-induced de-skilling of the population across a range of basic to complex tasks as technological systems become increasingly autonomous - Replacement of human beings through intelligent machines could potentially lead to long-term unemployment and put pressure on welfare states - The combination of greater amounts of data and increasing computing power leads to increasingly massive carbon emission associated to AI systems - AI systems can lead (and are leading) to discriminatory outcomes as a result of the adoption of human biases embedded in the code or integrated data

CONNECTED INFRASTRUCTURE

Description	Connected infrastructure refers to a system, of interconnected computer devices, mechanical and digital machines as well as other objects, which has the ability to autonomously exchange data over a network, autonomously and without human involvement.
Selected applications	**Healthcare:** Wearables are used in the medical sector to track vital functions of (potential) patients. They measure vital functions through various means (e.g. a tiny electrode placed under the skin that measures glucose levels) and relay the information to a monitoring device, alerting their users and/or medical professionals, if the values pass a certain threshold. **Agriculture:** Greenhouses with embedded devices not only make it easier to monitor the internal climate, but also allow autonomous smart systems to control the conditions inside. Sensors measure various parameters depending on the plants' requirements, the data is processed in the cloud and sent back to the greenhouse where appropriate action is applied.
Opportunities & Risks	+ Actions and conditions in a connected system can be more precisely adjusted to pursue and achieve a certain goal and can therefore be more resource-efficient + An interconnected environment allows for the automated/autonomous, effortless personalization of the environment - Loss of privacy in an increasingly connected environment - Interconnectedness increases the vulnerability of the system and also of the individuals in the system as a consequence

DIGITAL TWIN

Description	Digital Twin refers to a digital replica of potential and actual physical entity. The digital representation provides exact simulations of both the elements and the dynamics of how the physical object functions and lives throughout its life cycle under various conditions.
Selected applications	**Healthcare:** A digital twin of a patient or organs enables surgeons and medical professionals to practice procedures in a simulated environment instead of on a real patient. Sensors can monitor patients and create digital models that can be monitored by human medical staff or AI systems to improve care. **Manufacturing:** Because digital twins can provide a real-time overview of what is happening to equipment or other physical assets, they can reduce maintenance problems and ensure optimal production performance of manufacturing processes.
Opportunities & Risks	+ Save costs in the design phase, improve the performance of objects or processes without putting individuals at risk and enabling better predictions (at lower costs) + Safe and cost-effective training using simulations of real objects or processes + Safe and fast testing of new elements or conditions without interfering with real objects or processes, e.g. where testing is dangerous for human beings, unethical or highly costly - Creation of accurate digital twins might be too complex / expensive - Need to be constantly updated in order to accurately reflect changes in reality

DIGITAL MONEY

Description	Digital money is a digital representation of value, which can, but does not necessarily have to, be issued by a central bank or a credit institution and thus might have no geographical or political boundaries. It has no physical equivalent, but possesses the same basic functions as physical money.
Selected applications	**Government:** Governments can use digital money to encourage the use of public services among citizens through the introduction of digital money-based reward systems. Citizens earn government-owned digital money by using public service. The earned money can then be used to pay for goods in selected shops or public transport **Finance / banking:** Digital money ecosystems can offer own banking and asset management solutions, independent from the regulated traditional financial services sector.
Opportunities & Risks	+ Reaching the unbanked population + Cheap and fast international money transfers - Risk for financial privacy - Risk that states might lose oversight of money, limiting the effectiveness of traditional monetary policy - Non-transparent processes and inability for traditional institutions to enforce regulation lead to potential enablement of money laundering, financing of crime and terrorism

DISTRIBUTED LEDGER TECHNOLOGY

Description	Distributed Ledger technology is a database system characterized by the storage of data blocks in peer-to-peer networks (decentralized) and the continuous cryptographic chaining of data. It is based on a growing list of data blocks building on each other, which theoretically can't be changed without a visible trace.
Selected applications	**Real estate:** All parties involved in a property can transparently agree on rent payment plans, transfer of ownership and provision of services. Intelligent contracts would be used to enforce agreed terms and conditions that include the establishment of ownership and ensure that payments are made promptly. **Energy:** Trading energy using distributed ledger technology allows consumers to sell surplus energy to their neighbors, reducing the control of large electricity providers over energy supply, and potentially enabling the creation of energy markets consisting only of small-scale energy providers.
Opportunities & Risks	+ Efficient cooperation can be enabled even among parties that cannot be "trustworthy", since Distributed Ledger technology increases transparency and traceability of systems thereby limiting the possibility of fraud + Simplification and automation speeds up processes, such as applications, contracts or trade - Regulation, data protection enforcement and dispute resolution become more challenging as a variety of jurisdictions are involved due to the decentralized nature of technology and data storage - Limited scalability and high energy demand depending on set-up of the technology

EDGE COMPUTING

Description	Edge computing describes a procedure that shifts the processing of data away from the central nodes to the edge of a networked IT infrastructure, taking pressure away from central IT resources and increasing the speed and security of data processing.
Selected applications	**Government:** In the context of smart cities, autonomous systems, such as self-driving cars and video display systems, need to avoid lag to minimize the risk of accidents and harm to human life. Computation closer to devices, such as cars or displays, can minimize the lag compared to centralized cloud computing. **Communication:** Edge computing technology separates in voice assistant devices the user's voice from other environmental sounds. As the user moves, voice tracking algorithms running on the device can adjust the balance between the signals from the microphones so that the focus follows the voice source. With improving edge computing technology, voice assistants could eventually perform most or all user requests without the need to connect to the internet. This would expand the area of use for voice assistants even to areas outside of or with poor Wi-Fi or cellular services.
Opportunities & Risks	+ Decreased risk of centralized failures, increases resilience of the system from external attacks and reduces the load on central systems + Improved performance of and interaction between devices, especially in situations where sub-optimal performance can harm individuals + Improved data security and privacy as less data is in a corporate data center or cloud environment, which makes it less vulnerable if a environment is compromised - Edge systems need to be able to run with little or no intervention - Challenging monitoring and maintenance when installed in remote locations

ELECTRIC VEHICLES

Description	Electric vehicles transport passengers and goods with an electric drivetrain that draws electricity from accumulators, capacitors, fuel cells or overhead lines, or generates it through flywheel storage systems or combustion engines. Electric vehicles are not new, but expected growth from 2% of global share (2016) to 22% in 2030 will transform mobility systems.
Selected applications	**Mobility / battery electric vehicle:** A battery electric vehicle, is a type of electric vehicle that exclusively uses chemical energy stored in rechargeable battery packs, with no secondary source of propulsion (e.g. hydrogen fuel cell, internal combustion engine, etc.). **Logistics / fuel cell truck:** An electrically powered truck that draws its energy from a fuel cell. **Public transport / fuel cell trains:** Fuel-cell electric trains use hydrogen as an energy source to operate a traction engine, the auxiliary power unit or both. They convert chemical energy of hydrogen into mechanical or electrical energy. This is done either by burning hydrogen in a hydrogen combustion engine or by reacting hydrogen and oxygen in a fuel cell to drive electric motors.
Opportunities & Risks	(+) More efficient operation and maintenance than non-electric vehicles (+) No local exhaust emissions, which is beneficial to both local environment and individual health (-) EVs tend to have a lower center of gravity, which reduces the probability of rollover and a lower risk of causing larger fires or explosions (-) Significant battery manufacturing challenges remain to be overcome with regard to natural resources, environmental standards and human rights

ENERGY HARVESTING

Description	Energy harvesting refers to the extraction of small amounts of electrical energy from sources such as ambient temperature, vibrations or air currents in the immediate vicinity of a terminal device, which can then be stored or directly supplied for use, for instance in low-power mobile devices, thus avoiding the limitations of wired power supplies.
Selected applications	**Security:** Connected objects including wireless sensors and wearable electronic equipment play crucial roles in the surveillance of areas. Especially in environments, where energy supply is limited or can be potentially interrupted, devices independent from the main energy grid can ensure constant surveillance. **Healthcare:** Energy harvesting can be used in medical clinics, hospitals and care facilities, where electromagnetic, kinetic, thermal and airflow-based energy sources are identified as potential energy sources for essential electronic medical equipment, allowing medical facilities to become partially or fully self-sustaining regarding the supply of energy to essential equipment, which is especially crucial in the context of power outages.
Opportunities & Risks	(+) Lower maintenance and installation costs when powering a network with an energy harvester instead of a battery or wired connection (+) Reduced (traditional) energy consumption and associated carbon emissions when using ambient energy which otherwise is wasted (-) Ensuring a stable energy source is challenging due to unpredictable character of most sources of ambient energy, especially in remote locations and extreme environments

GENETIC ENGINEERING

Description	Genetic engineering is the direct manipulation of the genes of an organism with the help of biotechnology. Types of manipulation include the transfer of genes within and across species or the recombination or artificial synthesis of DNA strands.
Selected applications	**Food:** Genetic engineering could be used in the industrial production of proteins. Organisms could have their cells transformed with a gene that codes for a useful protein, e.g. an enzyme, so that they over-express the desired protein. Mass quantities of the protein can then be produced by culturing the transformed organism in bioreactor systems. **Environmental conservation:** Gene transfer by viral vectors has been proposed as a means of controlling invasive species and vaccinating threatened species against diseases. In the context of climate change, facilitated adaptation to rapidly changing new environments through gene optimization could be a solution to reduce the risk of extinction.
Opportunities & Risks	+ Genetic modification is significantly faster and more efficient than selective breeding, and in some cases delivers results that could not be achieved + Genetic engineering allows for an efficient intervention in natural systems + Genetic technologies are offering new solutions for disease control, prevention and cure - Unintended consequences of genetic modification, which could result in harmful outcomes for the flora, fauna or human beings - Ethical grey zones regarding the modification of genes in human beings in particular

NEXT-GENERATION ROBOTICS

Description	Intelligent machines support people at work and in everyday life in increasingly sophisticated ways. These machines are progressively more capable of following social behaviors and rules, working safely alongside human beings, adapting form and function to new environments and coordinating among each other.
Selected applications	**Security:** Swarm robots are useful for autonomous monitoring and environmental control, for instance in the case of a disaster, searching for survivors, locating spilled chemicals or gases, toxic pollution, pipeline leaks, radioactivity. Military applications include detecting bombs or other objects that potentially pose a threat to military personnel or civilians. **Healthcare:** Soft robots can be used in medicine, especially for assistance in invasive surgery. They can be used to support operations, navigating different structures in the human body by modifying and adapting their shape.
Opportunities & Risks	+ Reduced human exposure to life-threatening situations + Efficiency gains flowing from the use of automation and robots can free up resources to be invested elsewhere, and in the case of human capital allow workers to take up more complex and potentially meaningful work - Automation carries a huge risk of increased unemployment (e.g. job growth lagging behind the automation rate, new jobs created in different geographies etc.) - Reliance on robots comes with increased vulnerability to risks of mechanical/software malfunctions and hacking

PLANT-BASED MEAT

Description	Plant-based meat products are produced to mimic the characteristics of natural meat and are considered to be meat substitutes. Their aim to match the organoleptic properties of meat, such as flavor, aroma, texture, and appearance, using plant protein sources. The main ingredients of plant-based meat substitutes are usually soybeans (and other legumes), wheat gluten, lentils and tofu, tempeh and a variety of nuts.
Selected applications	**Food:** Fermentation by creating novel enzymes could make the taste or texture of a plant product become more comparable to the properties of meat. By making globular plant proteins act like animal proteins, which are naturally fibrous and cross-linked, plant-based products could imitate the usual texture, taste and feel of meat. **Food:** Blended meats consist of mixtures of specially composed plant-based proteins combined with beef, chicken or pork to enable meat processors to produce products consisting partly of plant proteins and partly of animal-based meat. This can result in blended products that are cheaper to produce and have less fat, calories and cholesterol than 100% animal meat products
Opportunities & Risks	+ The consumption of primarily non-animal-based protein leads to a reduction of CO_2 emissions either directly through CO_2 capture and conversion or indirectly through a reduction in livestock farming driven by decreasing demand for animal-based proteins + More resource-efficient protein production compared to animal-based proteins (e.g. water, land, feed) - To fully supplement animal-based protein, some drawbacks need to be overcome (e.g. the lack of vitamin B12)

3D PRINTING

Description	3D printing is the process of building a three-dimensional object from a computer-aided design model, usually by adding materials layer by layer. Objects can be created without the need for special tools that have stored the respective geometry of the workpiece.
Selected applications	**Construction:** In the construction industry, 3D printing can be used to create components flexibly on-site or even to construct entire buildings, with minimal involvement of construction workers. **Healthcare:** Bioprinting enables the precise three-dimensional structuring and composition of cells and extracellular matrices resulting in functional tissue constructs built from the patient's own cells. Implanted tissue should have a lower risk of rejection. Additionally, doctors can try out drugs and therapies on printed tissue to predict patients' reactions to them.
Opportunities & Risks	+ 3D printing allows individuals and SMEs to produce objects independently of big manufactures, providing that the required blueprints are accessible. + Fewer objects need to be stored or transported as they can be produced on-demand and on-site - Uncontrollable risk of decentralized production of illegal products (e.g. design and production of unlicensed weapons, card skimmers, etc.) - Patent infringements will become more challenging and identification of counterfeit products will become practically impossible

3.4 SOCIAL INNOVATIONS

CITIZEN SCIENCE

Description	Citizen science refers to the research activities conducted by members of the general public, often while collaborating with or being under the direction of professional scientists.
Selected applications	**Environment:** Members of society are asked to gather data, for example on the flora in their immediate surroundings via their mobile phone cameras, allowing professional scientists to use this geo-tagged information to better understand the spread of invasive plant species. **Healthcare:** Professional researchers can be more effective and efficient in their creation of pharmaceutical products through collaborations with amateur scientists, expanding the number of minds solving a problem. For instance, researchers have already used a computer game to crowdsource research identifying natural proteins' structural configurations.
Opportunities & Risks	+ Citizen science allows for scaling of sample sizes and thereby can improve the statistical power and precision of the analysis + External perspective by amateur scientists can break up existing theoretical frameworks and assumptions - Coordination among citizen scientists, as well as the gathering of data, is time-consuming and potentially costly for professional scientists and institutions - Monitoring of research environment to ensure (external and internal) validity is crucial and can be resource demanding - Potentially biased results in research based on data gathered by citizen scientists due to selection bias

CROWDLAW

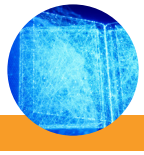
Description	CrowdLaw refers to a restructuring of the processes governing how parliaments, governments and public institutions work, to promote citizen engagement by using new technologies to tap into different sources of information, judgments and experience at each stage of the legislative and policy-making cycle, thereby improving the quality and legitimacy of the resulting laws and policies.
Selected applications	**Urban governance:** Citizens are integrated in the process of improving quality of life in urban areas, through the identification of problems such as the location of structural damages, or the submission of policy proposals to solve challenges faced by city governments, such as reducing criminal activities in public spaces. **Constitution drafting:** Local and national-level governments can include citizens in the drafting or redrafting of constitutions. Citizens provide elements to be added, draft versions of already decided-upon articles and most importantly vote on other people's proposals, giving governments an indication of the population's preferences.
Opportunities & Risks	+ Tapping into the collective intelligence of the population can improve the quality of the policies implemented and the outcomes thereof + Integrating citizens into the policymaking process gives increased legitimacy to the policies passed - Engaging citizens in the policy-making process, especially when relying on digital technologies, might lead to biased outcomes when certain groups are disproportionately engaged - The policy-making process, and specifically the points of integration, need to be thoroughly structured to efficiently take up the ideas, problems or proposals of the citizens

DIGITAL DELIBERATIVE DEMOCRACY

Description	Digital deliberative democracy uses digital technologies to improve the deliberative process of democratic institutions. Deliberative democracy focuses on citizens discussing views and opinions on what the state should and should not do. The emphasis is on input, opinion formation, self-expression and discussion.
Selected applications	**Online parliament:** An online parliament brings together a group of citizens to discuss and make recommendations on a specific issue. Participants are randomly selected to help ensure that they are representative of the general public and then invited to join a closed online group where the consultation process takes place. **Public opinion mapping:** As part of the mapping engagement, all citizens are encouraged to submit, evaluate and filter ideas to generate a collective intelligence that helps policy makers understand the key points of a population's opinions and divisions. The purpose is to improve understanding of the most important issues or to highlight points that need to be worked out in more detail in a face-to-face environment.
Opportunities & Risks	+ Digital tools can be used to make the offline consulting process more transparent. By transforming the entire consultation process into a publicly accessible auditable information trail, anyone can go back and see exactly where a particular decision was taken and the facts or opinions on which it was based + Using digital technologies to include citizens in, and open up, the political process, has the potential to improve the legitimacy of the whole political system - Lower barriers of engagement thanks to digital technologies increase the risk of self-selection bias, where certain groups of people are more likely to engage thereby making the participant body of the deliberative process unrepresentative of the general population - By opening up the process, people who may not want to be identified might be deterred from participating. A careful balance must therefore be struck between transparency and respect for the privacy of participants

OPEN EDUCATION

Description	Open Education refers to the educational policy goal of making education freely available. In the narrow sense, it is often reduced to the transfer of knowledge via the Internet, which is based on learning materials that are free of charge for the user and available from accessible learning platforms.
Selected applications	**Education:** Through the provision of freely accessible educational resources (text books, videos, tests) or full courses ("massive open online courses"), open educational resources aim to enhance the dissemination of information and learning material. **Research:** By providing free and open (no financial, legal or technical barriers) access to scientific information and resource output through open access journals or platforms without financial, legal or technical barriers, the "open access" movement aspires to increase the visibility and usage of academic research.
Opportunities & Risks	+ Open access to information can strengthen the basis for transfer (education), development (research) and valorization of knowledge + Free usage and modification of information can promote its further development and stimulate innovation and creativity + The open access to and consequent visibility of scientific research can lead to increased trust in academia and science in general. - The absence of centralized oversight can lead to the spread of misinformation - The reliance on user-generated or use-modified content can lead to a chaotic learning environment and a lack of respect for scientific principles



OPEN GOVERNMENT DATA

Description	Open Government Data (OGD) are public administration data, which are processed and made freely accessible. By making data sets available, public institutions become more transparent and accountable to citizens. By encouraging the use, re-use and free distribution of data sets, governments encourage the creation of businesses and innovative, citizen-centered services.
Selected applications	**Law enforcement:** Open data practices within government can be used to fight internal government corruption. It does so by raising awareness of specific governance issues, providing cost-effective online monitoring platforms and enabling more effective control of financial transactions that may call into question the integrity of political actors. **Business-making & entrepreneurship:** Established companies and start-ups alike can use open data to create a more direct link to the needs and wishes of their customer base. Additionally, a lack of information can hinder efficiency, which in turn increases costs and limits growth. By integrating data from the vast open government network, businesses can improve their efficiency. Free government data can also serve as a stimulus or foundation for new products or services.
Opportunities & Risks	+ OGD can improve the availability and accessibility of data on public sector performance, such as budgetary data or data on public procurement, and on infringement of legislation thereby discouraging inefficient or even corrupt behavior as well as increasing the government's legitimacy among citizens + New value can stem from the re-use of OGD, as it can be used by entrepreneurs to develop new or innovative products and services + The availability of OGD can help to identify inefficiencies and subsequently improve the delivery of public services - Risk that data is published that, for specific reasons should not be viewable for the general public (e.g. publication violates legislations, privacy infringement) - Users may intentionally for their own political or economic gain, or unintentionally, misinterpret the openly available data

SELF-SUSTAINING NEIGHBORHOOD

Description	With rising network dependencies and urbanization, geographically defined communities strive increasingly to achieve some level of economic independence or self-sufficiency, in respect to the larger system they find themselves in. This can be tackled for example by using community-owned urban gardening installations, local power grids and neighborhood apps, for communication and coordination.
Selected applications	**Agriculture:** Neighborhoods or local communities in general set up urban gardens and either manage them individually or collectively, with the harvested food being distributed among either the participants or all community members. Depending on the available space, communities might also rely on vertical farming elements to increase self-sufficiency. **Energy:** Self-sustaining communities must provide most or all of their own electrical energy. This can be achieved with on-site and off-grid energy solutions such as renewable energy sources (e.g. sun or wind) and energy generated from biomass. Communities can also set up their own local power grid, including grid storage solutions to adapt energy supply to demand, or use blockchain technology to cost-efficiently trade excess on-site energy between members of the community.
Opportunities & Risks	+ Self-sustainability of small geographical units decreases network dependencies (crucial in an increasingly interconnected environments that are also subject to increasing volatility) + Collective production of resources and provision of services in a neighborhood increases the sense of community and consequently incentivizes reciprocal altruistic behavior - Inward nature of self-sustaining local communities might encourage tribalism - Increasing reliance on hyperlocal production of resources leads to inefficiencies due to lacking economies of scale

OPEN SOURCE SOFTWARE

Description	Open source software is software where the source code can be viewed, changed and used publicly and by third parties, usually free of charge. Software can be turned into open source software by individuals for altruistic motives as well as by organizations or companies looking to share development costs or gain market share.
Selected applications	**Entertainment:** Open-source video games are either developed under a free and open source license with free content, which allows the reuse, modification and commercial redistribution of the entire game. Alternatively, only the game engines are developed under an open source license, which means that only the code may be reused and modified. **Healthcare:** Open-source software in the healthcare sector is used for various medical work practices, such as public health monitoring, electronic record or disease management. This allows medical institutions with restricted financial resources to leverage technology in support of high-quality medical services.
Opportunities & Risks	+ Users with limited budgets can adopt new technologies without having to pay subscription fees and commit to long contracts + Open source software provides essential, necessary functions, allowing developers to focus on optimizing and customizing the code + Collective intelligence of online communities can be leveraged to improve the quality or broaden the applications of software + Full transparency and visibility of the code base and elimination of lock-in risks - Widespread use of open source applications leads to greater potential vulnerability from cyber-attacks (although open source is usually more secure because it is much more thoroughly reviewed and vetted by the community) - No agreed standards for assessing the quality of an open source component can make measurement difficult

PARTICIPATORY BUDGETING

Description	The administration of a city, a municipality or another administrative unit strives for more budgetary transparency by allowing citizens to participate in the decision-making process for at least part of the budget available for spending. The citizens agree on the use of the available funds independently in a deliberative process (the administration takes part but mainly in a moderating and advisory capacity).
Selected applications	**Urban planning:** Governments collect and examine ideas for projects to improve public spaces and present the designs to the public. Out of the selection, citizens then vote on projects in such a way that the total cost of the selected projects remain within a predetermined budget. **Arts & culture:** Citizens get access to a list of local arts and culture projects and can distribute the financial resources from the arts & culture budget of the local government according to their preferences. At the end of the process, the actual allocation for each project is determined by the average amount of money assigned to the project.
Opportunities & Risks	+ Generally offers citizens the opportunity to learn about the work of government and to consult, debate and influence the allocation of public funds + Improved transparency and accountability provided by participatory budgeting can help to reduce government inefficiency and curb clientelism, patronage and corruption + Participatory budgeting has the potential to improve the effectiveness of budget allocation, better distributing it according to the needs of the population - Disproportionate participation of certain groups might lead to biased and potentially even discriminatory distribution of public funds - Outcome of the participatory budgeting process must be visible to the public to ensure that government complies with the allocation decisions of the citizens

4 Conclusion

4 Conclusion

We cannot predict the future, but we can identify the technologies that could shape it.

Just as Tesla and Instagram have undoubtedly shaped where we are today, we can ask how CRISPR, lab-grown meat and TikTok will shape the decade to come. We can ask what the Kodaks of the next 10 years will be. We can ask if we will still use cash, if 3D bio-printing will transform healthcare, and how baguette vending machines will further transform rural France. As AI becomes more and more advanced, we can ask whether just because something can be done, whether it should be done. We can wonder how far legalized same-sex marriage, #metoo and Black Lives Matter movements will be able to transform global approaches to tolerance and equality. And we can ask how COVID-19 will change everything: not just how we use public transport in cities, but who moves to and lives in cities at all; not just where we travel, but how we travel; not just where we work, but how much we work.

Above all, we can ask whether the ways we think innovations will affect the world we live in are societally positive. Will they make the world a better place to live, not just for a privileged few, but for all of us? We can ask if the innovations that will shape the next 10 years are likely to drive us towards a more sustainable world. And if the answers to these questions are no, then we will know we need to increase our efforts to uncover new innovations that do support a more sustainable world; to direct finance and investment towards these innovations; to explore more creatively the applications of technologies that already exist.

Understanding what will shape the future is the foundation to inventing a future of our choosing: a future in which 9+ billion people can live well, within planetary boundaries.

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For more information on the update of WBCSD's Vision 2050 visit www.wbcsd.org/vision-2050-refresh

ABOUT WBCSD

WBCSD is a global, CEO-led organization of over 200 leading businesses working together to accelerate the transition to a sustainable world. We help make our member companies more successful and sustainable by focusing on the maximum positive impact for shareholders, the environment and societies.

Our member companies come from all business sectors and all major economies, representing a combined revenue of more than USD $8.5 trillion and 19 million employees. Our global network of almost 70 national business councils gives our members unparalleled reach across the globe. Since 1995, WBCSD has been uniquely positioned to work with member companies along and across value chains to deliver impactful business solutions to the most challenging sustainability issues.

Together, we are the leading voice of business for sustainability: united by our vision of a world where more than 9 billion people are all living well and within the boundaries of our planet, by 2050.

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