ABAC
APEC Business Advisory Council

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Digital First Economy

ICT Infrastructure drives economic evolution for sustainable, inclusive growth

In Collaboration with

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Research Insights by

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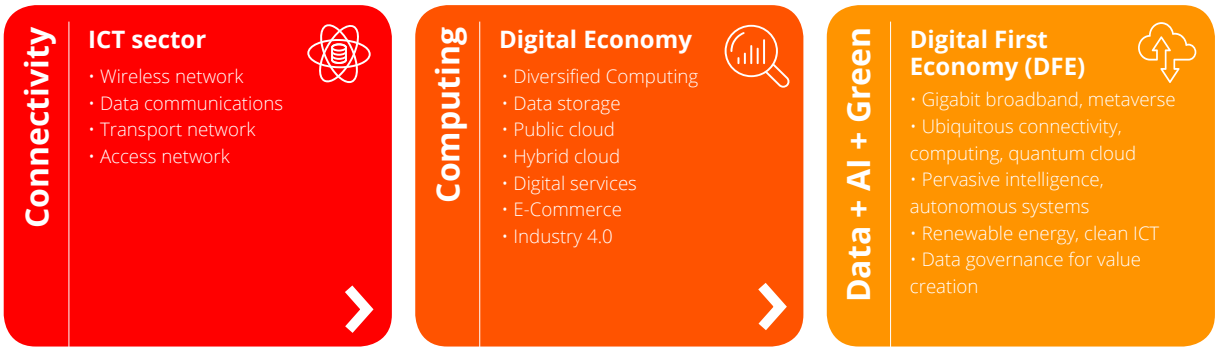
I. Executive Summary

The digitalization process has greatly picked up speed throughout the COVID-19 pandemic, forever changing how governments and businesses operate – and how we all go about our daily lives. As the world grows increasingly digital, economies have evolved in lockstep. All sectors of the economy have become heavily reliant on digital technology, and many organizations are now thinking "digital first" when it comes to developing new products, services, and business models. These trends are driving massive proliferation of data, greater investments in AI solutions, and growing demand for sustainable green technology, giving rise to the next wave of digital economy – the Digital First Economy (DFE).

ICT infrastructure has evolved beyond connectivity and computing to form a new ecosystem driven by AI, data, and green technology, giving rise to the DFE.



Moving forward, it will no longer be sufficient to simply digitalize products and services, or engage with customers, partners, and employees through basic digital connections. We will soon enter an economy where gigabit broadband infrastructure will deliver real-time, ubiquitous computing power to all four corners of the earth, where fully autonomous systems will drive industry, and where a much greater portion of our lives will take place in the digital world. Broad adoption of renewable energy will become even more critical than ever, and exponential growth in data will present new opportunities for economic growth, resiliency, and competitiveness.

In laying the groundwork for a Digital First Economy, APEC economies can expect to benefit from five key outcomes: stronger GDP growth, new business models, digital resiliency to protect against future economic disruption, greater inclusion where all people can share in the benefits of digital technology, and greener, more sustainable energy portfolios despite growing demand for energy.

This study was developed to provide APEC policymakers with a practical framework to assess their readiness for a Digital First Economy. We provide a quantitative index, as well as a snapshot of how key stakeholders (e.g., everyday people, micro, small and medium enterprises [MSMEs], and large enterprises) are adopting digital technology. The study covers the following:

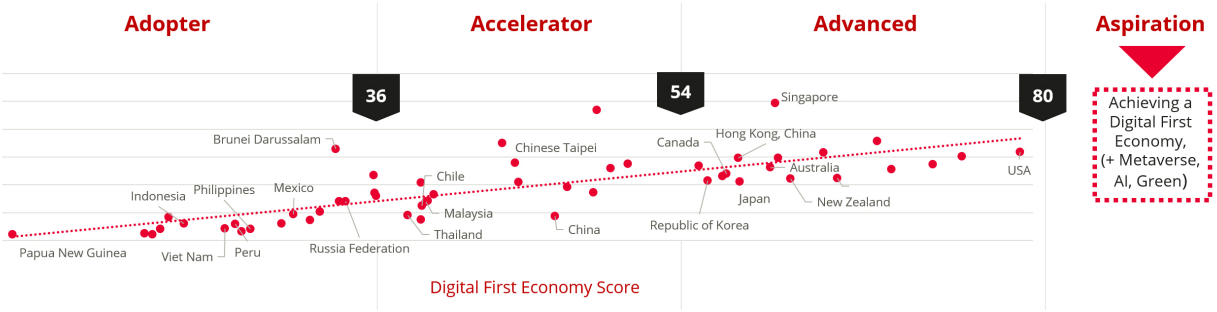
- An empirically defined framework developed based on primary and secondary research, as well as in-depth consultation with industry analysts, that reflects the drivers for and contributors to a Digital First Economy
- A DFE Index developed based on the abovementioned framework, designed to help APEC economies track their progress towards building a Digital First Economy
- A comprehensive survey of stakeholders (including everyday people, MSMEs, large enterprises, and government agencies) conducted in seven APEC economies to assess their ability to participate in the DFE
- A practical guide for building a Digital First Economy, with specific recommendations for economies at different stages of the transformation process

The DFE Index reveals three clusters of economies at different stages of digital economy development. It also explores an aspirational fourth stage – a Digital First Economy that forms the bedrock of our future intelligent world, where gigabit connectivity presents new opportunities for people, businesses, and communities.

DFE scores are computed based on the DFE Index, which is made up of 20 indicators that evaluate digital economy development.

There are 4 stages of development, outlining the progress of different economies on their path toward a fully Digital First Economy.

There are three transition points at scores 36, 54, and 80, indicating where economies typically advance to the next stage of development.



The characteristics of the four stages are as follows:

Adopter: Economies with policies in place to support the development of a robust digital economy but still need to build nationwide digital connectivity. Digital economy growth is mainly from e-commerce and IT services.

Accelerator: Economies with policies that focus on industry digitalization for economic growth, with increasing ICT investment and talent development as priorities. They are well on the way to a strong digital economy, but need to further boost digital connectivity to drive cloud computing and accelerate digitalization.

Advanced: Economies with policies in place to develop a DFE, with a strong focus on building data assets and driving data value creation. They regularly upgrade their networks, aiming for gigabit-level connections, and mandate a cloud-first environment with ICT and talent investments as their primary national objectives.

Aspiration: A fully Digital First Economy built on policies that harmonize intelligent systems with human aspirations, where robotics and AI perform key roles in enhancing our businesses and lives. This aspirational intelligent world requires concerted investment in digital technologies with AI embedded in everyday systems, ideally powered by renewable energy.

Some key findings:

Depending on which stage a given stakeholder is at, they have different abilities to participate in the DFE. Survey results show that about one-third of citizens interviewed are unsatisfied with their employment and income status, with up to 56% of citizens in the Adopter cluster eager to generate higher income by starting their own digital businesses. People in Adopter and Accelerator economies want their governments to encourage telcos to upgrade their networks and provide faster, more stable internet connections. There is also popular demand for subsidizing private ICT investments to increase local participation in the DFE and close the income gap with Advanced economies.

Only about half of MSMEs indicated that they have started to digitally transform their business, with the majority investing in digital solutions for their daily operations. In terms of digitalization, MSMEs in the Adopter and Accelerator clusters are far behind their peers in the Advanced cluster. MSMEs are keen to invest in gigabit broadband and cloud computing, but they tend not to have a long-term strategy or budget to guide their investments. Policymakers in these clusters can develop programs to facilitate MSME digitalization, bolstered by more robust ICT infrastructure, to help their MSMEs boost competitiveness and grow.

While most enterprises have begun their digital transformation journey, about four-fifths of them have not fully realized the value of their data. Enterprises in the Advanced cluster are primarily the ones that are able to leverage their data to create new economic value. In the Adopter and Accelerator clusters, many enterprises have not invested in the necessary IT infrastructure for data governance and value creation. Governments in Adopter and Accelerator economies can support them more effectively by providing the frameworks, guidelines, and capabilities needed to help organizations make the most of their data and forge the backbone of a new data economy.

Based on the survey and index data, the following key findings also emerged:

DFE performance has a clear multiplier effect on GDP growth. A one-point increase in DFE score correlates with 3% growth in GDP. And every $1 dollar of ICT investment drives $13 dollars in GDP output. That's more than double the returns compared to 2016.

People and companies are willing to pay more for better connectivity. They hope that governments can encourage telecom service providers to provide faster, more stable connections.

Digital infrastructure is a strong enabler of both green and sustainable development. In economies with high DFE scores, businesses are more resilient. They can respond better to emergencies, and recover operations more quickly.

APEC economies can boost DFE performance through concrete actions like developing digital master plans, increasing ICT infrastructure investment, and promoting cloud-first policy and investment in AI.

Key Recommendations:

To better accelerate post-pandemic recovery, and drive the inclusive and sustainable growth of APEC economies, we have identified a targeted set of actions that APEC economies can take to bring their digital economy to the next level.

Build and execute digital master plans, including targets for digital infrastructure and sustainable development, provision of greater spectrum resources, and financial support.

Encourage ICT spending by incentivizing public and private investment in frontier technologies, ICT infrastructure, and digital talent.

Enhance digital connectivity by building out ultra-broadband, intelligent network infrastructure (gigabit-level full fiber and 5G) and boosting network coverage to ensure inclusive, reliable access for all.

Promote cloud adoption, including cloud-first policies and support for cloud migration, to accelerate vertical industry digitalization.

Invest in data hubs and AI, with a particular focus on data hubs that promote data sharing, while ensuring effective data governance.

II. Defining DFE and Discussing Its Impact

A. What is the Digital First Economy (DFE)?

Rapid behavior, consumption, and supply changes have forced organizations to adopt digital-led business and operating models that can endure lockdowns, movement restrictions, social distancing, and more.

This is giving rise to a world where citizens, businesses, and governments rely on digital technologies and think digital first for developing new products, services, or business models. The accelerated digitalization due to the COVID-19 pandemic will bring about 60% of the global economy to be digitalized by this year. This ongoing digitalization will create 60-65 million new jobs by 2025 and will create a data-rich environment as well as drive new economic value in data monetization to US$13 trillion by 2030.

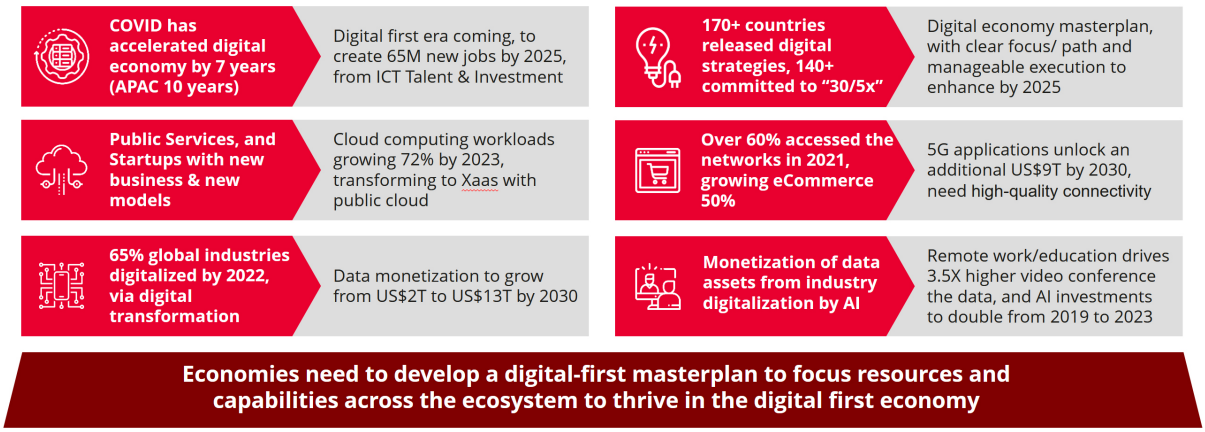
We have also seen new startups leveraging digital technologies with new business models, disrupting traditional business ways and creating new economic value. Cloud computing is the main platform to deploy their business and this is expected to grow by 70% in 2023.

Remote work, education, or remote interactions have always been possible during the pre-pandemic, but COVID-19 lockdowns have made it such that video conferencing is 3.5 times higher than before. With this, video conferencing is the new norm for operating and interacting with most businesses, governments, and people. Over 60% of the world went online and grew eCommerce by 50% - for the majority, online is a core part of how they function and operate now. Increasingly, 5G networks will open possibilities in new internet services and commerce opportunities, changing the landscape even today.

This digitalization and transformation need electricity to power, driving energy consumption up by 50% in 2050. To meet our global warming mitigation goals, businesses, governments, and people will need to rely heavily on renewable energy such as solar power.

As a result, the ongoing economic activities derived from everyday online interactions among people, businesses, devices, and data have risen dramatically, giving rise to the next digital economy wave, which is now called a digital first economy (DFE).

Figure II-1 Emergence of the digital-first world



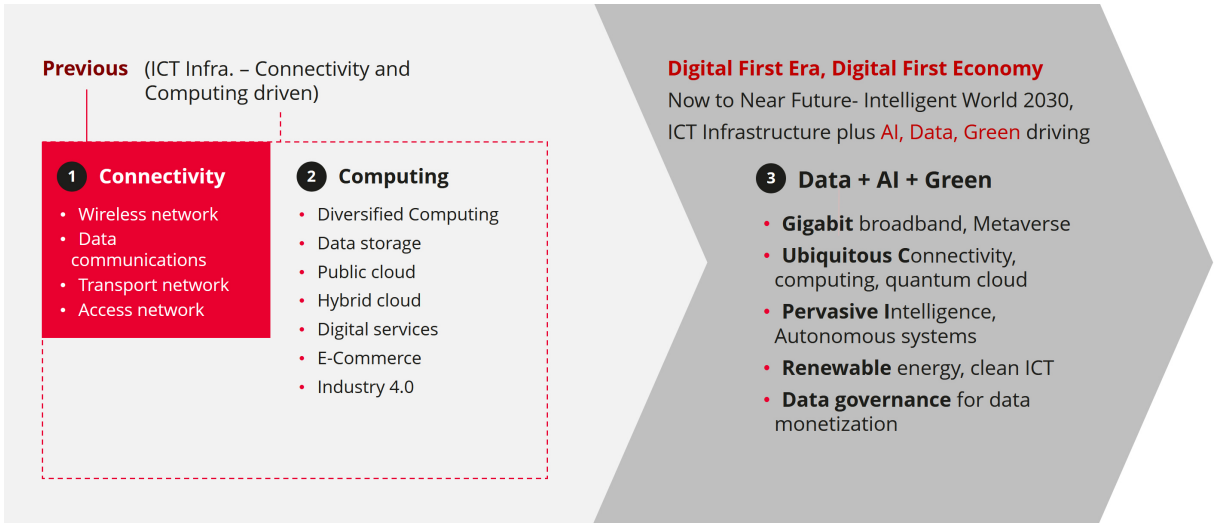
*Note: 30/5x refers to the commitment of peak carbon dioxide emissions before 2030 and reaches carbon neutrality between 2050 ~ 2060.

Source: IDC, McKinsey, news articles and reports

Competing in the DFE requires APEC businesses, governments, and consumers to become digital first.

We define a DFE as evolving from an ICT infrastructure-led stage where connectivity and computing are the focus to one that is still ICT infrastructure-led but is enabled by a combination of data, AI, and green assets. In other words, it is a series of economic activities based on strong connectivity and compute platforms. It has added data, AI, and green technologies to drive industry digital transformation, data monetization, and sustainable economic development.

Figure II-2 DFE is the next evolution of the digital economy



With high speed and low latency gigabit broadband, there are new business models and opportunities for people and businesses. The way people and businesses consume and produce will also change. The increase in bandwidth, speed, and stability will generate new income streams for people, such as enabling professional services to be delivered digitally through video and augmented reality/virtual reality (AR/VR) with the aid of AI systems and the Internet of Things (IoT) devices. The gig economy is no longer limited to a lower value and skilled jobs and a realm of contractors and freelancers. It is no longer tied to digital content that can only be delivered via digital devices with a screen. The anywhere and anytime immersive physical and digital-blended experiences and services will give rise to the metaverse.

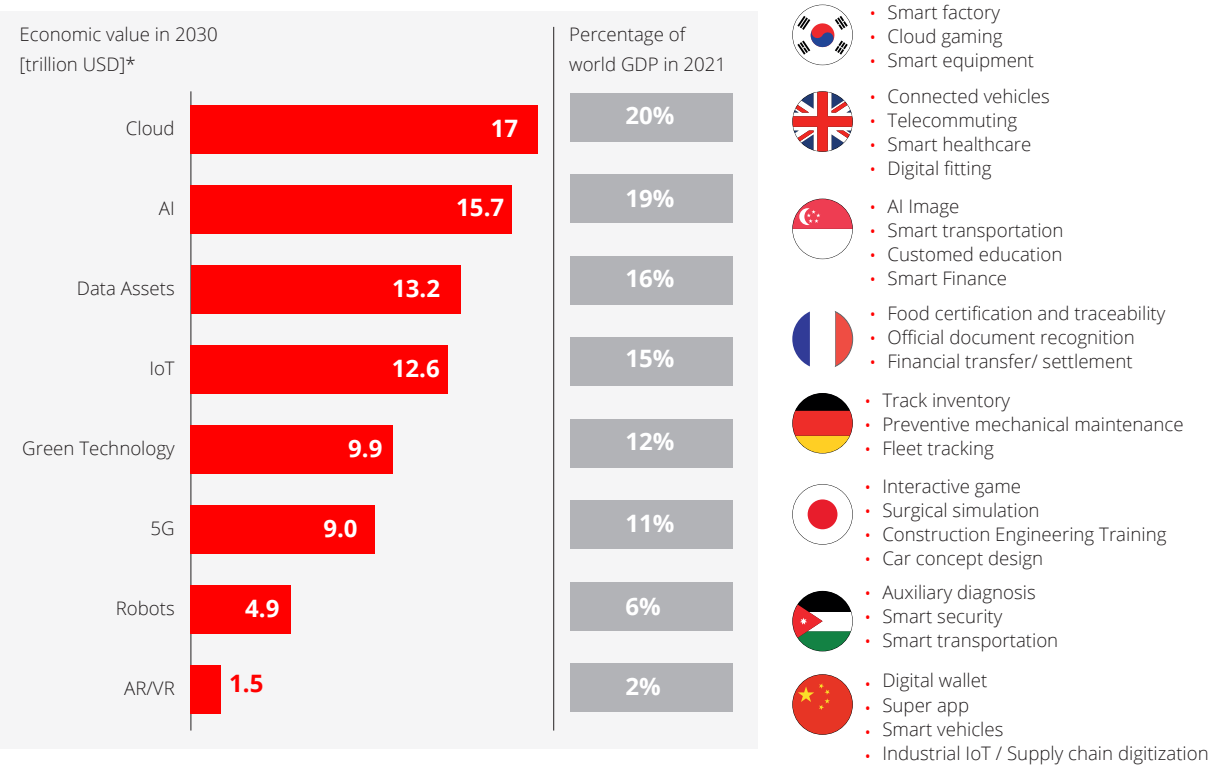
AI augmentation will become an essential productivity factor to unlock additional value in APEC economies as we move beyond automation-driven productivity to autonomous intelligence-enabled productivity. This will result in a rise in startups with business models centered around AI and data as their core, leveraging the ubiquitous computing and quantum cloud to challenge and transform traditional businesses. This will likely drive the transformation of the entire industry and the emergence of new industry sectors that are digitally based services or products, with digital content, creativity as a differentiator, and AI and autonomous systems leveling the production playing field.

The increase in digital consumption and production will demand a greater energy supply. This supply needs to shift from traditional high carbon emission sources to renewable energy for this digital evolution to be sustainable. Clean technologies will be prioritized alongside ICT investments as APEC communities and organizations are required to reduce their carbon footprint.

Data and information are not only a production input but also a final product that can be traded, sold, or function as further inputs to create other data products. As large volumes of data come into play, data governance for data monetization will be increasingly crucial for APEC economies.

To hasten the development of a DFE and thrive in this environment, leading economies are developing digital plans and policies, using frontier ICT digital technologies to realize additional economic value.

Figure II-3 Leading economies investing in frontier technologies



Note*: Economic values shown here are not mutually exclusive and can overlap in economic contributions

Source: IDC desktop research, Roland Berger, Huawei GCI, relevant databases

B. The five desired outcomes of the DFE

Transitioning into a digital-first world, a continuous transformation of the society is expected to become more resilient, data-driven, and sustainable. Research result of stakeholders in several APEC economies indicates that they expect the increasing digitalization of economies to be able to address the key issues impacting the world today and achieve these five outcomes.

Figure II-4 Five main DFE outcomes

Stakeholder Engagement shows these desired outcomes		Digital-first approaches
GDP Growth	Digital driven economic growth	**Digital business models** • Data monetization, digital goods and services • Organization is born digital
New Business Model	New competitive/ collaborative models	**Digital competitiveness** • Agile nation • Digitally competent • AI complemented capabilities • Collaborative ecosystem
Digital Resiliency	National resiliency and future proofing	**Digital government** • Digital integrated government • Data sharing and AI-enabled services • Efficient policy and regulations **Future proofing the economy** • Agile supply chain • Digital creative and content industries
Digital Inclusivity	Digital coverage, digital quality	**Digital citizen** • Digital lifestyle • Higher digital income
Green Sustainability	Renewable energy, efficiency	**Digital sustainability** • Intelligent systems, predictive energy savings • Better energy efficiency • Renewable energy smart distribution

It is important to overcome the issue of inflation or stagflation in some APEC economies by driving GDP growth. Digital-first businesses mean that new business models emerge through data monetization, new digital goods and services, as well as new types of organizations that are born digital, all driving economic growth.

As the world becomes more competitive and accessible through the internet, stakeholders in APEC economies hope to develop new competitive or collaborative capabilities or business models. A digital ecosystem and supply chain enabled by data sharing and collaboration could confer national competitiveness through an agile supply chain with a fast reaction to capture opportunities, collaborative ecosystems driving innovation, and new digital industries.

Digital resiliency is desired by APEC stakeholders to address the concerns of global disruptions. This can be done through a more effective and responsive government with digital capabilities to build national resiliency and future-proof the economy as much as possible; a digital-first government that is integrated; leveraging data and AI capabilities to steer the economy effectively and efficiently through disruptions, and to build a digitally competent economy with capabilities complemented by AI.

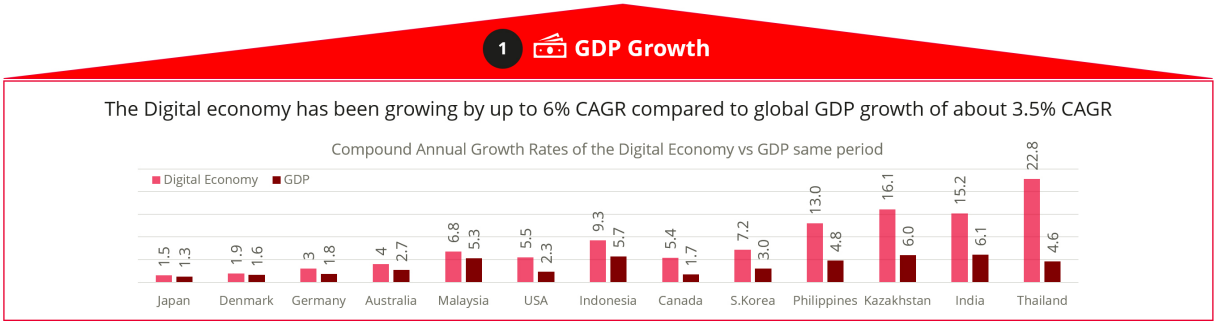
Digital inclusion is desired to address the rising inequality issue. Improving digital coverage to provide access for everyone, quality of access bandwidth to enable digital tools for better experiences, and opening new income opportunities for everyone transforms them into digital citizens.

Finally, green sustainability addresses the global warming issue – more focus on renewable energy and better energy efficiency using digital technologies to reduce the carbon footprint and emissions. Digital sustainability will enable significant energy savings through more efficient use and distribution.

1. GDP growth

The first outcome of the DFE is faster GDP growth partly from digitally delivered services and the data economy, enabled by ICT investments. From 2015 to 2018, growth in the global digital economy (~6% CAGR) has outpaced GDP growth (3.5% CAGR) by 2.5%. This is expected to be even more pronounced with the DFE.

Figure II-5 Digital economy versus GDP in 2021 (CAGR)



CAGR was calculated based on the earliest available data to the latest available data. For example, if the economy only reported digital economy data from 2015 to 2018, the GDP growth is calculated for the same 2015-2018 period as well.

Source: ADB Capturing the Digital Economy Report 2021, UNCTAD, IDC estimates

ICT investments, digitally delivered services, and the growth of the data economy are expected to give rise to new business models and become critical economic drivers for the DFE. It is estimated that every US$1 investment in ICT could drive US$13 of GDP value, including both direct and spillover contributions. Growth in digitally delivered services has reached US$3.2 trillion globally in 2020, a fast growth rate, and this is expected to accelerate in the next 10 years due to the DFE. The data economy will be a major economic driver in the DFE, contributing to global economic growth. For example, the European Union estimates its data economy to be €444 billion in 2020 but expects this to multiply by 2.3 times to €1.04 trillion by 2025.

Figure II-6 DFE drivers

Global GDP growth 2015 US$75T to 2020 US$81.6T about 1.08X

EU GDP growth 2015 US$13.4T to 2020 US$15.3T about 1.14X

Beyond driving economic growth, the DFE is also a growing, resilient, and inclusive economy which can generate new business and sustainable value in the future for APEC economies.

2. Digital inclusion

Digital inclusion is enabled through higher rates of internet coverage that help connect the unconnected, bringing them relevant information, better education, best practices, and eCommerce to help improve their livelihood.

Improving broadband throughput for better user experiences and access to digital tools would enable APEC users to create value through productive activities instead of consuming content only or just trading on eCommerce.

3. New business model

New business models are also an expected outcome from the DFE. To effectively compete in the DFE, leading organizations transform markets by creating new business models, products, and services that are enabled by technological advances as follows:

- 5G/Fixed 5G (F5G) develops new, used cases that can effectively generate business opportunities from their higher bandwidth and low latency capabilities
- ICT spending and developing ICT talent build new capabilities for creating new business models, such as digital business or digital government, digital startups, and unicorns
- Data monetization opens a new area of economic value through data business models

4. Digital resiliency

Digital resiliency is the ability of an organization to rapidly adapt to business disruptions by leveraging digital capabilities to not only restore business operations but also capitalize on the changed conditions. Digital resiliency is about acknowledging and sometimes modifying the interdependencies and risks associated with the technology embedded in every dimension of the modern business. Key components of digital resiliency are:

- ICT Investment and Talent helps digitalize APEC-based organizations for resiliency. Connected and digitalized supply chains provide flexible and fast responses to disruptions
- Cloud Computing provides an agile and flexible platform. Digital tools allow operations to function during lockdowns for APEC-based organizations

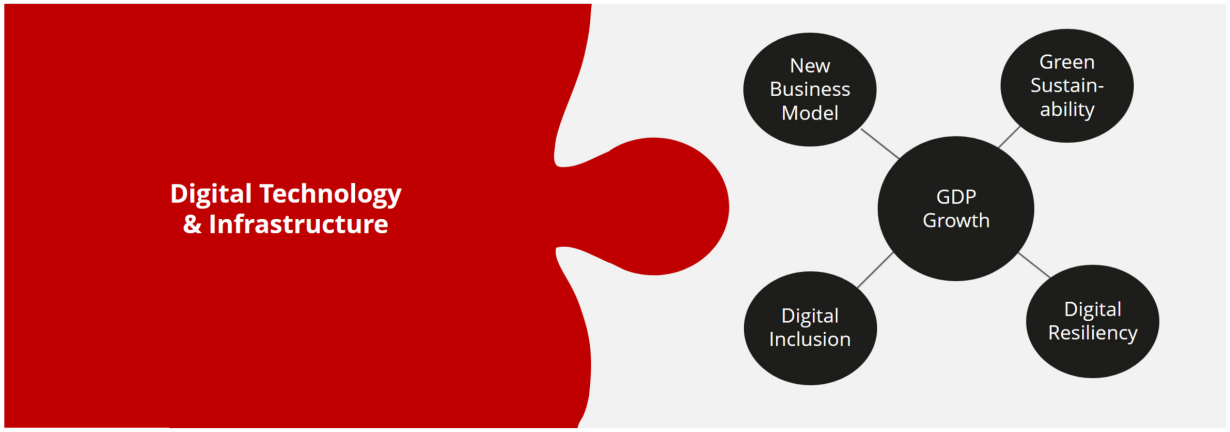
5. Green sustainability

Green sustainability is necessary to ensure a sustainable digital future. Today, driven by the increasing pressure from stakeholders (investors, regulators, employees, customers, etc.), APEC-based organizations are pushed to address sustainability holistically to avoid financial, operational, and reputational damage.

- ICT investment provides tools to increase energy efficiency and lower energy usage and carbon footprint in APEC economies. ICT enables product design for a circular economy
- Renewable energy sources have become more cost-effective and accessible, especially solar power. Cloud computing helps reduce the carbon footprint from a shared infrastructure standpoint

In conclusion, the fundamental of digital first is to utilize digital technology and digital infrastructure to empower economic growth, which is green, resilient, inclusive, and innovative growth.

Figure II-7 Digital first is the foundation of DFE



GDP Growth	Digital Inclusivity	New Business Model	Digital Resiliency	Green Sustainability
• Core economic value from World Bank, UNCTAD	• eParticipation Index from United Nations	• New Business Model scores from Global Innovation Index (WIPO)	• Digital Resiliency survey and research by IDC	• Environmental Performance Index from Yale University

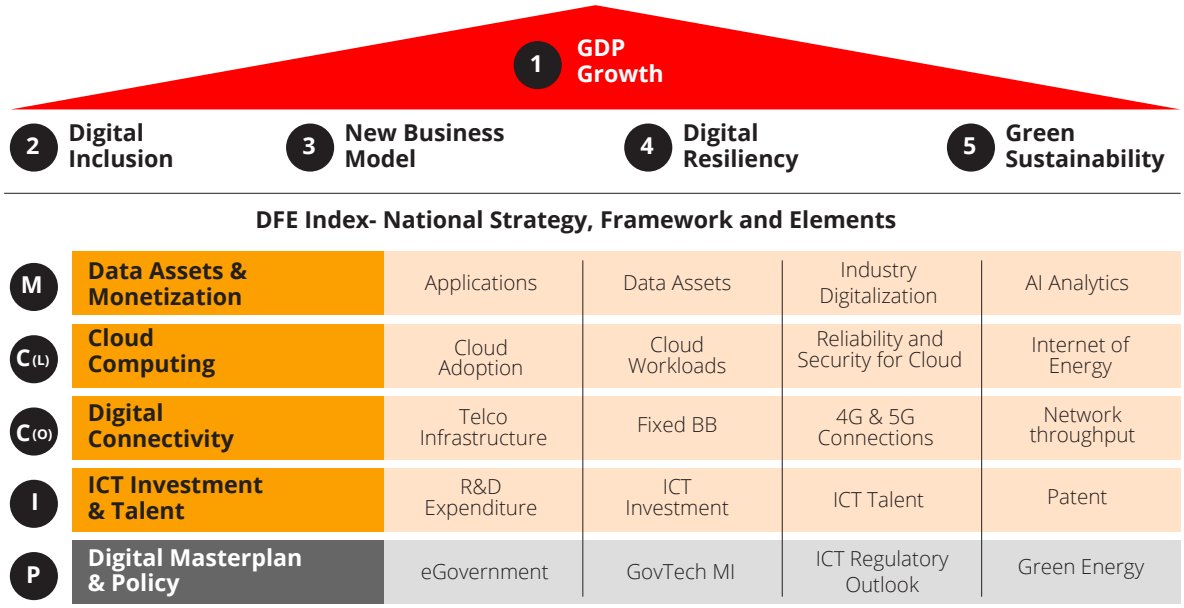
III. DFE Framework

The DFE is a series of economic activities based on strong connectivity and compute platforms with added data, AI, and green technologies to drive industry digital transformation, data monetization, and sustainable economic development.

Huawei and IDC collaborated to develop the DFE framework that could provide policymakers in APEC with information and tools to drive the development of a DFE. The framework assesses the state of an APEC economy's DFE. It tracks its progress and development to depict the environment more accurately for driving digitalization to achieve the outcomes presented earlier.

The framework has the following five dimensions that build the DFE environment for achieving the five outcomes.

Figure III-1 The DFE MCCIP dimensions for the five outcomes



Government leadership is a critical starting point. Government policymakers in APEC need to lead the economy into the DFE by setting the right vision and direction.

P – Policy dimension: This vision and direction should be articulated and realized through a robust Digital Masterplan and Policy with a taskforce or organization led by a senior ministerial committee. eGovernment and GovTech Maturity Index are indicators of digital masterplan and policy progress as most digital masterplans include eGovernment services and government technology strategy.

I – Investment dimension: Digital Masterplan and Policy drives ICT spending and talent development to build the foundation and capabilities for a DFE. ICT Investment & Talent for industry digitalization and resiliency give us the second dimension.

C(O) – Connectivity dimension: ICT spending and talent help build Digital Connectivity and Cloud Computing capabilities. Digital Connectivity with comprehensive coverage and quality throughput, such as a 5G/F5G dual-gigabit network help improve digital inclusion.

C(L) – Cloud Computing dimension: Cloud Computing provides an affordable and scalable platform for faster deployment of new business models and lower carbon footprint through facility sharing.

M – Monetization dimension: Digital Connectivity provides access to digital tools in Cloud Computing and gathers and stores data in the cloud, thereby building and retaining data assets. Data assets processed by AI systems become insights and information that can be monetized through trade or sale, new market identification, new product development, faster and better decision making, more efficient systems, and better product design for green sustainability.

Figure III-2 Five MCCIP dimensions

Monetization of data assets from industry digitalization by AI	M	Global data monetization grow 17% CAGR to US$13 trillion by 2030
Cloud computing for new business models, lower carbon footprint	C(L)	Workloads in cloud grows by ~50% to 72% by 2023
Digital connectivity with dual gigabit throughput enables digital inclusivity	C(O)	5G contribute US$13.2 trillion global economic output by 2035
ICT investment and talent for industry digitalization and Resiliency	I	EU invest €580M to equip 80% citizens with digital skills
Digital masterplan and policies achieve economic, social, sustainability outcomes	P	170 out of 195 economies have an ICT masterplan

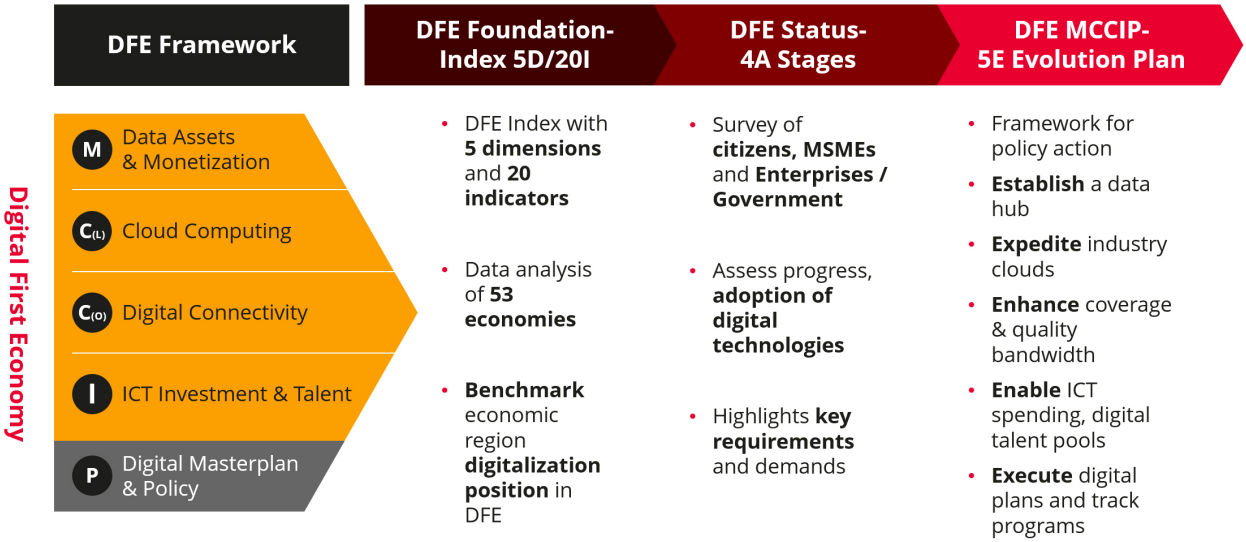
Using this MCCIP framework, Huawei and IDC developed the DFE Index, a snapshot of the DFE status to enable APEC economies to assess their DFE environmental readiness and adoption progress, which leads to a 5E recommendation for achieving the five outcomes. Below are the key takeaways from this study:

- A defined framework through literature research and consultation with industry analysts to reflect drivers for and contributions to DFE
- Based on the framework, a DFE Index was developed to track the progress of APEC economies in building the foundation for a digital-first economy. We selected the most appropriate proxy indicators to fill the index where the data is not available
- A comprehensive survey of stakeholders was conducted in seven selected APEC economies comprising citizens, MSMEs, large enterprises, and government agencies to assess their stage of DFE adoption
- The results were analyzed and the output became a guide how the progression of DFE can be achieved, leading to the 5E's recommendations and five policy guidance for APEC economies

DFE Roadmap: Based on the DFE Framework, we developed the DFE Foundation and Status to enable economies to work through specific DFE Dimensions to formulate a 5E Evolution Plan

The key takeaways are 5E policy recommendations for achieving the outcomes.

Figure III-3 DFE Roadmap



Combining government and industry focus, DFE analyzes the value of ICT infrastructure in promoting DFE and proposes digital infrastructure recommendations and policy directions for APEC.

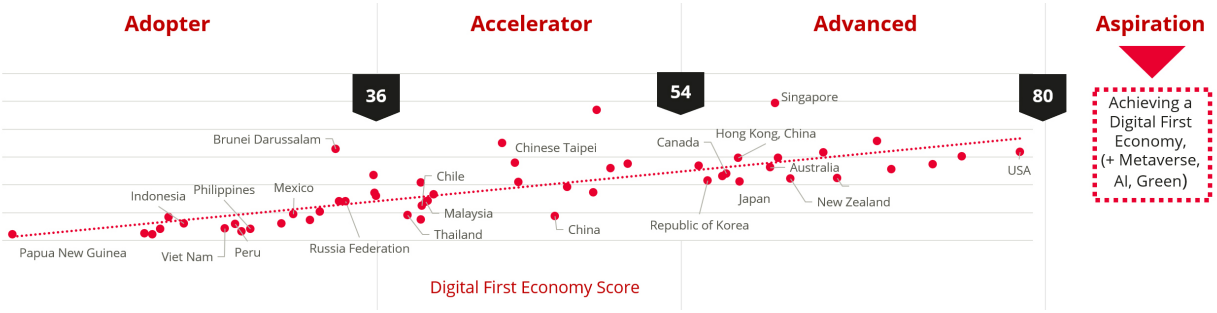
IV. DFE Index Findings

When the DFE Index with its 20 indicators is used to assess the position of 53 major economies worldwide, including APEC economies, it is expected that the DFE readiness state would vary across all economies. This study identifies four stages of readiness with distinct characteristics.

A. Four stages of DFE readiness

There are four stages of DFE readiness according to the output of the DFE Index, namely Adopter, Accelerator, Advanced, and Aspiration. The gaps that differentiate the various stages are around the 36 and 54 points, respectively, for evolving from being an Adopter to an Accelerator and Advanced stage. We further set the vision of an Intelligent World 2030 that no economy has achieved as yet (80 points) the future Aspiration goal.

Figure IV-1 Stages in the DFE Index



The characteristics of the four stages are as follows:

1. Adopter (scoring below 36 points)

- Digital policies are in place to develop a digital economy
- The focus of the economy is on expanding a national digital infrastructure
- The economy faces challenges with building nationwide digital connectivity with pockets of development in key city centers but not nationwide
- Digital economy growth is mainly from eCommerce and IT services

2. Accelerator (scoring below 54 points)

- Digital policies focus on the digitalization of the economy for economic growth
- Increasing ICT investments and talent development as a priority for the economy
- Challenges in accelerating digitalization as not all segments are ready nor have the tools
- Need high-speed digital connectivity to drive cloud computing to accelerate digitalization

3. Advanced (below 80 points)

- Policies on developing a DFE are in place
- Focus on building data assets and monetization.
- Constantly upgrading the next generation (5G, F5G) networks
- A cloud-first environment with ICT and talent investments as primary national objectives

4. Aspiration (to achieve an Intelligent World 2030)

- Policies to harmonize intelligent systems with human aspirations in an Intelligent World where robotics and AI perform key roles in enhancing our business and lives
- Digital technologies with AI embedded in everyday systems, from devices at home to complex industrial systems
- Sustainable progress with renewable energy like solar power to run digital systems while avoiding carbon footprint

Adopter Case Study
Indonesia

The Indonesian government's Presidential Regulation No. 10, enacted on 4 March 2021, represents a significant development in the opening of Indonesia's economy to foreign investment. All telecommunication networks and service activities, which include telecommunication activities with or without cable, satellite telecommunication activities, premium call services, premium SMS content services, and other multimedia services previously subjected to a 67% foreign investment restriction, have since been open for 100% foreign investment. This Indonesian government's policy is in line with their intention to encourage more foreign investments in Indonesia and create jobs to offset the impact of COVID-19. This is expected to benefit the sector in the continued commercial rollouts of both 4G and 5G networks.

Accelerator Case Study
Chile

The Chilean government has developed Matriz Digital 2018-2022, a roadmap on national connectivity priorities. This plan seeks to reduce the technological gap in Chile to promote the nation's development. Matriz Digital has three areas of focus. First, to define and respect the rights of digital citizens; second, to stimulate investment and infrastructure, including the implementation of 5G; and third, to promote digital development. One of the sector's challenges is the lack of IT professionals, which has worsened due to the COVID-19 pandemic. Chilean companies import talent from Argentina, Peru, Colombia, Venezuela, and Ecuador, making Chile one of the top 10 economies in the world to import IT, professionals. In January 2019, Talento Digital was created to develop new capacities in training people to meet the digital economy's demands through the integration of training institutions and government resources. In September 2019, Talento Digital pledged to train 16,000 people over the next several years through a Bootcamp format.

Advanced Case Study
Singapore

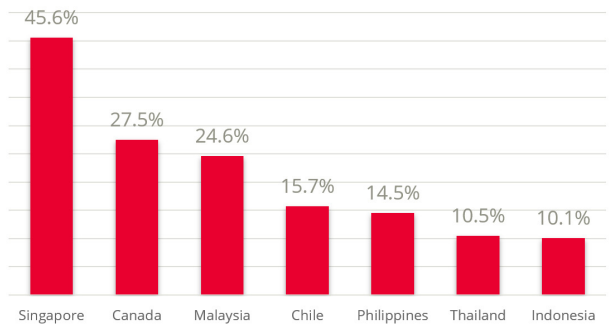
The Singapore Green Plan 2030, or the Green Plan, is a whole-of-nation movement to advance Singapore's national agenda on sustainable development and was launched in early 2021. Singapore is also home to a batch of green tech startups, such as solar energy solution provider Sunseap; biotech startup RWDC, attempting to stem the overflow of single-use plastics; and SensorFlow, which has set out to improve energy efficiency in hotels. Datacenters (DCs) are extremely energy-intensive facilities, with electricity accounting for more than 50% of the operating expenditure in a typical DC in Singapore. To help reduce the energy consumption and operating costs of DCs and enhance their competitiveness, the Infocomm Media Development Authority of Singapore has partnered with other government agencies to develop a Singapore Standard for Green DCs. The Green DC Standard helps organizations establish systems and processes necessary to improve the energy efficiency of their DCs.

B. DFE Index: Readiness to achieve the five outcomes

When the economies' DFE Index scores are compared with GDP performance, it can be seen that the DFE correlates closely with the GDP growth. APEC economies could grow their GDP per capita by developing the foundations of the DFE.

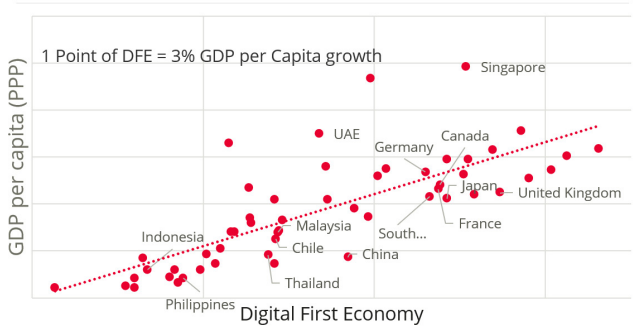
Using a selected few APEC economies, as shown below, each has made different progress in growing their digital economies and contributing to GDP. The DFE is expected to accelerate GDP growth through higher digital contribution to the economy.

Figure IV-2 Digital economy contribution to GDP (%)



There is a correlation when comparing the GDP (PPP per capita) against the DFE Index score. Building a DFE can potentially grow the GDP by 3% for every point of improvement in the DFE Index. A digital foundation is necessary for new business/technology startups to grow the economy through eCommerce, IT, and digitally delivered services.

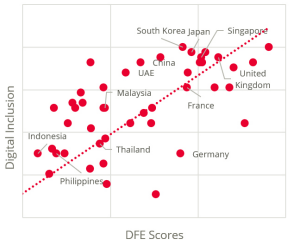
Figure IV-3 DFE versus GDP per capita (US$ PPP)



Beyond GDP, the DFE drives digital inclusion, new business models, digital resiliency, and green sustainability based on the proxy indicators mentioned above. Furthering DFE growth also drives cascading effect on other outcomes, which may not be related to the DFE but contributes to the overall economic value.

Figure IV-4 DFE driving desired outcomes

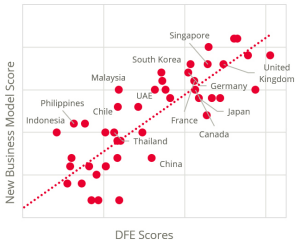
Digital Inclusion



Higher digital inclusion rate due to better digital connectivity from ICT investments

1pt DFE → **+0.7% digital inclusion**

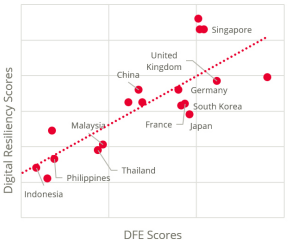
New Business Model



New business models emerging from better digital connectivity and cloud computing

1pt DFE → **+0.03% New Business Model**

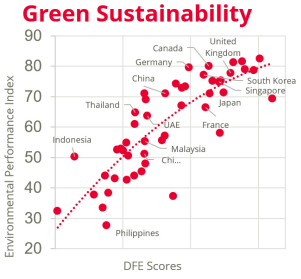
Digital Resiliency



More digitally resilient businesses from digital transformation

1pt DFE → **+0.014% Digital Resiliency**

Green Sustainability



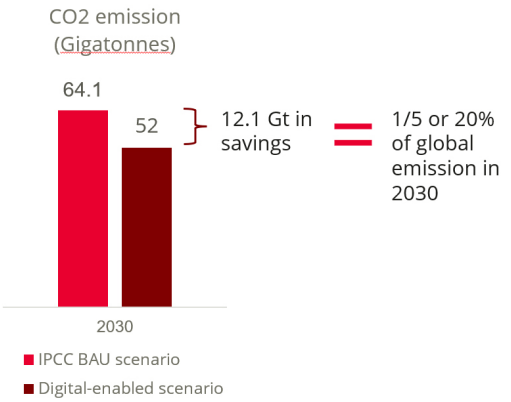
Digital policies and ICT investments to improve energy efficiency

1pt DFE → **+1.56 EPI Green Sustainability**

C. DFE for green sustainability stakeholders' digital adoption and behavior

A fundamental trait of the DFE is sustainability; Digitalization in the DFE will consume increased electricity. To develop a sustainable transformation, governments in APEC need to consider leveraging ICT technologies that can help improve the efficiency of energy usage and shared infrastructure like cloud computing with renewable energy like solar power to enable them to develop a DFE sustainably.

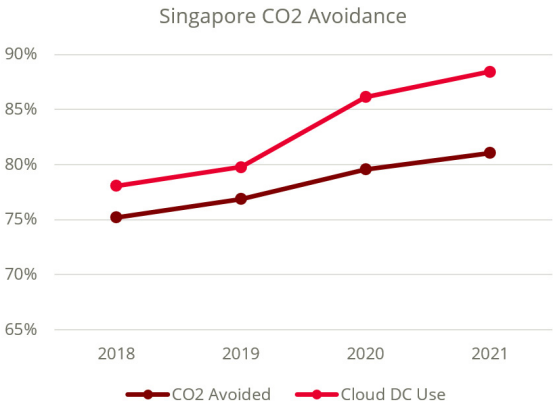
Figure IV-5 ICT helps to reduce the total carbon footprint



Furthermore, research shows that smart solutions could save 12.1 gigatonnes (Gt) of carbon dioxide or one-fifth of global emissions in 2030, according to the Intergovernmental Panel on Climate Change (IPCC) from business as usual. Technologies in smart devices can monitor and manage energy usage for better efficiency.

As a result, digital masterplans developed by APEC economies must include policies that provide clear advice, drive a switch to renewable energies, and invest in digital technologies that can drive better efficiencies and recyclable design. Figure IV-16 shows that economies with higher scores in Digital Masterplan and Policy and ICT Investment and Talent tend to score higher in the Environmental Protection Index.

Figure IV-6 Singapore's carbon dioxide avoidance



Digital policies are needed to switch to renewable energy and invest in digital technologies to monitor the environment, facilitate the sustainable use of the environmental resources, offer green alternatives, and provide information and intelligence to help enforcement.

Using shared ICT infrastructure like cloud computing significantly reduces or avoids carbon emissions for APEC economies. For example, Singapore's high usage of cloud computing has contributed to it being able to avoid 80% carbon dioxide emissions, sustaining its green digital transformation.

D. DFE Survey measures digital adoption by stakeholders

Besides the DFE Index above, a DFE Survey was conducted to help enterprises, MSMEs, and citizens understand and cope with the challenges and opportunities the DFE can provide its participants. The DFE Survey provides the basis to understand the current state of maturity, their gaps, and eventually, progress toward the gold standard or Aspiration state across five interrelated dimensions: Data Assets and Monetization, Cloud Computing, and Digital Connectivity, ICT Investment and Talent.

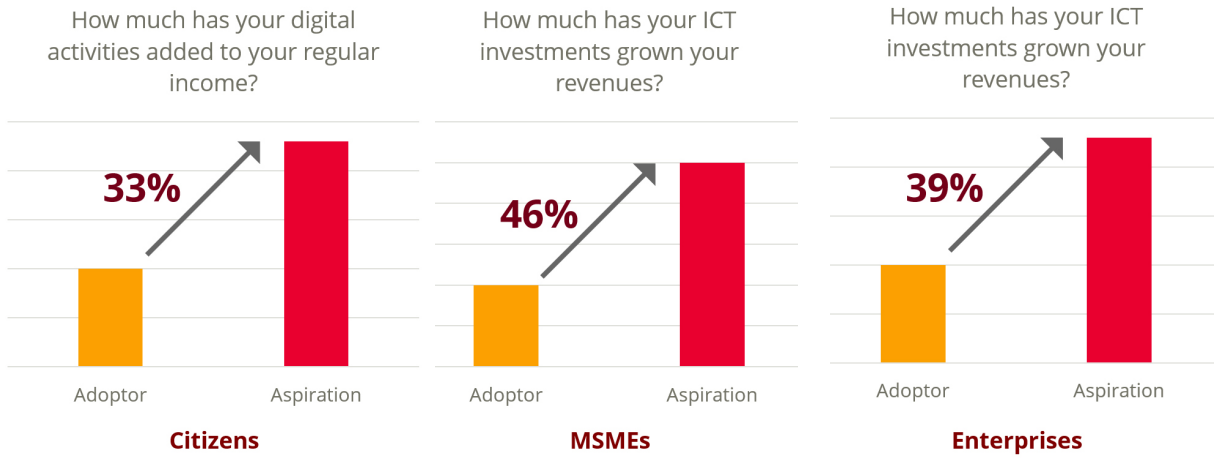
The DFE Survey covered citizens, MSMEs, large enterprises, and government agencies across seven selected APEC economies to represent the constituents as follows:

- A snapshot to assess their capabilities and stage of maturity in participating in the DFE
- Gather the voice of stakeholders on needs, challenges, and plans to identify key areas of digitalization capabilities that require strengthening
- Set guiding standards for pursuing future digitalization efforts

The DFE Survey was based on the five dimensions of the DFE framework described earlier. The DFE Survey showed that progressing in the digital revolution stages allows citizens to increase their income, while for MSMEs and enterprises, this can help them grow their revenues. The DFE is expected to increase the digital contribution to the economy through increased participation of citizens in the digital economy, revenue growth and new business model creation by MSMEs, and data monetization by organizations.

While a detailed econometrics study of each stakeholder has not been undertaken, the figure below is an estimate of the impact of digitalization. It can be used as an indicative possible additional impact if the economy increases its ICT investment to drive stakeholders toward the Aspiration stage.

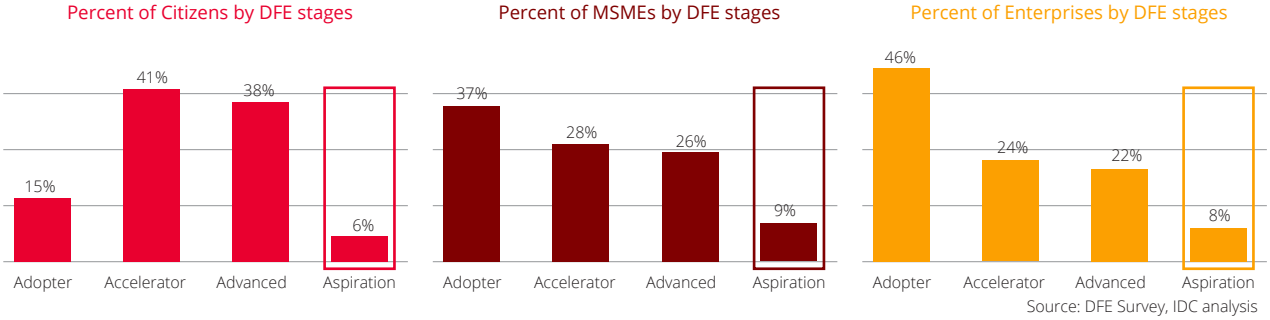
Figure IV-7 Benefits of evolving to the Aspiration stage



Source: DFE Survey, IDC analysis

Citizens at the Aspiration stage reported that their digital activities have helped them grow their income by 33% higher than Adopters. Similarly, Aspiration MSMEs have reported a 46% increase in revenue, and enterprises have reported a 39% increase from Adopters in their segment.
However, there are not many citizens or organizations at the Aspiration stage. Today, less than 10% are operating in that stage of maturity.

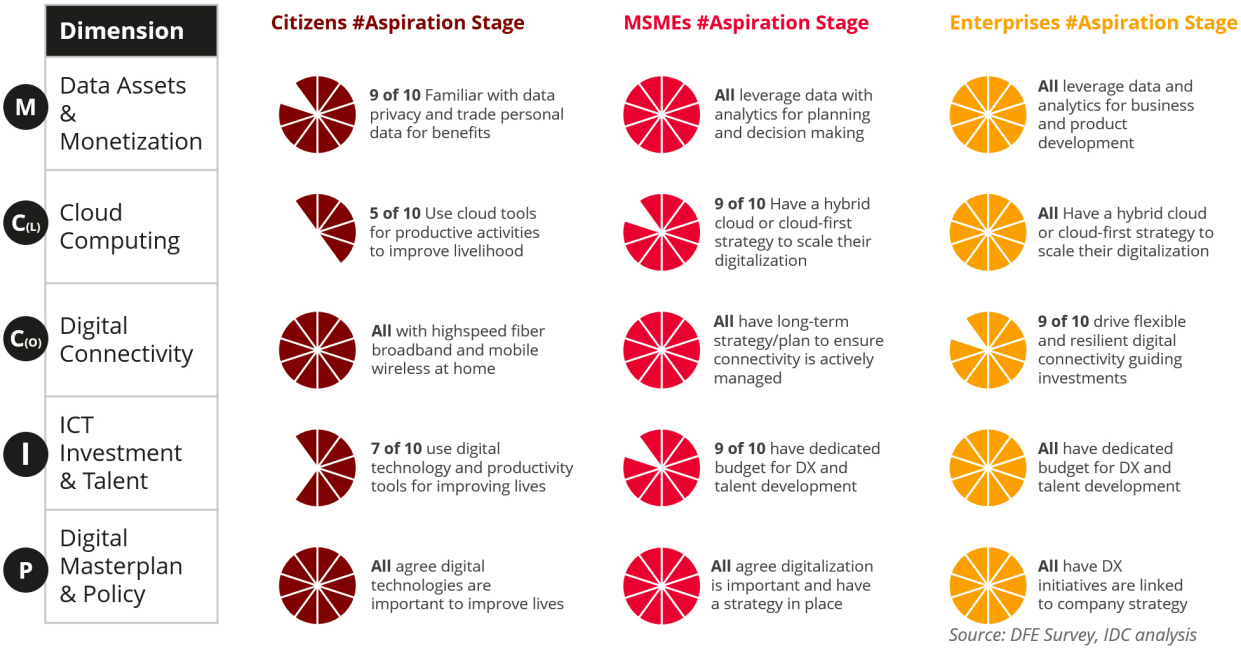
Figure IV-8 DFE Status distribution by segment



Source: DFE Survey, IDC analysis

Adopting effective policies, formulating digital transformation masterplans, and being willing to invest in ICT and talent to achieve robust digital connectivity that enables active use of cloud and data analytics are key characteristics that will help participants thrive in the DFE. The chart below shows the practices of stakeholders operating today at a high Aspirational stage. APEC policymakers need to develop policies to help their stakeholders achieve the desired Aspirational behavior to participate and gain the full benefits of the DFE.

Figure IV-9 DFE Status Aspiration behavior



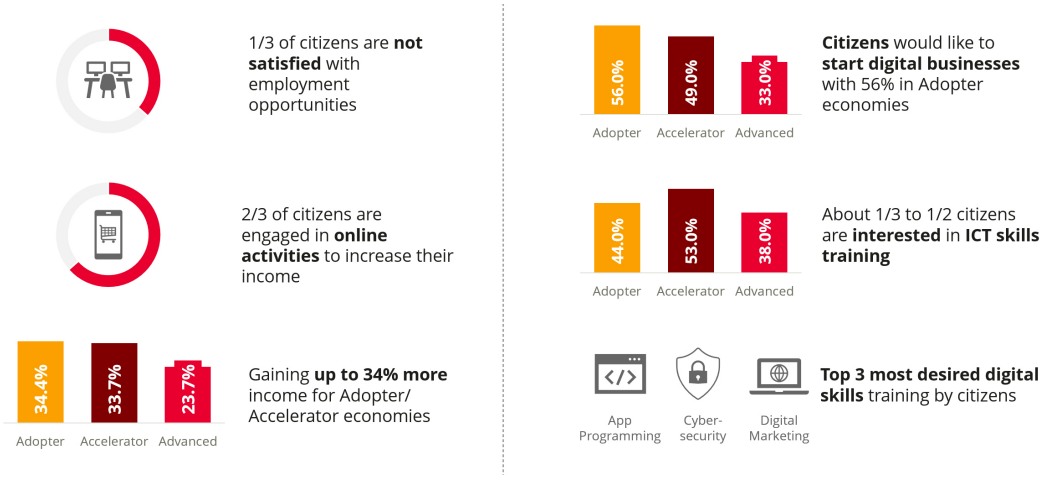
Source: DFE Survey, IDC analysis

1. Citizen stakeholder's digital adoption and behavior

Citizens surveyed informed us that they desire to improve their livelihood through starting new digital businesses. About a third of the citizens surveyed were dissatisfied with their employment opportunities, with about two-thirds of them engaging in online activities to increase their income. The percentage is higher amongst citizens in Adopter economies, followed by Accelerator and Advanced. Citizens in Adopter and Accelerator economies reported up to 34% improvement in their income due to their participation in the digital economy, higher than those seen by citizens in Advanced economies. Economies with lower GDP per Capita see a higher benefit from building a DFE as they can scale up their income from a lower base. It is not surprising more citizens in Accelerator and Adopter economies are keen to start their digital businesses using mobile apps, especially when these economies are more dependent on wireless connectivity and smartphone endpoints. Policymakers in these APEC economies need to consider upgrading their mobile networks to ensure that their citizens have affordable high-speed mobile broadband, including expanding into 5G for gigabit mobile broadband.

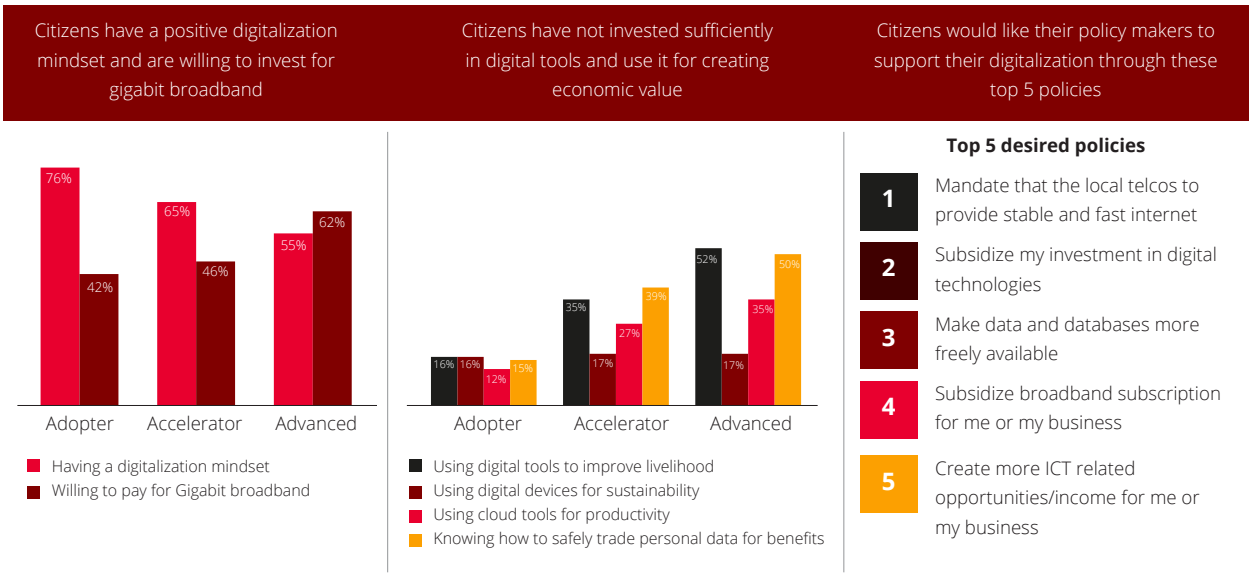
About a third to half of the citizens across the three DGE stages indicated that they are interested in ICT skills development and training to increase their participation in the DFE. As expected, more citizens in Adopter and Accelerator economies are keen on ICT training, especially to develop their mobile applications, work on cybersecurity opportunities or run digital marketing for their own businesses.

Figure IV-10: Citizen's desire to improve their livelihood through digital businesses



Citizens in the selected APEC economies are not averse to digitalization as it is a means to improve their livelihood — as more than half of the citizens surveyed have a digitalization mindset, with up to 76% in Adopter economies. Over 40% are willing to pay for gigabit networks to improve their participation in the DFE, with more than half in Advanced economies. However, citizens in APEC Accelerator and Adopter economies have not invested sufficiently in using cloud tools to improve their productivity, trade data for benefits, improve their livelihood using digital tools, and/or invest in digital devices to improve their sustainability. They want their governments to support their digitalization journey by mandating that the local telecommunication services providers provide them with stable and fast internet and that the government could subsidize their investment in digital technologies and broadband subscriptions. They also desire that policymakers develop a data economy to gain access to data for generating an information-based business and help create more ICT opportunities for their business.

Figure IV-11: Citizen's digitalization gaps and desired policies



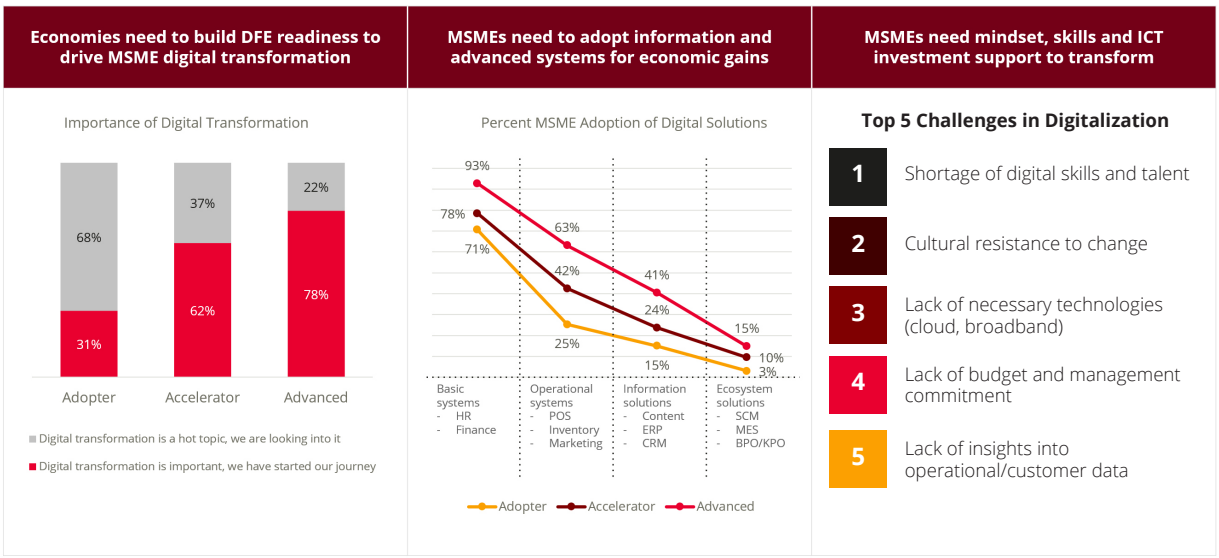
2. MSME stakeholders' digital adoption and behavior

The survey of MSMEs in APEC indicated that while almost 80% of MSMEs in Advanced economies and over 60% in Accelerator economies have started their digital transformation journey, only 30% in Adopter economies have done so. Even so, most of their digitalization is focused on the basic functions or HR and Finance digitalization, with less than half the MSMEs in Accelerator and Adopter economies invested in solutions to digitalize their operations, such as a Point of Sales solution, inventory, or marketing solutions. The number of MSMEs investing in information solutions like content management solutions (CMS), enterprise resource (ERP), or customer relationship management (CRM) solutions that would provide them with a large amount of information for analysis and decision-making is less than a quarter for Adopter and Accelerator and finally, Ecosystem solutions that collect information across the ecosystem and manages ecosystem partners only have a 15% or less adoption.

MSMEs cite the shortage of digital skills and talent and cultural resistance to change as their most significant barrier to digitalization. Lack of necessary technologies like cloud computing and highspeed broadband, budgetary and management commitment, and a lack of insights into data for decision making were also key hindrances.

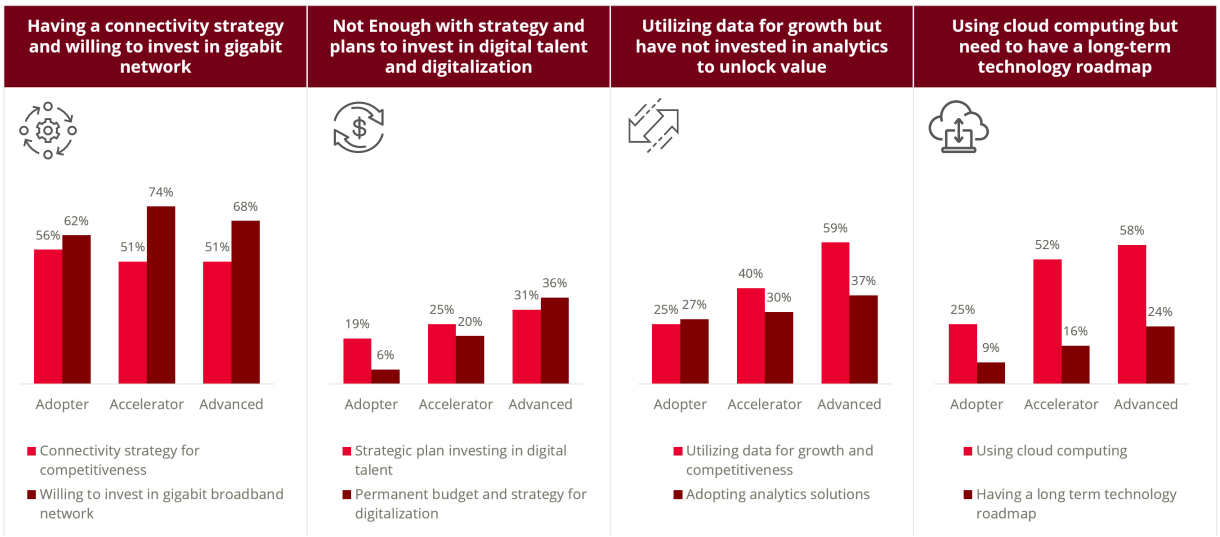
Figure IV-12: MSME DFE foundation and challenges

Over half the MSMEs depend on connectivity.



Over half the APEC MSMEs have a connectivity strategy to help them compete in the digital economy. They are willing to invest in gigabit networks for higher bandwidth to increase their DFE participation. However, they need to develop a long-term strategic plan to use digitalization for competitive advantage with permanent funding for digitalization instead of piecemeal investments. This strategy needs to consider investment in analytics and cloud computing as a long-term technology roadmap so that MSMEs can better utilize their data to drive growth monetization and competitiveness. About a third of the MSMEs have adopted analytics, and less than ¼ have a long-term technology roadmap.

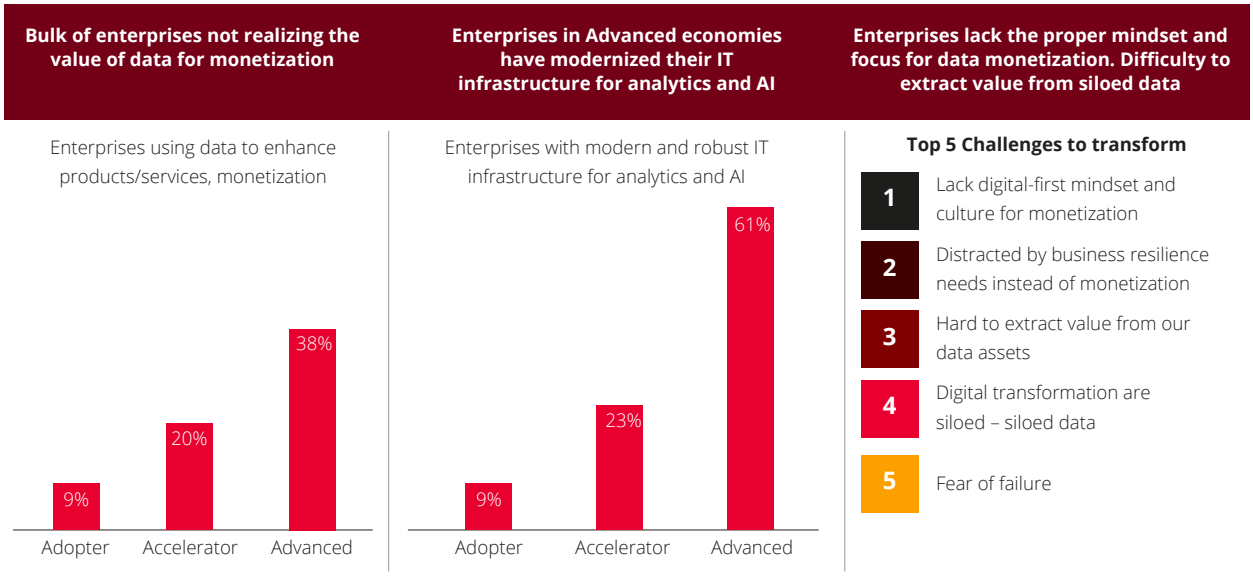
Figure IV-13: MSME digitalization gaps



3. Large enterprises and government

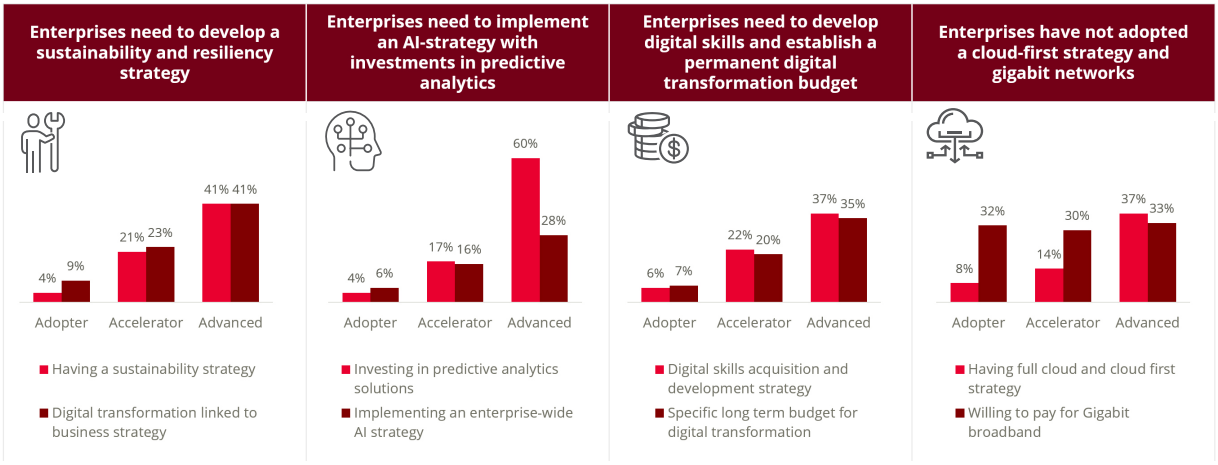
Large enterprises and government agencies in APEC economies have initiated their digital transformation journey, however, less than a third of them have been realizing the value of data that this has created for data monetization. While about 60% of enterprises in Advanced economies have modernized its IT infrastructure for analytics and AI, less than a quarter of enterprises in Accelerator and less than 10% in Adopter economies have done so. Enterprises cite the lack of digital mindset and culture for data monetization, a distraction from daily business resiliency demands and the difficulty in extracting value from data assets that remain in siloed databases as key challenges.

Figure IV-14: Enterprises and government agencies data monetization progress



To have greater participation in the DFE through data monetization, enterprises need to develop longer-term sustainability and digital transformation strategy aligned with their business strategy instead of ad-hoc digitalization efforts. They need to ensure their strategy has a plan for the long-term development of digital skills and talent with the appropriate funding every year. More than MSME, enterprises have the funds and ability to invest in analytics solutions as part of their AI strategy and adopt a cloud-first approach to their digitalization initiatives. While all enterprises have onsite internet connectivity, they must invest in gigabit networks to unlock used cases and business opportunities that could transform and increase their benefits from digitalization.

Figure IV-15: Enterprises digitalization gaps



The DFE Index and survey could provide a perspective to APEC policymakers on how their economies are building the necessary DFE foundation to achieve the outcomes. To support this aim, this study highlights the developmental gaps for DFE that must be addressed to guide decision-making and planning. The following section discusses how APEC economies could move up their current stages to reach the Aspiration stage thus increasing the likelihood of realizing the five desired outcomes.

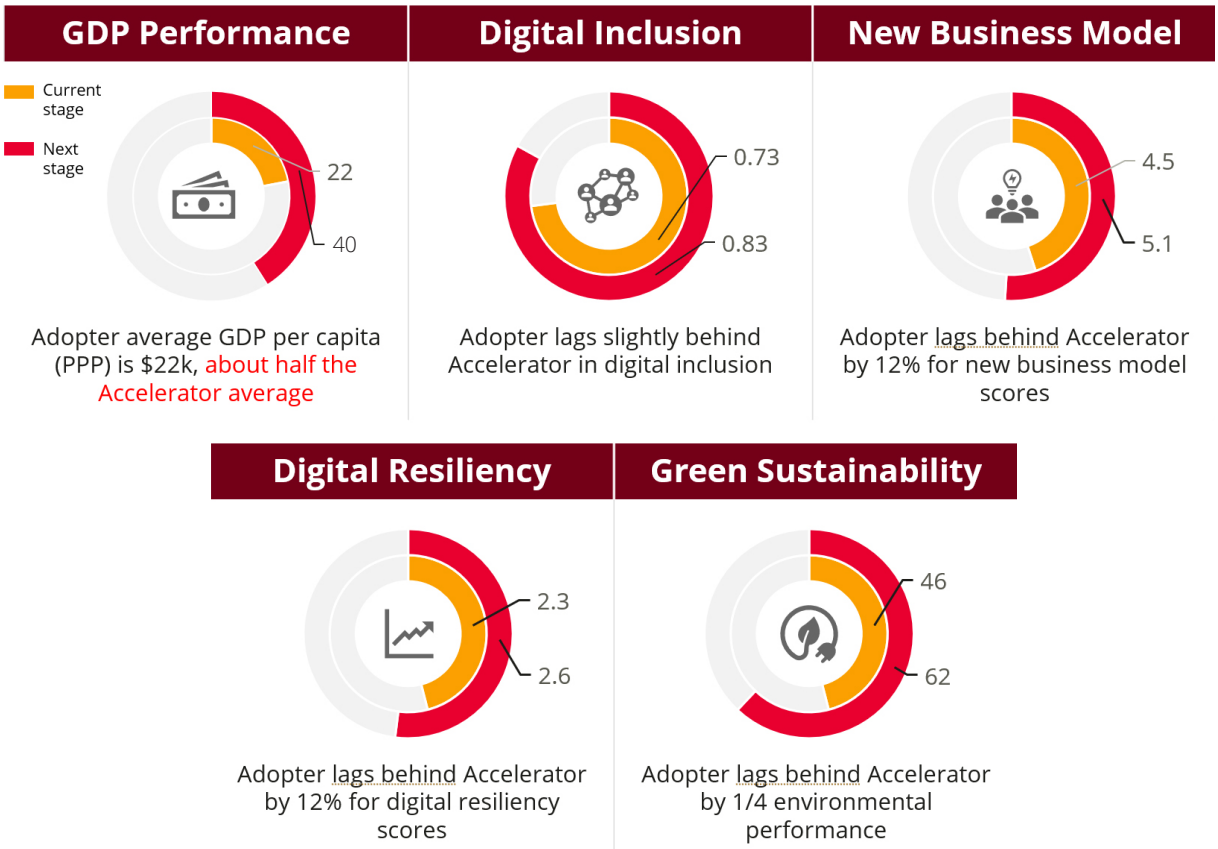
E. Evolving to the next stage

As APEC economies consider where they are in the DFE Index and how to build the necessary DFE supporting environment and infrastructure to enable their stakeholders to overcome their digitalization gaps, this section provides an overall perspective of the economies in each of the first three stages of the DFE, the characteristics of the economies in each stage, and the gaps and areas needing intervention to enable the economies to move up the stages and realize more of the five desired outcomes.

1. Moving Adopters to Accelerators

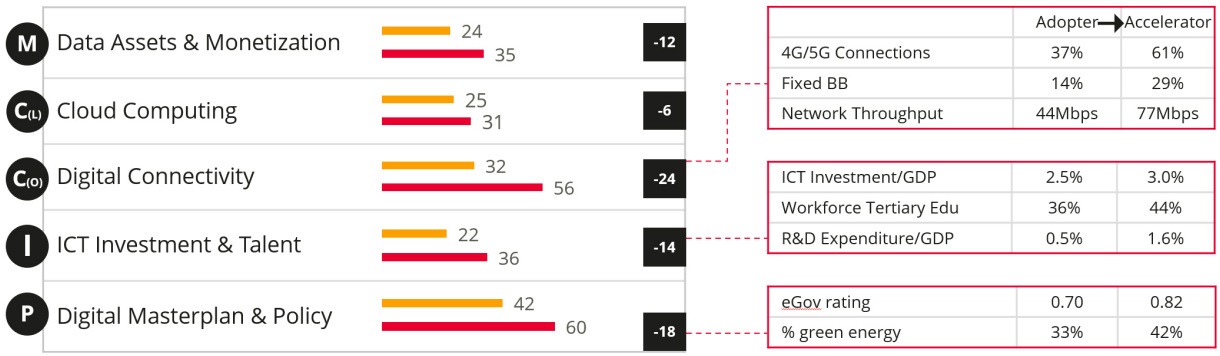
Adopters are behind the Accelerators in their DFE outcome performance. Adopters lag the most in GDP performance, followed by environmental performance.

Figure IV-16 Adopter Outcomes gap



Regarding DFE Index performance, the most significant gap is between Digital Connectivity and Digital Masterplan and Policy. Adopters must develop more comprehensive digital masterplans and policies to increase 4G/5G network coverage, expand fixed-line broadband, and improve network throughput speed.

Figure IV-17 Adopter DFE Index gaps



	Adopter	Accelerator
4G/5G Connections	37%	61%
Fixed BB	14%	29%
Network Throughput	44Mbps	77Mbps

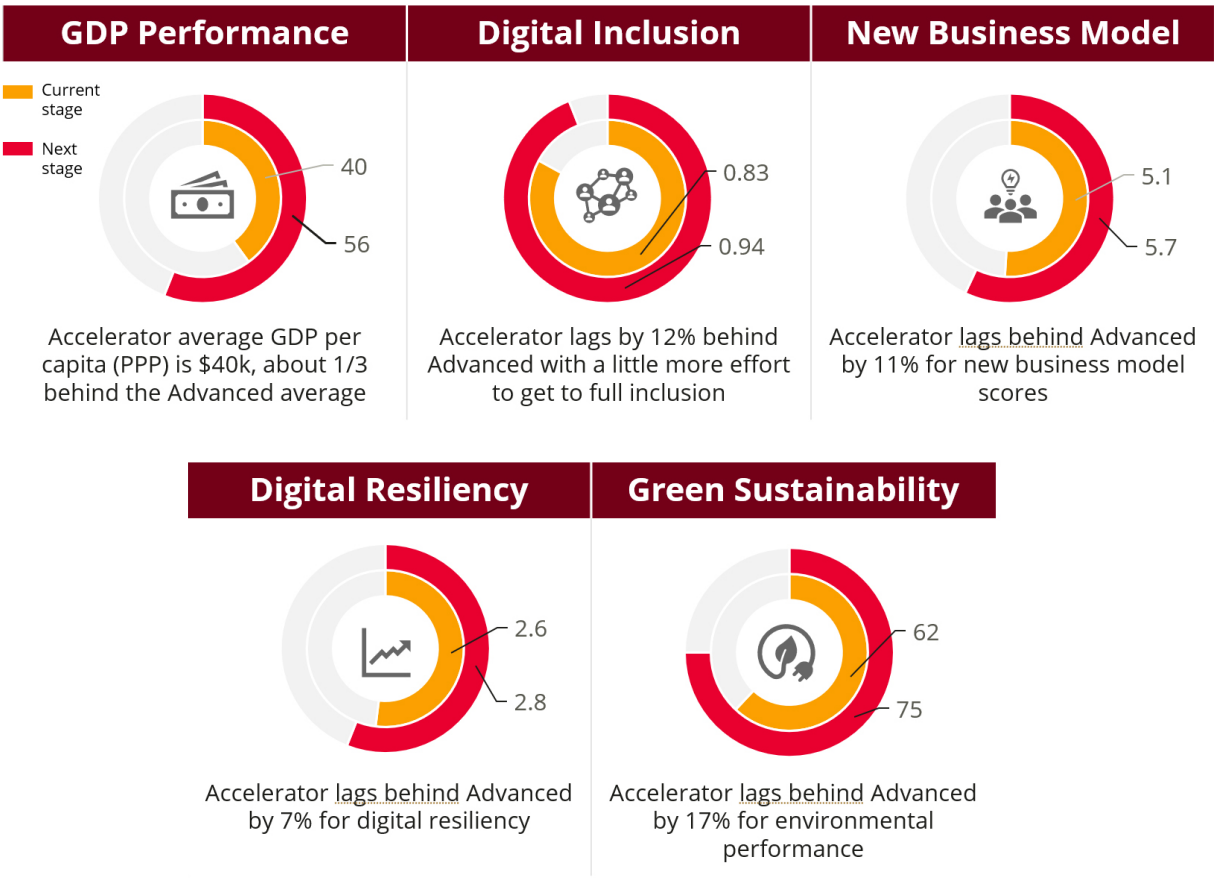
ICT Investment/GDP	2.5%	3.0%
Workforce Tertiary Edu	36%	44%
R&D Expenditure/GDP	0.5%	1.6%

eGov rating	0.70	0.82
% green energy	33%	42%

2. Moving Accelerators to Advanced

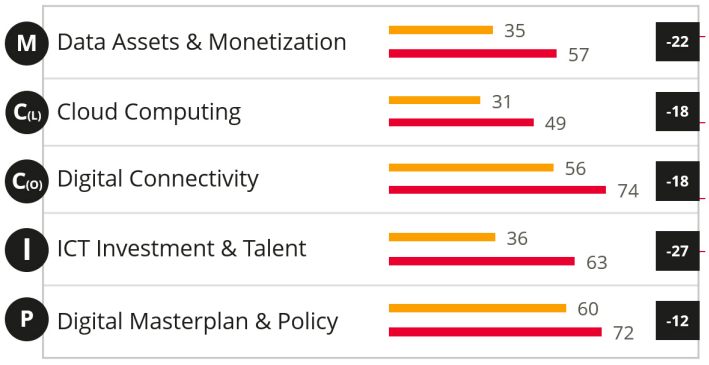
Moving to the Advanced stage requires ICT investment and talent development to build data assets for monetization. Economies in the Accelerator stage lag the Advanced group in GDP growth, followed by environmental performance and digital inclusion.

Figure IV-18 Accelerator Outcomes gap



The largest DFE gap is between Accelerator to Advanced are in ICT Investment and Talent and Data Assets and Monetization. Accelerators also need to double ICT investment to close the Digital Connectivity and data asset gaps, triple cloud spending, and increase usage of cloud tools for digitalization.

Figure IV-19 Accelerator DFE Index gaps

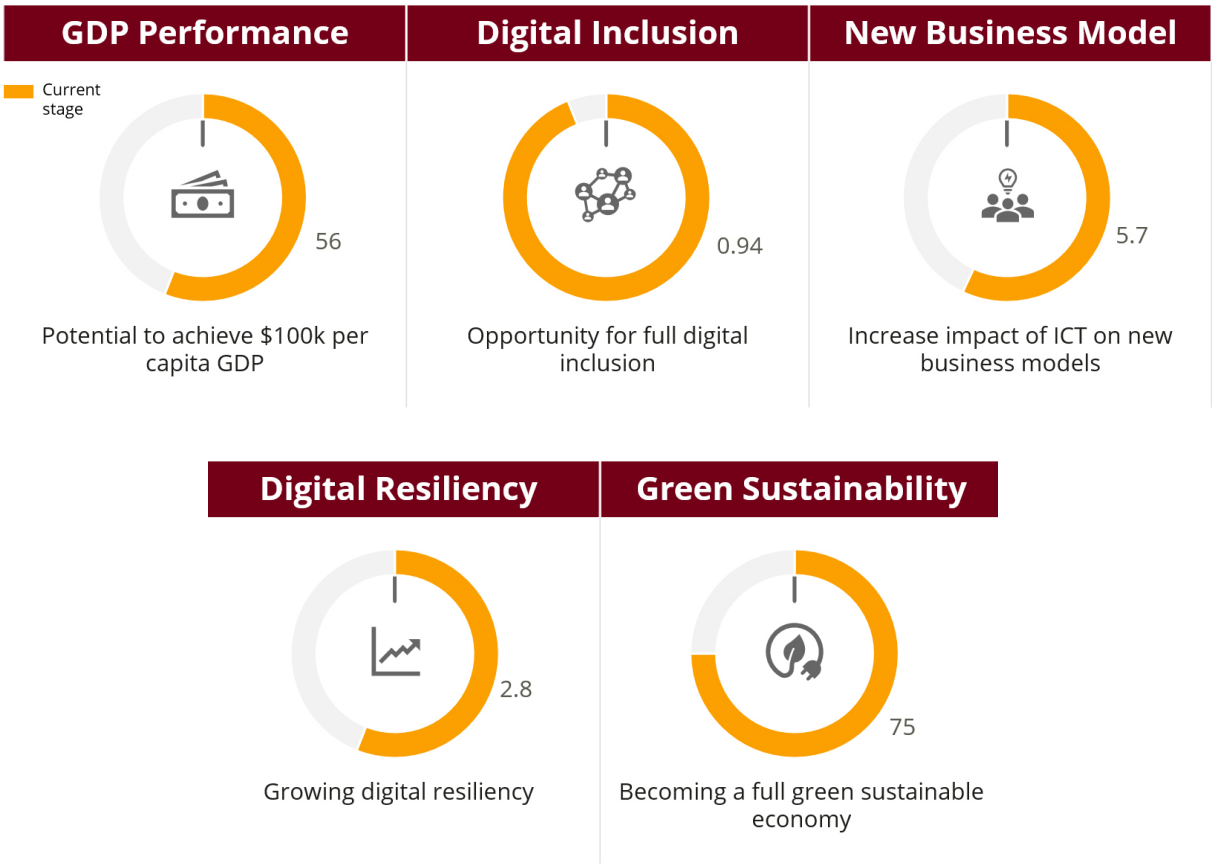


	Accelerator	Advanced
AI Analytics/GDP	0.007%	0.025%
Data Assets/Cap	0.08Zb	0.13Zb
Cloud Adoption/GDP	0.1%	0.4%
Cloud Workloads	16%	22%
4G/5G Connections	61%	81%
Fixed BB	29%	40%
Network Throughput	77Mbps	104Mbps
ICT Investment/GDP	3.0%	5.7%
Workforce Tertiary Edu	44%	65%
R&D Expenditure/GDP	1.6%	2.4%

3. Moving Advanced to Aspiration

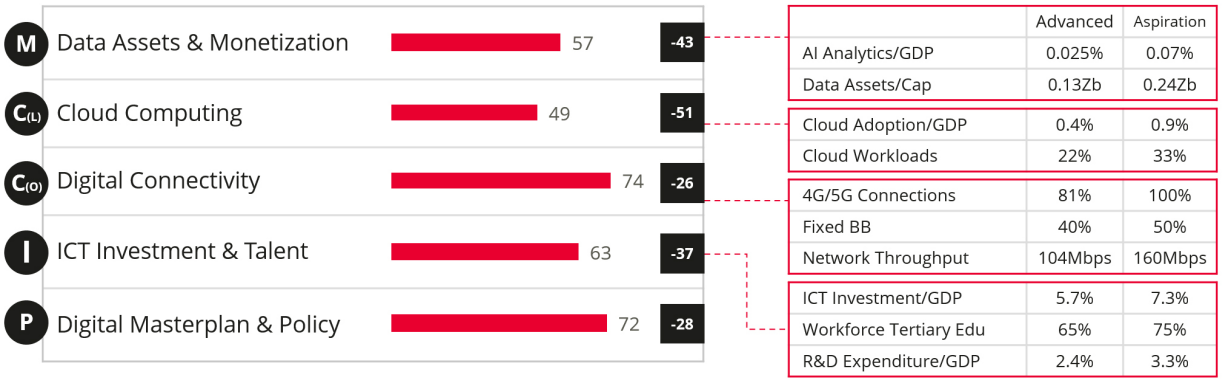
Moving to the Aspiration stage requires continuous ICT investment, talent building, and cloud platforms to drive data asset monetization. Advanced economies can reach US$100,000 GDP per capita PPP by improving their DFE, especially through Data Assets & Monetization.

Figure IV-20 Advanced outcomes gap



Those in the Advanced stage need to increase their ICT and research and development (R&D) investments by one-third, especially on cloud spending and 5G/F5G connectivity upgrades. Policies and incentives are needed to double cloud adoption and AI spending, while data frameworks and policies are necessary to monetize the data created.

Figure IV-21 Advanced DFE gaps



	Advanced	Aspiration
AI Analytics/GDP	0.025%	0.07%
Data Assets/Cap	0.13Zb	0.24Zb
Cloud Adoption/GDP	0.4%	0.9%
Cloud Workloads	22%	33%
4G/5G Connections	81%	100%
Fixed BB	40%	50%
Network Throughput	104Mbps	160Mbps
ICT Investment/GDP	5.7%	7.3%
Workforce Tertiary Edu	65%	75%
R&D Expenditure/GDP	2.4%	3.3%

F. The 5E evolution plan

How should the economies drive their ICT progress and move up the pathway of the DFE stages to achieve an Intelligent World in 2030? The following 5E approach recommends how a economy could develop the relevant policies for evolving into a DFE final stage.

Figure IV-22 The 5E recommendation framework for DFE

		A1- Adopter	A2- Accelerator	A3- Advanced	A4- Aspiration
Data Asset & Monetization (M)	**Establish data hub** that promotes data sharing and monetization	Make Data with digital infrastructure and industry digitalization	Manage Data governance with trusted data framework	Monetize Data assets through building data hubs, data driven innovation and new business models	**Intelligent World 2030** Intelligent Internet of everything
Cloud Computing (C_L)	**Expedite** industry **clouds** to accelerate digitalization	Cloud-first preference for all mandate and G-Cloud for government	Cloud for all industries and business workloads and apps	Cloud performance Standards and security guidelines for multi-tier cloud	
Digital Connectivity (C_O)	**Enhance broadband** coverage and quality of service	Continuously release TDD golden bands 3.5/2.6/2.3/4.9 in 2022-2024, Coverage expansion	Reserve 6GHz as IMT for 5G Advanced readiness 2025, Full fiber+ 5G Connectivity rollouts Dual Gigabit nation	Experience improvement with enhanced network throughput &quality of service	
ICT Investment & Talent (I)	**Enable ICT spending**, create digital talent pools	Invest in ICT education and training to create ICT and DX skills, cultivate startups	Incentivize public and private organizations to invest in ICT+Green frontier technologies	Invite foreign/overseas ICT talent with attractive programs, Incentive to AI/ Data digitalization	
Digital Masterplan & Policy (P)	**Execute digital plans** and track programs	National strategy and digital masterplans to update annually on frontier ICT infrastructure& digitalization	Progress review digital economy KPI targets annually for digital progress at ministerial level	Pursue renewable energy and green tech with aggressive targets, aiming at green digital DFE	

1. Digital Masterplan and Policy: Execute digital plans and track programs

- **Purpose** to update digital masterplans annually to track outcomes, align with frontier technologies and user evolution
- **Progress** review KPI targets annually for digital progress, investment, adoption, and outcomes at a high-level ministerial level
- **Pursue** renewable energy and green tech with aggressive targets in the ICT masterplan or policies to manage the carbon footprint of industry and home

2. ICT Investment and Talent: Enable ICT spending, create digital talent pools

- **Incentivize** public and private organizations to invest in frontier technologies like AI, IoT, robotics, and 5G
- **Invest** in education and training to create more ICT and DX skillsets and cultivate startups
- **Invite** foreign ICT talent and overseas nationals back with attractive policies

3. Digital Connectivity: Enhance coverage and quality experience

- **Coverage** expansion for rural with base tower subsidy and sharing for entire nation broadband cover
- **Connectivity** with full fiber and 5G rollouts enabling the dual-gigabit nation
- **Customer** experience improvement with enhanced network QoS through new technologies

4. Cloud Computing: Expedite industry clouds to accelerate digitalization

- **Cloud-first** preference for all mandates and G-Cloud for government
- **Cloud for industries** and business workloads and apps to accelerate the digitalization of target industry sectors
- **Cloud performance** standards and security guidelines for multi-tier cloud computing must be clearly defined

5. Data Assets and Monetization: Establish a data hub that promotes data sharing and monetization

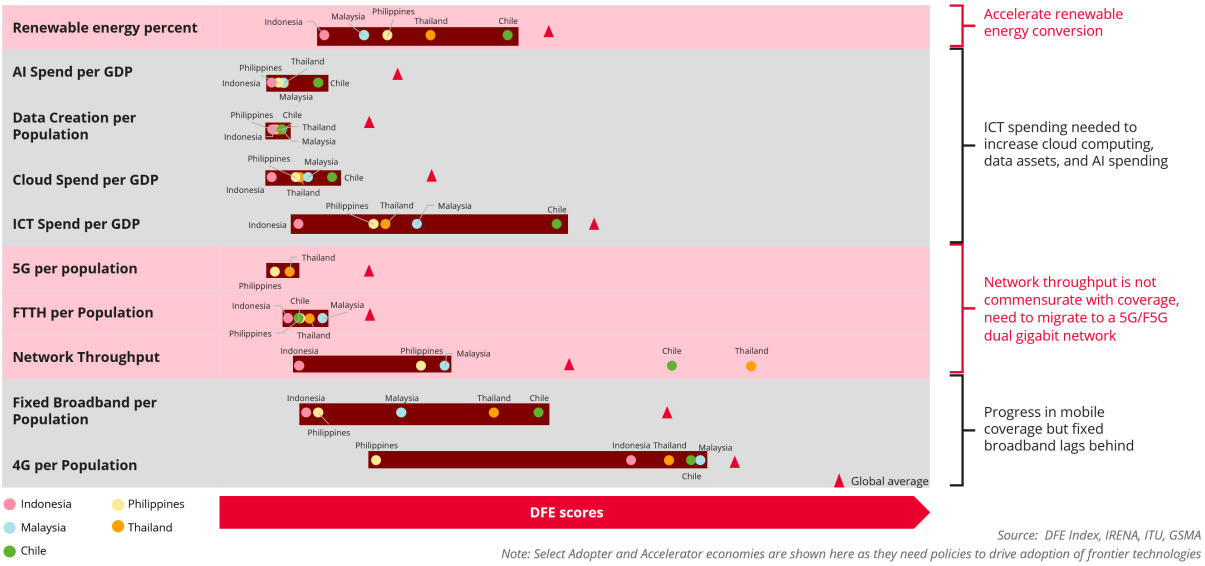
- **Make** more data assets by augmenting investment in digital infrastructure (5G, F5G, IoT) and industry digitalization. Drive AI investments with more data scientists and workers
- **Manage** data governance with a trusted data framework for data anonymization for trading and sharing
- **Monetize** data assets through the building of data hubs, data-driven innovation, and new business models

As shared earlier, digital technology and infrastructure are a DFE economy's foundational layer. Governments are advised to review existing masterplans and policies to ensure they will gear the economies toward achieving a higher status for DFE.

G. ICT Policy Recommendation

APEC economies need to develop masterplan and policies to accelerate their ICT spending on building a 5G/ Fiber dual gigabit network, cloud computing, data assets, and AI investments, beyond 4G mobile network connections to be at the forefront of the DFE evolution. These economies have made progress in mobile coverage, but fixed broadband lags. Network throughput is inconsistent with coverage requiring migration to 5G/F5G dual gigabit networks. ICT spending needs to increase cloud computing, AI spending, and renewable energy for the sustainable digital transformation of the economy and society.

Figure IV-23: ICT development in select APEC economies



Source: DFE Index, IRENA, ITU, GSMA

Note: Select Adopter and Accelerator economies are shown here as they need policies to drive adoption of frontier technologies

In addition, DFE considers the value of ICT infrastructure in promoting a digital-first economy and proposes MCCIP digital infrastructure recommendations and policy directions: Data Assets & Monetization, Cloud Computing, Digital Connectivity, ICT Investment & Talent, Digital Masterplan & Policy.

P Digital Masterplan and Policy: To lead the nation into a digital-first world, each government needs to become a digital-first government and considers the following critical programs in a government transformation master plan. In summary, the government needs to establish a national digital-first strategy and master plan and put a task force or a committee to drive it.

Figure IV-24: Digital-first government masterplan

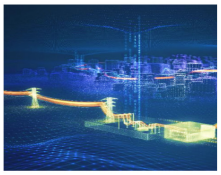
Digital-First Government Dimensions	Initiatives for digital first	Benefits	Country examples
M Data Assets & Monetization	One data government	• Improved and faster policy decision making • AI-enabled and analytics-supported processes	**National Data Strategy** Data foundation, analytics, skills, availability, ethics
Cu Cloud Computing	Cloud-first government	• Agile and scalable government services • Fast to deploy services	**SG Gov Tech Stack** Full cloud computing, APIs, Public-Private co-Dev
Co Digital Connectivity	Fully digital government services	• 24/7 accessible government • Inclusive government for all • Fast application, instant approvals	**National Digital Government Network** Regional and interagency information sharing
I ICT Investment & Talent	ICT budgets and talent development plan	• Improved productivity and efficiency • Higher approval ratings	**ICT Gov Strategy 2025** Talent development, cloud investment, data program
P Digital Masterplan & Policy	Government transformation and sustainability plan	• Higher global ratings • Future-ready government • Sustainability benefits	**Digital Government** President led, Intelligent Digital Gov, all ministries, Sustainable Gov

Source: IDC relevant databases, UN, Yale University, public sources

Cybersecurity: The ICT industry is growing fast, highly complex, serves a wide variety of needs, and faces an increasing range of threats. In addition to building the necessary digital infrastructure, governments must ensure adequate cybersecurity considerations in their master plan, continuously enhancing the security policies, laws, standards, and certification systems in the digital-first economy. Governments should encourage the entire ICT industry to invest more resources to develop globally-accepted, industry-led, voluntary, open, and robust industry security standards, along with international security control practices, security assurance solutions, compliance assessment systems, and security management efficiency. A robust cybersecurity system will help establish a fair and consistent environment where all parties can respond to cybersecurity challenges together.

P Green Policy: The Paris Agreement charted a new course to combat global climate change and has become a global green vision where economies are required to make commitments. Most economies set carbon neutrality targets to accelerate a green, sustainable economy, but policies and planning are needed to reach these targets. The digital master plan and policies must include green policies and financing to achieve carbon neutrality targets for a green, sustainable economy to limit global warming to 1.5 - 2°C by 2050/60. A possible approach is a 4D1E policy as adopted by Thailand.

Figure IV-25: Green sustainability 4D1E policy

Digitalization	De-carbonization	Electrification	Decentralization	De-regulation
All sectors	All sectors	Transport & others	Industry, Commercial building, Household	All Sectors RE, Power & Gas
Smart devices, EMS, ADR, Smart grid, AI, 5G, Blockchain	EE, RE, VRE & ESS, Green H2, CCUS, Low carbon city Low Carbon ICT	EV, CAV, V2X, Low cost RE, and etc.	DPV, Micro-mini grid, Community-scale	Energy market, Regional hub
5G, AI, Big Data, Cloud, IoT, and Blockchain	Wind-solar power generation will reach 85% by 2050	An estimated 6.5 million electric vehicles were sold worldwide in 2021	Incl. Smart Grid, Charging, Installed capacity	Energy Policy & Planning, accelerate energy industry to Carbon Neutral
				
Source: McKinsey	*Source: IRENA*	*Source: Canalys*	*Source: Business Wire*	*Source: Carbon Brief*

Green and sustainability policy recommendations to balance the economic development of a digital-first economy with environmental sustainability are as follows:

1 Solar and Storage: Renewable energy is vital to reducing carbon emissions. Solar adoption is gaining traction, driven by subsidies, credits and incentives to achieve grid parity and PV plus Storage. And among the different options, solar energy is the cleanest and most abundant renewable energy source.

a) To achieve grid parity for renewable energy, governments need to continue to offer subsidies, put in place schemes, such as feed-in tariff (FIT), and introduce energy efficient credits, rebates, funds, and different tax incentives, to drive down the to a green and low-carbon future ;

b) Governments can focus on policies that include solar and battery energy storage systems, scale expansion for renewable energy production, and safety regulations related to generating and storing renewable energy upon achieving grid parity.

2 Green datacenter

a) Encourage the utilization of green electricity such as wind power, and solar power in datacenter
b) Use of prefabricated assembled design in a datacenter to reduce construction waste
c) Specify the datacenter PUE requirements not to be higher than 1.x
d) Adopt tiered pricing for the power consumption ofdatacenter based on the PUE
e) Encourage datacenter operators to enhance the energy consumption monitoring and management

3 Green ICT

a) Well-defined carbon neutrality goals of the communications industry and gradually reducing the carbon emission annually by 2030 (NCN: Network Carbon Neutralization)

b) Strengthen the support of relevant funds and policies to the communications industry and provide tax incentives for energy conservation and emission reduction
c) Integrating site construction mode (SEE: Site Energy Efficiency) is encouraged for new sites. For existing sites, the reconstruction of low-efficiency sites (SEE) needs to be accelerated
d) Utilizing digital technologies, such as artificial intelligence and big data for smart O&M to reduce the carbon emission during operation

I ICT Investments: This is integral to every digital master plan and policy. Intergovernmental organizations establish guidelines, and governments, telcos, and suppliers channel investments to mobilize nations to achieve their digital masterplan goals.

- Guidelines from intergovernmental organizations to drive the availability of digital services across the region and multiple economies
  - ASEAN Digital Masterplan 2025 to develop ASEAN as a leading digital community and economic bloc
  - Digital Economy Working Group (DEWG) under G20 Sherpa Track for discussing collaboration on digital connectivity, digital entrepreneurship, and digital skills
  - The OECD Digital Economy Outlook 2020 highlights initiatives in ICT and the Internet to meet their public policy objectives
- Investments from telcos and suppliers to bridge the digital divide, drive 5G+F5G
  - Top-ranked telco from Asia (excluding China) in the latest Digital Inclusion Benchmark conducted by the World Benchmarking Alliance (WBA)
  - Telkomsel and XL Axiata are selected as Operational Cooperation Partners (KSO) to manage the provision of 4G BTS built by BAKTI KemKominfo in 7,904 villages
- Investments from Governments for new digital projects
  - MDEC in Malaysia offers different grants, such as Smart Automation, Digital Content, and Global Technology
  - Thailand DE Fund, established under the DES Act, will set aside THB2.6 billion for digital development projects in FY22
  - The Ministry of Communication and Information Technology (Kominfo) Indonesia has a budget of IDR25 trillion in 2022. One of the plans is to provide 4G to all villages by 2022

I Digital Talent: Talent or human capital is the key to digital transformation and economic growth in a digital economy. Society must consider driving quality and equity in education, promoting digital skills, and cultivating digital talent. Digital skills and literacy are the foundation for the digital economy, with the United Nations emphasizing the importance of literacy in the digital world and declaring it a fundamental human right. As part of an ongoing effort to develop talent, Huawei launched Seeds for the Future Program 2.0 in July 2021, with plans to invest US$150 million in talent development in the next five years to benefit an additional three million people. Seeds for the Future 1.0 is one of Huawei's earliest flagship CSR programs, launched in 2008, and has trained more than 12,000 students from 136 economies and regions. The program also held the first Tech4Good competition in 2021 to encourage students to collaborate and use technology to solve social problems in their home nation.

C(O) **Digital Connectivity**: Economies must set a national broadband vision and objective to build digital connectivity. Policies to support this include

1 National Broadband Vision and Objective 1: Ubiquitous gigabit connectivity as a national objective, fiber as a cornerstone, and 5G acceleration as a key priority

a) Clear national broadband target in mid-term, and with yearly QoS benchmarking
b) Clear fiber development target in mid-term, which includes fiber coverage, penetration, and yearly experience benchmarking
c) Harmonized and sufficient spectrum assignment, especially in mid bands, with reasonable price
d) The site and fiber infrastructure openness and sharing
e) Fixed and mobile technology synergy
f) Local ecosystem, local talent, and skills transformation

2 National Broadband Vision and Objective 2: 5G coverage expansion as a key target, 4G/5G co-ordination for national broadband experience improvement and growth

a) Accelerate 5G coverage expansions, spectrum allocation, and national coverage targets
b) Strengthen 4G/5G co-ordination and connectivity at home: 90% national 4G coverage target
c) Service benchmarking to ensure development and competitiveness

3 Release TDD golden bands 3.5/2.6/2.3/4.9 with an 80-100MHz large continuous block in 2022-2024, and reserve 6GHz as IMT for 5G advanced readiness before 2025 to guarantee 2000 MHz bandwidth of national mid-band for sustainable evolution

a) 2000MHz mid-band is required globally in 2025-2030, and 2000 MHz for a 40x increase in data traffic in the next 10 years. 3.5/2.6/2.3/4.9 and 6 GHz for 5G to ensure sufficient spectrum
b) Release TDD golden bands 3.5/2.6/2.3/4.9 with an 80-100MHz large continuous block in 2022-2024
c) Reserve 6GHz as IMT for 5G advanced readiness before 2025

4 Efficient use of spectrum for high-quality connectivity infrastructure: contiguous 100MHz block, reasonable pricing for spectrum, and technology neutrality for the evolution to 4G+5G target network

a) Allocate continuous 80-100 MHz per block to operators to maximize the technical potential of 5G
b) Reasonable pricing to promote 5G investment and adoption by ensuring the ratio of annualized spectrum cost over annual revenue: 5~10%
c) Technology neutrality for the evolution to 4G+5G target network by deploying 5G using the bands for 2/3/4G and letting the market choose the best technology and timing

5 Full fiber connectivity is future-oriented and boosts GDP Growth

a) National entire fiber plan: With clear coverage and speed targets (e.g., provide nationwide ultra-high-speed broadband access of 1Gbps and more to all physical addresses, including homes, schools, government buildings, businesses, and hospitals)
b) Financial incentives: Taxation deduction, gigabit voucher; Funding could be direct subsidy or low-interest loan; Universal Service Fund contributions for fiber rollout; Demand side subsidies are less common but becoming increasingly popular
c) Policy support: All stakeholders (governments, regulators, operators, etc.) have a role to play in accelerating fiber rollout; Facility opening/sharing/simply Right of Way; Fiber Pre-deployment policy

6 IPv6 enhanced is the next generation of the Internet. Governments need to accelerate the deployment of IPv6 to drive the growth of GDP

a) The IP industry is the foundation of the Internet and is evolving towards the IPv6 era
Strengthen network bearing: operators and ISPs need to upgrade to IPv6 to improve the network IPv6 bearing capacity. Synchronize 5G and F5G networks with IPv6's plan, construction, and implementation
b) Globally recognized IPv6 as the next-generation internet technology
Expand industry applications: IPv6 transformation of special networks in finance, government, manufacturing, education, medical treatment, transportation, and other industries, and support industry digital transformation through IPv6 industry innovation
c) IPv6 has the potential to increase GDP growth by 5%. Strengthen talent training: introduce a systematic ICT talent training mechanism to create a digital strategic talent reserve

7 National ICT policies to support shared infrastructure development: Enable/Enhance coordinated infrastructure sharing for economic and social benefits

a) Policy for infrastructure sharing promotes the use and sharing of exiting public infrastructure for sites, towers, and optical fibers. Process optimization and implementation for optimized Right of Way (ROW), road access rights and co-use
b) Funding through Universal Service Access funds for the rural, subsidy, affordable loans, Innovation Fund: using 5G and broadband technologies to develop use cases including education, healthcare, rural development, and environmental areas
c) Incentives through taxation benefits, carbon footprint reduction benefits, electricity subsidies

C(L) Cloud Computing: Economies need to promote a national cloud-first strategy to help enterprises migrate workloads to the cloud with industry digitalization and digital resiliency. Almost half of the organizations surveyed are not using cloud or on-premise datacenter that is less efficient, not scalable and does not confer agility and resiliency to their digital operations.

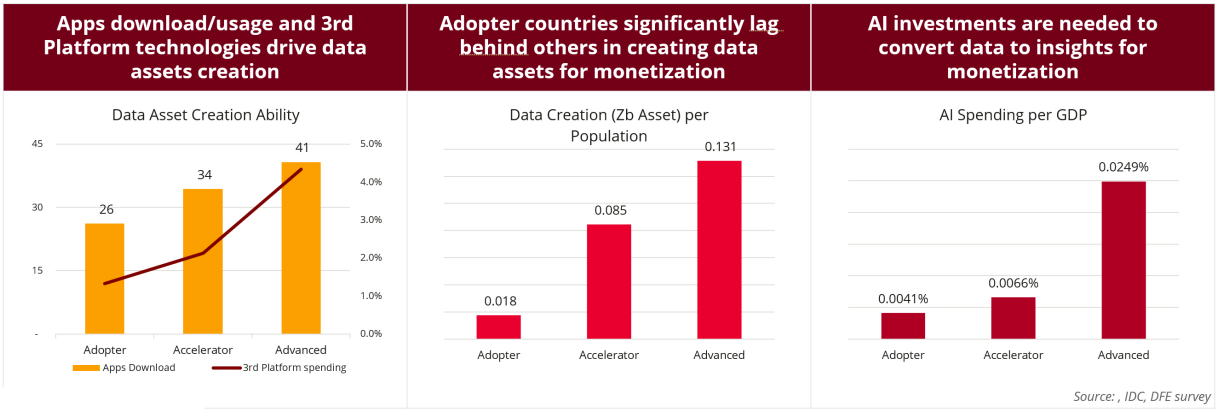
1) Funding and budget: APEC economies need to ramp up cloud computing spending and usage to be cloud-first in their digitalization journey
2) Cloud-native infrastructure: A large proportion of MSMEs are not using cloud computing for scalability and agility and should evolve towards being cloud native
3) XaaS with a public cloud: Likewise, enterprises and governments are also mainly still on-premise and need transformation to Everything-as-a-service with a public cloud
4) Policies regarding data sovereignty are needed to facilitate data capture, storage, and classification for data to be shared and traded on the cloud. A data sovereignty policy will include data residency, data masking, security certifications, compliance, standard clauses in contracts with CSPs, concerns on entrusting a local company, and rationalizing and limiting the data categories stored in the cloud.

M Economies need investments in digital infrastructure for more data creation and higher adoption of analytics and AI to get ready for data monetization. Most SEA economies have not invested in data asset creation and AI spending for data monetization, and many MSMEs do not use analytics in their business.

1) Policies are needed to push organizations to store, process, and use analytics for data monetization
2) Building data value cycle based on data foundation and governance, focusing on the data source, accessing, processing, and organizing, etc., to monetize raw data, information, knowledge in the intelligence journey

Governments must improve data governance to create data assets and invest in AI to convert data to insights to facilitate monetization.

Figure IV-26: Comparing data monetization readiness for Adopter, Accelerator, and Advanced economies



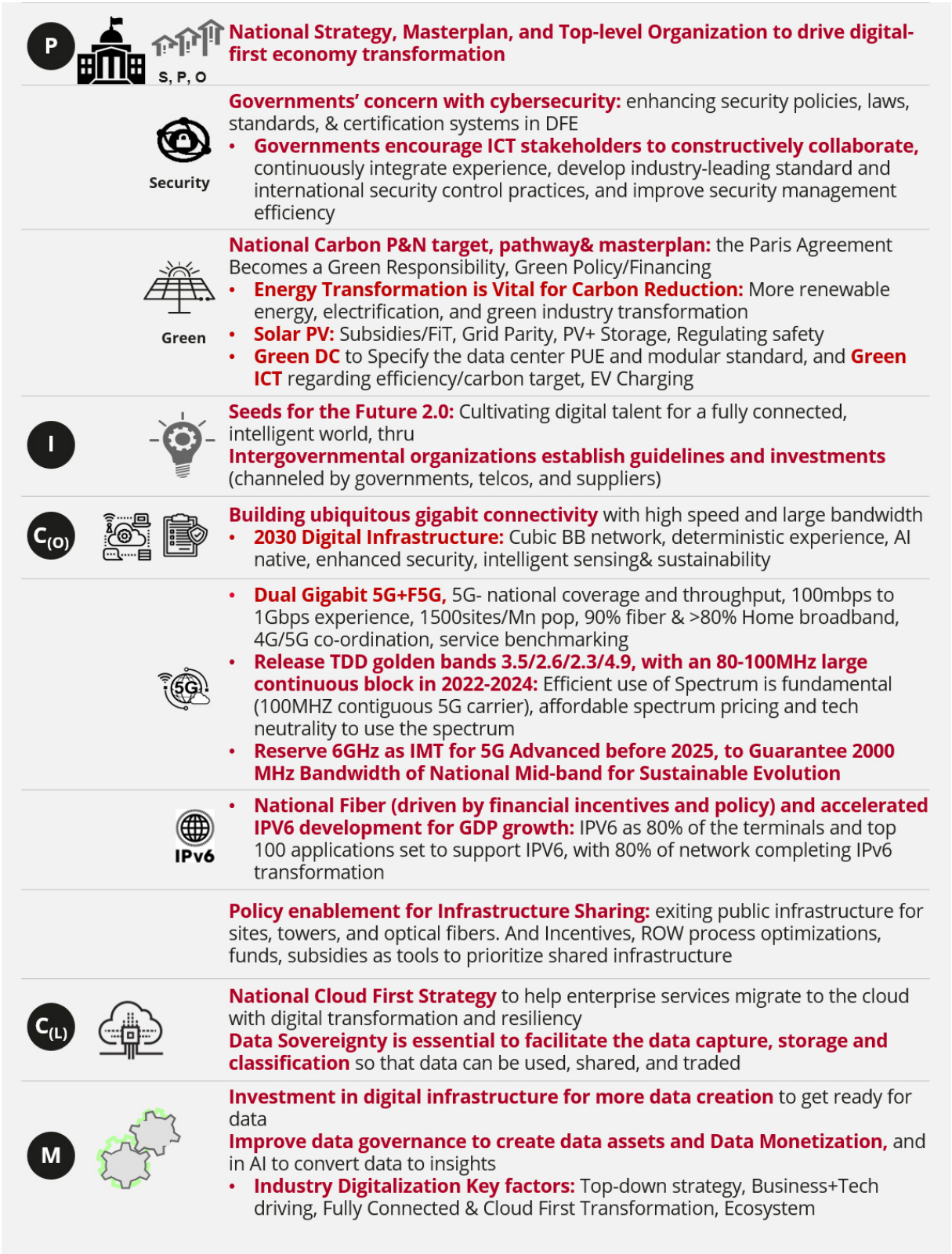
Economies in the Accelerator and Adopter stage need to increase their data assets significantly and AI investments to close the gap with economies in the Advanced setting, following data assets creation in the regional data value cycle ecosystem.

1) Addressing ownership and control of data to support openness in public sector data
2) Driving data quality and standards to ensure interoperability and a consistent approach
3) Enabling safe, legal data flow by maintaining the protection of personal data

Focus on critical success factors for Enterprise Digital Transformation, including having a top-down strategy, with business and technology teams making progress simultaneously, driving a fully connected and cloud-first & cloud transformation, and simultaneously building strategic partnerships in an ecosystem.

In summary, the DFE MCCIP report proposes the following ICT policy recommendations, with the vision to be a pivotal contributor to the digital-first economy development in APEC and create a better green digital life:

Figure IV-27: ICT Policy recommendations



V. Appendix I

A. DFE Foundation Index methodology

The DFE Foundation Index model provides economies with a quantitative tool to assess the state of their ICT investment and infrastructure foundation for building a digital-first economy.

Below is the DFE Index:

- Broad literature research identifies and collates the relevant indicators to represent the five dimensions of the DFE framework. Some sources were from the World Economic Forum, Worldbank, UNCTAD, OECD, ITU, IRENA, Global Connectivity Index, IDC research, etc.
- Data points were from established sources with historical data points of at least 20 economies. Alternative proxy indicators supplement where the direct data is not available for the indicator chosen
- Correlation analysis on a long list of indicators helps to identify indicators that have statistical significance in growing the digital-first economy
- Principal component analysis groups the indicators into the relevant five dimensions, the normalization of dimension scores, and weights
- Regression of the DFE model output to the five desired outcomes by using data from 50 economies to ensure the relevance of the DFE affecting the five outcomes

Figure V-1 The 5E recommendation framework for DFE

DFE Index- National Strategy, Framework and Elements

M	**Data Assets & Monetization**	Applications	Data Assets	Industry Digitalization	AI Analytics
C(L)	**Cloud Computing**	Cloud Adoption	Cloud Workloads	Reliability and Security for Cloud	Internet of Energy
C(O)	**Digital Connectivity**	Telco Infrastructure	Fixed BB	4G & 5G Connections	Network throughput
I	**ICT Investment & Talent**	R&D Expenditure	ICT Investment	ICT Talent	Patent
P	**Digital Masterplan & Policy**	eGovernment	GovTech MI	ICT Regulatory Outlook	Green Energy

Data Assets & Monetization

Applications – Applications by App Annie
Applications downloaded from App Annie are on a per capita basis. Applications create data as they are used and fed for more complex services in a reinforcing cycle. The data created is an asset tag to a context (e.g., user profile, location, action), providing relevant information. This proxy is for data generation capability of an economy.

Data Assets – Data Assets by IDC
Data assets or the annual accumulated data creation provides a measurement to indicate how much material is available for digital tools, services, and applications to use and monetize. It also measures how much AI systems can process data to generate insights that lead to value.

Industry Digitalization – Industry Digitalization by IDC's 3rd Platform Spending Black Book
Represented by 3rd Platform spending from IDC's Black Book. The 3rd Platform technologies are the foundation technologies that drive DX. This consists of mobile broadband, social business, big data analytics, and cloud services that drive the innovation and development of new digital products, services, and business models.

AI Analytics – AI Analytics by IDC's IT Spending Black Book
Represented by AI spending from IDC's Black Book. AI applications turn data into insights that can be monetized or used to provide digital services and new products that create economic value.

Cloud Computing

Cloud Adoption – Cloud Adoption by IDC Cloud Trackers
It compares how different economies provide cloud services by measuring cloud adoption as a percent of GDP. This is a proxy to benchmark how other economies have been using the cloud to enable their digital economy.

Cloud Workloads – Cloud Workloads by IDC Cloud Trackers
Businesses in the economy have moved from on-premises deployment of workloads to the cloud to scale and provide access to relevant users. More workloads in the cloud offer more information for cloud-based AI systems to harvest and measure.

Reliability and Security for Cloud –Reliability and Security for Cloud Scores from the Network Readiness Index
This proxy reflects the network's reliability and security of cloud performance. To grow a DFE, the network in the economy that provides access must be reliable and secure. Hacking and network corruption will lose users' trust, resulting in slower adoption and usage of digital technologies.

Internet of Energy – Internet of Energy by OECD/IEA
The International Energy Agency (IEA) energy balance methodology is derived from the calorific content of the energy commodities and a common unit of account: a ton of oil equivalent (toe). It consists of energy production plus energy imports, minus energy exports, minus international bunkers, plus or minus stock changes. This is a proxy to measure the available energy to power the network and the digital tools, services, and applications that rely on the network.

Digital Connectivity

Telco Infrastructure – Telco Capex Spending Expenditures by IDC
The CAPEX by telco companies over the past three years represents the investments in building connectivity services and enhancing the QoS needed to support the deployment and function of digital tools and applications.

Fixed BB - Fixed Broadband Subscription by ITU
This proxy measures wired broadband connections to provide digital access to people and businesses, especially for higher volume and throughput applications. Fixed broadband offers high speed and throughput for digital applications and tools.

4G & 5G Connections – 4G & 5G Connections by the GSMA
This proxy measures high-speed mobile broadband to provide digital access to people and businesses, especially in unwired communities in large part of Asia. This measurement is for supplying 4G and 5G services to individuals and organizations.

Network Throughput – Network Throughput by Ookla
In addition to providing connections for digital access, the links need ample throughput bandwidth to ensure that digital tools, services, and applications work seamlessly and are always available. We measure this by calculating the average download and upload speed recorded by Ookla.

ICT Investment & Talent

R&D Expenditure – R&D Expenditure by World Bank
RR&D expenditures are current, and capital expenditures (both public and private) on creative work are undertaken systematically to increase knowledge in humanity, culture, and society, as well as for new applications. R&D covers basic research, applied research, and experimental development. RR&D investments build digital capability from increased use of technology for R&D and the benefits of the R&D.

ICT Investment – ICT Investment by IDC Black Book
ICT investment build digital tools and capabilities to drive the digital economy. The total amount of end-user spending on ICT hardware (servers, storage, PCs, devices, peripherals, wireless and fixed network equipment, datacenters), software, IT services, telecom services, and Cloud/AI computing services determines the overall size of the ICT investment in each economy. This tracks IT and CT investments as a percent of GDP.

ICT Talent– ICT Talent by various sources but mainly the INSEAD Global Talent Competitiveness Index
This is the supply and management of ICT talent for each economy. This includes workers employed directly in the IT and CT industry (hardware manufacturers, software vendors, service providers, and channel organizations) and ICT staff employed by end-users in IT departments for the management, deployment, support, and strategic implementation of technology solutions.

Patent – Patent (per capita) by the OECD
This measures the total number of patents filed under PCT within the ICT technology domain in the inventor's place of residence. Patents indicate the degree of discoveries that could add to digital capabilities.

Digital Masterplan & Policy

eGovernment – eGovernment Development Index (EDGI) by United Nations
Policies to build digital capabilities often begin with the government. The state of eGovernment in the economy reflects the government's approach to transforming government interactions with its citizens and businesses. An ICT Masterplan needs to include a strategy for a strong eGovernment service. With this, the policymakers encourage the citizens, businesses, and other agencies to upgrade their digital capabilities to interact with the government for their essential services. A task force or committee is needed to coordinate the ICT master plan across all government organizations and industries.

GovTech MI – GovTech Maturity Index (GTMI) by World Bank
GTMI measures the degree of digital tools adoption by the government to transform the business of government and its operations. This goes beyond eGovernment platforms to impact how the government collects information, enforces rules, makes policies, runs operations, and forecasts/predicts the near term. A GovTech organization and investment policy are needed to drive the digital transformation of the government to lead the charge to transform citizens and businesses.

ICT Regulatory Outlook – ICT Regulatory Outlook by ITU
This measures the progress of ICT regulations that facilitates the investment and fair use of ICT. Having regulations promoting ICT investment, laying the guidelines for proper use of ICT, protecting the user, and establishing fair usage and access for everyone, is critical to developing a DFE.

Green Energy – Renewable Energy Sources by IRENA
As ICT runs on electricity, policymakers need to move electricity to more renewable sources to reduce the carbon footprint from greenhouse gas emissions. IRENA reports on the percent of renewable energy to total energy sources. Economies where policymakers have opted for renewable sources, will generate lower CO2 emissions per kWh of electricity. A DFE must be sustainable to the environment.

The 20 indicators are extracted from official sources and could be in the form of a percentage, whole numbers, or decimals with different measurement units. They were standardized to a 1 to 10 score based on their distribution between the highest and lowest scores for the 50 economies. The scores for each indicator averaged out to form the score for the respective dimension based on their weights as determined by regression to achieve the closest correlation to GDP. The final DFE score is an average of the five dimension scores. Equal weightage was used as correlation analysis showed an almost similar relationship.

B. DFE Survey methodology

Huawei and IDC developed the DFE Survey to help the identified three stakeholders in the economies – consumers or the citizens, MSMEs and large businesses, and governments – to understand and cope with the challenges and opportunities present in a DFE. The DFE Status, which is an output of the DFE survey, therefore provides the basis to understand the current state of maturity, the gaps, and, eventually, progress toward the gold standard or Aspiration stage across five interrelated dimensions: Data Assets and Monetization, Cloud Computing, and Digital Connectivity, ICT Investment and Talent, and Digital Masterplan and Policy.

Citizens, MSMEs, enterprises, and governments were surveyed to assess their DFE Status. A survey of the identified three stakeholders was conducted from October 2021 to May 2022, across seven selected APEC economies. The methodology is a mix of phone and online surveys, and it was an anonymous survey. The industries are representative across the seven selected APEC economies, and the sample includes government agencies. A snapshot of the digitalization status of these stakeholders as portrayed through their needs, challenges, and plans was captured. The DFE Status was assessed in four stages, from the Adopter to the Aspiration stage.

The following table shows the types of questions organized across the five dimensions included in the survey.

Digital Masterplan and Policy	• Attitude toward DX and digitalization policies • Sustainability programs and attitudes
ICT Investment and Talent	• ICT investments and digital tools used to create value • ICT skills development to participate in the DFE
Digital Connectivity	• Network connectivity solutions used to engage in digital business • Digital technology usage enabled by connectivity to create value
Cloud Computing	• Cloud computing used for managing data assets • Cloud computing to build scalable, agile capabilities for digital resiliency
Data Assets and Monetization	• Data utilization for decision making and value creation • Data analytics tools usage to convert data into assets that can be monetized

C. Description of the four DFE stages

This section presents an analysis of the selected APEC economies compared with 53 other economies using the DFE Index. The DFE Index shows four stages of maturity with varying states of readiness for the DFE as described earlier. Economies in the lower stages should review their position in such framework and develop strategic priorities and investments that will help them overcome challenges and narrow major dimensional gaps to effectively evolve from their current stage to the next or even leapfrog to the Aspiration stage. The following table highlights the current state of all economies in the analysis and the strategic priorities they need to consider to evolve effectively in the DFE economy.

Adopter	
DFE stage characteristics	• In this stage, ICT investments mainly focus on expanding network infrastructure • Most of their businesses are at the computerization stage, using computers to improve their administrative processes due to poor digital connectivity and low cloud computing usage • Citizens are mainly dependent on eCommerce and mobile apps
Strategic priorities	• Connect communities and businesses to the digital economy by improving digital connectivity • Introduce incentives and initiatives to transform basic computerization to digitalization
Investment directions	• Invest in 4G and fixed broadband expansion • Improve bandwidth to 100Mbps • Develop digital connectivity for all businesses and homes

Accelerator	
DFE stage characteristics	• In this stage, ICT investments are predominantly focused on upgrading network and computing infrastructure • DX-related policies are in place • Businesses are obtaining economic value from digitalization
Strategic priorities	• Increase the quality of network service with high bandwidth networks • Accelerate DX through cloud computing platforms and various digital tools
Investment directions	• 4G and fiber to the home expansion • Improve bandwidth to 1Gbps • Develop cloud computing facilities • Accelerate digitalization of businesses and homes

Advanced

DFE stage characteristics	• In this stage, ICT investments are focused on next-generation networks, cloud expansion, and data infrastructure • Data and intelligent transformation focused • Economic value from new business models and data is being derived
Strategic priorities	• Review and upgrade next-generation networks that can support new autonomous devices, robotic automation, and data economy • Adopt new business models and data economy
Investment directions	• Invest in 5G and F5G networks • Expand throughput bandwidth to 160Mbps • Push and incentivize cloud-first approaches across industries • Drive and promote broader investment in analytics • Explore and adopt new data business models

Aspiration

DFE stage characteristics	• In this stage, economies are effectively achieving the Intelligent World 2030 outlook • New AI and data-generated economic value • Robotics and AI-driven transformation
Strategic priorities	• Set policies to harmonize intelligent systems with human aspirations • Continue to invest in digital technologies with AI-embedded across systems and applications, driving ongoing innovation • Gain sustainable progress by leveraging renewable energy sources which can power digital systems
Investment directions	• Increase ICT investment in next-generation network, robotics automation, and AI

VI. Appendix II

APEC Economies Profiles

Australia

Basic Facts

Population (million): 25.7	• CO^2 emission (metric tons per capita): 15.48
GDP ($ billion): 1,331	• GDP (PPP) per capita ($): 52,518

DFE Score and Stage

DFE score: 60

DFE stage: Advanced

Average score among APEC economies: 43

Australia, with a population of 25.7 million and a $52,518 GDP per capita, scored 60 among the 21 APEC economies. Australia is above the APEC average in four DFE outcomes, while its New Business Model DFE outcomes are the same as the APEC average. It outperformed the APEC average in all the DFE Dimensions, with Digital Connectivity being its best dimension. Australia outpaced the APEC average in most 20 DFE indicators, with ICT investment being the best performer. Underscoring Australia's commitment to its digital economy plan is the large AA$1.2 billion allocation in its 2021–22 Budget that targets expanding/strengthening its digital foundations, building capabilities in emerging technologies, and improving online services.[1] The 2022-2023 Budget committed a further AA$130.1 million to support the digital economy strategy over the next four years.[2]

Key Digital Economy Policy/Actions

1. National Masterplan

The main strategies influencing Australia's digital economy development are the Digital Economy Strategy (DES), the Australian Data Strategy, the Secure Cloud Strategy, the Hosting Strategy, and the Digital Government Strategy. DES provides a roadmap toward Australia's vision to be a leading digital economy and society by 2030.[3] Australia's Tech Future includes more than 150 existing programs and policies to support Australia's digital economy agenda. [4] Australia has enacted several initiatives and legislation to provide it with a more secure and trusted digital economy. This includes the Australian Cyber Security Strategy 2020, National Data Security Action Plan, The Privacy Act 1988 (Privacy Act), Security Legislation Amendment (Critical Infrastructure) Act, and the Data Availability and Transparency bill.[5] Going forward, AA$6.2 million has been earmarked in its 2022-23 Budget to develop a Digital Age Policy over the next two years.[6]

2. Policy actions for Citizens

Some of the top digital economy priorities for citizens include high-speed internet provision for all Australians and an efficient and secure online experience for various government and non-government services such as healthcare, tax, immigration, and banking. Australia's digital identity (myGov) initiative allows access to online government services more secure and convenient. Enhancing myGov and enabling its next wave of My Health Record (secure health information digital storage) are among the digital growth priorities budgeted for citizens under the 2021–22 Budget.[7] Diversity and inclusivity also influence Australia's digital strategies; initiatives such as its Indigenous Digital Inclusion Plan, Regional Telecommunications Review, Regional Connectivity program, and its Advancing Women in STEM strategy (e.g., committing AA$3.9 million to support women to pursue a technology sector career) contributes to building a more egalitarian digital economy.[8]

3. Policy actions for Businesses

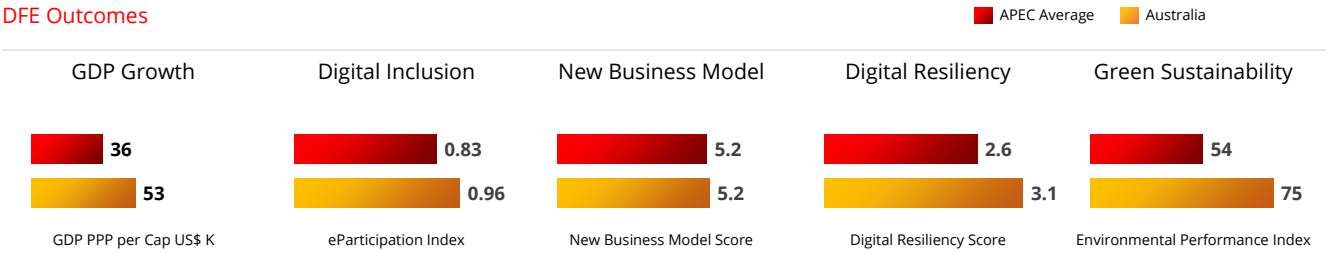
Australia's Digital Business Plan aims to help businesses adopt digital technologies to grow and create jobs as part of economic recovery. Priorities include upgrading digital infrastructure and skills, reforming regulatory barriers to digital economy advancement, building small business capabilities, and simplifying doing business with the government. Initiatives include the Australian 5G Innovation Initiative (funds for firms to assess and develop 5G use cases and products) and Regtech Commercialisation Initiative (to improve regulatory compliance while reducing regulatory administration and support innovative companies).[9] Initiatives to drive new technology adoption among businesses include providing funds (AA$44 million) to drive AI research commercialization in four industry-run AI and digital capability centers.[10]

4. Policy actions for Government (Public Service)

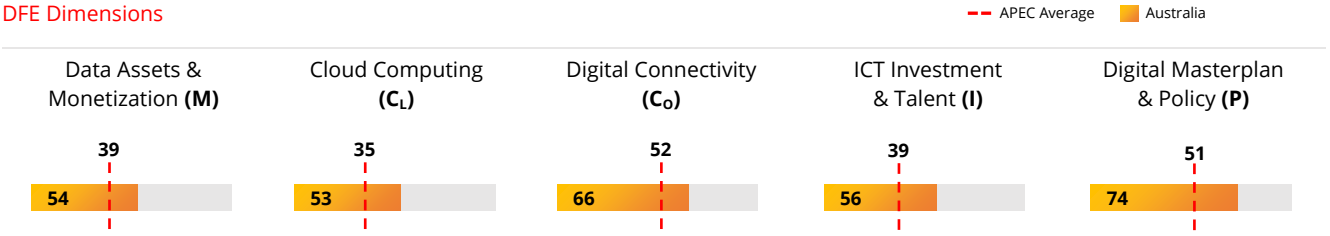
Australia's Digital Government Strategy aims to accelerate the government's digital transformation in line with Australia's target to be among the top three digital governments worldwide by 2025. Among the targets set are for all government services to be available digitally by 2025, accessible from a common and secure access point.[11] The Digital Transformation Agency (DTA) coordinates and oversees digital and ICT-related initiatives.[12] Its Digital Economy Strategy also aims to bring consistency by bringing together policies and programs across the government agencies to ensure a clear digital economy roadmap for this decade. Other digital government initiatives include a re-use policy and catalog of government architecture, a whole-of-government digital and IT oversight framework, and cyber hub trials.[13] Initiatives supporting this include the AA$30 million allocation in the 2022-2023 budget to continue network centralization through cyber hubs.[14]

DFE Indicators Dashboard

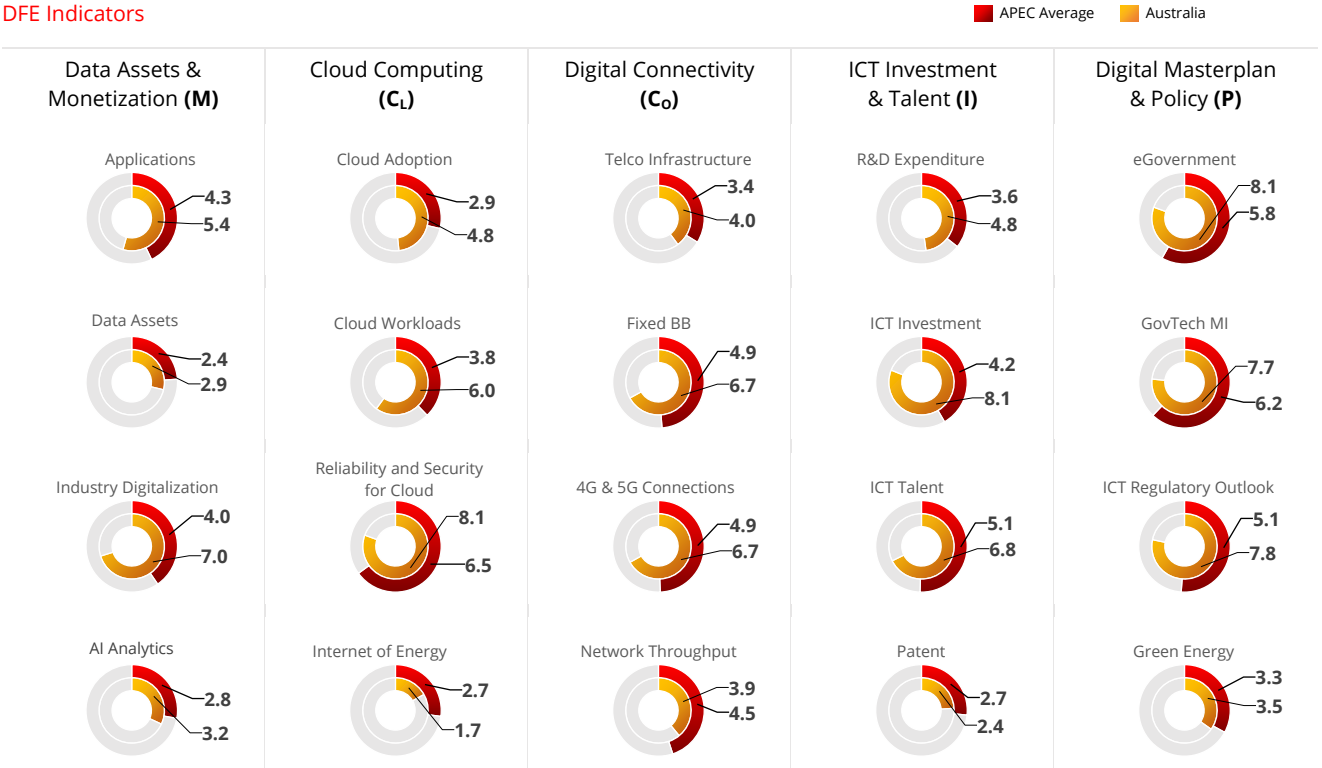
DFE Outcomes



DFE Dimensions



DFE Indicators



Brunei Darussalam

Basic Facts

Population (million): 0.437	• CO^2 emission (metric tons per capita): 16.64
GDP ($ billion): 12.0	• GDP (PPP) per capita ($): 65,662

DFE Score and Stage

DFE score: 33

DFE stage: Adopter

Average score among APEC economies: 43

With a population of under half a million (0.437 million), Brunei Darussalam has a GDP per capita of $65,662 and is in the Adopter stage, scoring 33. The sultanate's Digital Inclusion and Green Sustainability DFE Outcomes scores underperform the APEC average; however, Brunei Darussalam's GDP DFE Outcome outperforms the APEC average. Its DFE Dimensions underperform the APEC average except for Data Assets & Monetization, where the sultanate scored above the APEC average in three out of four indicators in Applications, Data Assets, and AI Analytics.

Key Digital Economy Policy/Actions

1. National Masterplan

Launched in June 2020, Brunei Darussalam's five-year Digital Economy Masterplan 2025 (the Masterplan) to transform the economy into a Smart Nation. The four strategic thrusts of the Masterplan are industry digitalization, government digitalization, a thriving digital industry, and manpower and talent development. Brunei Darussalam's Digital Economy Council (DEC) aims to steer the sultanate's digital economy initiatives[15]. Other complementing strategic policies or plans that will influence the direction of Brunei Darussalam's digital economy are the Brunei Vision 2035 initiative, the Strategic Plan for the Ministry of Transport and Infocommunications (MTIC 2025), the Digital Payment Roadmap, and the Authority for Info-communications Technology Industry (AITI) Strategic Plan 2020-2025. While Brunei Darussalam's regulatory landscape for the digital economy is at a relatively nascent stage, providing a trusted and secure digital economy is another focus area under the Masterplan; the economy is developing a law to address personal data[16] and a Digital Data Policy and Governance Framework.[17] Cyber Security Brunei (CSB) serves as Brunei Darussalam's national cyber security agency while the economy is also in the process of drafting its Cyber Security Order.[18]

2. Policy actions for Citizens

Brunei Darussalam's priority in providing all its citizens with broadband access as a basic utility to improve the quality of life is part of the Masterplan's key success measures.[19] The sultanate has focused on rolling out and improving its fixed-line and broadband infrastructure across the economy and, more so recently, via the Unified National Network (UNN), an organization 100% wholly owned by His Majesty's Government of Brunei Darussalam and recognized as a Government-Linked company under Darussalam Assets Sdn Bhd.[20] Brunei Darussalam also targets to make available all 5G spectrum bands (sub-6GHz & Millimeter Wave) for commercial use by 2022 as part of its strategy to build its digital economy infrastructure.[21] The COVID-19 pandemic has also driven the imperative to digitize public services, including adding more features to its TransportBN application, such as online payment for late penalty charges and the ability to renew expired licenses.[22]

3. Policy actions for Businesses

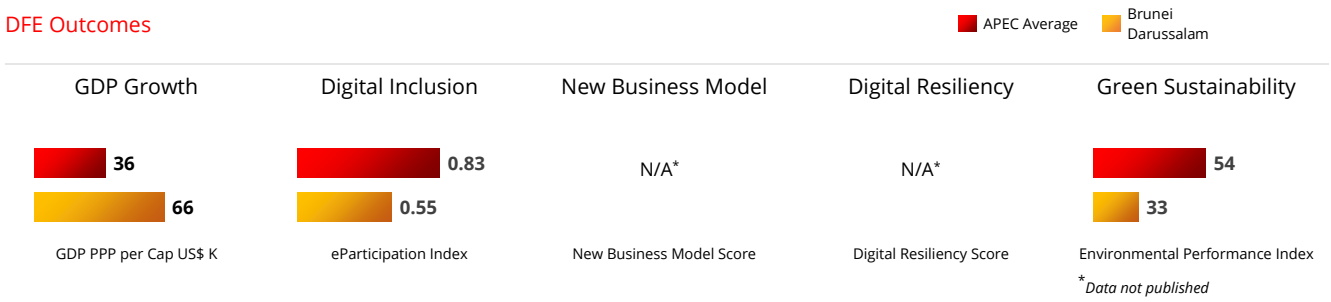
The DEC will drive the implementation of key projects under nine priority clusters: logistics and transportation, energy, business services, tourism, financial services, health, agri-food, education, and the Halal industry. This includes the financial services cluster's One Common Billing System, which generates bills, monitors outstanding bills, and enables e-payment.[23] In line with Brunei Darussalam's Digital Payment Roadmap, a digital mobile wallet initiative (DSTPay) was launched in collaboration with one of Brunei Darussalam's conventional banks, telco Datastream Digital (DST), an international payment brand UnionPay in 2021.[24] Initiatives to assist local businesses and local micro, small and medium (MSMEs) in their digitization journey include the launch of a local online e-commerce directory (www.eKadaiBrunei.bn) by AITI and DARe (Darussalam Enterprise). This e-commerce site connects to another government-initiated e-commerce website (www.1k1p.gov.bn) that features locally made items by districts and villages in Brunei Darussalam.[25] Other initiatives to assist businesses in their digital transformation journey include co-matching grants for starting/expanding into the e-Commerce and logistics sectors. [26] The government also focuses on current and future workforce's digital skills development, including those from the MSMEs sector.[27] Capacity-building programs include Teens In AI, Industry Business Academy Online, Go Digital ASEAN, Digital Business Transformation & eCommerce Adoption.[28]

4. Policy actions for Government (Public Service)

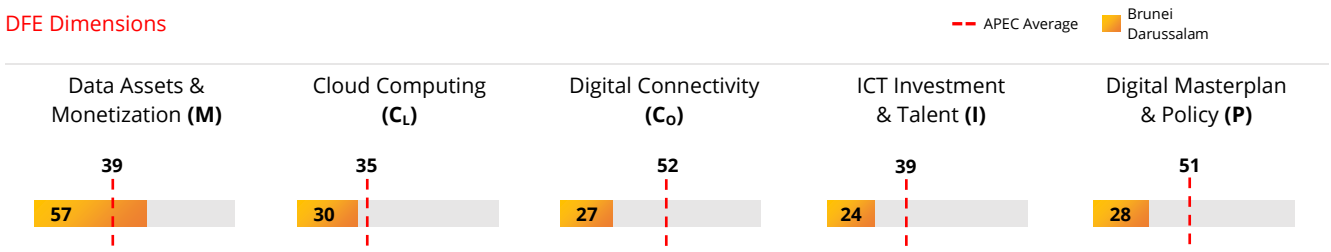
The Digital Government Strategy 2015-2020 focuses on advancing digital services, implementing universal access for government systems, strengthening security, optimizing digital assets, enhancing stakeholder engagement, and developing enterprise information management capability. Flagship projects to be/being implemented under the Masterplan's umbrella include the National Information Hub (information sharing platform), Digital ID platform (public access to government services), and Digital Payment Hub (payment through smart devices).[29] The government has also digitized more services for businesses and citizens via the unified eDarussalam digital services portal.[30]

DFE Indicators Dashboard

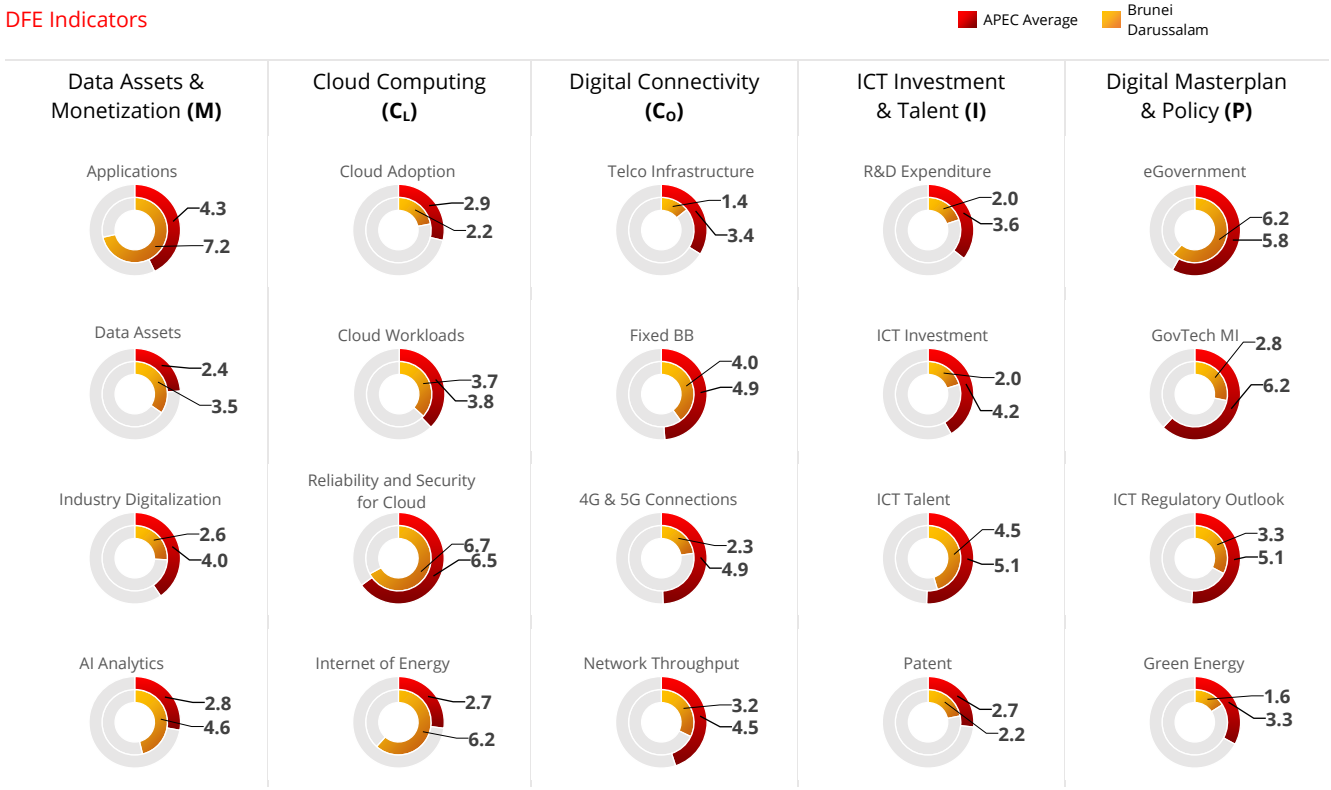
DFE Outcomes



DFE Dimensions



DFE Indicators



Canada

Basic Facts

Population (million): 38	• CO^2 emission (metric tons per capita): 15.5
GDP ($ billion): 1,643	• GDP (PPP) per capita ($): 48,073

DFE Score and Stage

DFE score: 58

DFE stage: Advanced

Average score among APEC economies: 43

Canada has a population of 38 million with a GDP per capita of $48,073. With a score of 58, Canada's DFE is in the Advanced stage. Its DFE Outcomes, DFE Dimensions, and DFE Indicators are generally above the APEC average. Canada outpaced the APEC average in most of the 20 DFE indicators, with ICT Talent and Fixed BB as best performing.

Key Digital Economy Policy/Actions

1. National Masterplan

Key policies and initiatives shaping Canada's digital economy are the Innovation and Skills Plan, Digital Operations Strategic Plan (DOSP) for 2021–2024, Canada's Digital Charter in Action, and the Digital Government Strategy. Legislations such as the Personal Information Protection and Electronic Documents Act (PIPEDA) and the Access to Information Act are in place and, in some cases, have been amended or studied to safeguard privacy better and provide a more secure digital economy.[31]

2. Policy actions for Citizens

One of the key priorities in its policy actions for citizens is on the digital divide; to close the digital connectivity gap between urban areas and rural and/or remote areas. Initiatives launched to drive this includes the CA$2.75 billion Universal Broadband Fund (funding high-speed Internet projects in rural and remote communities), the First Nation Infrastructure Fund (funding long-standing infrastructure gaps on reserves which includes connectivity), and the Low Earth Orbit (LEO) Satellite Capacity Agreement with Telesat (provides LEO satellite capacity at a reduced cost to connect Canada's most challenging areas to high-speed internet).[32] One of the more significant focus areas is plans for a new 'OneGC' integrated platform, part of its digital identity strategy that emphasizes open standards for public and private sector interoperability.[33]

3. Policy actions for Businesses

The government partners with the private sector to nurture and develop more competitive companies through boosting innovation – and including innovation in the digital economy. It has established five Global Innovation Clusters/Superclusters (Digital Technologies, Protein Industries, Advanced Manufacturing, Scale AI, and Ocean Industries). It has committed roughly CA$1 billion in federal government funding in a dollar for dollar spending matching by industry.[34] Besides providing funds, the Digital Technologies Cluster assists SMEs with international networking, developing intellectual properties (IP) (at least 75 IP assets created thus far), and providing skills and training under its Capacity Building program umbrella.[35] One of Scale AI's priorities is to help bridge the gap between AI development and industry adoption. Programs under Scale AI include commercialization of AI-powered supply chain solutions and adoption of AI-powered supply chain.[36]

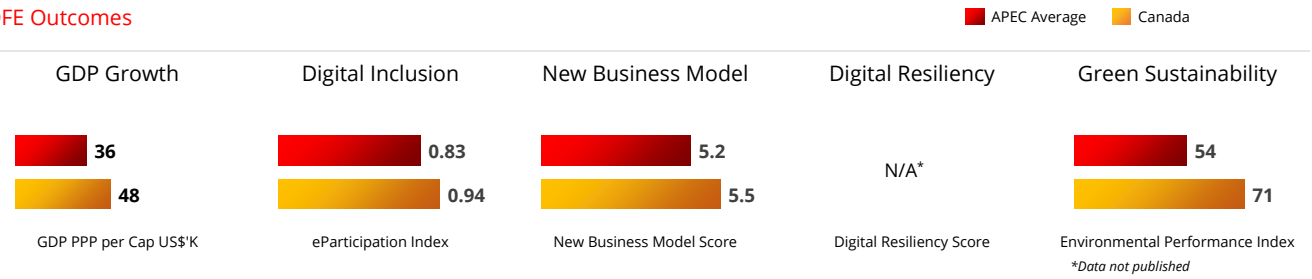
4. Policy actions for Government (Public Service)

Canada's Digital Government Strategy was launched in 2021 as part of its digital government transition agenda. Supporting this is the DOSP, which aims to modernize public service delivery, improve sustainability, and promote digital stewardship. Canada's focus on green sustainability is reflected in its Greening Government Strategy, which seeks to reduce government operations' carbon footprint through green procurement and clean technologies. The first Minister of Digital Government is mandated to lead the Digital Government team to align efforts across the government and build a consistent digital

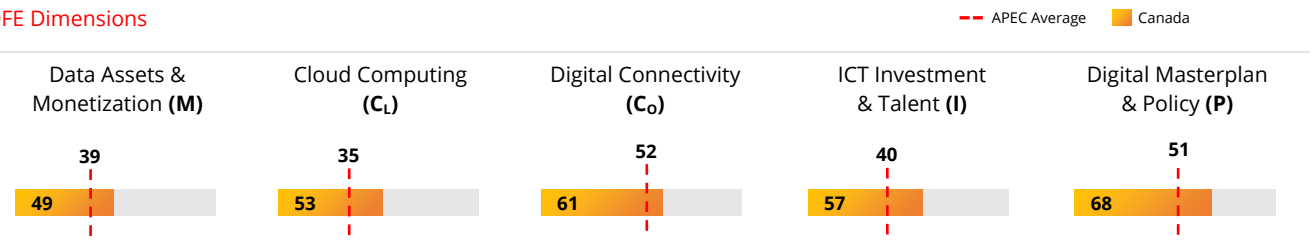
experience. This team includes the Office of the Chief Information Officer, Digital Transformation Office, Canadian Digital Service, and Shared Services Canada.[37] One of the DOSP's main priorities is to modernize legacy IT systems through assessing the government's application portfolio 'health' and migrating to the cloud or Shared Services Canada's (SSC) enterprise data center. Under the Cloud-First approach, SSC is closing legacy data centers, and government departments must use the public cloud to store, manage and process data and applications where feasible. Other priorities and strategies include improving online public services provision, managing, and using data as strategic assets, building, and using secure common solutions for digital service delivery, and cultivating a digital workforce.[38]

DFE Indicators Dashboard

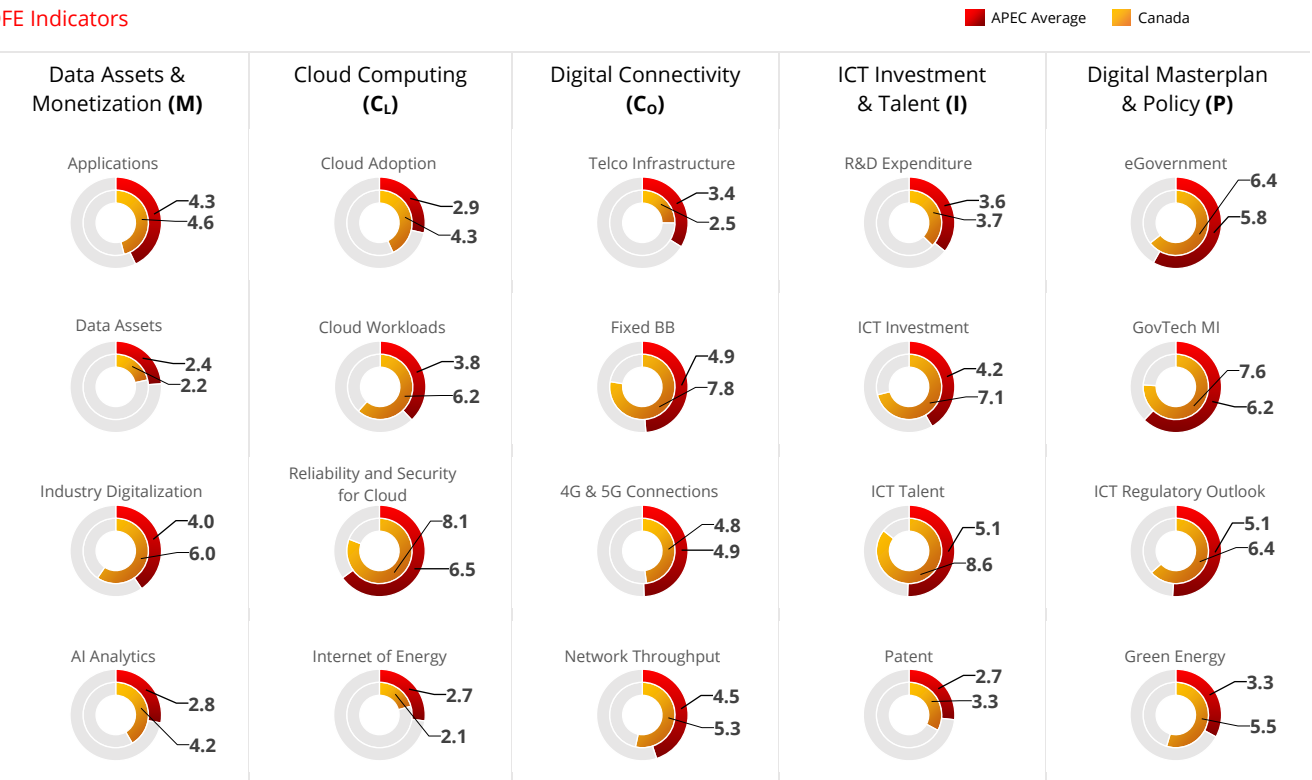
DFE Outcomes



DFE Dimensions



DFE Indicators



Chile

Basic Facts

Population (million): 19.12	• CO^2 emission (metric tons per capita): 4.62
GDP ($ billion): 252.9	• GDP (PPP) per capita ($): 25,068

DFE Score and Stage

DFE score: 38

Chile DFE stage: Accelerator

Average score among APEC economies: 43

Chile has a population of 19.12 million and a GDP per capita of $25,068. Its DFE score of 38 places it at the Accelerator stage. Chile underperformed or scored the same as the APEC average for the DFE Outcomes and DFE Dimensions. Chile outperformed the APEC average's DFE Outcomes in the New Business Model. It also did better than the APEC average in Digital Masterplan & policy, helped significantly by a robust ICT Regulatory Outlook score. However, it underperforms the APEC considerably in Cloud Computing, driven primarily by low scores in Reliability and Security for Cloud and businesses' cloud workloads.

Key Digital Economy Policy/Actions

1. National Masterplan

Chile's key focus areas are to build its digital foundations, expand quality broadband to rural and remote areas to help narrow the digital divide, and lay the foundations for new technology deployment such as AI and IoT.[39] Chile's public policy for 5G development is based on principles that include network neutrality, technological neutrality, free foreign investment, open access, free and fast licensing regime, and national cybersecurity policy alignment.[40] Chile's National Artificial Intelligence Policy is focused on building AI foundations across three axes: enabling factors, development and adoption, and ethics, social and economic considerations. The AI Action Plan includes prioritizing building the current and future workforces' AI and relevant digital skillsets, reviewing the legislative and regulatory framework to support ethical and responsive use of data and AI technologies, and investing in the enabling technological infrastructure such as 5G deployment.[41] While it does not have a cybersecurity law (as of the date of writing), Chile is, nevertheless, seeking to better secure and build trust in its digital economy through initiatives such as the 2022 Cybersecurity plan and the Chilean Data Protection Law.[42] Other laws that facilitate the digital economy's development include the Teleworking law and Digital Transformation bill.[43] Chile is going through significant political changes due to a new president sworn-in in March 2022, which may result in new policies and plans being amended in the near future. In fact, as of the date of writing, Chile's constitution is being redrawn.[44]

2. Policy actions for Citizens

A key focus area for Chile is improving digital skills. Programs launched include delivering laptops and one-year mobile broadband subscriptions to students, providing basic digital literacy training, and developing software development talent. These include "I connect to learn" (Me Conecto Para Aprender), "I choose my PC" (Yo elijo mi PC) and "Programme your ideas" (Programa tus Ideas). Gender diversity is another focus area with initiatives such as "*Ingeniosas: ciencia y tecnología para todas*" to promote STEM as a vocation for girls. While Chile has made significant progress in some aspects of digital connectivity, fixed broadband penetration rates, and high-speed connection speeds are still low.[45] The country invested in telecommunication infrastructure deployment to support a more inclusive digital transformation through initiatives such as the Telecommunications Development Fund. The Fund includes subsidies to promote telecommunications services coverage in rural and urban areas with low-income households and a telecommunications connectivity project tender which benefits rural areas by boosting connectivity and increasing the range of Internet and mobile phone services.[46] The government's digital agenda objectives include minimum Internet speed and quality guarantees, mobile phone users tariffs reduction, Internet connectivity provision for all public educational establishments, and extension coverage to remote areas.[47]

3. Policy actions for Businesses

Chile has numerous policies to promote R&D and innovation, including generous R&D tax credit that can be carried forward indefinitely. Chile also targets growing its startup scene, including Fintech firms, online platforms, and those in health, data-intensive services, through initiatives like Start-Up Chile and Chile's Visa Tech Program. The latter has seen some traction with software companies (e.g., Evernote and Everis) opening locations locally and using this visa program to repatriate Chileans working in tech companies in the Bay Area. Chile's fintech scene is growing and providing various financial services (e.g., payments, loans, and crowdfunding) for SMEs. Specific focus is given to helping SMEs digitize their business, such as "Digitaliza tu Pyme" (Digitalise your SME), with an end goal to digitalize 250,000 SMEs by 2022. The government also

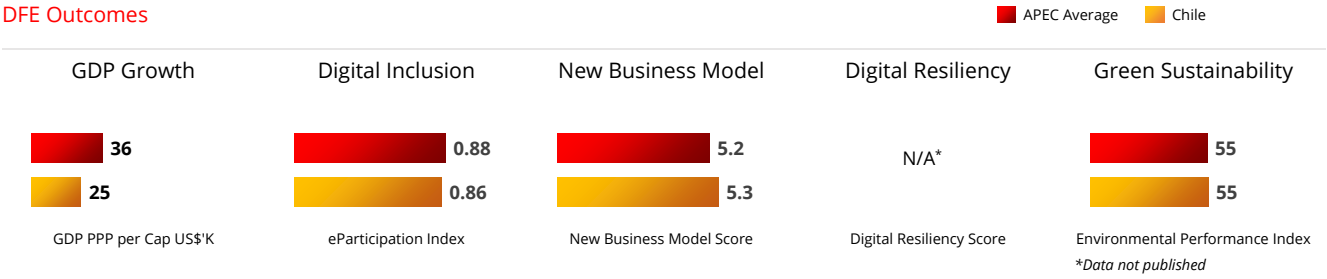
collaborates with the private sector to drive the digital and social agenda; such efforts include "*Talento Digital para Chile*" which targets the unemployed, vulnerable, and female workers through coordination with relevant public agencies and the private sector.[48]

4. Policy actions for Government (Public Service)

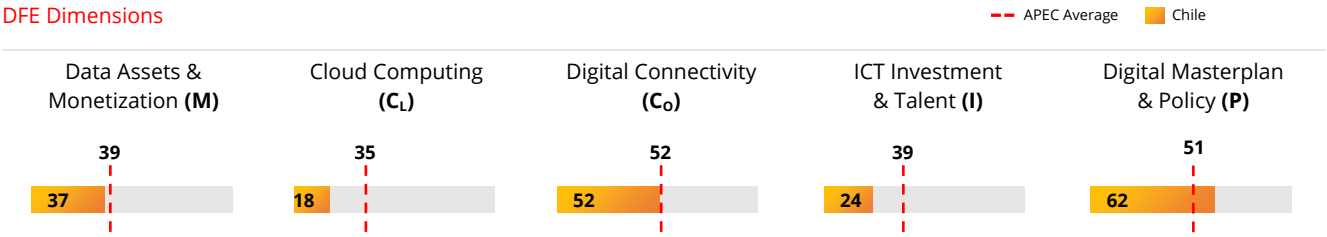
Chile's Ministry of Science, Technology, and Innovation is responsible for formulating, advocating, and implementing science, technology, and innovation policies, promoting collaboration, and coordinating the public sector's R&D initiatives. It also fosters public-private sector cooperation. Chile has started to enhance public sector data access through, for example, its centralized open data repository (datos.gob.cl) and for COVID-19 (github.com/MinCiencia/Datos-COVID19/). Chile's government digitalization endeavor is considered ahead of its regional peers. One of the goals of its Digital Transformation of the State Law (Ley de Transformación Digital) (MINSEGPRES, 2019) is to digitalize government/citizens interactions. A focus is improving interoperability between the various public sector agencies to facilitate data sharing and provide integrated service delivery.[49]

DFE Indicators Dashboard

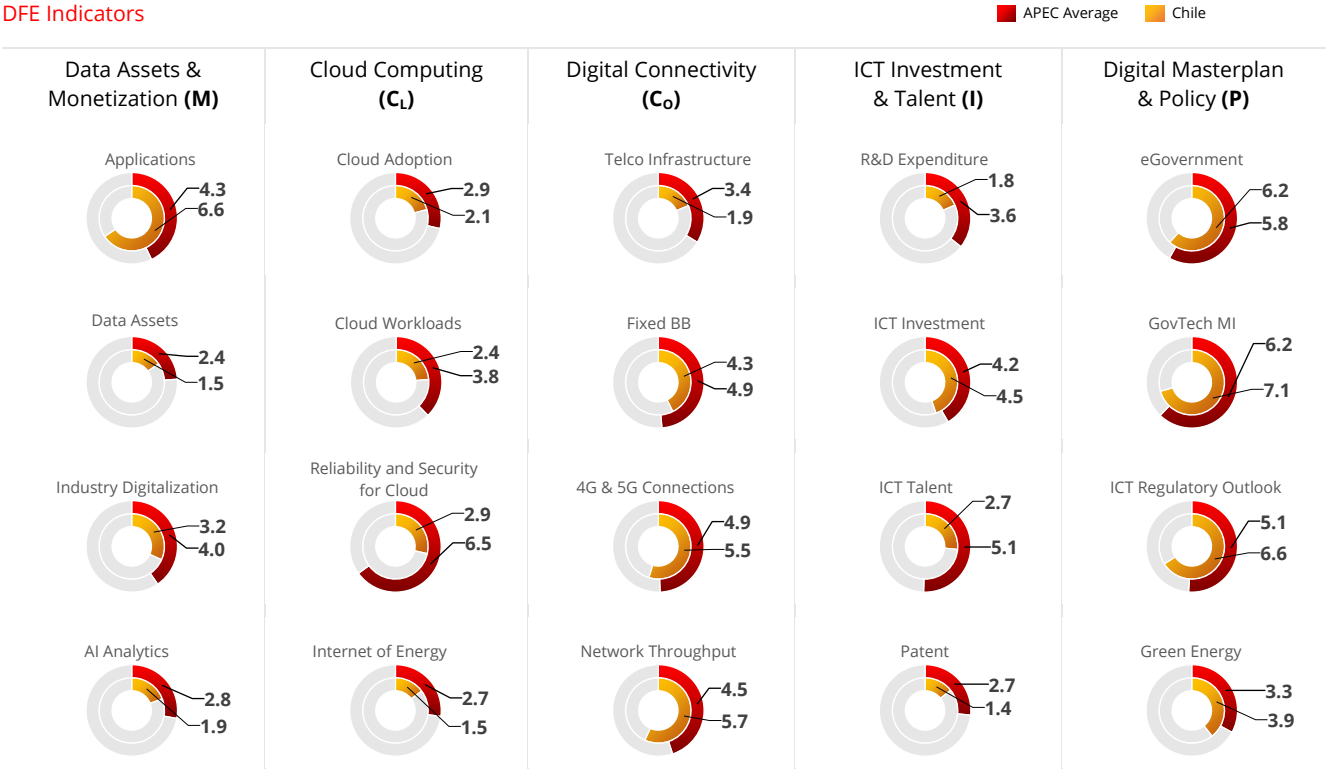
DFE Outcomes



DFE Dimensions



DFE Indicators



China

Basic Facts

Population (million): 1,402	• CO^2 emission (metric tons per capita): 7.35
GDP ($ billion): 14,723	• GDP (PPP) per capita ($): 17,312

DFE Score and Stage

DFE score: 47

DFE stage: Accelerator

Average score among APEC economies: 43

China has a GDP per capita of $17,312 and a population of 1,402 million. China secured a DFE score of 47 and is at the Accelerator stage. China outperforms the APEC average in the DFE Outcomes' Digital Inclusion and Digital Resiliency but underperforms in GDP Growth, New Business Model, and Green Sustainability. While China is below the APEC average in Digital Masterplan & Policy and ICT Investment & Talent, it outperformed the APEC average in Cloud Computing and Data Assets and Monetization. China also surpassed the APEC average in Digital Connectivity, consistent with its policies that prioritized expanding connectivity nationwide, for example, China's large-scale communications construction over the years.[50]

Key Digital Economy Policy/Actions

1. National Masterplan

Released in December 2021, China's 14th Five-Year Plan for National Informatization plan provides the strategic blueprint for its digital economy, including priority policy areas. It gives the main 2025 targets for "Informatization Development".[51] These include upgrading the economy's digital infrastructure system (e.g., expanding 5G and satellite telecommunications networks), rolling out nationwide integrated Big Data center building projects, improving data governance and maximizing data usage as a new "production factor", driving research and adoption of new technologies (big data and artificial intelligence) and encouraging the digitizing of key industries (e.g. through smart agriculture to support China's food security goal by driving digitalization and intelligence (analytics/AI) in the agricultural production chain).[52] Another significant focus area is a sovereign digital currency, e-CNY; trialed in several major Chinese cities, China's central bank is seeking support to go cashless and is expanding e-CNY's rollout to more cities.[53] Other policies and plans impacting China's digital economy in the coming years have been launched, including China's Fintech Development Plan for 2022-2025.[54] China's Personal Information Protection Law (PIPL), Cybersecurity Law (CSL), and Data Security Law (DSL) are China's key legislation to provide a more regulated and secure digital economy and improve national data security.[55] In recent years, China has cracked down on -profile technology companies and issued/amended laws such as its Anti-Monopoly Law and the Internet Information Service Algorithm Recommendation Management Regulations.[56] China also signalled that it would continue revising its legal and regulatory system better to regulate digital economy participants such as platform companies.[57]

2. Policy actions for Citizens

Underlying several China's digital economy initiatives is the government's goal to provide common prosperity in the digital economy. Examples include providing fiber-optic or 4G connectivity to 98% of villages in China, 100% internet access for primary and secondary schools, and a focus on delivering digital skills education and training for citizens, including those at an information disadvantage.[58] Policies supporting the growth of eCommerce in rural areas have also resulted in Taobao Villages, rural villages that are heavily engaged in e-commerce.[59] China's e-social security card, which provides personal information records and access to social services (e.g., self-service inquiries, medical insurance settlements and payments, and financial payments), has also been issued to 360 million people.[60]

3. Policy actions for Businesses

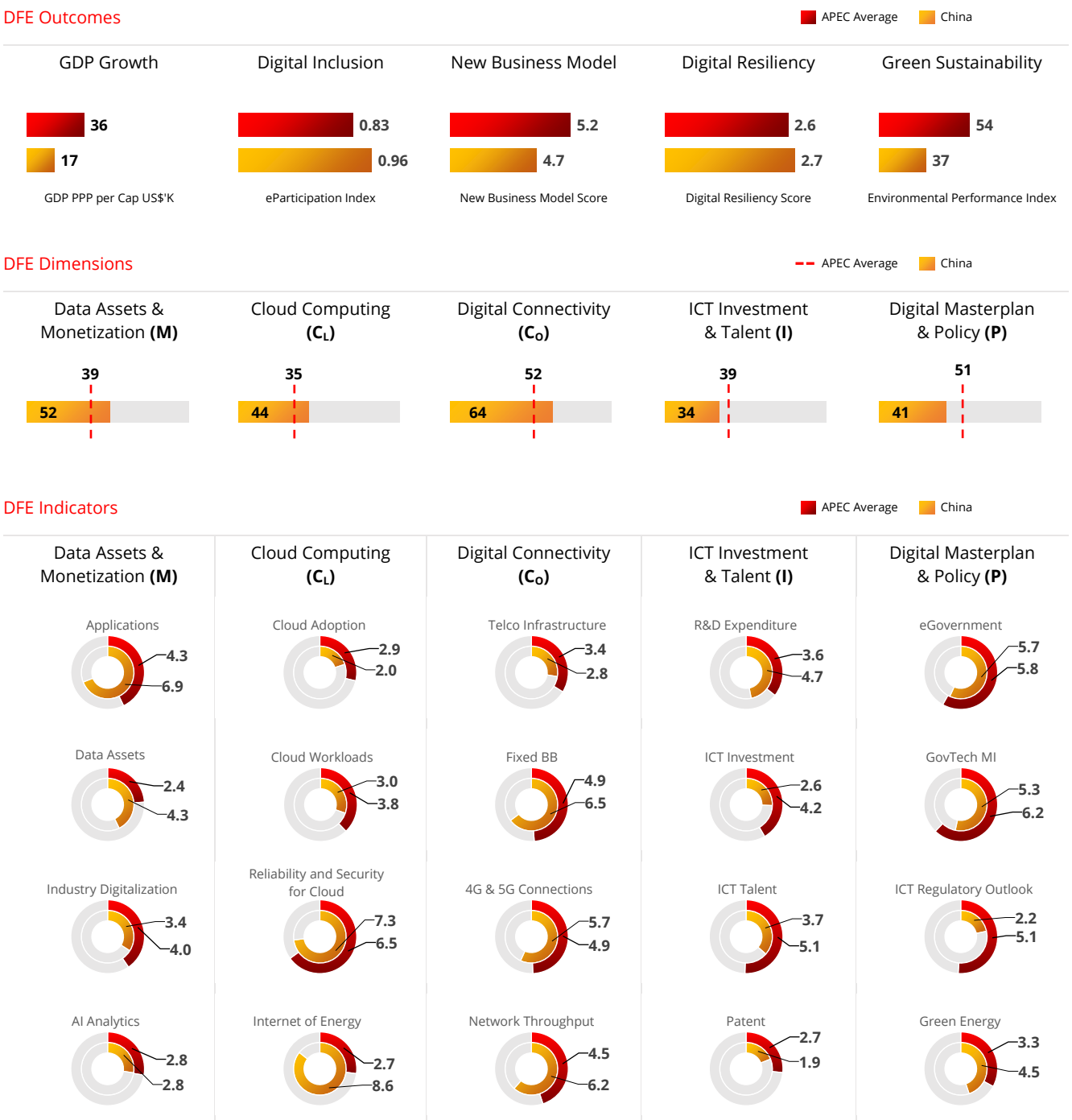
China tends to have close public-private relationships, where state-owned companies and private businesses would generally cooperate and comply with the relevant policy directions set by the government.[61] One initiative that reflects this is China's east-data-west-computing project, where data generated from the more developed eastern region is sent to the west for data storage backup, analysis, etc. Chinese telecommunication operators are building more highly efficient data centers with a low carbon footprint in the Western China region, in line with some of the priorities in China's 14th Five-Year Plan for National Informatization plan.[62] China's provincial and municipal governments are also launching initiatives that support the digital economy priorities in China's 14th Five-Year Plan for National Informatization plan. Examples include Beijing's industry clusters for new technologies like blockchain and AI and Chongqing's plan for developing 100 smart

factories. Meanwhile, Tianjin's pro-innovation policies resulted in 130 national-level Small and Medium Enterprises (SMEs) deemed specialized and innovative.[63]

4. Policy actions for Government (Public Service)

The Cyberspace Administration of China (CAC) is responsible for implementing the 14th Five-Year Plan for National Informatization.[64] Priority is also given to developing eGovernment to provide more equitable public services and optimize transaction costs. Plans to digitize government services nationwide were approved in late 2021.[65] China has expanded and deepened eGovernment services provision and has launched a national government service platform; it is in the process of integrating its government websites across the economy.[66] The government expects to double the number of residents registered for online government services from 400 to 800 million between 2020-2025.[67]

DFE Indicators Dashboard



Hong Kong, China

Basic Facts

Population (million): 7.48	• CO^2 emission (metric tons per capita): 5.34
GDP ($ billion): 346.6	• GDP (PPP) per capita ($): 59,238

DFE Score and Stage

DFE score: 58

DFE stage: Advanced

Average score among APEC economies: 43

A densely populated Hong Kong, China has a GDP per capita of $59,238 on the back of a population of just under 7.5 million. With a DFE score of 58, Hong Kong, China is at the Advanced stage. Hong Kong, China's GDP Growth score is above the APEC average, while its DFE Dimensions scores outperform most APEC Average except in Cloud Computing. Hong Kong, China outperforms the APEC average by the most in Data Assets & Monetization, where it scored particularly well in Applications and AI Analytics.

Key Digital Economy Policy/Actions

1. National Masterplan

Hong Kong, China has focused on building and establishing its ICT and digital economy sector in the last two decades, beginning with its Digital 21 Strategy in 1998.[83] Its digital economy blueprint (Smart City Blueprint for Hong Kong) was launched in 2017, followed by 2020's Smart City Blueprint for Hong Kong 2.0 (Blueprint 2.0), which contained over 130 smart city initiatives.[84] Hong Kong, China, has gone through a few recent years of political turbulence. Its new Chief Executive-elect (as of 8 May 2022) has signaled that Hong Kong, China's digital economy development, would be consistent with the direction set forth for Hong Kong, China, in China's 14th Five-Year Plan. This includes developing Hong Kong, China, as a global innovation and technology (I&T) hub to facilitate economic transformation. [85] Hong Kong, China, has comprehensive personal data privacy legislation (The Personal Data (Privacy) Ordinance), while cybersecurity is mainly addressed through sectoral regulators and other legislations.[86]

2. Policy actions for Citizens

The government's telecommunications policies are generally pro-competition and pro-consumer, with a target to place Hong Kong, China, as the best communications hub in the region while offering users a wide range of quality services.[87] 5G commercial launch started in 2020. The government is supporting 5G deployment through technical trials and launching a subsidy scheme (where 50% of the 5G deployment cost is subsidized with a HK$00.5 million cap) to foster innovative 5G product development.[88] One recent Smart City initiative launched to provide citizens with more convenient, digitized government services is the one-stop personalized digital services platform (iAM Smart) in 2020. Citizens can use a single digital identity and authentication to conduct over 190 commonly used government and commercial transactions online. The iAMSmart+ version incorporates a digital signing function to process legal documents and procedures online.[89] GovHK (www.gov.hk), the government's one-stop information and e-services portal, also utilizes AI technology for its Chatbot (Bonny) to provide more efficient interactive support for users.[90]

3. Policy actions for Businesses

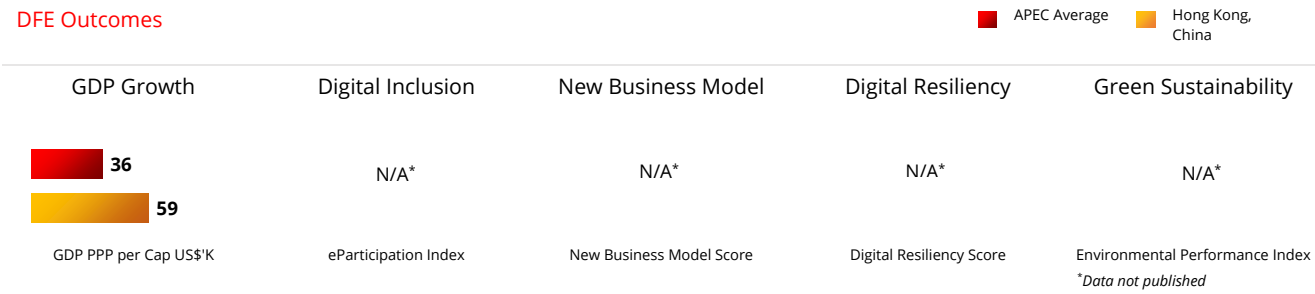
Priority is given to I&T infrastructure initiatives that align with China's National 14th Five-Year Plan. This includes the AIR@InnoHK research cluster focusing on AI and robotics technologies development, big data, and AI R&D in the Hong Kong-Shenzhen I&T Park, and the Hong Kong Science Park project Phase 2 expansion, which will focus on new technology research activities such as AI.[91] Investing in Hong Kong, China's Fintech infrastructure is another focus area, as reflected in the Faster Payment System and eTradeConnect's Fintech infrastructure project implementations.[92] The government has many programs and initiatives designed to support businesses in their digital transformation journey and adopt 4IR-related technologies. This includes the Reindustrialisation and Technology Training Programme (RTTP), which provides funds on a 2 (Government):): 1 (Enterprise) matching basis for local businesses to upskill staff in advanced technologies, especially 4IR ones.[93] Initiatives to support digital entrepreneurs, from funding to incubation, include establishing Hong Kong Science and Technology Parks Corporation and Cyberport.[94] Focus is also given to helping local businesses get on the digital economy bandwagon through initiatives such as the Technology Voucher Programme (TVP), which aims to support local businesses to digitize their business operations through a 3 (Government):): 1 (enterprise/organization) fund matching basis.[95] The government has adopted a multi-pronged approach to expand the I&T talent pool with initiatives such as the IT Innovation Lab in secondary schools, schemes targeted at university students, and the FinTech Anti-epidemic Scheme for Talent Development to enrich Hong Kong, China's Fintech talent pool.[96]

4. Policy actions for Government (Public Service)

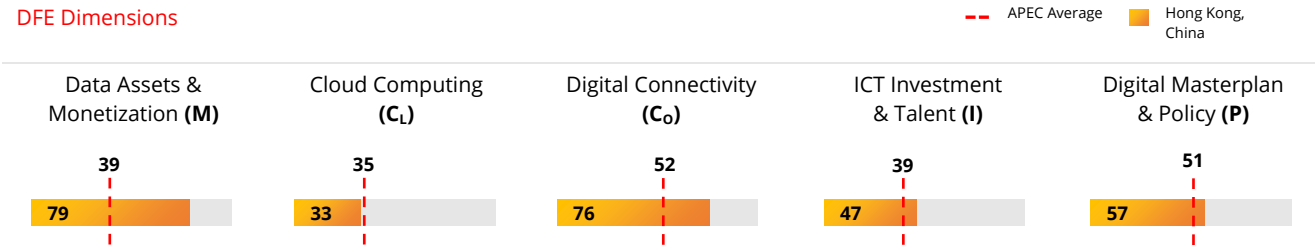
The Office of the Government Chief Information Officer (OGCIO) is responsible for Hong Kong, China's digital economy development through IT strategy development and IT services and support provision within the government.[97] The OGCIO's IT strategy initiatives include government-wide electronic information management, cloud-enabled electronic procurement, Government Human Resources Management Services (GovHRMS) implementation, building a government data center complex, and establishing and maintaining the Government Electronic Communications Infrastructure.[98] Other initiatives launched include the Next Generation Government Cloud Platform and Big Data Analytics Platform, facilitating data sharing between the government's Bureaux and departments (B/Ds) and support AI project implementations. Also Alsoendorsed were over 340 digital government services and over 15 big data analytics project implementations.[99] The government focuses on utilizing other new technologies, e.g., completing four pilot blockchain projects in different digital government services.[100] The government's focus on open data to drive more technological research and innovation is reflected in its public sector information portal (data.gov.hk), which contains over 4,900 data sets and records over 21 billion downloads in 2021.[101]

DFE Indicators Dashboard

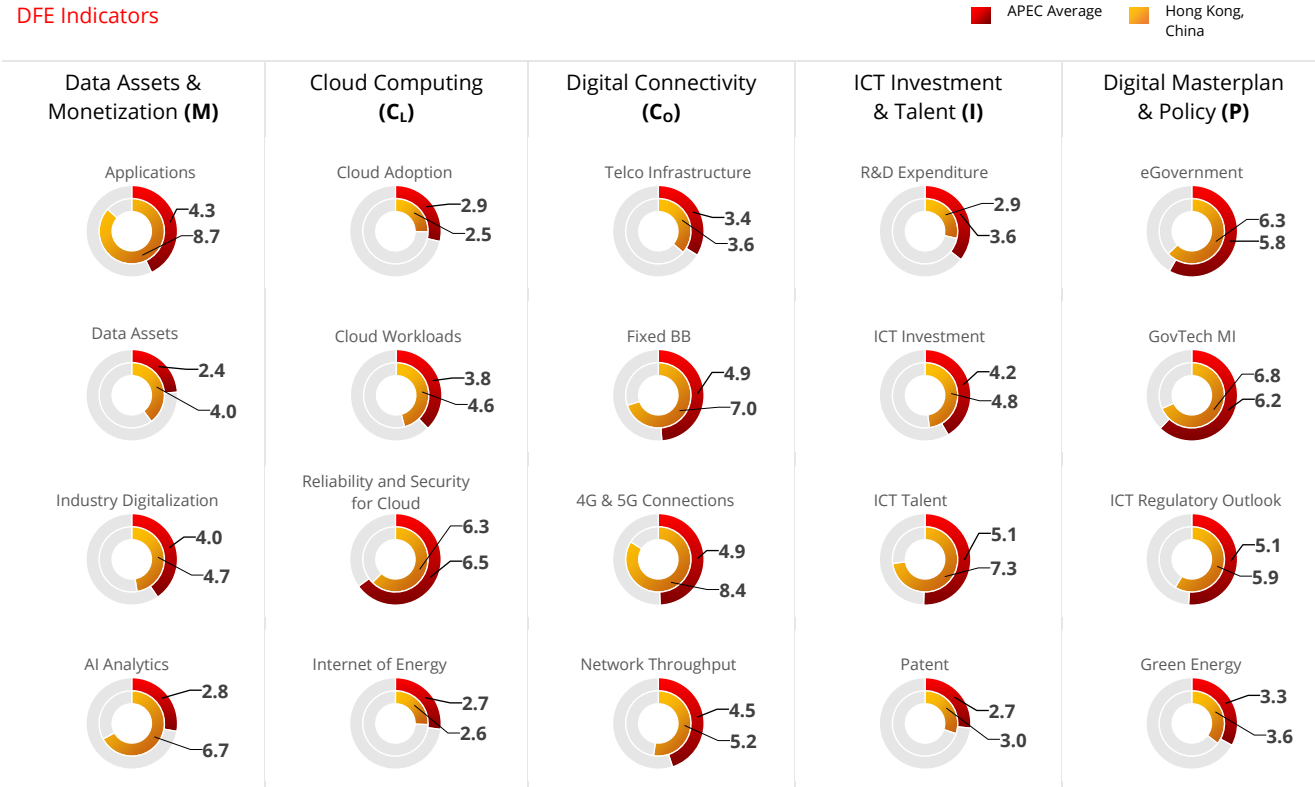
DFE Outcomes



DFE Dimensions



DFE Indicators



Indonesia

Basic Facts

Population (million): 274	• CO^2 emission (metric tons per capita): 2.18
GDP ($ billion): 1,058	• GDP (PPP) per capita ($): 12,073

DFE Score and Stage

DFE score: 23

DFE stage: Adopter

Average score among APEC economies: 43

Indonesia is the world's fourth most populous economy (274 million), with a GDP per capita of US$12,073. It has a score of 23 and is at the Adopter stage. Indonesia is below the APEC average in the five DFE Outcomes and five DFE Dimensions. Providing decent and consistent connectivity throughout Indonesia is a significant and expensive challenge for this developing economy, which is the world's largest archipelago with more than 17,500 islands. While most of its DFE indicators are below APEC average, Indonesia outperformed in Telco Infrastructure, consistent with its drive to reduce the spatial and socioeconomic digital gaps and build its digital economy foundation by expanding its connectivity infrastructure across the economy.

Key Digital Economy Policy/Actions

1. National Masterplan

Indonesia has launched initiatives over the years to drive the digital economy. Indonesia's national medium-term plan (RPJMN 2020-2024) has earmarked ICT infrastructure development as a project to support digital transformation.[102] Indonesia is currently prioritizing digital transformation and has launched its Digital Indonesia Roadmap for 2021-2024. The four strategic areas identified are digital infrastructure, eGovernance, digital economy, and digital society. The government has announced 100 top initiatives for 2021-2024 covering ICT infrastructure, eGovernment, digital regulatory framework, and encouraging new technology adoption in industries including health, education, digital media, and broadcasting eCommerce, fintech, logistics, and tourism.[103] Other initiatives are impacting Indonesia's digital economy include the National e-Commerce Roadmap and 2020 Go Digital.[104] Indonesia's digital economy policies largely prioritize building the foundational layers of a digital economy, including improving connectivity across the economy. After rolling out the fiber optic backbone in late 2019, the country is now, among other things, focused on middle and last mile connectivity, particularly in rural areas. This is on top of its emerging 5G plans, data policy, digitizing government services, and addressing the regulatory framework for the digital economy. As of the date of writing, Indonesia has yet to pass its long-awaited Personal Data Protection Bill, which would boost trust in online transactions and positively impact cross-border data flows.[105]

2. Policy actions for Citizens

Indonesia has seen some success in its digital economy, but nearly half of its adult population is estimated to be without internet access.[106] Indonesia is prioritizing resolving this, by making the "development of inclusive, safe, and reliable digital and connectivity infrastructure with high-quality services" the first strategic direction within its 2021–2024 Digital Indonesia Road Map.[107] Besides rolling out 'hard infrastructures', Indonesia has enacted the "Omnibus Law" that, among other things, enables better spectrum optimization, which would reduce the capital costs required to provide Indonesia's remote areas with affordable connectivity.[108] Indonesia is also investing in growing its digital talent base at three levels (basic, intermediate, and advanced) through its Ministry of Communication and Informatics. The ministry states that it will conduct digital literacy training for 12.5 million Indonesians in 2021. There is also a focus on growing digital talent in the more remote parts of Indonesia, for example, in East Nusa Tenggara.[109]

3. Policy actions for Businesses

Indonesia's digital economy's success has largely been driven by the private sector, which has produced three 'unicorns'—Tokopedia, Traveloka, and Bukalapak—and one decacorn worth more than US$10 billion, Gojek.[110] Indonesia is keen to attract foreign direct investments to Indonesia to boost its digital economy further and has launched initiatives to make Indonesia a more favorable FDI destination. This includes amending and relaxing a regulation requiring private cloud providers to build data centers in Indonesia.[111] Tax holiday incentives are also available for large investments in 18 pioneer industries. Data hosting was added to the list recently.[112] Indonesia is focusing more on IR4 in its national agenda, particularly to revitalize its manufacturing sector.[113] Its Making Indonesia 4.0 initiative includes incentives for the economy's small and mid-size enterprises to adopt new digital technologies.[114] In reality, Indonesia's policies, particularly how it is enforced, have historically favoured large businesses and the business elite. Indonesia appears to be focusing more on inclusivity in its digital economy agenda. Examples include fostering a startup ecosystem through initiatives like the

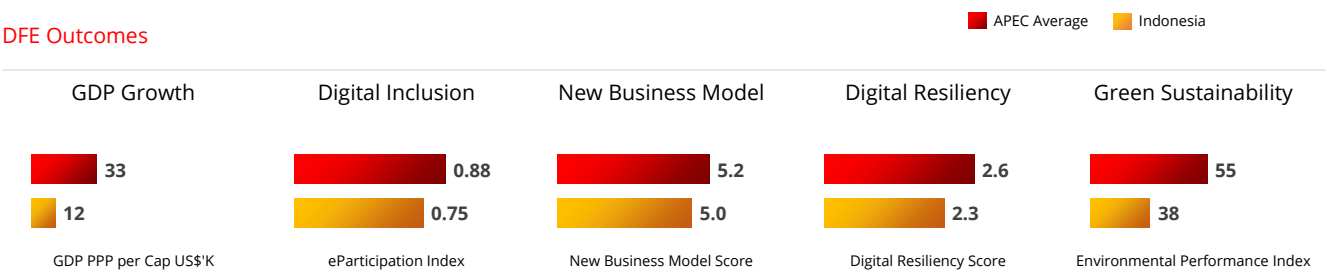
#1000StartupDigital movement and focusing on digital onboarding of its huge micro, small and medium enterprises (MSMEs) sector by targeting 30 million of them to go digital by 2024.[115]

4. Policy actions for Government (Public Service)

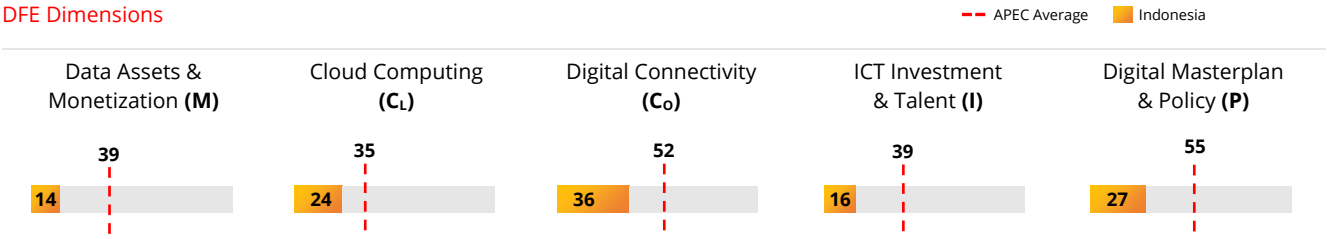
Over the years, Indonesia's government digitalization initiatives tend to be ad-hoc and/or limited in scope and have resulted in data silos and proliferation of systems, apps, and websites with interoperability and duplication issues. Thus, Indonesia is currently driving the One Data policy, its first whole-of-government data management policy, which aims to provide accurate and consistent information to the public and support data-driven policy making. The Ministry of National Development Planning/National Development Planning Agency (Bappenas) has been mandated to monitor, regulate, and enforce data management across Indonesia's government agencies. [116] Indonesia plans to build two National Data Centers in two locations with a 72 petabytes storage capacity under the One Data Indonesia umbrella.[117] Another significant initiative is the integrated electronic-based government systems (SPBE), where, among other things, all government agencies are to adopt a common and interlinked enterprise architecture and share IT resources. With better connectivity access, digitizing public services, particularly in the rural areas, can improve efficiencies and accountability and help government agencies stay transparent.[118]

DFE Indicators Dashboard

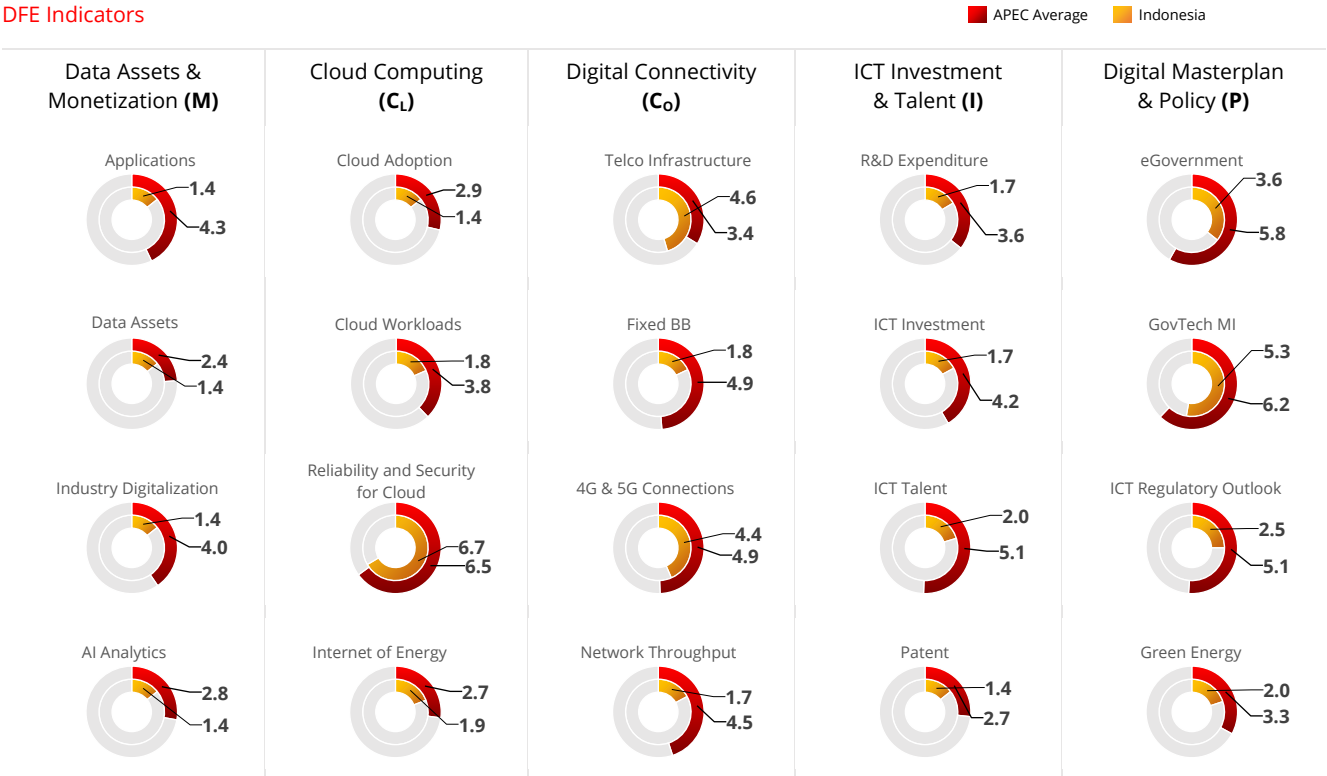
DFE Outcomes



DFE Dimensions



DFE Indicators



Japan

Basic Facts

Population (million): 125.8	• CO^2 emission (metric tons per capita): 8.74
GDP ($ billion): 5,065	• GDP (PPP) per capita ($): 42,197

DFE Score and Stage

DFE score: 59

DFE stage: Advanced

Average score among APEC economies: 43

Japan's population of 125.8 million enjoys a GDP per capita of $42,197. While Japan is a developed economy with a technologically advanced society, it lagged in its digital economy development on the back of outmoded social and economic systems.[119] With a DFE score of 59, Japan is at the Advanced stage. Japan is higher than the APEC average in all DFE outcomes except for Digital Resiliency, where it scores the same as the APEC average. Regarding DFE Outcomes and DFE Dimensions, Japan outperforms the APEC average by the most in Green Sustainability and ICT Investment & Talent, respectively. Japan's DFE indicators are mainly above the APEC average; they far outpaced the APEC average in the Patent DFE indicator.

Key Digital Economy Policy/Actions

1. National Masterplan

Japan's digital policy priorities include making online public services more user-friendly, rolling out a comprehensive data strategy, regulating new technology usage, and developing the digital infrastructure such as cloud services and networks. Japan's IT Basic Law has influenced its digital economy direction over the past 20 years. In recent years, Japan has focused on policy reforms and launched initiatives to better address its digital economy development and drive its vision of Society 5.0. Among these are its 6th Science, Technology, and Innovation plan 2021–2025 (STI), Integrated Innovation Strategy, and "Basic Act on Forming a Digital Society". The STI's top priorities are creating smart cities, disaster prevention solution development, and developing a strong platform to support collaborative data. Next-generation ICT infrastructure is also planned to support Japan's digital transition; besides the aforementioned plans, the "Beyond 5G Promotion Strategy—Roadmap towards 6G" policy will be influential in the coming years. A key policy measure in several strategies and plans that promote government, society, and industries' digital transition is research and development programs such as the Moonshot Program.[120] In addition, Japan has fostered a more secure digital ecosystem through its Cyber Security Strategy, Act on the Protection of Personal Information, and the Basic Act on Cybersecurity.[121]

2. Policy actions for Citizens

Society 5.0 is a key initiative undertaken by Japan that seeks to incorporate the fourth industrial revolution technological innovations such as AI, IoT, Big Data, and robotics for sustainable economic growth and resolve social issues, particularly those related to its aging population.[122] A key initiative to drive Society 5.0 is the Smart City public-private partnership platform, where priority is given to mobility, healthcare, and government administrative services implementation programs.[123] Japan is focusing on digitizing public services through initiatives such as broadening its My Number system utilization (e.g., the scope of information sharing / digitalizing various national licenses), encouraging more adoption, and widening the scope of My Number cards (e.g., driver's license integration by 2024) and digitalizing emergency administrative services such as the COVID-19 pandemic.[124]

3. Policy actions for Businesses

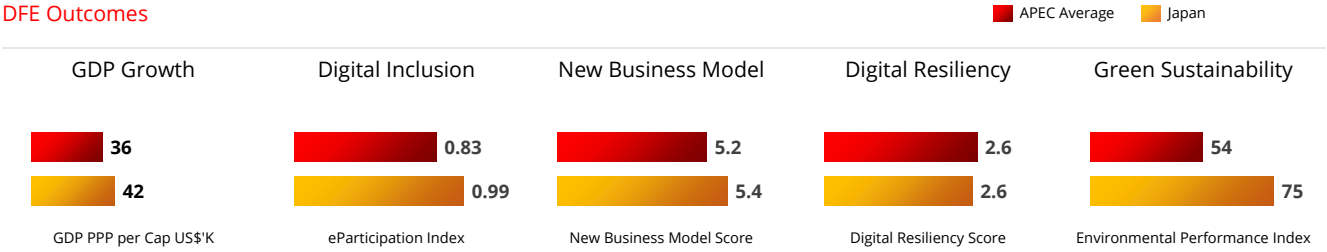
Japan's major challenges are economic stagnation and its relatively underdeveloped startup ecosystem.[125] Japan is focusing on startups and research to drive its innovative competitiveness as there are concerns that Japanese companies are too reliant on traditional business models and lack competitiveness. Japanese companies are traditionally cash hoarders. A measure undertaken to boost Japan's startup scene is a tax system change that would make more venture capital funds available for startups by offering sizeable tax deductions for companies investing in qualifying venture companies.[126] Other initiatives include driving digital innovation through financial support for SMEs to invest in new technologies and boost their innovation through public procurement.[127] Japan seeks to promote public-private collaboration in its digital economy development. Examples include the Public/Private R&D Investment Strategic Expansion Program and the Smart City public-private partnership platform.[128] Other steps include promoting the DFFT (Data Free Flow with Trust) initiative.[129]

4. Policy actions for Government (Public Service)

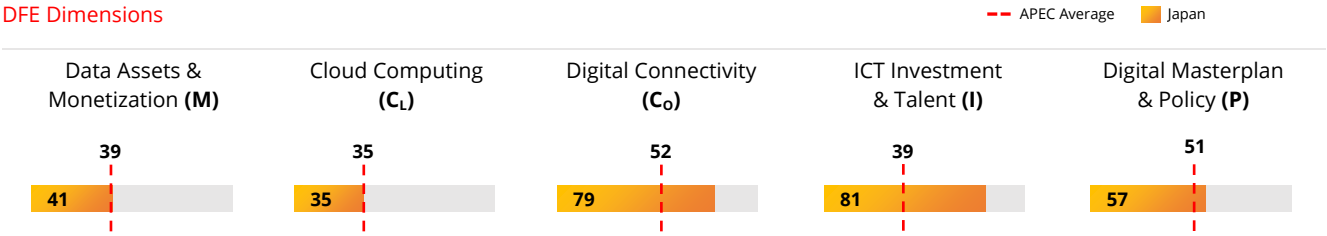
Established in September 2021, Japan's Digital Agency centralizes the government's IT budget and leads the drive to digitize public administrative procedures and services.[130] The pandemic focused on the inefficiencies of Japan's organizational system, particularly when it took months to disburse financial assistance.[131] Each ministry, local government, and agency has previously had its own responsibility for digitization. The Digital Agency has the mandate to centralize decisions that relate to digital measures and to drive Japan's digital economy transformation.[132] Some policy priorities include Government Cloud, reconstructing the central government's network, developing basic guidelines standardization, and improving online public services (e.g., adopting three digital principles: Digital First / Once Only / Connected One-Stop).[133]

DFE Indicators Dashboard

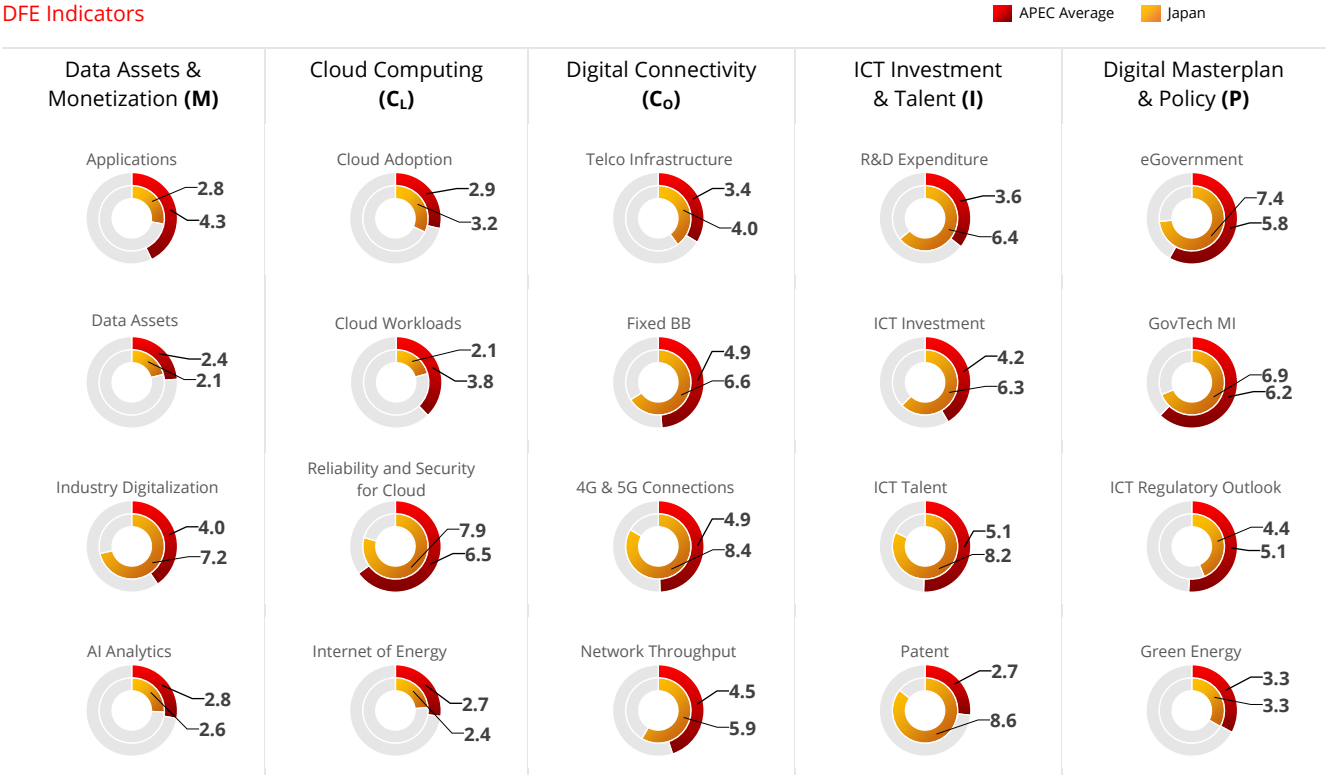
DFE Outcomes



DFE Dimensions



DFE Indicators



Malaysia

Basic Facts

Population (million): 32.37	• CO^2 emission (metric tons per capita): 7.6
GDP ($ billion): 336.7	• GDP (PPP) per capita ($): 27,887

DFE Score and Stage

DFE score: 39

DFE stage: Accelerator

Average score among APEC economies: 43

With a population of just over 32 million, Malaysia is a developing economy that has been significantly investing in its digital economy since 1996. Digital Malaysia was officially launched in 2012 to drive its transition toward a developed digital economy.[134] Malaysia is at the Accelerator stage and scored 39, with most DFE Outcomes slightly below the APEC average except for the New Business Model. Malaysia's DFE Dimensions also rated lower than the APEC average across all five categories. Among the 20 DFE indicators, Malaysia is strongest in its Telco Infrastructure and Reliability and Security for Cloud, scoring above the APEC average.

Key Digital Economy Policy/Actions

1. National Masterplan

Launched in February 2021, Malaysia's Digital Economy Blueprint (MyDIGITAL) looks to drive digital economy initiatives. MyDIGITAL appears comprehensive, with a dedicated governance structure and clear strategies and goals specified. The other policy that will significantly influence Malaysia's digital economy direction is the National Fourth Industrial Revolution (4IR) policy that was launched on 1 July 2021. The 4IR policy is realistic in addressing the existing structural challenges facing the economy in its 4IR journey, such as those in its legislation, infrastructure, and human capital capabilities. The Malaysian government acknowledges the lack of 4IR adoption readiness among the majority of businesses, and especially among micro, small and medium enterprises (MSMEs), which account for 97.2% of business establishments. Specific strategies were also formulated to address the digital divide, inadequacy of relevant skillsets, and other areas identified as critical to the policy's success.[135] But recent years of political instability and the 2021 change in government has resulted in uncertainty on the continuance of some digital policies.

2. Policy actions for Citizens

Digital inclusiveness and reducing the digital divide between urban and rural households are priorities for Malaysia's government. In 2007 the Government of Malaysia targeted to achieve 50% household broadband penetration by the end of 2010.[136] The target was achieved with 2010 household broadband penetration reaching 67.1%.[137] Malaysia made significant steps to future-proof the economy's digital infrastructure by implementing the National Fiberization and Connectivity Plan 2019-2023 (NFCP). Rebranded as the Jalinan Digital Negara (JENDELA) Plan in 2020 to provide 30Mbps broadband speeds in 98% of populated areas by 2023. [138] One of the four main policy thrusts under Malaysia's 4IR policy is equipping its citizens with 4IR-related knowledge and skillsets.[139] These include long-term strategies to increase students' 4IR technology exposure, encourage innovation and implement 21st-Century Learning (PAK-21).[140]

3. Policy actions for Businesses

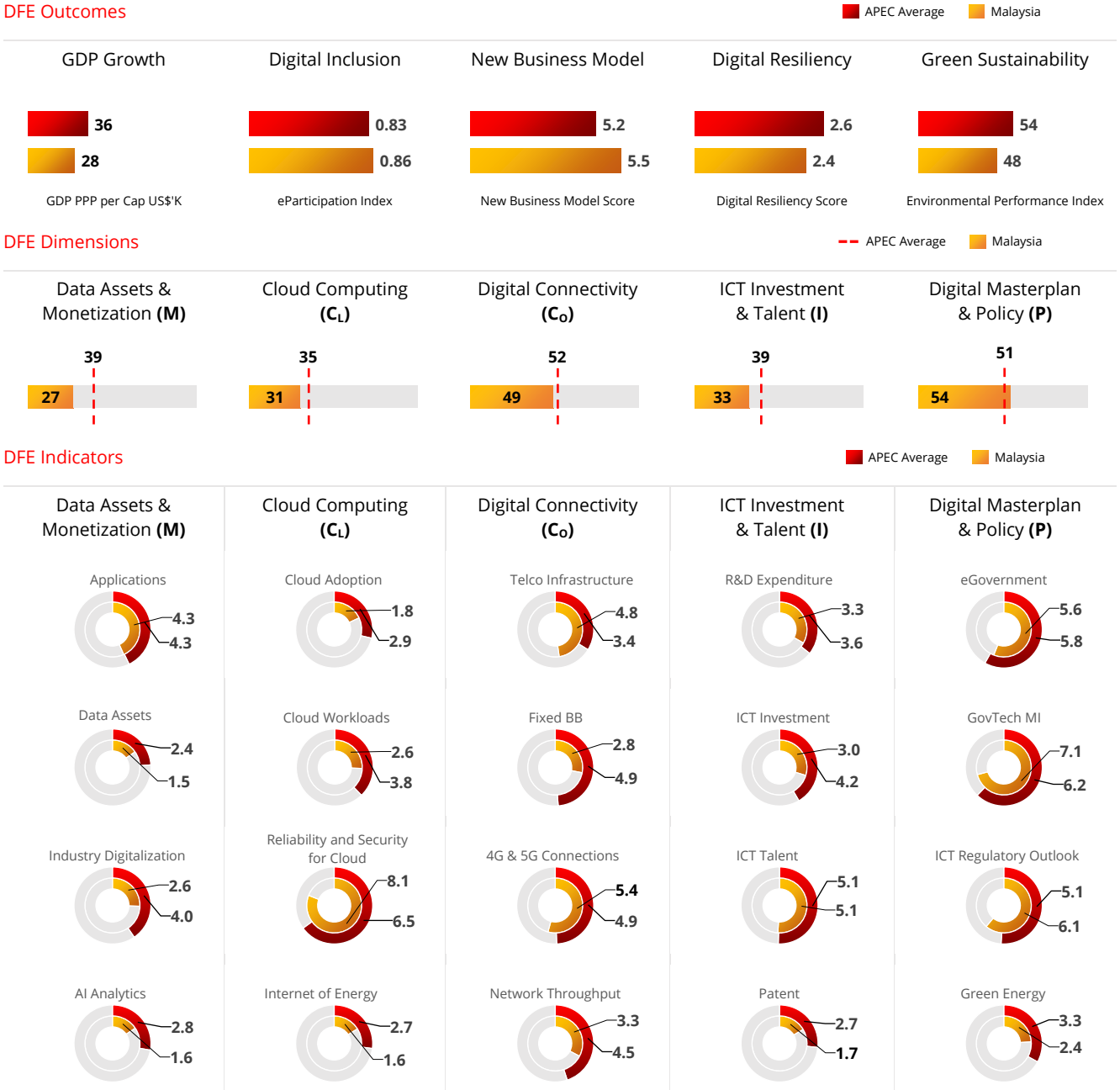
MyDIGITAL contains sectoral-focus initiatives to grow the digital economy, specifically to accelerate digital adoption via digitalizing business and processes and platform onboarding, data sharing, and analytics usage, and to cultivate the right digital skillsets in the current and future workforce. The three industries identified are agriculture, construction, manufacturing, and services, with services further drilled to 10 services subsectors.[141] Government funding (maximum of RM5 million and RM10 million for startup and growth stages, respectively) and advisory services have been made available for technology-based companies through government agencies such as the Malaysian Technology Development Corporation (MTDC).[142] Through initiatives like DataKITA, Malaysia also seeks to join forces with industry leaders to grow its talent base and help businesses kickstart their data transformation journey, improve data literacy, and promote better understanding and usage of data analytics, governance, data sharing, and AI.[143]

4. Policy actions for Government (Public Service)

The overarching focus is to improve public service delivery via digitization. Malaysia's "Cloud First" strategy at the federal and state levels is driving more public sector cloud computing adoption. One of the key targets is migrating 80% of public data to hybrid cloud systems by the end of 2022.[144] Initiatives include granting four cloud service providers conditional

approvals to build and manage hyper-scale data centers and offer cloud services. The government has also proposed appointing three local companies as Manage Service Providers (MSP)s to work with CSPs to manage cloud services for the public sector.[145] These initiatives will help drive new and sustained adoption of cloud services if appropriately executed. Another measure undertaken by Malaysia in its public sector digitalization agenda is to improve data-sharing, which includes facilitating data-sharing between government agencies, establishing data-driven policy analysis and development, and optimizing machine-readable data.[146] This involves establishing open data guidelines and for ministries and agencies to share real-time and aggregated data through their available Application Programming. One critical challenge in digitalizing public services is the shortage of relevant digital skills among civil servants. Therefore, Malaysia has formulated policies to improve the civil servants' digital skills through initiatives such as providing mandatory digital skills training by establishing a digital development cluster at a public training institution. Malaysia has set specific targets such as 100% digital literacy in civil servants and to develop 250 certified trainers or "Digital Transformers" to groom highly skilled in-house civil service talent in two areas, technical and subject matter experts, by 2025.[147] There appears to be some progress in public sector digitalization; by the end of 2021, 78% of targeted statutory bodies will have cashless payment options, and 30 out of 40 targeted government agencies and statutory bodies are utilizing the government data-sharing platform (MyGDX).[148]

DFE Indicators Dashboard



Mexico

Basic Facts

Population (million): 128.9	• CO^2 emission (metric tons per capita): 3.74
GDP ($ billion): 1,076.2	• GDP (PPP) per capita ($): 18,833

DFE Score and Stage

DFE score: 30

DFE stage: Adopter

Average score among APEC economies: 43

With a population of nearly 130 million, Mexico has a GDP per capita of $18,833. Mexico is at the Adopter stage with a DFE score of 30. Mexico underperforms the APEC average in most of the DFE Outcomes. Mexico fares better than the APEC average in its Digital Masterplan & Policy, boosted by a robust ICT Regulatory Outlook score. Mexico has one of the most advanced telecommunications regulations in Latin America per the International Telecommunications Union's regulatory tracker.[149] However, Mexico lags behind the APEC average in the other three DFE Dimensions, with the most significant lag in Digital Connectivity. This may indicate a need for a more results-oriented focus and investments, especially in 4G & 5G Connections.

Key Digital Economy Policy/Actions

1. National Masterplan

The provision of internet and broadband access is a fundamental right guaranteed by Mexico's Constitution.[150] This is reflected in the current government's focus on improving connectivity in rural areas through its Internet para Todos ("Internet for All") program.[151] Mexico's National Digital Strategy (NDS), established in 2013, was included in its National Development Plan 2013-2018. The plan's objectives were to drive government transformation, develop a digital ecosystem, improve the quality of ICT education, drive comprehensive digital health policy and improve public safety.[152] Award-winning programs under NDS include digitizing public services such as Online Birth Certificate and Your Online Company, allowing the user to obtain a birth certificate or start a company online.[153] Presently, however, some quarters have criticized the current government for failing to create a new national digital strategy or a clear ICT roadmap for public policy, thus leading to a lack of a structured and focused approach to transforming Mexico's digital economy beyond universal connectivity.[154] A controversial national cellphone user registry with biometric data (PANAUT) was overturned recently because it did not provide adequate measures to safeguard consumers' data, thus was unconstitutional for violating user privacy.[155] Mexico has made some progress in providing a more secure digital ecosystem, as reflected in its ICT Regulatory outlook score. While its Constitution enshrines the right to privacy and data protection,[156] Mexico has enacted legislation (e.g., the Private Data Protection Law)[157] and launched initiatives such as Mexico's National Cybersecurity Strategy and its Program for the Development of the Software Industry (PROSOFT), which support industrial innovation centers focused on training and encouraging new technologies adoption for digital security.[158] Finally, Mexico introduced measures to tax digital services in 2020 to improve its fiscal position.[159]

2. Policy actions for Citizens

As part of its priority to reduce the digital divide, Mexico's Internet para Todos initiative aims to provide 100% internet connectivity to its citizens by 2023.[160] Free nationwide public Wi-Fi sites have also been built with donations from large companies such as Google.[161] Another focus area is to improve the efficiency and effectiveness of government public services for users. For e.g., Mexico provided citizens with a single online portal to access government services through gob.mx that consolidates 34,000 databases from 250 government institutions and 5,400 public services.[162]

3. Policy actions for Businesses

One of the focus areas is to grow the information technology sector (IT) of its economy through initiatives such as forming IT clusters and technology parks, some through public-private sector collaboration.[163] The "Crafting the Future, a Roadmap for Industry 4.0 in Mexico"[164] aims to drive IR4 technology adoption in the nation's manufacturing industry. Government initiatives include the National Council on Science and Technology's (CONACYT's) intelligent manufacturing research. Under one of CONACYT's centers, public and private organizations use an experimental and productive innovation ecosystem with hardware and software infrastructure to experiment with IoT, Big Data, and cloud computing technologies. IR4 policies

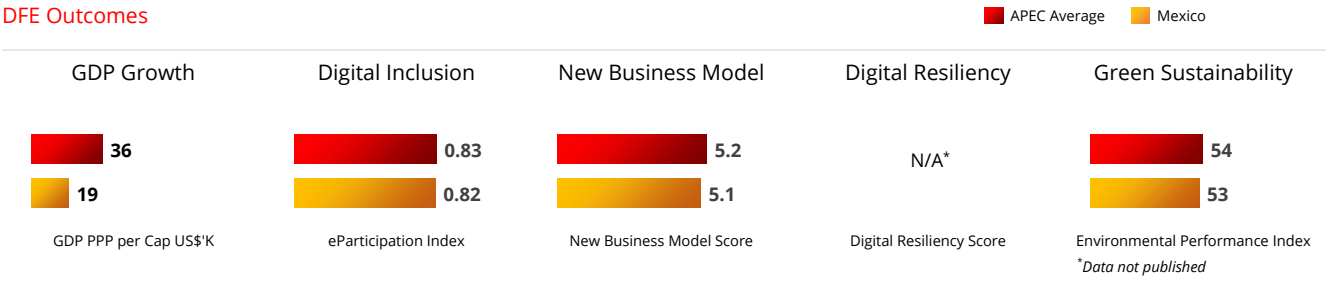
have seen some success with businesses such as tequila producer Casa Sauza adopting IR4 technologies to improve the automation of its tequila production processes.[165]

4. Policy actions for Government (Public Service)

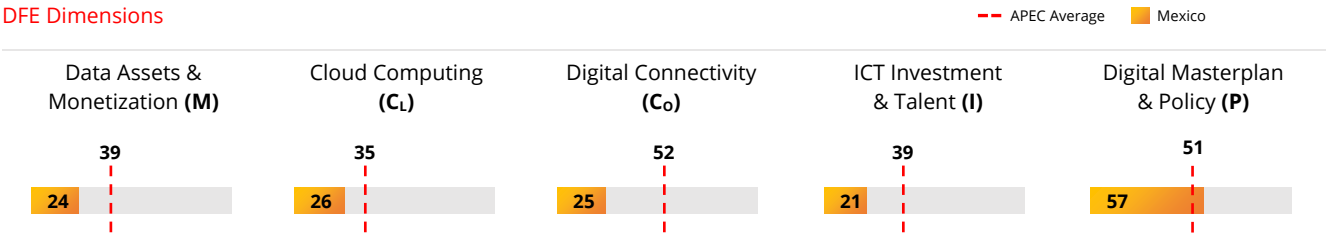
Comprehensive eGovernment endeavors began in 2001 with an e-government public policy to modernize the Mexican government. While there is room for improvement, Mexico has made headway in its eGovernment agenda in areas such as improving the existing legal and regulatory framework of e-government and better integration (e.g., International Trade Single Window and Federal Inventory System), and interoperability (e.g., Interoperability Scheme).[166] One-stop-shop mechanisms utilizing digital tools are rolled out at the state and municipality levels (e.g., Yucatán's fully digital single investment window), providing businesses the means to resolve all administrative procedures for starting a business online and thus reducing businesses' regulatory burden and scope for corruption.[167]Corruption, an endemic issue, is also being increasingly addressed through digital means. Initiatives include launching a national digital platform that collects and interconnects all data from federal agencies and the state anti-corruption systems.[168]

DFE Indicators Dashboard

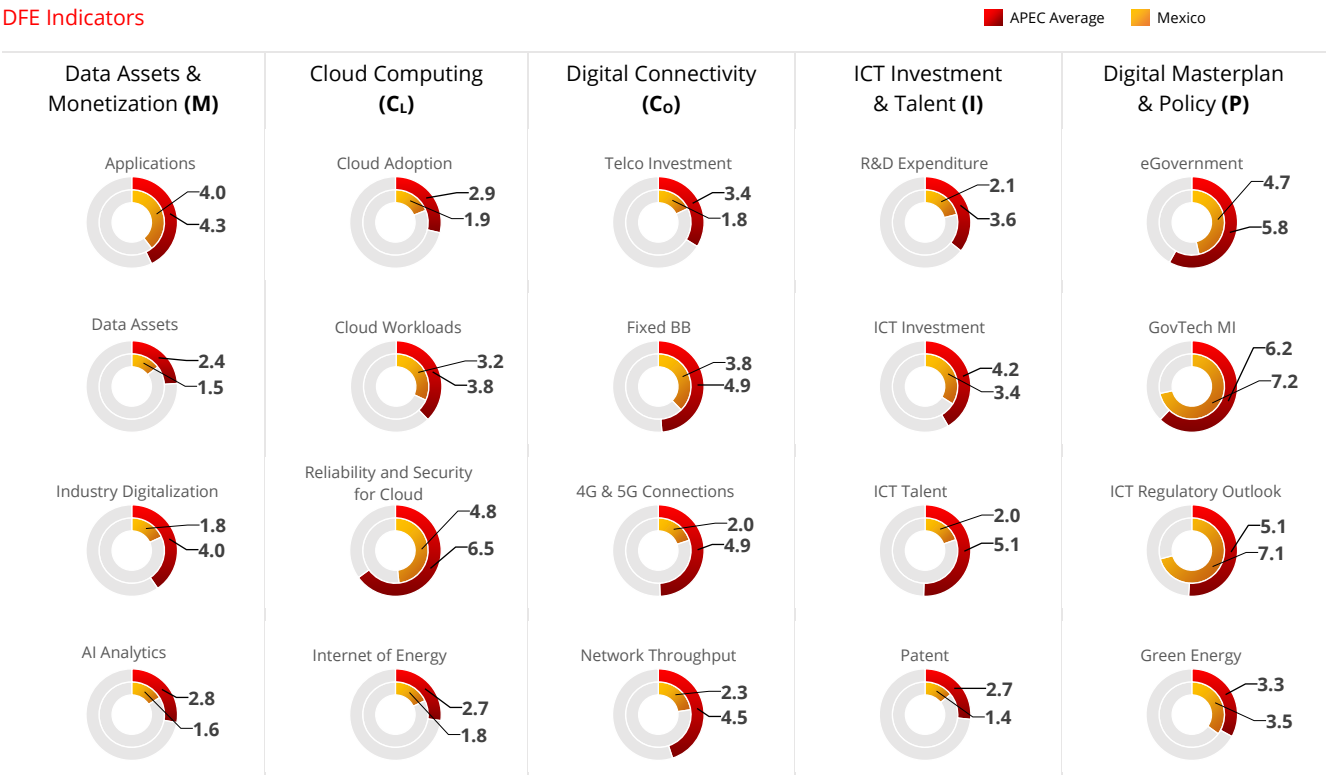
DFE Outcomes



DFE Dimensions



DFE Indicators



New Zealand

Basic Facts

Population (million): 5.08	• CO^2 emission (metric tons per capita): 6.57
GDP ($ billion): 212.5	• GDP (PPP) per capita ($): 44,252

DFE Score and Stage

DFE score: 62

DFE stage: Advanced

Average score among APEC economies: 43

New Zealand, with a population of just over five million and a GDP per capita of $44,252, has a DFE score of 62 and is at the Advanced stage. New Zealand scores above the APEC average in the five DFE Outcomes five 5 DFE Dimensions. For DFE Dimensions, it surpassed the APEC average by the most in Digital Connectivity, where Telco Infrastructure is robust. While most of its DFE Indicators outpaced the APEC average, New Zealand can focus more on its ICT Investment & Talent. Although ICT Investment is significantly higher than the APEC average, its DFE Indicators for R&D Expenditure and Patent are below the APEC average. This could indicate a need to invest more in R&D initiatives that drive innovation and the productization of new digital products and services.

Key Digital Economy Policy/Actions

1. National Masterplan

New Zealand's digital technology sector is one of its top revenue contributors in 2019.[169] As of the writing date, New Zealand has released a draft Industry Transformation Plan (ITP) to grow its digital technologies sector. ITP endeavors to transform New Zealand's digital technologies sector so that it can, among other things, generate high-value jobs and increase its export revenue (including Software as a Service and Interactive Media).[170] Other policies influencing its digital economy include the Strategy for a Digital Public Service (SDPS) and the Government Data Strategy and Roadmap 2021(GDSR). Of priority is inclusivity, particularly with the Māori community, where digital economy initiatives often include consultations and specific actions for such groups. New Zealand's prioritization of privacy and cybersecurity is reflected in its establishment of a Government Chief Privacy Officer specifically to assist government agencies more effectively in this constantly evolving area.[171] New Zealand has several legislation governing privacy and cybersecurity issues (e.g., The Privacy Act 2020, Data and Statistics Bill, and the Intelligence and Security Act 2017) and is in the process of reviewing its current regulatory landscape to make it more relevant to the changes that the digital economy has brought.[172]

2. Policy actions for Citizens

Better utilizing digital technology to provide more effective and efficient public services is a focus area for New Zealand. This is reflected in its fully online passport renewal service (the world's first of its kind), which has since been expanded to new passport applications.[173] New Zealand's Govt.nz website provides a one-stop-shop government information website for all agencies.[174] Another priority area is to deliver more personalized public services such as its SmartStart, an online tool for expecting parents and parents that provides a single online access point to relevant integrated government services (e.g., online birth registration) and information from multiple agencies (e.g., welfare benefits, health advise).[175]

3. Policy actions for Businesses

New Zealand's digital policy priority for businesses is largely around making everyday government dealings with businesses more efficient and effective through digitization. Such actions include Business Connect, a digital platform that reduces business costs by simplifying and reusing information businesses submit when applying for and renewing government licenses, permits, registrations, and certifications. All-of-government frameworks, standards and tools have and are being developed to support more integrated services for businesses.[176] Collaboration with the industry is another focus area with growing importance as New Zealand seeks to transform its digital technology sector. The draft ITP contains initiatives that were jointly designed between the industry and government, covering areas such as new skills and talent development pipeline, and creating a Tech Story for the overseas market.[177]

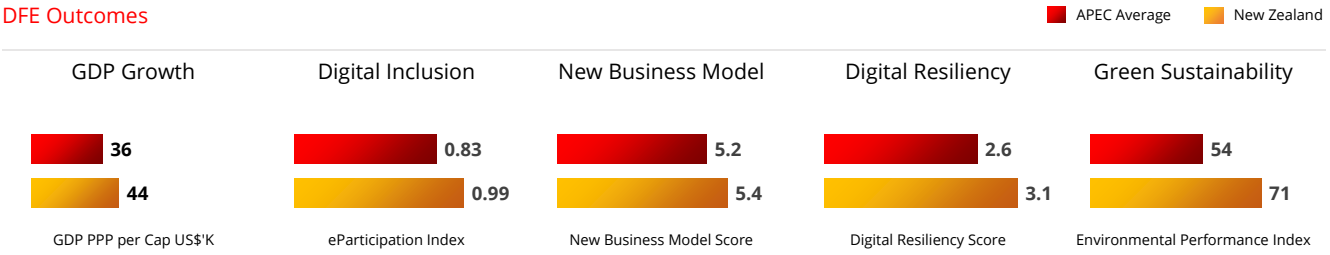
4. Policy actions for Government (Public Service)

The SDPS and GDSR are among the main policies driving the digitalization of New Zealand's government. The Government Chief Data Steward will lead the GDSR roll-out in collaboration with government agencies and the indigenous community.

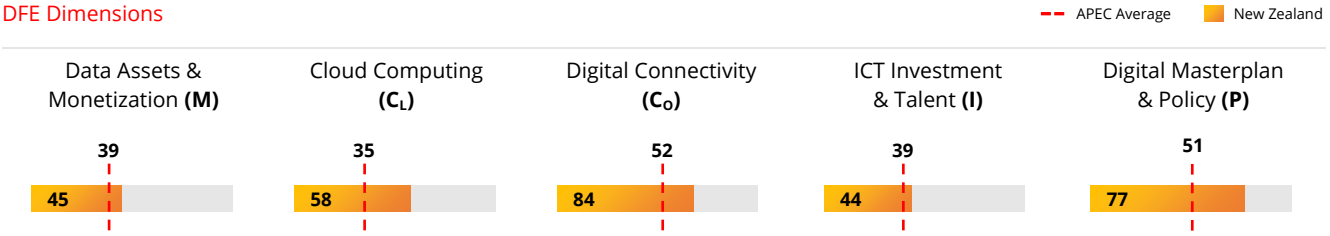
Both policies contain a slew of initiatives and plans that center around digital transformation and aim to allow its people secure, personalized public service access at the right time and place while not neglecting transparency and inclusivity.[178] The SDPS' priority focus areas include integrated services for people and business (e.g., SmartStart), Leadership, people, culture (upskilling current government leaders and workers' digital and data literacy skills), Foundation (e.g., prioritizing government systems interoperability, seeking to establish a coherent digital identity ecosystem), Investment (e.g., prioritizing an all-of-government view through digital, data management and other ICT investment) and New ways of working (e.g., cross-agency mobility and, standardize digital standards and practices throughout all agencies. New Zealand's Government Chief Digital Officer is leading the charge for the government's digital transformation agenda.[179]

DFE Indicators Dashboard

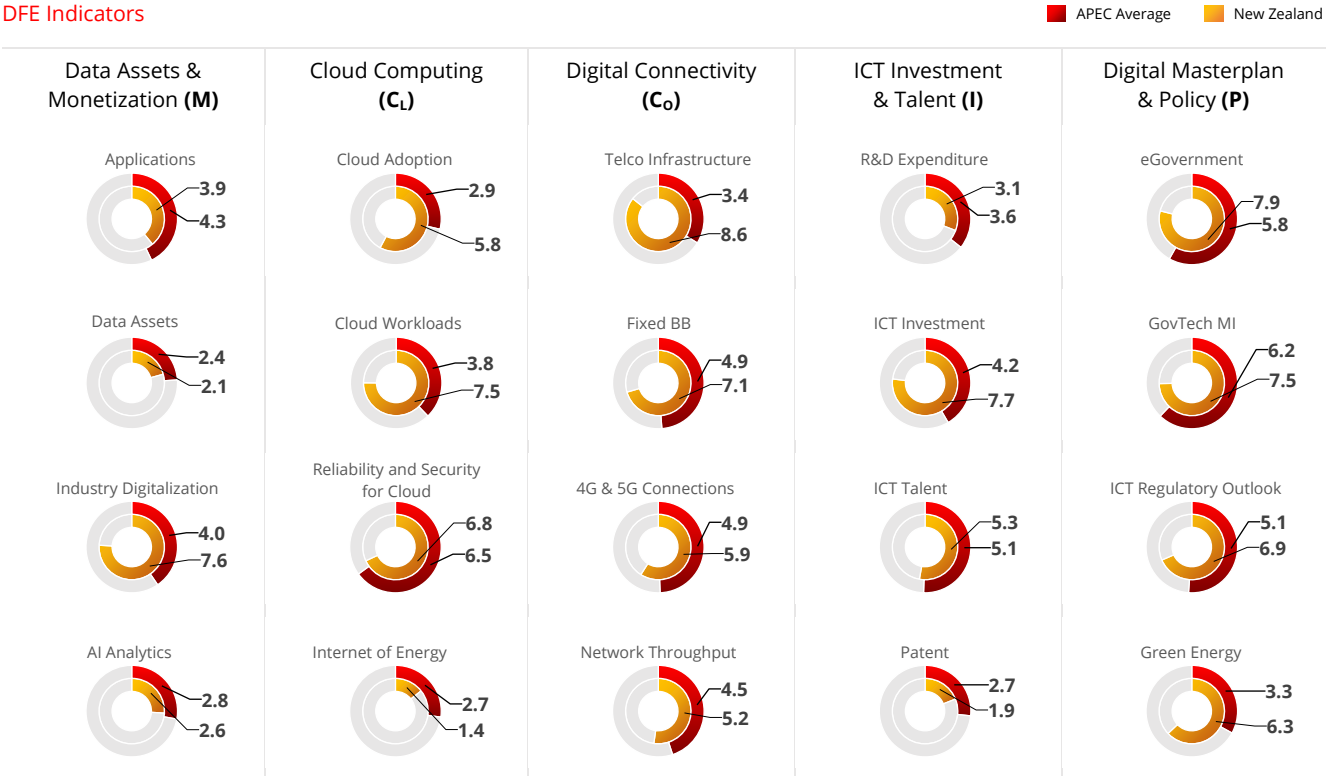
DFE Outcomes



DFE Dimensions



DFE Indicators



Papua New Guinea

Basic Facts

Population (million): 8.95	• CO^2 emission (metric tons per capita): 0.87
GDP ($ billion): 23.6	• GDP (PPP) per capita ($): 4,326

DFE Score and Stage

DFE score: 13

DFE stage: Adopter

Average score among APEC economies: 43

Papua New Guinea has a population of just under nine million and a GDP per capita of $4,326. With a DFE score of 13, Papua New Guinea is at the Adopter stage. Papua New Guinea underperforms the APEC average in three of the DFE Outcomes and across all DFE Dimensions. Its DFE Indicators scores are also below the APEC average except for Green Energy, helped by strong adoption of solar power to meet the economy's energy needs.[180]

Key Digital Economy Policy/Actions

1. National Masterplan

Papua New Guinea's digital economy is at a nascent stage of development. Nonetheless, it recognizes the importance of developing its digital economy and has developed policies and strategies to address building its digital foundations and digital transformation. Published in 2020, the proposed Papua New Guinea Digital Transformation policy provides the digital transformation strategic framework with a strong focus on digital government transformation. The six themes under this policy are Digital Infrastructure, Digital Government, Digital Skills, Innovation & Entrepreneurship, Cyber Safety, and Privacy and Financial Inclusion. [181] Other national policies or plans influencing Papua New Guinea's digital economy include Long Term Development Strategy 2010-2030, Papua New Guinea Vision 2050, Alotau Accord III (2017), Medium Term Development Plan III 2018 – 2022, and the National ICT Policy 2008.[182] As of the date of writing, there is no comprehensive law for privacy. Papua New Guinea's Cybercrime Code Act 2016 includes provisions that address cybersecurity and aspects of data protection[183] , and the government has plans to enact data protection policies and legislation. The National ICT Authority of Papua New Guinea (NICTA) is the ICT sector regulator, especially within the telecommunication sector.[184]

2. Policy actions for Citizens

The high cost of internet access and lack of electricity in some rural areas contribute to the digital divide and low digital literacy among Papua New Guinea's citizens, who are largely widely dispersed across the economy.[185] The World Bank estimates that 70% of Papua New Guinea's internet users are from its two largest cities.[186] Over the years, Papua New Guinea has invested significantly in developing its telecommunication infrastructure, including submarine cables, to increase speed and capacity. However, this has yet to materialize in more affordable internet connectivity for most citizens.[187] This is partly due to a lack of policy/regulation for mandatory sharing of telecommunications infrastructure.[188] One of the thrusts of its Long-Term Development Strategy 2010-2030 is to build a modern and affordable ICT system that reaches all parts of Papua New Guinea. Targets include having 800 mobile subscribers per 1,000 and providing 70% of citizens with internet access/usage by 2030.[189]

3. Policy actions for Businesses

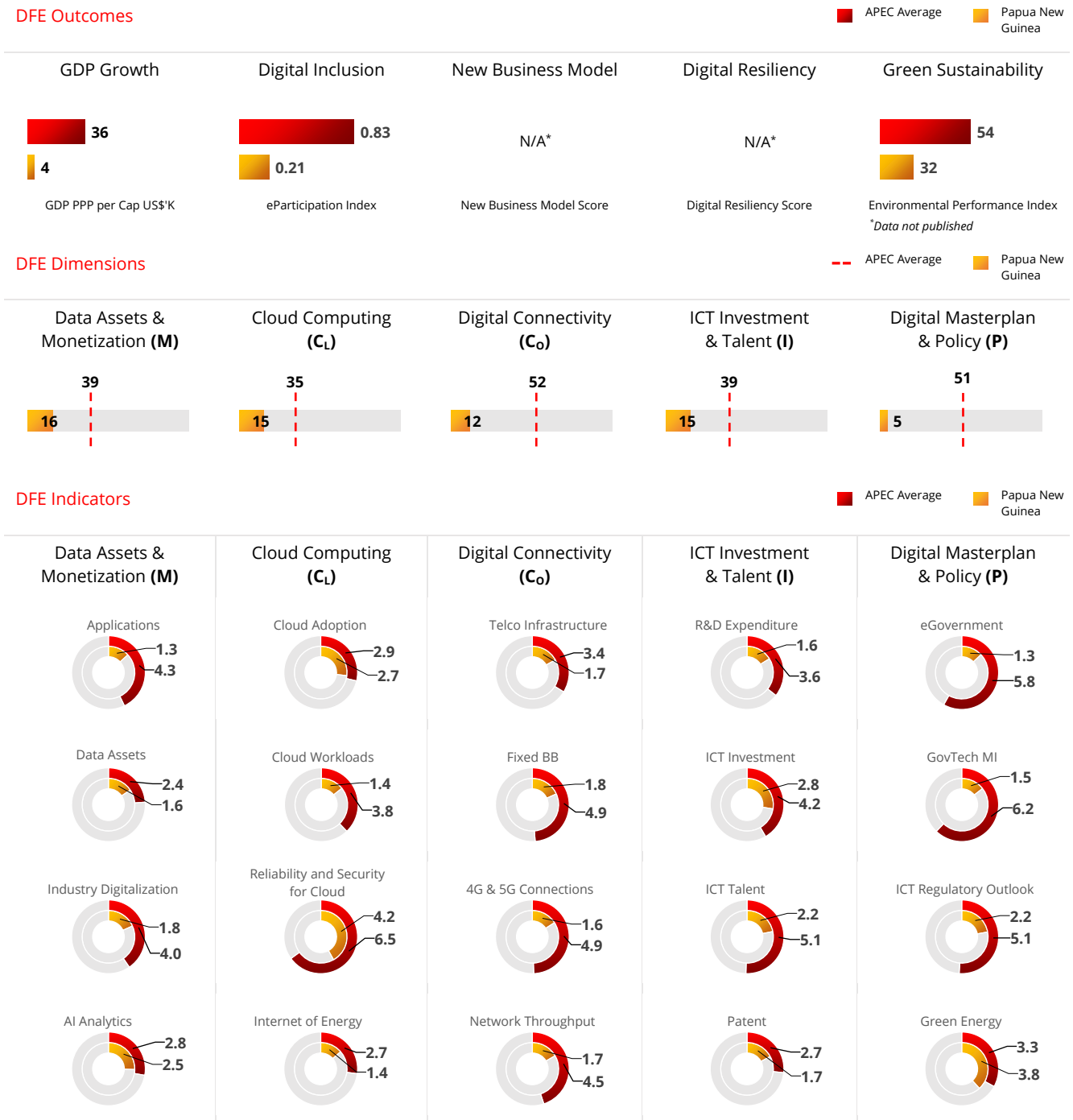
Papua New Guinea has created the world's first public-private Digital Foreign Direct Investment (FDI) working group to encourage investments in technology.[190] Beyond that, the government does not seem to focus on developing the business sector's digital transformation.

4. Policy actions for Government (Public Service)

Activities under the Digital Transformation Policy's Digital Government theme include providing and encouraging the adoption of digital government services and supporting local digital content development. The Department of Information and Communication Technology (DICT) leads Papua New Guinea's digital government transformation.[191] The government plans to formulate a Digital Government Strategy that would include implementation mechanisms. Also in the draft stage is a Government Cloud (GC) Policy that will set the direction for Papua New Guinea's government departments and agencies' Government Cloud Infrastructure usage.[192] Other initiatives include the Integrated Government Information System (IGIS) National Data Centre (NDC), which aims to provide shared services to 22 provinces by 2022.[193] It should be noted, too, that

Papua New Guinea's policy implementation and law enforcement are historically the public service's biggest challenges.[194] For example, IGIS did not realize its full potential with the non-execution of IGIS phase 2 and phase 3.[195]

DFE Indicators Dashboard



Peru

Basic Facts

Population (million): 32.97	• CO^2 emission (metric tons per capita): 1.70
GDP ($ billion): 202.0	• GDP (PPP) per capita ($): 11,879

DFE Score and Stage

DFE score: 27

DFE stage: Adopter

Average score among APEC economies: 43

Peru's population is a hair's breadth below 33 million, with a GDP per capita of $11,879. Peru is at the Adopter stage, with a DFE score of 27. Peru's DFE Outcomes and Dimensions are almost completely below the APEC average. Similarly, Peru largely underperformed the APEC average in the 20 DFE Indicators except for ICT Regulatory Outlook and Green Energy.

Key Digital Economy Policy/Actions

1. National Masterplan

The digital economy transformation policies in Peru are largely driven by Plan Nacional de Competitividad y Productividad 2019-2030 (National Plan for Competitiveness and Productivity 2019-2030) and the Law of Digital Government of 2018. The national plan contains several digital transformation measures with a focus on government entities and an overarching theme of increasing Peru's international competitiveness and providing steady growth. Frameworks established include those to manage digital identity, digital services, interoperable systems, and digital and data security.[196] Peru has introduced laws such as the Personal Data Protection Law and the Digital Confidence Law ("DCL") to build trust in its digital economy.[197] As of the date of writing, Peru's political situation is somewhat unstable, with erratic government policies and ministers that are frequently changed.[198] Such instability casts an air of uncertainty over the fate of policies that impact the development of Peru's digital economy.

2. Policy actions for Citizens

Narrowing the digital divide is one of the focus areas for Peru, and digital economy initiatives include those focusing on the national fiber-optic networks to narrow the digital divide.[199] Peru has launched a digital platform (GOB.PE) that allows interactions with the government through a single online access point.[200] Until the COVID-19 pandemic, Peruvians preferred using cash for transactions, limiting the development of digital economy, mainly eCommerce. E-Gob Peru, a government-established task force, was tasked to develop Peru's online payments landscape. Initiatives include tax payment (Gov2Citizens)) and Gov2Gov transactions to reduce expenses between different agencies.[201] The pandemic and associated economic slowdown have escalated the demand for cashless payment systems. Peru's Cámara de Compensación Electrónica (CCE), the central entity facilitating interbank payments and clearing services in Peru's financial system, modernized its real-time payments system and supported financial inclusiveness, which, among other things, enables users to make and receive payments using phone numbers.[202]

3. Policy actions for Businesses

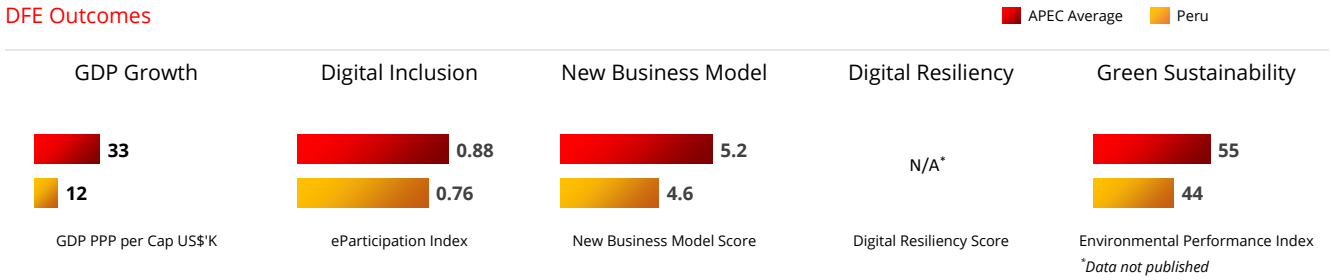
One of Peru's strategies for Rural Access Connectivity involves formulating telecom legislation that allows local companies that have their mobile infrastructure, Rural Mobile Infrastructure Operators (OIMR), to utilize the spectrum allocated to other operators, thus helping resolve the last mile issue in many rural areas that were deemed unprofitable to get into by traditional mobile carriers.[203] Priority has also been given to growing Peru's startup scene, as reflected in its Startup Peru initiative that provides co-financing for startups, incubators, accelerators, and angel networks.[204]

4. Policy actions for Government (Public Service)

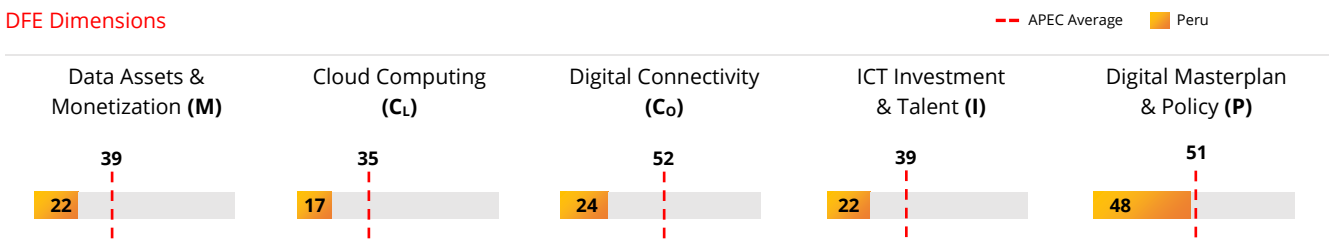
The High-Level Commission for multi-sectoral coordination and the Digital Government Secretariat of Peru were entrusted with formulating policies and driving the government's digital transformation. Peru's digital transformation agenda for its government include driving interoperability between systems to simplify administrative procedures and digitalize public services.[205] The government is implementing an Electronic Procurement System (SEACE: Sistema Electrónico de Adquisiciones y Contrataciones del Estado) to improve government purchase efficiencies and promote transparency.[206]

DFE Indicators Dashboard

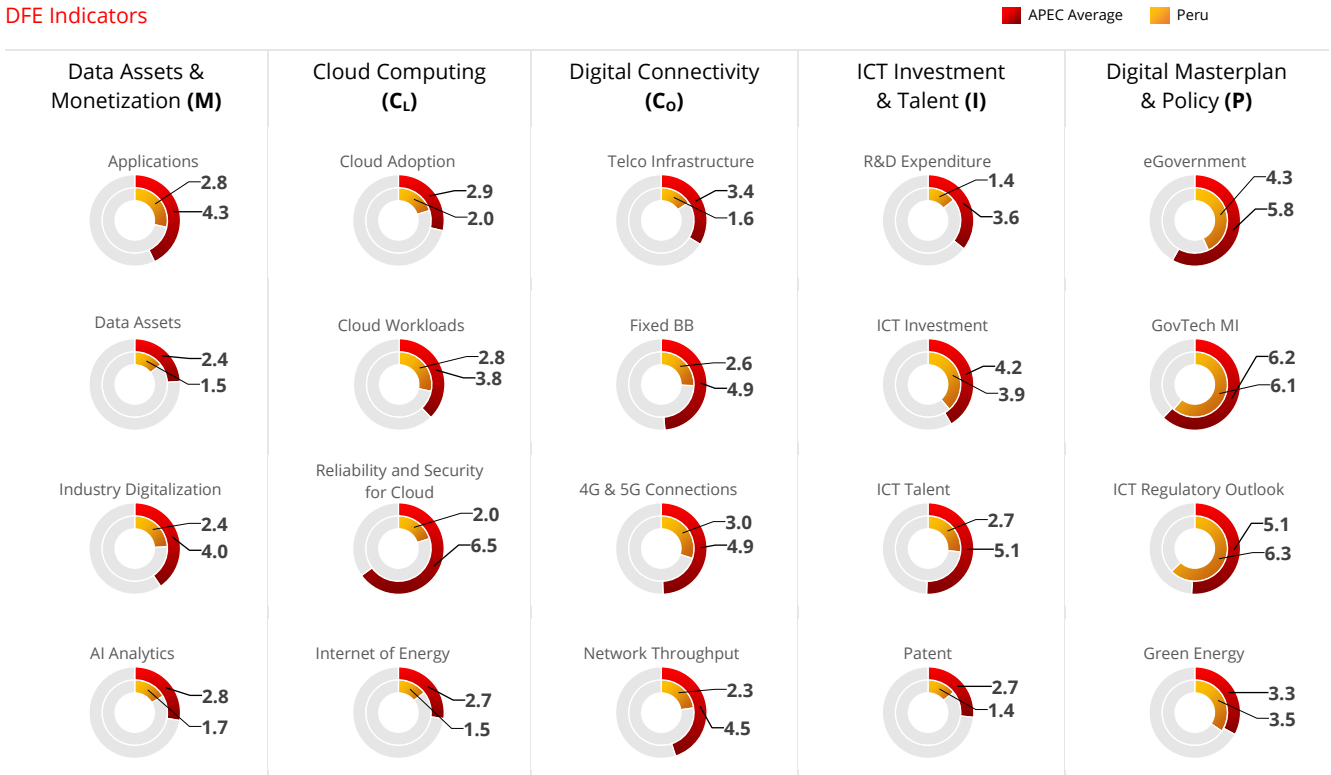
DFE Outcomes



DFE Dimensions



DFE Indicators



Philippines

Basic Facts

Population (million): 109	• CO^2 emission (metric tons per capita): 1.33
GDP ($ billion): 361	• GDP (PPP) per capita ($): 8,390

DFE Score and Stage

DFE score: 28

DFE stage: Adopter

Average score among APEC economies: 43

With a population of 109 million and a GDP per capita of $8,390, the island nation the Philippines secured a DEF score of 28 and is at the Adopter stage. The Philippines is below the APEC average in all the 5 DFE outcomes and 5 DFE Dimensions. The Philippines is also below the APEC average in all the DFE indications except for Cloud Workloads. This reflects the significance of the business processing outsourcing (BPO) industry in the Philippines, where large local BPO firms are typical cloud solution consumers. The pandemic, too, has driven demand in the data hosting and processing segment as businesses utilize cloud solutions for more efficiency and flexibility.[207]

Key Digital Economy Policy/Actions

1. National Masterplan

Philippines' current national development plan, the Philippine Development Plan 2017-2022 (PDP), has focused on the following ICT areas as priority strategies: expand ICT infrastructure deployment and address the gaps in digital connectivity, enhance its e-government system to improve governance, and reform the relevant policy and regulatory frameworks. Philippines has enacted its Philippine's Data Privacy Act of 2012 (DPA) and Cybercrime Prevention Act of 2012 (CPA) which would help build trust and foster a more secure digital ecosystem.[208] Elsewhere, key regulatory reforms and laws were passed that would increase competition and innovation in the digital financial industry. These include the new central bank charter, the National Payment Systems Act, the National Retail Payment System Framework, and the rolling out eGov Pay, an online facility for government digital collections and disbursements.[209]

2. Policy actions for Citizens

Compared to its ASEAN counterparts, the Philippines has a significant digital divide driven partly by internet connectivity that is both slow and expensive. Recognizing this, one of the Philippines' key digital policy priorities is to provide reliable, faster, and affordable internet connectivity across the economy to address the digital gap, particularly for citizens in geographically isolated and disadvantaged areas.[210] The Philippines has focused on its connectivity infrastructure and has made some efforts to reform its policies, including establishing the National Broadband Plan (NBP) to accelerate broadband infrastructure deployment across the Philippines and funding a free public Wi-Fi initiative in public sites nationwide.[211] The Philippines also passed the Common Tower Policy to hasten mobile network infrastructure rollout.[212] Bureaucratic red tape is one of the reasons hindering the economy's ICT infrastructure. The Philippines thus focused on streamlining the process for sectors, including the collaboration between DICT and the Anti-Red Tape Authority (ARTA) to fast-track fixed and wireless permits for telecommunications infrastructures.[213] Another initiative in the Philippines for citizens is rolling out a digital ID system. In an economy where many do not possess primary IDs such as passports and driving licenses, the Philippine Identification System (PhilSys) is viewed by the World Bank as an excellent method for the Philippines to bridge its digital ecosystem gaps.[214]

3. Policy actions for Businesses

The Philippines is presently reforming its business regulatory and licensing environment. This includes passing the Innovative Startup Act, Ease of Doing Business, Efficient Government Service Delivery Acts, and establishing ARTA, whose main task is implementing the law to reduce businesses' regulatory burdens while complying with business regulations.[215] The Innovative Startup Act provides startups and their enablers with incentives including travel grants, Startup Venture Fund access, visas, and business permit assistance.[216]

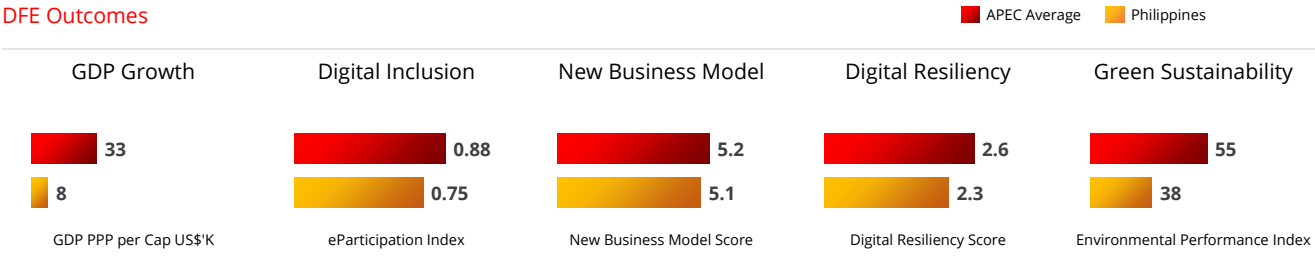
4. Policy actions for Government (Public Service)

Philippines' Department of Information and Communications Technology (DICT) is tasked with policy development, implementation, and developing and promoting of the economy's ICT agenda. This includes leading the Philippines' connectivity and e-government initiatives. DICT's key priorities are expanding the national infrastructure, e-governance,

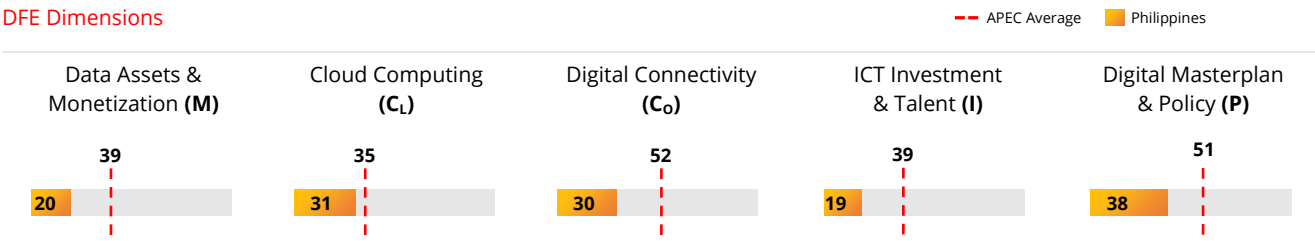
and policy reforms.[217] DICT launched the Philippines' E-Government Master Plan 2022 (EGMP 2022), a blueprint for integrating the whole government network and ICTs systems. It includes the GovNet project that aims to build essential infrastructure and shared services for government facilities to improve network connectivity between government agencies.[218]

DFE Indicators Dashboard

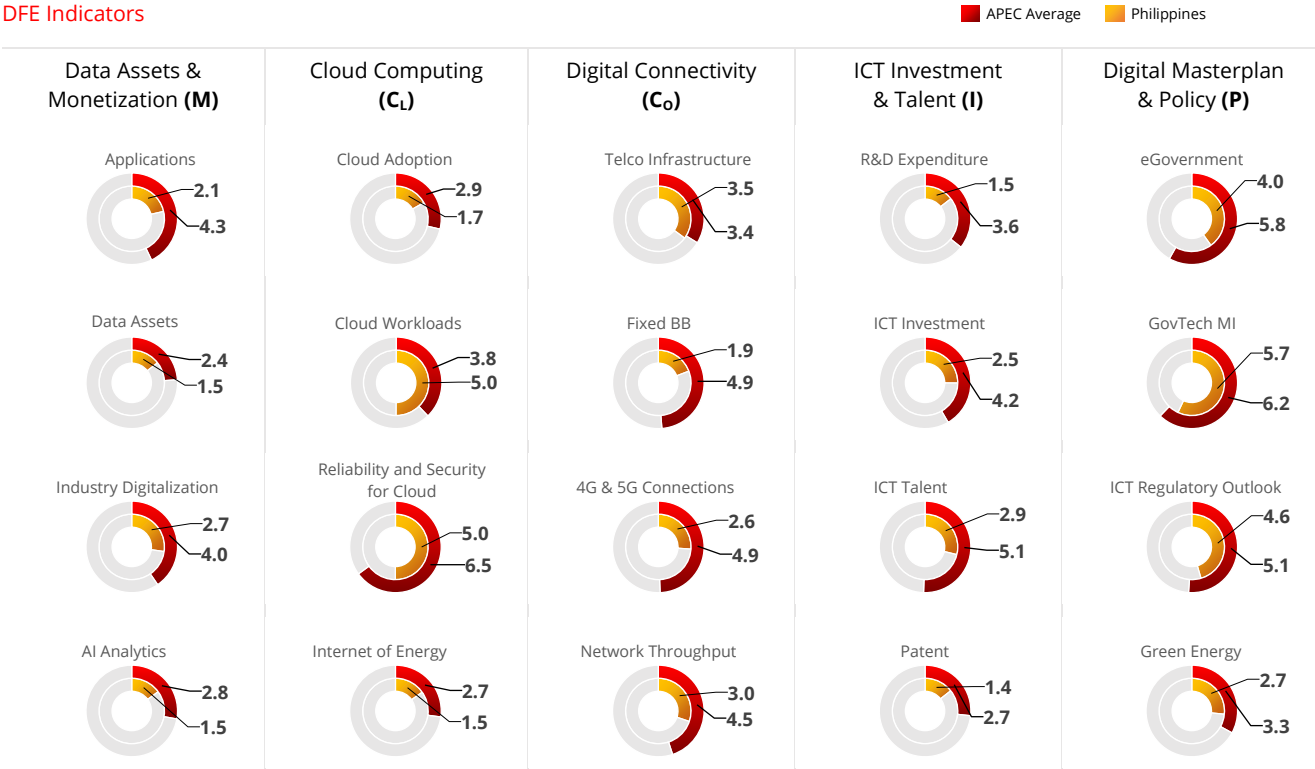
DFE Outcomes



DFE Dimensions



DFE Indicators



Republic of Korea

Basic Facts

Population (million): 51.78	• CO^2 emission (metric tons per capita): 12.23
GDP ($ billion): 1,630.5	• GDP (PPP) per capita ($): 43,124

DFE Score and Stage

DFE score: 57

DFE stage: Advanced

Average score among APEC economies: 43

The Republic of Korea has a population of 51.78 million and a GDP per capita of $43,124. It is at the Advanced stage with a score of 57. Its DFE Outcomes outperform the APEC average except for Digital Resiliency, where it scored the same as the APEC average. The Republic of Korea's DFE Dimensions far surpassed the APEC Average in 2 areas: ICT Investment & Talent (driven especially by R&D Expenditure) and Digital Connectivity (particularly Fixed BB). However, the Republic of Korea's Cloud Computing is rated below the APEC Average, pulled down, especially by its Cloud Workloads score, which may indicate low on-premises cloud deployment by businesses. The economy's Data Assets & Monetization DFE Indicator is also below the APEC average, indicating a need to focus more on data asset creation and commercializing.

Key Digital Economy Policy/Actions

1. National Masterplan

The Republic of Korea's Fifth Comprehensive National Territorial Plan (2020 to 2040) provides the high-level direction for its central and regional development plans. Previous iterations of the Plans have assumed continued growth and prioritized economic value while emphasizing the economy and driving efficiencies to drive a competitive society. On the other hand, the present Plans assume a shift to low growth and declining population and prioritize social values while emphasizing equity to drive a collaborative economic society.[219] A significant policy launched in 2020 is the Korea New Deal, which aims to drive digital/green economy transition while providing stronger safety nets for its society with a 5-year budget totaling 160 trillion won and a goal to create 1,901,000 jobs. The Republic of Korea is placing its bets on digital economy transformation through the Digital New Deal prong. The focus is on integrating data, networks, and AI (DNA). Projects under this include Data Dam, AI government, Smart Healthcare, and Digital Twins.[220] Due partly to ongoing cyber-attack threats from North Korea and China, the Republic of Korea has a well-developed regulatory framework and laws governing privacy and cybersecurity. These include the Personal Information Protection Act, Use and Protection of Credit Information Act, Protection, Use, ETC. of Location Information Act, National Cyber Security Management Regulation, Critical Information Infrastructure Protection Act, and the Cyber Security Industry Enhancement Act.[221]

2. Policy actions for Citizens

In line with its latest national plan, a major focus area is developing smart cities through utilizing 4IR technologies (e.g., AI) that are 'green' with two pilot smart city projects being carried out in Busan and Sejong.[222] The Republic of Korea is in the process of using smart technology to drive infrastructure management efficiency, e.g., using AI and IoT for infrastructure maintenance and administration in its transportation policy.[223] A key focus area is on expanding people-centric public services with initiatives that include the launch of its Virtual Assistant Service for the Public (GoodPy), which sends reminders (e.g., for driving license renewal, regular medical checkups, COVID-19 vaccination appointments) and handles inquiries based on AI technologies and through private-public collaboration. With a subscriber base of over 12 million residents, the government plans to add new services and expand the number of applications available on GoodPy.[224] Under the Stronger Safety Net prong of the Korea New Deal, the government has also allocated 28.4 trillion won, part of which would be used to expand internet connectivity to rural areas and provide its current and future workforce with digital skills through workforce and vocational training programs.

3. Policy actions for Businesses

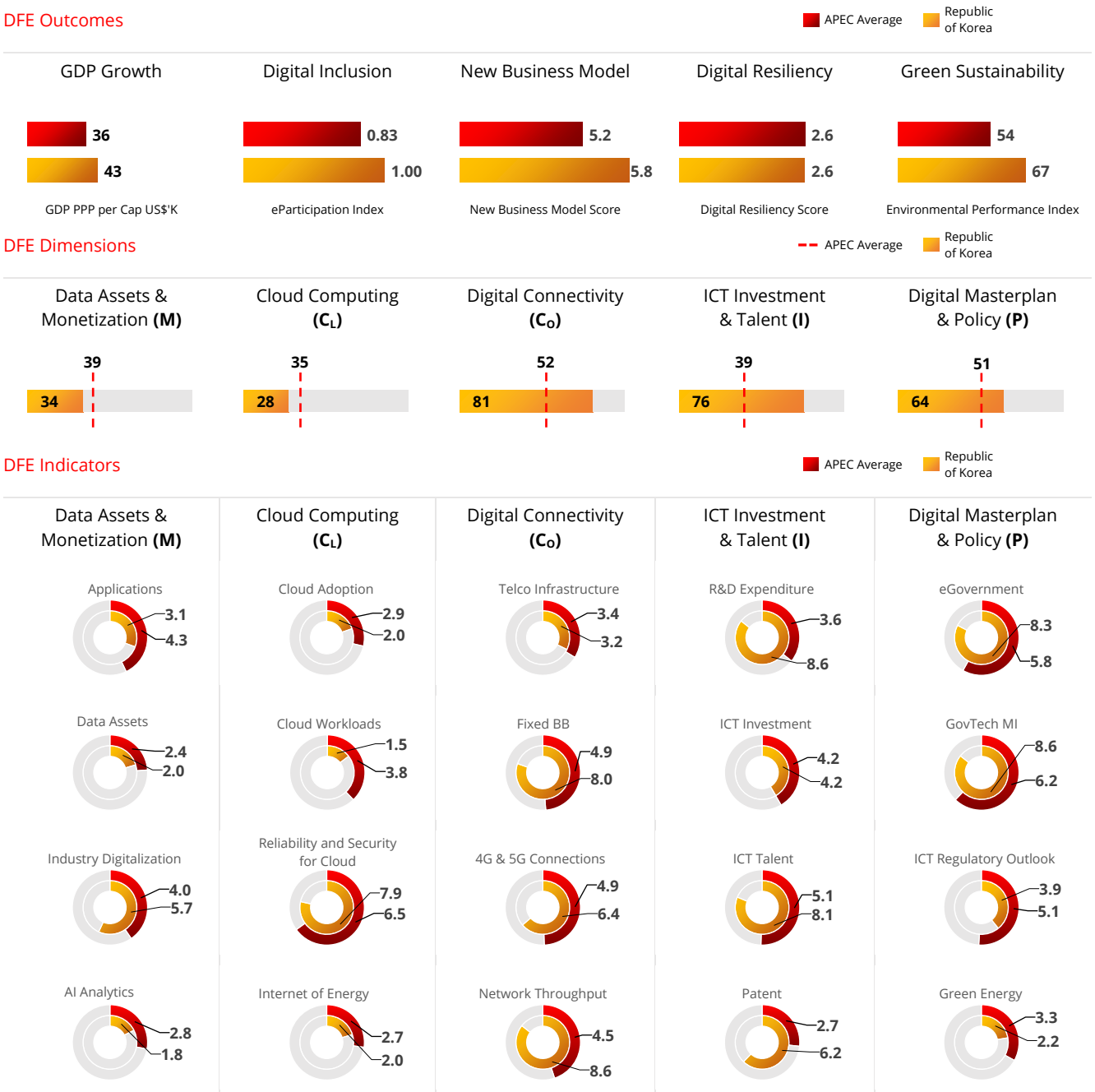
The Republic of Korea has prioritized supporting the digitalization of key sectors. This includes collaborating with relevant departments and institutions to establish a framework that promotes systematic development and utilization of ICT convergence services, including AI and blockchain technologies, to drive interoperability. To date, smart healthcare and smart farms are among the sectors that have completed this framework.[225] Initiatives have been in place to drive Smart Factories (defined here as a fully integrated technology-based manufacturing system that connects the entire production process) since at least 2017. The SME sector, which forms a sizable portion of the economy's businesses, is also being nudged along the digital transition path. In 2020, the government injected substantial funds into R&D projects to help SMEs

upgrade and upscale through automated technologies. Government-sponsored R&D and testbed projects include big data, smart sensors, wireless networks, and collaboration robots.[226]

4. Policy actions for Government (Public Service)

The United Nations (UN) 2020 E-Government survey rates the Republic of Korea as the 2nd best performer among 193 UN member states. It is also the global leader in online services provision.[227] The Republic of Korea's Digital Government Master Plan 2021-2025 was launched to drive a whole-of-government approach in its public sector digital transformation agenda.[228] Complementing this is the Intelligent Government Master Plan that, among other things, introduces an AI development and utilization framework and proactive provision of public services targeted at specific needs. Noteworthy public platforms include those for e-participation (e-People), open data (data.go.kr) and e-procurement (KONEPS).[229] At the foundational level, the Republic of Korea has an e-Government Standard Framework (eGovFrame) and is rolling out a Data Dam.[230] The data dam functions as a big data platform that funnels in data to derive useful insights from public and private sector sources, which could then be distributed across multiple industries.[231]

DFE Indicators Dashboard



Russian Federation

Basic Facts

Population (million): 144.10	• CO^2 emission (metric tons per capita): 11.13
GDP ($ billion): 1,483.5	• GDP (PPP) per capita ($): 28,213

DFE Score and Stage

DFE score: 34

DFE stage: Adopter

Average score among APEC economies: 43

The Russian Federation has a population of around 144 million and a GDP per capita of $28,213. The Russian Federation's DFE Outcomes, and Dimensions are largely below the APEC average. Most of the Russian Federation's DFE Indicators underperformed the APEC average, and the DFE indicators that the Russian Federation surpassed the APEC average by the most are ICT Talent and Reliability and Security for Cloud. With a DFE score of 34, the Russian Federation is at the Adopter stage.

Key Digital Economy Policy/Actions

1. National Masterplan

Digital economy transformation in the Russian Federation is increasingly prioritized under the Digital Economy of the Russian Federation national project (implementation: 2018 to 2024). The goals revolve around increasing domestic spending on digital economy development, rolling out sustainable, secure, and better quality ICT infrastructure, driving domestic software usage by government entities.[232] The Russian Federation has an overarching set of IT use and dissemination rules and coordinates the different digitalization programs and initiatives.[233] In recent years, the Russian Federation also enacted or amended its taxation legislation to favor qualifying local IT companies to develop the local IT sector. On a broader note, the Russian Federation has developed its legal and regulatory framework for the digital economy through legislation such as Law on Critical Infrastructure, Telemedicine Law, Online Cash Register Law, and Public-Private Partnerships Law. The right to privacy and personal and family secrets is provided for in the Constitution. At the same time, the main Russian data protection and cybersecurity laws are the Personal Data Law, the Data Localization Law, and the Runet Isolation Law.[234]

2. Policy actions for Citizens

A priority area is to provide quality connectivity to all its citizens. This is reflected in initiatives such as its 2016–2025 federal program for developing the Kuril Islands, which included submarine fiber-optic cable link construction in partnership with local telco Rostelecom, and, the Bridging the Digital Divide (BDD) project, where Rostelecom pledged to provide internet connectivity to 10,000 smaller communities (250 - 500 people) by 2020.[235] 5G infrastructure continues to be rolled out, and initiatives including launching a 5G network in St Petersburg that provides users with unlimited free 5G internet.[236]

3. Policy actions for Businesses

One of the initiatives under the Russian Digital Economy Program is to build a geographically diverse national network of data centers across the Russian Federation's regions by 2024 through the national telecom providers. While most of the data center capacity is in Moscow & St Petersburg, data centers are being expanded in the Russian Federation's Northern regions.[237] The Russian Federation is influencing its digital economy through state-owned companies investing in local social media companies.[238] From a longer-term perspective, local digital economy corporations may reap significant benefits. Due to less competition from foreign IT firms, the government has encouraged the development of local IT companies through significant tax incentives and preferential loans.[239] Approximately 21.5 billion rubles have been earmarked from the federal budget for producing Russian communication equipment.[240]

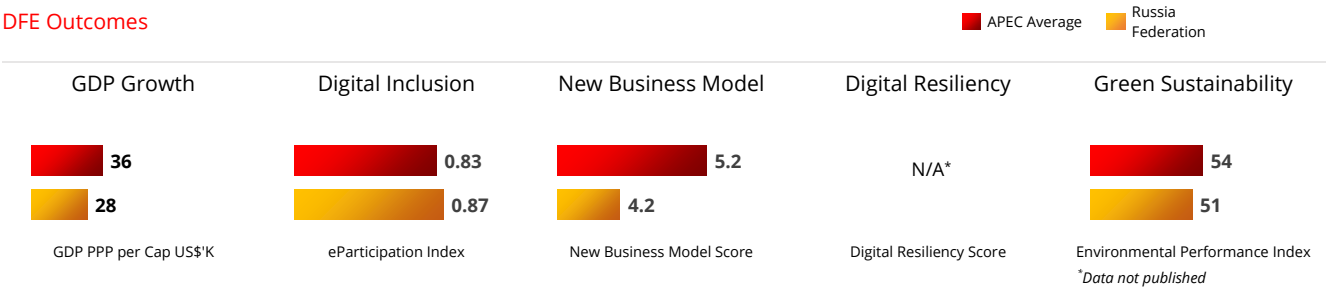
4. Policy actions for Government (Public Service)

The Russian Federation's eGovernment initiatives drive efficiencies and decrease public administration costs, with several initiatives designed for the state rather than the citizen as a primary focus. Nonetheless, progress has been made, particularly in digitalizing front-facing citizen and government public services.[241] Initiatives include launching the mobile version of the unified public services (e-government) portal and the Integrated Identification and Authentication System (IIAS), which provides a single access point for public officials and private entities to e-government infrastructure.[242] The

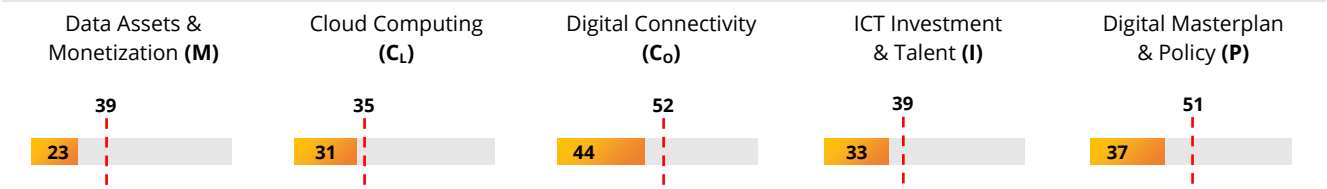
Ministry of Digital Development, Communications, and Mass Media develops digital transformation guidelines for state-owned companies while regulating digitalization processes under several state bodies' purview.[243]

DFE Indicators Dashboard

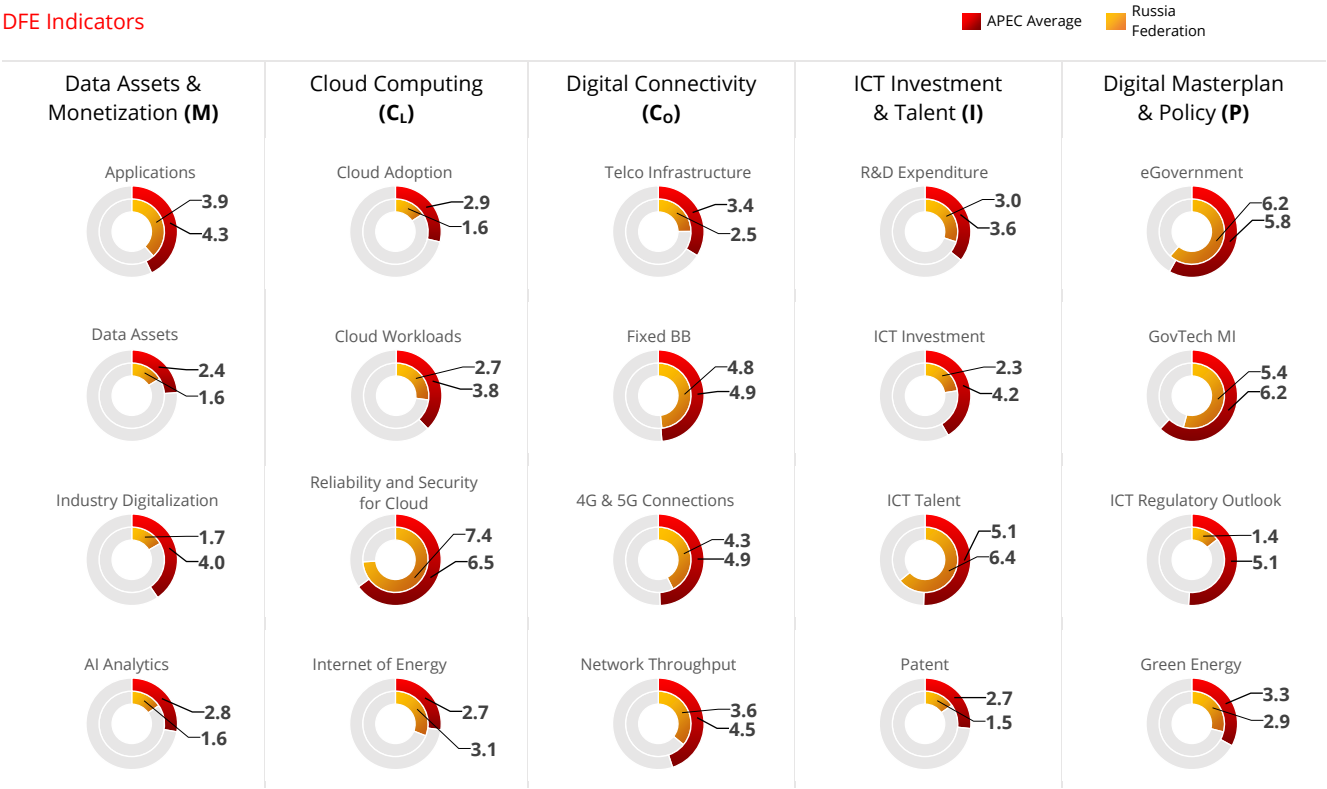
DFE Outcomes



DFE Dimensions



DFE Indicators



Singapore

Basic Facts

Population (million): 5.68	• CO^2 emission (metric tons per capita): 8.4
GDP ($ billion): 340	• GDP (PPP) per capita ($): 98,526

DFE Score and Stage

DFE score: 61

DFE stage: Advanced

Average score among APEC economies: 43

With a comparatively tiny population of just 5.68 million, Singapore has an enviable US$98,526 GDP per capita. Singapore secured a DFE score of 61 and is at the Advanced stage. Singapore's DFE outcomes and DFE Dimensions are above the APEC average across all the indicators. Singapore outpaced the APEC average by the most in the Digital Connectivity dimension; this is consistent with its excellent performance in the Network Throughput indicator, which is twice the APEC average. While Singapore's DFE indicators are mainly above the APEC average, it lags behind the APEC average in 3 areas: Green Energy, Internet of Energy, and AI Analytics.

Key Digital Economy Policy/Actions

5. National Masterplan

In 2014, Singapore launched the holistic Smart Nation strategy to drive digital transformation from silo-based to an ecosystem through a series of strategic national projects. The Digital Government Blueprint (DGB) was introduced in 2018 to harness modern technologies, better utilize data and drive efforts to build Singapore's digital economy and society in line with the larger Smart Nation strategy. The DGB was updated in December 2020 to add new digitization directions[244]. Singapore has made digitization a strategic priority to help cement its position as the ASEAN region's economic, business and technology hub in the coming years amid rapid technological shifts. Singapore has comparatively well-defined data protection and cybersecurity acts and policies that aim to strengthen public and international trust and organizational accountability.

6. Policy actions for Citizens

With decent connectivity readily available throughout most of Singapore, the focus now is on community development, resolving urban-municipal issues, and improving engaging its people to develop solutions that meet their needs. These include pilot projects that explore new modes of public transit.[245] Singapore's one-stop-shop government portal (Gov.sg) provides access to specialized government portals such as public procurement (gebiz.gov.sg) and e-services (citizenconnectcentre.sg). There are also digital platforms that citizens can utilize to plan and monitor their social security savings or lodge complaints about government services.[246] Singapore is also building the relevant digital economy skillsets within its citizenry with ICT skills- training through SkillsFuture courses to grow its IT professionals and data specialists' base.[247]

7. Policy actions for Businesses

One of Singapore's key policies is to increase commercial adoption of the latest digital technology such as 5G by businesses in actual use cases. It established funds, such as the SS$30 million government fund in January 2021, to help companies drive the commercialization of 5G applications.[248] Singapore also prioritizes AI technology development and deployment in the business sector. It has launched an AI national platform to assist startups and SMEs with pre-built AI solutions.[249] Singapore is also actively involved in initiatives to drive digital technology adoption within its small and medium-sized enterprises (SMEs). SMEs contribute almost 50% of Singapore's GDP and employ two-thirds of Singapore's workforce. In 2017, Singapore launched its SMEs Go Digital program, which contains initiatives that assist SMEs with starting their digitization journey and growing globally.[250] The government has extended the consent-based personal data platform MyInfo to businesses to help locally registered companies to digitalize and streamline their business operations by allowing them to obtain citizens' verified personal data via secure Application Programming Interfaces (API). It plans to provide access to more digital platforms to help drive new and innovative Business-to-Business and Consumer services.[251]

8. Policy actions for Government (Public Service)

Singapore's government aims to be 'digital to the core' to improve service quality, efficiency, and productivity and enable new means to engage people and businesses.[252] Led by the National Computer Board (now the Government Technology Agency or GovTech), Singapore began its digitization journey in the 1980s.[253] Singapore's government has adopted a "Cloud First" policy and aims to migrate 70% of Government systems deemed less sensitive to the cloud by 2023[254]. Since 2018, more than 150 government systems have moved to the commercial cloud[255]. Singapore's digital government-related policies have moved beyond digitizing processes and enabling online government service. The new focus includes using data science and AI to derive real-time, actionable information from multiple sources of government data assets. To better enable this, the government is focused on re-engineering its digital infrastructure through, for instance, providing a Government Data Architecture for common data standards and formats and a suite of shared software components and infrastructure (Singapore Government Technology Stack). AI deployment in the government has been earmarked in areas that include policy analysis and formulation improvement, automating processes to overcome manpower constraints, and providing personalized and anticipatory services.[256] Singapore is targeting to have all its public services officers equipped with basic digital literacy and to have 20,000 trained in data analytics and data science by 2023. [257]

DFE Indicators Dashboard

Chinese Taipei

Basic Facts

Population (million): 23.58	• CO^2 emission (metric tons per capita): 11.92
GDP ($ billion): 669.0	• GDP (PPP) per capita ($): 55,724

DFE Score and Stage

DFE score: 44

DFE stage: Accelerator

Average score among APEC economies: 43

Chinese Taipei has a population of just over 23.5 million and a GDP per capita of $55,724. Chinese Taipei, with a DFE score of 44, is at the Accelerator stage. Chinese Taipei's GDP growth and Green Sustainability scores are above the APEC average. The country's DFE Dimensions scores are generally close to the APEC average except for ICT Investment & Talent; Chinese Taipei outpaced the APEC average in ICT Investment & Talent, helped mainly by a strong R&D Expenditure score, where Chinese Taipei's score nearly doubles that of the APEC Average.

Key Digital Economy Policy/Actions

1. National Masterplan

Digital Nation, Smart Island is Chinese Taipei's national policy directory[68] . At the same time, its Digital Nation & Innovative Economic Development Program (DIGI+) 2017-2025 aims to enhance digital infrastructure, re-construct a service-based digital government, and realize a fair and active internet society with equal digital rights.[69] Initiatives include promoting broadband infrastructure, supporting the development of a regulatory framework, and advancing R&D.DIGI+'s main goals, including growing Chinese Taipei's digital economy to NT$6.5 trillion by 2025.[70] The government is also developing a legal and regulatory framework that safeguards privacy and addresses cybersecurity while supporting product innovation in its high-tech manufacturing industries. These include regulations and pilot plans addressing the digital economy, such as the AI Technology R&D Guidelines for technological researchers, the Unmanned Vehicles Technology Innovative Experimentation Act, and the AI application service pilot Guideline. Privacy and cybersecurity regulations are primarily addressed through the Personal Data Protection Act (PDPA) and the Cyber Security Management Act (CSMA).[71] Chinese Taipei has also initiated laws to address AI-Deepfake abuse.[72]

2. Policy actions for Citizens

One of the key policies that impact Chinese Taipei's digital infrastructure development for citizens is the Forward-looking Infrastructure Development Program. Under this program, funding provides for, among other things, digital infrastructure to enhance connectivity access for every citizen and reduce the digital gap (particularly in its regions). Also supported are initiatives that incubate young R&D talents and facilitate university innovation.[73] Recognizing its core strengths in ICT-related manufacturing industries, a fluent Chinese-speaking talent pool, and its vital role in several digital economy global supply chains, the government is investing in building citizens' English language proficiency through the Bilingual 2030 policy. The goals here include growing a pool of bilingual digital talent that is more internationally competitive.[74]

3. Policy actions for Businesses

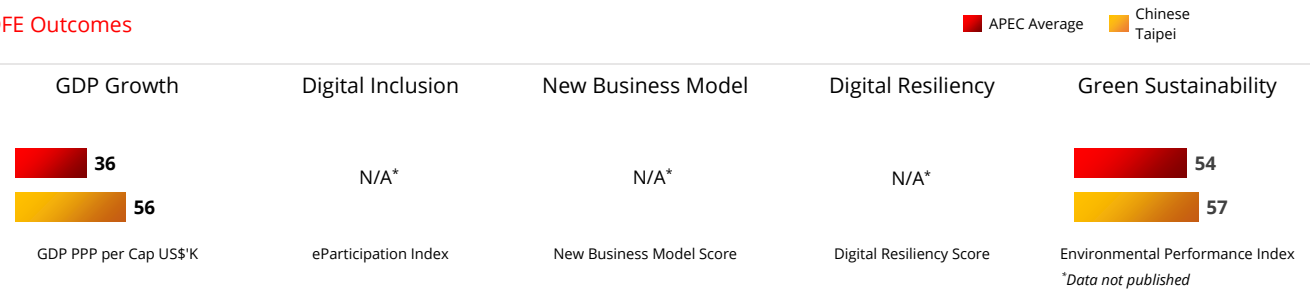
Chinese Taipei has put in place numerous policies and plans over the years to spur innovation and the competitiveness of its key industries through utilizing the latest technologies. One key policy is the Program for Promoting Six-Core Strategic Industries, launched in 2020. The program includes strategies to recruit and build the digital talent pool, optimize the regulatory environment, and provide financial support. The sectors covered are information and digital, cybersecurity, precision health, green and renewable energy, national defense, and strategic, and strategic stockpile industries. In addition, focus areas under the information and digital sectors are next-gen semiconductor technology R&D (goal: maintain Chinese Taipei's leading position), promoting AI and IoT (AIoT) applications (goal: export AIoT solutions), and 5G (goal: secure a position in the global 5G supply chain). [75] The government's AI technology priority is also reflected through its AI HUB initiative, which aims to support Chinese Taipei's businesses in several industries to upgrade by adopting AI technologies. Initiatives here include incentives for enterprises adopting AI technologies, support for companies' R&D research, and highlighting AI use cases.[76] Chinese Taipei's strong focus on 4IR and developing its core industries is reflected in the initiatives it has launched over the years, including the 5+2 Industrial Innovation plan (sectors covered: biotech and pharmaceuticals, green energy, national defense, smart machinery, the IoT, 'circular economy' and agricultural development)[77] and the Asia Silicon Valley Development Plan 2.0 (goals: drive innovation and IoT devices and applications R&D and, supporting Chinese Taipei's startup and entrepreneurship ecosystem).[78] Initiatives to develop the local startup scene include the Action Plan for Enhancing Taiwan's Startup Ecosystem, which provides funds, tax incentives, and others.[79]

4. Policy actions for Government (Public Service)

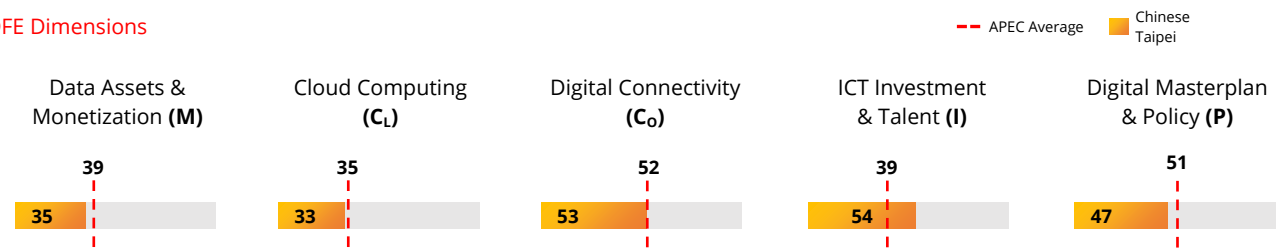
Chinese Taipei has been investing in digitizing its government operations in stages since 1998. Formulated by the National Development Council (NDC), the current policy, Digital Government Program 2.0 of Taiwan (2021-2025), was launched to implement the digital government transformation plan with three key goals – drive the release and reuse of government data, improve public service provision via digital technologies, and utilize data to drive evidence-based policy or action plan making. Initiatives include a complete government cloud infrastructure, a one-stop online service across relevant government agencies for citizens and businesses and expanding public policy communication and collaboration.[80] Also, Chinese Taipei's Government Open Data Platform contains over 40,000 data sets and records over two million downloads annually. The focus going forward includes expanding the release of high-value data, increasing data quality, and driving data reuse.[81] Other digital government plans currently in progress include the Smart Government Action Plan, which complements the Digital Government Program 2.0.[82]

DFE Indicators Dashboard

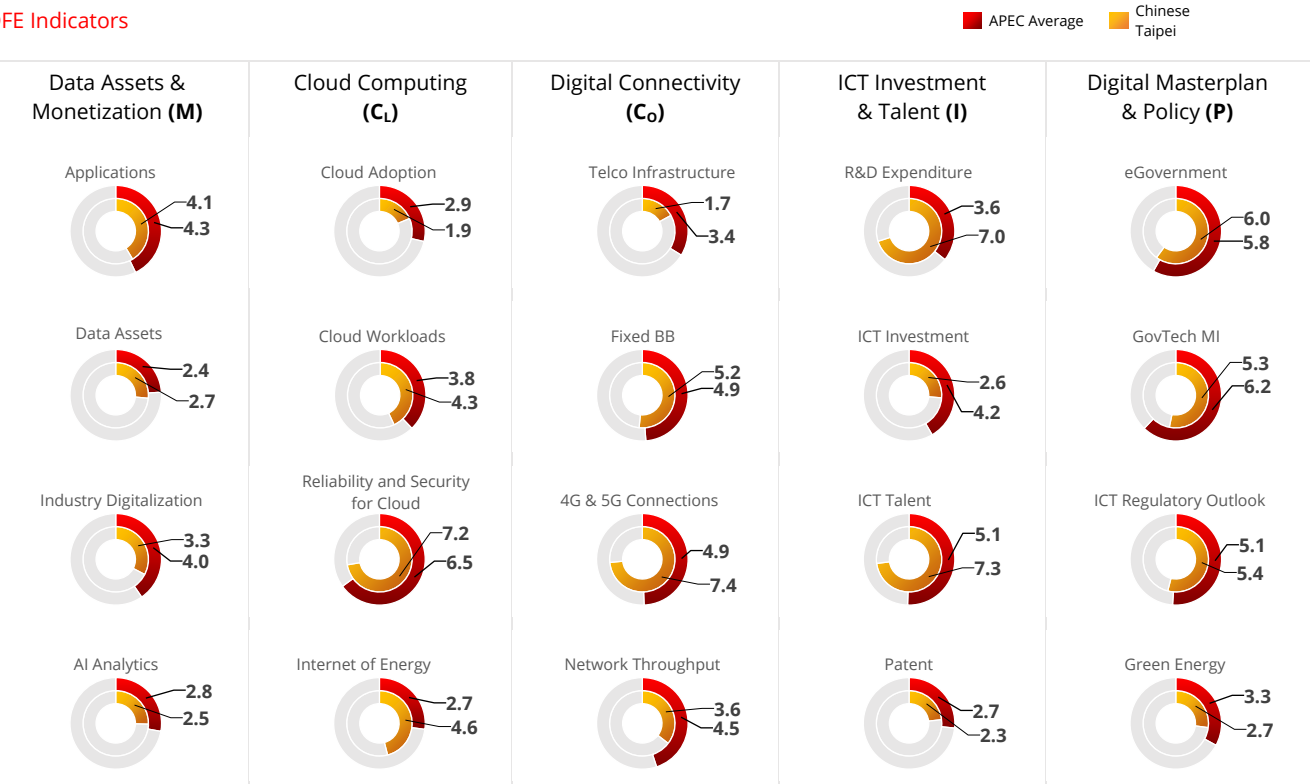
DFE Outcomes



DFE Dimensions



DFE Indicators



Thailand

Basic Facts

Population (million): 69.80	• CO^2 emission (metric tons per capita): 3.71
GDP ($ billion): 501.8	• GDP (PPP) per capita ($): 18,236

DFE Score and Stage

DFE score: 38

DFE stage: Accelerator

Average score among APEC economies: 43

Thailand has nearly 70 million people and a GDP per capita of US$18,236. With a DFE score of 38, it is at the Accelerator stage. Thailand's 5 DFE outcomes are below that of the APEC average. Among the 5 DFE Dimensions, Thailand is below the respective APEC averages except in Digital Connectivity, where it scored well in Telco Infrastructure and Network Throughput.

Key Digital Economy Policy/Actions

1. National Masterplan

Thailand has been investing in its digital economy for over 20 years. Some of the current key policies influencing its digital economy development include the Digital Thailand Plan and the 20 year-National Master Plan for Digital Development (2018–2037). Meanwhile, Thailand 4.0 is a sector-specific national development plan that aims to unlock the economy from several challenges resulting from past economic development models, which emphasize agriculture (Thailand 1.0), light industry (Thailand 2.0), and advanced industry (Thailand 3.0). The government also announced new investment incentives in 2017 to attract investors to tech-oriented activities. The Ministry of Digital Economy and Society (MDES) is responsible for Thailand's digital economy development. Thailand's government has prioritized cybersecurity and data privacy issues but appears to have focused less on data sovereignty issues which may weaken its ability to enforce data security. The Personal Data Protection Act 2019 is Thailand's first consolidated law governing data protection. Other regulations, including the Cybersecurity Act, were introduced in the past few years to facilitate, protect, and create a secure digital ecosystem for both consumers and digital providers.

2. Policy actions for Citizens

Under Phase 1 of its Digital Thailand initiative, the government is focused on building and investing in its digital foundation. This includes extending better quality connectivity to more remote areas to reduce the digital divide. Initiatives include the "Village Broadband Internet" scheme, a flagship digital infrastructure development project to expand high-speed internet networks throughout the economy to enable Thai people who live in remote areas to access broadband or high-speed Internet. At present, all of Thailand's 74,987 villages can access high-speed internet networks, which allow users to access the government's e-services on health care and online government, as well as e-commerce, e-business, and e-banking applications. Other initiatives include broadband subscription subsidies for the low-income and elderly population and subsidizing broadband costs for border villages. Connectivity infrastructure for innovative technologies is not neglected, and Thailand has invested in upgrading its city connectivity infrastructure. Driven by the health crisis requirements from the COVID-19 pandemic, it became the first economy in ASEAN to launch commercial 5G services ahead of Singapore and Malaysia.

3. Policy actions for Businesses

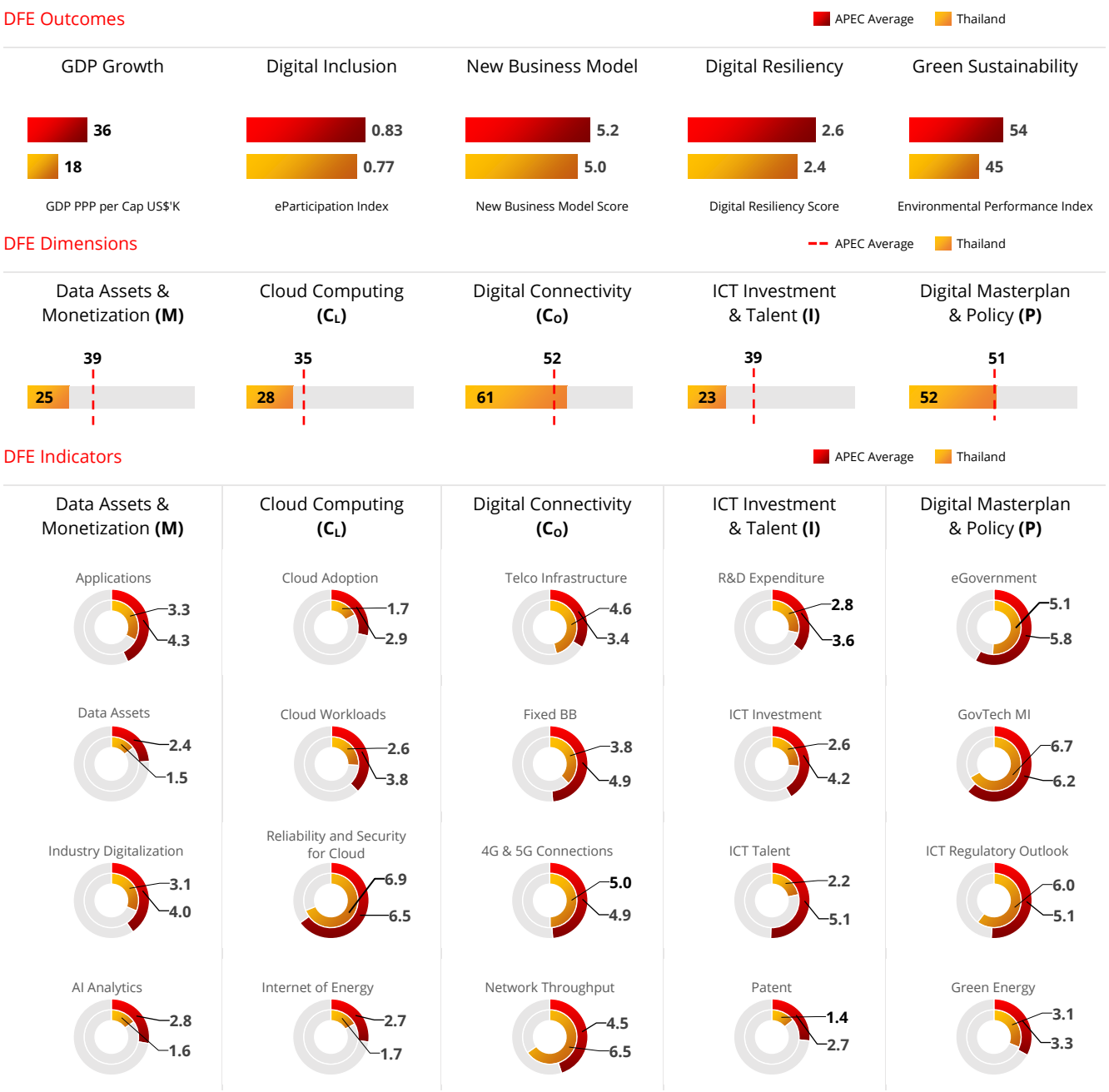
A key prong of the "Thailand 4.0" national development plan is to promote the adoption and innovation of digital, automation, and robotics technology among SMEs, manufacturing companies, and the service sector. This will also underpin the robust demand for data centers. The data center industry continues enjoying a healthy demand, with more organizations adopting cloud technology, big data and analytics, and Internet of things colocations as businesses look for more stable and affordable resources for server storage and data analytics and connection. The proliferation of technology companies, IT service providers, and e-commerce companies in Thailand has shifted towards hyper-scale colocation data centers. There are 18 colocation centers in Thailand, 16 in Bangkok, and the other two in the Eastern Economic Corridor.

4. Policy actions for Government (Public Service)

The Digital Government Development Agency (DGA), entrusted by law to move digital government implementation forward, has accelerated the digital government architecture among government agencies in the wake of the COVID- 19 pandemic.

Among the key measures are the acceleration of the Thailand Government Information Exchange, a central database of government agencies designed to reduce the documentation burden on the private sector, improve efficiency by eliminating redundancy, and promote the use of Digital ID, including digital signatures, among government agencies. Other important initiatives include the creation of a government data catalog (to enable the private sector to access the public sector's data more efficiently) and a central cloud system providing cloud service for government agencies (to ensure the safety of government data, optimize IT spending, and serves as a backup in the event of disasters). The government plans to upskill 2,500 employees with cloud computing expertise to address government employees' digital skills gap issue.

DFE Indicators Dashboard



The United States

Basic Facts

Population (million): 329.48	• CO^2 emission (metric tons per capita): 15.24
GDP ($ billion): 20,936.6	• GDP (PPP) per capita ($): 63,544

DFE Score and Stage

DFE score: 76

DFE stage: Advanced

Average score among APEC economies: 43

The United States has a population of just under 329.5 million and a GDP per capita of $63,544. The United States' advanced stage of DFE is scored 76, which outpaces the APEC average across all 5 DFE Outcomes and 5 DFE Dimensions. It does better than the APEC average in most DFE Indicators, except Green Energy. The United States outperformed the APEC average by the most in Data Assets & Monetization, where it did exceptionally well in AI Analytics.

Key Digital Economy Policy/Actions

1. National Masterplan

In general, the United States' policies for the digital economy have a private-driven, free-market approach that supports innovation and favors companies' first-mover and/or dominant position in the local and global digital economy.[258] The Digital Economy Agenda has four key objectives: to promote a free and open internet globally, to promote trust online to help electronic commerce flourish, to ensure fast broadband network access and to promote innovation through smart IP rules and NextGen technologies. [259] Focus is also given to building trusted networks, as reflected in the Federal Communications Commission's $1.9 billion programs that subsidize the costs for small telecommunication companies to rip and replace equipment from Chinese telecommunication companies deemed by the United States government as national security risks.[260] The United States also prioritizes new technology development in its national plan – recently signed Presidential directives that advance the national quantum information science initiative (QIS) and The National Artificial Intelligence Initiative (NAII), which seeks to ensure its continuity AI R&D leadership position globally.[261] Unlike most developed countries, the United States does not have a single comprehensive federal law covering data privacy.. However, some states have privacy laws (e.g., California and Virginia).[262] The United States' cybersecurity regulatory framework is being strengthened (e.g., with the draft Strengthening American Cybersecurity Act of 2022).[263]

2. Policy actions for Citizens

Building out the 5G infrastructure continues, with a heavier focus now on safeguarding 5G infrastructure domestically and abroad. In 2020 and 2021, the United States established the National Strategy to Secure 5G and its Implementation Plan to support the continued development, deployment, and management of secure and reliable 5G.[264] Digital inclusion is another key focus area. Under the Bipartisan Infrastructure Deal (Infrastructure Investment and Jobs Act), the United States aims to provide everyone in America with low-cost, reliable, high-speed internet. Among other things, $65 billion has been allocated to expand broadband access across communities, subsidize connectivity costs for low-income households, and address further digital inequity and inclusion needs. These include funding for the Tribal Broadband Connectivity Program and middle-mile connections to build a high-speed backbone.[265]

3. Policy actions for Businesses

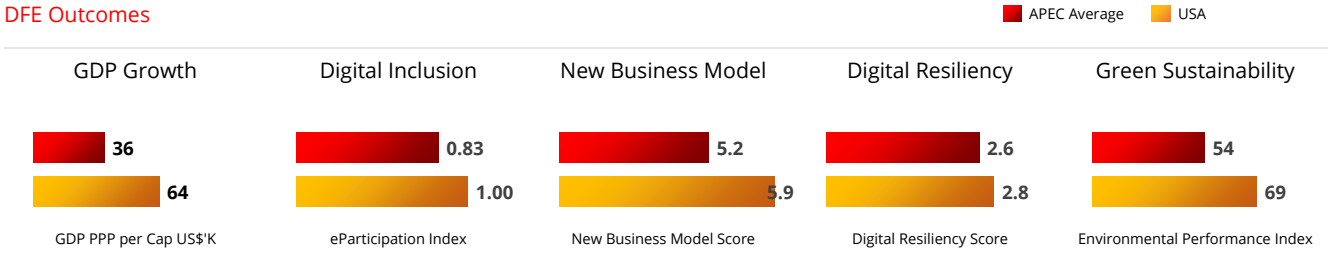
Recent industrial policy efforts, including those impacting the digital economy, are significantly different in size (in terms of $billions) and scope. The COVID-19 pandemic and resulting shortages in critical pharmaceutical and other needs have highlighted domestic supply chain gaps and its dependence on imported inputs. Operation Warp Speed (OWS) therefore involved rapidly scaling up the technology to the manufacturing process and administering COVID-19 vaccinations through massive multiagency coordination (private and public organizations) and significant funding. Regarded as a highly public success, OWS has further driven industrial policy interest in the United States.[266] The United States is currently formulating policies to strengthen its domestic supply chains through domestic production in sectors, including those that impact the digital economy, such as critical minerals, advanced batteries, and semiconductors. New industrial policies proposed include the Innovation and Competition Act (which authorizes funding over $100 billion to advance 10 developed technology areas), and the CHIPS (Creating Helpful Incentives to Produce Semiconductors) Act. Priority is also given to advance clean energy technologies - the Senate passed a major bipartisan $1 trillion infrastructure funding package in 2021 that includes funding for renewable energy programs, a new DOE Office of Clean Energy Demonstrations, critical minerals and materials projects and demonstrations and carbon management projects.[267]

4. Policy actions for Government (Public Service)

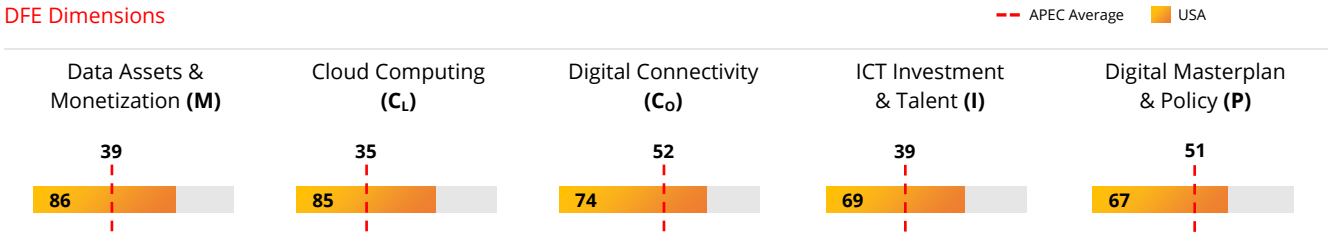
The Federal Data Strategy's (FDS') annual Action Plans provide milestones and targets a systematic, incremental maturity ladder, ~2020-2022: Foundational activities (governance, planning, and infrastructure), ~2023-2025: Enterprise activities (standards, budgeting, and coordination), ~2026-2028: optimized self-service analytics, and ~2029 onwards: Data-Driven activities (proactive, evidence-based decisions and automated data improvements). The Chief Data Officer Council was formed to facilitate interagency collaboration and information sharing for the FDS.[268] Launched a decade ago in 2012, the United States federal government's data strategy milestones were successfully achieved after the focus on building secure interoperability and openness in government systems through, for example, common standards and providing a growing list of API data sets.[269] Among the measures undertaken to provide better public service are in the 21st Century Integrated Digital Experience Act and through digital.gov.[270] Transparency in governance and citizen participation is also a focus, as reflected in the United States' no.1 position (tied with two other countries) in the UN's 2020 E-Participation Index.[271] Examples include the Data.gov open data site (which provides a broad range of the U.S. Government's open data, tools, and resources.) [272] and Regulations.gov (which provides public access to regulatory material and rulemaking participation).[273]

DFE Indicators Dashboard

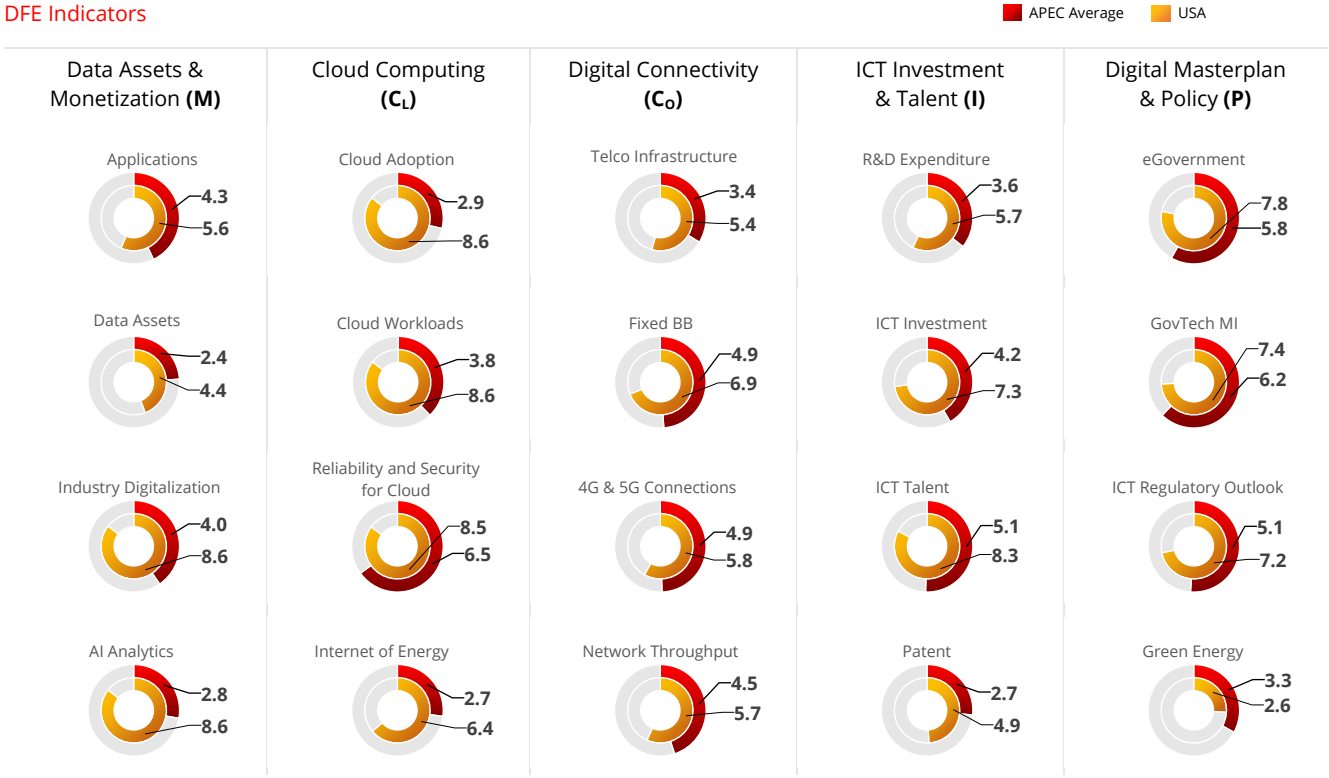
DFE Outcomes



DFE Dimensions



DFE Indicators



Viet Nam

Basic Facts

Population (million): 97.34	• CO^2 emission (metric tons per capita): 2.70
GDP ($ billion): 271.2	• GDP (PPP) per capita ($): 8,651

DFE Score and Stage

DFE score: 26

DFE stage: Adopter

Average score among APEC economies: 43

Viet Nam's population is just over 97 million, with a GDP per capita of $8,651. Viet Nam is in the Adopter stage with a DFE score of 26. Viet Nam's DFE Outcomes and Dimensions scores are below the APEC average. While its Green Energy DFE indicator score surpasses the APEC average, the rest of its DFE indicators scores are below the APEC average, indicating more work to be done to implement policies and strategies to develop the digital economy in Viet Nam.

Key Digital Economy Policy/Actions

1. National Masterplan

Digital economy, digital society, and government are increasingly prioritized in Viet Nam's policies and strategies. This is also reflected in Viet Nam's Socio-economic development plan for 2021-2025 (Plan), where the digital economy is targeted to contribute to about 20% of the Viet Nam's GDP.[274] Major digital economy-related actions in the Plan include accelerating digital infrastructure's policy formulation and legal framework development, driving the digital transformation of Vietnamese enterprises, nurturing digital talent, and building and implementing eGovernment.[275] Viet Nam launched its National Digital Transformation program in 2020 with the twin goals of developing a digital government and economy as well as launching Vietnamese digital businesses with a global reach.[276] Other policies influencing Viet Nam's digital economy's direction include its National strategy for the Fourth Industrial Revolution[277]. Laws were introduced to support the national innovation system. However, there is still room for improvement in areas such as law enforcement.[278] Data sovereignty is an issue that Viet Nam is attempting to address as it seeks to develop a competitive and robust digital economy while maintaining control over data deemed sensitive. Viet Nam is forming its personal data protection law while its Cybersecurity Law and Network Information Security Law regulate data protection and data privacy rights.[279]

2. Policy actions for Citizens

Priority areas for Viet Nam include creating conditions to narrow the digital divide (e.g., improving rural connectivity coverage and addressing citizens' digital skills deficit) and digitizing public services to improve efficiencies. One of the objectives of the National Strategy Towards 2030 on Technology and Innovation is to provide over 80% of households and all villages with broadband network infrastructure coverage by 2025.[280] Initiatives launched to reduce the digital divide through education and training in digital skills include collaborating with a global technology company to provide digital skills training to 650,000 people and the 'Internet Connection and Computers for Students', which supports disadvantaged students lacking online learning facilities.[281] Viet Nam has also rolled out initiatives to improve public service provision, including the National Public Service Portal, which has integrated 3,552 online public services (e.g., tax payments and driving licenses).[282]

3. Policy actions for Businesses

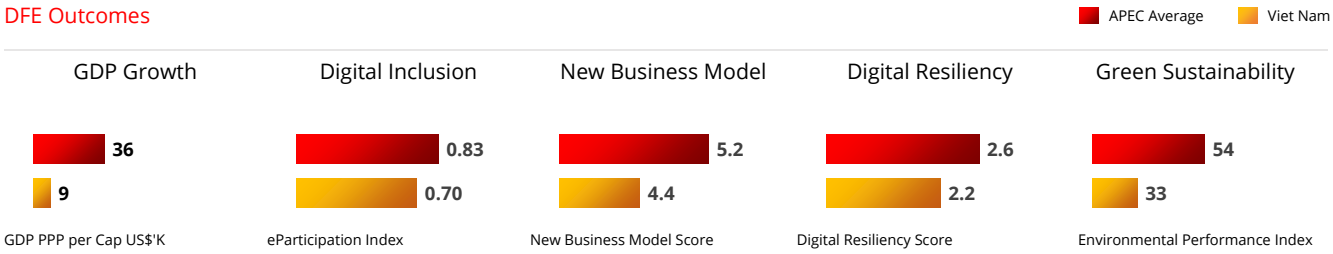
Key challenges businesses face in their bid to 'go digital' include the lack of financial resources, poor IT infrastructure, cybersecurity concerns, and digital talent shortage. Viet Nam has been investing in its 5G infrastructure as part of a larger strategy to build its digital economy foundations to drive, among other things, a 4IR 'revolution' in key industries (agriculture, manufacturing, and logistics)[283]. With 5G trials already in the works, Viet Nam plans to license 5G commercialization in 2022 and expand 5G coverage in urban areas and high-tech industrial zones.[284] Viet Nam's National Digital Transformation Program provides incentives and support for startups and encourages the use of new technologies by large companies in line with the Made in Vietnam strategy.[285] It also aims to develop 100,000 technology companies by 2030.[286] The government is providing support to assist businesses in digitalizing their operations in line with the Plan; initiatives here include online tools to help companies to build their digital strategy via a government portal (digital.business.gov.vn)) and provision of a digital transformation consultant network.[287] Collaboration with United States Agency for International Development (USAID) was initiated through the LinkSME Project to run the Digital Transformation Business Support Program between 2021 to 2025.[288] Viet Nam has also deployed the electronic invoice system nationwide to increase efficiencies and reduce opportunities for corruption.[289]

4. Policy actions for Government (Public Service)

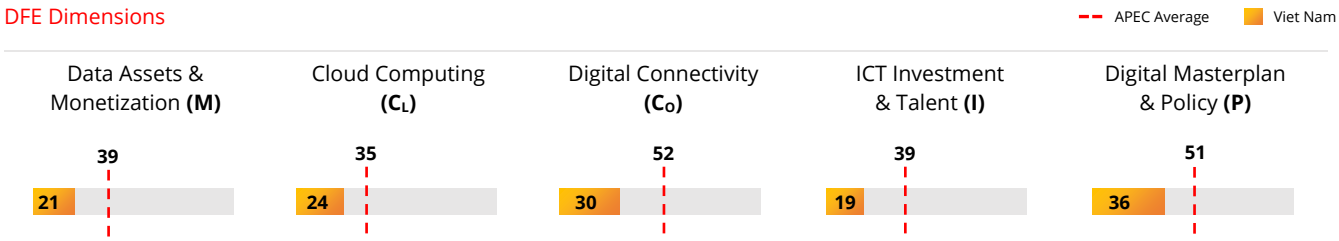
Viet Nam's policies for digitizing its government is primarily driven by The National Digital Transformation Programme and the eGovernment development strategy. In 2021, Viet Nam launched its first eGovernment development strategy (e-Government Development Strategy Towards the Digital Government in the 2021-2025 period, with an Orientation to 2030) with an emphasis on cybersecurity in its Digital Government development.[290] Its 2030 vision is to rank among the top 30 countries in e-government and digital government as measured by the United Nations. Some of the strategy's targets include improving state agency operations, expanding public engagement, and providing better public services. [291] Initiatives to drive the digital government agenda include equipping its human resource with digital skills (at least 1000 officials and public sector workers have been trained to date, and the goal is to train 100,000 trained by October 2022), interconnecting all national databases (including population, land, business registration, finance, and insurance) to provide a consolidated view through a government reporting information system, and greenlighting a mobile money service pilot program in 2021 for two years.[292]

DFE Indicators Dashboard

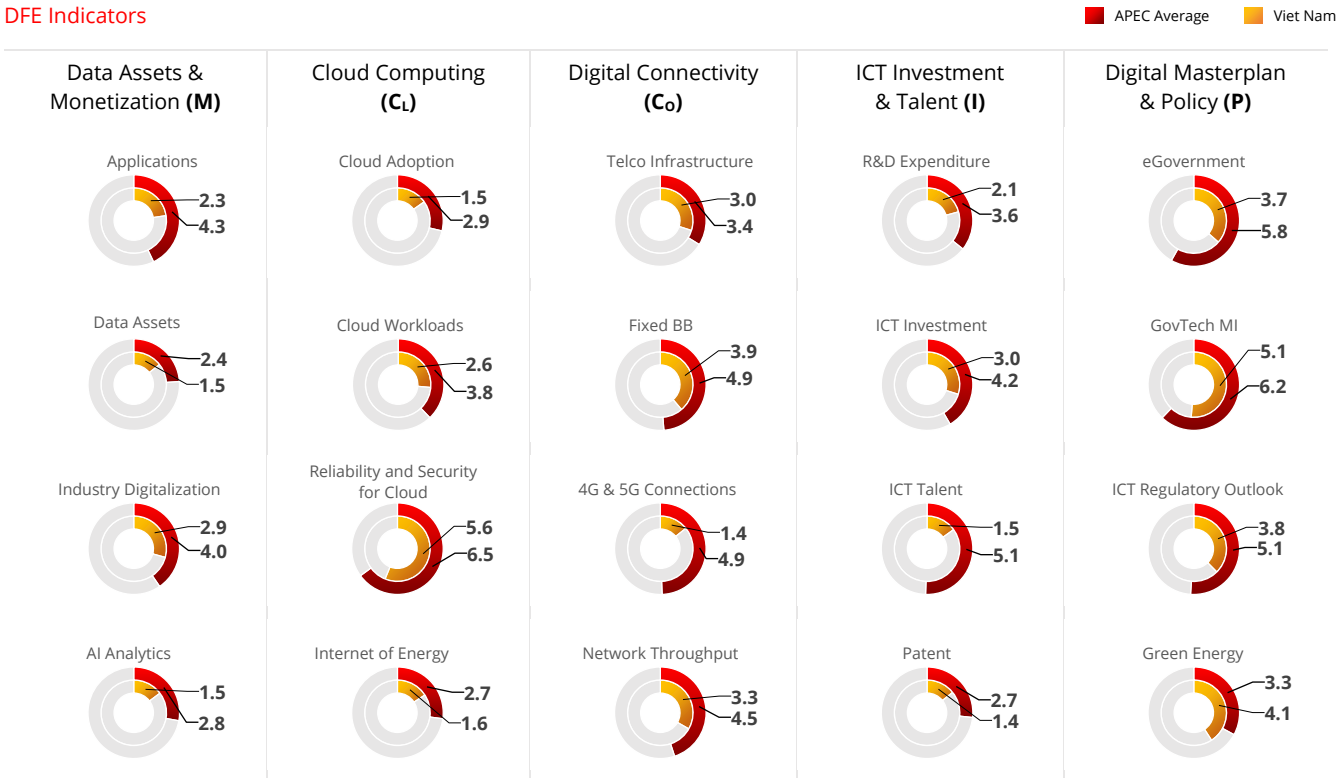
DFE Outcomes



DFE Dimensions



DFE Indicators



[1] Australia's Digital Economy. https://digitaleconomy.pmc.gov.au/strategy/key-investments
[2] Justin Hendry, "Gov tops up digital economy strategy with $130m". it News. Mar 29, 2022. https://www.itnews.com.au/news/gov-tops-up-digital-economy-strategy-with-130m-578036
[3] Digital Government Strategy, Australian Government. https://www.dta.gov.au/sites/default/files/2021-12/Digital%20Government%20Strategy_web-ready_FA.pdf
[4] Digital Economy Strategy 2030, Australian Government. https://digitaleconomy.pmc.gov.au/sites/default/files/2021-07/digital-economy-strategy.pdf
[5] Privacy Act 1988, Australian Government. https://www.ag.gov.au/rights-and-protections/privacy#:~:text=The%20Privacy%20Act%201988%20(Privacy,and%20in%20the%20private%20sector,
[6] Justin Hendry, "Gov tops up digital economy strategy with $130m". it News. Mar 29, 2022. https://www.itnews.com.au/news/gov-tops-up-digital-economy-strategy-with-130m-578036
[7] Australia's Digital Economy. https://digitaleconomy.pmc.gov.au/strategy/key-investments
[8] Justin Hendry, "Gov tops up digital economy strategy with $130m". it News. Mar 29, 2022. https://www.itnews.com.au/news/gov-tops-up-digital-economy-strategy-with-130m-578036,
Australia's Digital Economy. https://digitaleconomy.pmc.gov.au/sites/default/files/2021-07/digital-economy-strategy.pdf
[9] Australia's Digital Economy. https://digitaleconomy.pmc.gov.au/sites/default/files/2021-07/digital-economy-strategy.pdf
[10] Justin Hendry, "Four industry-run AI centres to share in $44m", it News, Mar 31, 2022. https://www.itnews.com.au/news/four-industry-run-ai-centres-to-share-in-44m-578142
[11] Digital Economy Strategy 2030, Australian Government. https://www.dta.gov.au/sites/default/files/2021-11/Digital%20Government%20Strategy_acc.pdf
[12] Digital and ICT investments, Australian Government. https://www.dta.gov.au/help-and-advice/digital-and-ict-investments
[13] Alita Sharon, "Australian Government Updates Digital Government Strategy", Open Gov, December 25, 2021. https://opengovasia.com/australian-government-updates-digital-government-strategy/
[14] Justin Hendry, "Gov tops up digital economy strategy with $130m". it News. Mar 29, 2022. https://www.itnews.com.au/news/gov-tops-up-digital-economy-strategy-with-130m-578036
[15] Digital Economy Masterplan 2025, Brunei Darussalam. http://www.mtic.gov.bn/DE2025/documents/Digital%20Economy%20Masterplan%202025.pdf
[16] The Star. https://www.thestar.com.my/aseanplus/aseanplus-news/2021/05/23/brunei-to-launch-new-law-to-protect-personal-data
[17] Digital Economy Masterplan 2025, Brunei Darussalam. http://www.mtic.gov.bn/DE2025/documents/Digital%20Economy%20Masterplan%202025.pdf
[18] Cyber Security Brunei. https://www.csb.gov.bn/cyber-security-order
[19] Digital Economy Masterplan 2025, Brunei Darussalam. http://www.mtic.gov.bn/DE2025/documents/Digital%20Economy%20Masterplan%202025.pdf
[20] UNN. https://unn.com.bn/, James Barton. "Brunei's fixed-line telecom markets blossom while mobile languishes" Developing Telecoms, January 24, 2022. https://developingtelecoms.com/telecom-business/market-reports-with-buddecom/12742-brunei-s-fixed-line-telecom-markets-blossom-while-mobile-languishes.html
[21] AITI Strategic Plan 2020 -2025, Brunei Darussalam. https://www.aiti.gov.bn/SiteCollectionDocuments/Strategic_Plan/AITI%20Strategic%20Plan%202020-2025.pdf
[22] Izah Azahari. "Journey to become Smart Nation" Borneo Bulletin, February 23, 2021. https://borneobulletin.com.bn/journey-to-become-smart-nation/
[23] BruDirect. https://brudirect.com/news.php?id=88060, "Gov't releases first digital economy masterplan", The Scoop. https://thescoop.co/2020/06/05/govt-releases-first-digital-economy-masterplan/
[24] Nursyazwani HR. "Baiduri Bank, DST and Union Pay launched DSTPay eWallet". The Brunei Post, July 8, 2021. https://www.thebruneipost.co/sponsored-content/2021/07/08/baiduri-bank-dst-and-union-pay-launched-dstpay-ewallet/
[25] Satu Kampung Satu Produk. http://www.1k1p.gov.bn/SitePages/Latar%20Belakang.aspx, Aaron Wong, "eKadaiBrunei: Brunei's first online e-commerce directory launched". BIZ|BRUNEI, April 1, 2020. https://www.bizbrunei.com/2020/04/ekadaibrunei-bruneis-first-online-e-commerce-directory-launched/
[26] "Brunei Darussalam and COVID-19: Shifting Towards Digital Transformation" APEC.
http://mddb.apec.org/Documents/2020/MM/SMEMM/20_smemm_016.pdf
[27] AITI Strategic Plan 2020 -2025, Brunei Darussalam. https://www.aiti.gov.bn/SiteCollectionDocuments/Strategic_Plan/AITI%20Strategic%20Plan%202020-2025.pdf
[28] "Brunei Darussalam and COVID-19: Shifting Towards Digital Transformation" APEC.
http://mddb.apec.org/Documents/2020/MM/SMEMM/20_smemm_016.pdf
[29] James Kon. "Initiatives keep country on track for Smart Nation aspirations". Borneo Bulletin, January 14, 2021. https://borneobulletin.com.bn/initiatives-keep-country-on-track-for-smart-nation-aspirations/, http://mddb.apec.org/Documents/2020/MM/SMEMM/20_smemm_016.pdf
[30] AITI Strategic Plan 2020 -2025, Brunei Darussalam. https://www.aiti.gov.bn/SiteCollectionDocuments/Strategic_Plan/AITI%20Strategic%20Plan%202020-2025.pdf
[31] Office of the Privacy Commissioner of Canada. https://www.priv.gc.ca/en/privacy-topics/privacy-laws-in-canada/the-personal-information-protection-and-electronic-documents-act-pipeda/ , Melissa Lukings and Arash Habibi Lashkari, "Understanding Canadian cybersecurity laws: Privacy and access to information, the Acts (Article 2)". IT World Canada, February 20, 2020. https://www.itworldcanada.com/blog/understanding-canadian-cybersecurity-laws-privacy-and-access-to-information-the-acts-article-2/440303
[32] "High-speed Internet for all of Canada", Government of Canada. https://ised-isde.canada.ca/site/high-speed-internet-canada/en
[33] Chris Burt, "Canadian digital identity strategy to emphasize open standards for interoperability " Biometric Update, May 24, 2021.
https://www.biometricupdate.com/202105/canadian-digital-identity-strategy-to-emphasize-open-standards-for-interoperability
[34] Saskatoon, Saskatchewan, "Minister Wilkinson Highlights Innovation Clusters Investments in Budget 2022 ",Government of Canada, April 14, 2022.
https://www.canada.ca/en/natural-resources-canada/news/2022/04/minister-wilkinson-highlights-innovation-clusters-investments-in-budget-2022.html
[35] Digital Transformation for all, Annual report 2021- 2022. https://annualreport.digitalsupercluster.ca/2021/

[36] Strategic Plan, Scale|AI. https://cdn.scaleai.ca/uploads/2020/05/scale-ai_strategic-plan_en.pdf
[37] Digital Operations Strategic Plan: 2021–2024, Government of Canada. https://www.canada.ca/en/government/system/digital-government/government-canada-digital-operations-strategic-plans/digital-operations-strategic-plan-2021-2024.html
[38] Digital Operations Strategic Plan: 2021–2024, Government of Canada. https://www.canada.ca/en/government/system/digital-government/government-canada-digital-operations-strategic-plans/digital-operations-strategic-plan-2021-2024.html
[39] OECD Economic Surveys: Chile 2021. https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[40] OECD Economic Surveys: Chile 2021. https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[41] 70 actions for AI in the next decade, Ministry of Ministry of Science, Technology, Knowledge and Innovation, Chile. https://minciencia.gob.cl/areas-de-trabajo/inteligencia-artificial/politica-nacional-de-inteligencia-artificial/plan-de-accion/
[42] CMS.Law.https://cms.law/en/int/expert-guides/cms-expert-guide-to-data-protection-and-cyber-security-laws/chile, OECD Economic Surveys: Chile 2021.
https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[43] "President Piñera presents digital transformation bill and creates advisory council on State modernization". Gob.cl. https://www.gob.cl/en/news/president-pinera-presents-digital-transformation-bill-and-creates-advisory-council-state-modernization/
[44] Maolis Castro (EN) and Adam Critchley, "Maolis Castro (EN) and Adam Critchley", Bloomberg Línea, March 11, 2022.
https://www.bloomberglinea.com/2022/03/11/chiles-gabriel-boric-sworn-in-faces-major-economic-and-political-challenges/

[45] OECD Economic Surveys: Chile 2021. https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[46] OECD Economic Surveys: Chile 2021. https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[47] OECD Economic Surveys: Chile 2021. https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[48] OECD Economic Surveys: Chile 2021. https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[49] OECD Economic Surveys: Chile 2021. https://www.oecd-ilibrary.org/sites/4c7db951-en/index.html?itemId=/content/component/4c7db951-en#chapter-d1e6428
[50] iNews. "Comparison of leading enterprises in China's telecommunications optical fiber and cable industry in 2021: YOFC VS Hengtong Optoelectronics" https://inf.news/en/economy/2cb91c4c408da3857db621bbb31456ee.html
[51] Digichina, Stanford University. https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/
[52] Digichina, Stanford University. https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/
[53] Zhou Xin, "China digital currency: e-CNY rollouts expand to Hangzhou and Chongqing as Chinese central bank seeks broad support for its push to go cashless", South China Morning Post, April 2, 2022. https://www.scmp.com/tech/policy/article/3172885/china-digital-currency-e-cny-rollouts-expand-hangzhou-and-chongqing
[54] Qian Zhou, "A Close Reading of China's Fintech Development Plan for 2022-2025 ", China Briefing, January 20, 2022. https://www.china-briefing.com/news/a-close-reading-china-fintech-development-plan-for-2022-2025/
[55] Samuel Yang, " The Privacy, Data Protection and Cybersecurity Law Review: China", The Law Reviews. November 05, 2021. https://thelawreviews.co.uk/title/the-privacy-data-protection-and-cybersecurity-law-review/china#:~:text=Being%20effective%20from%201%20November,effect%20on%201%20June%202017
[56] Xinmei Shen, "China amends Anti-Monopoly Law for the first time amid tech crackdown, increasing penalties and regulatory control", South China, Morning Post, October 27, 2021. https://www.scmp.com/tech/policy/article/3153881/china-amends-anti-monopoly-law-first-time-amid-tech-crackdown, https://www.china-briefing.com/news/china-passes-sweeping-recommendation-algorithm-regulations-effect-march-1-2022/
[57] Zoey Zhang, "China's Regulatory Plans for Technology Companies and the Platform Economy in 2022", China Briefing, February 9, 2022. https://www.china-briefing.com/news/new-government-document-indicates-chinas-regulatory-plans-for-technology-companies-platform-economy-in-2022/
[58] Digichina, Stanford University. https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/
[59] The World Bank, "E-Commerce Can Boost Job Creation and Inclusive Growth in Developing Countries", November 23, 2019. https://www.worldbank.org/en/news/press-release/2019/11/23/e-commerce-can-boost-job-creation-and-inclusive-growth-in-developing-countries
[60] Digichina, Stanford University. https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/.
Xu Wei, "Digital economic growth plan unveiled", China Daily, January 20, 2022. http://english.www.gov.cn/policies/policywatch/202201/20/content_WS61e8a11bc6d09c94e48a3f04.html
[61] BRIAN A. WONGMARIA & MONICA WIHARDJA "What can Indonesia learn from China's digital economic transformation?", World Bank Blogs, February 24, 2022. https://blogs.worldbank.org/eastasiapacific/what-can-indonesia-learn-from-china-digital-economic-transformation
[62] Jerome Siacor, "China's East-to-West Digital Transformation in Motion", Open Gov Asia, April 14, 2022. https://opengovasia.com/chinas-east-to-west-digital-transformation-in-motion/
[63] Xinhua, "China's local governments double down on innovation to drive growth", China Daily, February 17, 2022. https://www.chinadaily.com.cn/a/202202/17/WS620e0b31a310cdd39bc87567.html
[64] Digichina, Stanford University. https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/
[65] Xinhua, " China approves plan to digitalize government services", November 17, 2021. https://english.www.gov.cn/premier/news/202111/17/content_WS619508f0c6d0df57f98e5186.html#:~:text=BEIJING%20%E2%80%94%20A%20State%20Council%20executive,period%20(2021%2D2025) .
[66] Digichina, Stanford University. https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/
[67] Xu Wei, "Digital economic growth plan unveiled", China Daily, January 20, 2022. http://english.www.gov.cn/policies/policywatch/202201/20/content_WS61e8a11bc6d09c94e48a3f04.html
[68] Digital Innovation & Governance Initiative Committee. https://digi.ey.gov.tw/en/5329AD162CD5F88A
[69] DIGI+ Taiwan. https://digi.taiwan.gov.tw/
[70] Priyankar Bhunia, "EXCLUSIVE – Expanding Taiwan's digital economy through the government's 8-year DIGI+ Plan", Open Gov Asia, October 27, 2017. https://opengovasia.com/exclusive-expanding-taiwans-digital-economy-through-the-governments-8-year-digi-plan/
[71] Jaclyn Tsai, Elizabeth Pai and Jaime Cheng, "The Privacy, Data Protection and Cybersecurity Law Review: Taiwan", The Law Reviews, November 05, 2021. https://thelawreviews.co.uk/title/the-privacy-data-protection-and-cybersecurity-law-review/taiwan
[72] Jerome Siasor, "Taiwan Initiates Laws to Curtail AI-Deepfake Abuse", Open Gov Asia, April 1, 2022. https://opengovasia.com/taiwan-initiates-laws-to-curtail-ai-deepfake-abuse/
[73] Forward-looking Infrastructure Development Program, National Development Council. https://www.ndc.gov.tw/en/Content_List.aspx?n=BCDB1EECF95E18E2&upn=7767B950199EF590
[74] Bilingual 2030, National Development Council. https://www.ndc.gov.tw/en/Content_List.aspx?n=BF21AB4041BB5255&upn=9633B537E92778BB
[75] Program for Promoting Six Core Strategic Industries, National Development Council. https://www.ndc.gov.tw/en/Content_List.aspx?n=2D827BFE7E3598BE&upn=4D3DA452D04C42CC
[76] Jerome Siasor, "New AI HUB Sets Taiwan as a Global Leader in Artificial Intelligence", Open Gov Asia, March 8, 2022. https://opengovasia.com/new-ai-hub-sets-taiwan-as-a-global-leader-in-artificial-intelligence/
[77] Priyankar Bhunia, "EXCLUSIVE – Expanding Taiwan's digital economy through the government's 8-year DIGI+ Plan", Open Gov Asia, October 27, 2017. https://opengovasia.com/exclusive-expanding-taiwans-digital-economy-through-the-governments-8-year-digi-plan/
[78] The Asia Silicon Valley Development Plan 2.0, National Development Council. https://www.ndc.gov.tw/en/Content_List.aspx?n=5B40E2CED6E6DB42
[79] Action Plan for Enhancing Taiwan's Startup Ecosystem , National Development Council. https://www.ndc.gov.tw/en/Content_List.aspx?n=DD6EB3B5F084F394&upn=69E65819639628EC
[80] Public governance of Taiwan in the digital age, National Development Council. https://www.ndc.gov.tw/en/Content_List.aspx?n=EAF760724C4E24A5
[81] Digital Government Program 2.0 of Taiwan (2021 – 2025), National Development Council , July 2020. https://ws.ndc.gov.tw/Download.ashx?u=LzAwMS9hZG1pbmlzdHJhdG9yLzExL3JlbGZpbGUvMC8yMDYwLzVkYTI0OWMzLTVkYzYtNGI0Mi1iMTdiLWEyMWNkNmM0NWM0Zi5wZGY%3D&n=RGlnaXRhbCBHb3Zlcm5tZW50IFByb2dyYW0gMl8wIG9mIFRhaXdhbiAoMjAyMS0yMDI1KS5wZGY%3D&icon=..pdf
[82] Public governance of Taiwan in the digital age, National Development Council. https://www.ndc.gov.tw/en/Content_List.aspx?n=EAF760724C4E24A5#:~:text=The%20current%20%22Digital%20Government%20Program,technologies%20to%20improve%20pubic%20service%22
[83] Andy Chun, "Why the future of Hong Kong's economy lies in digital transformation", The Coronavirus Pandemic, December 8, 2020. https://www.scmp.com/comment/opinion/article/3113010/why-future-hong-kongs-economy-lies-digital-transformation
[84] Development of digital economy, The government of the Hong Kong SAR. https://www.info.gov.hk/gia/general/202105/26/P2021052600331.htm
[85] Opening remarks by CE-elect, The government of the Hong Kong SAR. https://www.info.gov.hk/gia/general/202205/08/P2022050800490.htm?fontSize=1

[86] Yuet Ming Tham, " The Privacy, Data Protection and Cybersecurity Law Review: Hong Kong", The Law Reviews, November 5, 2021. https://thelawreviews.co.uk/title/the-privacy-data-protection-and-cybersecurity-law-review/hong-kong#:~:text=Hong%20Kong%20was%20the%20first,the%20private%20and%20public%20sectors.
[87] Telecommunications Policies, Communications and Creative Industries Branch, Hongkong SAR, China. https://www.cedb.gov.hk/ccib/en/policies/telecommunications.html#:~:text=Telecommunications%20services%20in%20Hong%20Kong,restrictions%20for%20telecommunications%20service%20providers.
[88] 5G Regulation and law in Hong Kong, CMS.Law. https://cms.law/en/int/expert-guides/cms-expert-guide-to-5g-regulation-and-law/hong-kong
[89] Denise Tsang, "Hong Kong's new iAM Smart app set to launch, allowing residents access to 20 public services including coronavirus jabs and test results", South China Morning Pose, December 29, 2020. https://www.scmp.com/news/hong-kong/hong-kong-economy/article/3115730/hong-kongs-new-iam-smart-app-set-launch-allowing, FAQ, iAM Smart. https://www.iamsmart.gov.hk/en/faq.html#this
[90] Sustain Hong Kong's position as Asia's leading digital city, Office of the government of Hong Kong SAR. https://www.ogcio.gov.hk/en/about_us/facts/doc/Fact_Sheet-OGCIO-EN.pdf
[91] Development of digital economy, The government of the Hong Kong SAR https://www.info.gov.hk/gia/general/202202/23/P2022022300241.htm
[92] Development of digital economy, The government of the Hong Kong SAR https://www.info.gov.hk/gia/general/202202/23/P2022022300241.htm
[93] SmartmeupHK. https://www.startmeup.hk/startup-resources/government-funding-scheme-and-support/nurturing-tech-talent-pool/reindustrialisation-and-technology-training-programme-rttp/
[94] Andy Chun, "Why the future of Hong Kong's economy lies in digital transformation", The Coronavirus Pandemic, December 8, 2020. https://www.scmp.com/comment/opinion/article/3113010/why-future-hong-kongs-economy-lies-digital-transformation
[95] SmartmeupHK. https://www.startmeup.hk/startup-resources/government-funding-scheme-and-support/facilitating-technology-adoption-patent-application-grant/technology-voucher-programme/
[96] Development of digital economy, The government of the Hong Kong SAR https://www.info.gov.hk/gia/general/202202/23/P2022022300241.htm
[97] Sustain Hong Kong's position as Asia's leading digital city, Office of the government of Hong Kong SAR. https://www.ogcio.gov.hk/en/about_us/facts/doc/Fact_Sheet-OGCIO-EN.pdf
[98] Sustain Hong Kong's position as Asia's leading digital city, Office of the government of Hong Kong SAR. https://www.ogcio.gov.hk/en/about_us/facts/doc/Fact_Sheet-OGCIO-EN.pdf
[99] Development of digital economy, The government of the Hong Kong SAR https://www.info.gov.hk/gia/general/202202/23/P2022022300241.htm
[100] Development of digital economy, The government of the Hong Kong SAR https://www.info.gov.hk/gia/general/202202/23/P2022022300241.htm
[101] https://data.gov.hk/en/
[102] INDONESIA: DIGITAL ECONOMY OPPORTUNITIES, International Trade Administration. https://www.trade.gov/market-intelligence/indonesia-digital-economy-opportunities
[103] Menkominfo Paparkan Roadmap Digital Indonesia dalam ATxSG. https://www.kominfo.go.id/content/detail/35713/siaran-pers-no240hmkominfo072021-tentang-menkominfo-paparkan-roadmap-digital-indonesia-dalam-atxsg/0/siaran_pers
[104] "Indonesia Set to Become a Digital Economic Powerhouse", Ministry of Investment/ BKPM https://partners.wsj.com/bkpm/indonesia-open-for-business/indonesia-set-to-become-a-digital-economic-powerhouse/
[105] Nur Janti, "Passage of PDP bill essential in achieving Indonesia's digital agenda in G20,experts say" The Jakarta Post, April 5, 2020. https://www.thejakartapost.com/indonesia/2022/04/04/passage-of-pdp-bill-essential-in-achieving-indonesias-digital-agenda-in-g20-experts-say.html
[106] "Beyond Unicorns: Harnessing Digital Technologies for Inclusion in Indonesia", The World Bank, July 29, 2021. https://www.worldbank.org/en/country/indonesia/publication/beyond-unicorns-harnessing-digital-technologies-for-inclusion-in-indonesia
[107] Lifia Putri, Fadhli Ruhman, "Minister outlines priorities within Digital Indonesia Road Map", Antaranews, March 23, 2022. https://en.antaranews.com/news/221329/minister-outlines-priorities-within-digital-indonesia-road-map#:~:text=%E2%80%9CThe%20Digital%20Indonesia%20Road%20Map,digital%20citizens%2C%22%20he%20said
[108] "BEYOND UNICORNS: HARNESSING DIGITAL TECHNOLOGIES FOR INCLUSION IN INDONESIA 2021", The World Bank, July 29, 2021. https://www.worldbank.org/en/country/indonesia/publication/beyond-unicorns-harnessing-digital-technologies-for-inclusion-in-indonesia
[109] Kirana Aisyah, "Indonesian Government Inaugurates Facility to Foster Digital Talent", Open Gov Asia, February 24, 2022. https://opengovasia.com/indonesian-government-inaugurates-facility-for-fostering-digital-talent/
[110] *Innovate Indonesia: Unlocking Growth Through Technological Transformation*, March 2020, Ministry of Finance Republic of Indonesia and ADB, https://www.adb.org/sites/default/files/publication/575806/innovate-indonesia-unlocking-growth.pdf

[111] Aineena Hani, "Indonesia Expected to be the Fastest-Growing IT Market in Asia Pacific", Open Gov, Asia, August 30, 2021. https://opengovasia.com/indonesia-expected-to-be-the-fastest-growing-it-market-in-asia-pacific/
[112] Gilbert Sanjaya "The bane of Indonesia's digital policy", Strategic Review, October 2021. https://sr.sgpp.ac.id/post/the-bane-of-indonesias-digital-policy
[113] "Making Indonesia 4.0: Indonesia's Strategy to Enter the 4th Generation of Industry Revolution", BKPM. https://www5.investindonesia.go.id/en/why-invest/indonesia-economic-update/making-indonesia-4.0-indonesias-strategy-to-enter-the-4th-generation-of-ind
[114] Vishal Agarwal, Karel Eloot, and Alpesh Patel, "Moving past the 'pilot trap' to unleash Industry 4.0 in Indonesia", McKinsey & Company, February 11, 2019. https://www.mckinsey.com/business-functions/operations/our-insights/moving-past-the-pilot-trap-to-unleash-industry-4-0-in-indonesia
[115] INDONESIA: DIGITAL ECONOMY OPPORTUNITIES, International Trade Administration. https://www.trade.gov/market-intelligence/indonesia-digital-economy-opportunities
[116] Yunindita Prasidya, "Data standardization poses challenge for Satu Data Indonesia plan" The Jakarta Post, August 6, 2020. https://www.thejakartapost.com/news/2020/08/06/data-standardization-poses-challenge-for-satu-data-indonesia-plan.html, "BEYOND UNICORNS: HARNESSING DIGITAL TECHNOLOGIES FOR INCLUSION IN INDONESIA 2021", The World Bank, July 29, 2021. https://www.worldbank.org/en/country/indonesia/publication/beyond-unicorns-harnessing-digital-technologies-for-inclusion-in-indonesia
[117] "Ministry drafts roadmap for Indonesia Digital 2021-2024", Antaranews, February 1, 2021. https://en.antaranews.com/news/167151/ministry-drafts-roadmap-for-indonesia-digital-2021-2024
[118] "One Data Indonesia Policy and E-Government Implementation Require the Support from Technology Providers like Huawei", JakartaGlobe, July 11, 2021. https://jakartaglobe.id/special-updates/one-data-indonesia-policy-and-egovernmentimplementation-require-the-support-from-technologyproviders-like-huawei
[119] Japan's digital agency head blames regulation for preventing progress. https://www.ft.com/content/d4f62e32-ed00-4243-a727-1b8564481f65
[120] Lena Broeckaert, "Digital Transformation in Japan", EU-Japan Center for Industrial Cooperation, February 2022. https://www.eu-japan.eu/sites/default/files/publications/docs/Digital-Transformation-Japan-Assessing-opportunities-forEU-SMEs.pdf
[121] Tomoki Ishiara, "The Privacy, Data Protection and Cybersecurity Law Review: Japan", The Law Reviews, November 2021. https://thelawreviews.co.uk/title/the-privacy-data-protection-and-cybersecurity-law-review/japan#:~:text=In%20Japan%2C%20the%20Act%20on,force%20since%2030%20May%202017, Lena Broeckaert, "Digital Transformation in Japan", EU-Japan Center for Industrial Cooperation, February 2022. https://www.eu-japan.eu/sites/default/files/publications/docs/Digital-Transformation-Japan-Assessing-opportunities-forEU-SMEs.pdf
[122] Society 5.0, Cabinet Office. https://www8.cao.go.jp/cstp/english/society5_0/index.html
[123] Lena Broeckaert, "Digital Transformation in Japan", EU-Japan Center for Industrial Cooperation, February 2022. https://www.eu-japan.eu/sites/default/files/publications/docs/Digital-Transformation-Japan-Assessing-opportunities-forEU-SMEs.pdf

[124] Priority Policy Program for Realizing Digital Society, Japan. https://www.digital.go.jp/assets/contents/node/basic_page/field_ref_resources/0f321c23-517f-439e-9076-5804f0a24b59/20211224_en_priority_policy_program_01.pdf
[125] Lena Broeckaert, "Digital Transformation in Japan", EU-Japan Center for Industrial Cooperation, February 2022. https://www.eu-japan.eu/sites/default/files/publications/docs/Digital-Transformation-Japan-Assessing-opportunities-forEU-SMEs.pdf
[126] Leo Lewis "Japan launches university fund to spur innovation" Financial Times, April 7, 2022. https://www.ft.com/content/5273734e-1768-4209-9321-b3a7e89d187e
[127] Japan Policy Brief, OECD. https://www.oecd.org/policy-briefs/Japan-Policy-Brief-Digitalisation.pdf
[128] Lena Broeckaert, "Digital Transformation in Japan", EU-Japan Center for Industrial Cooperation, February 2022. https://www.eu-japan.eu/sites/default/files/publications/docs/Digital-Transformation-Japan-Assessing-opportunities-forEU-SMEs.pdf
[129] National Data Strategy, The government of Japan. https://www.digital.go.jp/assets/contents/node/basic_page/field_ref_resources/0f321c23-517f-439e-9076-5804f0a24b59/20210901_en_05.pdf
[130] Lena Broeckaert, "Digital Transformation in Japan", EU-Japan Center for Industrial Cooperation, February 2022. https://www.eu-japan.eu/sites/default/files/publications/docs/Digital-Transformation-Japan-Assessing-opportunities-forEU-SMEs.pdf, WATARU SUZUKI, "Japan launches agency to undo 'digital defeat': 5 things to know", Nikkei Asia, September 1, 2021. https://asia.nikkei.com/Politics/Japan-launches-agency-to-undo-digital-defeat-5-things-to-know
[131] Japan's digital agency head blames regulation for preventing progress. https://www.ft.com/content/d4f62e32-ed00-4243-a727-1b8564481f65
[132] Lena Broeckaert, "Digital Transformation in Japan", EU-Japan Center for Industrial Cooperation, February 2022. https://www.eu-japan.eu/sites/default/files/publications/docs/Digital-Transformation-Japan-Assessing-opportunities-forEU-SMEs.pdf
[133] National Data Strategy, The government of Japan. https://www.digital.go.jp/assets/contents/node/basic_page/field_ref_resources/0f321c23-517f-439e-9076-5804f0a24b59/20211224_en_priority_policy_program_01.pdf
[134] A. Asohan, "Digital Malaysia details out ... finally!", Digital News Asia, July 5, 2012. https://www.digitalnewsasia.com/digital_economy/digital-malaysia-details-out-finally
[135] National Fourth Industrial Revolution (4IR) Policy https://www.epu.gov.my/sites/default/files/2021-07/National-4IR-Policy.pdf
[136] HSBB Malaysia's Drive for High Speed Broadband, .myCONVERGENCE, Vol. 3 / No. 1, January 2009
[137] High Speed Broadband, Malaysia Government. https://www.malaysia.gov.my/portal/content/30046
[138] Cindy Yeap, "Special Report: All eyes on potential winners in 5G race", The Edge Markets, January 22, 2020. https://www.theedgemarkets.com/article/special-report-all-eyes-potential-winners-5g-race
[139] National Fourth Industrial Revolution (4IR) Policy https://www.epu.gov.my/sites/default/files/2021-07/National-4IR-Policy.pdf
[140] Emmanuel Santa Maria Chin, "Four things to know about the govt's new 4IR policy", Malaysia Mail, July 02, 2021. https://www.malaymail.com/news/malaysia/2021/07/02/four-things-to-know-about-the-govts-new-4ir-policy/1986710
[141] Malaysia Digital Economy Blueprint. https://www.epu.gov.my/sites/default/files/2021-02/malaysia-digital-economy-blueprint.pdf
[142] MTDC. https://www.mtdc.com.my/bgf/
[143] "MDEC's DataKITA empowers M'sia's digital ecosystem", Digital News Asia, October 1, 2021. https://www.digitalnewsasia.com/digital-economy/mdecs-datakita-empowers-msias-digital-ecosystem
[144] Malaysia Digital Economy Blueprint. https://www.epu.gov.my/sites/default/files/2021-02/malaysia-digital-economy-blueprint.pdf
[145] Tan Zhai Yun "Malaysia Digital Economy Blueprint: Boosting cloud capabilities in Malaysia", The Edge Malaysia, March 01, 2021. https://www.theedgemarkets.com/article/malaysia-digital-economy-blueprint-boosting-cloud-capabilities-malaysia
[146] Malaysia Digital Economy Blueprint. https://www.epu.gov.my/sites/default/files/2021-02/Malaysia-digital-economy-blueprint.pdf
[147] Malaysia Digital Economy Blueprint. https://www.epu.gov.my/sites/default/files/2021-02/Malaysia-digital-economy-blueprint.pdf
[148] "Tok Pa: National Council of Digital Economy and Fourth Industrial Revolution to harmonise state-level digital economic plans", Malaysia mail, January 26, 2022. https://www.malaymail.com/news/malaysia/2022/01/26/tok-pa-national-council-of-digital-economy-and-fourth-industrial-revolution/2037762
[149] Ryan C. Berg & Henry Ziemer, "The Development of the ICT Landscape in Mexico: Cybersecurity and Opportunities for Investment", CSIS. November 19, 2021. https://www.csis.org/analysis/development-ict-landscape-mexico-cybersecurity-and-opportunities-investment
[150] Rios-Ferrer, Guillen-Liarena, Trevino, Rivera y Gutierrez Abogados, "Spotlight: telecoms and internet access in Mexico" Lexology, January 11 2022, https://www.lexology.com/library/detail.aspx?g=7fa867b6-d97b-4efb-bd05-1bd4d9fc2f75
[151] Ryan C. Berg & Henry Ziemer, "The Development of the ICT Landscape in Mexico: Cybersecurity and Opportunities for Investment", CSIS. November 19, 2021. https://www.csis.org/analysis/development-ict-landscape-mexico-cybersecurity-and-opportunities-investment
[152] National Digital Strategy, Mexico. http://nsdsguidelines.paris21.org/sites/default/files/national_digital_strategy.pdf
[153] "Innovations in information technology use, due to the National Digital Strategy, have won Mexico international recognition: ESH",Government of Mexico. https://www.gob.mx/epn/prensa/innovations-in-information-technology-use-due-to-the-national-digital-strategy-have-won-mexico-international-recognition-esh
[154] Ryan C. Berg & Henry Ziemer, "The Development of the ICT Landscape in Mexico: Cybersecurity and Opportunities for Investment", CSIS. November 19, 2021. https://www.csis.org/analysis/development-ict-landscape-mexico-cybersecurity-and-opportunities-investment
[155] Cinthya Alaniz Salazar, "Mexican Supreme Court Finds Cellphone Registry Unconstitutional", April 22, 2022. Mexico Business News. https://mexicobusiness.news/tech/news/mexican-supreme-court-finds-cellphone-registry-unconstitutional?tag=tech
[156] César G Cruz Ayala and Marcela flores gonzález "The Privacy, Data Protection and Cybersecurity Law Review: Mexico", The Law Reviews, November 05, 2021,https://thelawreviews.co.uk/title/the-privacy-data-protection-and-cybersecurity-law-review/mexico
[157] César G Cruz Ayala and Marcela flores gonzález "The Privacy, Data Protection and Cybersecurity Law Review: Mexico", The Law Reviews, November 05, 2021. https://thelawreviews.co.uk/title/the-privacy-data-protection-and-cybersecurity-law-review/Mexico
[158] Ryan C. Berg & Henry Ziemer, "The Development of the ICT Landscape in Mexico: Cybersecurity and Opportunities for Investment", CSIS. November 19, 2021. https://www.csis.org/analysis/development-ict-landscape-mexico-cybersecurity-and-opportunities-investment
[159] OECD Economic Surveys: Mexico 2022, https://www.oecd-ilibrary.org/sites/2bafc785-en/index.html?itemId=/content/component/2bafc785-en
[160] STEVE SALDAÑA, "Habrá cobertura de internet para todo México en 2023, dice AMLO: un nuevo retraso en la promesa de cierre de brecha digital", Xataka, September 2, 2021. https://www.xataka.com.mx/telecomunicaciones/habra-cobertura-internet-para-todo-mexico-2023-dice-amlo-nuevo-retraso-promesa-cierre-brecha-digital
[161] Ryan C. Berg & Henry Ziemer, "The Development of the ICT Landscape in Mexico: Cybersecurity and Opportunities for Investment", CSIS. November 19, 2021. https://www.csis.org/analysis/development-ict-landscape-mexico-cybersecurity-and-opportunities-investment
[162] Max Cesar, Alberto Chaia, Andre de Oliveira Vaz, Gonzalo Garcia-Muñoz, and Philipp Haugwitz, "How Mexico can become Latin America's digital-government powerhouse", McKinsey Digital, November 01, 2018. https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/how-mexico-can-become-latin-americas-digital-government-powerhouse
[163] "Crafting the future, a roadmap for Industry 4.0 in Mexico", Ministry of Economy, Mexico. https://amiti.org.mx/wp-content/uploads/2018/01/Crafting-the-future-10-agosto-2016.pdf
[164] "Crafting the future, a roadmap for Industry 4.0 in Mexico", Ministry of Economy, Mexico. https://amiti.org.mx/wp-content/uploads/2018/01/Crafting-the-future-10-agosto-2016.pdf
[165] Lilian Robayo, "Casa Sauza: Model of Digital Transformation in Tequila Production", Automation world, February 16, 2022. https://www.automationworld.com/process/iiot/article/22018574/mundo-pmmi-tequila-industry-in-mexico-automates-for-industry-40
[166] "The evolution from e-government to digital government in Mexico", OECD iLibrary. https://www.oecd-ilibrary.org/sites/2e68807c-en/index.html?itemId=/content/component/2e68807c-en

[167] OECD Economic Surveys: Mexico 2022. https://www.oecd-ilibrary.org/sites/2bafc785-en/index.html?itemId=/content/component/2bafc785-en
[168] OECD Economic Surveys: Mexico 2022 https://www.oecd-ilibrary.org/sites/2bafc785-en/index.html?itemId=/content/component/2bafc785-en
[169] Jerome Siacor, "New Zealand Drafts Road Map to Grow Digital Technology Sector", Open Gov Asia, March 3, 2022. https://opengovasia.com/new-zealand-drafts-road-map-to-grow-digital-technology-sector/
[170] "Government partners with industry to transform and grow digital technologies sector", Ministry of Business, Innovation & Employment, New Zealand, February 2022. https://www.mbie.govt.nz/about/news/draft-industry-transformation-plan/
[171] "Introduction to NZ's digital transformation", DIGITAL.GOVT.NZ. https://www.digital.govt.nz/digital-government/about-digital-government/introduction-to-nzs-digital-transformation/, Stats NZ. https://www.stats.govt.nz/about-us/data-leadership/#investment
[172] "Cabinet papers – new data and statistics legislation policy proposals", April 21, 2020, Stats NZ.https://www.stats.govt.nz/corporate/cabinet-papers-new-data-and-statistics-legislation-policy-proposals, Privacy Act 2020, New Zealand Legislation. https://www.legislation.govt.nz/act/public/2020/0031/latest/LMS23223.html, Intelligence and Security Act 2017, New Zealand Legislation. https://www.legislation.govt.nz/act/public/2017/0010/latest/DLM7118909.html
[173] "Introduction to NZ's digital transformation", DIGITAL.GOVT.NZ. https://www.digital.govt.nz/digital-government/about-digital-government/introduction-to-nzs-digital-transformation/
[174] New Zealand Government. https://www.govt.nz/
[175] "SmartStart a new type of service", DIGITAL.GOVT.NZ, November 01, 2018. https://www.digital.govt.nz/showcase/smartstart-a-new-type-of-service/
[176] Digital government priority focus areas. https://www.digital.govt.nz/digital-government/strategy/strategy-summary/strategy-for-a-digital-public-service/#our-priority-focus-areas-_title
[177] Jerome Siacor, "New Zealand Drafts Road Map to Grow Digital Technology Sector", Open Gov Asia, March 3, 2022. https://opengovasia.com/new-zealand-drafts-road-map-to-grow-digital-technology-sector/
[178] Government Data Strategy and Roadmap 2021, New Zealand Government. https://www.data.govt.nz/assets/Uploads/4e-government-data-strategy-and-roadmap.pdf , "Strategy for a Digital Public Service", DIGITAL.GOVT.NZ, November 2019. https://www.digital.govt.nz/digital-government/strategy/strategy-summary/strategy-for-a-digital-public-service/.

[179] "Strategy for a Digital Public Service - Government Chief Digital Officer's Foreword", DIGITAL.GOVT.NZ, November 2019 https://www.digital.govt.nz/digital-government/strategy/strategy-summary/strategy-for-a-digital-public-service/#government-chief-digital-officer---s-foreword_title
[180] "Solar power soars in Papua New Guinea", MAF, February 21, 2021. https://www.maf-uk.org/news/solar-power-soars-in-papua-new-guinea
[181] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[182] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[183] OneTrust DataGuidance, Papua New Guinea. https://www.dataguidance.com/jurisdiction/papua-new-guinea
[184] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[185] Felix Pupokei, "PAPUA NEW GUINEA QoS REGULATORY FRAMEWORK", NICTA, PNG, August 2019. https://www.itu.int/en/ITU-T/Workshops-and-Seminars/qos/201908/Documents/Felix_Rupokei_Presentation.pdf, "Could Papua New Guinea develop a generation of technology entrepreneurs?" Business Advantage PNG, March 18, 2015. https://www.businessadvantagepng.com/papua-new-guineas-technology-secot-needs-incentives-to-fulfil-its-potential-says-ict-specialist-priscilla-kevin/
[186] Harry Kretchmer, "This Pacific island is working towards a digital revolution", World Economic Forum, September 22, 2020. https://www.weforum.org/agenda/2020/09/papua-new-guinea-digital-transformation-COVID-19/
[187] Papua New Guinea – Country Commercial Guide, International Trade Administration. https://www.trade.gov/country-commercial-guides/papua-new-guinea-market-opportunities
[188] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[189] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[190] Harry Kretchmer, "This Pacific island is working towards a digital revolution", World Economic Forum, September 22, 2020. https://www.weforum.org/agenda/2020/09/papua-new-guinea-digital-transformation-COVID-19/
[191] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[192] Government Cloud Policy, PNG. https://www.ict.gov.pg/Policies/Cloud%20Policy/Government%20Cloud%20Policy%20Final%20Draft-%20Edit%20JS160821.pdf
[193] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[194] Papua New Guinea – Country Commercial Guide, International Trade Administration. https://www.trade.gov/country-commercial-guides/papua-new-guinea-market-challenges
[195] PNG Digital Transformation Policy, PNG Government. https://www.ict.gov.pg/Policies/Digital%20Transformation%20Policy/PNG%20Digital%20Transformation%20Policy_21122020_updated.pdf
[196] "Latin American Economic Outlook 2020 : Digital Transformation for Building Back Better", OECD iLibrary. https://www.oecd-ilibrary.org/sites/4f73e4bf-en/index.html?itemId=/content/component/4f73e4bf-en
[197] Local Cybersecurity laws and scope, CMS. https://cms.law/en/int/expert-guides/cms-expert-guide-to-data-protection-and-cyber-security-laws/peru#:~:text=The%20Supreme%20Decree%20No.,Digital%20Security%20Incident%20Response%20management
[198] Financial Times. https://www.ft.com/content/11851cab-864b-47fd-9802-699a6dbd0cbb, Peru – Country Commercial Guide, International Trade Administration. https://www.trade.gov/knowledge-product/exporting-peru-market-overview
[199] "Latin American Economic Outlook 2020 : Digital Transformation for Building Back Better", OECD iLibrary. https://www.oecd-ilibrary.org/sites/4f73e4bf-en/index.html?itemId=/content/component/4f73e4bf-en
[200] "Latin American Economic Outlook 2020 : Digital Transformation for Building Back Better", OECD iLibrary. https://www.oecd-ilibrary.org/sites/4f73e4bf-en/index.html?itemId=/content/component/4f73e4bf-en
[201] Peru Ecommerce, International Trade Administration. https://www.trade.gov/market-intelligence/peru-ecommerce
[202] "Driven by the Mastercard and ACI Worldwide Real-Time Payments Joint Solution, Peru's Cámara de Compensación Electrónica (CCE) Wins Celent Model Bank 2022 Award", Business wire, April 28, 2022. https://www.businesswire.com/news/home/20220428005089/en/Driven-by-the-Mastercard-and-ACI-Worldwide-Real-Time-Payments-Joint-Solution-Peru%E2%80%99s-C%C3%A1mara-de-Compensaci%C3%B3n-Electr%C3%B3nica-CCE-Wins-Celent-Model-Bank-2022-Award
[203] "Telefónica presents "Internet para todos", a collaborative project to connect the unconnected in Latin America" Feb 26, 2018. https://www.telefonica.com/en/communication-room/telefonica-presents-internet-para-todos-a-collaborative-project-to-connect-the-unconnected-in-latin-america/
[204] Startup Peru https://startup.proinnovate.gob.pe/

[205] "Latin American Economic Outlook 2020 : Digital Transformation for Building Back Better", OECD iLibrary. https://www.oecd-ilibrary.org/sites/4f73e4bf-en/index.html?itemId=/content/component/4f73e4bf-en

[206] Peru Ecommerce, International Trade Administration. https://www.trade.gov/market-intelligence/peru-ecommerce

[207] World Bank. 2020. Philippines Digital Economy Report 2020 : A Better Normal Under COVID-19 - Digitalizing the Philippine Economy Now. World Bank, Washington, DC. © World Bank. https://documents1.worldbank.org/curated/en/796871601650398190/pdf/Philippines-Digital-Economy-Report-2020-A-Better-Normal-Under-COVID-19-Digitalizing-the-Philippine-Economy-Now.pdf

Philippines – Country Commercial Guide, International Trade Administration. https://www.trade.gov/country-commercial-guides/philippines-information-and-communications-technology

[208] Mark Parsons And Louise Crawford, "Philippines Finalizes Data Privacy Act Implementing Rules", Hogan Lovells, September 9, 2016. https://www.hldataprotection.com/2016/09/articles/international-eu-privacy/philippines-finalizes-data-privacy-act-implementing-rules/, Cybersecurity – Philippines,- Q&A guide, 2019 edition, LexisNexis. https://www.lexisnexis.co.uk/legal/guidance/cybersecurity-philippines-q-a-guide

[209] World Bank. 2020. Philippines Digital Economy Report 2020 : A Better Normal Under COVID-19 - Digitalizing the Philippine Economy Now. World Bank, Washington, DC. © World Bank. https://documents1.worldbank.org/curated/en/796871601650398190/pdf/Philippines-Digital-Economy-Report-2020-A-Better-Normal-Under-COVID-19-Digitalizing-the-Philippine-Economy-Now.pdf

[210] Philippine Development Plan 2017-2022, https://pdp.neda.gov.ph/wp-content/uploads/2017/01/19-04-07-2017.pdf

[211] World Bank. 2020. Philippines Digital Economy Report 2020 : A Better Normal Under COVID-19 - Digitalizing the Philippine Economy Now. World Bank, Washington, DC. © World Bank. https://documents1.worldbank.org/curated/en/796871601650398190/pdf/Philippines-Digital-Economy-Report-2020-A-Better-Normal-Under-COVID-19-Digitalizing-the-Philippine-Economy-Now.pdf , "DICT proposes ₱13.4-B budget to boost national broadband program in 2021", CNN Philippines, July 22, 2020. www.cnn.ph/news/2020/7/22/dict-p13.4-billion-budget-national-broadband-program-2021-.html

[212] Ian Nicolas Cigaral, "Common tower rules finally out but telcos stay 'cautious'", Philstar.com, June 10, 2020. https://www.philstar.com/business/2020/06/10/2020003/common-tower-rules-finally-out-telcos-stay-cautious

[213] Raymond Carl Dela Cruz, "Improved connectivity, free internet under Duterte admin" , PNA, July 23, 2021. https://www.pna.gov.ph/articles/1148087

[214] Cai Orginario, "PhilSys a 'great example' of filling digital gaps", Business Mirror, April 4, 2022. https://businessmirror.com.ph/2022/04/04/philsys-a-great-example-of-filling-digital-gaps/

[215] World Bank. 2020. Philippines Digital Economy Report 2020 : A Better Normal Under COVID-19 - Digitalizing the Philippine Economy Now. World Bank, Washington, DC. © World Bank. https://documents1.worldbank.org/curated/en/796871601650398190/pdf/Philippines-Digital-Economy-Report-2020-A-Better-Normal-Under-COVID-19-Digitalizing-the-Philippine-Economy-Now.pdf

[216] Teresa Umali, "The Philippines signs Innovative Startup Act into law", Open Gov Asia, July 31, 2019. https://opengovasia.com/the-philippines-signs-innovative-startup-act-into-law/

[217] World Bank. 2020. Philippines Digital Economy Report 2020 : A Better Normal Under COVID-19 - Digitalizing the Philippine Economy Now. World Bank, Washington, DC. © World Bank. https://documents1.worldbank.org/curated/en/796871601650398190/pdf/Philippines-Digital-Economy-Report-2020-A-Better-Normal-Under-COVID-19-Digitalizing-the-Philippine-Economy-Now.pdf

[218] "DICT proposes ₱13.4-B budget to boost national broadband program in 2021", CNN Philippines, July 22, 2020. www.cnn.ph/news/2020/7/22/dict-p13.4-billion-budget-national-broadband-program-2021-.html

[219] The 5th Comprehensive National Territorial Plan, Space & Environment, March 2020. https://www.krihs.re.kr/fileViewer.do?fname=24EFE19D02CD4859895E78896C2E72DF.pdf&path=7&oname=Space+and+Environment+Vol.81.pdf

[220] "Korean New Deal - Digital New Deal, Green New Deal and Stronger Safety Net ", Iea, July 16, 2021. https://www.iea.org/policies/11514-korean-new-deal-digital-new-deal-green-new-deal-and-stronger-safety-net

[221]Personal Data Protection Laws in Korea. https://www.privacy.go.kr/eng/about_us.do, Introduction to Korean Cyber Security Law, https://www.klri.re.kr/kor/publication/1663/view.do, Tae-jun Kang, "South Korea Beefs Up Cyber Security With an Eye on North Korea", The|DIPLOMAT, April 01, 2015. https://thediplomat.com/2015/04/south-korea-beefs-up-cyber-security-with-an-eye-on-north-korea/, Information Security South Korea, Intralink Limited, July 2018. https://www.intralinkgroup.com/getmedia/0c9a1b6d-677a-450a-aa94-fd3f88a1bbfb/Korean-Info-Security-Final-Report,-Technology,-Brochure

[222] national pilot smart city, Smart City Korea. https://smartcity.go.kr/en/%ec%a0%95%ec%b1%85/%ec%a0%95%ec%b1%85%ec%82%ac%ec%97%85/%ea%b5%ad%ea%b0%80%ec%8b%9c%eb%b2%94%eb%8f%84%ec%8b%9c/

[223] The 5th Comprehensive National Territorial Plan, Space & Environment, March 2020. https://www.krihs.re.kr/fileViewer.do?fname=24EFE19D02CD4859895E78896C2E72DF.pdf&path=7&oname=Space+and+Environment+Vol.81.pdf

[224] Kan Hyeong-woo, "From vaccination reminders to relief aid info: Virtual assistant helps over 12m residents", The Korea Herald, September 20, 2021. http://www.koreaherald.com/view.php?ud=20210916000750#:~:text=The%20virtual%20assistant%20service%20named%20%E2%80%9CGoodPy%E2%80%9D%20provides%20various%20information%20on,applications%20Naver%2C%20KakaoTalk%20and%20Toss, "Digital, the Door to a Better World: Digital Government Strategy and Cases in Korea", The World Bank, February 24, 2022. https://www.worldbank.org/en/events/2022/02/09/digital-the-door-to-a-better-world-digital-government-strategy-and-cases-in-korea

[225] "South Korea's digital push to help with economic recovery", Ciotech Asia, July 23, 2020. https://ciotechasia.com/south-koreas-digital-push-to-help-with-economic-recovery/

[226] South Korea – Country Commercial Guide, International Trade Administration. https://www.trade.gov/country-commercial-guides/south-korea-manufacturing-technology-smart-factory

[227] E-Government Survey 2020, United Nations. https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20(Full%20Report).pdf

[228] "Digital, the Door to a Better World: Digital Government Strategy and Cases in Korea", The World Bank, February 24, 2022. https://www.worldbank.org/en/events/2022/02/09/digital-the-door-to-a-better-world-digital-government-strategy-and-cases-in-korea

[229] E-Government Survey 2020, United Nations. https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20(Full%20Report).pdf

[230] "Digital, the Door to a Better World: Digital Government Strategy and Cases in Korea", The World Bank, February 24, 2022. https://www.worldbank.org/en/events/2022/02/09/digital-the-door-to-a-better-world-digital-government-strategy-and-cases-in-korea Kan Hyeong-woo, "Korea to invest W9tr to speed up digital transformation", The Korea Herald, January 26, 2022. http://www.koreaherald.com/view.php?ud=20220126000752&np=1&mp=1

[231] Kan Hyeong-woo, "Korea to invest W9tr to speed up digital transformation", The Korea Herald, January 26, 2022. http://www.koreaherald.com/view.php?ud=20220126000752&np=1&mp=1 ,

"Korea Kicks Off 'Data Dam'", Cision PR Newswire, July 06, 2021. https://www.prnewswire.com/news-releases/korea-kicks-off-data-dam-301325717.html#:~:text=The%20Data%20Dam%20is%20a,be%20created%20across%20the%20board

[232] Anna Lowry "Russia's Digital Economy Program: An Effective Strategy for Digital Transformation?" SpringerLink, December 16, 2020. https://link.springer.com/chapter/10.1007/978-3-030-42855-6_4

[233] Anna Lowry "Russia's Digital Economy Program: An Effective Strategy for Digital Transformation?" SpringerLink, December 16, 2020. https://link.springer.com/chapter/10.1007/978-3-030-42855-6_4

[234] Russia – Country Commercial Guide, International Trade Administration https://www.trade.gov/country-commercial-guides/russia-information-communication-technology, Vyacheslav Khayryuzov, "The Privacy, Data Protection and Cybersecurity Law Review: Russia" The Law Reviews, November 5, 2021.https://thelawreviews.co.uk/title/the-privacy-data-protection-and-cybersecurity-law-review/russia

[235] "Digital Economy of the Russian Federation National Programme", Rostelecom, Annual Report 2018. https://csr2018.rostelecom.ru/en/60/20
[236] "5G Networks in Russia: Development and Trajectories", geohistory, February 22, 2022. https://geohistory.today/5g-networks-russia-development/#:~:text=By%20the%20end%20of%202020,%2C%20using%20Russian%2Dmade%20technologies.
[237] "Russia Cloud and Data Centre Market Growth Report 2021-2025", Business Wire, September 29, 2021. https://www.businesswire.com/news/home/20210929005622/en/Russia-Cloud-and-Data-Centre-Market-Growth-Report-2021-2025---ResearchAndMarkets.com, Taras Chirkov, "Is there a future for data centers in northern Russia?", realwire, July 7, 2020. https://www.realwire.com/releases/Is-there-a-future-for-data-centers-in-northern-Russia
[238] "Analysis: As foreign digital firms leave, Russia's domestic providers pounce", Reuters, April 1, 2022. https://www.reuters.com/world/europe/foreign-digital-firms-leave-russias-domestic-providers-pounce-2022-04-01/
[239] "Analysis: As foreign digital firms leave, Russia's domestic providers pounce", Reuters, April 1, 2022. https://www.reuters.com/world/europe/foreign-digital-firms-leave-russias-domestic-providers-pounce-2022-04-01/
[240] "5G Networks in Russia: Development and Trajectories", geohistory, February 22, 2022. https://geohistory.today/5g-networks-russia-development/#:~:text=By%20the%20end%20of%202020,%2C%20using%20Russian%2Dmade%20technologies.
[241] Daria Gritsenko & Mikhail Zherebtsov, "E-Government in Russia: Plans, Reality, and Future Outlook", Springer Link, December 16, 2020. https://link.springer.com/chapter/10.1007/978-3-030-42855-6_3#Sec5
[242] "Digital Economy of the Russian Federation National Programme", Rostelecom, Annual Report 2018. https://csr2018.rostelecom.ru/en/60/20
[243] Maryam Orzkhanova , Sakhadin Hubolov, and Esma Polyakova "Digitalization of the Russian Federation's economy in the context of global transformation: problems and development prospects" SHS Web of Conferences. https://www.shs-conferences.org/articles/shsconf/pdf/2021/17/shsconf_mtde2021_01013.pdf
[244] Digital Government Blueprint, December 2020. https://www.tech.gov.sg/files/media/corporate-publications/dgb-public-document_30dec20.pdf
[245] "Singapore's Smart Nation Initiative – A Policy and Organisational Perspective", Lee Kuan Yew, School of Public Policy, NUS. https://lkyspp.nus.edu.sg/docs/default-source/case-studies/singapores-smart-nation-initiative-final_112018.pdf?sfvrsn=354e720a_2
[246] Digital Government Blueprint, December 2020. https://www.tech.gov.sg/files/media/corporate-publications/dgb-public-document_30dec20.pdf
[247] "Singapore's Smart Nation Initiative – A Policy and Organisational Perspective", Lee Kuan Yew, School of Public Policy, NUS. https://lkyspp.nus.edu.sg/docs/default-source/case-studies/singapores-smart-nation-initiative-final_112018.pdf?sfvrsn=354e720a_2
[248] Lester Wong, "Singapore sets up $30m fund to drive commercialisation of 5G solutions", The Straits Times, January 20,2021. https://www.straitstimes.com/tech/singapore-sets-up-30m-fund-to-drive-commercialisation-of-5g-solutions
[249] Tang See Kit, "Singapore rolls out national strategy on artificial intelligence for 'impactful' social, economic benefits", CNA, November 13, 2019. https://www.channelnewsasia.com/singapore/singapore-national-strategy-ai-economic-benefits-heng-swee-keat-849691
[250] "Helping SMEs go digital", Infocomm Media Development Authority, Singapore. https://www.imda.gov.sg/-/media/Imda/Files/Programme/SMEs-Go-Digital/SMEsGD-Factsheet.pdf?la=en&hash=2838949FFB3EC351DE649234EDCDFF10
[251] Digital Government Blueprint, December 2020. https://www.tech.gov.sg/files/media/corporate-publications/dgb-public-document_30dec20.pdf
[252] Ng Chee Khern, "Digital Government, Smart Nation: Pursuing Singapore's Tech Imperative", Civil Service College Singapore, August 8, 2019. https://www.csc.gov.sg/articles/digital-government-smart-nation-pursuing-singapore's-tech-imperative
[253] Ng Chee Khern, "Digital Government, Smart Nation: Pursuing Singapore's Tech Imperative", Civil Service College Singapore, August 8, 2019. https://www.csc.gov.sg/articles/digital-government-smart-nation-pursuing-singapore's-tech-imperative
[254] Digital Government Blueprint, December 2020. https://www.tech.gov.sg/files/media/corporate-publications/dgb-public-document_30dec20.pdf
[255] "Doubling down on cloud to deliver better government services", GovTech, Singapore, June 24, 2020. https://www.tech.gov.sg/media/technews/doubling-down-on-cloud-to-deliver-better-government-services
[256] Future of life. https://futureoflife.org/ai-policy-singapore/
[257] Digital Government Blueprint, December 2020. https://www.tech.gov.sg/files/media/corporate-publications/dgb-public-document_30dec20.pdf
[258] Digital Economy Report 2021, UNCTAD. https://unctad.org/system/files/official-document/der2021_en.pdf
[259] James Riley, "US pushes Digital Economy strategy" InnovationAus.com, April 13, 2016. https://www.innovationaus.com/us-pushes-digital-economy-strategy/
[260] Lauren Feiner & Amanda Macias, "FCC finalizes program to rip and replace Huawei, ZTE telecom equipment in the U.S.", CNBC, July 13, 2021. https://www.cnbc.com/2021/07/13/fcc-finalizes-program-to-rip-and-replace-huawei-zte-equipment-in-us.html
[261] National Artificial Intelligence Initiative. https://www.ai.gov/about/#NAII_National_Artificial_Intelligence_Initiative
[262] Digital Economy Report 2021, UNCTAD. https://unctad.org/system/files/official-document/der2021_en.pdf
[263] "U.S. Senate Unanimously Passes Cybersecurity Legislation Requiring 72 Hour Cyber Incident Notification", The National Law Review, March 17, 2022. https://www.natlawreview.com/article/us-senate-unanimously-passes-cybersecurity-legislation-requiring-72-hour-cyber#:~:text=U.S.%20Senate%20Unanimously%20Passes%20Cybersecurity%20Legislation%20Requiring%2072%20Hour%20Cyber%20Incident%20Notification&text=On%20March%202%2C%202022%2C%20the,or%20the%20%E2%80%9CBill%E2%80%9D
[264] "5G Security And Resilience", Cybersecurity & Infrastructure Security Agency. https://www.cisa.gov/5g#:~:text=In%20March%202020%2C%20the%20White,accompanying%20Implementation%20Plan%20was%20released.
[265] "Fact Sheet: Department of Commerce's Use of Bipartisan Infrastructure Deal Funding to Help Close the Digital Divide", U.S. Department of Commerce. https://www.commerce.gov/news/fact-sheets/2021/11/fact-sheet-department-commerces-use-bipartisan-infrastructure-deal-funding
[266] William B. Bonvillian, "Emerging Industrial Policy Approaches in the United States", ITIF, October 4, 2021. https://itif.org/publications/2021/10/04/emerging-industrial-policy-approaches-united-states
[267] William B. Bonvillian, "Emerging Industrial Policy Approaches in the United States", ITIF, October 4, 2021. https://itif.org/publications/2021/10/04/emerging-industrial-policy-approaches-united-states
[268] Federal Data Strategy, 2021 Action Plan. https://strategy.data.gov/assets/docs/2021-Federal-Data-Strategy-Action-Plan.pdf
[269] Digital Strategy, U.S. General Service Administration. https://www.gsa.gov/technology/government-it-initiatives/digital-strategy
[270] Digital.Gov. https://digital.gov/
[271] E-Government Survey 2020, United Nations. https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20(Full%20Report).pdf
[272] Open Government, Data.Gov, US. https://data.gov/open-gov/
[273] Regulations.gov. https://www.regulations.gov/about
[274] Socio-economic development plan for 2021-2025, Vietnam. https://vietnam.gov.vn/socio-economic-development-plans/socio-economic-development-plan-for-2021-2025-12056314
[275] Socio-economic development plan for 2021-2025, Vietnam. https://vietnam.gov.vn/socio-economic-development-plans/socio-economic-development-plan-for-2021-2025-12056314
[276] Samaya Dharmaraj, "Vietnam to Formulate National Strategy on Digital Economy", Open Gov Asia, May 12m 2021. https://opengovasia.com/vietnam-to-formulate-national-strategy-on-digital-economy/
[277] National strategy for 4th Industrial Revolution,Vietnam. https://en.baochinhphu.vn/national-strategy-for-4th-industrial-revolution-11140283.htm
[278] SME and Entrepreneurship Policy in Viet Nam, OECD Library. https://www.oecd-ilibrary.org/sites/509a0d39-en/index.html?itemId=/content/component/509a0d39-en

[279] Data Protection Laws of the World – Vietnam. https://www.dlapiperdataprotection.com/index.html?t=law&c=VN#:~:text=Vietnam%20does%20not%20have%20a,number%20of%20competent%20State%20authorities.
[280] Cece Nguyen, "Vietnam to Commercialize 5G: What Should Investors Expect", Vietnam Briefing, December 04, 2021. https://www.vietnam-briefing.com/news/vietnam-to-commercialize-5g-what-should-investors-expect.html/
[281] "Digital Skills Programme Trains 650,000 in Vietnam", Open Gov Aisa, November 05, 2021. https://opengovasia.com/digital-skills-programme-trains-650000-in-vietnam/
[282] "Vietnam's digital economy revenue reaches US$53bil in Q1", The Star, April 28, 2022. https://www.thestar.com.my/aseanplus/aseanplus-news/2022/04/28/vietnam039s-digital-economy-revenue-reaches-us53bil-in-q1, "Australia-World Bank Group Strategic Partnership in Vietnam", The World Bank, November 2021. https://openknowledge.worldbank.org/bitstream/handle/10986/37179/P16734904490250bd0b6830feee7a77690c.pdf?sequence=1&isAllowed=y
[283] National strategy for 4th Industrial Revolution,Vietnam. https://en.baochinhphu.vn/national-strategy-for-4th-industrial-revolution-11140283.htm , https://www.vietnam-briefing.com/news/vietnam-to-commercialize-5g-what-should-investors-expect.html/,
[284] Cece Nguyen, "Vietnam to Commercialize 5G: What Should Investors Expect", Vietnam Briefing, December 04, 2021. https://www.vietnam-briefing.com/news/vietnam-to-commercialize-5g-what-should-investors-expect.html/
[285] Julia Nguyen, "Vietnam's E-government Ranking Only Tells Partial Story of Digital Transformation", Vietnam Briefing, August 24, 2020. https://www.vietnam-briefing.com/news/vietnams-e-government-ranking-only-tells-partial-story-of-digital-transformation.html/
[286] Phuong Nguyen, "'Make in Vietnam' campaign targets top 30 IT status", VN Express, May 8, 2019. https://e.vnexpress.net/news/business/industries/make-in-vietnam-campaign-targets-top-30-it-status-3920371.html#:~:text=On%20Thursday%2C%20May%209%2C%20the,means%20'Produced%20in%20Vietnam'
[287] "Digitalisation Key to Vietnam's Economic Recovery", Open Gov Asia, December 20, 2021. https://opengovasia.com/digitalisation-key-to-vietnams-economic-recovery/
[288] http://digital.business.gov.vn/
[289] "Vietnam's digital economy revenue reaches US$53bil in Q1", The Star, April 28, 2022. https://www.thestar.com.my/aseanplus/aseanplus-news/2022/04/28/vietnam039s-digital-economy-revenue-reaches-us53bil-in-q1
[290] "Vietnam issued its first e-government strategy towards digital government", Ministry of Information and Communications, June 15, 2021. https://english.mic.gov.vn/Pages/TinTuc/tinchitiet.aspx?tintucid=147615#:~:text=Vietnam%20issued%20its%20first%20e%2Dgovernment%20strategy%20towards%20digital%20government,-15%2F06%2F2021&text=On%20June%2015%2C%202021%2C%20the,with%20a%20vision%20to%202030.
[291] "Vietnam issued its first e-government strategy towards digital government", Ministry of Information and Communications, June 15, 2021. https://english.mic.gov.vn/Pages/TinTuc/tinchitiet.aspx?tintucid=147615#:~:text=Vietnam%20issued%20its%20first%20e%2Dgovernment%20strategy%20towards%20digital%20government,-15%2F06%2F2021&text=On%20June%2015%2C%202021%2C%20the,with%20a%20vision%20to%202030.
[292] "Vietnam's digital economy revenue reaches US$53bil in Q1", The Star, April 28, 2022. https://www.thestar.com.my/aseanplus/aseanplus-news/2022/04/28/vietnam039s-digital-economy-revenue-reaches-us53bil-in-q1, Pritesh Samuel, "Vietnam's Digital Transformation Plan Through 2025", Vietnam Briefing, September 16, 2021. https://www.vietnam-briefing.com/news/vietnams-digital-transformation-plan-through-2025.html/?hilite=%27digital%27%2C%27government%27