EU – GCC Dialogue on Economic Diversification Gulf Cooperation Council (GCC) countries

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Innovation ecosystems in the GCC region and opportunities for collaboration with the European Union

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Your contact persons within
GFA Consulting Group GmbH are

Mr. Lukas Kudlimay (Project Director)
Mr. Douglas Aitkenhead (Team Leader)
Ms. Daniela Stratulativ (Key Expert, Trade and Foreign Direct Investment)

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Author:
Ms. Daniela Stratulativ, Key Expert, Trade and Foreign Direct Investment

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Introduction

Report's role in increasing EU-GCC collaboration

The European Commission Foreign Policy Instruments identified as priority deliverable for the EU – GCC Dialogue on Economic Diversification project, a position paper on innovation, sustainable innovation eco-systems, and innovation management in GCC region.

The topic has been found to be of utmost importance in view of the challenges the GCC countries have been facing in view of the COVID-19 pandemic in combination with the plummeting oil prices. Some of the GCC countries have already reacted, increasingly focusing their policies on AI, innovation, digitalization, and clean energy. These are all areas which are central to the EU agenda and where there is a great potential for strengthened EU-GCC cooperation, including providing EU assistance to the GCC economic diversification.

The changes in the global economic and environmental landscape, such as lower demand for hydrocarbons e.g. electric vehicle technology, U.S. self-sufficiency in oil through fracking and increasing restrictions on single use of plastic, along with supply side factors such as rising population pressures and increasing number of well-educated entrants to GCC labour markets, present a strong incentive for economic diversification in the GCC, objective that requires increased focus on innovation and adoption of new technologies to increase productivity, streamline business processes and increase the resilience of the business environment to prepare for future economic shocks.

If the COVID-19 crisis represents a dramatic shock to the global economy it is an even greater shock to the economies of the GCC with current economic diversification models based on client facing services such as Tourism, Transport, Commercial and Residential Property Development, Financial Services, funded by hydrocarbon revenues badly affected by the virus. The EU can assist the GCC economies in their recovery from the COVID-19 crisis and increase the number of opportunities for collaboration between the EU Member States and the GCC countries by using the EU knowledge, expertise, and tools to engage in the areas of innovation and emerging technologies.

What the report provides in regard to the innovation ecosystem in each GCC country

The report includes details of the GCC countries' capabilities in areas conducive to innovation, as well as a presentation of the innovation environment in each of the GCC countries.

The report draws from an extensive number of sources, such as each GCC country main government portal, as well as each country's ministries' portals, press releases, strategies, policies, development plans and projects e.g., ministry of Information and Communication Technology (ICT), transport and logistics, agriculture and environment, commerce and industry, urban planning, clean energy, education, healthcare, as well as financial sector portals.

The emerging technologies in focus include artificial intelligence (AI), Internet of Things (IoT), and blockchain, amongst others. Fourth Industrial Revolution – induced changes in the innovation environment are included, as well as developments in building Smart Cities, which leverage a number of emerging technologies e.g., AI, IoT.

In addition, international organizations' reports and analysis have been consulted and included. Extensive search by country, topic, and sector has also been conducted in order to include views of industry leaders and additional insights i.e., 'Country name' AI banking, 'Country name' Financial innovation, 'Country name' Agriculture innovation, 'Country name' transport IoT, 'Country name' Smart Cities, 'Country name' HealthCare innovation, 'Country name' Education digitalization and similar searches for all combinations of topics and sectors included in the report, for each GCC country.
The report also highlights GCC countries' participation in international initiatives related to innovation.

While the current report provides the main policies, organizations, sectors, emerging technologies, and initiatives in each of the GCC countries, given the large scope of this initial undertaking, it can be augmented by additional research in separate studies focusing on a specific GCC country, sector, technology.

Report structure

The report is structured as follows. Chapter 1 presents the innovation capabilities of the GCC member states and opportunities for the EU to assist the GCC countries in further developing their innovation ecosystems and achieving their economic diversification goals. Chapters 2 to 7 are dedicated to each of the GCC countries policies and strategies related to innovation, the organizations and entities who are shaping the innovation environment, as well as details on the application and implementation of emerging technologies by economic sector and/or technology, since many of the frontier technologies are implemented across sectors. The information in the country-specific chapters is organized by technology, which is applied cross-sector, followed by a discussion on sector-specific innovation projects and initiatives.

1. EU – GCC opportunities for collaboration

Innovation is widely recognized as a central driver of economic growth and development. A number of international organizations rankings of countries' capabilities related to innovation use indicators that reflect areas of strength and weaknesses of each country in promoting innovation and creating an environment conducive to innovation that will lead to sustainable economic growth.

Research and Development (R&D) spending – systematic efforts to create and apply new knowledge – is one of the main drivers of innovation and long-term economic success. There is a strong correlation between national R&D spending and GDP per capita. The world's most successful economies tend to have high levels of R&D spending. The economies of the Gulf are exceptions, having only low levels of R&D spending.

The World Economic Forum Global Competitiveness Index measures the **R&D expenditures as % of GDP**, amongst other indicators. In 2019, **many of the EU Member States ranked in the top 10 economies** in R&D expenditure as % of GDP. The UAE and Saudi Arabia ranked 37th and 43rd out of 141 countries included in the analysis, while the other GCC members had much lower levels of R&D spending.

The WEF Global Competitiveness Index measures of the **Innovation Capability** of each GCC country from 2017 to 2019 are presented in Figure 1. The UAE, Saudi Arabia, and Qatar have the highest scores in innovation capability and continue to improve. Qatar and Kuwait have recorded only a slight improvement since 2017. While Oman had the lowest score among the GCC countries in 2017, it improved sharply and ranks now 4th in the region compared to 6th place in 2017.

Figure 1: Innovation Capability Score GCC countries, 2017-2019
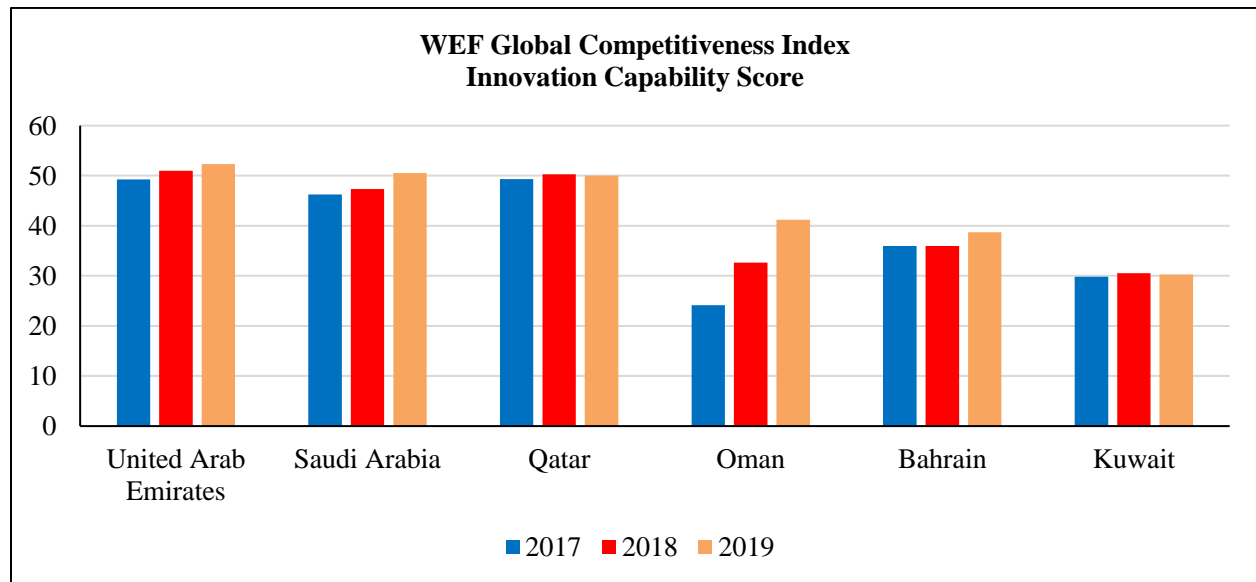
Source: Author's calculations using WEF Global Competitiveness Index database.

These results are consistent with **the findings of the Global Innovation Index (GII) analysis and rankings of the GCC countries**. The Global Innovation Index provides insightful data on innovation and assists economies in evaluating their innovation performance and making informed innovation policy considerations. The GII adopts a broad notion of **innovation, originally elaborated in the *Oslo Manual* developed by the European Communities and the Organisation for Economic Co-operation and Development (OECD).** In its fourth edition, the Oslo Manual 2018 introduces a more general **definition of innovation**: *An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).*

The Global Innovation Index (GII) 2020 includes 131 countries, which represent 93.5% of the world's population and 97.4% of the world's GDP in purchasing power parity current international dollars. The GII relies on two sub-indices—the Innovation Input Sub-Index and the Innovation Output Sub-Index—each built around the pillars shown in Figure 2.

Figure 2: Global Innovation Index pillars
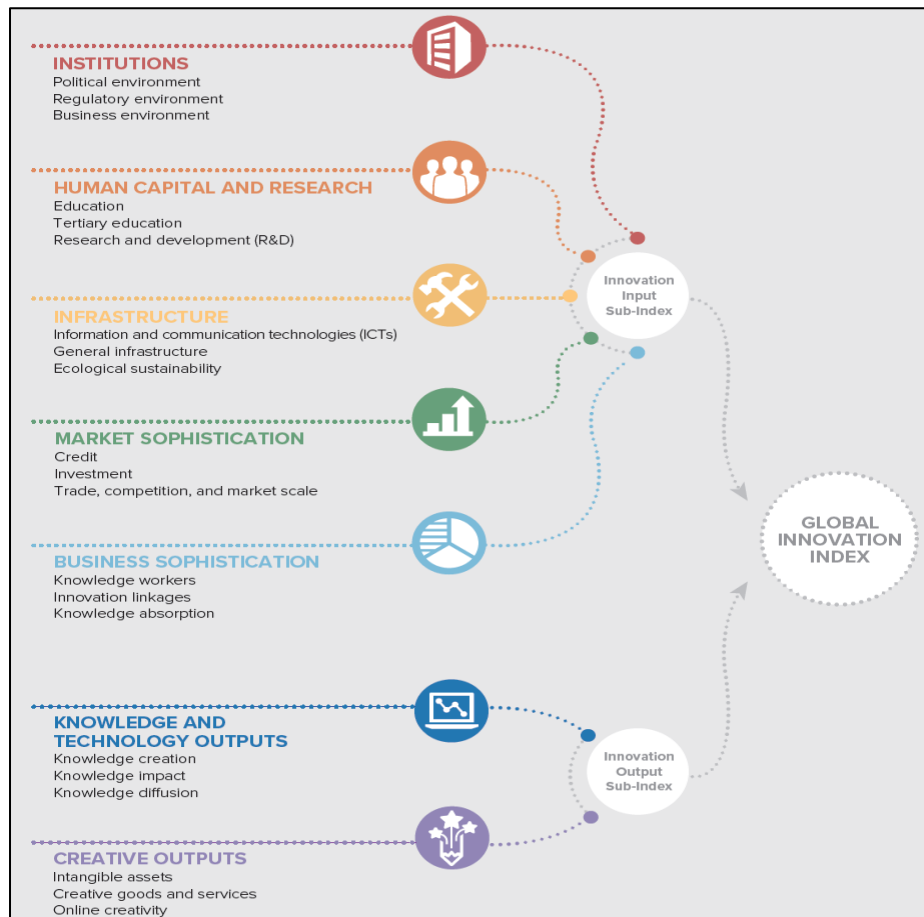
Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

The results of the GII study and rankings show that **innovative leaders have balanced innovation systems** – the top countries in the Global Innovation Index have strong performance across all pillars. Innovation leaders have complementarity and balance across the different areas of their innovation system. A **successful innovation system balances** the forces that push knowledge creation, exploration, and investments—the innovation inputs with the forces that pull ideas and technologies towards application, exploitation, and impact—the innovation outputs. In Table 1, highlighted in yellow are the highest rankings across GCC countries for each pillar of the Global Innovation Index 2020.

Table 1: Global Innovation Index 2020 GCC rankings

Global Innovation Index Pillars	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates
Institutions	51	88	70	58	102	28
Human capital and research	84	63	43	83	31	17
Infrastructure	43	55	56	28	57	17
Market sophistication	80	81	104	94	44	30
Business sophistication	86	98	95	77	51	22
Knowledge and technology outputs	86	73	124	85	88	78
Creative outputs	98	88	94	58	69	34
GII rank 2020	**79**	**78**	**84**	**70**	**66**	**34**

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

Based on the analysis of the Global Innovation Index measures, a number of **areas require special attention** to enhance the GCC countries' innovation capabilities that would contribute to the achievement of the countries' economic diversification and sustainable development.

Table 2 presents the **key areas where the EU can support the GCC countries** in the development of their innovation ecosystems.

Table 2: Key areas in each GCC country where EU can support innovation

Global Innovation Index Pillars	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates
Human capital and research	Number of graduates in science and engineering, number of researchers.	Research and Development, number of researchers.	Research and Development, number of researchers.	Number of researchers.		
Infrastructure	Logistics performance, Ecological sustainability, Environmental performance.	Information and communication technologies, ICT use, online e-participation, Logistics performance, Ecological sustainability, Environmental performance, ISO 14001 environmental certificates.	ICT use, Ecological sustainability, Environmental performance.	Information and communication technologies (ICTs) - Online e-participation, Ecological sustainability, Environmental performance.	Information and communication technologies, ICT use, online e-participation, Logistics performance, Ecological sustainability, Environmental performance, ISO 14001 environmental certificates.	
Business sophistication	Knowledge workers - Employment in knowledge-intensive services, University / industry research collaboration, Knowledge absorption - ICT services imports,	Knowledge workers - Employment in knowledge-intensive services, Knowledge absorption - ICT services imports.	Knowledge workers - Employment in knowledge-intensive services, Knowledge absorption - ICT services imports, Research talent in business enterprise.	Knowledge workers - Employment in knowledge-intensive services, Research talent in business enterprise.	Knowledge workers - Employment in knowledge-intensive services.	

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Global Innovation Index Pillars	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	United Arab Emirates
	Research talent in business enterprise.					
Knowledge and technology outputs	Knowledge creation - Scientific and technical publications, High-tech and medium high-tech manufacturing, high-tech exports.	Knowledge creation - Patent applications by origin, international patent applications, Scientific and technical publications, Knowledge impact (ISO 9001 quality certificates), high-tech exports.	Knowledge creation – international patent applications, Scientific and technical publications, Knowledge diffusion - High-tech exports.	Knowledge creation - Patent applications by origin, international patent applications, Scientific and technical publications, Knowledge impact - ISO 9001 quality certificates, Knowledge diffusion - High-tech exports.	Knowledge impact - ISO 9001 quality certificates, Knowledge diffusion - High-tech exports, ICT services exports.	Knowledge creation - international patent applications, Utility model applications by origin, Scientific and technical publications, Knowledge impact - ISO 9001 quality certificates, Knowledge diffusion - High-tech exports.
Creative outputs	Trademark applications, creative goods and services - cultural and creative services exports.	Intangible assets - Trademark applications, ICTs and organizational model creation, Creative goods and services - National feature films produced, Entertainment and media market, Online creativity.	Intangible assets - Trademark applications, ICTs and organizational model creation, Creative goods and services - National feature films produced, Entertainment and media market, Online creativity.	Intangible assets - Trademark applications, Online creativity.	Intangible assets - Trademark applications, ICTs and organizational model creation, Creative goods and services - National feature films produced, Entertainment and media market, Online creativity.	Trademark applications.

Source: Author's recommendations.

2. Innovation Environment - Bahrain

Policies and strategies

Economic Vision 2030

The Economic Vision 2030 was launched in October 2008 by His Majesty King Hamad bin Isa Al Khalifa. The Vision 2030 provides a clear direction for the continued development of the Kingdom's economy by enhancing productivity and skills and further opening Bahrain's market to expose national companies to process innovation and best practices. The Vision emphasizes the importance of attracting foreign investment as a key driver of process innovation and best-practice transfer. Bahrain is planning to transform the economy in the longer-term by capturing emerging opportunities. The Government of Bahrain and the private sector will act as partners in this by creating an environment highly conducive to entrepreneurship and innovation and establishing a platform for advancing innovation-to-market readiness, which will enable Bahrain tap into the global knowledge economy.

Digital Government Strategy 2022

The Digital Government Strategy 2022 highlights the Government's commitment to proactively transform its services utilizing digital technologies and thereby reinforce the advancements made in enabling the digital environment, digital readiness, and digital usage in Bahrain. Through the Digital Government Strategy 2022, the Government of Bahrain aims to advance the utilization of both emerging and mature technologies to enable a more open, responsive, and efficient government. The Government aspires to develop services that are designed around the needs and experience of citizens and deliver them in real time. An effective monitoring mechanism supervised by the Supreme Council for Information & Communication Technology (SCICT) has been established and supported by the National ICT Governance Committee which monitors the coordination and implementation of strategic digital initiatives across the Kingdom.

Various strategic initiatives are envisaged to lead the citizen-centric digital transformation based on the specific focus areas. Government entities will:

1. Develop an approach that ensures provision of digital services for everyone, with specific emphasis on strategies that tailor the service offerings to the specific needs of citizens.
2. Channel the efforts to attract more constituents to interact with Government via the digital channel of their choice. For those who cannot access online services, utilizing Assisted Digital approach is available to support the access of digital services independently.
3. Design the new public services on a 'digital first principle' and concentrate on digitizing the entire chain of activities where they provide the most benefit to the constituents.
4. Consider rebuilding identified public services with digital delivery at the foundation.
5. Enable citizens and businesses to supply diverse data only once to a Government entity.

6. Utilize advanced technologies to make more accurate predictions and smarter decisions through the analysis of the vast amount of data.
7. Consolidate government data and make them available to the public to enable greater transparency and civic engagement.

The government has identified ambitious plans for extensively utilizing digital technologies to strengthen its services, processes, and decision making as well as in sharing data to its constituents. In addition, the individual, organizational capabilities of government entities will be enhanced by aligning their digital strategies to the national digital government strategy, strengthening the governance mechanisms, enabling a digital workforce, and adopting agile development, while deploying robust cybersecurity measures and controls.

National Digital Strategy of the Kingdom of Bahrain

The strategy, which will be released soon, will set the directions on how to take advantage of the emerging technologies to streamline service delivery in Bahrain and take the Kingdom towards a better life for all.

The innovation ecosystem

As Bahrain has witnessed rapid advancement in the technologies, the focus has been shifted to create the right ecosystem for fostering innovation through emerging technologies, such as artificial intelligence, biotechnology, material sciences, and robotics within and across the Bahraini society. Bahrain has been encouraging those involved in designing, developing, and deploying new technologies to ensure that they are consistent with the Kingdom's values as well as in adherence to the existing international norms and standards. The use of these technologies has contributed to achieving the Kingdom's Vision 2030 and are supporting the implementation of Government Action Plan 2019-2022. The Information and eGovernment Authority (iGA), Economic Development Board (EDB), Tamkeen, The Central Bank Of Bahrain (CBB), and other governmental agencies have paved the way and facilitated the ecosystem to absorb the latest innovations and technologies.

The Information and eGovernment Authority aims to help the government entities identify the potential areas for the implementation of technologies such as the Internet of Things, blockchain, and artificial intelligence, which offers a remarkable transformation in the public service delivery and citizen engagement. The Information and eGovernment Authority is constantly exploring the potential of emerging technologies impact on the citizen engagement as well as in public administration.

Bahrain Investment Market (BIM) is an innovative equity market that is designed to enable fast-growing companies in the Kingdom of Bahrain, the GCC, and wider MENA region to obtain growth capital via direct offering. BIM enables fast-growing companies to obtain the needed growth capital for expansion and has the ripple effect of encouraging entrepreneurship, creating new job opportunities, and boosting the private sector's contribution to the national economy.

Tamkeen is a public authority that was established in 2006 to reform the labor market with the main aim of supporting the development of the private sector to be the main engine of economic and sustainable growth. Tamkeen has two primary objectives: to foster the development and growth of enterprises, and to provide support to enhance the productivity and training of the national workforce. Tamkeen's goal is to contribute towards the development and growth of the national economy, by strengthening the private sector and paving the way for Bahrain's ongoing diversification towards a technology-driven, knowledge-based, globally competitive, and sustainable economy. The authority supports individuals by financing training programs, professional certification, and through wage support. It also supports financially companies that are in the process of establishing enterprises, startups, and companies that are in the process of expansion. From its establishment, Tamkeen has supported more than 234,000 individuals and 53,000 organizations.

The Economic Development Board's (EDB) main tasks are to support the private sector, develop the economy, provide suitable conditions for investment, and create job opportunities for the Bahraini youth. The EDB allows 100% ownership of foreign investment in most business sectors.

Other government entities and organizations with major role in supporting innovation include the Ministry of Industry, Commerce and Tourism, the Bahrain Chamber of Commerce and Industry, Export Bahrain, and Bahrain Economic Development Board.

The Bahrain Development Bank (BDB) supports business incubators and accelerators. This led to the establishment of the Bahrain Business Incubator Centre in 2003. It became the first diversified incubator in the GCC region. One of Bahrain Development Bank's goals is to strengthen Bahraini businesswomen's capacity through the "Riyadat" center, which aims to increase the creativity and entrepreneurship of Bahraini women and bridge the gender gap.

StartUp Bahrain is Bahrain's national ecosystem for innovative scalable startups. It is made up of startups, investors, accelerators, incubators, educational institutions, and the Bahrain government. The Kingdom of Bahrain currently has more than 75 innovative startups and over 34 accelerators, incubators, and co-working spaces. All these efforts are aimed to grow the economy and increase the share of industry contribution to GDP.

The Ministry of Industry, Commerce, and Tourism (MOIC) encourages the private sector to invest in incubators and accelerators by providing business incubators and accelerators licenses. MOIC has issued terms, conditions, and legislation regulating incubators and accelerators activities. The Ministry offers Trademark and Patent eServices that facilitates online filing for patents and allows uploading all required documents. These services are offered for nationals and residents. Patent applicants can submit online all their "Requests for changes" such as change of owner, change of agent, change of owner details or change of agent details, as well as annual payments. Foreign applicants who are not resident in the Kingdom must apply through the Intellectual Property Registration Office or a law firm in the Kingdom of Bahrain. The protection period is 20 years from the date of application in the Kingdom of Bahrain.

Emerging technologies and initiatives

Artificial Intelligence (AI)

Bahrain recognizes the importance of artificial intelligence in streamlining business processes and has taken a few steps in the study and application of AI in different fields. Tamkeen, in cooperation with Bahrain Polytechnic and Microsoft Corporation, has announced the **Artificial Intelligence Academy** at Bahrain Polytechnic which aims to provide a platform for the youth to boost their innovation and creativity capabilities in the field of artificial intelligence. Bahrain Polytechnic has signed an MoU with Microsoft Corporation to enhance cooperation in using artificial intelligence at the University and provide a platform for students to develop their projects and ideas using AI. His Highness Sheikh Khalid bin Hamad Al-Khalifa, First Deputy President of the Supreme Council for Youth and Sports, has launched a tournament for students on innovation in artificial intelligence under the slogan #Let_Us_Innovate_Future.

The **World Economic Forum's Centre for the Fourth Industrial Revolution has been working closely** with the Economic Development Board and the Information and eGovernment Authority to design guidelines to enable governments to use artificial intelligence technologies responsibly and sustainably.

Blockchain Technology

Many industry leaders have already achieved significant benefits by adopting blockchain technology in their business operations. They have achieved greater transparency, enhanced security, improved traceability, increased efficiency and speed of transactions, and reduced costs. Therefore, the Economic Development Board, in cooperation with the Information and eGovernment Authority, is developing a National Strategy for Blockchain in the Kingdom of Bahrain. The strategy will set the general directions and support the adoption of blockchain technology within the public and private sectors in Bahrain. Following are examples of blockchain application in the public sector in Bahrain.

The **Blockchain Vehicle Registration** project at the General Directorate of Traffic (GDT) is part of the Government of Bahrain's drive to achieve the objectives of Bahrain Economic Vision 2030, achieve sustainable development goals for sustainable infrastructure, and catalyze comprehensive and sustainable manufacturing by providing high-quality services and employing the latest technology in the management of vehicle registration. The new registration system significantly reduces the cost of maintaining basic vehicle data and enables vehicle registrars to obtain accurate and up-to-date vehicle information while achieving greater information management efficiency and greater transparency.

The University of Bahrain (UOB) has adopted blockchain technology to **award certificates** to its graduates. With the application of the blockchain technology, it is possible to achieve greater security and to verify the credibility of the academic certificates granted by the University of Bahrain via the Internet without having to go back to the university or any other entity to verify its credibility.

APM Terminals. Operators of Khalifa Bin Salman Port (KBSP) has been working on the adoption of blockchain technology in coordination with other stakeholders, including customs authorities and customers.

Cloud Computing

The Kingdom of Bahrain has partnered with Amazon Web Services (AWS) in 2017 to be the official Cloud infrastructure provider for the public sector in Bahrain. To date, more than 40 government systems and services have been successfully **migrated to the cloud** on AWS data centres. In regard to equipping the workforce with the skills and knowledge needed during the transformation to cloud, iGA and Tamkeen have put together a certification program fully funded by Tamkeen to bridge the gaps and support building cloud-ready workforce.

Data Analytics

Open Data is the foundation for the government to provide machine-readable data to individuals, businesses, and government entities, who will be able to utilize government data to research and develop new solutions and make better decisions.

Bahrain Open Data Portal provides a wide range of government data without any restrictions to be reused, analyzed, or shared while respecting all personal data privacy rules under the Personal Data Protection law. Leveraging Big Data has enabled Bahrain to implement several projects that require analysis of large amounts of data such as the population census and other administrative records of the state institutions, saving effort, time, and expenses. The Information and eGovernment Authority is producing a large amount of data that can be used to help develop the Kingdom's infrastructure and develop the sectors of the economy, health, and education.

Internet of Things (IoT)

Kingdom of Bahrain was the first in the GCC to issue **standards for IoT connectivity**. Bahrain supports the use of the frequency band for IoT (NB-IoT) systems within the international mobile communications systems. The Information and eGovernment Authority has provided government entities with the required frequency bands that will contribute to the Kingdom's Digital Transformation journey and support achieving 2030 Kingdom's vision for smart cities and IoT.

The Ministry of Transportation and Telecommunication has launched several digital initiatives to streamline business processes. **Lift Portal** is the new online platform at APM Terminals Bahrain, Khalifa Bin Salman Port Operating Company Licensed and managed under Ports & Maritime Authority. Offering real-time visibility of container status within the terminal, Lift helps drive increased efficiency in container operations. **Marasi Portal** is a fully automated portal established to facilitate easy access to different port services to customers, which include licensing, handling charges, and ship movements, amongst others. All procedures and applications can be completed electronically, with an integrated financial system.

The Ministry of Works, Municipalities Affairs, and Urban Planning in Bahrain are utilizing **IoT for the irrigation system automation**, which will the irrigation process more efficient.

The Electricity & Water Authority adopt IoT for Distribution Automation in which the collection, analysis, and execution of data are automated.

Economic Development Board EDB) and Batelco launched the "Brinc Centre" - **Batelco Internet of Things Hub** - which supports and contributes to the Bahrain ecosystem by fostering the growth of IoT and entrepreneurship in the region.

Bahrain Airport company utilizes the latest Information and communications technology (ICT) solutions for the communication system, such as cloud-based unified communications, video cloud, IoT, and Big Data platforms.

Robotics

The Kingdom of Bahrain has witnessed several initiatives that reflect the Kingdom's direction towards adopting robotic technologies in facilitating customer service delivery.

The Arab Banking Corporation in Bahrain (ABC) has unveiled Fatema in 2019, ABC's and the region's first emotionally intelligent **digital employee**. Bahrain Islamic Bank (BISB) has also launched its first virtual employee Dana as part of BISB's efforts towards transforming their banking services through emerging technologies. Kuwaiti Financial House (KFH) in Bahrain has used the first robotic assistant for loan applications. The robot named "Baitak Assistant" handles customer loan applications and autonomously create credit reports for applicants.

On the educational level, Bahrain hosted in 2018 the 8th **World Robotics Olympiad** (WRO2018). Student teams from the various primary, intermediate, and secondary governmental and private schools competed in offering their best innovative design and construction of robotics.

The Ministry of Labor and Social Development (MoLSD) has launched a training program for children at the Children's and Young People's Clubs, to install and program robots, to inspire young people to become future leaders in science and technology. The program connects them to an exciting program built with scientific, technological, and creative skills.

The Ministry of Finance is exerting efforts to automate financial operations in its various departments by using **Robotics Process Automation** to increase productivity, minimize human errors and costs.

Smart Cities

Bahrain has initiated the movement towards smart cities whereby the urban areas in Bahrain can become more efficient, livable, and sustainable in both the short and long term with the active participation from public administration, citizens, and businesses.

The Telecommunication Regulatory Authority (TRA) has applied many smart cities' initiatives, such as **smart traffic lights**. Smart traffic lights or Intelligent traffic lights are a vehicle traffic control system that combines traditional traffic lights with an array of sensors and artificial intelligence to route vehicle and pedestrian traffic. The **Electricity and Water Authority** is encouraging citizens to use solar energy and affording soft loans to move towards a full solar energy system. The University of Bahrain has conducted the 2nd Smart Cities Symposium in 2019 covering topics related to Smart Cities adoption and applications.

Bahrain is developing its human capital and equip them with the skills and knowledge needed for working with emerging technologies through the development programs provided by the Universities and funded by Tamkeen. Moreover, the Kingdom has paid attention to the needs of early-stage businesses and startups within the sector improving access to venture capital funding. Therefore, Bahrain Development Bank (BDB) has provided many **funding programs**. One of the major announcements was the launch of the Al Waha Fund, dedicated venture capital fund aimed at attracting Venture capital - VCs and strengthening the region's startup ecosystem.

Education

The Fourth Industrial Revolution is an important part of the process of curriculum development and education outcomes. To ensure fair and inclusive education and to enhance lifelong learning opportunities for all, the Kingdom of Bahrain is working hard to achieve a sustainable, knowledge-based and diversified economy in line with developments in the technology sector in education in order to achieve the objectives of Bahrain Economic Vision 2030. The Kingdom of Bahrain has introduced **new programs in universities** and educational institutions such as the Big Data operations program, The Master of Environment and Sustainable Development Program, and the FinTech Financial Technology Master Program.

Financial sector

Bahrain has 104 licensed banks with assets of USD 189 billion, 59 investment firms, 144 insurance firms, 53 specialized licensees, and 16 capital market firms. The Kingdom is also home to the world's highest concentration of Islamic finance institutions with more than 25 institutions covering almost every aspect of Islamic banking. The Banking & Finance sector alone continues to be the largest non-oil contributor to Bahrain's real GDP. The Central Bank of Bahrain (CBB) is widely regarded as one of the region's most advanced supervisors. It continuously enhances a tried-and-trusted regulatory framework that meets international best practice and plays a leading role in achieving regional standardization

Bahrain has taken steps to embrace the FinTech industry with the development of a wide range of financial innovations and initiatives. The CBB has provided a **regulatory framework to facilitate innovations** in financial technology and has set up the Fintech & Innovation Unit within the CBB structure to ensure the best regulatory and implementation of the financial services in Bahrain. Examples of such **FinTech initiatives regulated by CBB are Bahrain FinTech Bay, the Regulatory Sandbox** - that allows startups, FinTech firms, and licensees to provide innovation in banking and financial solutions. In addition, CBB issues crowdfunding regulations for both conventional and Islamic Banking services and other initiatives.

Bahrain's FinTech Bay is one of the Kingdom's most important initiatives focusing on investing in innovation such as advanced laboratories, business accelerators, and educational opportunities.

Bahrain Economic Development Board has taken significant steps to support and boost the FinTech industry in Bahrain through attracting foreign direct investment and setting the direction of the industry. **Flat6Labs Bahrain** is a startup accelerator supported by Tamkeen to accelerate and launch both local and international startups in the Kingdom of Bahrain. The program welcomes ideas and startups working in innovation-based and knowledge-driven industries, including but not limited to financial services and payments, education technology, ICT and electronics; mobile apps and games, B2B infrastructure services, healthcare, tourism and real estate technologies, and hardware and industrial solutions.

Open Banking is a direct response to consumer demand for greater access to their own financial information and the ability to seamlessly interact with that data. Bahrain is the first country in the Middle East to adopt Open Banking, replicating the efforts of global finance hubs such as the United Kingdom. The first step is the adoption by the National Bank of Bahrain (NBB) of the **FinTech Tarabut Gateway's Open Banking infrastructure**. Tarabut Gateway is a trailblazer, having been the first company to graduate from the CBB's Regulatory Sandbox.

ICT sector

In January 2021, Bahrain achieved **full national 5G coverage**, with two of the three mobile operators now covering the entire population with 5G. Authorities hope the roll-out will attract global tech firms to invest in the country to leverage the next generation technology across a wide variety of applications. Bahrain's telecoms sector attracted some BHD 787m in investments (more than $2bn) between 2009 and 2019. In line with the kingdom's economic diversification efforts, Bahrain's ICT sector now accounts for nearly 3 percent of the national GDP. The Kingdom has pursued a strategy of flexible regulation to encourage **investment in the telecoms sector**. Bahrain was the first GCC member to open and liberalise its telecoms market and remains one of the region's only telecoms markets with no restrictions on VoIP services.

Oil and Gas 4.0

In light of the Fourth Industrial Revolution, the Oil & Gas 4.0 initiative will adopt emerging technologies to transform the downstream, midstream, and upstream activities into a connected, information-driven environment through AI and IoT solutions. The initiative will pilot new projects utilizing emerging technologies and ensure **digital transformation of all Oil and Gas companies**.

Bahrain Space Team

The Kingdom of Bahrain is keen to invest in space science and its diverse applications. The National Space Science Agency (NSSA) was established in 2018 and it announced the launch of Bahrain's 'Space Team' program, which aims to support Bahrainis working across a wide range of areas related to **space, science, and technology**. The NSSA is working to build its employees capabilities in working with Big Data. It also

organizes specialized workshops in the space, smart cities, and IoT fields. Bahrain supports the participation of a group of students from the Kingdom in the space camp held annually in the United States of America within the program of the Bahrain Space Team. The program aims to achieve the objectives of the National Space Science Authority (NSSA) and provide the opportunity to learn about space journeys and select astronauts. This participation supports the national approach to achieve comprehensive, sustainable development and prosperity in line with Bahrain Vision 2030.

Global Financial Innovation Network (GFIN)

CBB is a member of the coordination group of the Global Financial Innovation Network. The Global Financial Innovation Network (GFIN) was launched in January 2019 by an international group of financial regulators and related organisations, including the Financial Conduct Authority (FCA). This built on the FCA's early 2018 proposal to create a global sandbox. The GFIN is a network of 28 organisations committed to supporting **financial innovation in the interests of consumers**. The GFIN seeks to provide a more efficient way for innovative firms to interact with regulators, helping them navigate between countries as they look to scale new ideas. This includes a pilot for firms enabling them to test innovative products, services, or business models across more than one jurisdiction. It also aims to create a new **framework for co-operation between financial services regulators on innovation related topics**, sharing different experiences and approaches.

Digital Cooperation Organization (DCO) – Bahrain, Jordan, Kuwait, Pakistan, Saudi Arabia

Bahrain is one of the founders of the Digital Cooperation Organization, a global organization aimed at strengthening cooperation across all innovation driven areas and accelerating growth of the digital economy. Founded by Bahrain, Jordan, Kuwait, Pakistan, and Saudi Arabia, the DCO is driven by a vision to realize a **digital future for all by empowering women, youth, and entrepreneurs** and grow the digital economy. Based on its digitally focused charter, the DCO welcomes participation and guidance from the private sector, international organizations, non-government organizations, and the academic world.

3. Innovation Environment - Kuwait

Policies and strategies

Kuwait Vision 2035

The goal of Kuwait Vision 2035 is "to transform Kuwait into a financial and trade hub, attractive to investors, where the private sector leads the economy, creating competition and promoting production efficiency". Innovation is a critical factor in achieving the Kuwait National Development Plan's objectives, that include reforming administrative and bureaucratic practices to reinforce transparency, accountability, and efficiency in the government, developing a prosperous and diversified economy to reduce the country's dependency on oil export revenues, and increasing Kuwait's regional and global presence in trade.

The innovation ecosystem

Kuwait Direct Investment Promotion Authority (KDIPA)

KDIPA was established in 2013 as a specialized public authority with financial and administrative independence. KDIPA has a developmental role by contributing to the national goals of economic diversification, job creation and quality training for nationals, and by extending the positive spillover impact of foreign direct investment impact for the local economy. The authority has a promotional role by attracting and encouraging value-added and innovation-based direct investment into Kuwait for the purpose of enhancing technology transfer and settlement.

The Central Agency for Information Technology (CAIT)

CAIT has developed the Kuwait National IT Governance Framework (KNIGF) to be implemented by all IT Centers across the State of Kuwait's Government entities and agencies. The objectives include better management of IT to improve quality of IT services delivered by the government agencies, better alignment between IT and the organizational strategic plans, and government entities' compliance with regulatory requirements.

National Bank of Kuwait

In January 2021, the National Bank of Kuwait (NBK) launched the Second Edition of the Tamakan program, that promotes the creativity of Kuwaiti youth. NBK is committed to support sustainable development that focuses on preparing a creative and innovative generation. Over the past years, NBK has invested heavily in community programs to empower Kuwaiti youth. In addition, developing its employees is the key pillar for NBK's leadership and excellence.

The "Tamakan" program for training fresh Kuwaiti university graduates was organized by Creative Confidence and sponsored by National Bank of Kuwait (NBK) for the second year in a row. Creative

Confidence is a Kuwait-based consulting and training company specialized in stimulating innovation and creativity and providing hands-on training experiences for Kuwaiti fresh graduates with the aim of developing young national cadres. The bank hosted 40 trainees at different training positions at its HQ for three months, from January to April 2021, during which the bank provided them with courses aimed to develop their skills and qualify them for the labor market. NBK Group CEO stressed that sponsoring Tamakan program comes as part of the bank's commitment to its social responsibility and national duty to achieve sustainable development that mainly depends on preparing an innovative and hard-working generation that is able to take responsibility. The program focuses on many themes and workshops about creativity and innovation, design thinking, business model design, career exploration and innovative de-risking solutions.

The bank recognizes the need for educational outputs that meet the current requirements of the labor market, which has evolved and is looking for competent and experienced candidates in the areas of advanced technologies including artificial intelligence, robotic systems, programming, as well as digitization.
NBK organizes various activities and training programs starting with training newly hired employees to enhance their skills and help develop and qualify them to be future leaders. The NBK Academy provides graduates with training courses developed in cooperation with leading international institutions and universities.

Zain

In December 2002, Zain, the leading digital service provider in Kuwait, announced the launch of the sixth edition of its Zain Great Idea (ZGI) tech startup accelerator program. The program was established in collaboration with Brilliant Lab, a startup Accelerator Service from Kuwait, and Mind the Bridge, a global organization based in Silicon Valley that bridges the world through entrepreneurship education for startups, enterprises, and investors to succeed in global markets.

ZGI offers a refreshed opportunity for local talents and Kuwait's entrepreneurial community, as it has been one of the most successful initiatives Zain presented to the Kuwaiti market as part of its comprehensive innovation and entrepreneurship strategy. Throughout five successful editions, ZGI empowered, trained, and invested in hundreds of creative and driven Kuwaiti youth, of which many now own thriving and active Small and Medium-sized Enterprises (SMEs) in local and regional markets. Zain is well aware of the crucial role played by private sector organizations in supporting social and economic sustainability projects. Springing from its growing commitment towards practicing its social responsibility, the company is committed to printing a positive impact through all its activities. This has led Zain to embrace the most influential issues in the community, including the support of youth, entrepreneurship, and innovation.

The National Fund for Small and Medium Enterprise Development

In April 2013, the Government established a National Fund for SME Development (the "SME Fund"). The law is intended to help the country make significant progress in the efforts to support the youth, combat unemployment, and enable the private sector to drive economic growth. As an independent public

corporation, with a total capital of KD 2 billion, the SME Fund aims to finance up to 80 percent of capital for feasible small and medium projects submitted by Kuwaiti nationals. The law defines eligible SMEs as enterprises that employ 1 to 50 Kuwaiti workers, with financing requirements that do not exceed KD 500 thousand. The fund goal is to build an inclusive, collaborative, and innovative ecosystem for entrepreneurs to lay the foundation for economic opportunities in Kuwait.

Emerging technologies and initiatives

Internet of Things

In February 2020, the Deputy Director General of the Central Agency for Information Technology announced the start of **using IoT applications at government agencies**, in line with Kuwait Vision 2035. The Deputy Director General stressed the importance of **cloud computing applications in state agencies** due to the impact on the speed and ease of data exchange, as it works to unify and simplify the use of technology between state machines. He also stressed the importance of joining efforts to raise awareness of electronic hacking.

Agriculture

Kuwait imports more than 80% of its food, making the country vulnerable to disruptions in global supply chains, as seen during the COVID-19 crisis. Digitally transforming Kuwait's agricultural sector supports New Kuwait 2035 goals and helps foster the local innovation economy and job creation. In 2020, a joint venture between a Kuwait and a German company has opened a **commercial indoor vertical farm**, that produces high-quality and sustainable crops indoors, which increase the nutritional quality and decrease environmental impact. The vertical farming method uses 90 percent less water compared to traditional farming, 60 percent less fertilizer, and zero pesticides. The technology used to develop climatized rooms is 40 percent more energy-efficient than other indoor vertical farming systems when it comes to energy use for climatisation.

Smart agriculture will continue to be an important area for investment as the food supply chain comes under increasing stress resulting from a changing climate. Desertification, drought, flooding, and wide climatic shifts are putting more pressure on the global food chain.

The project on the "**Construction of specialized integrated and advanced agricultural systems to promote sustainable agricultural production**", scheduled for completion in 2022, is 88% complete. The goals of the project are to increase productivity of the agriculture sector, provide technological infrastructure to support sustainable agricultural production, and establish four specialized agro-system facilities, including an integrated modular field agricultural research station.

The establishment of an integrated agricultural system is one solution to the problem of global warming. The integrated farming system efficiently uses natural resources, reduces the waste problem, reduces the need to transport materials to and from the farm, and helps reduce greenhouse gas emissions. The use of

the integrated farming system contributes to improving production in a qualitative way and promoting the production of healthy and clean food. The integrated farming system contributes to the application of the principle of sustainability in local production and therefore contributes to enhancing food security in Kuwait.

Financial sector

In line with its vision and aim to encourage and adopt innovation in financial technology (FinTech), the Central Bank of Kuwait (CBK) has issued the **Regulatory Sandbox Framework** document which encourages both companies and individuals looking to provide innovative products and services, that are built on or associated with electronic payment of funds and that utilize new technology or an existing technology in an innovative way, to test their innovations within a methodology that ensures the safety and soundness of the financial & banking sector.

The Regulatory Sandbox Framework includes four stages to be completed within one year at the most. The Regulatory Sandbox starts with the application stage of the proposed product or service, then the evaluation stage where thorough evaluation, which covers technical, security, and regulatory aspects of the application will take place, followed by the experimentation stage of the proposed product or service in a testing environment, and finally the accreditation stage, where CBK grants its approval (or rejection) to deploy the proposed product or service in the local market.

Kuwait Finance House (KFH), established in 1977 as the State of Kuwait's first Islamic bank is adopting emerging technologies, like **robotic process automation**, as well as **investing in fintech startups**, to keep up with customer expectations. **Cloud services and emerging technologies such as artificial intelligence** and robotic process automation have disrupted a number of different sectors, especially the banking industry. The response is an ongoing process of digital transformation that consists in selective adoption of emerging technology, constant effort to optimize business processes, continual measurement of digital maturity, and smart investments in startup technologies. New technologies and new competitors have increased customer expectations, making banks more vulnerable to disruption.

Healthcare

Kuwait's 2035 vision aims to strengthen investment in high quality healthcare which has already led to increased efficiency, use of innovative technology, and a changing culture. Kuwait's Vision 2035 is to diversify and also to make the private sector a key player in providing health services. Moving forward, Kuwait is **investing in growing, and scaling up its health sector leveraging digital health and IT**.

Events

The 12th IIFME – International Invention Fair of the Middle East – was organized in February 2020 by Kuwait Science Club under the Patronage of His Highness the Emir of Kuwait, Sheikh Sabah Al-Ahmad Al-Jaber Al-Sabah, and in collaboration with the International Exhibition of Inventions Geneva &

International Federation of Inventors' Associations (IFIA). The convention promoted Kuwait's role in encouraging and supporting the inventors and participants in this public service. The 12th IIFME brought 42 different countries together including United Kingdom, USA, Switzerland, Sweden, Spain, Thailand, Egypt, Syria, Lebanon, Oman, Qatar, Iran, Iraq, Kuwait, Algeria, Tunisia, Bahrain, amongst others. A total of 130 inventions were showcased during the exhibition that attracted 45000 visitors.

In **October 2021, Kuwait will host the 4th Financial Technology Conference and Exhibition**, designed for the financial services and innovation community. It will unravel the opportunities that exist today in the sector, open the discussion on the challenges faced by the sector, and aim to find solutions to these challenges.

International Cooperation

Kuwait is also one of the founders of the Digital Cooperation Organization, mentioned in the section on Bahrain.

Project – cross-sector

Research and development centres

As part of the New Kuwait Development Plan, the "Research and Development centres to support the private sector" project has been completed in 2021, as planned. The objectives of the project include developing and supporting knowledge management capabilities to enhance the capacity of the national private sector, improving the technological capabilities of the Kuwaiti private sector to activate its role in economic development and achieve the state vision.

The project established nine specialized research units to support scientific research activities at the Kuwait Institute for Scientific Research. The project established specialized research facilities and centers in nanotechnology, biotechnology, genetic engineering, sustainable development, weather forecasting of natural and environmental disasters, marine management, food and nutrition, desert development, urban development, sustainability of facilities and infrastructure, a regional center for Persistent Organic Pollutants (POPs), and economic and financial studies.

4. Innovation Environment - Oman

Policies and strategies

Oman Vision 2040 aims to enable the Sultanate to overcome challenges, keep pace with regional and global changes, generate and seize opportunities to foster economic competitiveness and social well-being, stimulate growth, and build confidence in all economic, social and developmental relations nationwide. The goal of the Vision is for Oman to join the world's developed countries. While identifying the national priorities, the Vision focuses on reshaping the roles of and relation between the public, private, and civil sectors to ensure effective economic management, achieve a developed, diversified, and sustainable national economy, ensure fair distribution of development gains among governorates, and protect the nation's natural resources and unique environment.

Economic diversification and fiscal sustainability are among the national priorities. The goal is to build a diversified, sustainable, and competitive economy that is based on knowledge and innovation, operates within integrated frameworks, adapts with the industrial revolutions, and achieves fiscal sustainability. To achieve this goal, innovation and entrepreneurship are key enabling factors.

Digital Oman Strategy

Endorsed in 2003, Digital Oman Strategy aims to transform Oman into a sustainable knowledge-based economy. The Sultanate of Oman has embarked upon its journey to transform Oman by empowering its people, through the eOman initiative, besides opening up thousands of job opportunities for nationals in the IT sector. The goal includes a significant improvement in the quality of services the government provides to its citizens. The strategy consists of six pillars: advancing the digital society, smart government and services, vibrant digital and ICT industry ecosystem, governance, standards and policies, next gen-infrastructure, and promotion and awareness regarding the digital strategy.

Advancing the Digital Society pillar will be implemented by achieving the following goals:

- Develop and implement a National IT Training and Awareness Framework.
- Train citizens and government employees on basic IT literacy.
- Provide students with basic IT knowledge in schools.
- Offer intermediary IT training and skills development to professionals.
- Offer specialized IT training and Certification to IT professionals.
- Offer PCs and internet access to the public at reduced prices.

Smart Government and Services goals include:

- Re-engineer identified processes.
- Deploy Free and Open-Source packages in government organizations besides licensed packages.
- Acquire and deploy government infrastructure required for offering services online.

- Enhance government applications to deliver online services.
- Develop IT business continuity processes to meet recovery targets.
- Protect and secure information assets of the government.

Vibrant Digital and ICT industry ecosystem will be developed as follows:

- Establish more multi-national companies' branches to operate from Oman.
- Run centers of excellence to help enabling the development of the IT industry.
- Develop local IT industry to move to solutions provision.
- Develop and market Omani content and applications internally and externally.
- Create industry partnerships between Omani companies and foreign partners.
- Create IT industry support services to enable multi-national companies to operate from Oman.
- Incubation program to provide business, financial, and technical support for incubates.
- Industry associations to play active role in creating partnerships.

Digital Transformation Program

The eGoverment vision in Oman was developed after the approval of the National Strategy for Digital Society and eGovernance in May 2003. The Digital Transformation Program aims to create a sustainable knowledge-based society and raise the productivity and efficiency of the public sector by building national capacities, strengthening the infrastructure, developing the IT industry, and improving the quality and execution of government services. These services should adhere to specific standards and timeframes to achieve the objective of simplifying the service procedures to citizens, businesses, and government entities.

The Ministry of Technology and Communications (MTC) is the authority responsible for supervising the development and implementation of the Digital Transformation Program as well as monitoring the performance. MTC is responsible for supporting the government entities in improving business processes, developing operations, and automating the channels of service delivery:

- Developing the Digital Transformation Program by applying a unified institutional framework for the digital transformation.
- Introducing the methodology of the Digital Transformation Program.
- Developing all necessary models, standards, and tools for the digital transformation.
- Providing the required IT infrastructure and integrating the different digital systems in the institutions.
- Providing Advisory support in all areas of the digital transformation to serve the strategic objectives and improve performance.
- Developing information exchange in the institution and improving the utilization of available resources and skillsets.
- Aligning business strategies and information technologies with the digital transformation program.
- Reviewing the administrative work, simplifying and facilitating procedures, and re-engineering processes.

- Supporting the implementation of the digital transformation projects, managing them, and ensuring the best practices are applied in the project management.
- Organizing and presenting specialized and awareness-raising workshops in all related digital transformation areas.
- Assessing readiness, measuring progress, and preparing regular reports.

National Innovation Strategy (NIS)

Launched in 2017 by the Research Council of Oman, the strategy is the roadmap towards innovation and the transition from traditional thinking in regard to goods and services, to a creative and knowledge-based economy. The strategy focuses on achieving a national innovation-driven economy that can place Oman among the top 20 leading countries for innovation in the world by 2040.

NIS aims at the establishment of an innovation enabling environment, diversification of the national income sources, creation of renewable job opportunities, and enhancement of the standard of living of citizens. The strategy's four pillars include economic diversification, intellectual property and knowledge transfer, institutional and social integration, and human capital. To achieve institutional and social integration, a number of areas of focus have been identified: a national system for open innovation, integration of innovation policies - education, research and development (R & D), knowledge transfer and infrastructure, and infrastructure - research & innovation capacity.

In 2020 The Research Council (TRC) has reaffirmed the harmony between the vision of the National Innovation Strategy (NIS) with Oman Vision 2040, reinforced by a political will and continuous institutional integration, which has resulted in various initiatives in all fields.
As research and development are some of the main components of the innovation system, TRC has also updated the National Strategy for Research and Development (NSRD 2040) to align with Oman Vision 2040's perspective that research leads to the development of a knowledge-based society and capable national cadres.

The Director of National Innovation Strategy (NIS) at TRC stated in an interview in 2020: "The completion of the first stage of the NIS in the Sultanate has enabled us to reap the low-hanging fruits, in the form of focusing on activating existing national initiatives, strengthening interactive relationships between institutions of knowledge and innovation, strengthening relationships with technical and financial supporters, and strengthening relationships with the users of intellectual and scientific production to establish a solid and fully-fledged national system and active circles that lead to the second stage, which is the stage of sustainable empowerment of innovation circles and actors in all components of the national system, starting from 2021."

According to the TRC, the Ministry of Commerce and Industry is preparing a comprehensive national strategy for the development of an intellectual property system that is powered by smart electronic services. They are also providing special support to students by offering them a reduction of 90% on the patent application fees, which has contributed to the encouragement of the youth to register their patents. This

approach is expected to enhance the indicators of innovation outputs of the Sultanate in international reports.

National Aviation Strategy 2030

Oman's Ministry of Transport National Aviation Strategy 2030 aims to strengthen the country's economy by improving the aviation industry in the Sultanate. The strategy outlines ambitious goals that are set to be achieved by 2030, including developing an effective organisational framework that contributes to supporting and developing the aviation sector, strengthening the Omani economy, creating job opportunities, building manpower; and strengthening companies' capabilities and expertise. Due to playing an important role in the success and improvement of aviation services with regards to logistics, marketing, and communications, among other areas, the new strategy will also benefit from digital innovation and technology.

The innovation ecosystem

Oman Research and Education Network (OMREN)

OMREN is a central part of a sustainable infrastructure that contributes to the emergence of an effective national innovation ecosystem. It provides the research and education community in the Sultanate of Oman with a common network and collaboration infrastructure adapted to their needs. Its goal is to enable a technically, financially manageable and sustainable national Information and Communication Technology infrastructure, as well as services that shall effectively contribute to the development of innovation, research, education, strategic and international e-collaboration with the research and education community of the Sultanate of Oman.

The Research Council (TRC)

TRC's mission is to create an innovation environment that is responsive to local needs and international trends, fosters social harmony, and leads to creativity and excellence.
TRC's vision is focused on the following areas:
- Oman to become a regional hub for innovation, and a leader in producing new ideas, products, and services.
- Oman to have the largest research capacity in the region.
- Omani research to excel in selected fields of national importance.
- Oman to have a research culture that responds swiftly to local social and economic needs.
- Oman to have a world-class infrastructure for evidence-based policy making.

To achieve its objectives of building research capacity mechanisms, achieving research excellence, building knowledge transfer and value capture, and providing an enabling environment for research and innovation, TRC has launched a number of programs and initiatives. These include Innovation Programs, the Research and Innovations Award in Water Science, the Oman Eco House Design Competition, the Academic

Innovation Assistance Program, the Industrial Innovation Assistance Program, the Individual Innovation Competition Scheme, the Education Innovation Assistance Program, and the Community Innovation Assistance Program.

Ministry of Transport, Communications and Information Technology

The vision of the ministry is to position the Sultanate among the top ten countries in the logistical performance internationally, by the year 2040. One of the objectives is to introduce modern technology and promote scientific research in the field of Transport and Logistics by:

- Embracing modern technology in the field of Transport and Communications.
- Establishing Transport Research Center to ensure the quality of the Infrastructure.
- Improving the safety standards.
- Activating cooperation with other research organizations and institutions.

Another objective is to achieve a high level of accessibility and development of the telecommunication services. This will contribute to supporting innovation across sectors by developing broadband infrastructure, ensuring the availability of the telecommunication services across the country, and providing high-quality and affordable telecommunication services.

Industrial Innovation Center (IIC)

Oman Industrial Innovation Center (IIC) is an independent government company, established under Tanfeedh program to support the growth and diversification of Oman economy through acceleration of innovation and knowledge-based industries. The Center's main programs include:

- Capacity Building: Training Omani nationals to qualify and work as Industrial Innovation Specialists, then become members of knowledge based industrial economy network.
- Startups Innovation: Commercialization of industrial innovations by establishing startups and coach/mentor them to accelerate and grow. IIC extends support in fine-tuning of the innovation, technology scouting, opportunity scoping and implementation till the startup is sustainable.
- Company Innovation: Facilitating and co-funding innovative projects aimed at new product development, product / process optimization, problem solving, developing technologies, prototyping and implementation to enhance company's performance and competitiveness.
- Sector Innovation: Supporting management and operations towards best global innovation practices. Championing and co-funding innovation in key industrial sectors through transfer of technologies, identifying and developing opportunities, waste reduction / management, introduction of new products / services.

Support funds that finance startups

Support funds include Oman Technology Fund (OTF) and Innovation Development Oman Holding (IDO), an equity-based venture capital firm offered by the government of Oman to support youth projects. The funds have contributed towards raising Oman's ranking on the Early Stage Venture Deals indicator, with

the Sultanate reaching the fourth position in the region of the Middle East and North Africa (MENA). Competing with other funds from the MENA region, OTF has been ranked first place regionally on the Early Stage Venture Deals indicator in 2020. There are also some private sector funds that provide support for startups, such as Phase Ventures, which has national and global investments in the field of energy. Empowerment of startups has seen remarkable progress, with Oman achieving a continuous increase in the number of startups, especially those specialized in digital technology and applications.

Emerging technologies and initiatives

Innovation Park Muscat (IPM) initiative

Innovation Park Muscat is Oman's newest and most ambitious **science and technology development**. It is one of the major initiatives by The Research Council (TRC) in a bid to encourage scientific research and innovation and activate collaboration between the academic, private and the diverse industry sectors of local and international communities. Initially focusing on companies with the **Energy, Food and Biotechnology, Health, Water and Environment sectors**, IPM will provide vital access to outstanding facilities, services, and talent – creating an environment that inspires innovators and entrepreneurs to develop innovative ideas and startups.

The Government Innovation Initiative

The Government Innovation Initiative has been established to support **innovation and creativity in government entities** providing effective proposals that contribute to finding innovative solutions to enhance the governmental performance and increase its efficiency in various fields. The initiative aims to reduce time and effort required to provide a service while maintaining the highest standards of quality and effectiveness. This is fulfilled by using emerging technologies such as artificial intelligence, blockchain, IoT, cloud computing, virtual reality applications, as well as procedures that are considered a paradigm shift in supporting advanced governmental performance.

Smart Cities

As part of the Research Council initiative to raise awareness about eco-friendly houses, save energy in hot atmospheres, and reinforce the concept of sustainable development; several **eco-houses** have been designed by Dhofar University, Sultan Qaboos University, Nizwa University, German University of Technology and High College of Technology. State-of-the-art technology such as eco-friendly designs and solar panels have been used.

In 2019, a memorandum of understanding has been signed between Oman Telecommunications Company (Omantel) and University City (Oman University, Science and Technology City) to develop **University City** and turn it into a smart academic city equipped with the latest ICT services and Fourth Industrial Revolution technologies to promote scientific research and build a digital community able to keep up with the technological advancements.

The Internet of Things (IoT) Laboratory was opened in 2019 at Sultan Qaboos University as a platform for developing various IoT applications in smart cities and finding smart solutions based on ICT and latest digital technologies. The lab aims to transform the campus into a smart one, as well as enhance the application of IoT technology in Oman to improve the quality of life in different Omani cities.

Madinat Al Irfan is being developed to be the first smart city in Oman. It aims to enhance and improve the lifestyles of citizens and residents through integrating the latest smart technologies, such as smart parking system, biometric security check technology, waste tracking, real time digital wayfinding signage, command and control centre.

There is also a plan to turn **Duqm** into a smart city as per the memorandum of understanding signed in 2019 between the Oman Company for the Development of the Special Economic Zone at Duqm (Tatweer) and Omantel. The development will cover different aspects including infrastructure, public services, tourism services, security and safety services, smart harbour solutions, smart building management, waste management, transport services, smart bus station, parking, video surveillance, vehicle plate identification, and Special Economic Zone Authority in Duqm (SEZAD) e-application "My Duqm", amongst others.

Oman Smart City Platform (SCP) is a knowledge-sharing consortium to drive smart city initiatives in Oman. The objective of the platform is to provide a knowledge-sharing, collaborative, and networking environment among smart city stakeholders. The platform functions as an enabler and facilitator for smart city innovations through funding research and hosting innovations' competitions.

Smart City Platform aims to:
- Provide a platform for knowledge sharing, collaboration, and networking between stakeholders
- Facilitate and enable smart city innovations
- Promote and test smart solutions targeting city challenges
- Build awareness on the importance of smart city solutions
- Enable a path towards a national smart city vision & strategy.

Agriculture

The **Strategic Program for Water Research,** supervised by the Research Council, aims at supporting the projects that seek to secure reusable water sources to be used for irrigation and develop new methods of water treatment that do not involve the use of chemicals harmful to the environment. Its goals are to increase agricultural productivity, expand green spaces, and reduce water loss to more than 50%. The program awarded several projects such as Biological Treatment, Smart Irrigation, Smart Tank, Grey Water Filtration, as part of the Research and Innovation Award, for their national benefits.

The **Million Date Palm Plantation Project** is one of the important applications of the development and use of smart irrigation systems to achieve nutritional, economic, social, and environmental benefits. The project is run through the cooperation between the Ministry of Agriculture and Fisheries, support funds, and the Public Authority for SME Development (Riyada).

The farms of the project depend on the use of new technology to manage water resources, mitigate depletion, and increase dates production process. They also depend on drones for pollination and early detection of diseases that may affect palm trees. The same technology is planned to be used for other agricultural purposes, such as a **desert locust survey** in the Wilayat Bidiyah, conducted by the Ministry of Agriculture and Fisheries.

A scientific study has been conducted at the College of Agricultural and Marine Sciences at Sultan Qaboos University to develop reliable methods to **evaluate the freshness of fish using advanced techniques** such as e-nose and e-tongue, which would complement or replace traditional methods. The study findings would provide a scientific basis and develop protocols and guidelines for this technology.

During the COVID-19 crisis, a number of applications have been launched to enable online services in the sector. The **smart platforms 'behar_market' and 'Athmar'** have been developed with the Ministry of Agriculture and Fisheries, and Muscat Municipality to convert auctions in the Central Fish Market to online auctions. The **smart platform 'Fastmovers'** has been tailored for ordering refrigerated trucks for transporting fish and vegetables from central markets.

Education

The **Educational Portal** was launched along with learning technologies which are used in higher education institutions. The portal aims to provide increased access to information and knowledge to empower youth and improve the teaching and learning methods in an effort to achieve the sustainable development goals and increase the use of digital technologies.

A laser lab of high-efficiency solar cells has been installed in the Department of Chemistry at **Sultan Qaboos University** to enable studying high-speed chemical and physical reactions occurring in one billionth of a second. This new tool will help studying the chemical and physical properties of **new materials** used in creating modified semiconductors in solar cells. Moreover, it provides students with a training opportunity on a wide range of scientific research tools.

It is expected the **Omani Satellite Company** will enhance the Sultanate's position in the world innovation rankings and will contribute effectively to enabling the digital platforms launched by the Ministry of Education to promote distance learning. It is also expected to enable the digital initiatives of the Ministry of Higher Education, Sultan Qaboos University, and the Ministry of Manpower, represented in the technical and vocational colleges by providing education and distance learning for all students in all governorates of the Sultanate. It is also hoped that a third telecommunications service provider will be included in 2021, which will lead to a reduction in the price of telecommunications services and enable the integration of the next stage towards a digital Oman and smart services in all sectors.

Additionally, the **Research Council** (TRC) is contributing to the rise of the status of the digital world in Oman through a number of programs affiliated with TRC, such as the **Oman Research and Education**

Network (OMREN), **Oman Virtual Science Library (Masader)**, and **Oman Research Repository (Shuaa)**, in collaboration with relevant partners, such as **Omantel**.

During the COVID-19 crisis, the distance-learning platform 'easy' was launched to offer distance-learning services, along with the 'Igtimaati' application that provides video conferencing services.

Energy

Research on renewable energy is an integral part of the development plan of the Research Council and Public Authority for Electricity and Water. Innovative ideas and initiatives have been adopted in this area such as **Miraah,** which will be one of the world's largest solar plants, **renewable energy projects.** Currently, "Smart meters" are being installed across the Sultanate to automatically calculate water consumption and send it directly to the consumer.

Oman Oil Company has launched the first service station in Oman energized by solar power. **Petroleum Development Oman (PDO)** is exploiting emerging digital technologies and agile ways of working in innovative and transformative ways as part of its newly created digitalization function. Examples of the business problems currently being solved with these exciting technologies include:

- Automating workflows that were once impossible to be automated using Robotic Process Automation.
- Virtually bringing experts closer to problems in the field using Industrial Mobility solutions.
- Predicting when equipment will fail before traditional methods using artificial intelligence.
- Remote & automated inspection of far-off equipment and pipelines using drones and artificial intelligence.

A number of initiatives have also been launched to link the industry to academia, including the Industrial Innovation Center and EJAAD, which is the membership-based virtual collaborative platform launched by TRC and the Ministry of Oil and Gas and Petroleum Development Oman (PDO), where industry, academia and government can interact and engage in **energy-related research and innovation activities**. To date, EJAAD has successfully linked 45 institutions including private companies, as well as government and private higher education institutions, in order to reach effective scientific and research solutions to address the challenges faced by the private sector.

Environment and Climate

New technologies are being adopted to invest in **Al Khuwair Natural Reserve** such as using electric cars for transport and installing telescopes to observe the wildlife of the Reserve. Muscat Municipality offers a **Plants Program** which identifies the characteristics of all existing plants in the Municipality plantations, such as colors, diseases, seasons, and areas of growth as well as images. Moreover, the Municipality uses drones for wadis monitoring purposes. **Sultan Qaboos University** has invested in **remote sensing and GIS technology** to carry out a number of research projects such as the potential **extraction of diamonds** in Al Batinah, remote sensing and analysis of the **geospatial data** of Bar Al Hakman, achieving sustainable

development in the **fisheries and aquaculture** sector in Musandam, and the conservation of Al Jabal Al Akhdar environment. The Directorate General of **Metrology** is in the process of installing early warning systems in the coastal areas.

Financial sector

The National ePayment Gateway (ePG) is an operational component of the eGovernment infrastructure as it ensures a secure online payment process. It allows online payment for shopping and services for the public as it accepts all types of debit and credit cards. The easy and secure payment process helps to increase the number of customers, save administrative costs, and reduce queueing at the physical counters. Currently, the ePG provides new services including the payment of traffic fines, internet and landline telephone bills, mobile bills, electricity bills, amongst other services.

Recently, blockchain technology has been introduced in the Sultanate. The technology will be implemented in various fields such as finance, banking, e-commerce, and import and export. As a result, **Blockchain Solutions & Services** and **Oman Blockchain Club** were established to manage the trade processes based on blockchain technology and seeking a rapid adoption of this technology for its great economic returns.

Health, Safety and Security

Researchers at **Sultan Qaboos University** have adopted **artificial intelligence technologies** in a number of medical projects, such as the use of artificial neural networks to diagnose obstructive sleep apnea, congestive heart failure and preeclampsia, an investigation of heart rate on variability of patients in non-surgical ways, and a mobile healthcare system to monitor and diagnose remote patient with sleep disorders through a wireless body area sensor network that provides all the necessary biomedical signals.

The **eHealth Portal** and **Al Shifa** system ensure the provision of **comprehensive health care** using the latest technology.

The Ministry of Education has signed an agreement to develop "Darb Al Salamah" system by providing school buses with the latest information and communication technologies. The new system enables the ministry and the parents to ensure the **safety of their children** remotely by monitoring the bus speed, notifying the parents when the bus leaves the school and gets closer to the house, notifying the school if a student was left in the bus, and alerting the school administration and the Directorate of Education if the bus was derailed.

Information and Communication Technology

Oman National Computer Emergency Readiness Team (OCERT) was established to analyze and tackle cyber-security threats and protect information and privacy of end users. Also, **Oman Government Cloud** ensures the optimal use of the IT resources and increases the efficiency of the electronic services provided to the public. In addition, the work is in progress to build a data and cloud services center to meet

the high demands from the entities. The center will be located in Al Jabal Al Akhdar to avoid the risk of high temperatures and energy waste.

'Saeed' is the first **chatbot** (AI software) in the Sultanate which is available on Ooredoo's mobile app and website to help customers know more about the company products and services, provide them with the best solutions, and respond to their questions and enquiries. Some other entities have adopted this technology such as **Muscat Municipality,** the **Ministry of Finance, Al Raffd Fund**, **Oman Oil**, as well as the **Information Technology Authority** through "Manshood" to bring the best customer experience and interact with the users in the local dialect to provide information, answer inquiries, and get direct and quick responses. The service developers are seeking to integrate all the eGovernment services with Manshood to better serve citizens and residents in the Sultanate.

The Communication & Information Research Centre at **Sultan Qaboos University** is currently implementing several projects relevant to the **Fourth Industrial Revolution**, such as smart street, remote healthcare system for monitoring and diagnosis, a vision-based navigation system using the robot application of deep learning techniques in the National Museum of Oman, smart urban water management, neural networks for medical diagnosis depending on artificial intelligence technology, and Internet of Things in security and privacy aspects related to architecture and communication.

Innovation Development Oman **- IDO Investments** is a **technology investment firm** that identifies and invests into established local Omani and international companies who deliver disruptive and innovative products or provide solutions to address challenges in Oman and beyond. The company has invested in several fields such as health, energy, water, food and agriculture, logistics as well as emerging technologies.

Oman Technology Fund (OTF) focuses on defining the futuristic ideas in the technology sector and amongst the entrepreneurs who have high potential technology and technical innovation ideas/projects, within a geographic area covering Oman and the Middle East, through a phased plan that includes investment, guidance and cooperation. OTF provides investments and guidance to technology startups and entrepreneurs through three investment programs: "Techween Incubator", "Wadi Accelerator" and "Jasoor Ventures". Wadi Accelerator, which is a seed stage fund and accelerator program, has invested $ 1.2 million in 12 tech startups in Oman and MENA region. These companies provide services in the field of technology, biotechnology, Industrial Internet of Things, artificial intelligence, smart cities, digital media, e-commerce and advertising, such as: Almanjam, Crowd Media, Iris Technology, MerMaid, Mrayti, Social Champ, Smartchoice, PG Studios and WattNow.

Upgrade is an initiative aims at capitalizing the hidden potentials and opportunities presented by student ICT graduation projects with a vision to help convert 1% of such projects to successful ICT startups. The partners in the initiative include The Ministry of Higher Education, Research and Innovation, Omantel, the Ministry of Transport, Communications and Information Technology, the Ministry of Culture, Sports and Youth, Oman Technology Fund, and the Authority for SME Development.

The Research Council emphasizes the role of communication infrastructure in enabling innovation, as it is one of the indicators that contribute to achieving a knowledge-based economy and achieving the goals of the NIS. The expansion of the broadband network and comprehensive digital services, which emerged as a result of the initiatives taken during this stage, has been achieved after the government harnessed various efforts and financial capabilities to implement the '**Comprehensive Digital Service' initiative**, with the aim of covering all regions of the Sultanate with communications and internet services via satellite during 2020, in addition to strengthening the networks to provide high-speed communication services, especially in remote areas. This initiative was established in cooperation between the Ministry of Technology and Communications, Oman Telecommunications Company (Omantel), Telecommunications Regulatory Authority, and local telecommunications companies.

Industry and Manufacturing

Many Omani companies, such as **Bilad Oman,** merge design with production through the use of 3D modeling software or computer-aided design**.**
Work has started to build the Oman-Qatar buses assembly factory in Duqm, which will be equipped with the latest technologies in the field. The facility will be the first of its kind in the Sultanate.

The Institute of Advanced Technology Integration (IATI) develops scientific research into innovative technologies and **marketable products** that the Sultanate meet market demands and tackle current challenges in water, renewable energy and oil and gas sectors.

Tourism and Entertainment

Innovation-related activities are incorporated in tourism and entertainment projects. Work is in progress to build Hayy Al Sharq to be the biggest entertainment destination for children and adults. In addition to the amusement and water parks and the zoo, the project will include innovative learning-focused activities as part of the interactive Science and Technology Multimedia Centre.

Many **virtual reality projects** are being developed by the **SAS Virtual Reality Centre** to encourage the use of technology in presenting the Omani culture and landscape to the world. In addition, a number of mobile apps have been developed to help visitors and tourists explore the different places of interest in Oman such as the Muscat Geotourism Guide.

Transportation and Logistics

Advanced technologies are widely used in Oman to reduce traffic congestions, facilitate movement, and provide transportation and smart parking. This is reflected in the use of **Intelligent Transportation System (ITS) by Mwasalat,** the government-owned company founded in 1972, which is the leading public transport company in the Sultanate of Oman. The ITS includes a mobile app, passengers and cargo details, reservation system, electronic tickets, and buses and drivers monitoring system. Another example of a smart app is **Baladiyeti** mobile app, used by Muscat Municipality, which provides parking reservation services

and e-payment of parking violations. In addition, smart parking has been provided in many places in Oman such as Knowledge Oasis - Muscat and in government entities like the Ministry of Endowment and Religious Affairs.

In addition, **drones** are under study to be used in transport and logistics in the oil and gas industry and manufacturing facilities logistics as per a memorandum of understanding signed by **Oman Technology Fund** to find intelligent solutions for transport and delivery using this technology.

Oman Airports has introduced electronic immigration gates (E-gates) to make the entry and exit process easier with no more waiting in long queues to get the passport stamped upon entering and exiting the country. Similarly, an **automated gate** has been launched at **Sohar Port** to help reduce the waiting time for ships at the port.

ASYAD Group is Oman's new integrated logistics provider established in 2016 and consisting of three deep ports and three free zones supported by Oman's five airports and a world-class road network. The logistics sector is rapidly changing with the introduction of Fourth Industrial Revolution technologies, the development of e-commerce, and the broadening scope of demand for logistics solutions. ASYAD has integrated and restructured its businesses to offer end-to-end solutions to its customers.

The Ministry of Manpower established an innovation unit aimed at developing an integrative relationship between the innovation support entities within and outside the ministry. The ministry also launched the Ministry of Manpower's Innovation Award, under the slogan 'Innovation: Partnership and Sustainability'. It also organized the 'Oman Open Data Competition', with the slogan of 'We innovate with Data', to generate more marketable ideas and establish startups." The award is aimed at spreading the concept and culture of innovation, stirring the spirit of competition among students of technical and vocational colleges and employees of the Ministry of Manpower.

Oman vs COVID-19 campaign

Since the beginning of January 2020, the world has been enduring the COVID-19 crisis, including the Sultanate. Omani government has made all the efforts to decrease the impact of this virus on its citizens and residents. A royal decree been issued to create The National Supreme COVID-19 Committee headed by the Minister of Interior and membership of several core ministries to take all measures against COVID19, including those related to using digital technologies. The national campaign **Oman vs. COVID-19** has been launched to curb the spread of the coronavirus in the Sultanate through spreading awareness among citizens and residents using all available channels.

The Ministry of Technology and Communications in cooperation with the National Supreme Committee on COVID-19 has launched Work from Home initiative since March 2020. The initiative aims is to provide the government entities and staff all required infrastructure and tools to continue the government tasks. The ministry exerted great efforts to support all government entities and provide secure connections and environment on government cloud.

The Ministry also formed the **Technological Innovation Committee** to oversee all IT initiatives to ensure diversity, strengthen the partnership between sectors to implement the new projects accurately, and provide innovative IT solutions. Students and teachers are able to use the Digital Education platform, supervised by the Ministry of Education, to access a group of free Google applications designed specifically for schools to share documents, digitally attend class, submit assignments, take tests electronically, and communicate with students. Through this platform, education in the Sultanate is moving towards a new phase, which mainly depends on distance learning.

Sultan Qaboos University (SQU) has launched recently an online tutoring platform for medicine college students called the **U Project**. **The Research Council** has launched a national program and called for proposals for projects addressing the current COVID-19 pandemic. The proposals must focus on COVID-19 crisis and address the clinical and public health scope, and non-clinical scope. The non-clinical scope includes but is not limited to artificial intelligence, e-learning during pandemic, emerging tracking and monitoring technologies, economic and business impact, and crisis management.

The Royal Oman Police (ROP) activated **the use of the drones** to ensure that people maintain the social distancing and stay safe. This helped the policed to cover wide ranges in a relatively short time as drones give a wider view of spaces. A similar use of this new technology is implemented by **Muscat Municipality (MM)** who has been using drones to sterilize the streets in Muscat governorate to contain the spread of the virus efficiently without exposing humans to the hazard of being infected.

The Ministry of Health has recently launched Tarassud mobile app to keep the public informed with the updates and statistics of COVID-19 in Oman. The Ministry, in collaboration with **Wareed.co**, provides the delivery service for prescribed medicine to homes in order to curb the spread of the virus and to facilitate the process for patients, especially elderly people and heart and diabetes patients, to ensure they get their medicine regularly.

Also, **Oman Technology Fund** has allocated USD 2.6m (OMR 1m) to support SMEs and also invest in long-lasting solutions to fight chronic diseases and pandemic situations. The purpose is to support companies to mitigate the impact of the current crisis and encourage the youth to design innovative solutions to facilitate remote engagement and care.

A number of applications and innovations have been launched in collaboration with the Oman Technology Fund (OTF) including:
- The 'dakhterclinic', which is an application launched by Omani doctors for providing specialized online medical consultations by specialist doctors for emergencies.
- The 'Wareedco' platform, which has been designed to offer medicine home delivery to the elderly people in a bid to avoid infection with COVID-19.
- The use of unmanned aircrafts (drones) to sterilize Omani neighborhoods, cities and villages by Muscat Municipality.

- The use of unmanned aircrafts (drones) for comprehensive investigation and remote examination of heat temperatures for individuals suspected of COVID-19 infection.

With the support received from the Public Authority for Privatization and Partnership (PAPP), the Research Council, represented by the Innovation Park Muscat (IPM) prototyping center **'Makers Oman'** enabled a group of Omani youth to convert a diving mask into a respirator mask for COVID-19 patients, using 3D modelling technology. The mask has been tested with specialists at the Royal Hospital and proved to be a success. Through the use of the 3D modelling technology, the Makers Oman team also managed to produce locally engineered items, including a uniquely designed hands-free door opening and a face shield that is designed to strengthen the capabilities of Oman's frontline healthcare workers when dealing with the COVID-19 pandemic. The IPM's prototyping center has also developed a digital artificial ventilator to fight the virus by simulating the ventilation systems approved in the Sultanate's government hospitals.

TRC's Smart City Platform, in collaboration with the Supreme Council for Planning, Muscat Municipality and Information Technology Authority (ITA), launched a competition for Omani youth to combat the pandemic by designing smart solutions to contain the spread of the virus within Omani society. The winning projects of this competition were the application 'Es-hah' for faster epidemiological investigation, using a satellite tracking system; the application of 'Oman faces Corona', which includes an introductory platform on COVID-19 and ways to prevent it while the third winning application was named 'Khallona Nehjaa', which has been developed to assist the concerned authorities in following up with and monitoring COVID-19 patients and those in home and institutional quarantine.

5. Innovation Environment - Qatar

Policies and strategies

Qatar Vision 2030

Qatar National Vision 2030 (QNV 2030) was launched in 2008 with the aim of transforming Qatar into an advanced country, sustaining the country's development and providing a high standard of living for its people for generations to come. QNV 2030 seeks to build a "knowledge-based economy characterized by innovation" to enable economic diversification, as stated under the pillar of 'economic development' - one of four key pillars underpinning the vision.

Creativity and innovation have an important role in the achievement of Qatar's Vision 2030 goals. Qatar aims to build a modern world-class educational system that provides students with a first-rate education, comparable to that offered anywhere in the world, a system that encourages analytical and critical thinking, as well as creativity and innovation. Qatar's bountiful hydrocarbon resources can be leveraged to make sustainable development a reality for all its people. Converting these natural assets into financial wealth provides a means to invest in world-class infrastructure, build efficient delivery mechanisms for public services, create a highly skilled and productive labour force, and support the development of entrepreneurship and innovation capabilities. These achievements would in turn provide a broader platform for the diversification of Qatar's economy and its positioning as a regional hub for knowledge and for high value industrial and service activities.

Qatar First National Development Strategy 2011-2016 (NDS-1) and Second National Development Strategy (NDS-2)

The First National Development Strategy 2011-2016 (NDS-1) was launched to provide a roadmap to help achieve the goals set out by QNV 2030. The Second National Development Strategy 2018-2022 (NDS-2) followed, further emphasizing that knowledge and innovation, private-sector development, and foreign direct investment are all key contributors to economic diversification. More specifically, NDS-2 called for the development of a strategy for scientific activities and a national strategy and operating model to support innovation.

The Economic Diversification and Private Sector Development (EDPSD) is an essential pillar in the process that would lead to a more stable and resilient economy against the fluctuations of the global economy. EDPSD strategy is driven by the National Diversification Agenda and focuses on two strategic areas: (1) productivity and competitiveness and (2) private sector led growth. Priority economic sectors include the manufacturing sector, financial services, professional and scientific activities, and information and communications technology (ICT). In addition, they include tourism and logistics services as catalyst or promoter of other sectors.

Qatar Second National Development Strategy 2018-2022 (NDS-2) identifies one of the intermediate outcomes related to entrepreneurship and innovation and the promotion of vibrant entrepreneurship and innovation culture, especially among Qatari nationals. The target is to promote entrepreneurship in priority sectors and enable the SME sector to grow and compete during the period 2018-2022. Another intermediate outcome of NDS-2 is strengthening the positioning of Qatar as a regional hub for priority sectors. This intermediate outcome is important because it enhances the regional presence of Qatar as a competitive incubator for priority sectors. In this regard, the NDS-2 identifies the following targets: focus and coordinate national efforts to achieve excellence in research during the period 2018-2022 and build international recognition and strengthen partnerships relevant to Qatar's research and priority sectors over the period 2018-2022.

Qatar Research Development and Innovation Strategy 2030

Qatar Research, Development and Innovation (QRDI) Council was established in 2018, representing a new milestone in Qatar's research, development and innovation (RDI) agenda. The Council's first mission was to develop a national strategy that would optimize RDI activities and help realize the country's overarching goals and ambitions. The Council accomplished this mission at the end of 2019, having drafted the Qatar Research, Development and Innovation Strategy 2030. The Council brings together prominent national and international figures from across government, industry, and academia and draws on the wealth of knowledge and expertise of individuals from varied disciplines.

The innovation ecosystem

The State of Qatar supports entrepreneurship and the development of small enterprises, in line with Qatar National Vision 2030 and the Sustainable Development Goals, especially "Decent Work and Economic Growth" and "Quality Education".

Qatar was ranked first in the global entrepreneurship environment, according to the Global Entrepreneurship Monitor (GEM) report 2018, that featured 54 countries worldwide. According to Qatar Development Bank (QDB), a GEM member, the report showed that the local environment index for business entrepreneurship in Qatar registered about 6.7 points out of 10, and Qatar is ranked first among all countries participating. A number of Qatar institutions are supporters of entrepreneurship and innovation, as follows.

Enterprise Qatar

A diverse economy is more capable of creating jobs and opportunities for future generations and is less vulnerable to the boom-and-bust cycles of oil and natural gas prices. As of 2009 hydrocarbon revenues accounted for 50% of Qatar's GDP and 98% of its exports. Creating growth and opportunities for a future beyond this reliance will involve significant shifts to the culture and institutions of Qatari society. Building a strong entrepreneurial culture will be a major initiative in the coming years. Currently, small- and medium-sized businesses constitute only 15% of Qatar's economy. Enterprise Qatar, a newly launched

initiative, has been created to increase this number by providing performance-based grants and vouchers to nascent businesses. Creating highly skilled jobs is another priority, since the current proliferation of labor-intensive, low-wage jobs limits opportunities for Qatari citizens. Building a culture of research and development will attract foreign investment and provide additional outlets for skilled Qataris who would otherwise emigrate or go into the public service.

Recently, Qatar has committed 2.8% of its GDP to support research initiatives. These include:
- **Qatar Foundation**, which expands access to education and supports knowledge-based enterprises
- **Qatar Science and Technology Park** -- an innovative, multi-disciplinary research environment which encourages collaboration across traditional research boundaries.

Qatar Foundation (QF)

Qatar Foundation is a non-profit organization supporting Qatar's development through its education, research, and community development initiatives. Qatar Foundation established Qatar National Research Fund (QNRF) in 2006 as part of its ongoing commitment to establish Qatar as a knowledge-based economy. QF views research as essential to national and regional growth, as the means to diversify the nation's economy, enhance educational offerings and develop areas that affect the community, such as health and environment.

QNRF advances knowledge and education by providing funding opportunities for original competitively selected research and development at all levels and across all disciplines with emphasis on the four pillars of the Qatar National Research Strategy:
- Energy and Environment
- Computer Sciences and ICT
- Health and life Sciences
- Social Sciences, Arts and Humanities.

QNRF provides opportunities for researchers at all levels, from students to professionals, whether in the academic, public, or private sectors. Research will help improve education and health, spur technological innovation and adoption, conserve vital natural assets, and create intellectual property.

QF Education City is a campus that spans more than 12 square kilometers and hosts branch campuses of some of the world's leading educational institutes, a homegrown university, and other research, scholastic, and community centers.

Qatar Science and Technology Park (QSTP)

Qatar Science and Technology Park (QSTP) is part of the Qatar Foundation. QSTP, a "free zone," houses international companies such as Microsoft, Shell, ExxonMobil, Cisco, Siemens, and local tech-focused

firms. They are advancing their technologies alongside startups that, through QF, can access the funding, facilities, and networks on which nascent "techpreneurs" depend. QSTP's tech-driven environment is combined with nine world-class universities and three established research institutes, all within the same location – QF's unique Education City. This ecosystem has opened a pipeline of Qatar-based talent, where students can become researchers and tech entrepreneurs, and have the support to do it.

Other organizations are becoming part of this ecosystem. The European Innovation Academy – one of the world's top entrepreneurship education providers – partners with QSTP to run the Arab Innovation Academy, the Middle East and North Africa (MENA) region's largest entrepreneurship "boot camp," where young innovators develop a startup from scratch in just two weeks.

The QSTP Incubation Center is a technology-focused incubation program that aims to foster local tech entrepreneurship in the State of Qatar. The program aims to accelerate the establishment and growth of promising tech startups through quick incorporation, collaborative co-working space, business facilitation, and support services that provide access to a network of mentors, funding programs, training, and prototyping facilities. The period of the incubation is 12 months, allowing the startups to focus on developing a product/service, acquiring early customers, and fundraising.

Benefits of the Program include:
- Quick and affordable incorporation in QSTP free zone
- One year of 100% subsidized co-working space
- Subsidized business support services
- Training, workshops, and networking events
- Prototyping facilities' access
- QSTP funding programs' access
- Mentors' network
- Access to QSTP's tenant network of high-tech companies and R&D centers.

Qatar Development Bank (QDB)

QDB aims to develop and empower Qatari entrepreneurs and innovators to contribute to the diversification of the Qatari economy, through successful small and medium enterprises that are able to compete in global markets, through:
- Direct and indirect financing of mandated sectors in general, with a sector-agnostic approach
- Promoting and supporting exports
- Providing business support, through a set of initiatives and services associated with real estate development and housing loans to citizens
- Enhancing technical skills and developing capabilities
- Providing opportunities for small and medium enterprises domestically and globally
- Promoting SME ecosystem development.

QDB adopts the distinctive projects proposed by citizens, contributing to financing those projects and reviewing the feasibility study proposals, legal, financial, and marketing consultancy services which contribute to their success. The services provided by QDB include the following:

- Direct Lending - a simple, competitive option to easily finance new initiatives or existing companies, given that the projects are in any of the following sectors: manufacturing, education, healthcare, services, agriculture, livestock, and fisheries.
- Ithmar (Seed Funding) - a Shari'a-compliant equity product, which is an integrated, comprehensive approach giving entrepreneurs the investment support needed to start their businesses in Qatar.
- Business consultancy and mentoring services - provide citizens with the necessary guidance and support to launch a successful project.
- Co-working office space - offers shared office space with a package of services for entrepreneurs.
- Entrepreneurship Leave Program (ELP) – through a cooperation between QDB and the Ministry of Administrative Development, Labor and Social Affairs, the (ELP) program gives Qatari entrepreneurs a career break, on condition of devoting their full time to develop their businesses according to the agreed plan with QDB.

Digital Incubation Center (DIC) of Ministry of Transport and Communications

The Digital Incubation Center (DIC) affiliated to the Ministry of Transport and Communications (MoTC) was created to boost ICT innovation in Qatar, particularly among young people at the critical early stages of starting or growing a technology-related business. DIC is looking for entrepreneurs capable of harnessing emerging technologies to create innovative products, solutions, or services that would contribute to Qatar's digital economy.

DIC supports entrepreneurs through:

- Startup Track - supports potential entrepreneurs and early-stage tech startups that have a market-ready product or prototype.
- IDEACAMP - a program from DIC for entrepreneurs, developers, and designers who have great ideas for technology solutions.
- Co-working space

Qatar Business Incubation Center (QBIC)

Qatar Business Incubation Center (QBIC) provides business support services to help entrepreneurs and companies that either have an idea to start a business or want to grow an existing business. QBIC was established by leading institutions working to promote entrepreneurship in Qatar, namely QDB and the Social Development Center "NAMA".

QBIC supports high-level and promising projects as part of its wider ambition to play an active role in Qatar's journey towards a knowledge-based economy. It urges all budding entrepreneurs to pursue what they love with passion, turn challenges into opportunities, and ultimately drive economic diversification for the future, through the following programs:

- Start Your Company program - offers a leading methodology for streamlined business management providing hands-on experience on how to start projects successfully.
- Accelerate Your Company program - helps to accelerate the growth of companies that are considered to have great potential.

Qatar Innovation Community (QIC)

The Qatar Innovation Community (QIC), which was launched by the Supreme Committee for Delivery and Legacy (SC), in collaboration with the Ministry of Transport and Communications, Qatar Science & Technology Park (QSTP), and Ooredoo, works with 20 national and international organisations to accelerate innovation across Qatar and create solutions for the FIFA World Cup™ and beyond.

The QIC supports and enables Qatar's innovation capabilities and knowledge capital and addresses national priorities, looking to enhance Qatar's image and global competitiveness. Members of QIC include Qatar Chamber, International Chamber of Commerce – Qatar, QDB, Qatar Financial Centre, and Qatar University, amongst others.

The most important outcome of the QIC will be the creation of a sustainable and effective national innovation ecosystem – one which will accelerate innovation and entrepreneurship in Qatar, create competitive advantage in the global market and lead to quality-of-life improvements for Qatar's citizens.

Qatar Mobility Innovations Center (QMIC)

The Qatar Mobility Innovations Center (QMIC) focuses on using R&D to develop and deploy Intelligent Mobility and Smart Cities platforms and technologies. QMIC's main goal is to use locally engineered innovations and knowledge to enable creating home-grown technology industries that address national strategies and tackle regional emerging challenges. It was founded by Qatar University in 2009 and is registered and licensed to operate as a technology innovations center from the Qatar Science and Technology Park (QSTP).

Since 2009, QMIC has been utilizing emerging technologies including Internet of Things (IoT), artificial intelligence, and location-awareness to deliver data-centric platforms and services. In particular, QMIC has been leading in delivering platforms and solutions focusing on key domains including Intelligent Transport, Logistics & Telematics, Road Safety, and Connected & Autonomous Mobility (CAM). Through its integrated innovations development & delivery model, QMIC represents a unique and important category within the national Research & Development & Innovations (RDI) enterprise in Qatar that is strategically driven, R&D-based, solution-focused, and business-oriented.

European Innovation Academy

European Innovation Academy has become a recognized leader in tech entrepreneurship education. The non-profit, educational programs are developed through joint partnerships with professionals from Stanford University, U.C. Berkeley, and Google. The European Innovation Academy has Qatar headquarters.

Emerging technologies and initiatives

Smart Cities[1]

Realizing the enormous potentials of the Smart Cities initiative as one of the key factors to accelerate the achievement of all pillars of the Qatar National Vision 2030, the Ministry of Transport and Communication (MoTC) "Smart Qatar" initiative, also known as **TASMU**, was launched at the 2017 Qatar Information Technology Conference & Exhibition (QITCOM) - the largest Information and Communication Technology showcase and event in Qatar.

TASMU is a $1.65 billion country-wide initiative that focuses on harnessing the power of technology and innovation to drive sustainable economic diversification while improving the quality of life and enhancing the delivery of public services in Qatar. The programme oversees the development and implementation of more than 100 projects that rely on smart and advanced technologies across five priority sectors including transport, logistics, environment, healthcare, and sports.

According to MoTC, Qatar has made significant progress in internet connectivity, which is the backbone for smart cities. With the **launch of the 5G telecoms** on a commercially available network globally in May 2018, Qatar cemented its position as a world leader in high-speed broadband access for households and businesses. In addition, the market size of the Internet of Things, a fundamental component of the smart cities, is growing exponentially in Qatar with sales projected to reach $573 million by 2022, compared to $172.5 million in 2018, while the monetary value of smart homes in Qatar is estimated to rise to $344 million within the same period.

Agriculture

The **Ministry of Municipality and Environment** has a number of agricultural research centres: Agricultural research in the Soil and water Laboratory, Plant Feed and Fertilizers Laboratory, the bio saline Agriculture Research Station, Rawdet Alfaras Research Station, Al Qashamiya Research Station, Horticulture and Protected Agriculture Research Station, and the Aquatic research centre.

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[1] The EU-GCC Dialogue on Economic Diversification Project has completed a position paper on Qatar Smart Cities. The paper can be made available to all project stakeholders by contacting the project team.

Financial sector

Qatar banks have rolled out innovative products and services that are encouraging customers to use digital channels to complete their banking transactions. Banks have introduced **new features in ATMs, credit and debit cards and mobile applications**. COVID-19 outbreak accelerated the pace of launch of technology-based banking solutions.

Qatar Islamic Bank's (QIB), the largest private bank in Qatar, received three prestigious awards at The Global Retail Banking Innovation Awards 2020 from The Digital Banker Magazine. QIB was awarded "Best Digital Bank of the Year in Qatar", "Best Retail Bank of the Year in Qatar", and "Best Client Onboarding and Account Opening in the Middle East" awards. The Global Retail Banking Innovation Awards Program recognizes the world's top retail banking and finance institutions with distinguished contribution to the industry. The awards are accolades of excellence and are attributed to outstanding banks that showed excellence on the levels of digital innovation, products development, service delivery, customer centricity and customer experience, in addition to financial performance and strength of balance sheet. The awards program is globally acclaimed and co-judged by top international consulting companies and subject matter experts to ensure full transparency and impartial assessment.

Qatar FinTech Hub (QFTH) FinTech Incubator & Accelerator Programs are launch pads for early-stage startups, and matured FinTechs to scale up. The Incubator is a 12-week program for budding entrepreneurs and early-stage FinTechs with a Minimum Viable Product (MVP) who want to transform their prototype into a sellable product, build traction and raise funds. The Accelerator is a 12-week program designed for mature FinTechs looking for global expansion with a proven product market fit. The program focuses on cultivating business collaborations between FinTech and QFTH partners.

Transport

Qatar Mobility Innovations Center provides intelligent transport solutions and fleet and asset management solutions.

Intelligent transport solutions include :
- Mobile solutions - Mobile location-based solutions & services
- Traffic information - Comprehensive traffic flow and information services
- Analytics - Complete traffic analytics platform and services
- Sensing network - Multi-source local data collection network.

Fleet and Asset Management solutions:
- Fleet management - Smart solution to track and maximize the efficiency of fleets
- Workforce manager - mobile-based smart workforce management solution
- Dispatching - an intelligent scheduling system to better utilize enterprise fleets
- Asset management - an intelligent system to manage outdoor stationary assets

6. Innovation Environment - Saudi Arabia

Policies and strategies

Vision 2030

The Kingdom of Saudi Arabia's 'Vision 2030' outlines the Kingdom's goals and objectives that will enable the country to become 'a pioneering and successful global model of excellence, on all fronts'. The Vision 2030 was approved by the Cabinet in April 2016. The Vision is built around three themes - a Vibrant Society, a Thriving Economy, An Ambitious Nation. Creativity and innovation are critical in enabling the achievement of the Vision goals.

The Thriving Economy pillar specifically focuses on creating jobs, growing the economy, privatizing services, and attracting talent. Among the objectives are increased competitiveness of the Saudi business environment, increased FDI as percentage of GDP, increased private sector contribution, development of sophisticated digital infrastructure that is integral to advanced industrial activities, and increased contribution of modern retail trade and e-commerce to the economy.

The Kingdom of Saudi Arabia has launched a number of Vision Realization Programs (VPRs), as follows.

National Transformation Program

The National Transformation Program aims to develop the necessary infrastructure and create an environment that enables the public, private, and non-profit sectors to contribute to the achievement of the Kingdom's Vision 2030. This will be accomplished by attaining governmental operational excellence, supporting digital transformation, enabling the private sector, developing economic partnerships, and promoting social development, in addition to ensuring the sustainability of vital resources.

The National Transformation Program was launched in 2016 to achieve governmental operational excellence and establish the necessary infrastructure to improve economic enablers and raise the standard of living through its eight strategic themes. These include transforming healthcare, improving living standards & safety, ensuring the sustainability of vital resources, social empowerment and non-profit sector development, achieving governmental operational excellence, improving labor market accessibility and attractiveness, enabling the private sector and developing the tourism and national heritage sectors.

National Industrial Development and Logistics Program

The program aims to transform the Kingdom into a leading industrial powerhouse and a global logistics hub, by maximizing the value of its mining and energy sectors while unlocking the full potential of local content and the Fourth Industrial Revolution. NIDLP largely contributes to driving the Kingdom's

economic diversification towards sustainable growth by fostering a globally attractive investment environment.

The National Industrial Development and Logistics Program was launched at the beginning of 2019, out of the leadership's belief in the importance of the program's four sectors - energy, mining, industry, and logistics - and via integration to maximize their contribution to the Kingdom's efforts to grow and diversify the economy. The program also focuses on the two enabling pillars of local content and the Fourth Industrial Revolution, given their importance towards enabling the main sectors to reach their pre-set strategic objectives.

Human Capability Development Program

The Human Capability Development Program aims to ensure that citizens have the required capabilities to compete globally by instilling values and developing basic and future skills, as well as enhancing knowledge. The program focuses on developing a solid educational base for all citizens to instill values from an early age, while preparing the youth for the future local and global labor market. It also focuses on upskilling citizens by providing lifelong learning opportunities, supporting innovation and entrepreneurship culture, and developing and activating policies and enablers to ensure KSA competitiveness. The HCDP will be officially launched in the third quarter of 2021.

Health Sector Transformation Program

The Health Sector Transformation Program was newly established for the Kingdom's Vision 2030 and will be launched during 2021 to ensure continued development of healthcare services in the Kingdom and focus efforts in this vital sector.

The program aims to restructure the health sector in the Kingdom to be a comprehensive, effective, and integrated health system that is based on the health of the individual and society, including the citizen, the resident, and the visitor. The program depends on the principle of value-based care, which ensures transparency and financial sustainability by promoting public health and preventing diseases, in addition to applying the new model of care related to disease prevention. It also aims to improve access to health services through optimal coverage and a comprehensive and equitable geographical distribution, expanding the provision of e-health services and digital solutions, as well as improving the quality of health services.

It will focus on the satisfaction of beneficiaries by implementing and following the best evidence-based international standards and establishing and enabling integrated health care systems that cover all regions of the Kingdom, by activating meaningful procurement of services and enhancing societal awareness of traffic and safety.

The Health Sector Transformation Program also works on harmonizing and coordinating between all health sector entities, VRPs and relevant government entities, in addition to aligning and linking with strategic national goals during the transformation journey.

Privatization Program

The Privatization Program was launched in 2018, aiming to identify government assets and services that can be privatized in a number of sectors, develop the privatization system and its mechanisms, define public and private sector partnership frameworks to enhance the quality and efficiency of public services, and support contributions to economic development. The Privatization Program's goal is to enhance the role of the private sector in providing services and making government assets available. This will improve the quality of services provided and contribute to the reduction of costs, also encouraging economic diversity and development, and boosting competitiveness to face regional and international competition. The program also seeks to attract foreign direct investment and improve the balance of payments.

Financial Sector Development Program

The Financial Sector Development Program was launched in 2017 to enable financial institutions to support the growth of the private sector, develop an advanced capital market, and to boost and enable financial planning.

In the previous stage, the program achieved great success after having the Saudi Stock Exchange "Tadawul" join the global indices "FTSE" and "MSCI", which contributed to the success of the initial public offering of Saudi Aramco shares in 2019. The program also increased support in the field of financial technology for startups and led many efforts with a significant impact on citizens, such as moving towards a cashless society and launching the instant payment system, which exceeded its goals in less than 12 months.

In the next stage, the Financial Sector Development Program will continue to strengthen financial institutions to support the private sector, through boosting the financial planning options and increasing the share of financing SMEs in banks. The program will also develop a sustainable and thriving insurance sector in the Kingdom, increasing the share of non-cash transactions from 36% in 2019 to 70% in 2025. To ensure overall financial stability of the financial services sector, the program adheres to relevant international standards, including the requirements of the Bank for International Settlements and the International Organization of Securities Commissions.

Public Investment Fund Program

The Public Investment Fund Program was launched in the fourth quarter of 2017 with the aim of strengthening the fund's position and making it an essential arm to achieve the Kingdom's Vision 2030. It is considered a pioneering economic catalyst for the Kingdom and an effective component of a thriving economy.

The program seeks to enhance the economic and investment sustainability of the Kingdom through four objectives according to a number of investment pillars. The pillars focus on launching promising local sectors, developing local real-estate projects, launching and supporting major projects, and increasing and diversifying the fund's global assets.

Since its launch, the Public Investment Fund program has scored many achievements, including maximizing the fund's assets, increasing the total return to shareholders, expanding the establishment of local companies in various fields, and launching a number of major national projects. This contributed to the creation of hundreds of thousands of direct and indirect jobs and increasing the fund's participation in non-oil gross domestic product.

In the next stage, the Public Investment Fund program will continue to enhance the fund's role as one of the main pillars of the Kingdom's Vision 2030, based on an ambitious strategy to empower the private sector and launch promising sectors, as it commits to investing 150 billion into the local economy annually until 2025, targeting new local projects.

National Strategy for Data & Artificial Intelligence

Saudi Data & AI Authority (SDAIA) was established to drive the national agenda for Data & AI to elevate the Kingdom as a global leader in the elite league of data driven economies. To capitalize on Data & AI for the Kingdom economically and socially through national combined efforts by all stakeholders, SDAIA has developed the National Strategy for Data & AI. The strategy approval was issued on July 17, 2020. SDAIA is currently working with different entities on launching the strategy and activating its initiatives.

The implementation of the National Strategy for Data & AI (NSDAI) will follow a multi-phase approach, which will focus on addressing the immediate national requirements for Saudi Arabia until 2025, particularly the development of data and AI programs to support the Vision 2030 strategic development goals. From 2025 until 2030, Saudi Arabia will shift focus to establishing the foundations of a competitive international AI ecosystem, with the aim of becoming one of the leading AI and data-driven economies by 2030. In the initial stage, the Strategy will focus on initiatives to accelerate the use of AI in five critical sectors: healthcare, mobility, education, government, and energy.

According to the Strategy, Saudi Arabia will build and enable core research and innovation institutions in data and AI, to enable the Kingdom to lead in the development and commercialization of new technologies. The nation aims to rank among the top 20 countries in the world for peer reviewed data and AI publications.

The National Strategy for Data & AI will aim to stimulate data & AI adoption through the creation of a collaborative and forward-thinking ecosystem, that will drive the commercialization and industry application of data and AI, for the benefit of public and private sectors. The strategy aims to create the environment for at least 300 AI and data startups to thrive by 2030.

The innovation ecosystem

Center Of Excellence for Telecom Applications (CETA)

CETA is a collaboration between the University of California San Diego and King Abdulaziz City for Science and Technology. The Center aims to work in advanced scientific research in the field of

telecommunications and IoT and to provide the operators with the latest and advanced solutions that meet the requirements of various authorities to increase the efficiency of the communication networks and internet services in the Kingdom of Saudi Arabia and also all over the world.

The Center has a number of tracks, all of which aim at enhancing the capabilities of scientific research in telecom and wireless applications and the development of human resources in this field, through the creation of a research environment based on a solid scientific base. All of these tracks enable Saudi researchers to participate in joint research with the university. It also allows the use of laboratories and equipment available at the university.

The center provides the right environment for the preparation of professional Saudi researchers and outstanding prospective graduate students through direct interaction between the Saudi researchers and their counterparts at the University to increase knowledge and gain the necessary experience.

King Abdullah University of Science and Technology (KAUST) Innovation Fund

The KAUST Innovation Fund aims to grow an innovation and technology investment community and to attract international investors and VCs to the emerging Saudi technology ecosystem. KAUST makes venture capital investments in high-tech startups from seed (less than $200,000) to early-stage (up to $2 million) and becomes a long-term strategic partner of these ventures.

Emerging technologies and initiatives

Internet of Things

According to a study published in February 2021 by the Saudi Arabia Communications and Information Technology Commission, it is expected that by the end of 2022, 82% of medium and large organizations in the Kingdom will adopt an IoT solution for their business. Among the uses with the highest adoption in the Kingdom are **closed-circuit TV (CCTV), Fleet Management, Staff Identification, Digital Signage and Freight Monitoring**.

IoT offers immense opportunities to the enterprises in the Kingdom, particularly for the **manufacturing, automotive, transportation & logistics, retail, public sector and healthcare industries**, which have already started to utilize IoT solutions and are expected to benefit from further adoption of IoT technologies. In terms of spending, the manufacturing sector is expected to constitute more than 20% of IoT spending in the Kingdom, primarily driven by the use of 5G and rollout of industrial IoT in the Kingdom. The IoT solution provider market in the Kingdom is forecasted to significantly grow over the next few years as all Saudi telecom operators expand their portfolio of IoT services offerings, and partnerships between global and local IoT service providers continue to grow.

Smart Cities

The Kingdom has allocated $500 billion to invest across 285 municipalities to implement smart cities. Saudi Arabia has already initiated efforts towards transforming the first five cities, including Makkah, Riyadh, Jeddah, Al-Madinah, and Al-Ahsa. The development of new economic sectors combined with the rise in demand for sustainable and eco-friendly cities supported by green initiatives globally and improving living conditions for its citizens/residents are the main drivers for developing smart cities in Saudi Arabia.

In January 2021, Saudi Arabia announced the planning of a **network of smart cities** that will not have any cars or roads. It is called **The Line**, due to its arrangement of hyper-connected future communities, and will form part of NEOM project. The development will offer "ultra-high-speed transit," autonomous vehicles and an urban layout that ensures basic facilities, such as schools and medical clinics, are never more than a five-minute walk away. The project's organizers expect that no journey will be longer than 20 minutes. One million people are supposed to live inside The Line. It will stretch 170 km, according to the official announcement, and be powered by 100 percent clean energy. The city will be focused on nature, with a pedestrian layer on the surface and two additional layers, for infrastructure and transport, hidden underneath. In addition, the organizers claim that AI will be able to monitor The Line and, using data and predictive models, figure out ways to improve daily life. Construction of this metropolis is supposed to begin this quarter. It is part of Saudi Vision 2030, a project designed to create 380,000 jobs and 180 billion Saudi Riyal ($48 billion) in GDP.

Agriculture

In August 2020, Saudi Arabia's Ministry of Environment, Water, and Agriculture has signed an agreement for cooperation with King Abdulaziz City for Science and Technology (KACST) aiming at establishing a **technical innovation center for water and agricultural research**.

The objectives of the agreement include finding solutions for the water sector, developing research skills, building national capabilities, and exchanging information and data in the fields of water and water studies to attain efficiency in the sustainable management of water resources and benefit from the services and equipment of plants and national laboratories.

Both sides have agreed to conduct research in several areas, including the **sustainability of water resources** to reduce groundwater depletion in the Kingdom, the development of simulation models for groundwater, as well as the **development of systems for rainwater and torrential management**, the detection of water transmission and distribution leaks, and the **use of treated wastewater** for various purposes.

The cooperation seeks to **rationalize water use in agricultural irrigation processes**, develop techniques to treat water desalination and reduce its production cost, protect water sources from pollution, in addition to developing techniques for harvesting water from the air, monitoring climate changes, and predicting their effects on water sources.

In the agricultural field, the goal is to develop greenhouse technologies that take into consideration the Kingdom's conditions, as well as integrated agriculture and rural development.

Both sides also aim at building a system of smart villages and manufacturing industries for agricultural waste and developing phytosanitary techniques and an electronic agricultural quarantine model, digital herbicides, and micro-insecticides.

Education

The human capability ecosystem has undergone many successful transformational changes including continuation of the educational processes and activities during COVID-19 pandemic. Several **digital platforms** have been launched including the virtual kindergarten and "Madrasati". On the other hand, research, development, and innovation ecosystem output has increased significantly in terms of the number of research publications and global partnerships. For instance, the Kingdom was ranked 14th in the number of COVID-19 publications.

Financial sector

Saudi Arabia's central bank, the Saudi Arabian Monetary Authority (SAMA), announced in January 2021 that is launching a framework for **open banking** in the Kingdom, allowing a new direction for a sector known much more for its dedication to stability rather than for change and innovation.

SAMA plans to go live with open banking during the first half of 2022. The decision is set to present significant opportunities for fintech companies and citizens themselves.

The central bank's move is set to revolutionize how customers, merchants and financial institutions augment the value they reap from accessing financial data. It will also open the market to numerous fintech services, spurring competition, innovation, and increase consumer choice.

SAMA has recently announced the deployment of **blockchain technology** for money transfers, aiming to enhance its capabilities with regard to emerging technologies and keeping pace with the global trends of central banks. Such a move will also allow SAMA to continue its efforts in exploring, experimenting, and assessing the impact of such technologies on the financial sector. SAMA is one of the first central banks to experiment with blockchain technology for money transfers. The move is one of the key initiatives launched by SAMA to promote fintech in the Kingdom.

Other SAMA actions include the Fintech Saudi Initiative launched in cooperation with the Capital Market Authority, the introduction of the SAMA Regulatory Sandbox, and an array of **digital banking services** and payments.

International Cooperation - Artificial Intelligence

Saudi Arabia has signed a series of partnership agreements with international tech companies to advance artificial intelligence in the Kingdom.

MoU – Saudi Arabia – China Huawei

Saudi Arabia's National Center for Artificial Intelligence (NCAI) announced a memorandum of understanding (MoU) with China's Huawei to enable strategic cooperation on the kingdom's National AI Capability Development Program.

Under the MoU, Huawei will support the NCAI to train Saudi AI engineers and students, and to address **Arabic language AI-related capabilities**. NCAI and Huawei will also explore the creation of an AI Capability Platform to localise technology solutions. NCAI and Huawei will also explore the **National AI Talent cultivation and onboarding programme**, which will provide professional training in AI to Saudi university students and AI researchers and developers, to enable them to master AI technologies and tools.

MoU – Saudi Arabia - International Telecommunication Union

The Saudi Data and AI Authority (SDAIA), and the International Telecommunication Union (ITU), a specialised agency of the United Nations, signed an MoU to collaborate on initiatives aimed at supporting and strengthening efforts to optimise the benefits of **AI technologies** and applications for sustainable development. Under the agreement, Saudi Arabia will support ITU in developing projects, activities, and initiatives that will aim to **facilitate greater multi-stakeholder participation, international cooperation, and knowledge sharing** to accelerate progress towards the UN Sustainable Development Goals (SDGs). This could potentially include developing initiatives such as an "AI Readiness Landscape Framework" that would explore and highlight country responses, progress, and best practices related to AI policy frameworks.

MoU – Saudi Arabia – China Alibaba Cloud

SDAIA also signed an MoU with China's Alibaba Cloud, to develop **digital and AI solutions** in areas including **safety and security, mobility, urban planning, energy, education and health**. The partnership will leverage Alibaba Cloud's AI platform in Saudi Arabia's cities, enabling intelligent management of city services and other smart solutions for citizens.

7. Innovation Environment - UAE

Policies and strategies

The United Arab Emirates has launched the UAE Vision 2021 and designed a number of strategies and development plans for particular policy areas, as following.

United Arab Emirates Vision 2021

The UAE Vision 2021 was launched by H.H. Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai, in 2010.
The UAE outlined its vision to make the United Arab Emirates one of the best countries in the world by the Golden Jubilee of the Union, in 2021.To translate the Vision into reality, its pillars have been mapped into national priorities which represent the key focus sectors of government action. Following are the priority areas for which innovation is a critical driver.

Competitive Knowledge Economy
Innovation, research, science and technology will form the pillars of a knowledge-based, highly productive and competitive economy, driven by entrepreneurs in a business-friendly environment where public and private sectors form effective partnerships. The UAE will benefit from a sustainable and diversified economy, flexible in adopting new economic models, and capitalising on global economic partnerships to guarantee long-term prosperity for current and future generations of Emiratis. The UAE will harness the full potential of its National human capital by maximising the participation of Emiratis, encouraging entrepreneurship, and nurturing home-grown public and private sector leaders while attracting and retaining the best talent.

Key Performance Indicators include share of knowledge workers in the labour force – to reach 40% of total workforce, research and Development Expenditure as % of GDP, Global Competitiveness Index, Global Innovation Index (GII) – UAE to become one of the top ten countries in the world in GII.

Sustainable Environment and Infrastructure
The UAE Government wants to ensure sustainable development while preserving the environment, and to achieve a perfect balance between economic and social development.

Key Performance Indicators include Telecommunication Infrastructure Index (TII), Online Services Index, Logistics Performance Index, Quality of Overall Infrastructure (such as transportation, electricity, and telephone lines), and Quality of water transport infrastructure.

First-Rate Education System
The National Agenda aims for all schools, universities, and students to be equipped with smart systems and devices as a basis for all teaching methods, projects, and research. The Agenda will aim to elevate the rate

of graduation from secondary schools to international standards and for all schools to have exceptional leadership and internationally accredited teaching staff.

UAE Policy for Advanced Industries

In December 2019, the UAE Government launched the UAE Policy for Advanced Industries. The policy was prepared by Ministry of Energy and Industry in coordination with the UAE's Industrial Coordination Council and other relevant entities to promote industrialization and the application of Fourth Industrial Revolution across all sectors.

The main enablers of the strategy are:
- Developing a supportive infrastructure for advanced industrial sectors
- Adopting proactive regulations, laws, and governance to achieve leadership in advanced manufacturing across industrial sectors
- Investing in advanced industries and new technologies
- Developing specialised workforce and identifying advanced skills required for industries
- Promoting industrial research and development.

The strategy aims to:
- Encourage businesses to adopt and develop futuristic industries and advanced technologies
- Promote the competitiveness of local industries on the global level
- Push the UAE towards clean and sustainable industries
- Attract talent and create jobs for the UAE's citizens.

UAE Strategy for Artificial Intelligence

In October 2017, the UAE Government launched the UAE Strategy for Artificial Intelligence. This marks the post-mobile government phase that will rely on various future services, sectors, and infrastructure projects. The strategy aims to:
- Achieve the objectives of UAE Centennial 2071
- Boost government performance at all levels
- Use an integrated smart digital system that can overcome challenges and provide quick efficient solutions
- Make the UAE the first in the field of AI investments in various sectors
- Create new vital market with high economic value.

The strategy will cover the following sectors:
- Transport – to reduce accidents and cut operational costs
- Health – to minimise chronic and dangerous diseases
- Space – to help conduct accurate experiments, reduce rate of costly mistakes
- Renewable energy – to manage facilities
- Water – to conduct analysis and studies to provide water sources

- Technology – to increase productivity and help with general spending
- Education – to cut costs and enhance desire for education
- Environment – to increase forestation rate
- Traffic – to reduce accidents and traffic jams and draw more effective traffic policies.

Emirates Blockchain Strategy 2021

In April 2018, the UAE Government launched the Emirates Blockchain Strategy 2021. The strategy aims to capitalise on the blockchain technology to move 50 percent of government transactions into the blockchain platform by 2021.

The blockchain technology will help save time, effort and resources and facilitate people to process their transactions at the time and place that suit their lifestyle and work. By adopting this technology, the UAE government expects to save:

- AED 11 billion in transactions and documents processed routinely
- 398 million printed documents annually
- 77 million work hours annually.

The UAE will use blockchain for digital transactions, giving each customer a unique identification number that points to their information on the secure chain. Information and data on the blockchain cannot be hacked or changed, which will ensure the digital security of national documents and transactions and eventually reduce operational cost and accelerate decision-making.

Abu Dhabi Economic Vision 2030

The Abu Dhabi Economic Vision 2030, launched in 2007, has innovation at its core, focusing on areas including the private sector, knowledge-based economy, transparent regulation, education, values and culture. It promotes infrastructure projects and collaboration with academic institutions, which positions Abu Dhabi to embrace innovative technologies.

Ajman Digital Government Strategic Plan 2022

In 2020, Ajman Executive Council launched the Ajman Digital Government Strategic Plan 2022 through which the Ajman Government aims to provide the best services by linking all departments and authorities through digital transformation. The Government of Ajman has prioritised the upgrading of government authorities in Ajman, to achieve the Emirate's comprehensive development and its desired overall progress, especially in digital services.

Dubai Blockchain Strategy

The Dubai Blockchain Strategy is a result of a collaboration between the Smart Dubai Office and the Dubai Future Foundation to explore and evaluate continuously the latest technology innovations that demonstrate an opportunity to deliver more seamless, safe, efficient, and impactful city experiences.

Adopting blockchain technology Dubai stands to unlock AED 5.5 billion in savings annually in document processing alone — equal to the one Burj Khalifa's worth of value every year. The Dubai Blockchain Strategy establishes a roadmap for the introduction of blockchain technology for Dubai and the creation of an open platform to share the technology with cities across the globe. The Dubai Blockchain Strategy is built on the three pillars of government efficiency, industry creation and international leadership.

Dubai Internet of Things Strategy

The Dubai Internet of Things (IoT) Strategy seeks to build the world's most advanced Internet of Things (IoT) ecosystem in the world's smartest city to improve people's lives. The strategy aims to protect Dubai's digital wealth, encourage government departments to join the emirate's smart transformation, and achieve the objectives of the Smart Dubai Plan 2021 to transition to a 100 per cent paperless government. It covers six strategic domains: governance, management, acceleration, deployment, monetisation and security.

Dubai Autonomous Transportation Strategy

The strategy aims to transform 25 percent of the total transportation in Dubai to autonomous mode by 2030. The strategy is expected to bring AED 22 billion in annual economic revenues in several sectors by reducing transportation costs, carbon emissions and accidents, and raising the productivity of individuals as well as saving hundreds of millions of hours wasted in conventional transportation.

The strategy will help cut transportation costs by 44 percent, resulting in savings of up to AED 900 million a year. It will also help save AED 1.5 billion a year by reducing environmental pollution by 12 percent, as well as generate AED 18 billion in annual economic returns by increasing the efficiency of the transportation sector in Dubai by 2030.

Dubai Autonomous Transportation Strategy also aims to reduce traffic accidents and losses by 12 percent, equivalent to savings of AED 2 billion annually, and increase the productivity of individuals by 13 percent. It will save 396 million hours on transportation trips yearly and it will also reduce the spaces allocated for parking.

UAE Strategy for the Fourth Industrial Revolution

In September 2017, the UAE Government launched the UAE Strategy for the Fourth Industrial Revolution. The strategy aims to strengthen the UAE's position as a global hub for the Fourth Industrial Revolution and

to increase its contribution to the national economy by means of advancing innovation and future technologies.

The UAE Strategy for the Fourth Industrial Revolution focuses on a number of key fields including innovative education, artificial intelligence, intelligent genomic medicine, and robotic healthcare.

The strategy also aims to:
- Achieve future security of water and food supply by using bioengineering sciences and advanced renewable energy technologies
- Enhance economic security by adopting digital economy and blockchain technologies in financial transactions and service
- Optimise the utilisation of satellite data in planning future cities
- Develop advanced defence industries by developing national industries in the field of robotics and autonomous vehicle technologies.

The Science, Technology and Innovation Policy

In November 2015, H. H. Sheikh Khalifa bin Zayed Al Nahyan announced the adoption of the Emirates Science, Technology and Innovation Higher Policy which includes 100 national initiatives with an investment budget of over AED 300 billion.

The policy works towards establishing a solid future for the coming generation, moving away from the oil sector, and creating a sustainable economy that will depend on science, knowledge and technology.
It will include special fields such as space research, specialised aviation industries, global pharmaceutical industries, solar power, civilian nuclear energy programme, and robotics, amongst others.

The Science, Technology and Innovation Policy aims to change the national economy equation to drive it away from dependence on limited oil resources. This policy aims to foster sustainable innovation based on science and technology, in an attempt to build a true knowledge-based economy. Focusing on science and technology will help the UAE leapfrog to achieve its global ambition and vision for the year 2021.

National Strategy for Advanced Innovation

In February 2018, the UAE government approved the National Strategy for Advanced Innovation. The new strategy is the updated version of the National Innovation Strategy and marks a new phase that is based on enabling people to focus on the goals and outcomes in seven areas:
- Exploration
- Future skills
- Quality of health
- Living and life
- Green power
- Transport

- Harnessing technology to serve humankind.

The innovation strategy aims to position the UAE among the world's top leaders of innovation and to develop a type of thinking that encourages experimentation and taking well-thought-out risks to achieve the goals of UAE Centennial 2071.

The strategy also aims to:
- Establish a national platform for innovation, communication, and learning
- Encourage the community to take the spirit of initiative
- Try out new models of government for serving society
- Test advanced economic patterns and lay the groundwork to create new sectors
- Achieve scientific breakthroughs that focus on the welfare of people
- Collaborate with leading international institutions and companies specialised in the field of innovation.

National Advanced Sciences Agenda 2031

In April 2018, the UAE government launched the National Advanced Sciences Agenda 2031 and the 2021 Advanced Science Strategy, which falls under the Agenda 2031. The 2031 Agenda aims to utilise advanced sciences in the development and creation of solutions to future challenges and support the government's efforts to achieve the objectives of Vision 2021 and Centennial Plan 2071.

The 2031 Agenda sets out eight scientific priorities up to 2031. The priorities aim to make the most of all strategic natural resources in the country through:
- National capacity-building
- Promoting the sustainable energy sector
- Enhancing water security using advanced and clean technology
- Developing advanced scientific food security system
- Addressing health challenges in the UAE through a national scientific system
- Developing advanced industries sector
- Building a system of logistical support based on scientific studies and data
- Creating a strategic industries complex.

The agenda also aims to develop four enablers which are:
- Economic information services
- A coherent scientific community
- A supportive technology
- An entrepreneurship in science and technology.

UAE Energy Strategy 2050

In 2017, the UAE launched 'Energy Strategy 2050', which is considered the first unified energy strategy in the country that is based on supply and demand. The strategy aims to increase the contribution of clean energy in the total energy mix from 25 percent to 50 percent by 2050 and reduce carbon footprint of power generation by 70 percent, thus saving AED 700 billion by 2050. It also seeks to increase consumption efficiency of individuals and corporates by 40 percent.

The strategy targets an energy mix that combines renewable, nuclear, and clean energy sources to meet the UAE's economic requirements and environmental goals as follows:
- 44 percent clean energy
- 38 percent gas
- 12 percent clean coal
- 6 percent nuclear.

The UAE government aims to invest AED 600 billion by 2050 to meet the growing energy demand and ensure a sustainable growth for the country's economy.

National Climate Change Plan of the UAE 2017–2050

The National Climate Change Plan of the UAE 2017–2050 is the UAE's comprehensive framework to address the causes and impacts of climate change, plan the transition into a climate resilient green economy, and achieve a better quality of life.

The primary objectives of the Climate Plan are to:
- Manage greenhouse gas (GHG) emissions while sustaining economic growth
- Minimise risks and improve capacity of adaptation to climate change - promoting a climate-resilient economy is a prerequisite for the UAE to realise the transformation outlined in the Vision 2021
- Enhance the UAE's economic diversification agenda through innovative solutions - as the UAE continues to invest in non-oil sectors with high growth potential, the Climate Change Plan will facilitate a stronger growth momentum in key emerging sectors.

National Food Security Strategy 2051

In November 2018, Mariam Hareb Almheiri, Minister of State for Food Security, presented the National Strategy for Food Security. It includes 38 short- and long-term key initiatives and focuses on:
- Facilitating the global food trade
- Diversifying food import sources
- Identifying alternative supply schemes, covering three to five sources for each major food category.

The strategy aims to:
- Make the UAE the world's best in the Global Food Security Index by 2051 and among the top 10 countries by 2021.
- Develop a comprehensive national system based on enabling sustainable food production through the use of modern technologies
- Enhance local production
- Develop international partnerships to diversify food sources
- Activate legislation and policies that contribute to improving nutrition
- Activate legislation and policies to reduce waste.

By launching the National Food Security Strategy 2051, the UAE aims to achieve SDG Zero Hunger by ensuring access to safe, nutritious, and sufficient food all year round throughout the world. The strategy specifically aims to implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems.

UAE Water Security Strategy 2036

In September 2017, the Ministry of Energy & Industry unveiled the UAE Water Security Strategy 2036, which aims to ensure sustainable access to water during both normal and emergency conditions in line with local regulations, standards of the World Health Organisation, and the UAE's vision to achieve prosperity and sustainability.

The strategy focuses on three main programmes: the Water Demand Management Programme, the Water Supply Management Programme and the Emergency Production and Distribution Programme. The strategy also tackles policy development, legislation, water conservation awareness campaigns, use of advanced technologies, innovation and building national capabilities in the field of water security.

UAE Centennial 2071

H. H. Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai launched UAE Centennial Plan 2071. It is a long-term, full-vision plan that extends for five decades after 2021. It forms a clear map for the long-term government work, to strengthen the country's reputation and its soft power.

The plan aims at investing in the future generations, by preparing them with the skills and knowledge needed to face rapid changes and to make the UAE the best country in the world by the next centennial in 2071. The UAE Centennial 2071 strategy is based on four pillars: future-focused government, excellent education, a diversified knowledge economy, and a happy and cohesive society.

The innovation ecosystem

Mohammed Bin Rashid Centre for Government Innovation

The Centre was established in September 2014 to stimulate the culture of innovation within the government sector, making the UAE one of the most innovative governments around the world.

The Centre serves federal and local government entities by organizing the government innovation labs and developing solutions for the challenges, in coordination with top world universities, in addition to training and building capacities of national cadres in government innovation, as well as provision of integrated system of modern tools to help government entities in their innovation efforts.

The centre's initiatives include:
- Innovation Diploma program that is conducted in partnership with the University of Cambridge in the United Kingdom. It aims to support the government plan to prepare a generation of innovative CEOs in the government entities.
- Government innovation labs that consist of interactive sessions and workshops that use innovative methods to inspire innovative ideas and generate solutions to the challenges that face government entities. This is achieved by bringing together all stakeholders to discuss government challenges through solution-focused perspectives.
- Ibtikar talks that aim to make a serious and comprehensive transformation in government operating model by increasing the effectiveness of processes, keeping up with the latest technological developments. The initiative seeks to enhance national cooperation between the various government entities and to stimulate innovation in key sectors.
- 'CEO of Innovation', a new post created in each government entity. This step reflects the UAE's keen interest in investing in management and leadership in the field of innovation.

UAE Innovation Week and UAE Innovation Month

The UAE Innovation Week was launched in August 2015. The event aimed to help in creating a widespread culture of innovation in the UAE. Following the success of UAE Innovation Week in 2015 and 2016, H.H. Sheikh Mohammad bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai ordered to observe 'Innovation Month'.

UAE Innovates

UAE Innovates is a comprehensive portal that documents all the core innovation activities and achievements in UAE. It covers innovation across the different levels and sectors in the country from federal and local governments to private sector businesses, community, individual citizens and residents, and students. The portal also provides data, information, tools, and references related to innovation in UAE. It also functions as an interactive platform where the public gets involved and can be part of the innovation ecosystem by participating in building the innovation portfolio of UAE.

Abu Dhabi Ghadan 21 Accelerator Program

The AED 50 billion three-year programme, launched in 2019, focuses on economy, knowledge, and community. Ghadan 21 has launched more than 50 initiatives in its first year. In response to global economic challenges in 2020, the Abu Dhabi Executive Council launched an economic stimulus package, fast-tracking the implementation of key Ghadan 21 initiatives. Under the package, 16 initiatives have been announced to improve the ease of doing business and reduce the cost of living in the Emirate.

Abu Dhabi Advanced Technology Research Council (ATRC)

ATRC is a future-focused organisation that prioritises attracting and retaining global research talent. Since its establishment in 2020, the organisation has consolidated investment funding and driven policy and regulation to facilitate research across academia, with the objective to "solve tomorrow's challenges today". It comprises two pillars: its applied research Technology Innovation Institute and ASPIRE, which focuses on programme management.

Abu Dhabi Research and Development Authority (ADRDA)

The entity has been established in 2019 and mandated with the growth and development of a holistic and world-class (R&D) ecosystem in the Emirate. The ADRDA have determined a number of R&D initiatives, which include establishing five Virtual Research Institutes (VRIs) with emphasis on biotechnology, food security, sustainability, artificial intelligence and high-performance computing and advanced materials. These inter-institutional centers will provide a platform for collaboration between national, regional, and international higher education institutes and industry.

Ajman University Innovation Center (AUIC)

In May 2021, AUIC has received the Accredited Business Incubator (ABI) certification by the Global Innovation Institute (GInI) for providing a highly conducive environment for the launch of a globally competitive start-up businesses. AU is the first UAE university to earn Gini's coveted ABI certification for nurturing globally competitive start-ups by students and other budding entrepreneurs. GInI is the world's leading professional certification, accreditation, and membership association in the field of innovation that maintains a highly rigorous and evidence-based accreditation program for business organizations.

The mission of AUIC is to provide an innovation platform to students, alumni, faculty, industry, government, and society in order to achieve significant economic and social benefits for the engaged stakeholders through sharing and implementing innovative ideas and solutions to resolve existing problems and address future challenges.

Dubai Future Accelerators

In 2016, Sheikh Hamdan bin Mohammad bin Rashid Al Maktoum, Crown Prince of Dubai and Chairman of the Dubai Executive Council, launched the Dubai Future Accelerators initiative to enable rapid deployment of transformative technologies. The accelerators are programmes and integrated systems designed to help entrepreneurs and innovators turn their ideas into successful companies.

The initiative will bring together top international companies and entrepreneurs to address key 21st century opportunities which include the application of cutting-edge technologies like artificial intelligence and robotics, genomics, 3D printing, biotechnology, new business models, and best practices.

The UAE Hackathon – Data for Happiness

The UAE Government started an annual nationwide hackathon titled 'The UAE Hackathon – Data for Happiness' in February 2018. The hackathon involved using government data to create apps that provide solutions and services for the benefit of people. The UAE is pursuing an active role in the era of the Fourth Industrial Revolution, primarily, artificial intelligence and smart city. Data has become one of the most important features of the digital era, and the focus on data in terms of understanding, analysis and employment has become one of the most important highlights in the transformation towards a digital and knowledge economy.

The UAE Hackathon aims to draw attention to the high value of data and the solutions inherent within it when encountering challenges regarding the economic, social, environmental, and scientific aspects of life. The hackathon aims to use data to develop innovative solutions and ideas that contribute to the happiness of the community. It also aims to engage a significant number of students with participants from other sectors of the society as well to develop modern solutions based on the analysis of available data.

The UAE Hackathon revolves around several challenges, which include:
- Transportation and traffic congestion
- Health and safety
- Sustainable development (post-oil age)
- Environment and climate change
- Education
- Gender balance
- Enhancement of social relations in the UAE community
- Enhancement of lifestyle

Afkari initiative

In 2015, the UAE Government launched 'Afkari', a government initiative at the federal level to support and fund innovative ideas of federal government employees that will contribute to the development of

government services in the ministries and entities. Afkari supports and funds innovative ideas of more than 90,000 federal government employees to develop work system in their institutions.

Sheikh Mohammed bin Rashid Al Maktoum Fund to Finance Innovation

In November 2015, Sheikh Mohammed launched the fund to finance innovation with a value of AED 2 billion. This is a federal initiative designed to provide financing solutions for innovators across various sectors in the UAE. Innovators could be individuals and companies registered in the country. Innovation could be an idea, a technique, a process, a product, or a service.

The objectives of the fund include:
- Support National Innovation Strategy and achieve the UAE's developmental vision to be among the 10 most innovative countries internationally by 2021
- Provide financing solutions and the necessary guarantees to innovative entrepreneurs to facilitate their access to business loans to finance their projects and help them turn their ideas into actual projects
- Contribute to establishing a supportive environment for innovation in collaboration with financial institutions and funding entities such as commercial banks, investment funds and family businesses among others.

Priorities will be renewable energy, transport, education, health, technology, water and space sectors, and applicants must provide a business development plan to be eligible for funding. The fund is managed by the Ministry of Finance, in collaboration with local banks and various investment entities.

Dubai Science Park

The Dubai Science Park is a holistic community dedicated to supporting entrepreneurs, SMEs and Multi-National Enterprises (MNEs) in the sciences, energy, and environmental sectors. With its robust infrastructure and supportive environment, Dubai Science Park aims to play a significant role in facilitating a more sustainable and self-sufficient future that maximises the use of local resources and talent, supporting scientific innovation and fostering growth and change in human science, plant science, material science, environmental science, and energy science industries.

ICT Fund

The ICT Fund was launched in 2007 by the Telecommunications and Digital Government Regulatory Authority (TDRA) to achieve rapid, progressive, and concrete developments within the ICT sector in the UAE. The Fund launched its operations to jump start innovation within the ICT sector in the UAE mainly in the fields of intellectual capital, technological leadership, smart research, innovative ideas, and incubating startups.

Betha Scholarship Program

ICT fund has launched its initiative Betha (Arabic for Scholarship) to enhance the stature and role of the national education sector by supporting and sponsoring scientifically distinguished students to boost the education process in the UAE in all scientific majors that are based on the UAE needs. The initiative comes as a by-product of the growing demand for UAE national human resources specialized in the telecoms sector and related fields.

The ICT fund invested vastly in school seats for bachelor and master's degrees in the most prestigious universities in the UAE and around the world. The program aims to attract 1,000 students over the next few years in domains related to the ICT sector. "Betha" is part of the ICT fund strategy for enabling a generation of Emirati male and female students specialized in telecommunication and information technology, including computer engineering, electronic engineering, and computer science.

Blockchain Council

As part of its efforts to adopt the latest technologies and innovation practices at the global level, Dubai Future Foundation established the Global Blockchain Council to explore and discuss current and future applications and to organise transactions through the blockchain platform. The Council will facilitate transactions within the various sectors of financial and non-financial sectors as well as increase efficiency and reliability levels. The council consists of 46 members, which include government entities, international companies, leading UAE banks, free zones, and international blockchain technology firms.

Emerging technologies and initiatives

Smart Cities and AI

Masdar City is one of the world's most sustainable urban communities, a low-carbon development made up of a rapidly growing clean-tech cluster, business free zone and residential neighbourhood with restaurants, shops, and public green spaces. Masdar's philosophy of urban development is based on the three pillars of economic, social, and environmental sustainability. Masdar City is a 'greenprint' for the sustainable development of cities through the application of real-world solutions in energy and water efficiency, mobility, and the reduction of waste.

In March 2014, the government of Dubai announced the **Smart Dubai initiative** to make Dubai a leading smart city. AI has been the trigger and the technology behind the facilitation of Smart Dubai. A smart city requires a digital infrastructure that can link the various sensors, devices, and machines to make up the public system so they can exchange information in real-time. For city governments, the challenge will be to ensure that the huge volumes of data created by smart cities remain safe. Other initiatives created for this purpose are Ibtekr, the first interactive platform designed by the Mohammed bin Rashed Centre for Government Innovation (MBRCGI), as well as Dubai Future Foundation. In addition, Mubadala, the UAE's leading Sovereign Wealth Fund,has reportedly invested $15 billion in a technology fund to subsidize its efforts.

UAE has seen a multitude of initiatives that have seen the **deployment of AI** in various sectors. This has been possible as the country has a dedicated ministry for AI.

In **security and police services**, it developed a police officer robot. In Dubai, the **Water and Electricity Authority** employed a customer service robot and used a pilotless flying taxi, which are not yet in service. The main areas of focus for implementing AI are radar, radio communication, a variety of aerospace technologies, as well as transport and aviation. The following are some of the top efforts taken by UAE in the deployment of AI.

30 Minute Visa with the Help of AI - One of the most innovative breakthroughs achieved by the Dubai government in the application of AI is the recent 30-minute visa system. The 'Smart Salem' under the Dubai Health Authority (DHA) is an innovative medical fitness centre, which is automated with AI. Four robots deployed in the centre makes the process of medical test required for visa quicker. The Salem centre has also deployed a robot to greet the investors and VIPs who come for the tests. A smart valet service is facilitated for the efficient car-parking system.

DIFC's Courts of Future Initiative - courts of the future will handle the legal disputes using digital methods with the help of advanced technologies like AI and machine learning. The Dubai International Financial Centre (DIFC) and the Dubai Future Foundation have created the Court of the Future Forum in a bid to resolve commercial and civil disputes within the DIFC jurisdiction using disruptive technologies like AI, blockchain, and machine learning. Protecting the Intellectual Property (IP) rights of entrepreneurs using emerging technologies is one of the top priorities of the Courts of Future.

Exploring the Use of AI in Intellectual Property Protection - Entrepreneurs and investors will enjoy greater benefits in the realm of protecting their Intellectual Property (IP) rights including the business trademark as the UAE is exploring initiatives to use AI in the domain of IP. In this regard, the UAE Ministry of Economy signed a Memorandum of Understanding (MoU) with the Korean Intellectual Property Office (KIPO), which will ensure efficient protection of IP including trademarks, copyright, patents, and industrial design.

3D Printing - The Dubai Future Foundation has created the world's first commercial building using 3D Printing technology. The office has been created using a single printer and completed in just 17 days. The building is 120 feet in length and 40 feet in width.

Transport - blockchain

Vehicle history blockchain project

The Roads and Transport Authority (RTA) is working on a project to create a **vehicle lifecycle management system** using the blockchain technology. The project aims to provide car manufacturers, dealers, regulators, insurance companies, buyers, sellers, and garages with a transparent record about the

vehicle's history from the manufacturer to the scrap yard. This blockchain-based system will help boost transparency and trust in vehicle transactions, prevent disputes, and lower the cost of services. It tracks ownership, sale, and accident history to create smart and more efficient systems for supply chains.

Clean energy

The **Technology and Innovation Center** in Ras Al Khaimah research projects and facilities include High Precision Solar Tracking Platform (Solar Island), Solar Outdoor Facility, Polygeneration, Solar Water Desalination, Solar Mini Grid, Solar Calorimeter and Green Buildings, Photovoltaic Center, Solar Cooling, and Concentrated Solar Power (CSP).

Education

The **Centre of Excellence for Applied Research & Training** (CERT) has been established in 1996 to design and deliver world- class programs to develop the nation's workforce. The goal is to deliver economic and strategic value to the UAE through **Emiratization and upskilling and re-skilling the UAE workforce** across federal, local government and semi-government organizations. CERT has garnered expertise over the past two decades in channeling organizational strategy and resources and playing a leading role in our future's transformative digital journey. This has been achieved by engineering technological change across a range of products, services, markets, industries, and the economy.

Since its inception, CERT has been at the forefront of national development, through life-long learning and technology solutions that deliver value for leading organizations in the UAE and the region. CERT is positioned at the intersection of academia, industry, and government, offering integrated solutions that contribute to industry competitiveness and government excellence. The Center has 300 faculty and staff and over 30,000 graduates.

Agriculture

The UAE is also one of the most advanced countries in the world when it comes to agricultural innovation, such as **vertical farming**. Vertical farming allows crops to be grown up in the air, rather than over vast fields. This technique allows for reduced water consumption and less spoilage of the crops due to no fluctuations in weather when the crops are grown in a controlled environment. In 2017, the first vertical farm in Dubai was set up by Badia Farms.

Financial sector

The technologically advanced and innovative systems are largely elevating the level of service in banking and insurance and the way financial organizations operate. With the increasing use of **blockchain technology and artificial intelligence**, the UAE Ministry of Finance (MoF) is helping businesses in the UAE to adopt these changing trends. MoF's online and smart services provides benefits to individuals as well as the government and private sector and SME enterprises.

e-Dirham - first introduced in 2001 to reduce the efforts, errors, and risks associated with manual collections, the e-Dirham includes a wide range of convenient financial functions and is seeing excellent growth (YOY 52.33% in 2018) and is helping to foster green finance in the UAE. MoF consults with acknowledged global experts for its fintech developments, one of which is the aim to transform e-Dirham into the national ePayment ecosystem, offering a viable alternative to services like VISA and Mastercard.

Smart Identity - as a service to government employees, MoF has linked the Emirates ID card to individuals and their salaries as a digital personal identification document. The MoF system uses encryption and smart features offered by the ID to validate data, including the holder's biometrics. This saves time, effort, and money, and accelerates the transformation to smart services.

Support for innovative fintech entrepreneurs - innovative ideas require innovative financial solutions, which the MoF provides through the Mohammed bin Rashid Al Maktoum Innovation Fund. The Innovation Fund aims to deliver financial backing worth AED 2 billion to support the work of pioneering startups. The targeted financial risk mitigation and business development tools provided by the Fund help to facilitate innovation activities and contribute to the sustainable growth of the UAE.

eDMobile - the innovative eDMobile, launched in October 2018, supports smart government programs and allows customers to easily access e-Dirham services. The free digital government service is an electronic wallet that includes all the customer's payment cards, so it provides a safe and effortless replacement for a physical wallet filled with plastic cards. The application can be simply downloaded from Google Play or the AppStore to create a default virtual account that does not expire.

Smart Digital Channels - MoF has several smart digital channels in place to communicate with its internal and external customers. The channels include the MoF website, smart app, live chat, feedback and suggestion gateway, opinion polls, scale of happiness, and various social media channels. Inquiries, information, services, suggestions, and complaints can all be handled at the customer's convenience, anytime, anywhere.

MoF supports the aspirations of the UAE to be one of the world's most innovative nations by 2021. The **Innovation Lab** is one such interactive platform developed by MoF. In addition, the MoF's e-training is an interactive and innovative education and development system through which suppliers and federal employees can be trained in line with the government's strategic and financial goals.

Blockchain in banking

Abu Dhabi Commercial Bank (ADCB) has digitized trade finance for its customers using the Singapore-based dltledgers Blockchain platform. ADCB is the first bank in UAE to run the end-to-end blockchain trade finance transaction with full document automation through the dltledgers platform, as reported in Singapore.

Emirates NBD

In July 2020, Dubai's Department of Economic Development (DED) and Emirates NBD bank rolled out their UAE Know Your Customer (KYC) Blockchain Platform where over 120 SMEs have signed up. The new blockchain platform is designed to unlock digital customer onboarding, instant bank account functions through Emirates NBD's E20 Digital Business Bank and verified KYC data sharing between licensing authorities and financial institutions.

The platform will soon feature a number of banks including Commercial Bank of Dubai, ADCB, HSBC, and RAKBANK. Also, Emirates NBD's 'Cheque Chain' in 2017 has integrated blockchain into issued cheques to strengthen their authenticity and minimize potential fraud.

Abu Dhabi Islamic Bank

Abu Dhabi Islamic Bank (ADIB) reportedly became the first Islamic bank to execute trade finance distribution transactions using blockchain technology. ADIB conducted multiple cross-border transactions with partner banks using TradeAssets, a blockchain-based digital trade finance marketplace.

Mashreq Bank

The Dubai Land Department (DLD), in partnership with UAE-based Mashreq Bank, has released a blockchain-based mortgage platform, which can serve as a repository for mortgage records. It is also designed to enable confirmation that mortgages comply with registration policies.

Support for innovation and entrepreneurship – cross-sector initiatives

Ajman Department of Economic Development "In Ajman" 2021

The Initiative will be launched by promoting the distinctive projects in the Emirate of Ajman, selected according to a set of criteria. The aim is to strengthen the relationship between the department and **entrepreneurs** and support project owners in the Emirate, through marketing and promotion of local products and industries for the emirate of Ajman, in a manner that ensures opening new opportunities for these products at the local and federal level. In addition, the initiative will contribute to educating and spreading the awareness among **new entrepreneurs and those wishing to enter the entrepreneurship world** through sharing the successful experiences of prominent entrepreneurs and project owners.

International cooperation - Agriculture

Agriculture Innovation Mission for Climate (AIM for Climate)

In April 2021, the United Arab Emirates and the United States, with support from the United Kingdom, Brazil, Denmark, Israel, Singapore, Australia and Uruguay, announced the Agriculture Innovation Mission for Climate (AIM for Climate) at President Biden's Leaders Summit on Climate. The initiative aims to

increase and accelerate global agricultural innovation and research and development (R&D) over the next five years, to address climate change.

AIM for Climate will address the principal challenges related to the agricultural sector and climate change, including emissions, food security, and water security. The sector is currently responsible for 24 percent of all greenhouse gas emissions, and as the world's population continues to grow, innovations in efficient, productive farming techniques can reduce the sector's environmental impacts, make healthy food more available and create new economic opportunities, skills, and jobs.

8. Next steps

The GCC economies are in different stages of digital transformation and application of emerging technologies in various sectors of their economies. The report presents a number of areas related to emerging technologies and innovation in which GCC countries have launched initiatives aimed at increasing their innovation capabilities and also the pace of economic diversification.

According to the World Economic Forum, "the combined health and economic shocks of 2020 have impacted the livelihoods of millions of households, disrupted business activities, and exposed the fault lines in today's social protection and healthcare systems. The crisis has also further accelerated the effects of the Fourth Industrial Revolution on trade, skills, digitization, competition and employment, and highlighted the disconnect between our economic systems and societal resilience."

The EU expertise and tools in the areas of digital transformation, entrepreneurship, and innovation, as well as sector-specific tools, can be shared with the GCC countries to assist them in their recovery from the COVID-19 pandemic and to strengthen the economic ties between the EU and the GCC for mutually beneficial collaboration.