# Estimating the economic impact of the Single Wholesale 5G Network in Malaysia

November 2021

EY

Building a better working world

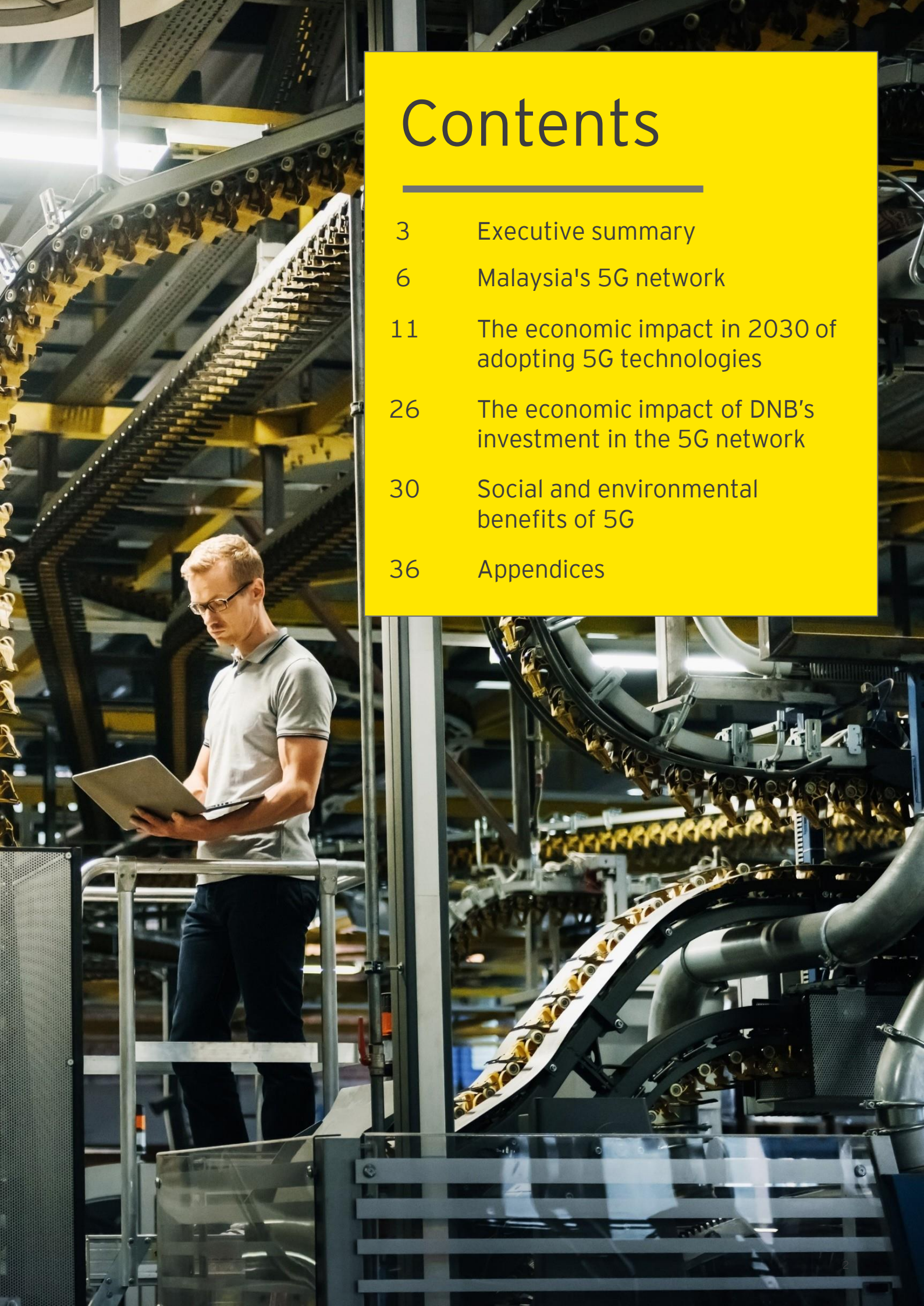
# Disclaimer

This Report was prepared by Ernst & Young Consulting Services Sdn Bhd ("EY") for Digital Nasional Berhad ("DNB") only.

The Report sets out our independent forecast for the economic impact which results from 5G adoption across different sectors of the economy. It also sets out our independent forecast for the impact on the economy as a direct result of DNB's investment in the 5G network. This second model uses data inputs including financial data provided by DNB as well as other publicly available data. EY has been assisted in the economic modelling and the production of the Report by colleagues from the Economic Advisory practice from Ernst & Young LLP, based in the United Kingdom .

EY shall not accept and/or shall not assume any responsibility in respect of the Report to any readers of the Report (Third Party). To the fullest extent permitted by law, EY will accept no liability in respect of the Report to any Third Party. Should any Third Party choose to rely on the Report, then they do so at their own risk.

EY has not been instructed by its client, DNB, to respond to queries or requests for information from any Third Party and EY shall not respond to such queries or requests for information. Further, EY is not instructed by DNB to update the Report for subsequent events or additional work (if any) performed by EY. Accordingly, without prejudice to the generality of the foregoing, EY accepts no responsibility to any Third Party to update the Report for such matters.



# Contents

Section 1

# Executive summary

# 1 Executive summary

**The deployment of a world leading 5G network and the subsequent adoption of 5G enabled "use cases" will generate a wide range of economic and social benefits for Malaysia. To understand the impact of 5G on Malaysia's economy, we have developed two economic models.**

The first model considers the impact of 5G adoption and usage by enterprises on Gross Domestic Product ("GDP"),[1] employment and skill mix in 2030 against a baseline forecast for 2030 with no assumed 5G impact. The second model considers the full impact across the economy of the development and running of the 5G network being developed by Digital Nasional Berhad ("DNB"), over its 10-year license period. These models are described further in the appendices.

We have also considered the wider social and environmental benefits that 5G use cases can deliver to support prosperity, inclusivity and sustainability.

### Quantifying the economic impact of adopting 5G technologies

In 2030 alone, we estimate that the adoption of 5G technologies will increase GDP across Malaysia by RM 122 billion, compared to our baseline with no assumed 5G impact. This increase in GDP of 5% compared to our 2030 baseline is driven by increases in efficiency and improvements in productivity that are delivered by digital transformation, enabled by 5G use cases. The expansion of digital industries and the entry of new firms to the market will also drive increases in GDP.

Our analysis indicates that in 2030 alone, 5G technologies will also support almost 148,000 net additional jobs across the economy compared to our baseline, and will contribute to the loss / avoidance of lower skilled jobs and the creation of higher skilled jobs. We estimate this will lead to an increase in the proportion of high skilled jobs in the economy by 3 percentage points.

Section 3 of this report provides further detail on the GDP, jobs and skills impact for different sectors of the economy in 2030.

**RM 122 billion (+5%) increase in GDP in 2030**

**148,000 net increase in jobs supported in 2030**

**Increase of 3ppt of high skilled jobs in the economy**

### Quantifying the economic impact of DNB's investment in the 5G network

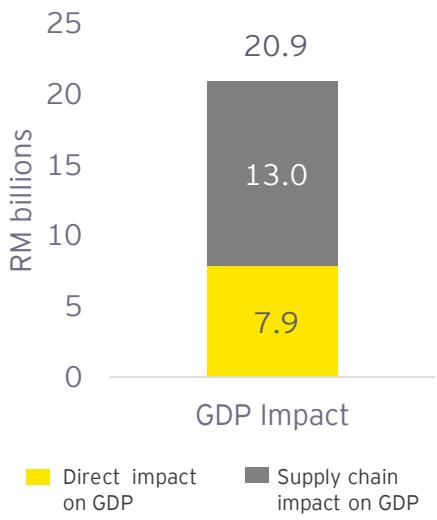
We estimate that over its 10-year license period, DNB's investment in the 5G network could generate a total economy-wide incremental GDP contribution of RM 20.9 billion.

Of this, we estimate that RM 7.9 billion (38%) relates to the GDP generated directly by DNB through its income and salaries to employees, with RM 13 billion being generated throughout the supply chain and wider economy.

At the peak of the network deployment in 2022, DNB's investment could support over 14,800 jobs across the economy with the majority of these created through the increased demand placed on the sector's supply chain.

Section 4 of this report provides further detail of the economic contribution of DNB's investment in the 5G network.

**GDP impact of DNB's investment in the 5G network (2021 – 2031)**




[1] Within this Report, we have used Gross Value Added ("GVA") as a proxy for GDP. GVA is a measure of economic activity which can be viewed as the incremental contribution to GDP. The difference between GVA and GDP is the net impact of taxes and subsidies

### Understanding the socio-economic and environmental benefits of 5G enabled technologies

The deployment and operation of the 5G network in Malaysia will support the Government in delivering its 12th Malaysia Plan by promoting prosperity, inclusivity and sustainability across the country, and will help meet the digital transformation targets set out in the MyDIGITAL strategy. It will support the strategic goals of the 12th Malaysia Plan by:

| | |
|---|---|
| Prosperity | Creating opportunities to transform industries, increase productivity and drive the acceleration towards higher skilled labor |
| Inclusivity | Bringing connectivity to rural areas, providing more opportunities for education, skills development and employment. It will support the development of the rural economy |
| Sustainability | Helping businesses minimize their impact on the environment through better monitoring and control of pollutants, water and other resources |

Investment in digital technologies and improved connectivity has supported economies around the world in their recoveries from the COVID-19 crisis. Investment in the 5G network in Malaysia along with improving coverage of 4G and fiber broadband will help support Malaysia's economic recovery.

There is currently a significant "digital divide" across Malaysia in terms of the adoption of fixed and mobile broadband services. The Single Wholesale Network ("SWN") being developed by DNB for 5G services will provide a more level playing field across the country in terms of connectivity by providing the Rakyat with access to a high quality fixed wireless access ("FWA") broadband connection. Bringing connectivity to rural areas will improve inclusivity, providing more opportunities for education, skills development and employment, as well as improving access to healthcare services. This will help in driving rural economic growth, and provide rural businesses more opportunities to access online markets.

Section 5 of this report sets out the wider benefits that could be realized by 5G technology.

Section 2

# Malaysia's 5G network

# 2 Malaysia's 5G network

World leading technology infrastructure will be a key enabler of Malaysia's strategic goals set out in the MyDIGITAL initiative and the 12th Malaysia Plan.

The MyDIGITAL initiative seeks to position Malaysia as a ***regional leader in the digital economy*** and achieve inclusive, responsible and sustainable socio-economic development. The 12th Malaysia Plan sets out goals to achieve a ***prosperous, inclusive and sustainable Malaysia.*** Achieving 5G network coverage across the majority of the country in the coming years will help provide the platform for accelerating the digital transformation of the economy.

The timeline below sets out a number of key milestones in Malaysia's journey to improve its digital infrastructure.

JENDELA

MyDIGITAL

Digital Nasional


**August 2020**

- Jalinan Digital Negara ("JENDELA") plan announced
- The first key goal of JENDELA is to improve 4G coverage
- The second key goal is to increase the number of premises with access to fiber broadband

**February 2021**

- MyDIGITAL initiative and Malaysia Digital Economy Blueprint announced
- 5G recognized as a critical digital infrastructure to achieve the MyDIGITAL vision
- Investment will be made over 10 years (2021-2030) to implement 5G nationwide

**March 2021**

- Ministry of Finance announced the establishment of Digital Nasional Berhad ("DNB")
- DNB will be a wholly-owned Government entity to accelerate 5G rollout nationwide
- Network to be built using the latest 5G technology for improved speed and capability

**December 2021 onwards**

- Launch of 5G in December 2021
- Plans to deploy 5G in major cities and districts in 2022 (40% coverage in populated areas)
- Expanding to further cities and rural areas in 2023 (70% coverage in populated areas)
- Target to achieve 80% 5G coverage in populated areas in 2024

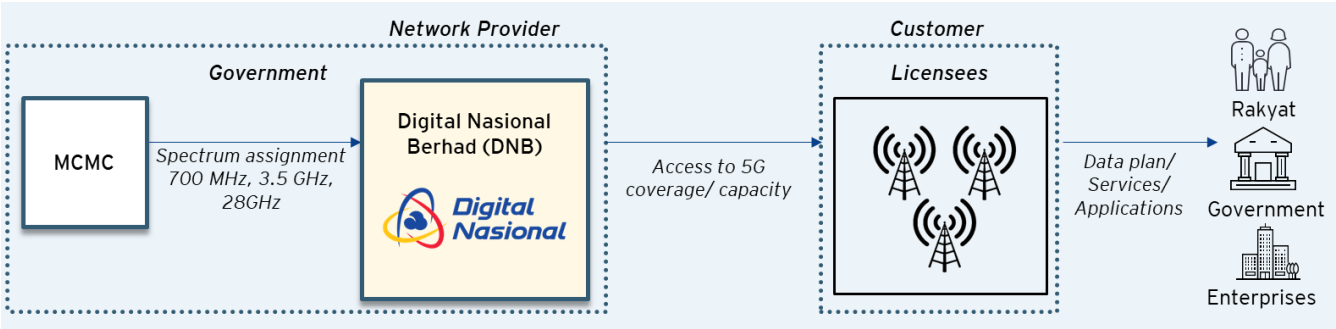
As set out in the timeline above, the creation of DNB is part of a number of initiatives which will improve both mobile and fixed connectivity across the country. The DNB network rollout will seek to cover 80% coverage in populated areas with 5G by 2024. The operating model of the 5G network is described on the next page and its capabilities on the subsequent page.

***The operating model of the 5G network will support the rapid rollout of 5G across the country, helping to support the realization of the Government's strategic goals.***

The Ministry of Finance, on 1 March 2021, established DNB as a special purpose vehicle ("SPV") to build and run the 5G network. ***The deployment of the 5G network will be financed entirely by the private sector***.

DNB will raise around RM 5.0 billion from the domestic financial markets, including establishing a long-term Sukuk programme. The Ministry of Finance will invest RM 500 million in DNB's equity to capitalize the company to commence operations.

DNB will be the single neutral party to undertake the deployment of 5G infrastructure and network nationwide and is licensed under the Communications and Multimedia Act 1998 ("the Act") with a 10-year license to provide wholesale 5G coverage and capacity to licensees under the Act, which include mobile network operators, application service providers and other licensees. The licensees will in turn provide services to the Rakyat, government and enterprises as illustrated in the schematic below.




There is a growing trend for new wholesale models and network sharing as a result of the challenging economics of 5G rollout, due to the increased requirement for cell sites. A full "neutral host model" of 5G deployment is rare internationally, and the deployment of such a model is, therefore, not without its risks. Monitoring and control of the network will be needed to ensure that service quality is maintained, prices remain fair and reasonable and that licensed operators have the ability and incentive to innovate and differentiate their service offerings.

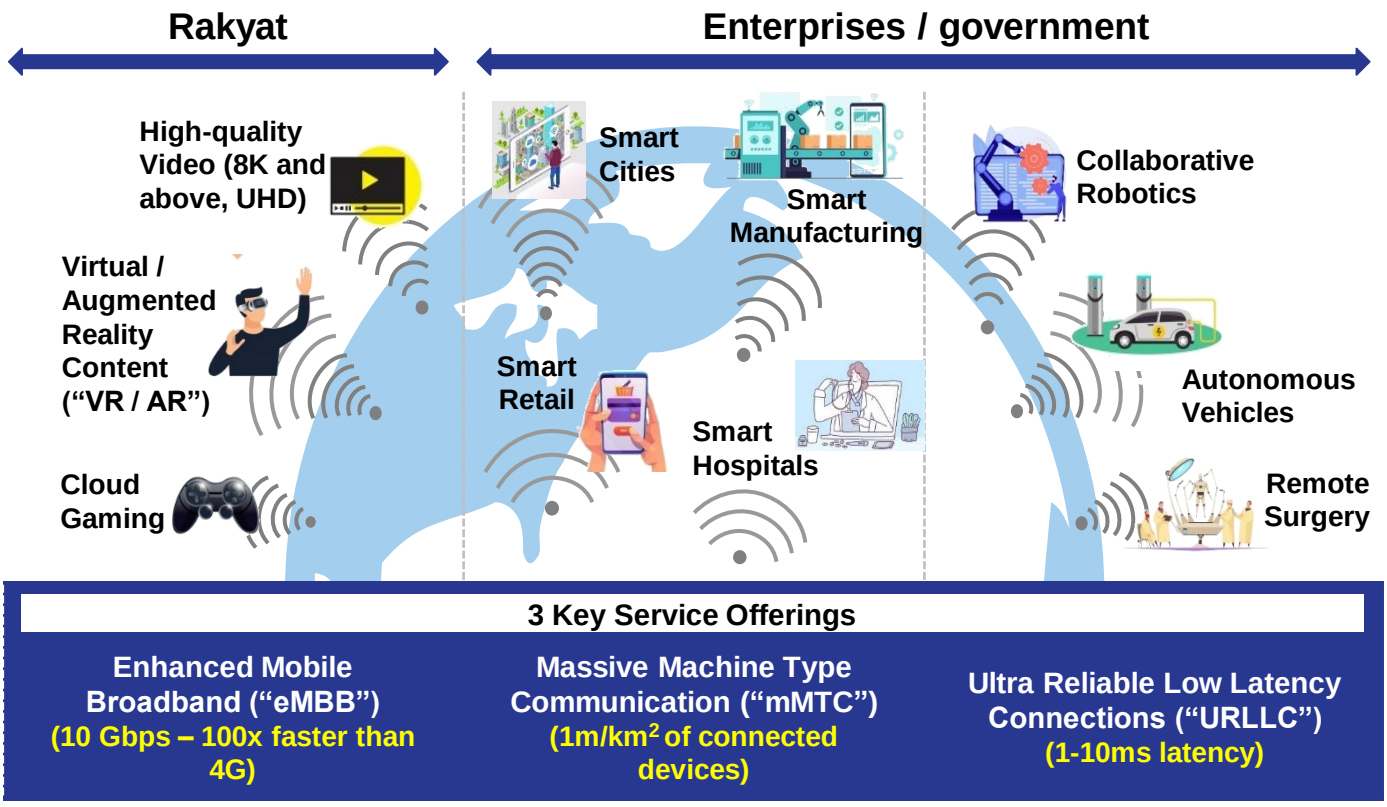
The model will, however, provide substantial benefits. The typical deployment of mobile networks by the private sector is characterized by duplication of infrastructure, as all operators largely build networks in the same locations as they compete for high value customers in urban areas. They are also characterized by rural areas being potentially under-served due to a weaker or negative investment case for network deployment in rural areas. This is because rural cell deployments will typically have a smaller number of people within each cell site coverage area and because rural consumers typically have lower income and spending power compared to urban consumers, both limiting the revenue that can be generated from providing mobile services at a given cell site.

The neutral host model employed by DNB ***improves the economics of 5G network development***. First, it reduces the duplication of network infrastructure, as a single network can be used to provide 5G services by all licensed operators to all users across the country. This will ensure the most efficient use of resources, including natural resources such as the radio spectrum. Second, it improves the economics of rural network development by allowing DNB to receive wholesale revenue associated with **all** 5G users at a given 5G rural cell site. This also reduces the risk for licensed operators to provide services to rural customers as it removes the requirement to invest in network infrastructure at rural sites.

***The characteristics of the DNB SWN will enable the acceleration of 5G network coverage to 80% of the populated areas by 2024 and to 90%+ by 2030.***

The SWN will use the most modern 5G technology. The first generation of 5G networks were launched in 2019 and are an extension to existing 4G networks. These are known as "non-standalone" ("NSA") 5G as they involve the replacement of equipment at cell towers with 5G radio equipment, but still rely on the existing 4G "core network". This provides significant benefits in terms of network speed and performance, but as the core network provides the applications and computing power, NSA 5G does not deliver the full potential of 5G.

The first "standalone" 5G network in the world was launched in late 2020. DNB is using this latest standalone 5G technology to develop the SWN. The SWN will enable the following capabilities:




| | |
|---|---|
| eMBB | The SWN will deliver significant speed benefits compared to 4G with speeds of up to 100 times faster. Even at the edges of cell site coverage, it will enable mobile broadband speed of up to 100Mbps. The speed and quality of the mobile broadband will be sufficient for home broadband connections using FWA. |
| mMTC | The 5G network will support the widespread deployment of 'Internet of Things' ("IoT") devices. The network will be able to support around 1 million of these devices per $km^2$ as they typically transmit small amounts of data on an intermittent basis. IoT devices will support use cases including smart sensor networks for enterprises and wearable devices for consumers. |
| URLLC | Latency refers to the speed of data transfer between sending and receiving information across the network. Standalone 5G enables very low latency and reliable data transfer which will support the delivery of critical applications such as remote surgery and autonomous vehicles. |

Our interviews with industry leaders from across the Malaysian economy, undertaken to inform our economic modelling, highlight the positive impacts that will be driven by widespread and accelerated access to 5G. The adoption of 5G will have a transformative effect on the society and the economy of Malaysia, helping to deliver the goals of the MyDIGITAL initiative and the 12th Malaysia Plan.

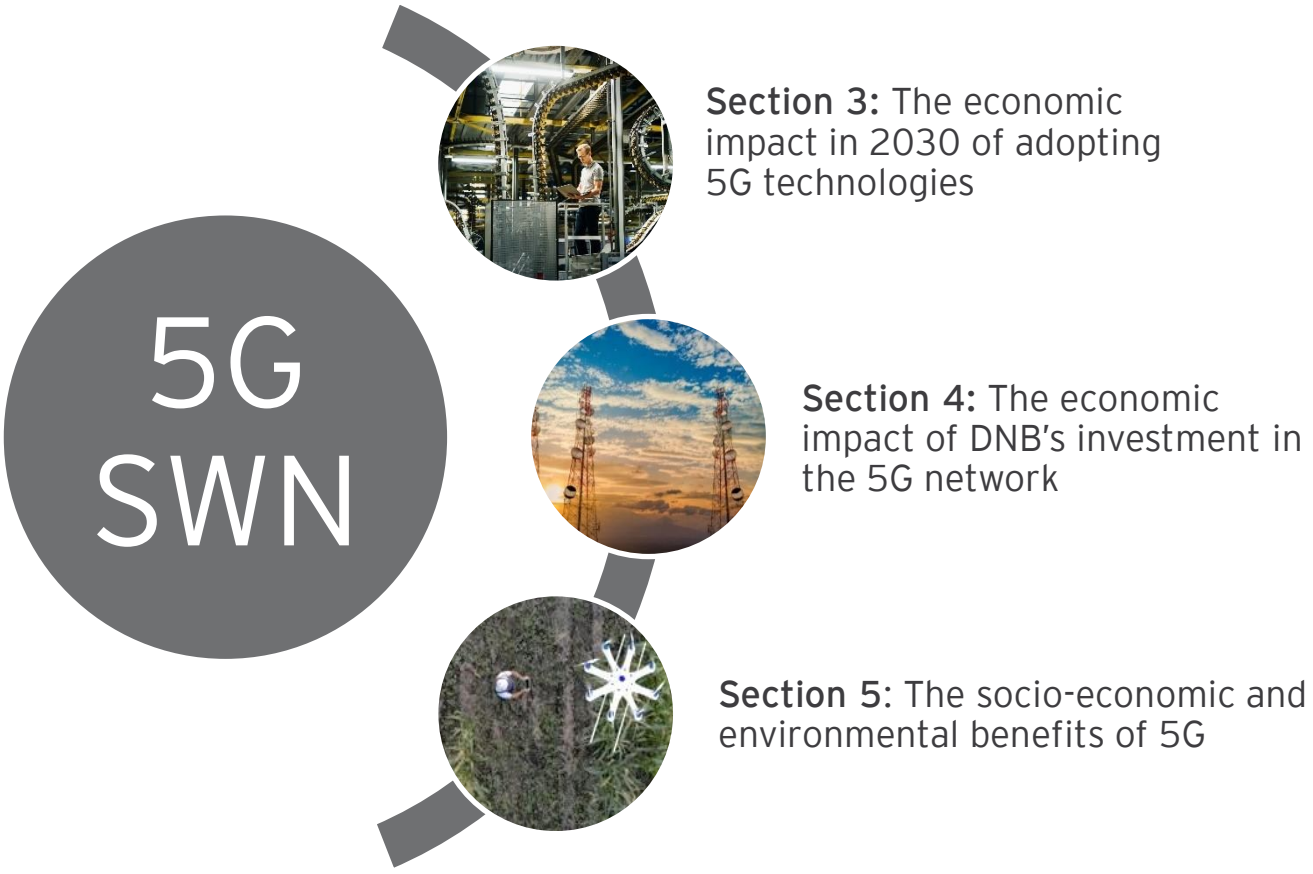
For citizens, it will enable a more connected society, bringing high speed broadband to those currently with limited or no access, helping to bridge the digital divide. It will provide better and faster consumer experiences, new ways to interact with businesses, government and each other, and enable new forms of entertainment.

For businesses, it will enable new ways of working, drive efficiencies and accelerate the move towards high skilled labor. As well as supporting the digital transformation of sectors across the economy, 5G will support the development of new skills and new industries.

The accelerated rollout of the network will help to "level-up" the divide between urban and rural economies, creating new opportunities for rural businesses and leading to a more inclusive and equitable economy. 5G will increase business efficiency and help to minimise environmental impacts through more optimized use of water and other natural resources.

We have developed two economic models to estimate the impact of 5G in Malaysia by 2030. The first model considers the impact of 5G adoption and usage by enterprises in 2030 against a baseline forecast with no assumed 5G impact. The second considers the full impact across the economy of the development and running of the SWN over its 10-year license period. More detail on our modelling approach is set out in the Appendices. We have also undertaken qualitative analysis of the potential socio-economic and environmental benefits which will be driven by 5G adoption.

The schematic below sets out the remaining sections of this report:



Section 3

# The economic impact in 2030 of adopting 5G technologies

# 3 The economic impact in 2030 of adopting 5G technologies

The adoption of 5G technology will be a key driver of economic growth in Malaysia, with high speed connectivity and ultra-reliable networks supporting the development of new use cases and applications which will drive efficiencies, increase productivity and create new opportunities.

In this section, we have considered the incremental impact that the adoption of 5G use cases will have on Malaysia's GDP, the number of jobs these technologies will create, and the impact they will have on the skill mix of the labor force in 2030.[1]

To calculate the economic impact of 5G, we have first forecast a baseline view of the Malaysian economy in 2030 with no assumed impact of 5G adoption. This forecast of GDP and employment by sector is based upon estimates sourced from the Malaysian Department of Statistics and other external economic data sources, along with our own assumptions.

Once this 2030 baseline view of the economy was established, we then considered the impact of 5G technology adoption on each sector. Some of the key inputs considered in the calculation include:

- Rate of adoption of 5G technology across the sector by 2030;
- Labor cost savings delivered through implementing 5G technologies;
- Non-labor cost (operating costs, capital costs and factor input costs) savings delivered through implementing 5G technologies;
- The impact on productivity and output;
- The impact of 5G on the number of people in employment (job creation vs jobs lost / avoided); and
- The proportion of low and semi skilled jobs created and lost / avoided compared to high skilled jobs created and lost / avoided.

To inform our assumptions for these key inputs, we undertook eight interviews with industry leaders which work across all sectors of the economy, and undertook a detailed literature review to corroborate the findings from our primary research.

5G technology will start to drive economic benefits once the adoption of 5G use cases that improve efficiency and productivity within industries begin. There will be significant cumulative benefits between 2022, when the network is rolled out, and 2030, the year which we have modelled.

We would expect the impact on GDP and employment to become increasingly material over time as adoption grows and 5G use cases mature and evolve. Our analysis focuses on the impact of 5G technologies on GDP, jobs and skills in 2030, at which point the adoption of 5G and 5G use cases will be more established across Malaysia.

The level of impact on GDP and employment will be impacted by the success of the deployment of the SWN. Under DNB's current deployment plan, it is expected that the SWN will have 40% coverage in populated areas in 2022, 70% in 2023 and 80% in 2024. Over 90% coverage is to be expected by 2030. The speed of the deployment of the SWN will drive the initial adoption of 5G use cases across sectors. However, the success of the innovative use cases will be key to further drive adoption and subsequent economic growth in the economy and is therefore a key dependency on our forecasts and central to the economic benefits being realized.

The remainder of Section 3 provides the findings of our economic analysis on the economy as a whole (pages 13-14), labor force dependencies (page 15), the economic impact on each sector of the economy (pages 16 to 24) and sensitivity analysis (page 25).

Further details on the methodology for our economic analysis presented in this section can be found in appendix B.

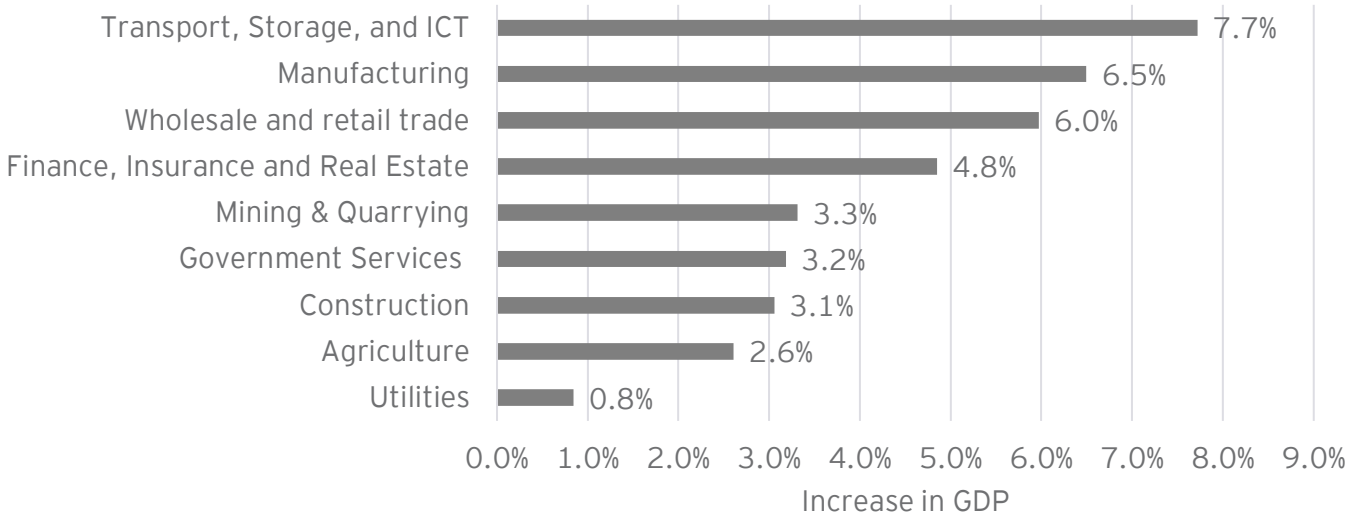


[1]We have not modelled the economic impact of consumer adoption of 5G technology

Our analysis suggests that the adoption of 5G technologies could produce an incremental GDP impact across the Malaysian economy of RM 122 billion (5.0%) in 2030, compared to our baseline view of 2030 with no assumed 5G impact.

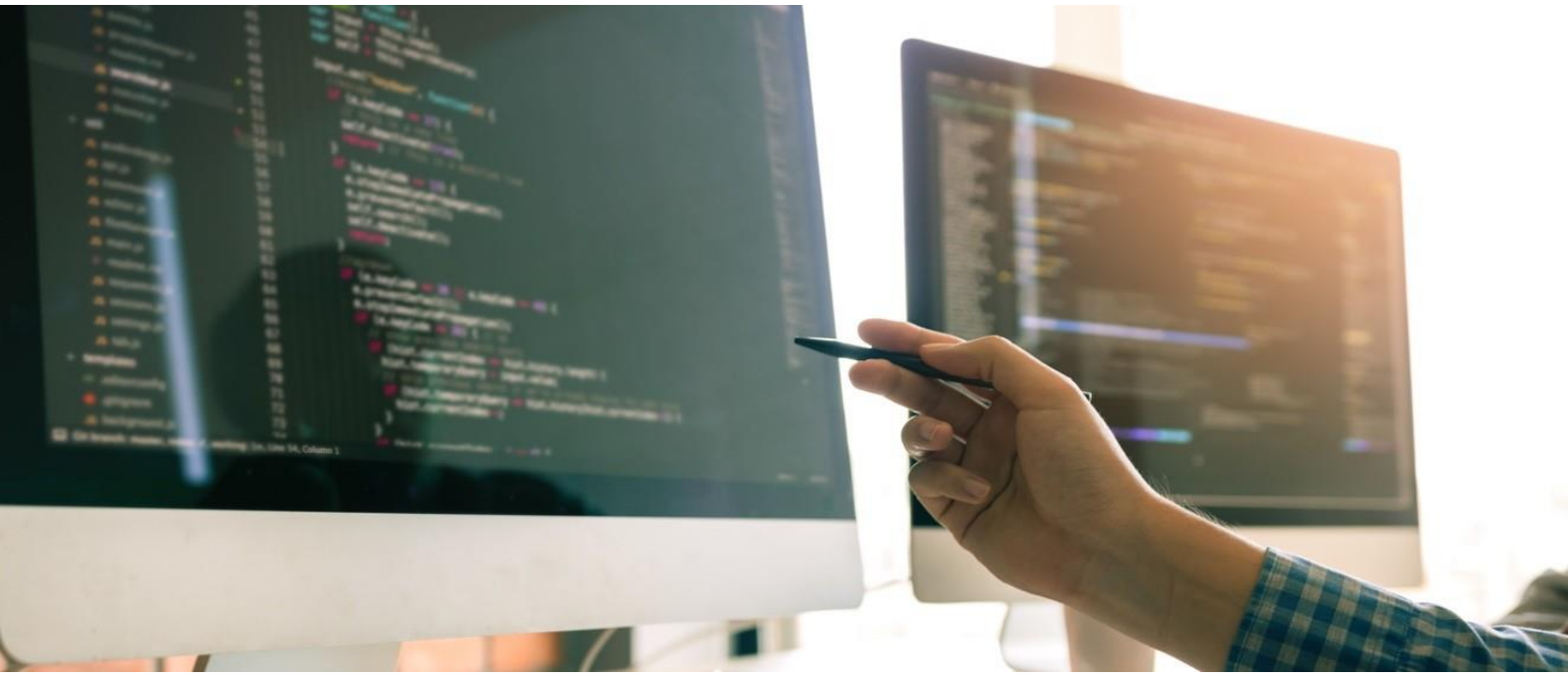
As set out in the chart below, 5G will have a differential impact on different sectors of the economy as each has unique characteristics in terms of the scope for labor and other cost efficiencies and the scope for improvements in productivity that are delivered from the adoption of 5G enabled technologies.

**GDP impact of adopting 5G technologies in different sectors of the economy in 2030, compared to a baseline view of the economy in 2030 with no assumed 5G impact**



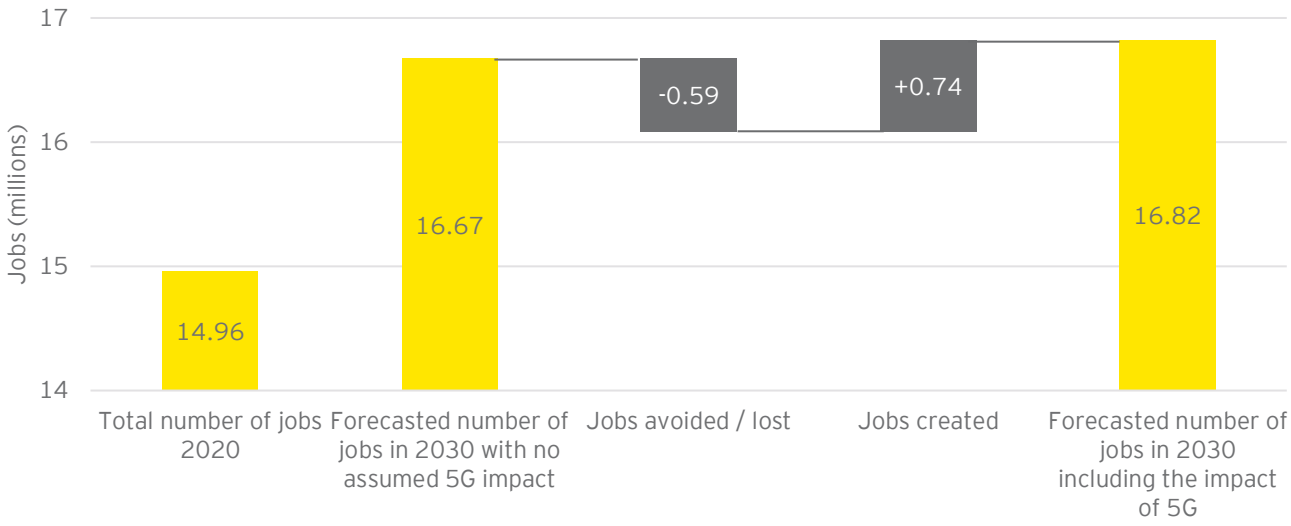

The information and communication technology ("ICT") sub-sector will see substantial growth as a result of 5G. Manufacturing, wholesale and retail trades and transport will all see material impacts in terms of incremental GDP growth. 5G use cases for these sectors are already well established.

We do not expect 5G to have a material impact on GDP or employment in the "other services" sector of the economy (not shown on the chart as a result). This sector comprises services including hairdressing, libraries and repair shops. Although 5G may improve user experiences within these services, we would not expect 5G to have a significant impact on GDP or employment.



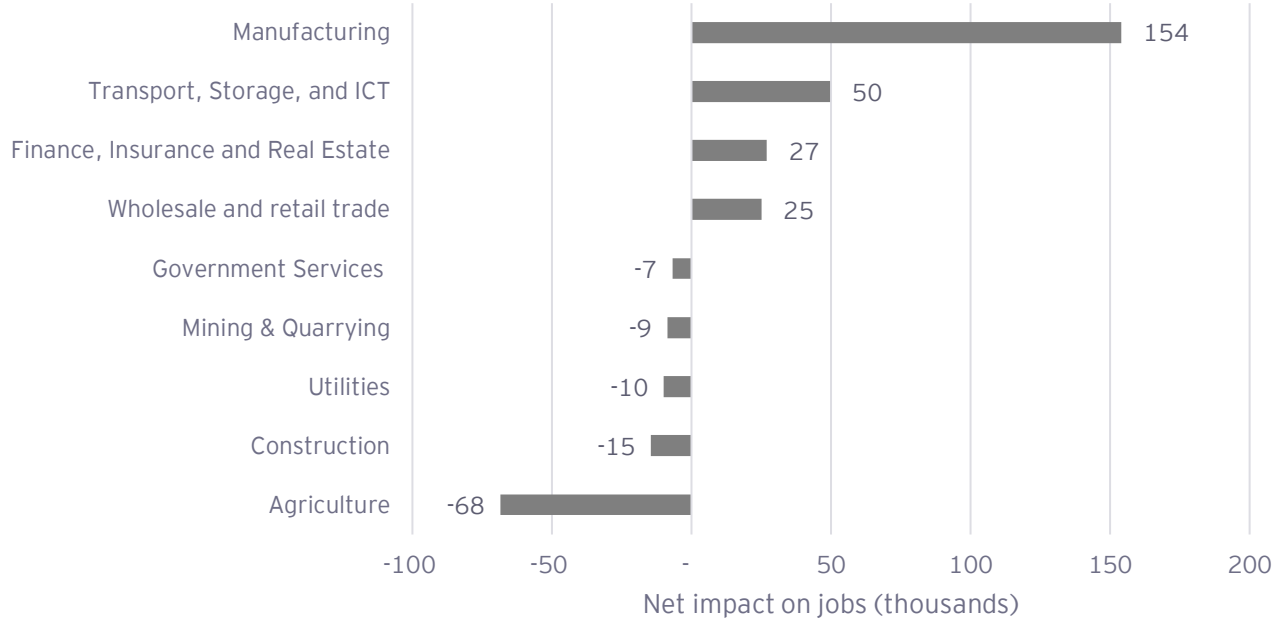
As shown in the chart below, in our baseline view of no assumed 5G impact, we forecast the number of jobs in Malaysia to grow from 15 million to 16.7 million between 2020 and 2030. Our modelling of the sectors suggests that 592,000 jobs could be lost or avoided, i.e. not created, as a result of the digital transformation supported by 5G, the majority of which would be low or semi skilled roles. The implementation of 5G and the adoption of 5G use cases will lead to the creation of 740,000 new jobs, leading to a net increase of 148,000 jobs.

**The impact of 5G technology on jobs supported across the economy in 2030, compared to a baseline view of the economy in 2030 with no assumed 5G impact**




We expect that the biggest net impact on jobs will be in the manufacturing and transport, storage and ICT sectors, where 5G will power new technologies, such as smart production lines and enhanced logistical solutions. Our analysis suggests that there will be a negative impact on employment within the agriculture sector (around 4% of 2020 employment levels in the sector), however as set out on page 23, 5G will still drive productivity benefits in the sector and increase GDP by 2.6%. 5G will also provide opportunities for these low skilled workers to develop new skills and become re-employed in other sectors of the economy.

**The net impact of 5G technology on jobs supported across the economy in 2030 by sector, compared to a baseline view of the economy in 2030 with no assumed 5G impacts**



## Key labor force dependencies

**The adoption of 5G technology is expected to drive significant economic growth across Malaysia. However there is the inherent risk that with the deployment of new technologies, groups of the population are left behind.**

For the rollout of 5G to be a success, and for the job creation which we have forecast to be realized, there will be a need for the continuous upskilling and reskilling of the workforce to ensure that the public can take advantage of the opportunities presented by the technology and that these skills can be successfully deployed in the economy to drive the economic growth.

Our interviews have highlighted that the adoption of 5G technology is expected to create more higher skilled jobs than low or semi skilled jobs. Without the provision of the necessary education and training programmes to reach the required skill levels to be able to access these jobs, the deployment of new technology could exacerbate the problem of access to new opportunities between those in rural and urban areas, or expand regional income disparities between those who come from poorer backgrounds compared to wealthier backgrounds.

The COVID-19 pandemic has heightened the importance of accelerating efforts to close the digital divide and ensure inclusivity when it comes to network access. The provision of either physical or virtual access to education throughout the country will help narrow the gap between rural and urban areas, and give rural economies the skills to capitalise on the opportunities that 5G can provide their communities with.

As per the ambitions of the 12$^{th}$ Malaysia Plan, incentives such as grants or tax credits could be introduced to encourage businesses to contribute towards digital reskilling and upskilling programmes, with the focus of promoting inclusivity across the population. The 12$^{th}$ Malaysia Plan also sets out the priority to mainstream digitalisation for inclusive development, and that inclusion is vital to ensure every citizen has an equal opportunity to benefit from digital transformation across the economy. This will partially be achieved by scaling up digital opportunities for vulnerable groups to exploit the benefits of new technology.

The following pages provide further detail on the GDP, employment and skills impact for different sectors of the economy in 2030, along with examples of use cases which will help support the digital transformation in these sectors.

# Transport, Storage, Information and Communication

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**7.7% increase in GDP**
(RM 19.0 billion incremental GDP)

**50,000 (+4.0%) net increase in jobs supported**
(124,000 created, 74,000 lost / avoided)

The adoption of 5G enabled technology could have a transformative impact on the sector, generating an increase in GDP of 7.7%, and supporting an additional 50,000 jobs in 2030 when compared against our baseline scenario.

A combination of new use cases alongside the enhancement of existing applications which 5G enables will enhance the efficiency of transportation and logistics services. The creation of new jobs will drive further productivity. Improvements in fleet management and the optimization of real-time routing and navigation will increase efficiency and productivity in the sector, as well as delivering environmental benefits. Real-time stock monitoring will also create significant benefits across the supply chain, enabling more efficient delivery, more "just-in-time" stock management, more efficient logistics and reduced need for storage and stock management.

Our interviews with experts and industry stakeholders identified this sector as one of the top three adopters of 5G enabled technology, and as one of the sectors which would benefit the most from operational cost efficiencies as a result of 5G adoption. Interviewees also identified that this is one of the sectors in which the most jobs will be created as a direct result of the introduction of 5G. The introduction of 5G will support the development of new digital skills and the creation of new digital ecosystems and new firms which will further support the increase in GDP and employment in the sector.

## Example use cases of 5G technology

### Smart ports: Crane automation and remote control

The high bandwidth, high capacity and low latency enabled by 5G can support multiple high quality video streams and support the full automation of machinery at ports. For example, 5G enables cranes to either be operated from a remote location based on HD video feeds, or to be fully automated, which can reduce operating costs and drive efficiency in smart ports.

### Fleet management

5G enables responsive networks with fleet-wide communication between drivers, managers and customers. Smart connected sensors can improve safety by alerting workers of imminent dangers, contacting emergency services and collecting data that can be analyzed to increase efficiency and identify maintenance needs.

# Manufacturing

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**6.5% increase in GDP**
(RM 36.8 billion incremental GDP)

**154,000 (+4.8%) net increase in jobs supported**
(231,000 created, 77,000 lost / avoided)

The manufacturing sector is the largest sector in the economy based on data from 2020 for GDP. It is the second largest sector for employment. Our analysis suggests that growth in the sector, supported by productivity improvements driven by automation and digital transformation could lead to an increase in GDP of 6.5% in 2030 when compared against our baseline scenario, and could support an additional 154,000 jobs.

These increases are driven primarily by increases in productivity due to the adoption of 5G, and the automation of manual processes. Given the scale of the sector both in Malaysia and globally, many large businesses have already started to adopt use cases of robotics and automation. The development of 5G will improve the speed and efficiency of these use cases further, and make adoption more accessible for smaller businesses. Our interviews with industry experts specifically identified the transformational impact that 5G connections will have on the sector through the use of sensor networks, real time monitoring and remote operations.

As per the ambitions of the 12th Malaysia Plan, 5G will support a transition to higher value manufacturing, such as aerospace and pharmaceutical manufacturing by the creation of more advanced facilities. Overall we would expect displacement of lower skilled workers along with jobs lost / avoided, but also the creation of highly skilled jobs. Some areas of manufacturing will continue to follow manual processes in production, meaning a need for lower skilled workers across the sector will remain. Our interviews with industry experts also identified that although there will be labor efficiencies, some of the jobs created by the adoption of 5G technology would be low skilled jobs.

## Example use cases of 5G technology

### Predictive maintenance

Unplanned downtime due to equipment failure has been one of the biggest factors that has impacted operations in the manufacturing sector globally. This is where predictive analysis using 5G network data can help. With 5G connectivity, high volumes of data can be analyzed to diagnose and fix operational issues in real-time. Manufacturers can therefore predict and prevent unwanted downtime in critical systems.

### Automated guided vehicles (AGVs)

AGVs are used in industrial applications to transport heavy materials around large industrial facilities, such as factories and warehouses. Powered by 5G, AGVs can use navigation algorithms, laser sensors, vision technology and virtual map sharing to detect objects and move autonomously across the factory or warehouse floor.

# Wholesale and Retail Trade, Accommodation, Food and Beverage

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**6.0% increase in GDP**
(RM 30.2 billion incremental GDP)

**25,000 (+0.5%) net increase in jobs supported**
(250,000 created, 225,000 lost / avoided)

The adoption of 5G enabled technology could have a sizeable impact on the sector, generating an increase in GDP of 6.0%, and supporting an additional 25,000 jobs in 2030 when compared against our baseline scenario.

5G will improve the efficiency of the supply chain for the sector, with wholesalers and large retailers in particular driving 5G adoption to be able to monitor the status and location of goods in real-time. This will ensure that stock levels are maintained, and perishable goods with a short shelf life are transported in the right environmental conditions, and that excess stock is not ordered. 5G sensors and advanced video will also enhance security across the sector, with connected cameras and motion detectors being able to set off alarms and inform security services. Both of these use cases will result in reductions in lost stock through wastage and theft.

The retail shopping experience of customers could also be redefined by 5G enabled technology, with various different use cases impacting the buying process. The adoption of technology will change the way that retailers interact and engage with customers, and will be able to bring a more personalized experience throughout each stage of the transaction. Augmented and virtual reality will enable customers to "try before you buy", by being able to visualise potential purchases in their homes, or virtually try on new clothes. This will also give retailers the opportunity to suggest other items of interest for shoppers to virtually try.

## Example use cases of 5G technology

### Food quality monitoring

IoT enables integrated food monitoring by creating a network of interconnected devices and sensors. These devices can monitor the temperature, humidity and gas levels, and assist in evaluating and managing the quality of food, reducing wastage. Users can monitor the evolution of the food quality over time to ensure quality levels.

### Enhanced tourism experiences

Many tourism attractions and services could be enriched through the use of virtual and augmented reality technologies. The higher bandwidth offered by the new 5G network will reduce latency and improve content and synchronization between participant movements and visual perception, making the experience more exciting and insightful, giving tourists a real-time, interactive experience.

# Finance, Insurance, Real Estate and Business Services

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**4.8% increase in GDP**
(RM 17.3 billion incremental GDP)

**27,000 (+1.6%) net increase in jobs supported**
(41,000 created, 14,000 lost / avoided)

In this sector, our analysis suggests that GDP contribution could increase by 4.8% in 2030, and that an additional 27,000 jobs could be supported when compared against our baseline scenario.

5G enhancement can support financial institutions in increasing productivity, efficiency and security. Improved connectivity and coverage can catalyse financial inclusion, particularly in rural or deprived areas where physical access to bank branches is not possible. In areas of network coverage, automated tellers can support in performing a range of transactions, removing the need for physical banking and enabling labor efficiencies. Real-time financial advice can also support customers in making informed decisions when it comes to investments and purchases. The increased speed of 5G will also support financial institutions in time-sensitive scenarios, where reducing the milliseconds in a transaction can have large financial impacts – for example in the buying and selling of stocks or cryptocurrency.

In the insurance industry, improvements in connectivity can improve the efficiency in evaluating claims. For example, drone technology and remote sensors can assess damage to properties, and twinned with artificial intelligence, can effectively assess the validity of a claim.

In the real estate sector, developers can improve the efficiency and design of construction, provide buyers with virtual reality tours of properties, and implement smart sensors to promote the conservation of energy, for example by turning off heating when peoples' homes or workplaces are empty.

## Example use cases of 5G technology

### Robot financial advisers

Robot advisers are an alternative to face-to-face services, providing advice to customers at any time, in any location. These 5G enabled advisors will be able to provide advice on investing and reducing general spending, helping customers with financial planning and forecasting. 5G can enable the access to digital financial services on the go, with improved security and data volume handling capabilities.

### Interactive automated tellers

Interactive automated teller machines offer ATM like interfaces, but with the enhancement of being able to virtually connect with bank representatives in real-time. Users can perform a range of transactions but without the need of physically accessing a branch of the bank.

# Mining and Quarrying

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**3.3% increase in GDP**
(RM 3.9 billion incremental GDP)

**9,000 (-14.0%) net decrease in jobs supported**
(2,000 created, 11,000 lost / avoided)

In this sector, our analysis suggests that GDP contribution could increase by 3.3% against our baseline scenario, despite a decline of 9,000 in the number of jobs supported. We would expect that this reduction in roles would be in low and semi skilled jobs, as the adoption of 5G use cases, such as digital twin technology will lead to significant labor efficiencies.

Our interviews with experts and industry stakeholders found that the take up of 5G enabled technology in the sector would likely be high, and that the sector would be one of those with the highest level of operational efficiencies achieved.

A combination of new use cases will enhance the efficiency and productivity of the sector. Remote operations, such as the autonomous control of vehicles used at mining and quarrying sites will maximise productivity as equipment and vehicles can be used 24 hours a day. Autonomous vehicles will also lead to improvements in employee safety, as vehicles can be operated away from dangerous working environments. Remote asset monitoring will also enable predictive maintenance, meaning that the status of machinery can be monitored in real-time, and repairs can take place on a timely basis, ensuring there will be no negative impacts on productivity.

5G enabled technology will also help drive down the carbon footprint of the sector. Industry experts considered that the adoption of technology will lead to a significant and sustained net reduction in environmental damage, particularly when considering energy conservation and the prevention of global warming.

## Example use cases of 5G technology

### Digital twin technology

Digital twin technology allows for a virtual representation of physical mining and quarrying sites to be created, allowing users to visualise assets and data in real-time. This technology will allow users to monitor the performance of machinery, identify areas to increase productivity and maximise efficiency, and remove the requirement for physically visiting dangerous or remote mining sites.

### Remote control of vehicles and machines

The reduced latency and high bandwidth provided by 5G enables the use of unmanned haulage trucks in mining and quarrying. Using autonomous, unmanned haulage trucks allows mining to be carried out at dangerous locations while reducing the risk to the safety of mining workers. Operations can be conducted remotely without any need to travel to the site.

# Government Services

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**3.2% increase in GDP**
(RM 7.9 billion incremental GDP)

**7,000 (-0.9%) net decrease in jobs supported**
(23,000 created, 30,000 lost / avoided)

In this sector, our analysis suggests that GDP contribution could increase by 3.2% in 2030 when compared to our baseline scenario. However there would be a 7,000 decline in the number of jobs supported. Improvements in efficiency and productivity mean that in this sector, increase in GDP would still be generated despite a reduction in the level of employment.

The "Government services" sector which we have defined includes traditional government services such as public administration and defence, as well as private and public education, healthcare and residential care services.

The adoption of 5G enabled technologies will enable the enhancement of existing services and the creation of new services particularly in the healthcare and education sectors. The application of 5G will enhance the interaction between students and teachers, as well as patients and doctors and the improved coverage and increased reliability of connections will help to remove the barriers to education and healthcare, particularly for those in rural areas and ensuring that vulnerable people are not excluded from accessing these services.

Enhanced connectivity will enable remote consultations to take place between patients and care providers regardless of location, meaning patients who are not in need of urgent treatment can receive basic primary care advice. Similarly students who are based in remote locations will be able to participate in classes in real-time, ensuring that students do not miss out on the benefits of 'face-to-face' education.

## Example use cases of 5G technology

### Smart education

5G enabled education and training provides learners with immersive and experiential learning. Connected devices including VR/AR headsets can be used for skill based training, and increase knowledge retention and engagement. This also brings value and enhanced understanding as students can benefit from live demonstration of the concepts being taught.

### AR / VR assistance for the visually impaired

AR / VR headsets can enable visually impaired people to be connected in real time to a guide that can help them perform not only daily activities but also activities that require precision and enhanced skillsets. AR/VR headsets can also be used by those who are partially visually impaired. The headsets project live images on specific areas of the retina which can assist in improving vision for those with partial visual impairments.

# Construction

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**3.1% increase in GDP**
(RM 3.3 billion incremental GDP)

**15,000 (-1.0%) net decrease in jobs supported**
(29,000 created, 44,000 lost / avoided)

In this sector, our analysis suggests that GDP contribution could increase by 3.1% in 2030 when compared to our baseline scenario. However there would be a 15,000 decline in the number of jobs supported.

Improvements in efficiency and productivity mean that in this sector, an increase in GDP would still be generated despite a reduction in the level of employment. The construction sector will benefit from a range of efficiencies, particularly in the management of its supply chain. Real-time information on what supplies have been used, and what resources are needed will prevent delays in construction and help developments to be completed in line with the project plan.

5G enabled technology will also assist some of the highly skilled jobs in the sector, and support architects throughout the design process, as well as being able to monitor progress and easily identify any issues throughout the construction phase. Holographic visualisation can also provide workers with a 3D visualisation of the site.

Health and safety in the sector could be enhanced through the application of sensors throughout construction sites, as well as the provision of wearable devices. These could trigger alarms and alert site workers of imminent danger, or could be linked directly to workers so that rises in body temperature, air quality or increase in blood pressure could be easily identified.

## Example use cases of 5G technology

### Holographic visualisation

With holographic visualisation, construction workers could see the complete model of the project they are working on, and gain insight on the actual progress of construction and the status of the raw materials used. Workers can inform and update this view by taking live photos and videos, meaning that the holographic image of the construction project is updated in real-time.

### Supply chain optimization

Real-time information on the order status and location tracking of materials and other components is vital in the construction sector to ensure a project is running on time. With real-time tracking of supply chain components, 5G can help the construction sector to increase productivity, improve resource management, reduce wastage and save time, helping projects to be delivered on time and on budget.

# Agriculture, Livestock, Forestry and Fishing

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**2.6% increase in GDP**
(RM 3.5 billion incremental GDP)

**68,000 (-5.4%) net decrease in jobs supported**
(38,000 created, 106,000 lost / avoided)

In this sector, our analysis suggests that 5G technology would lead to an increase in GDP contribution of 2.6% in 2030, despite a reduction in the number of jobs supported in the sector of 68,000 compared to our baseline scenario.

There are a wide range of use cases that could be implemented in the sector which would be enabled by a 5G network, and further examples are provided on page 35 of this report. The use of sensor technology will assist farmers in monitoring livestock, as well as monitoring soil quality. Real-time monitoring will enable farmers to quickly respond to changing conditions such as extreme weather events. Farmers will also be able to gather data to understand and manage how much fertiliser and pesticide the land requires, and be able to use unmanned drones to identify areas of spoilt land. Effective use of these chemicals will save money, improve yields, and have positive effects on the environment.

Our interviews with stakeholders across the economy identified farming as one of the top three sectors to benefit from labor efficiencies, as the deployment of 5G use cases will replace some of the lower skilled roles in the sector. This displacement will however lead to more efficient and productive methods of farming, increasing yields, but also output and GDP in the sector. We would expect this job displacement to typically be seen on large farms and plantations, with subsistence farming in more rural areas continuing without the adoption of 5G technology.

## Example use cases of 5G technology

### Livestock monitoring

With the adoption of 5G, farmers can reap the benefits of technology to monitor their livestock. 5G will help in providing geo-location tracking and real-time connectivity which will allow farms to monitor the health, fertility, and food intake of their livestock. By attaching wearable tags and sensors, farmers can also monitor the temperature, blood pressure and heart rate of animals and be alerted in real-time if livestock fall ill.

### Smart connected farming

5G supports smart farming that can enable farmers to monitor field conditions and be informed when crops need watering, or require pesticides or fertilizers. With the help of 5G enabled sensors and drones, farmers can get data about potential weeds and spoilt crops and be able to identify the exact location, allowing for effective irrigation and targeted pest / weed control, saving both time and costs.

# Utilities

## The impact of 5G on the sector in 2030 against our 2030 baseline view is:

**0.8% increase in GDP**
(RM 0.5 billion incremental GDP)

**10,000 (-5.4%) net decrease in jobs supported**
(1,000 created, 11,000 lost / avoided)

The adoption of 5G enabled technology will have a modest impact on the sector, generating an increase in GDP of 0.8%, and leading to a reduction in 10,000 jobs supported in 2030 when compared against our baseline scenario.

Our interviews with experts and industry stakeholders identified this sector as one which would benefit significantly from labor cost efficiencies as a result of 5G adoption. This would primarily be a result of the roll out of smart meters which would reduce the demand for manual meter reading. As the utilities sector is dominated by a relatively small number of providers, based on the assumptions in our economic model, the number of new roles that would be created in the sector would not offset the roles which are lost as a result of smart meter adoption.

The adoption of 5G technology and the implementation of "Smart Grids" will lead to a range of benefits, some of which we have not factored into our analysis. Better monitoring and management of power and water will reduce costs through more efficient management of these resources leading to improvements in operating costs for utility companies.

The better monitoring and more efficient usage of power and water will benefit both enterprises and the Rakyat through more efficient usage of these resources, bringing environmental benefits. We have not modelled these broader benefits in our analysis.

## Example use cases of 5G technology

### Smart Grids

5G and IoT connected devices and sensors can power smart utilities by measuring and monitoring the usage of electricity, water and gas, delivering real-time reporting on efficiency, capacity, usage levels and demand levels in peak times, helping to manage capacity across the network and reduce wastage. Private consumption can be enhanced by smart meters that help with more accurate bills and improved usage tracking.

### Smart Water Management

Smart water management is a system designed to gather data on the flow, pressure and distribution of a water by leveraging 5G and IoT with the use of sensors and other connected devices. It ensures that the infrastructure and energy used to transport water is managed effectively.

As 5G is yet to be launched in Malaysia and the rollout and adoption of standalone 5G is in its infancy around the world, there is inherent uncertainty in any forecasting exercise. Adoption of 5G by different sectors in Malaysia will be driven by the benefits that the use cases will bring. These benefits will need to be considered by individual firms across the economy, along with the associated costs of deploying the use cases, before an investment decision is made. A number of factors will impact these decisions, including yet-to-be-defined use cases, pricing levels and the investment climate.

The inputs to our modelling have been informed by a number of evidence based assumptions, which have been based on our literature review, our interviews with industry leaders across the economy and our professional judgement. Our interviews suggest that demand for 5G will be high across the economy and that the adoption of 5G will deliver significant economic benefits.

Given the inherent uncertainty of modelling the impact of 5G on the economy in 2030, we have considered two scenarios reflecting the potential upside and downside of changes in adoption. These scenarios are described below. The table shows the key outputs of these scenarios compared to our central case scenario findings, as set out on pages 13 and 14.

### Scenario A: Encouraging adoption through incentives

One factor which could positively impact adoption is the introduction of financial incentives to businesses across the economy. Providing such incentives (e.g. through tax credits or direct grants) will increase affordability, improve the investment case, and drive additional adoption by businesses.

The provision and the exact form and nature of any potential financial incentives are still to be determined, but our interviews have suggested these could make a positive impact to adoption. To understand the impact this could have on the economy, we have modelled a simple scenario where we have increased the adoption of 5G technology in each sector of the economy by 5 percentage points.

### Scenario B: Reduced adoption at 2030 due to later and slower network rollout

Under DNB's current deployment plan, it is expected that the SWN will have 40% coverage in populated areas in 2022, 70% in 2023 and 80% in 2024. Over 90% coverage is to be expected by 2030 and these assumptions on the timing and scale of coverage have been considered within our economic modelling assumptions when estimating the impact of 5G technologies on GDP and employment at 2030.

If the rollout of the 5G network in Malaysia was to happen later than in DNB's plan, e.g. starting in 2024, and were to occur at a slower rate of network rollout, we would expect to see materially lower rates of adoption by 2030. Compared to our central case aligned to DNB's rollout plan, this would result in a lower GDP and employment impact at 2030. To understand the impact this could have, we have modelled a simple scenario where we have decreased the adoption of 5G technology in each sector of the economy by 20 percentage points.

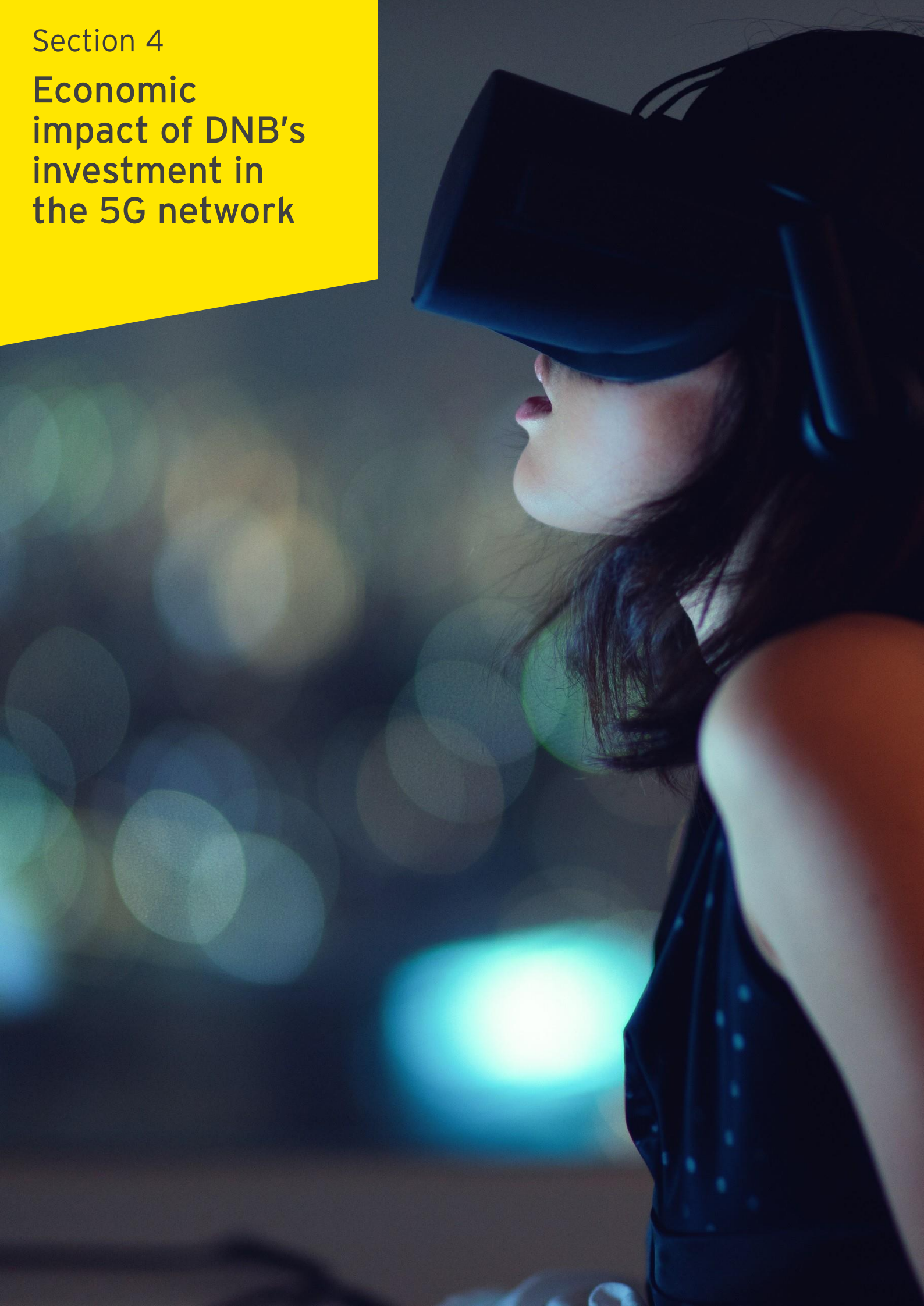
### Scenario impacts

| | Central case | Scenario A: Financial incentives[1] | Scenario B: Later 5G network rollout |
|---|---|---|---|
| GDP contribution (RM billions) | 122 | 129 (+ RM 7 bn) | 94 (- RM 28 bn) |
| GDP contribution (% of 2030 baseline) | 5.0% | 5.3% (+0.3 percentage points) | 3.8% (-1.2 percentage points) |
| Net change in employment | 148,000 | 156,000 (+ 8,000) | 114,000 (- 34,000) |

[1]We have not explicitly included the subsidies themselves in the incremental GDP impact for Scenario A. Our assumption of no impact of GDP from the subsidies is consistent with an assumption that the government spending on subsidies for 5G would be substitutive of government spending elsewhere, as only any incremental government spending would contribute to GDP

Section 4

# Economic impact of DNB's investment in the 5G network



# 4

# Economic impact of DNB's investment in the 5G network

**In this section, we consider the economic impact of DNB's investment in the SWN.**

In our analysis, we have assessed the SWN's annual contribution to GDP over a 10-year period between January 2021 and May 2031, reflecting the SWN's license period.

The analysis uses data inputs including data from DNB's financial plan for this period. This data includes forecast investment of RM 16.5 billion over the license period, of which RM 14.5 billion will be spent within the Malaysian economy. We use this data, along with other data inputs, in our established economic modelling methodology to produce the outputs.

We have estimated the SWN's contribution to Malaysia's GDP and employment by considering two forms of impacts:

- **Direct impacts:** We have analyzed the economic impacts driven directly by DNB's investment in the SWN and the revenues generated by DNB over the period. This includes the direct incremental impact on Malaysia's GDP and the number of jobs directly supported by DNB over the 10-year license period. We refer to these as "direct impacts".
- **Supply chain impacts:** DNB purchases goods and services from other firms in its supply chain, which in turn have their own suppliers. Each entity involved in the SWN's supply chain pays compensation to its employees, who spend part of their salaries on goods and services. These activities drive additional economic impacts throughout the supply chain, increasing GDP and the number of jobs supported across the economy over the 10-year license period. We refer to these as "supply chain impacts".

The findings of our analysis in terms of the impact on GDP and employment are set out on the following pages. Further detail on our modelling methodology is provided in Appendix C and further detail on the calculation of the GDP output is provided in Appendix D.

**We estimate that over its 10-year license period, DNB's investment in the SWN could generate a total economy-wide incremental GDP contribution of RM 20.9 billion (in 2021 prices).**

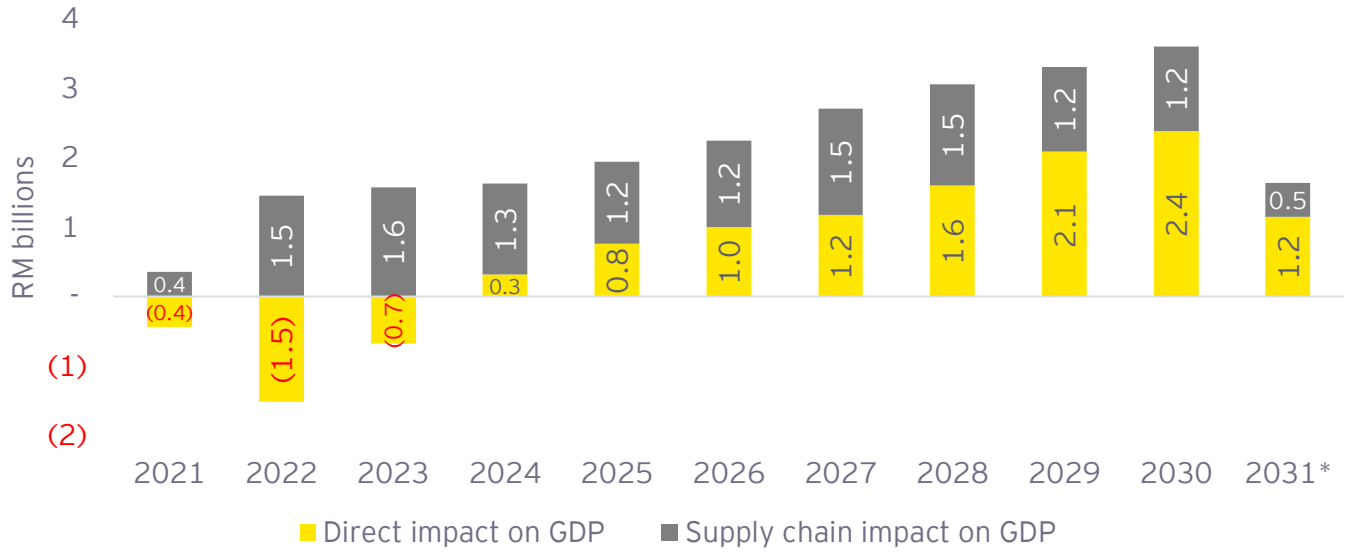
The chart below sets out the annual GDP contribution of the SWN to the Malaysian economy. The gray and yellow bars sum to RM 20.9 billon over the full period. Over the period to May 2031, we estimate that RM 7.9 billion (38% of the total) relates to the GDP generated directly by the SWN through DNB's income and its salaries to employees, calculated as the sum of the yellow bars below. During the first three years (2021-2023), where the costs of deploying the network exceed the revenues generated by DNB, the direct GDP contribution is negative. In the first two years (2021-2022) the overall GDP contribution is neutral as the positive supply chain impacts offset the negative direct impacts. By 2023, the direct impacts of DNB's investment becomes positive, driving overall incremental GDP growth as a result.

The majority of DNB's economic contribution results from its significant expenditure through its supply chain, comprising RM 13 billion (62%) of its overall economy-wide GDP contribution. This is calculated as the sum of the gray bars below.

The total incremental GDP generated of RM 20.9 billion cannot be directly compared to the RM 14.5 billion of domestic investment in the SWN. As set out in more detail in Appendix D, the incremental GDP impact is dependent on the economic output which is created and the costs of producing the output. Where the output is greater than the cost, this generates economic value in the form of incremental GDP.

***Of the RM 20.9 billion impact, RM 3.6 billion (the figures in the chart below for 2030) is additive to the GDP impact set out in Section 3, i.e. the impact will not be included in our economic model which considers 5G use case adoption in 2030.***

GDP contribution by year from SWN investment (2021 prices)




*2031 covers a five month period between January and May 2031

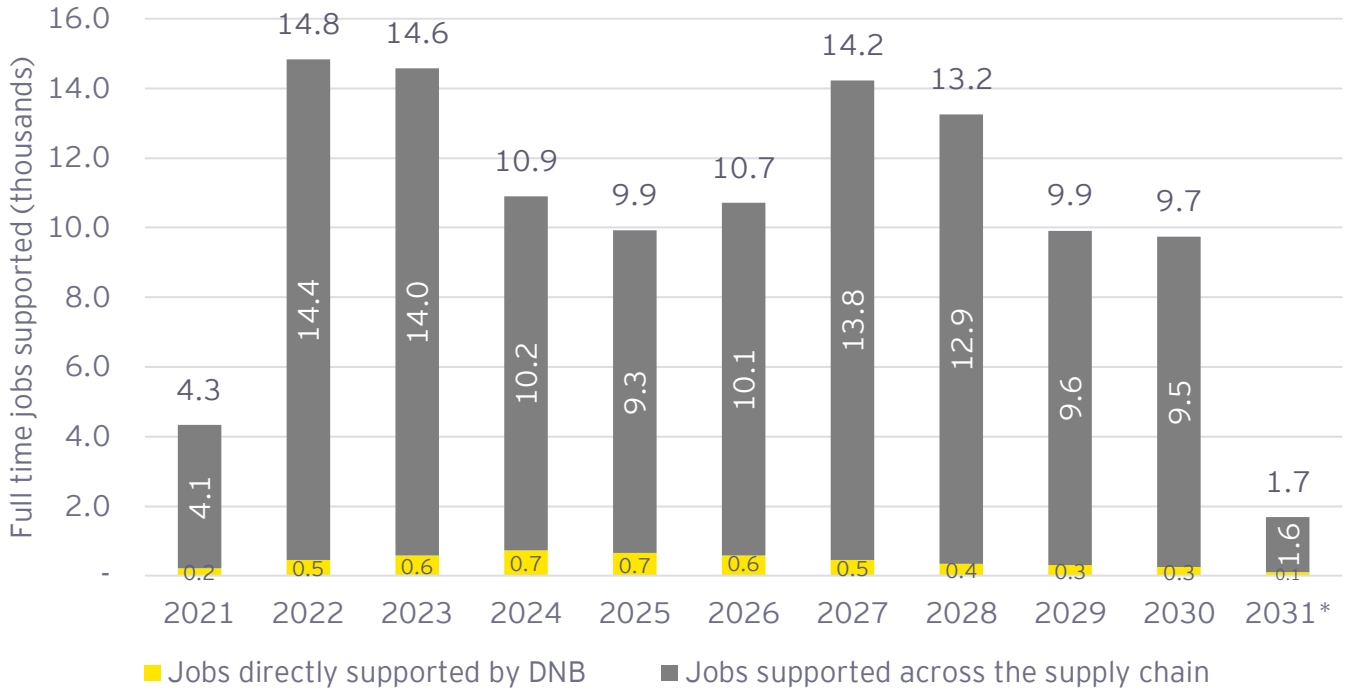
**As set out in the chart below, at the peak of the network deployment in 2022, DNB's investment could support over 14,800 jobs across the economy.**

The chart below shows the total number of full time equivalent jobs supported in each year as a result of the investment in the 5G network. It does not show the incremental number of new jobs created each year.

Across the 10-year license period, our analysis shows that 96% of total employment supported is in the supply chain (calculated as the sum of the gray bars compared to the sum of the gray and yellow bars). This is due to the increased employment created through the increased demand placed on the sector's supply chain, and the impact of increased spending by DNB employees and employees across the supply chain on goods and services in the wider economy. These impacts are generated in mostly the consumer oriented sectors such as wholesale and retail trade, accommodation and food service activities, as well as human health and services.

The peak number of jobs directly supported by DNB is in 2024, where current plans indicate that over 700 roles will be supported by DNB as 5G coverage increases to 80% of the populated areas.

## Jobs supported by DNB's investment per year




*2031 covers a five month period between January and May 2031

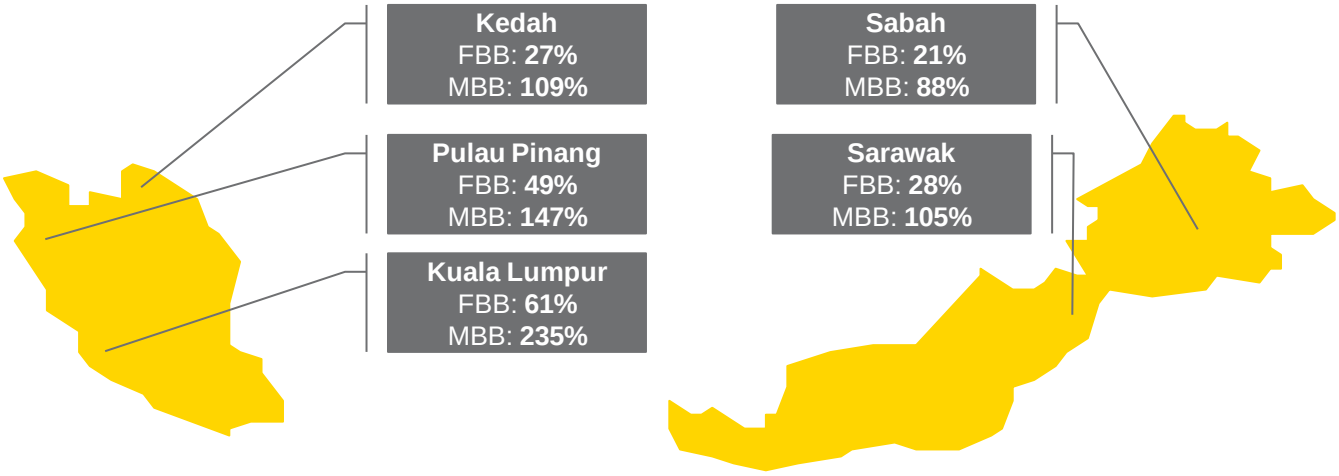
Section 5

# Socio-economic & environmental benefits

# 5 The SWN will drive more inclusive connectivity across Malaysia

Data from the Malaysian Communications And Multimedia Commission ("MCMC")[1] shows that there is currently a significant divide across Malaysia in terms of the adoption of fixed broadband ("FBB") and mobile broadband ("MBB") services.

For Malaysia as a whole, penetration of FBB is 41% of households. Penetration of MBB is measured with reference to the population and is 124% overall, i.e. there are 124 mobile broadband enabled SIM cards in operation for every 100 inhabitants. The penetration for MBB is above 100% as people can have multiple SIM cards, e.g. for business and personal use. Data from the GSMA[2] suggests that the penetration of 'unique subscribers' is around 80% of the populated areas.




As highlighted in the schematic, there is a significant disparity in FBB and MBB penetration across Malaysia, with the highest penetration being in Kuala Lumpur, and more rural states having below average penetration.

These differences in penetration will partly be as a result of income disparity but also a result of the quality of the underlying network infrastructure in rural areas. A 2019 survey by MCMC[3] highlighted that 71% of broadband users relied solely on their mobile connection for broadband access. Historic poor or non-existent coverage of 3G and 4G networks, combined with a potential lack of FBB infrastructure, will mean that digital literacy and internet usage will be lower in rural areas. Ownership of internet connected devices such as laptops will also be lower in rural areas, with people more likely to access the internet through a mobile device, limiting their online experience.

JENDELA is accelerating 4G coverage across Malaysia. While this will bring significant benefits to the Rakyat in terms of connectivity, 4G FWA technology is not a direct substitute for FBB as it suffers from latency and network congestion issues. ***The transformation in home broadband experience will only truly be realized with 5G, and the speed, quality and reliability that will come from its enhanced eMBB capabilities, providing a viable substitute for FBB.***

A focus on the provision of FWA from 2023 onwards will provide Malaysian households with a high quality alternative to FBB. It will be capable of supporting multiple devices within a household and will provide households with the bandwidth they need to be able to use online services such as streaming high definition video, accessing high quality video calling services and accessing online education and skills resources.

***The SWN will provide a more level playing field across the country in terms of connectivity by providing a substantial proportion of the Rakyat with access to high quality broadband.***

[1] C&M Q2_211029_(BI)_PDF (mcmc.gov.my)
[2] GSMA_MobileEconomy_2020_AsiaPacific.pdf
[3] BDS-2019.pdf (mcmc.gov.my)

# The SWN will provide opportunities for rural economic development

Even in the most advanced economies in the world, there are disparities between urban and rural economies. As is the case in Malaysia, rural economies tend to be characterized by poorer access to digital infrastructure and lower income / lower skilled workers.

Rural economies globally have been disproportionately impacted by the COVID-19 pandemic. Whilst many high skilled urban jobs in Malaysia could be undertaken by people transferring to working from home, many in the rural economy were unable to do so, resulting in significant job losses. Others were able to continue in their jobs, e.g. agriculture and fishing, but the Movement Control Order meant that there were limited buyers for produce. Many roadside food stalls and markets were shut. Factors such as these contributed to Malaysians in poorer, more rural areas being hit hardest by the pandemic.

The COVID-19 pandemic has highlighted the importance of telecoms networks as critical national infrastructure. Governments around the world have recognized the need for greater economic resilience and that investment in telecoms infrastructure will both support economic recovery and the "levelling up" between urban and rural economies.

In Europe, 5G and connectivity is one of seven flagship areas of the European Union Recovery and Resilience Facility ("RRF"), which aims to *"mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions."* A significant share of this area's targeted €150 billion digital budget should finance 5G network infrastructures, boosting 5G network rollout, accelerating adoption and helping to close the urban / rural digital divide.

The extensive coverage of 5G in rural areas of Malaysia will bring new opportunities for education, skills development and training, which will help drive rural economic growth. Our interviews with industry leaders from across the Malaysian economy have highlighted that they believe 5G will play a major role in developing opportunities for rural areas, and balancing the urban / rural divide.

5G will give rural businesses more opportunities to access online markets and e-commerce platforms (such as Lazada) for selling their produce, strengthening linkages with urban economies and connecting directly with buyers. This will help achieve better prices for their products by cutting out the middle men.

Examples from rural economies in Europe have highlighted that, as livestock markets went online as a result of COVID-19 restrictions, and buyers could view livestock via video, the markets transformed from being local to becoming national, expanding their scope.

New opportunities such as these in Malaysia will support economic recovery and accelerate rural economic development. 5G will play a critical role in creating a more inclusive and equitable economy through providing these opportunities to rural businesses.

[1]The Recovery and Resilience Facility, The European Commission (2021)
https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en

# The SWN will support new opportunities for education and skills development

Following the temporary closure of schools across the world, the pandemic exposed a deep digital divide between children who can access digital learning facilities and children who do not have such access. This was the case in Malaysia, with many households in rural areas lacking the connectivity to access high-quality remote learning. In areas with poor broadband, children may not be able to participate in virtual classroom scenarios via video, and accessing remote learning can be particularly challenging where more than one child in the household needs to be online at the same time. This can increase inequality between urban and rural areas, with rural areas typically having lower access to networks and internet enabled devices.

As a result of the enforced closures of schools in Malaysia across 2020, students lost on average 7.9 months of learning time.[1] This is the second highest amount of time lost across the Southeast Asia region (second to Myanmar). A study by UNICEF also found that 22% of homes in Malaysia did not have an internet connection reliable enough to allow children to study online.[2]

5G technology will support the education sector by offering universal and faster access to education material irrespective of where students are located. Enhanced connectivity, high speed and low latency connections will empower flexible learning experiences for students, and create opportunities for new methods of learning. Example use cases enabled by 5G are set out below:

### *Virtual learning*

Students often look for a flexible option to learn outside the classroom, and it becomes challenging for students to learn on the go due to connectivity issues. Currently, students in remote locations often face challenges in participating in classes in real-time due to latency issues.

5G can accelerate access to education in an inclusive and affordable way. Improving coverage and connectivity, particularly for the under-privileged or those in remote locations will help give everyone more opportunities to access education.

### *Personalized and Immersive learning*

With the rise in digital learning, educators are exploring new avenues to find interactive and effective methods for teaching.

5G connected AR / VR headsets can be used for educating and simulation exercises for students. Increased connectivity, reduced latency issues and image lags make the experience better for the students and teachers. With a fully immersive approach, VR can increase knowledge retention and engagement. 5G allows students to learn via high quality videos in a virtual environment and they can immerse themselves by visualizing historical or cultural events by using AR / VR headsets.

[1]The Economic Impact of School Closures in Malaysia (2021) https://www.researchgate.net/publication/351991555_The_Economic_Impact_of_School_Closures_in_Malaysia

[2]Families on the edge, UNICEF (2021) https://www.unicef.org/malaysia/media/1976/file/Families%20on%20Edge%20part%204.pdf

# The SWN will have a transformative impact on patients and healthcare providers

The adoption of 5G enabled technologies in the healthcare sector will have a transformative impact on both patients and healthcare providers. Improvements in network access, speed and reliability will help improve patient care and create a more efficient and intelligent healthcare system, helping to ease the burden on staff and facilities, reducing the cost of healthcare and improving quality.

For the patient, 5G can improve access to healthcare professionals and obtaining medical advice, as patients can benefit from virtual consultations no matter their location, enabling more inclusive healthcare. Wearable technology can improve the monitoring of patients health, and identify illnesses at an early stage. Technology can also increase the efficiency of hospital visits and reduce the length of stays by coordinating resources to ensure that patients can be treated as soon as possible. Example use cases enabled by 5G are set out below:

### *Remote patient monitoring*

Remote patient monitoring can help to address challenges in monitoring vulnerable patients who require acute care.

5G powered remote monitoring will make care delivery more efficient: with the use of sensors, wearables and e-health tools, patient data will be collected and transmitted to healthcare facilities for monitoring. AI powered analytics will also be able to monitor and interpret data and raise alerts based on the patient's conditions. Monitoring will allow the elderly to stay in their homes for longer, easing the burden on social care.

### *Virtual consultations*

Healthcare facilities face increasing challenges in managing a higher number of patients with fewer healthcare professionals available. At the same time, vulnerable patients with limited access to conventional services are at risk of exclusion from care.

Enhanced connectivity enables remote consultations to take place between patients and care providers regardless of location, and means that appointments can be scheduled without the need to travel. Patients who are not in need of urgent treatment can receive basic primary care advice, ensuring vulnerable people are not excluded from access to 'face-to-face' healthcare services.

### *AR / VR powered surgery*

Complex surgeries often require the input of specialist healthcare professionals and surgeons based in different locations to that of the patient's hospital. By enabling augmented reality surgeries, 5G will play a key role in addressing this issue.

5G-enabled AR / VR headsets allow experts to virtually sit through major surgeries and guide the team in the operating room. A future development will be enabling the remote surgeon to operate directly on the patients by means of virtually controlled robotics, enabled by URLLC connectivity.

[1]The Economic Impact of School Closures in Malaysia (2021) https://www.researchgate.net/publication/351991555_The_Economic_Impact_of_School_Closures_in_Malaysia

[2]Families on the edge, UNICEF (2021) https://www.unicef.org/malaysia/media/1976/file/Families%20on%20Edge%20part%204.pdf

# 5G technology can play a major role in tackling climate change

5G enabled technology will provide opportunities across all sectors of the economy to protect and preserve the environment. Powered by increased speed, increased capacity and increased connectivity, 5G technologies can help industries become more efficient with their energy usage, drive the use of renewable energy and minimise their impact on the environment. Smarter, real-time energy management systems could prevent an overbuild of energy capacity, which could save emissions of 7.7 billion tonnes of CO2 globally, equivalent to reducing global decarbonisation by 23% by 2050.[1] Our interviews with industry leaders across the Malaysian economy have highlighted that 5G will play a major role in reducing pollution and preventing global warming. Example use cases enabled by 5G are set out below:

### *Smart buildings*

Buildings are responsible for a significant amount of energy consumption with lighting, heating, cooling, and other operations having a major impact on the environment.

Smart buildings relying on 5G networks will enable the monitoring of energy usage and identify where and when energy can be saved, reducing carbon emissions and helping to combat climate change. Smart lighting technologies can detect natural lighting and automatically turn lights off when they are not needed.

### *Agriculture drones*

Farmers often face the problem of determining the right amount of pesticides to use in farming, which in turn can result in excessive usage of chemicals, leading to increased input costs and damage to the environment through the impact on water systems.

With the rise in unmanned aerial vehicles, farmers can utilise drone technology to monitor crops, reducing the environmental impact of traditional farming machinery. Drones can be utilized to identify areas to target with pesticides and weed killers, helping farmers to both increase efficiency in crop production and reduce usage of potential pollutants.

### *Precision Agriculture*

As the global population continues to increase, resources available for agriculture and farming, such as water and land, are diminishing. Changing consumer patterns and increased focus on environmental issues are also pushing farmers and producers to rethink their approach to business.

With IoT, connected smart sensors are placed around fields to retrieve data on soil temperature, moisture, weather conditions, rainfall and water quality, pollution, crop growth. IoT can help manage livestock breeding and feed levels. Smart harvesters can also be connected, while sensors also control smart and tailored irrigation systems and alert in case of fire, flood or other issues.

[1]Smart energy systems: connectivity for a zero-emissions future, GSMA (2021)
https://www.gsma.com/betterfuture/wp-content/uploads/2021/02/Smart-Energy-Systems-Report.pdf

Section 6

# Appendix

# 6 Appendix A: Overview of the economic models

The table below provides an overview of the inputs and outputs calculated by the two economic models considered within this report.

| | The economic impact in 2030 of adopting 5G technologies | Economic impact of DNB's investment in the 5G network |
|---|---|---|
| Report section | Section 3 (page 11) | Section 4 (page 26) |
| What outputs does the model show? | The economic impacts per sector of the economy resulting from the adoption of 5G use cases in 2030, compared to a baseline view of the Malaysian economy in 2030 with no assumed 5G impact.<br>The economic impacts calculated for 2030 versus our 2030 baseline in the analysis include:<br>▶ The incremental impact on GDP in 2030;<br>▶ The incremental impact on jobs supported in 2030; and<br>▶ The impact on skill mix in the economy in 2030. | The economic impact on Malaysia's economy between January 2021 and May 2031 from DNB's investment in the SWN.<br>The economic impacts calculated in the analysis include:<br>▶ The incremental impact on GDP on an annual basis between January 2021 and May 2031; and<br>▶ The incremental impact on employment supported on an annual basis between January 2021 and May 2031. |
| What impacts are calculated? [1] | ▶ Direct impacts only. | ▶ Direct impacts; and<br>▶ Supply chain impacts. |
| Annual outputs calculated? | The model considers outputs for a single year only (2030). It is a single year impact and not a cumulative impact.<br>While the 5G network will support digital transformation and drive incremental GDP in the years to 2030, we do not model the impacts in these years as this would require a separate model to be produced to calculate the impact for each year. | The model uses annual inputs taken from financial data provided by DNB. After applying economic multipliers, we have calculated outputs on an annual basis for each year of the license period.<br>Outputs calculated for GDP can be aggregated over the period.<br>The outputs calculated for employment impact are annual figures and should not be aggregated. |
| Key source of inputs/ assumptions | ▶ Estimates from the Malaysian Department of Statistics / Oxford Economics.<br>▶ Inputs from industry interviews.<br>▶ EY assumptions. | ▶ DNB financial data.<br>▶ Data from the Malaysian Department of Statistics.<br>▶ OECD multipliers. |
| Detailed methodology | This can be found within appendix B. | This can be found within appendix C. |

[1]Please see Appendix C for further detail on defining direct and supply chain impacts

# Appendix B: The economic impact in 2030 of adopting 5G technologies - methodology

**Forecasting a base case scenario of the economy in 2030, without the impact of 5G technology**

The first part of this analysis involves forecasting a base case scenario of the Malaysian economy in 2030, without considering any potential economic impacts generated by the adoption of 5G technology.

To calculate a base case scenario, we have taken estimates of GDP and its component parts, employment, labor costs and population growth forecasts sourced from Oxford Economics along with other inputs from the Department of Statistics Malaysia and other external economic data sources. We have assumed that the 2030 forecasts from Oxford Economics will include some assumptions for technological evolution (either implicitly or explicitly) and improvements in efficiency and productivity as a result. However, we assume that they do not explicitly include the benefits to the economy which can be realized from the accelerated adoption of standalone 5G. We therefore assume that the economic benefits generated by our economic model are incremental to the 2030 baseline, informed by Oxford Economics forecast data.

**Modelling the impact of 5G technology in 2030 on our base case scenario**

The model calculates the incremental impact on Gross Value Added ("GVA"). The incremental change in GVA is a widely used proxy for the incremental change in GDP. The difference between GVA and GDP is that GDP includes the net impact of taxes and subsidies. We have not modelled the impact of taxes and subsidies and assume that the GVA impact will be equal to the GDP impact.

Once this baseline 2030 view of the economy was established, we then considered the impact of 5G technology adoption on each sector. To calculate the impact, we have applied assumptions to the below metrics:

- Rate of adoption of 5G technology across the sector by 2030;
- Labor cost savings delivered through implementing 5G technologies;
- Non-labor cost (operating costs, capital costs and factor input costs) savings delivered through implementing 5G technologies; and
- The impact of 5G on the number of people in employment (job creation vs jobs lost / avoided).

The assumptions used in the model have been informed by conducting interviews with industry leaders across the Malaysian economy and a detailed literature review.

By flexing these assumptions, we are able to calculate the difference between our base case scenario, and our 5G use case scenario, with the difference in GDP and employment between the two scenarios representing the impact of adopting 5G technology. For example, increasing the rate of adoption applied accelerates the impact of 5G adoption. If a sector's output, GVA and employment are supported by 5G, then higher adoption will increase output, GVA and employment. Similarly increases in labor cost savings will increase GVA, as businesses will have higher profits which they can reinvest to further increase output.

**Measuring the impact on skills and productivity**

Two other assumptions within our modelling include productivity and the proportion of low and semi skilled jobs created and lost / avoided, compared to high skilled jobs created and lost / avoided.

As part of our modelling, we have taken employment data from the Department of Statistics Malaysia, and applied assumptions of what proportion of staff in the sector are high skilled, semi skilled and low skilled. When we model the impact of job creation and jobs avoided / lost, this takes into account the current mix of skills in the sector, and applies the impact proportionately. We use differential productivity levels by skill level in each sector, so the change in skill mix impacts the incremental GDP calculation.

# Appendix C: Economic impact of DNB's investment in the 5G network - methodology

## Overview of our methodology

Our economic model utilises an "Input-Output" methodology, which is a widely used economic modelling technique and is an established methodology employed by the EY UK firm. The model represents the interdependencies between different sectors of the Malaysian economy and allows the modelling of the "direct" and "supply chain" impacts on GDP and employment created by an investment.

We have applied the Input-Output methodology to calculate the economic impact of DNB's investment in the 5G network, calculating the incremental impact of the investment on GDP and the employment supported, both directly and across the supply chain and wider economy. We have calculated this for each year of DNB's 10-year license period.

Our economic model uses inputs provided by DNB for forecast revenues and forecast costs for the deployment, running and maintenance of the network over the 10-year license period. It also uses publicly available data for employment, household income, tax receipts, household consumption and for the calculation of sector-specific economic "multipliers", described in more detail below.

## We have estimated the SWN's contribution to Malaysia's GDP and jobs by considering two forms of impacts

- **Direct impacts:** We have analyzed the economic impacts driven directly by the 5G network, such as DNB's incremental GDP contribution (or contribution to the economy) and the number of employees hired directly by DNB. The direct impact on GDP is defined as the income received by DNB's employees (including wages, benefits, pension costs and employment taxes) and the income generated by DNB over the full 10-year license period.
- **Supply chain impacts:** DNB purchases goods and services from other firms in its supply chain, which in turn have their own suppliers. The GDP contribution this creates is referred to as the indirect economic impact. Each entity involved in the network's supply chain pays compensation to its employees, who spend part of their salaries on goods and services, driving additional economic impacts (referred to as induced economic impacts). We estimate the indirect and induced economic impacts of the 5G network's activities across its whole supply chain. Taken together, we refer to the indirect and induced economic impacts as "supply chain impacts".

Our supply chain impacts are based only on DNB's spend within the Malaysian economy, as spend with overseas suppliers contributes to economic activity in the countries where those overseas suppliers are based, rather than in Malaysia. Our calculation of income which is included in the direct impact is reflective of the full investment, including spend with overseas suppliers.

## Applying sector multipliers

Our Input-Output model calculates the supply chain impacts through our mapping of the investment (at a cost type level of granularity) to the sectors in the economy where the money is spent and through the use of sector-specific economic multipliers.

Any increase in DNB's demand for goods and services will trigger demand for other goods and services throughout the supply chain – this is known as the multiplier effect. We have derived appropriate multipliers to estimate the supply chain impacts of DNB's activities based on Malaysian specific data from the OECD. This OECD data is based on data from the National Accounts of Malaysia.

The combined GDP impact of the direct value added and the indirect and induced effects can be estimated by applying these multipliers to expenditure. For example, a multiplier of 1.5 for a particular sector in the economy would imply that RM 5 million of spend by an entity in that sector results in total economic activity of RM 7.5 million.

# Appendix D: Outputs of the Input-Output model

Interpreting the incremental GDP outputs of our Input-Output model

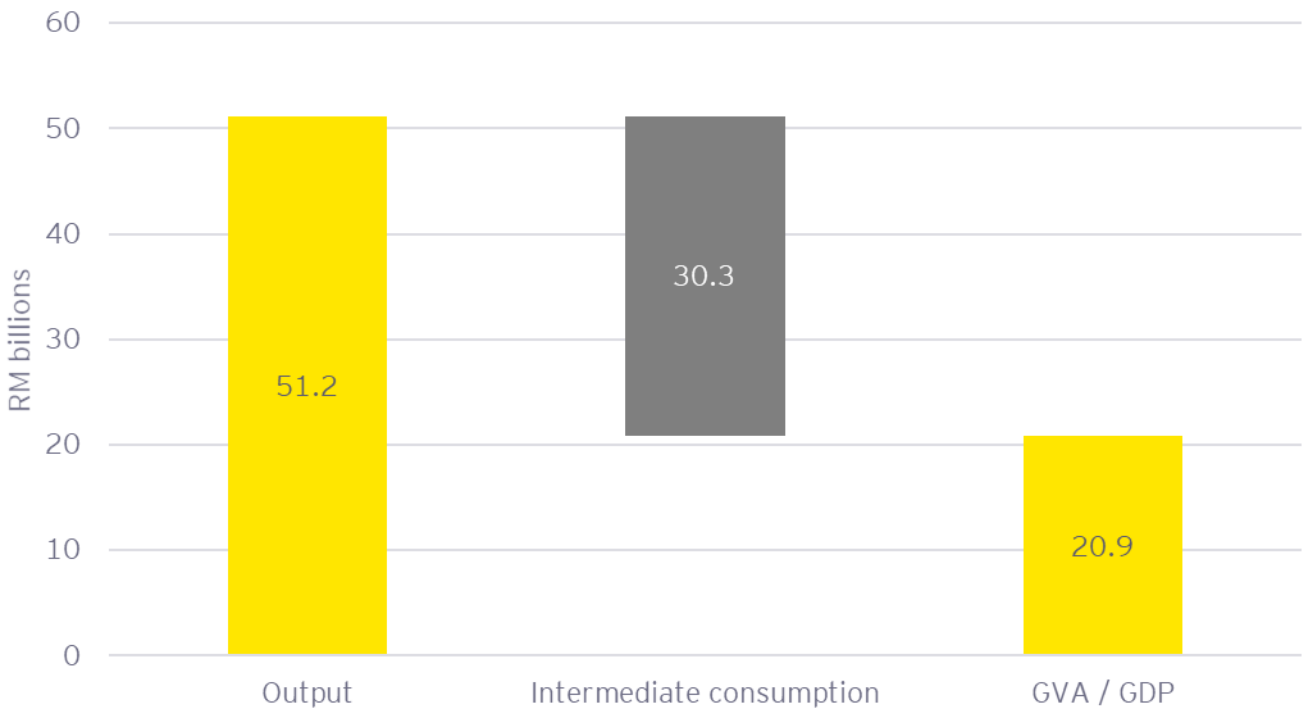
Our Input-Output model calculates the incremental impact on GDP. Consistent with our approach set out in Appendix B for our model of 5G use case adoption, the Input-Output model calculates the incremental GVA which we assume will be equal to the GDP impact.

Incremental GDP is only created in an economy when economic value is created. The act of spending money in an economy only contributes to incremental GDP to the extent that the value of the sale of the goods or services, or the "output", is greater than the sum of the value of the inputs used to create those goods or services, or the "intermediate consumption".

For example, if a product that costs RM 90 to produce is sold for RM 100, the incremental GVA created is RM 10. If the same product which cost RM 90 to produce was sold for RM 90, there would be no incremental GVA associated with the sale as the output would be equal to the intermediate consumption.

We set out below the aggregated outputs for the 10-year period from our Input-Output model. As shown below, the investment of RM 14.5 billion in the Malaysian economy as a result of DNB's investment creates RM 51.2 billion of total output over the period. This output requires RM 30.3 billion of intermediate consumption to create the outputs, generating RM 20.9 billion of incremental GVA, which we assume to represent the incremental GDP impact of the investment.

**The components of GDP contribution from our Input-Output model**




It should also be noted that we have only considered the economic contribution of the investment over the 10-year license period of DNB. The network will still be fully operational at the end of this period and our analysis does therefore not consider the full extent of the economic contribution of the 5G network over its full lifetime.

EY | Building a better working world

EY exists to build a better working world, helping to create long-term value for clients, people and society and build trust in the capital markets.

Enabled by data and technology, diverse EY teams in over 150 countries provide trust through assurance and help clients grow, transform and operate.

Working across assurance, consulting, law, strategy, tax and transactions, EY teams ask better questions to find new answers for the complex issues facing our world today.

EY refers to the global organization, and may refer to one or more, of the member firms of Ernst & Young Global Limited, each of which is a separate legal entity. Ernst & Young Global Limited, a UK company limited by guarantee, does not provide services to clients. Information about how EY collects and uses personal data and a description of the rights individuals have under data protection legislation are available via ey.com/privacy. EY member firms do not practice law where prohibited by local laws. For more information about our organization, please visit ey.com.



This material has been prepared for general informational purposes only and is not intended to be relied upon as accounting, tax, legal or other professional advice. Please refer to your advisors for specific advice.

EY
Building a better working world