

EMPOWER EVERY GENERATION

to Accelerate Climate Action

Task Force on Climate-related Financial Disclosures 2022
for Singtel Group Operations in Singapore and
Optus Operations in Australia



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Front and back cover photo credit: **Andrew Buay**

Front Cover: Mount Kaputar, NSW Australia, showing signs of regrowth two years after the devastating bushfires of October 2019. Over 17,000 hectares of the national park were destroyed.

Back Cover: Early morning fog mixed with bushfire smoke created spectacular sunrise that concealed the terror experienced by many living along the south coast of NSW Australia during the summer bushfires of 2019.

About this report

This is the Singtel Group’s inaugural standalone climate-related financial report prepared in accordance with the framework recommended by the Task Force on Climate-related Financial Disclosures (TCFD). The report presents a detailed discussion of our approach to all 11 disclosure recommendations of the TCFD framework under the four core elements: climate-related governance, strategy, risk management, and metrics and targets.

This report builds on the TCFD information previously disclosed in our sustainability reports and covers the period 1 April 2021 to 31 March 2022 (FY2022). The report should be read in tandem with the **Singtel Group Sustainability Report (SR) 2022**, which details our approach to our material sustainability topics across our operations in Singapore and Australia. All references to figures in dollars are in Singapore Dollars (SGD) unless otherwise indicated.

Given that TCFD is an emerging practice using climate scenario analysis and incorporating management opinion, assumptions and financial analysis to assess and understand the materiality of climate-related risks and opportunities to the business, there are limited external assurance standards available.

Hence, in this report, there is only limited assurance given on the metrics disclosures which originated from the Singtel Group SR2022. This includes key metrics such as energy and greenhouse gas emissions which are reported and externally assured in accordance with Global Reporting Initiative (GRI) standard as part of our sustainability reporting disclosures.

This report will form the basis of our subsequent assessments, reviews and updates, should there be material changes in the externalities and underlying assumptions.

We are fully committed to listening to our stakeholders and we welcome feedback on this report. Please address all feedback to the Group Chief People and Sustainability Officer at sustainability@singtel.com.



Message from Group CEO

Government and business leaders are increasingly focusing their attention on building the resilience of assets and communities and accelerating decarbonisation efforts because the effects of climate change are highly visible today.

A critical component in this effort is data and sense-making – of the risks, how various actions impact the climate, and whether our efforts are making a difference to business sustainability. As investors increasingly consider climate risk a material financial issue, we have seen heightened expectations from government, regulators, investors and customers for climate-related disclosures. One of the ways the global corporate community is working to address these stakeholder expectations and information needs is through adopting harmonised data disclosure framework such as the TCFD framework for reporting.

For the Singtel Group, climate action is an area that resonates strongly with our purpose to Empower Every Generation. We believe that the timely and transparent disclosure of climate-related information is important to help our stakeholders understand the financial implications of climate risks on our business and provide them the confidence that we are continually assessing and managing the challenges and opportunities. This is why the Singtel Group was one of the first companies globally to endorse the TCFD framework in 2017 and commit to the Business Ambition for 1.5°C Pledge in 2019 to reach net-zero emissions by no later than 2050.

This year, we reached two important milestones in our climate journey towards net-zero emissions. First, we have completed our full greenhouse gas (GHG) emissions inventory and baseline for all three scopes under the GHG protocol. This enables us to further develop and refine our roadmap for more aggressive decarbonisation action both internally and externally with our value chain stakeholders.

Second, we have published our inaugural standalone TCFD Report – one of a handful of progressive Singapore companies to issue a comprehensive TCFD report. It incorporates all 11 disclosure recommendations of the four core elements in the TCFD framework. Through our climate scenario analysis, the Singtel Group gained additional insights on the potential extent of climate-related risks to our business as well as potential opportunities presented to our business. These understandings are valuable and beneficial for us as we embed climate action into our future strategy.



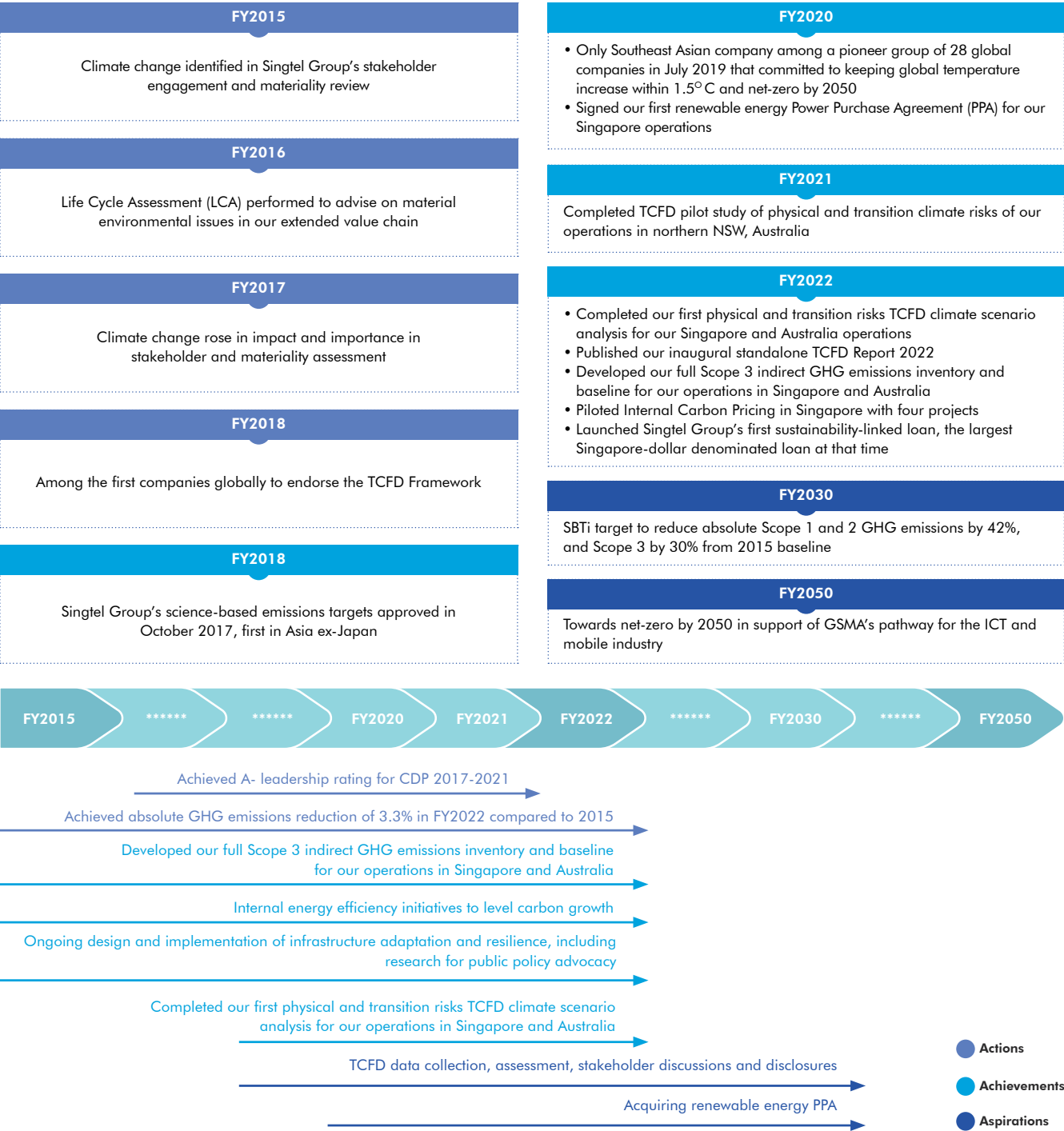
The Singtel Group is at the beginning of our climate-related financial disclosure journey alongside the global corporate community and will contribute to this movement as it evolves to be more informative. We are committed to further incorporating the climate change agenda into our strategy, decision-making and enterprise risk management approach, to empower the present generation to accelerate climate action and safeguard the planet.

We welcome your feedback on this inaugural report as it will help us to improve on what matters most in our climate-related disclosures.

Yuen Kuan Moon
Singtel Group CEO
30 June 2022

Progress on our climate journey

Figure 1: Singtel Group climate action journey towards net-zero by 2050



Ever since climate change first emerged as a material topic for Singtel Group in 2014, we have been working consistently to develop and refine our approach to understanding and tackling the risks and opportunities that it presents to our business (see Figure 1). Equipped with this knowledge, we have been able to make informed business decisions, set goals and targets, and focus on critical climate actions in the last few years. Figure 2 outlines the Singtel Group Environmental Framework. We are also guided by our Environmental Management System and Environment Policy to manage and minimise our impact. Please refer to our [website](#) for more information.

Since 2017, our climate strategy and targets have been developed and aligned with internationally recognised frameworks such as TCFD, Science Based Targets initiative (SBTi) and the Paris Agreement.

The various studies, analyses and exercises that we have conducted have been key to guiding our strategy in managing these risks and opportunities as the global climate agenda evolves. We recognise the importance of communicating how we manage our climate-related risks and opportunities to maintain stakeholder trust and confidence. Figure 3 and 4 depict our emissions trajectory since 2015.

Figure 3: Singtel Group Scope 1 and Scope 2 baseline, performance and targets

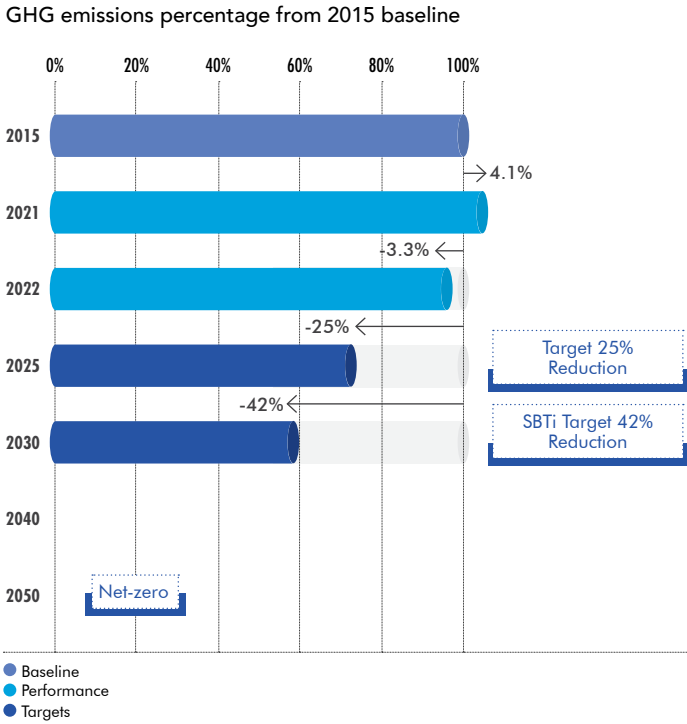


Figure 2: Singtel Group Environmental Framework

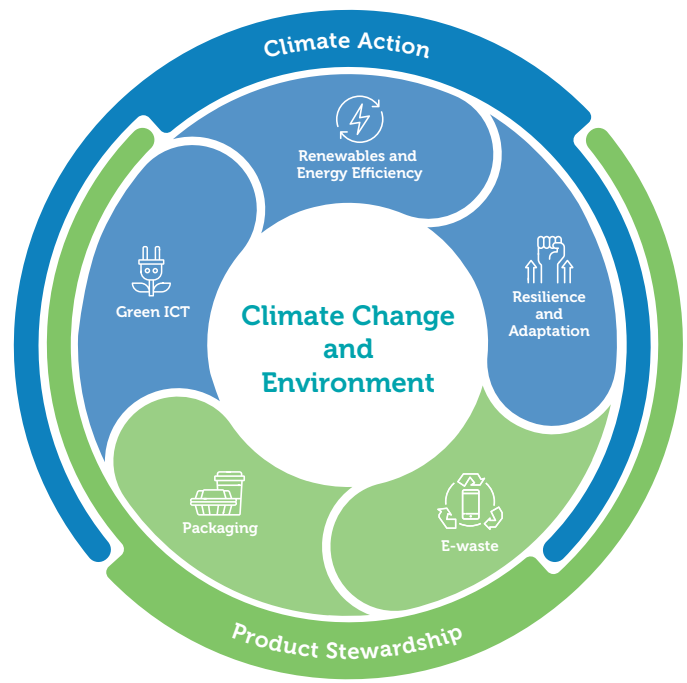
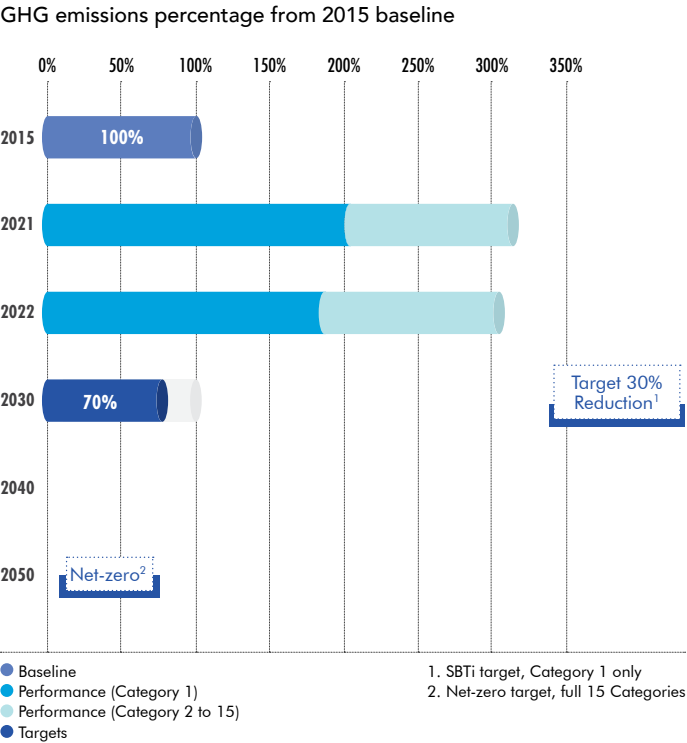


Figure 4: Singtel Group Scope 3 baseline, performance and targets



TCFD progress

Singtel Group has been working towards aligning with the TCFD framework since 2017. Our progress in each respective core element of the framework is summarised in Table 1, with details of each area captured in the subsequent sections of this report.

Table 1: Our TCFD progress

Actions	Pre-FY2021	FY2021	FY2022
Governance			
Endorse the TCFD framework	Completed		
Establish oversight and accountability for climate risk and carbon reduction strategy at Board and management levels	Completed	Reviewed and enhanced	Reviewed and enhanced
Formalise climate-related key performance indicators (KPIs) into executives' long term incentive plans and management's short term incentive plans		Completed	Reviewed and revised
Introduction of Renewable Energy Management Sub-Committee (RESC) comprising four senior key executives of the Management Committee to oversee the company's renewable energy strategy			Completed
Capability building for Board and management levels			Ongoing
Strategy			
Reduce absolute GHG emissions and emissions intensity throughout our business	Ongoing	Ongoing	Ongoing
Invest in network adaptation and resilience	Ongoing	Ongoing	Ongoing
Innovate smart mobile technology solutions to advance climate progress	Ongoing	Ongoing	Ongoing
Set one, three and five-year carbon and renewable energy targets to shape our renewable energy Power Purchasing Agreement (PPA) tenders		Completed	Reviewed and revised
Undertake physical climate scenario analysis to identify material drivers and indicators affecting our networks		Piloted	Completed
Undertake transition climate scenario analysis to understand both short and long term risks to our business		Piloted	Completed
Undertake sustainability linked financing with climate-related sustainability performance targets (SPTs)		Completed	Reviewed and enhanced
Develop an internal carbon price and pilot assessment framework to assist in energy intensive CAPEX decisions			Piloted
Risk management			
Incorporate climate-related risk into Singtel Group Risk Management Framework (RMF)	Ongoing	Ongoing	Ongoing
Use risk management process to map climate-related risks	Ongoing	Ongoing	Ongoing
Metrics and targets			
Established science-based targets for 2030 approved by SBTi in alignment with the Paris Agreement of a well-below 2°C scenario	Completed		Review and enhance in FY2023
Established net-zero ambition by 2050 aligned to 1.5°C scenario			
Publicly disclose climate-related metrics and targets, and performance data	Completed	Completed	Ongoing
Measure our GHG footprint for Scope 1 and 2 emissions across operations	Completed	Completed	Ongoing
Measure our GHG footprint for all 15 categories of Scope 3	Partial Scope 3	Completed full Scope 3	Ongoing
Achieve and maintain A- leadership score for CDP	Achieved	Achieved	Ongoing
Establish other key climate-related metrics and targets (apart from GHG reduction)		Ongoing	Ongoing

Summary of our response to TCFD disclosure recommendations

Recommendations	Key Points
Governance: Disclose the organisation’s governance around climate-related risks and opportunities	
a) Describe the Board’s oversight of climate-related risks and opportunities	Singtel Board provides oversight of the company’s sustainability strategy and initiatives, and approves the sustainability-materiality register, targets and disclosures which include climate-related risks and opportunities. The Board is updated on the strategy, plans and performance at least twice a year, and officially signs off on the annual sustainability report which includes comprehensive disclosures on the company’s climate change agenda, climate-related risks and opportunities, targets and performance.
	Board Risk Committee (RC) reviews the company’s ESG risks including climate-related strategies and mitigation. At least one session per year is dedicated solely to discussing climate-related issues affecting the company operations in addition to regular updates, including specific discussions on overall climate strategy and targets.
	Board Executive Resource and Compensation Committee (ERCC) reviews and approves senior as well as top executives compensation structure with long and short term incentives related to sustainability KPIs and performance.
	Board Finance and Investment Committee (FIC) approves sustainability-linked financing framework and associated ESG KPIs.
b) Describe management’s role in assessing and managing climate-related risks and opportunities	Designated members of the Singtel Management Committee (MC) provide oversight and stewardship on the company’s GHG reduction strategy and climate-related investments.
	Risk Management Committee (RMC) reviews key climate-related risks, including emerging risks, mitigation plans and progress against targets, and makes recommendations to the RC.
	Renewable Energy Management Sub-Committee (RESC) comprises four key senior executives of the MC to provide oversight and guidance to the company’s renewable energy strategy.
	Group Chief People and Sustainability Officer (GCPSO) has the overall accountability for the management of sustainability and is supported by the Vice President of Group Sustainability who oversees sustainability strategy, programmes, execution, performance and disclosures across the company operations in Singapore and Australia, including climate-related risks and opportunities. GCPSO makes recommendations to the Group Chief Executive Officer and MC.
Strategy: Disclose the actual and potential impacts of climate-related risks and opportunities on the organisation’s businesses, strategy and financial planning where such information is material	
a) Describe the climate-related risks and opportunities the organisation has identified over the short, medium, and long term	Opportunities: Development of enabling green and low emissions ICT solutions; first mover advantage as a climate leader; brand recognition as a reliable and resilient telecommunications service provider during extreme weather events
	Risks: Material transition risks include carbon pricing, capital allocation and risk of stranded assets and counterparty risk. Physical risks include surface water flooding across years 2030, 2050 and 2100; bushfires across years 2030, 2050 and 2100; riverine flooding in the long term (specifically for control rooms) and extreme heat by year 2100.
b) Describe the impact of climate-related risks and opportunities on the organisation’s businesses, strategy and financial planning	We looked at the possible impact over the short (2030), medium (2040) and long term (2050) horizons. The outcome of the scenario modelling has been summarised as climate-related risks and opportunities, organised by physical and transition risks that potentially influence the financial impact on the company’s income and balance sheet performance in the long run as well as our strategies to drive GHG emissions reduction and increase climate resilience (see Figure 10). Management of climate-related risks and opportunities is aligned with our business strategies, operations and it forms an integral part of the annual business planning and budgeting (financial planning) process.

Recommendations	Key Points
c) Describe the resilience of the organisation’s strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario	<p>Selected three climate-related scenarios for analysis to understand the potential implications of climate-related physical and transition risks to the company’s strategy over the short (2030), medium (2040) and long term (2050). Scenario 1 (warming to 1.5°C) and 2 (warming to 1.8°C) are used for transition risks while Scenario 1 (warming to 2°C) and 3 (warming to 4°C) are modelled for physical risks.</p> <p>Overall, Singtel Group has relatively low risk after mitigations. Two areas for improvement are:</p> <p>a) Accelerate the renewable energy (RE) transitioning</p> <p>b) Develop the competitiveness of data centres(DC) from an environmental sustainability-perspective.</p> <p>We build climate resilience into the core of our corporate strategy and operations. We are resilient and well prepared for climate-related risks based on the outcomes of the scenario analysis. Refer to page 20 for more information on our resilience efforts.</p>
Risk Management: Disclose how the organisation identifies, assesses and manages climate-related risks	
a) Describe the organisation’s processes for identifying and assessing climate-related risks	<p>We identify, assess and manage risks to reduce the uncertainty associated with executing our business strategies, and mitigate potential adverse impacts on our business. We have established a comprehensive Risk Management Framework (RMF) at the enterprise level, which sets out our governance structure for managing risks, risk philosophy, risk appetite and tolerance levels, management approach and risk factors. In addition, through stakeholder engagement and materiality assessments, we regularly review and assess ESG risks that exist or emerge in our broader value chain, and we address them with various corporate sustainability initiatives. We have undertaken a Life Cycle Assessment (LCA) and climate scenario analysis, and set SBTi targets as part of the methodology to identify climate-related risks.</p> <p>Our risk register has been updated with climate-related risks. Climate change poses a range of strategic and operational risks to the company. They can include financial risks as a result of stranded assets in the transition to a low carbon economy, disruption of business activities and damage to network infrastructure due to extreme weather events, as well as impact to people’s livelihoods. The approach is for each business unit to identify, assess and manage risks within their own risk register, plan actions, and include it as part of annual business planning and budgeting process.</p>
b) Describe the organisation’s processes for managing climate-related risks	
c) Describe how processes for identifying, assessing and managing climate-related risks are integrated into the organisation’s overall risk management	
Metrics and Targets: Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material	
a) Disclose the metrics used by the organisation to assess climate-related risks and opportunities in line with its strategy and risk management process	Refer to Table 7 for our key material metrics, which include GHG emissions, energy consumption, capital deployment, internal carbon price and management remuneration relating to ESG KPIs.
b) Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks	We report Scope 1, 2 and 3 GHG emissions (see Table 7).
c) Describe the targets used by the organisation to manage climate-related risks and opportunities and performance against targets	<p>Established absolute GHG reduction emissions science-based targets for 2030 approved by SBTi in alignment with the Paris Agreement of a well-below 2°C scenario.</p> <p>Committed to net-zero ambition by 2050 aligned to 1.5°C scenario.</p>

01.

Governance

Climate change is a priority issue for the highest level of governance within the Singtel Group. We have a sustainability governance structure (see Figure 5) and robust processes to effectively engage the Board, management and working groups in managing climate-related risks and opportunities. This ensures that all material issues across operating geographies are addressed in line with our strategy, commitments and targets.

Board oversight and expertise

The Board oversees the overall sustainability and climate-related strategies, approves the materiality matrix which has climate-related topics, reviews the progress and performance of the Group’s climate commitments and strategy, and approves disclosures in the Annual Report and Sustainability Report including climate-related disclosures and metrics.

Separately, the Board Risk Committee (RC), on behalf of the Board, reviews our material ESG risks including climate risks, strategies and mitigation. The RC has at least one session per year dedicated solely to discussing climate issues affecting our operations in addition to regular updates, including specific discussions on overall climate strategy and targets.

For remuneration tied to ESG including climate-related topics, the Executive Resource and Compensation Committee (ERCC) is the approving body. The Board Finance and Investment Committee (FIC) approves sustainability-linked financing and associated ESG KPIs.

The Board comprises directors from a diverse range of industries and geographies, with a variety of interests and skills. We select Board members who can bring unique perspectives to the business, which is crucial to ensure that we have a well-rounded view of issues, especially climate change risks and opportunities.

The current chairman is from Temasek Holdings, which places a significant focus on sustainability and corporate stewardship and takes a proactive approach towards climate actions, including setting emissions reduction targets for their portfolio companies, emissions tracking as well as physical climate risk assessments. Other directors have led companies that are recognised leaders in corporate sustainability and from time to time also facilitate climate knowledge sharing with the boards and companies they sit on. The Board is briefed regularly by Singtel Group Sustainability, and all Board members are also required to

attend formal training in sustainability organised by accredited parties by the Singapore Exchange. In the coming year, the company intends to augment Board knowledge on climate matters by providing external perspectives from climate experts.

The composition and experience of the Singtel Board and Management Committee can be found [here](#).

Management structure

The Management Committee (MC), comprising all C-level senior executives, plans, reviews and approves Singtel Group’s climate strategy and other ESG decisions including investments across Singapore and Australia operations. Specifically, climate-related risks are managed by the Risk Management Committee (RMC).

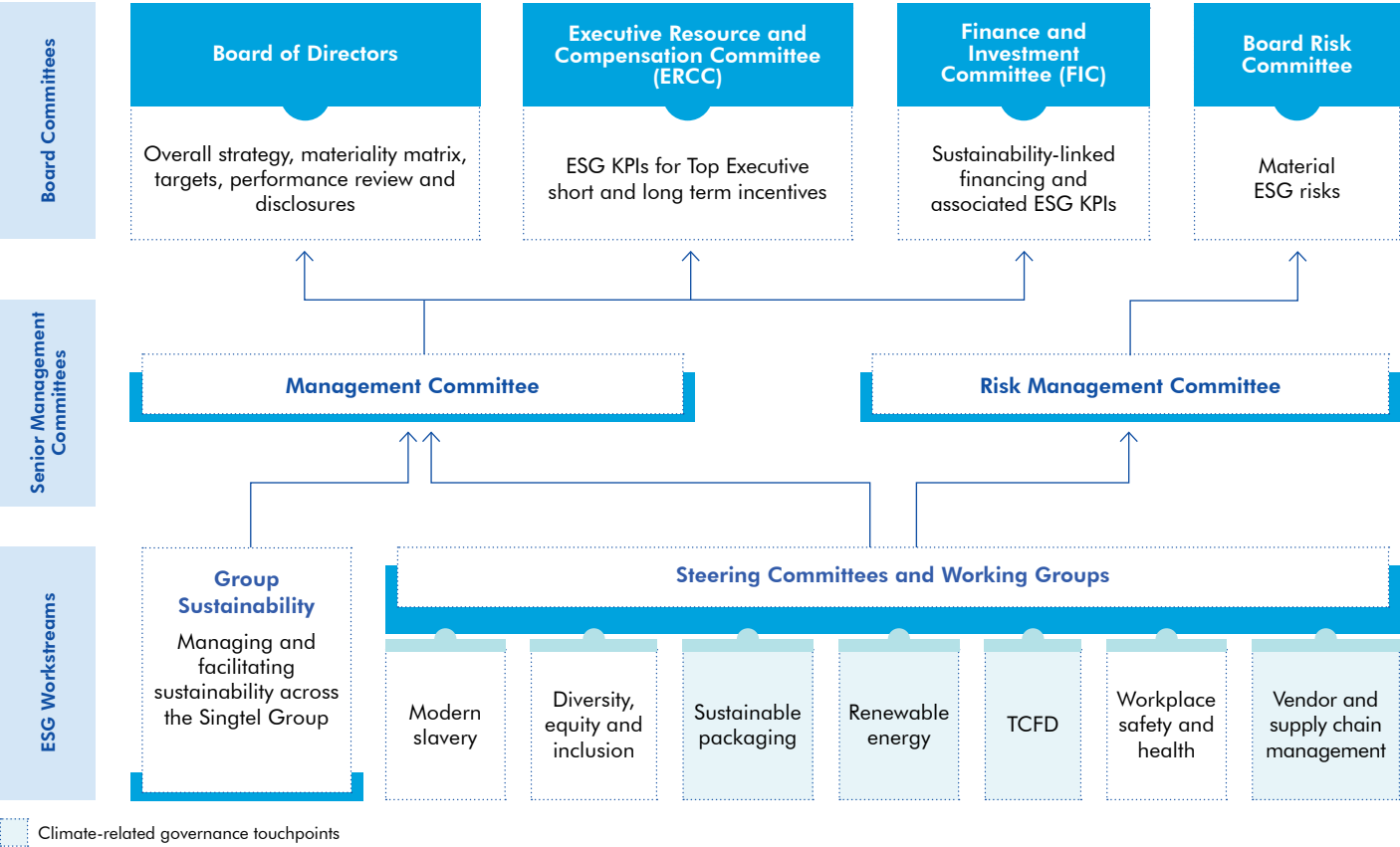
RMC reviews key climate risks, including emerging risks, mitigation plans and progress against targets, and makes recommendations to the RC. The RMC also reviews the Group’s progress to ensure that it is in alignment with TCFD framework and disclosures.

Our dedicated Group Sustainability function, including an environmental sustainability team of specialists, is responsible for managing climate change and the broader sustainability issues for the Singtel Group.

It collaborates with strategy and risk management functions, and other business units such as networks and energy teams to ensure alignment in strategy and governance across the business as well as report progress against agreed action plans.

Given the importance of renewable energy to the emissions reduction strategy of the Group and the complexity and volatility of the renewable energy and energy markets, in FY2022, we established a Renewable Energy Management Sub-Committee (RESC) to provide oversight and guidance on the Group’s renewable energy procurement strategy.

Figure 5: Singtel Group sustainability governance structure



RESC comprises the Group Chief Corporate Officer, Group Chief Technology Officer, Group Chief People and Sustainability Officer and Optus CEO, supported by various stakeholders who have an impact on the company’s emissions reduction strategy, including Energy procurement, Networks, Finance and Group Sustainability.

Our comprehensive climate-related governance is detailed in Table 2 (page 11), describing the roles, responsibilities and meeting frequency for each governance body.

KPIs and incentives

Climate-related issues require long-term commitment and actions. In FY2021, the Singtel Group introduced common ESG-linked KPIs for the long-term incentives (LTI) plan of all top

executives (Heads and above), and annual short-term incentives (STI) for MC members. These ESG KPIs comprise 20% of LTI and 10% of STI, with climate-related targets representing one of five ESG-related KPIs for both executives (4% of total LTI KPIs) and MC (2% of total STI KPIs). For MC members, the focus and weightage of KPIs is dependent on their role and how closely they are linked to climate change.

For example, energy efficiency and decarbonisation targets carry more weightage for members with energy intensive functions or a stronger role in influencing the company’s decarbonisation strategy.

MC KPIs are then cascaded down to their business units, departments and employees, whose performance bonus and other incentives are tied to their KPIs.

Table 2: Singtel Group sustainability governance climate-related roles and responsibilities

Governance body	Climate-related roles and responsibilities	Meeting and reporting cadence
Board of Directors	The Board oversees the overall sustainability and climate-related strategies, approves the materiality matrix which includes climate-related topics, reviews the progress and performance of the Group’s climate commitments and strategy, and approves disclosures in the Annual Report and Sustainability Report including climate-related disclosures and metrics.	Twice a year for ESG matters
Executive Resource and Compensation Committee (ERCC)	ERCC reviews and approves executive and management’s compensation structure, and long and short term incentives. ESG KPIs comprise 20% of these incentives, with climate-related KPIs representing one in five targets for both groups.	Once a year to review KPIs and performance
Board Finance and Investment Committee (FIC)	FIC approves sustainability-linked financing and associated ESG KPIs.	Up to twice a year for ESG-related topics, as required
Board Risk Committee (RC)	RC reviews key climate risks, including emerging risks, mitigation plans and progress against targets, and reviews recommendations from the RMC.	At least twice a year for ESG-related risks, and once a year for climate-related risks
Group Chief Executive Officer (GCEO)	GCEO, a Board member and Chairperson of the Management Committee, is responsible for making climate-specific recommendations to the Board, related to strategy, performance, risks and disclosures.	Participates in meetings with Board and Management Committee
Management Committee (MC)	MC, comprising all C-level senior executives, plans, reviews and approves Singtel Group’s climate strategy and other ESG decisions and investments across our Singapore and Australia operations.	Monthly to quarterly for different ESG topics
Risk Management Committee (RMC)	RMC reviews key climate risks, including emerging risks, mitigation plans and progress against targets, and makes recommendations to RC. RMC also ensures the Group’s progress is in alignment with TCFD framework and disclosures.	Up to twice a year for ESG-related risks, and at least once a year for climate-related risks
Group Chief People and Sustainability Officer (GCPSO)	GCPSO has overall accountability for the management of sustainability. This role is supported by the Vice President of Group Sustainability who oversees sustainability strategy, programmes, execution, performance and disclosures across the Singtel Group operations in Singapore and Australia, including climate-related issues. GCPSO makes recommendations to GCEO and MC.	Monthly
Renewable Energy Management Sub-Committee (RESC)	RESC, by delegation from MC, is responsible for specific renewable energy strategy across our Singapore and Australia operations. The four RESC members are: i) Group Chief Corporate Officer, who oversees risk and energy procurement and is RESC Chairperson; ii) GCPSO, who is accountable for overall sustainability management; iii) Group Chief Technology Officer, who oversees the infrastructure network which has large energy consumption and is highly exposed to both physical and transition risks; and iv) Optus CEO, who leads Optus which constitutes about two-thirds of the current Group emissions and experiences climate-related natural disasters on a regular basis.	Monthly to bi-monthly
TCFD Task Force	The TCFD Task Force comprises team members from the Singapore and Australia operations such as Data Centre, Networks, Finance, Procurement, Risk and Group Sustainability. It undertakes climate-related scenario analysis, risk and materiality assessment in alignment with TCFD framework.	Project based

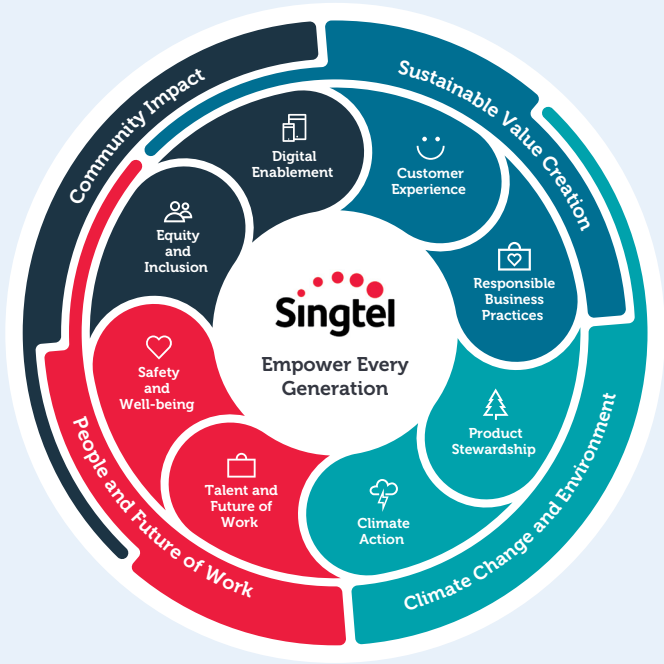
02. Strategy

As Asia’s leading communications technology company, Singtel Group aims to create sustainable value for all our stakeholders. We want to attract, develop and retain our people, connect and enrich the lives of our customers and community through innovation, and create a positive impact on our environment. Under our strategic reset in 2021, we refreshed our sustainability framework comprising four sustainability pillars of Climate Change and Environment, People and Future of Work, Community Impact and Sustainable Value Creation to better align sustainability with our business strategies and how we engage our key stakeholders (see Figure 6).

Climate Change and Environment framework and strategy

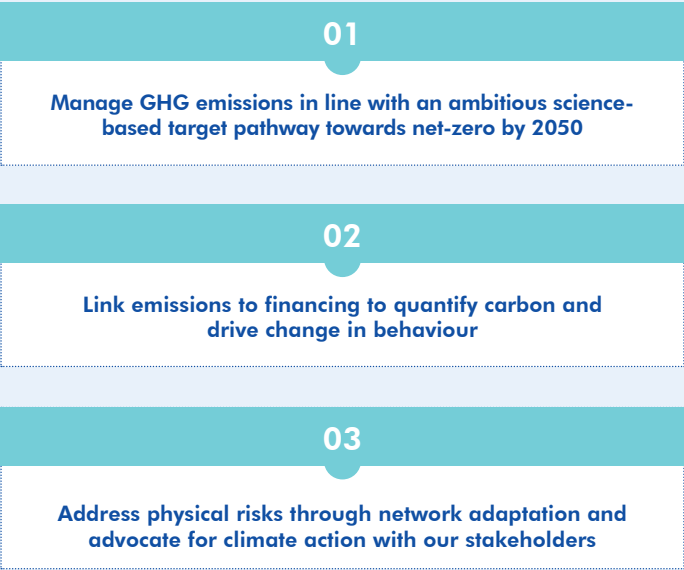
Climate Change and Environment is a strategic pillar under the Singtel Group Sustainability Framework (Figure 6). We also align our approach with our Group purpose, Empower Every Generation, where we want to empower the present generation to accelerate climate action and safeguard the planet to chart a sustainable future for generations to come. We are committed to minimising our environmental footprint in our business operations and value chain and meet our carbon reduction targets, while building resilient networks and communities to deliver long term value to our business and stakeholders.

Figure 6: Singtel Group Sustainability Framework



Under Climate Action, we are concerned with climate resilience and adaption, renewables and energy efficiency, as well as green ICT. These three aspects are elaborated in the following paragraphs. They are then translated into our climate action plan as shown in Figure 7.

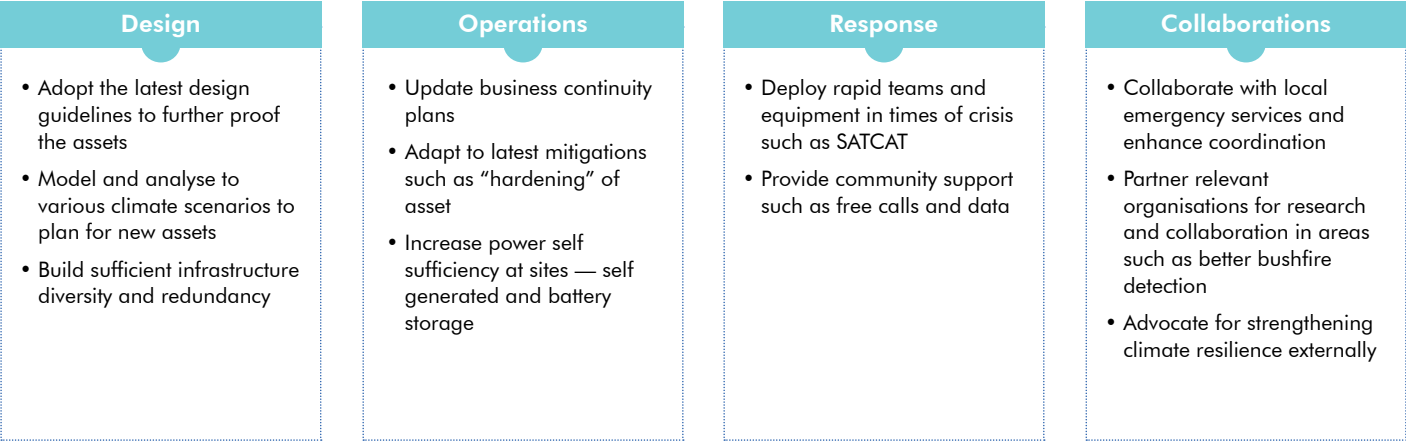
Figure 7: Singtel Group climate action plan



a) Climate resilience and adaptation

Climate-related extreme weather events have become increasingly severe and frequent in the past few years and this trend is forecast to continue. In FY2022, we saw bushfires and damaging floods in Australia, which impacted thousands of people and businesses. The first and most critical response to these events is for governments and businesses to push harder to mitigate climate change.

Figure 8: Approach to climate resilience



It also calls for greater focus on business resilience and adaptation in parallel. Singtel Group is therefore committed to increasing our climate resilience through proactively taking steps to reduce the physical impacts of climate-related extreme weather on our network infrastructure to ensure that we can serve the communication needs of our customers and communities. We will continue to invest in network adaptation and resilience, while stress testing and disclosing long term climate change risks and mitigation based on various scenarios and aligned with TCFD framework. Figure 8 illustrates our approach to climate resilience.

With this approach, we have undertaken various initiatives under our climate action plan to address physical risks through network adaptation and advocate for climate action with our stakeholders. These include:

- Incorporating climate adaptation activities within our \$2.2 billion investment in our network to improve its resilience to physical risks, so that we can continue to serve our communities in the long-run and in times of critical need, as we have done during the recent bushfires and floods in Australia.
- Supporting customers affected by physical climate events such as the recent floods in Australia where we set up a dedicated customer hotline for flood victims which offered a range of support options depending on our customer needs, such as bonus data boost, call diversion, service suspension, free prepaid credit or bill waiver.
- Completing our GHG emissions inventory (including all Scopes) and conducting scenario modelling to understand the challenges that climate change presents, so that we can mitigate the negative impacts of, and on, our business and

undertake adaptation activities to ensure that we are resilient to the impacts we are likely to face.

- Disclosing climate-related information in this report, our Sustainability and Annual Reports, to communicate vital information to our stakeholders and being accountable for our actions.
- Engaging external and internal stakeholders in Singapore and Australia to foster a collaborative approach to address climate change and its impacts at national and global levels, including governments and other organisations.

Past examples include the now-defunct Australian Business Roundtable on Disaster Resilience and Safer Communities (ABR), Singapore’s National Climate Change Secretariat (NCCS), TCFD Secretariat and Resilient Cities Network 100.

Current examples include engagement with NCCS on climate policy, Commonwealth Scientific and Industrial Research Organisation (CSIRO)-Optus study on building resilient telecommunications infrastructure, and the ongoing programme to research and develop hi-tech solutions to predict, detect and extinguish bushfires under the Australian National University-Optus Bushfire Research Centre of Excellence.

b) Renewables and energy efficiency

On the back of global movement towards a climate conscious future, we have set rigorous corporate decarbonisation goals and targets in recognition of our role and responsibility in tackling climate change. Our SBTi targets were aligned to the Paris Agreement with a well-below 2°C pathway when it was approved in October 2017.

We took a further step and became the first Southeast Asian company to pledge net-zero by 2050 among the pioneering group of companies. In May 2022, MSCI assessed the implied temperature rise of Singtel Group’s targets to be 1.59°C. We are in the process of strengthening our emissions reduction commitment in FY2023 by updating our interim SBTi target to a 1.5°C scenario to align to our net-zero commitment by 2050.

With the ambitious goals set, we recognise the imperative to accelerate our decarbonisation efforts. We want to actively manage our GHG emissions towards net-zero throughout our value chain. We develop the decarbonisation hierarchy as shown in Figure 9 to guide us in reducing our emissions.

These are the key efforts that Singtel Group has embarked on:

- Progressively enhancing governance and accountabilities across the business.
- Disclosing climate-related information in this report, our Sustainability and Annual Reports, to communicate vital information to our stakeholders and being accountable for our actions.
- Mapping and tracking all scopes of our emissions footprint.
- Adopting renewable energy and implementing energy efficiency measures across our Singapore and Australia operations to minimise the emissions associated with running a large network of mobile base stations.
- Implementing an internal carbon price mechanism to enable the business to assess the external impact of policies such as carbon taxes.
- Collaborating with customers and partners, and engaging our suppliers in alignment to our 1.5 °C pathway above pre-industrial levels, the most ambitious goal of the Paris Agreement.

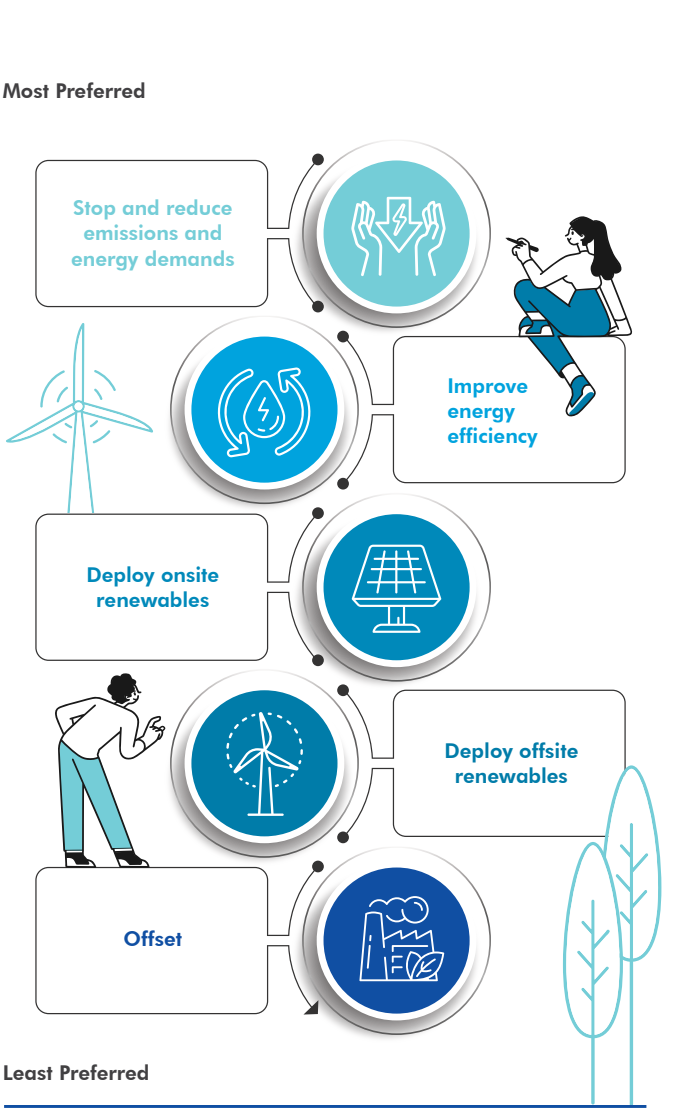
For more details on our emissions-related efforts, please refer to our Singtel Group SR2022 page12-22.

c) Green ICT

Being in the ICT sector, Singtel Group believes that we are well-positioned to enable a transition to a low-carbon economy by providing innovative products and services to customers.

We are constantly exploring smart mobile technologies to reduce energy consumption and emissions beyond our industry to benefit other sectors of the economy.

Figure 9: Singtel Group decarbonisation hierarchy

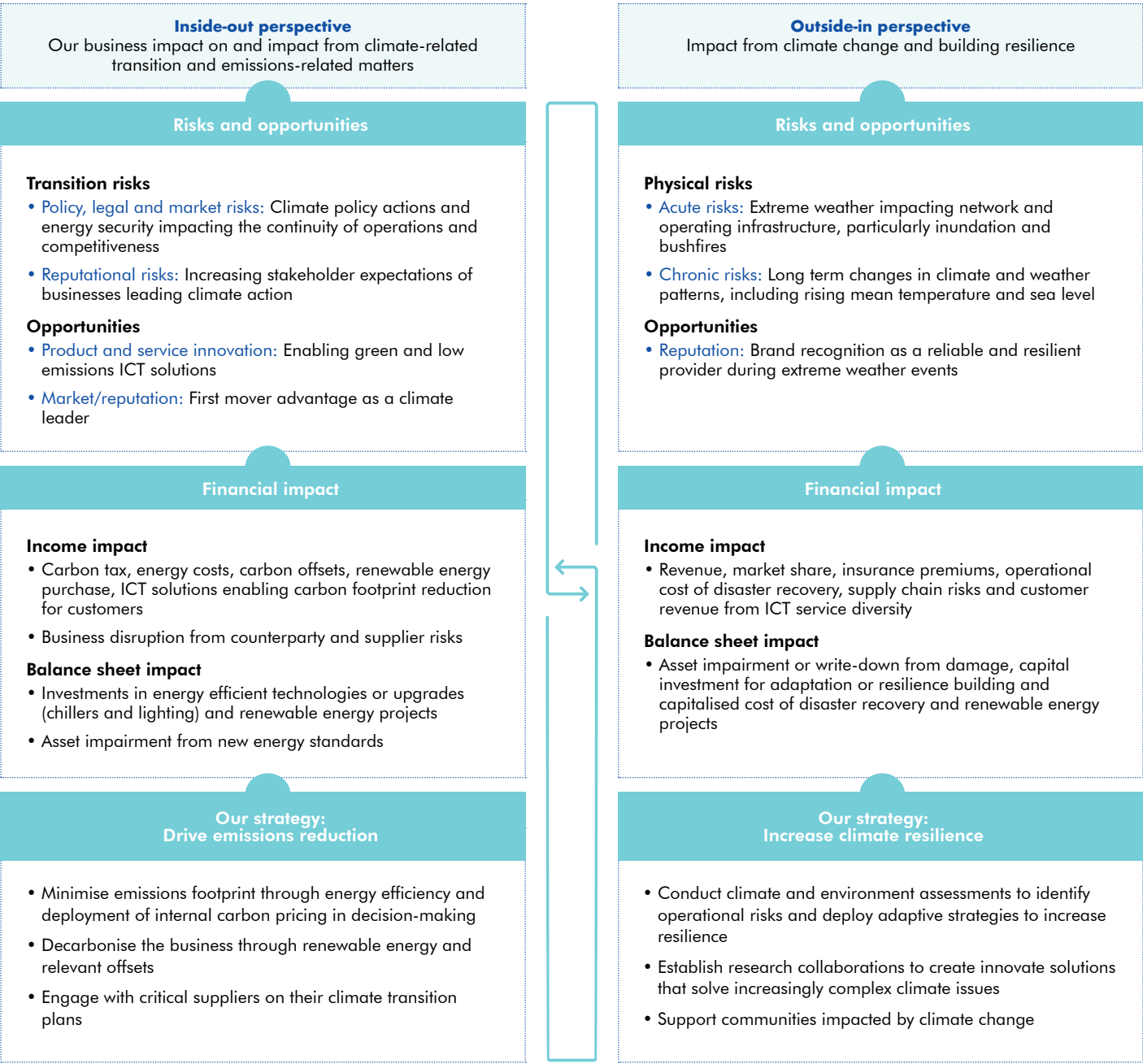


Technology innovation in the areas of connectivity, low PUE data centres, cloud solutions, big data and IoT enable the development of energy efficient solutions that can be applied across industries and help advance decarbonisation efforts in other sectors. During the year, we focused on our 5G network rollout in Singapore and Australia to empower our customers by delivering greater speed, higher device capacity and ultra-low latency.

Material risks and opportunities

Singtel Group takes a comprehensive and proactive approach to anticipate and manage climate change impacts on our business, which includes building climate resilience into the core of our corporate strategy and operations. We use climate risk assessments, including scenario modelling, to identify events that can potentially affect our business operations or be a business opportunity. In this section, we present our view of climate risks, the associated opportunities and financial impact, and our response to these risks in Figure 10 below.

Figure 10: Singtel Group double materiality of climate-related risks and opportunities



Climate scenarios analysis

Singtel Group conducted two smaller scale climate scenario analysis in the years prior to FY2022 for physical risks and ran a pilot in New South Wales, Australia for transition risks in FY2021 (refer to our [Sustainability Report 2021](#)). This report is the first organisation-wide climate scenario analysis for Singtel Group on our material climate-related risks built on previous studies.

Figure 11 shows the process of how we conducted both types of risk analyses.

Figure 11: Summary of our physical and transition risks analysis process

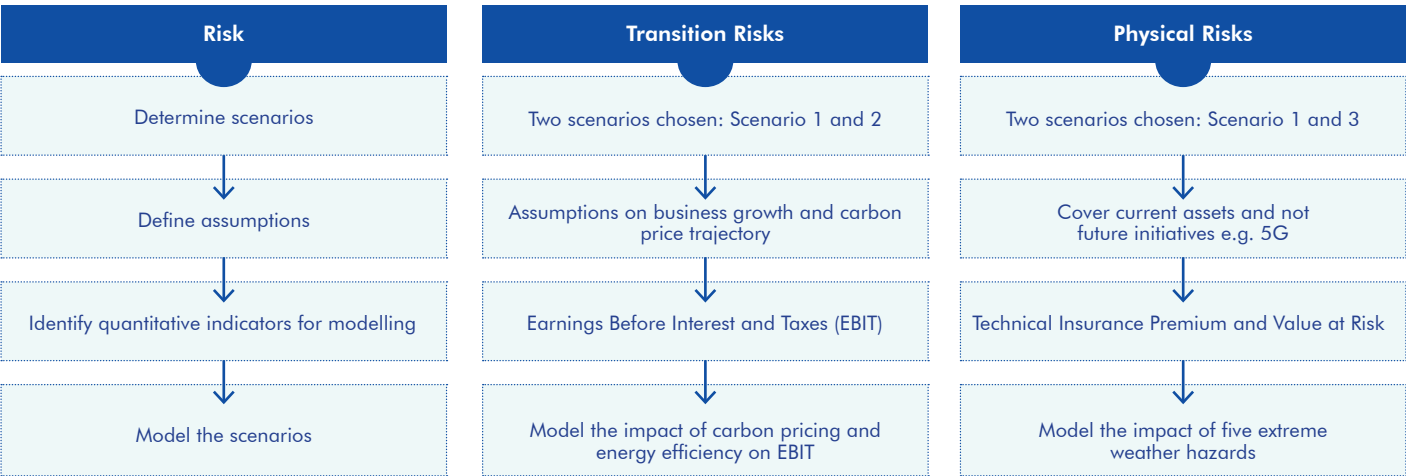


Figure 12: Climate scenarios¹

	<div>°C</div> <div>Policy ambition</div>	<div></div> <div>Policy reaction</div>	<div></div> <div>Technology change</div>	<div></div> <div>Carbon dioxide removal (CDR)</div>	<div></div> <div>Regional policy variation</div>
<div>+1.5°C</div>	<div>Scenario 1:</div> <div>1.5°C aligned orderly transition</div> <div>Warming limited to 1.5°C by 2100 (transition risk)</div> <div>Warming limited to 2°C by 2100 (physical risk)</div>	<div>1.5°C</div> <div>Immediate and both</div>	<div>Fast change</div>	<div>Medium use</div>	<div>Medium variation</div>
	<div>Scenario 2:</div> <div>Delayed or disturbed transition</div> <div>Warming limited to 1.8°C by 2100</div>	<div>1.8°C</div> <div>Delayed</div>	<div>Slow/fast change</div>	<div>Medium use</div>	<div>High variation</div>
<div>+4°C</div>	<div>Scenario 3:</div> <div>Business-as-usual (BAU)</div> <div>Warming exceeds to +4°C by 2100</div>	<div>4°C+</div> <div>Non-current policies</div>	<div>Slow change</div>	<div>Low use</div>	<div>Low variation</div>

¹ These scenarios were developed with reference to Network for Greening the Financial System.






We have selected three climate scenarios to analyse in this modelling. See Figure 12.

Scenario 1 and 2 are used for transition risks while Scenario 1 and 3 are modelled for physical risks. After we have identified and selected the risks for analysis, the various business units are engaged to understand more about the current business and operations in order to reflect as close as possible the business plans in the modelling. Both qualitative and quantitative modelling are applied. The following sections detail the analysis for both chosen physical and transition risks.

Physical risks modelling and analysis

Singtel Group faces both chronic and acute physical risks in our business, particularly in Australia due to its geography. To assess the extent of physical climate risk to our business, we modelled how vulnerable our assets are to extreme weather conditions. These results show us the potential extent of the financial impact from hazards at sites across Singapore and Australia. They also inform us where the highest physical risks are, and where we need to focus our mitigation and adaptation efforts to ensure the continuity, reliability and resilience of our network and services to local communities and our customers. See page 20 for more information on our resilience efforts.

Hazard definitions

	Riverine flooding	Increased frequency and intensity of rainfall alter the frequency and intensity of river flooding, which can damage low-lying equipment and infrastructure assets.
	Surface water flooding	Increased frequency of extreme rainfall leading to floods including flash flooding, which can damage low-lying equipment and infrastructure assets.
	Extreme heat	New extremes of high temperatures, more frequent hot days and longer-lasting heatwaves, which can result in the loss of use or failure of equipment and infrastructure.
	Coastal inundation	Rising sea levels and higher incidence of extreme sea events including sea water flooding due to high tides, low air pressure and waves, which can damage coastal assets.
	Bushfires	Increased incidence of fire weather due to confluence of days with higher temperatures, high wind speeds and drier conditions. Flames and heat from burning vegetation can damage equipment and infrastructure.

We modelled the climate impacts on assets under two opposing Representative Concentration Pathway (RCP) scenarios taken from the Intergovernmental Panel on Climate Change (IPCC). These are outlined in Figure 13 as Scenario 1 and Scenario 3.

The IPCC has recently released updated Shared Socioeconomic Pathways (SSPs) scenarios with its 6th Assessment Report. As its required data is not available, we have used data from the 5th Assessment Report for our scenario modelling. We will update our analysis when the 6th Assessment Report data is available.

We conducted the assessment over three time horizons: short term (2030), medium term (2050) and long term (2100). The model overlays localised climate hazards with asset costs to produce a financial output of Technical Insurance Premium (TIP).

Technical Insurance Premium (TIP)
TIP is a risk indicator expressed as an absolute dollar number, derived by multiplying three elements:

01

An asset’s full replacement cost

02


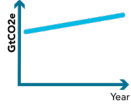
The proportion of that full asset replacement cost assigned to each element that might get damaged

03

The probability of that damaging event occurring in a given year

More information on the modelling methodology, assumptions and limitations is in Appendix 1.

Figure 13: Physical risk scenarios

Physical risk scenario	Description
 Scenario 1: RCP 2.6 Warming limited to 2°C by 2100	The global community agrees on the need to decarbonise. Global harmony limits warming to 2°C in an orderly transition. This glidepath, which is the least-cost option, will best protect economically sensitive regions from the physical and financial implications of climate change.
 Scenario 3: RCP 8.5 Warming exceeds 4°C by 2100	No policy implementation or intervention to support an economical transition towards decarbonisation. Physical impact of climate change and natural disasters are the most prominent under this BAU scenario.

Selecting hazards and assets

Our physical risk analysis commenced with identifying hazards and assets most relevant to our business, and for the specific climate conditions in Singapore and Australia.

For Singapore, we determined these hazards and assets through a high-level qualitative analysis of 82 Singtel assets across seven hazards (riverine flooding, coastal inundation, fire weather stress, drought stress, extreme heat, precipitation stress and tropical cyclone). These 82 assets are located in flood-prone areas and hotspots identified by the Public Utilities Board. The rest of our assets are excluded from the analysis as they are housed in buildings or not critical.













Figure 14 showed that of the 82 assets:

- All have very high exposure to precipitation stress
- All have high exposure to extreme heat
- Three assets have high to very high exposure to coastal inundation (sea level rise)
- Two assets have very high exposure to riverine flooding

We then identified ten assets that are the most vulnerable to the range of hazards but core to our business (comprising mobile base stations, equipment cabinets and exchanges) with distinct geographic locations. They are then included together with the highest risk hazards in our subsequent quantitative modelling. Given precipitation stress typically manifests as flash floods in Singapore, we narrowed the focus of precipitation hazard to surface water flooding in this model.

For Australia, the hazards selected were based off the pilot project we conducted in Northern Rivers region in northern New South Wales in FY2021. Through this study, we found that bushfires, riverine flooding and extreme heat present the highest

Figure 14: Result of Singapore physical climate risk assessment

82 assets							
Exposure Rating							
 Very High	0	2	1	0	0	0	82
 High	0	0	2	0	0	82	0
 Medium	0	0	5	0	0	0	0
 Low	0	0	0	59	3	0	0
 Very Low	82	80	74	23	79	0	0

risk to our assets. Given the large geographic spread of our network operations in Australia, we included a larger number of assets – 1,909 in total (covering core assets like controlled environmental vaults (CEV), towers, fibremux and macrocells) – in this quantitative model to provide an accurate representation of climate hazards and their associated costs.

We also assessed each asset’s dependencies on power supply, looking at the failure probability of their nearest electrical substation and whether a hazard event may cut power supply to our assets. These inputs were used to derive the associated financial impact in the form of TIP.

The results from this work inform our strategy to increase the resilience of our assets.

Results

For Singapore, we found that without proactive and adaptive network design and deployment, surface water flooding is the hazard which will potentially cause the highest financial impact on capital expenditure for asset repair or replacement under both RCP scenarios and across all years. Table 3 provides key findings from the modelling outcomes.

The results suggest that in the near to medium term, we should continue to focus our capital expenditure on raising the height of equipment rooms at our exchanges at low-lying flood-prone sites, installing flood gates at the entrance of our equipment

rooms, and using sandbags to mitigate the impacts from flash flooding. Long term flood mitigation plans are also currently under discussion, with a range of options from installing a detention tank to collect flood water, to relocating any existing low-level power points to a higher location.

We will continue to ensure adequate cooling for our exchanges to prevent functional failure from extreme heat. In the long term, we will focus our capital expenditure on ensuring the resilience of energy supply that powers our exchanges and mobile base stations through onsite renewable energy generation as much as we can.

Table 3: Key results for Singapore and Australia

Items	Key results for Singapore	Key results for Australia
Critical hazards with highest potential financial impact	<p>Without proactive and adaptive network design and deployment, we found the following hazards to potentially have the highest financial impact on capital expenditure for asset repair or replacement in 2030 and 2050:</p> <ul style="list-style-type: none">Surface water flooding: Highest financial impact due to a combination of factors, including proximity of assets to bodies of water, increased heavy rainfall events and drainage infrastructure in an urbanised landscape.Extreme heat: Expected to slightly increase between 2030 and 2100, with heat-related failure occurring once every 1.4 years for exchanges by 2100 due to this asset type's low temperature thresholds for heat failure. <p>Contrary to our expectations, the modelling found that the risk of sea level rise is low, as all coastal assets are currently sufficiently elevated.</p>	<p>Without proactive and adaptive network design and deployment, we found the following hazards to potentially have the highest financial impact on capital expenditure for asset repair or replacement in 2030 and 2050:</p> <ul style="list-style-type: none">Bushfires: Highest financial impact across 2030, 2050 and 2100, due to increased vulnerability of Australia's native vegetation to hotter and drier conditionsRiverine flooding: Highest financial impact in the long term for control rooms, with moderate impact in near to mid term; but low impact for all other assetsExtreme heat: Significantly increases between 2050 and 2100, with heat-related failure expected to occur once every 1.2 to 1.8 years for control rooms and fibremux assets by 2100.
Asset type likely to incur highest average TIP	<p>We found that without proactive and adaptive network design and deployment, exchanges are the asset type likely to incur the highest average TIP due to physical impacts from climate change. Specifically, the average TIP could potentially increase from \$433,020 to \$476,475 per asset from 2030 to 2050 in the BAU scenario, due to their high replacement costs in Singapore.</p>	<p>Optus' macrocell assets have the highest average hazard TIP figures in both scenarios and all analysed years. This can be attributed to their greater VAR* than the other asset types, with NSW being the state with the highest average maximum VAR. We found that the average TIP for macrocells could potentially increase from about A\$4,898 to A\$5,508 per asset from 2030 to 2050, due to the high volume of macrocell assets at risk across Australia.</p>
Critical sites at risk	<p>As surface water flooding is our most significant physical risk, our critical sites found to be at risk are in low-lying, flood-prone areas such as the Central Catchment and Lower Seletar Reservoir.</p>	<p>We found New South Wales to be the state at highest critical risk of facing negative physical impacts from climate change (see Figure 15). These individual assets are also at risk: Broulee (New South Wales), Caboolture (Queensland) and Green Head (Western Australia).</p>
Asset dependencies	<p>We found that by 2100, all ten assets analysed could be at high risk of failure without adaptation due to physical climate events interrupting electricity supply.</p>	<p>We found that by 2100, without adaptation and mitigations, 27% of assets analysed could be at high risk of failure due to physical climate events interrupting electricity supply, up from less than 1% in 2050.</p>

* Value at Risk percentage (VAR) is an asset's TIP expressed as a percentage of its replacement cost.

For Optus, we found that bushfires present the highest financial impact across all timeframes (2030, 2050 and 2100) and under both RCP scenarios, due to the impacts that hotter and drier conditions have on Australia's native vegetation.

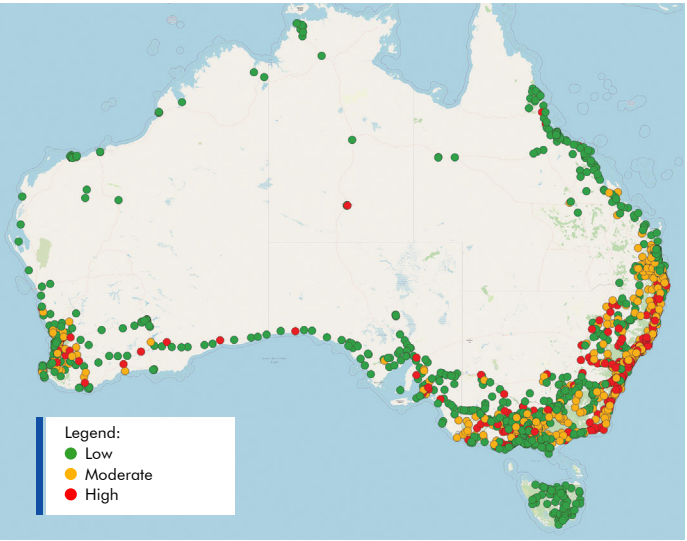
We also found bushfires to be the dominant hazard for all asset types in all years, except CEVs, where riverine flooding is expected to be more significant in the 2100 timeframe. The key findings from our modelling outcomes are summarised in the Table 3.

The results suggest that in the near to medium term, we should focus capital expenditure on minimising the vulnerability of all assets, in particular macrocells to bushfires, and on adaptive design for CEVs to ensure they are resilient to riverine flooding.

This could include the addition of fire-resistant filters, replacement of treated pine retaining walls with durable concrete-based retaining walls, and examining vegetation in close proximity of our assets for any dead part removals, which would be particularly vulnerable to trapping embers, and raising the height of our equipment at our CEVs.

In the long term, we will focus our capital expenditure on providing adequate cooling for our CEVs and fibremux assets, and strengthening the resilience of our energy supply to physical climate events through onsite renewable energy generation.

Figure 15: Results of modelling on our assets in Australia



Bushfire prediction exercise

Australian bushfires have impacted mobile coverage during disaster events when communities are most in need of reliable telecommunications services. Since 2021, we have been working with Australia's national science agency CSIRO to conduct a research investigation to understand the vulnerability of our assets and improve the bushfire resilience of critical telecommunications infrastructure.

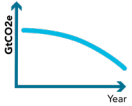
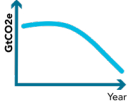
We assessed the potential and nature of impacts of embers, radiation and flame on and around Optus sites with telecommunications equipment. We then developed maps using information on topography, fuel load, vegetation type and local bushfire weather severity to assess which sites are most at risk, to inform our risk mitigation strategy. This strategy included deploying capital to effectively plan for hazards and making design changes to our sites.

From this study, we have implemented mitigation activities at two sites in Victoria to demonstrate the potential of larger, longer term resilience programmes. Examples of threats identified and how we have addressed them are detailed in Table 4 on the next page.

Table 4: Addressing vulnerabilities to bushfire threats

Threats	Vulnerabilities	Solutions
Ember attack and surface fire threats	<ul style="list-style-type: none">Shelter gaps allow embers to collectExposed generator inletDoor filter and mat vulnerability	<ul style="list-style-type: none">Bury metal skirting attached to shelter surroundings (with 2mm perforations to allow ventilation)Install generator inlet shielding (letter box)Replace door filter and mat
	<ul style="list-style-type: none">Various shelter cooling inlets with poor or no filteringExposed cable ways to nearby surface fires or that allow embers to collectFlammable debris (bark, leaves, twigs, weeds etc.) on cable way, shelter roof or compound surface	<ul style="list-style-type: none">Add fire resistant filtersFully enclose open cable ways up to a height above exposure areaRegularly remove debris, especially during times of high fire threatWeeding and sealing the compound surface
	<ul style="list-style-type: none">Plastic lids or inspection hole covers with flammable debris in close proximity	<ul style="list-style-type: none">Replace with fire-proof material, e.g. concreteRegularly remove debris
Consequential fire threats	<ul style="list-style-type: none">Treated pine retaining walls act as a consequential threat and are a health and safety risk	<ul style="list-style-type: none">Build concrete retaining walls, which are more durable
Tree damage	<ul style="list-style-type: none">Trees located close to infrastructure could potentially fall and damage infrastructure during storms or bushfires	<ul style="list-style-type: none">Engage an arborist to assess trees on asset sites on a regular basis and remove dead parts of the tree and any surrounding debris

Figure 16: Transition risk scenarios

Transition risk scenario	Description
 Scenario 1: net-zero aligned orderly transition Warming limited to 1.5°C by 2100	The global community agrees on the need to decarbonise and limit warming to 1.5°C through stringent climate policies reaching net zero emissions around 2050. This glide path is the least-cost option, and will best protect economically sensitive regions from the physical and financial implications of climate change.
 Scenario 2: Delayed or disruptive decarbonisation Warming limited to 1.8°C by 2100	Decarbonisation occurs in the same timeframe as the orderly transition scenario. However, the path is different, less cost-effective, more delayed and more disruptive. More drastic policies introduced from 2030 in an effort to expedite the global economy's alignment with net zero emissions.

Transition risks modelling and analysis

Based on the previous TCFD-related work undertaken in the FY2021 pilot, we refined and expanded our climate scenario analysis and adaptation exercise across our Singapore and Australian operations to quantify the potential financial impact of capital risk and risk of stranded assets, carbon pricing and counterparty risk under two net-zero 2050 transition scenarios.

We maintained the same three time-horizons: short (2030), medium (2040) and long term (2050), and adjusted parameters from FY2021, such as the degree of warming ambition, to

reflect the global uptake of net-zero 2050 targets aligned with keeping global warming to 1.5°C or well below 2°C by 2100. More information on the scenario narratives used for stress testing transition risk, as well as our two-step process for the stress testing exercise, are presented in Figure 16.

Further information on the modelling methodology, assumptions and limitations is in Appendix 1.

Qualitative analysis

We began our assessment with qualitative analysis to identify the transition risks that could impact our business, which involved identifying a range of universal levers relevant for Singtel

Group’s climate scenario analysis, then agreeing upon five first order levers for a preliminary investigation.

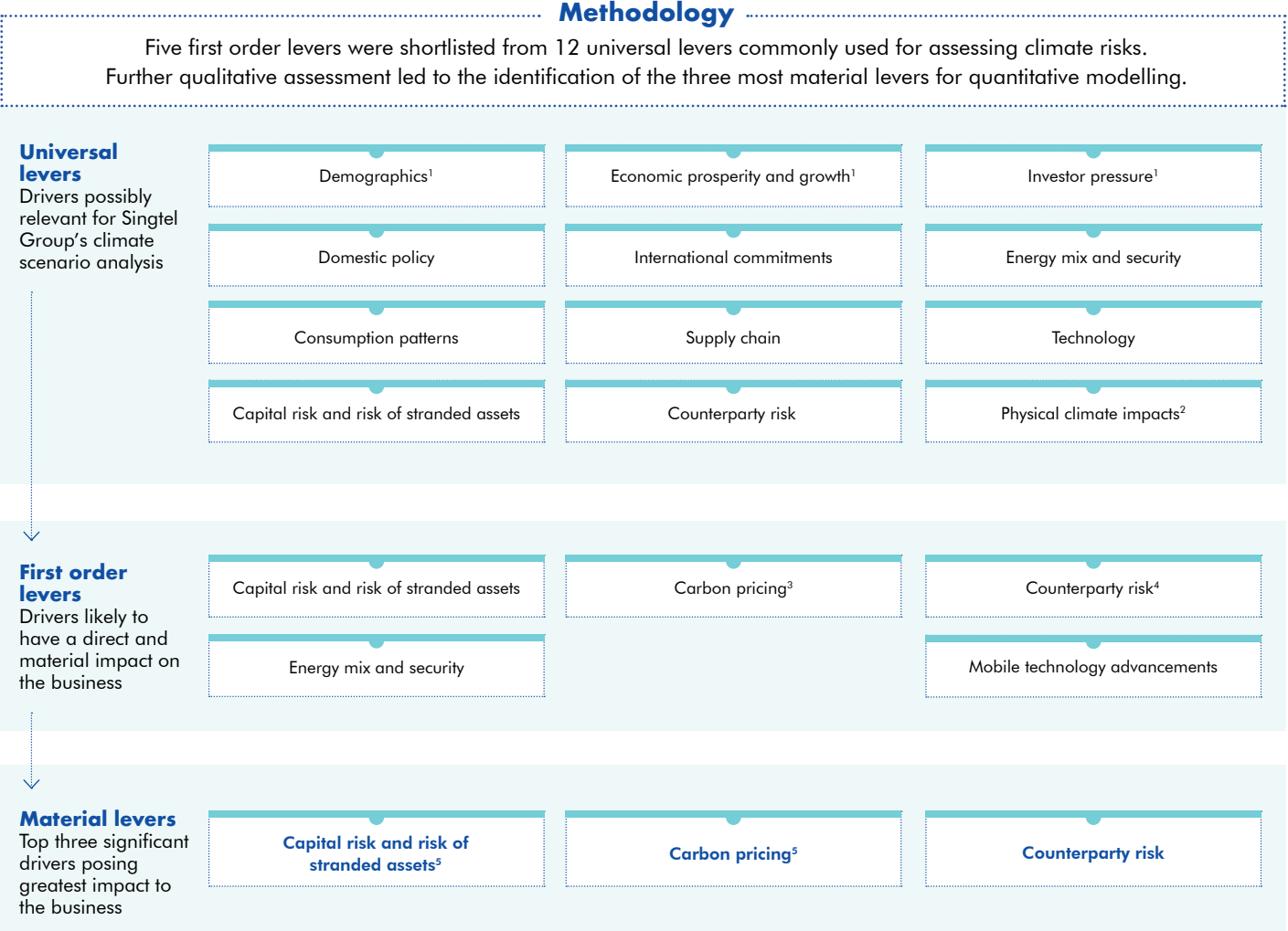
We assessed the risks and opportunities for each of these levers through desktop research with reference to the Cambridge Institute for Sustainability Leadership ClimateWise Transition Risk framework and the Singtel Group risk criteria. Through this review, we identified the three levers that pose the greatest impact to our business, which were then used in the quantitative modelling in step 2.

Figure 17 depicts our process for narrowing down the most material levers and the definition of these levers. Our FY2022 analysis was informed by the modelling and hypothesis

developed in the FY2021 pilot phase conducted in Australia (see SR2021 page 20-21). We initially used the same three material levers for our Australian operations that pose sufficiently significant impact for our Singapore operations that warrant in-depth analysis.

However, we have since refined the definition of our material levers to capture more accurately the nature of each risk, and we are currently working to refresh the qualitative analysis for our Singapore and Australia operations. We expect this refresh may identify new material levers for quantitative modelling in future years.

Figure 17: Risk selection process of qualitative assessment



1. Not shortlisted due to difficulties establishing causal linkages between these levers and climate change for quantitative modelling, or the organisation’s ability to control these factors
2. Addressed separately in physical risk modelling
3. Combines the universal levers of ‘domestic policy’ and ‘international commitments’
4. Includes aspects of ‘consumption patterns’ and ‘supply chain’
5. Quantitative modelling includes certain aspects of ‘energy mix and security’

Three most material levers identified from the FY2021 TCFD pilot conducted in Australia

- 1. **Carbon pricing:** Impact due to carbon pricing, an instrument that levies a cost to companies for their carbon emissions.
- 2. **Capital risk and risk of stranded assets** (previously 'capital allocation'): Impact due to early retirement of our network assets (for Optus) and increase expenditure to meet data centres carbon reduction (PPAs and energy efficiency (EE)) expectations rather than retirement (for Singtel).
- 3. **Counterparty risk:** Impact on business continuity due to critical suppliers' business no longer viable in a low-carbon economy, and customers defaulting on their contractual obligations.

Quantitative modelling

With the three most material levers identified, we then commenced the quantitative modelling. We have refined our scenario modelling methodologies and assumptions from the FY2021 exercise, including a focus shift from quantifying potential financial impact on the Earnings Before Interest and Tax (EBIT) metric, to a broader range of financial impacts including capital expenditure and operating expenditures.

Our FY2022 analysis found that carbon pricing risk as well as capital risk and risk of stranded assets are interdependent and have an impact on the security and mix of Singtel Group's renewable energy procurement. As a result, we included volume and pricing of renewable Power Purchase Agreements (PPAs) in the modelling for these two levers. We also adjusted the modelling focus to account for differences in the operating context between Singapore and Australia.

In Singapore, there are more advanced regulatory measures and market demand around energy efficiency of data centres. Hence our modelling of capital risk and risk of stranded assets focused exclusively on data centres, given the energy intensity of data centres as well as building and technology upgrade cycle is longer compared to other elements of our network, where technology is constantly refreshed. In Australia, where our customer base includes regions where some local economies may be heavily reliant on fossil fuel industries, we extended the modelling of counterparty risk to include the risk of default from individual consumers.

This was based on the premise that certain employment sectors are expected to face challenges in the transition to a low carbon economy. While significant for our Australian operations, this particular risk was deemed insignificant in the Singapore context due to the country's small geographic spread and workforce mobility.

Results from modelling and analysis of key transition risk

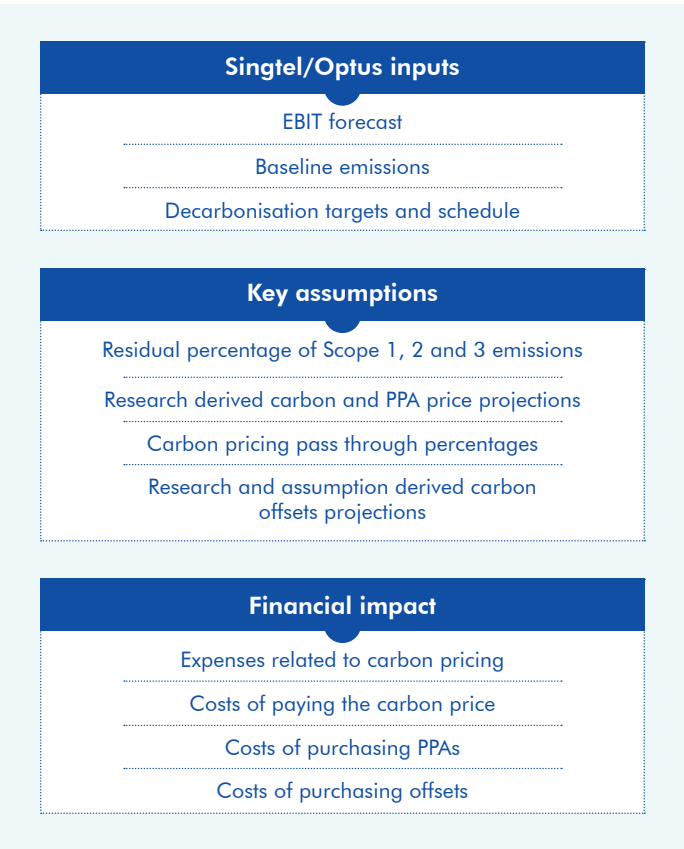
a. Carbon pricing

The modelling approach for carbon pricing risk for Singtel and Optus combined business inputs and key assumptions to derive expenses relating to carbon pricing. See Figure 18 and Appendix 1 for further detail on the modelling approach and methodology.

Across both scenarios and geographies, carbon pricing was found to have a minor financial impact on EBIT ranging from less than -1% to -2% in 2030, and increasing to a more material financial impact ranging between -1% and -8% by 2050 (see Figure 19). This impact was found to be more severe in the delayed or disruptive decarbonisation scenario due to higher carbon prices (see Figure 20), where it acts as a significant instrument to decarbonise rapidly in the disorderly scenario. This financial impact in 2050 is driven by the following assumptions:

- High carbon prices aligned with the Network for Greening the Financial System (NGFS) scenarios, which act as an extreme penalty on carbon in a net-zero economy (see Figure 20).

Figure 18: Modelling approach for carbon pricing risk



The carbon prices we have chosen for the stress testing are far higher than in the International Energy Agency (IEA) World Energy Outlook (WEO).

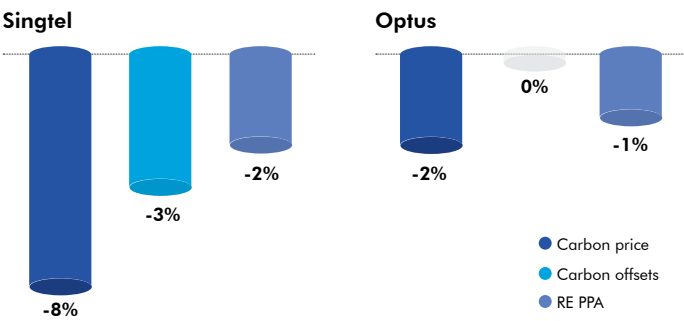
- The application of a conservative lens by including Category 13 (Downstream leased assets) and 15 (Investments) of Scope 3 emissions in our carbon liability and by assuming there would be a small amount of residual emissions across all scopes of emissions despite our current strategy to achieve our 2030 SBTi targets and 2050 net-zero ambitions. Nonetheless, as the majority of Singtel's emissions inventory used for this analysis arise from Scope 2 rather than Scope 1 sources, the expected decarbonisation of the electricity grid due to technology advancements across both scenarios is anticipated to result in lower residual emissions in 2050. Refer to Appendix 2 for details.

Under both scenarios, purchasing a combination of renewable energy (PPAs) and carbon offsets as mitigating measures for the residual emissions is likely to present a lower impact on EBIT (about 3% less by 2050 under the delayed or disruptive decarbonisation scenario) to Singtel Group than directly incurring a carbon price over time. See Figure 19 where a combination of PPAs and carbon offsets would impact EBIT by 5% compared to 8% if carbon price is incurred directly.

Given these modelling outcomes, our mitigation strategy is to explore advancing and increasing procurement of a greater portion of our electricity needs through PPAs in addition to the ongoing use of credible offsets. This solution presents its own challenges, particularly in Singapore where land for

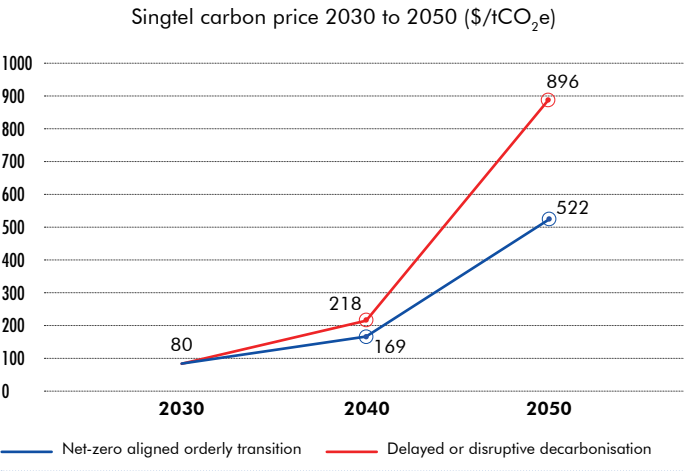
Figure 19: Singtel and Optus percentage EBIT impact from carbon pricing analysis under the disorderly net-zero scenario

Delayed or disruptive decarbonisation: Singtel and Optus potential financial impact (% of EBIT) in 2050 of carbon pricing from a carbon price over Scope 1, 2 and 3 vs carbon offsets over Scope 1 and 3 and PPAs over Scope 2.



¹Similar magnitude of carbon prices is used for our Australia operations across all time horizons, with the main difference being the source of the 2030 carbon pricing (Singapore: latest Government announced pricing; Australia: NGFS)

Figure 20: Singtel carbon price trajectories



installation of solar panels is scarce and likely to lead to PPA supply constraints in the face of increased market demand from corporates seeking to meet their own net-zero targets in future.

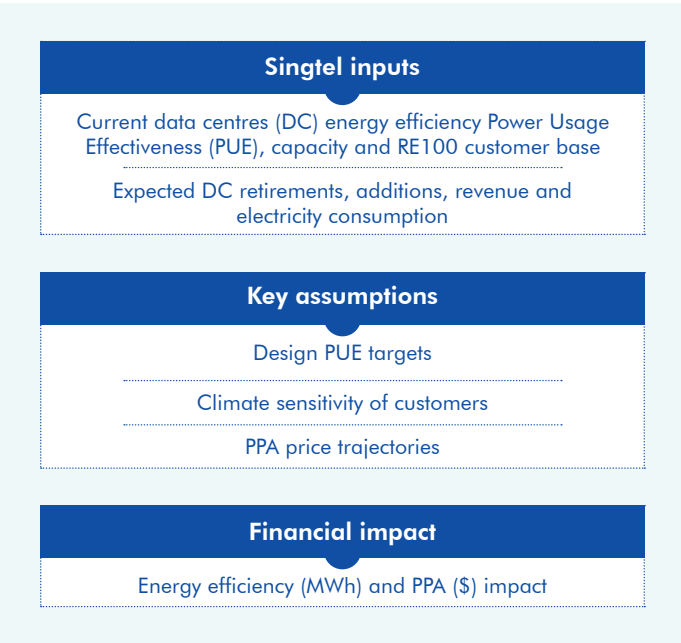
b. Capital risk and risk of stranded assets

For the capital risk and risk of stranded assets, the modelling approach was tailored to each business due to the differences in asset composition between Singtel and Optus. For Singapore, the modelling approach for capital risk and risk of stranded assets combined business inputs and key assumptions to derive energy efficiency and PPA impacts. See Figure 21 and Appendix 1 for further details on the modelling approach and methodology.

Capital risk and risk of stranded assets from the transition to net-zero are found to be more relevant for our Singapore operations than Australia given the different business and asset mix. While we have a large network infrastructure in Singapore, most of our network and equipment exchanges had been depreciated, and mobile networks are upgraded regularly to the latest energy efficient standards. However, data centres for enterprise customers which tend to be more energy intensive continue to be in expansion mode as part of our corporate growth strategy.

Given the longer asset life of data centres, they are at higher risks of exposure due to major changes in regulations or energy efficiency standards and other competitive considerations. Hence the analysis for our Singapore operations focused on data centre assets. In Australia where the bulk of investments is in mobile network infrastructure, upgrades of the electronics and technology tend to be undertaken more regularly hence leaving less risk of stranded assets from energy-related regulations.

Figure 21: Modelling approach for capital risk and risk of stranded assets for Singtel



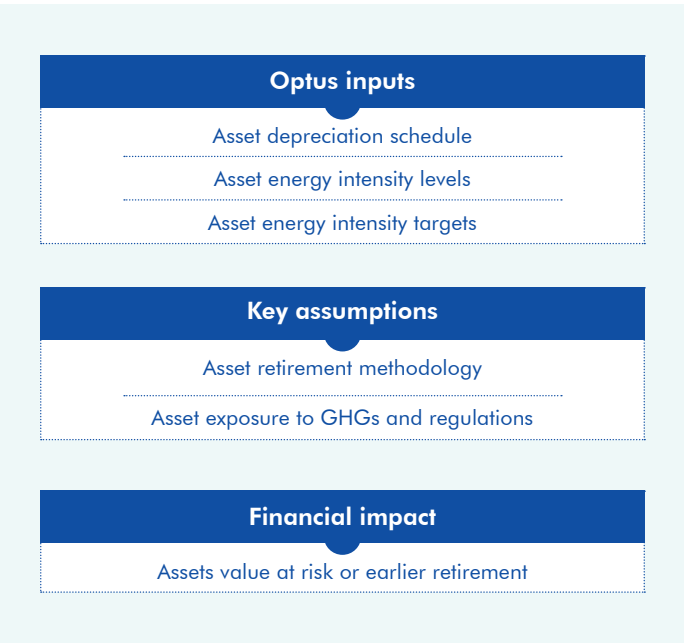
In Singapore, there is a high likelihood that national energy efficiency targets for data centres will be introduced, in line with Singapore's ambition to cut its emissions and become a global hub for data centres. In addition, as customers' understanding of climate issues increases, we expect demand for green data centres to grow.

Should our data centres fail to meet these requirements, we risk losing our market share to more progressive service providers. As several of our incumbent data centres were built many years ago, our analysis has found that the majority of our capital expenditure on energy efficiency improvements needs to take place between now and 2030, to meet internal design Power Usage Effectiveness (PUE) targets.

However, our modelling has also found that emissions abatement on data centres would be primarily driven by renewable energy procurement rather than energy efficiency improvements (see Figure 23), costing us less than 1% of EBIT per year¹ to abate emissions from remaining electricity usage. This is due to the fact that more than 90% of the power consumed in data centres are attributed to running and to cool servers deployed in data centres by tenants. As part of our data centre strategy review, we undertook an initial Marginal Abatement Cost Curve (MACC) analysis for our data centres, as a first step to allow us to better quantify the potential cost impacts for energy efficiency against emissions offset abatement opportunities.

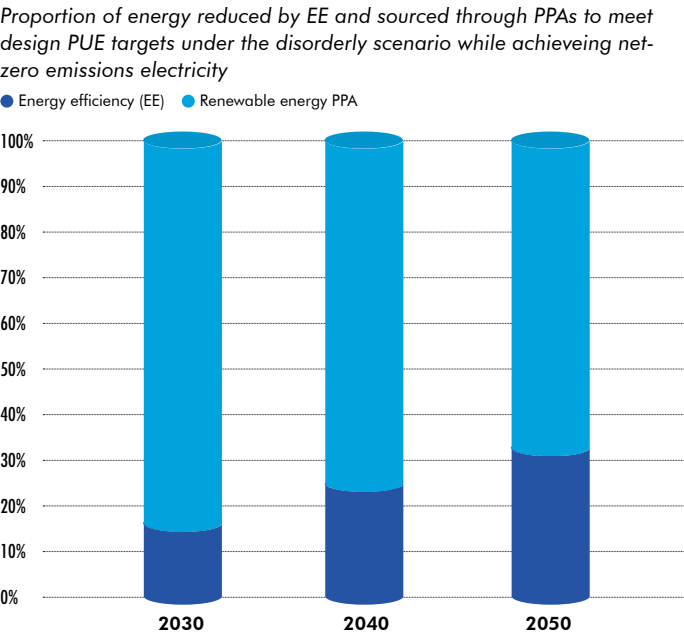
¹This figure is a subset of the amount representing the impact on EBIT from PPA and offsets procurement under the carbon pricing lever.

Figure 22: Modelling approach for capital risk and risk of stranded assets for Optus



Capital risk and stranded assets for other infrastructure such as mobile assets are deemed a lower risk and less material because technologies such as 4G and 5G tend to be refreshed in shorter cycles compared to data centres. We are also working with global network vendors who place energy efficiencies central to their technology roadmaps.

Figure 23: Singtel capital risk and risk of stranded asset proportion of energy required to be sourced through a RE PPA



In Australia, our modelling approach for capital risk and risk of stranded assets combined business inputs and key assumptions to derive asset value at risk of earlier retirement for a small sample of assets. See Figure 22 and Appendix 1 for further details on the modelling approach and methodology.

Our portfolio of network assets reflects our large mobile carrier network business. Given the pace of grid decarbonisation is expected to be faster from current levels in Australia than in Singapore (due to supply constraints for renewables), we deem it unlikely that the Australian Government will introduce any significant energy efficiency targets on electricity-reliant assets to achieve its net-zero goals.

In addition, the retirement of assets in our Australia portfolio will more likely be due to BAU technology upgrades rather than any specific energy efficiency requirements. Notwithstanding, increasing the sourcing of electricity linked to renewable energy is one way for us to offset residual emissions resulting from the energy intensity of our network in Australia.

c. Counterparty risk

Counterparty risk refers to risks in our customer base and supply chain. These parties' actions are outside our control, which makes it difficult to precisely model the overall financial impact on our business in Singapore and Australia.

However, the assessment has improved our understanding of the inherent risk profiles of our suppliers and customers. We have used the exposure to, or relative share of, spend or revenue attributed to sectors with more transition risks (example: transportation and industrials) to represent these inherent risk profiles.

Supplier risk

For our suppliers, the modelling approach (see Figure 24) for counterparty risk combined business inputs and key assumptions to derive exposure of supplier contracts at Moderate and High risk due to an inability to transition. See Appendix 1 for further detail on the modelling approach and methodology.

From our pilot exercise in FY2021, we noted the relative maturity of climate action among our suppliers of major spend. This year's bottom-up deep dive focused on the credibility of the net-zero transition plans of suppliers who were most critical to the business continuity of our services.

The results highlighted that more than half of our most critical suppliers (representing over \$750 million annually in contract value) appeared to be ready for the transition, largely due to their own ambitious emissions reduction targets supported by feasible action plans (see Figure 25 - supplier names and expenditure not disclosed for confidentiality).

Figure 24: Modelling approach for counterparty risk (supplier)

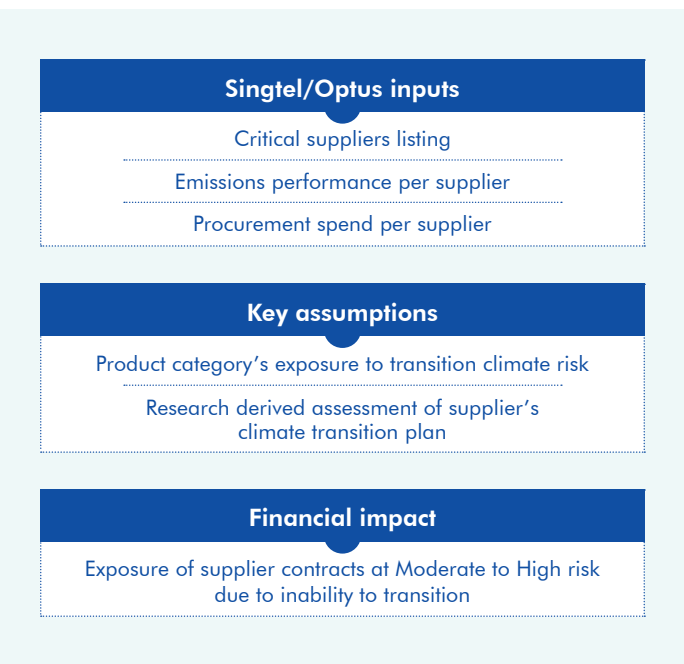
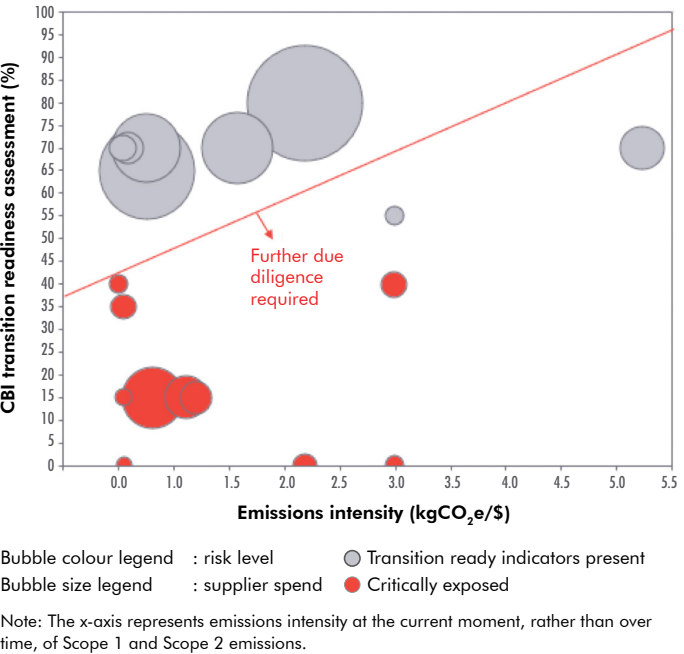
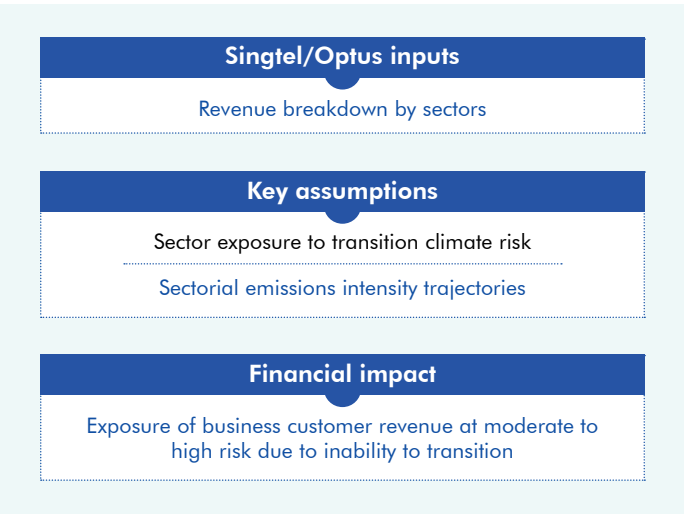


Figure 25: Critical supplier deep dive into credibility of their net-zero transition plans



The results from this assessment have identified opportunities for further engagement with other suppliers on their decarbonisation strategies.

Figure 26: Modelling approach for counterparty risk (enterprise customer)



Customer risk

For our enterprise customers, the modelling approach for counterparty risk combined business inputs and key assumptions to derive exposure of enterprise customer revenue at Moderate and High risk due to an inability to transition. See Figure 26 and Appendix 1 for further detail on the modelling approach and methodology.

We performed an analysis of our enterprise customers using a top-down sector-level approach. Our assessment showed that approximately 5% of our revenue from Singapore and Australia enterprise customers are in high emitting sectors. This number is projected to decline over time as the sectors transition across both scenarios.

The exposure is slightly higher for our Australia operations due to a small portion of higher risk revenue streams – livestock and coal – in Australia’s agriculture and electricity generation sectors (see Table 5). This is a contrast to Singtel’s higher risk industries which centre around energy and resources, transport and industrials.

For our retail customers in Australia, the modelling approach for counterparty risk combined business inputs and key assumptions to derive exposure of retail customer revenue at moderate and high risk due to an inability to transition. See Figure 27 Appendix 1 for further detail on the modelling approach and methodology.

Figure 27: Modelling approach for counterparty risk (retail customer)

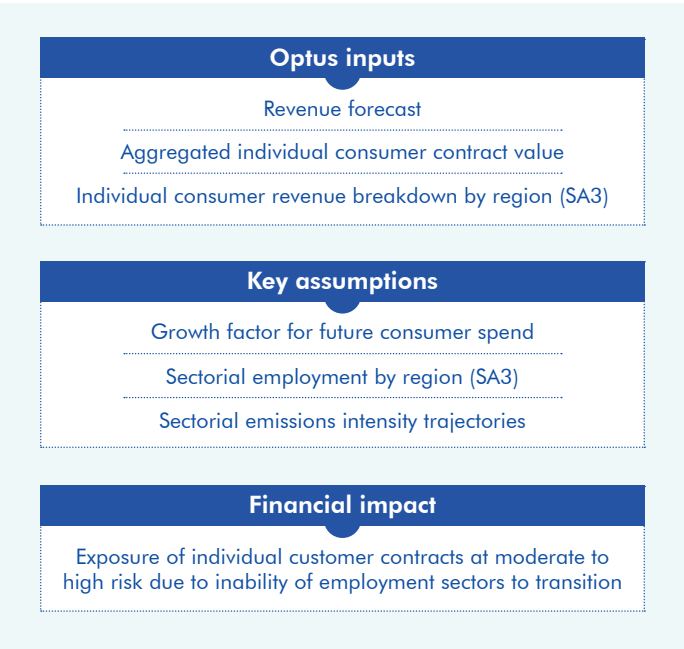


Figure 28: Inherent risk of Optus revenue from individual customers

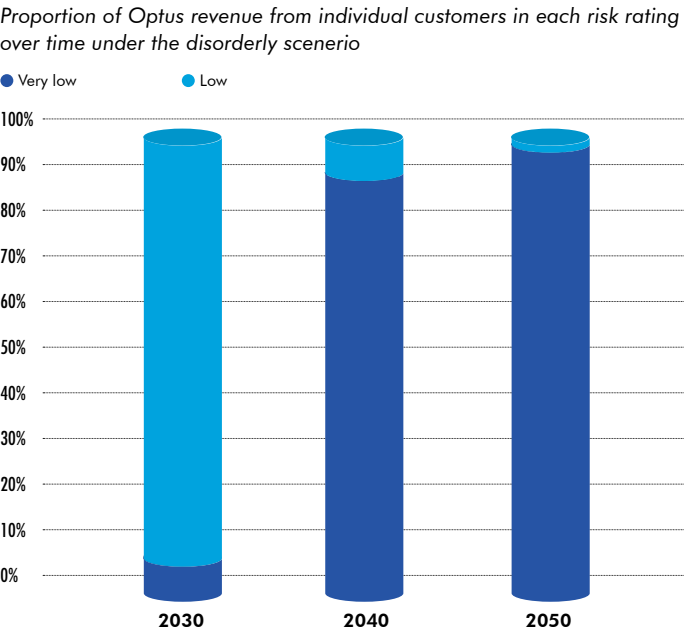


Table 5: Sector-based counterparty customer inherent risk assessment

Industry		2030	2040	2050	High level explanation of inherent risk rating overtime
Singapore	Energy and Resources	High	High	Low	High inherent risk in 2040 and 2050 due to the prominence of oil and gas exports in the Singapore economy with Singapore aiming to build an liquefied natural gas (LNG) hub.
	Transportation and Logistics	High	Moderate	Low	High risk declining to low in 2050 due to the inherent dependency on fossil fuels and difficulty to decarbonise aviation and shipping – both of which are strategic to Singapore’s transport industry. The sudden shock in 2030 under a disorderly scenario corresponds to the high inherent risk rating with moderate inherent risk in 2040 as the aviation and shipping component of this sector continue to decarbonise.
	Industrials	High	Moderate	Low	High and moderate inherent risk in 2030 and 2040 respectively due to the emissions intensive nature of this sector and the challenge it faces in decarbonising, which prolongs its critical period of transition past 2030.
Australia	Agriculture, Forestry and Fishing	Very high	High	High	Very high to high inherent risk across all time horizons due to high methane and nitrogen emissions from livestock and fertiliser with well proven decarbonisation options yet to be developed.
	Electricity, Gas and Water Supply	Very high	High	Low	Very high risk in 2030 due to the large proportion of coal-fired electricity. High risk in 2040 as some coal may remain and gas may take on a larger role in the Australian Government’s gas-led recovery plan. Low in 2050 once the electricity grid reaches net-zero emissions.
	Mining	High	Low	Low	High in 2030 when coal and gas extraction are expected to be strong under Australian Government policy before a sudden and rapid shift away from these commodities and a decarbonisation of other mineral mining in 2040 and 2050.

Our assessment of individual consumer default risk in Australia showed there is insignificant exposure due to the high diversification of industries within each region, with overall risk profiles aligned with the overall decarbonisation trajectory of the Australian economy (see Figure 28).


This is further supported by the fairly inelastic nature of telecommunications demand, and the strong societal, business and government support for a just transition for workers and communities.


The potential risks are assessed to be greater where changing consumer preferences for companies with sustainable products and stronger climate commitments could influence purchasing preferences.


Transition and physical opportunities


Climate change presents a range of physical and transition impacts. Our qualitative and quantitative assessments to-date have focused on understanding the potential negative impacts on our business.

However, we believe that mitigative actions can also enable a range of opportunities, including:

- 

First mover advantage from achieving net-zero emissions and carbon neutral data centres, hence attracting more customers as preference shifts towards green service providers and enabling corporate customers to achieve their net-zero targets
- 

Price premium or increase in market share as a result of being a reliable and resilient telecommunications brand supporting the community in the face of extreme weather events
- 

Cost effectiveness from more energy-efficient operations due to energy savings and emissions avoidance
- 

Innovative ICT solutions can minimise resource consumption in various sectors of the economy, including smart grid solutions and precision agriculture digital solutions

As we further develop and refine our climate risk analysis and mitigations, we have the opportunity to carry out quantitative modelling on key opportunities in future. A summary of key results from the quantitative transition (Top 3 risks) and physical (Top 5 risks) climate risk modelling covered in this strategy section of this report is in Table 6.

These results are inherent rather than residual risk assessment, and do not consider the impacts of current and planned mitigation effort.

Table 6: Summary of key results of transition and physical climate risk modelling

Risk type	Risk	Risk description	Risk trend
Transition	Carbon pricing	Impact on Singtel and Optus EBIT as a result of the introduction of or increase in carbon price, an instrument that applies a cost to GHG emissions for emitters.	Increasing
	Capital risk and risk of stranded assets	Singtel: Energy efficiency (MWh) and PPA (\$) impact on Singtel’s data centres to meet potential regulatory and market expectations of energy efficient and low carbon data centres. Optus: Value of assets that would be at risk as a result of assets being retired earlier than their natural capital depreciation schedule due to the transition to a low carbon economy.	Singtel: Increasing Optus: Decreasing
	Counterparty risk	Impact on our business continuity due to disruptions to critical suppliers because of the economy’s decarbonisation transition, as well as causing business and individual consumers to default on contractual obligations.	Decreasing
Physical	Riverine flooding	Increased frequency and intensity of rainfall changing the frequency and intensity of river flooding, which can damage low-lying equipment or infrastructure assets.	Increasing
	Surface water flooding	Increased frequency of extreme rainfall leading to floods including flash flooding damaging low-lying equipment or infrastructure assets.	Increasing
	Extreme heat	New extremes of high temperatures, more frequent hot days and longer lasting heatwaves which can result in the loss of use or failure of equipment and infrastructure.	Increasing
	Coastal inundation	Rising sea levels and higher incidence of extreme sea events including sea water flooding due to high tides, low air pressure and waves which can damage coastal assets.	Increasing
	Bushfires	Increased incidence of fire weather due to confluence of days with higher temperatures, high wind speeds and drier conditions. Flames and heat from burning vegetation can damage equipment and infrastructure.	Increasing

Modelling performed	Implications for Singtel	Implications for Optus
<p>Projected EBIT and emissions based on internal financial and decarbonisation plans, leading climate scenarios and national government policies.</p> <p>Assessed the financial impact of carbon pricing, carbon offset and renewable electricity power purchase agreements (REPPAs) by applying prices for these costs derived from leading climate scenarios, national government research and market knowledge.</p>	<p>Singtel and Optus are both able to mitigate the risks related to potential future carbon pricing risk due to:</p> <ol style="list-style-type: none">1. Strong decarbonisation strategies including science-based emissions reduction targets and strategies to achieve these targets2. Rigorous quantitative analysis into the potential financial impacts in line with leading climate scenario data and TCFD best practice <p>Renewable energy generation and procurement will be a key focus to mitigate this risk and deliver on our commitments given that over 90% of emissions under our operational control comes from scope 2 emissions (and therefore likely to be liable under current or future carbon taxes).</p>	
<p>Singtel: Projected data centre electricity consumption based on revenue projections and data centre capacity. Estimated energy efficiency improvements needed for data centres to reach design PUE targets. Projected the cost of REPPAs to account for the residual energy consumption using REPPA price trajectories.</p> <p>Optus: Co-optimised energy intensity and remaining asset value by site type for a sample of higher energy intensive locations with smart meters to reduce average sample energy intensity.</p>	<p>Singtel may face capital risk and risk of stranded asset from market and regulatory forces, but is well prepared for this by committing to:</p> <ol style="list-style-type: none">1. Continuously improving energy efficiency of existing data centres, and building new data centres to highest energy efficiency standards2. An action plan to procure electricity backed by renewable energy	<p>Optus’ capital risk and risk of stranded assets is low due to:</p> <ol style="list-style-type: none">1. Our action plan to procure electricity backed by renewable energy; our main asset being mobile networks are updated frequently to keep up with technology2. The relatively fast decarbonisation of the Australian electricity grid and availability of renewable energy reducing the likelihood of future regulations on asset energy intensity
<p>Exposure to transition risk of critical suppliers was assessed individually based on their (Scope 1 and 2) emissions intensity and preparedness for decarbonisation (according to the CBI Transition Principles). Disruption from transitional risk to enterprise customers was determined based on sector exposure and emissions intensity trajectories. Disruption from transition risk to individual consumers was determined based on the sectoral employment of the region of the consumer, and the sectoral emissions intensity trajectories.</p>	<p>The progressive climate and emissions preparedness of our major suppliers deemed critical imply low disruption risk to our business continuity. This inherent risk is further reduced by mitigation efforts that we can take, such as selecting suppliers in sectors of high transition risk such as transport and logistics which have extensive decarbonisation strategies in place.</p>	
<p>Each hazard was modelled under two IPCC scenarios, RCP2.6 and RCP8.5 over three time horizons: short term (2030), medium term (2050), long term (2100). To determine the vulnerability of our assets, the model overlays localised climate hazards with asset costs to produce a financial output, technical insurance premium (TIP).</p> <p>We also assessed each asset’s dependencies on its power supply, by looking at the failure probability of their nearest electrical substation and whether a hazard event may cut power supply to our assets.</p>	<p>Surface water flooding was the hazard with the highest potential financial impact, while extreme heat presents a risk in the long term through functional failure to assets with low heat thresholds.</p> <p>We will therefore continue our risk mitigation efforts including:</p> <ol style="list-style-type: none">1. Raising the height of our equipment rooms at our exchanges at low-lying flood-prone sites2. Installing flood gates at the entrance of our equipment rooms3. Using sandbags to mitigate the impacts from flash flooding4. Ensuring implementation of adequate cooling technology to facilitate equipment functioning <p>Contrary to our expectations, the modelling found that the risk of sea level rise is low, as all coastal assets are currently sufficiently elevated.</p>	<p>Bushfires present the highest financial impact, while extreme heat presents a risk in the long term through functional failure to assets with low heat thresholds.</p> <p>In addition, by 2100,without further adaptation and mitigation 27% of assets analysed could be at high risk of failure due to physical climate events interrupting electricity supply from the public grid. Our efforts to mitigate these risks include:</p> <ol style="list-style-type: none">1. Removal of vegetation overhanging our assets2. Raising the height of our equipment3. Replacing wood shelter structures with concrete or steel-based materials4. Installing fire-resistant cladding and air filters5. Implementing adequate cooling technology for our equipment6. Onsite energy generation and batteries to strengthen the resilience of our energy supply

03.

Risk management

Our enterprise risk management framework

This section covers the overall risk management approach of the company related to climate and other enterprise risks. Our risk management processes facilitate alignment of our strategy and annual operating plan with the management of key risks.

The Singtel Group identifies, assesses and manages risks to reduce the uncertainty associated with executing our business strategies, and mitigate potential adverse impacts on our business.

We have established a comprehensive Risk Management Framework (RMF) at the enterprise level, which sets out our governance structure for managing risks, risk philosophy, risk appetite and tolerance levels, management approach and risk factors. The RMF also includes our risk management policy, guidelines and risk register, and is detailed in our Annual Report.

The Board is responsible for determining the Group’s risk appetite, tolerance and profile, overseeing the RMF, reviewing the Group’s key risks and mitigation strategies and ensuring the effectiveness of risk management policies and procedures. The Risk Committee (RC) and the Audit Committee (AC) review the management of these risks and effectiveness of mitigation strategies and controls.

The Risk Management Committee (RMC) supports the Board and RC in terms of risk governance and oversight and sets the direction and strategies for corporate risk management to be in line with the Group’s risk appetite and tolerance thresholds. Management is responsible for ensuring that the RMF is effectively implemented within the business units, which are supported by specialised functions such as Legal, Regulatory, Cyber Resilience, Insurance, Credit Management, Tax, Treasury and Group Sustainability in the management of risks.

In addition, through stakeholder engagement and materiality assessments, we regularly review and assess the ESG risks that exist or emerge in our broader value chain, and we address them with various corporate sustainability initiatives.

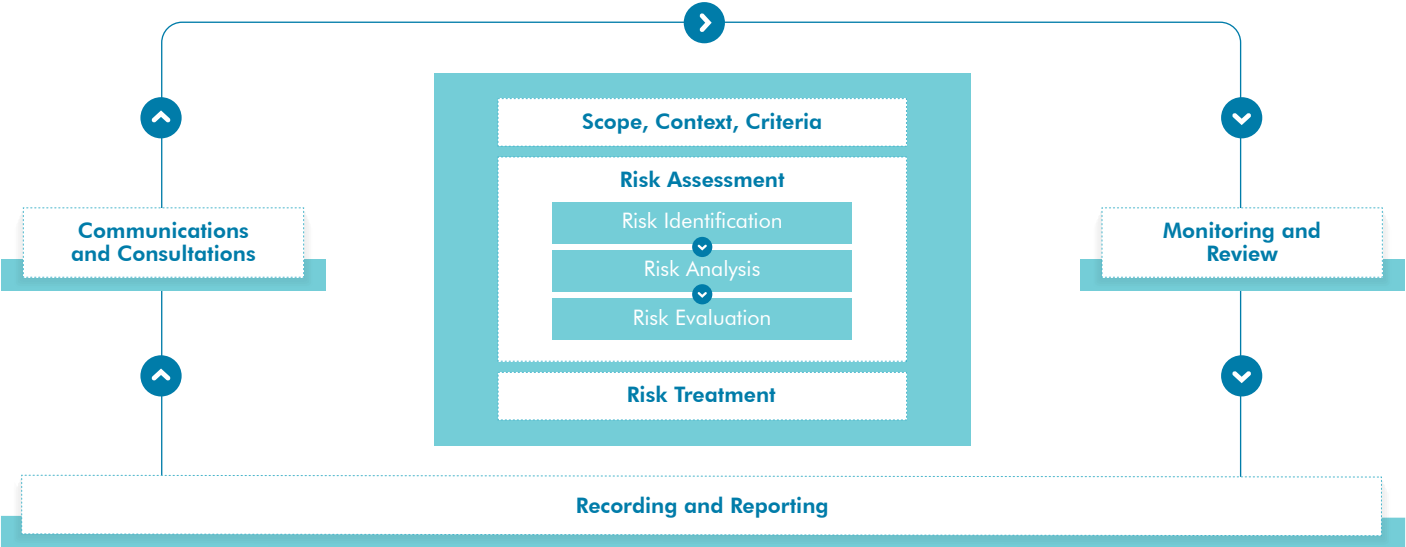
Climate change poses a range of strategic and operational risks to Singtel Group. These can include risks such as financial risks as a result of stranded assets in the transition a low carbon economy, disruption of business activities and damage to network infrastructure due to extreme weather events as well as impact to people’s livelihoods, and others described on Figure 10 on page 15.

Our approach is for each business unit to identify, assess and manage risks within their own risk register, action plan, annual business planning and budgeting process. For example, natural disaster risk is considered from the perspective of infrastructure damage, such as from bushfires and flooding, and sits within the remit of the Networks business unit.

Moving forward, we are working towards formalising the integration of climate risk into our RMF by leveraging our recent climate risk assessments described in the previous chapter. We intend to scale and formally incorporate these activities into decision-making processes to better manage climate risks within our business, for example by ensuring our infrastructure is resilient to physical risks and by mitigating the financial risks from the transition to a low carbon economy.

We also review climate risks in our broader supply chain and address these risks through various sustainability initiatives. Our risk management processes, summarised in Figure 29, facilitate alignment of our strategy and annual operating plan with the management of key risks.

Figure 29: Singtel Group risk management process



Risk process stages	Status	How are climate risks being managed?
Stage 1: Establishing the Context Defining the business environment within which the entity undertaking the risk assessment operates, providing context for the assessment and the criteria against which risks will be assessed later in the process.	Completed	The climate risks related to Singtel Group are elaborated on page 15.
Stage 2: Risk Identification Identifying Business Unit material risks using inputs from top and senior executives, and research of external and internal information sources.	Completed	The various risk stakeholders and owners are identified within the organisations. They are involved in the risk assessment process.
Stage 3: Risk Analysis Understanding the root causes and factors that contribute to the occurrence of the identified risks and making an evaluation of the likelihood of occurrence, financial or non-financial impact of risks. The overall risk rating is determined using a set of assessment rating scale to provide a consistent way to evaluate and rate risks across specified dimensions.	Completed	The material climate risks, both physical and transition, have been analysed and modelled under selected climate scenarios on page 16.
Stage 4: Risk Evaluation Evaluating the residual risk (remaining risk after considering the effectiveness of the existing controls we have implemented for risk mitigation) to determine whether further actions are required to mitigate the risk further.	Partially completed	Some of the residual risks are elaborated in the climate scenario analysis. However, as we are only at the beginning stage of implementing some of the risk mitigations, the full evaluation of all the residual risks can only be carried out later.
Stage 5: Risk Treatment Determining risk treatment strategies that can be applied to mitigate the identified risks.	Partially completed	For similar reason as risk evaluation, risk treatment can only be completed when we have a comprehensive risk evaluation done.
Stage 6: Monitoring and Review Monitoring risks to ensure that they remain within acceptable levels.	To be carried out	With the completion of the TCFD climate analysis work, the next step is to incorporate the monitoring of climate risks within the current monitoring regime.
Stage 7: Communication and Consultation Consolidating key information gathered throughout the risk profiling process and reporting it to the appropriate level of management and to the Board.	Ongoing	This will be done once the above six steps are completed.
The final stage is Recording and Reporting as a Risk Register to management and the Board.		

04.

Metrics and targets

Realising our climate ambitions requires setting targets, measuring and improving related climate-related metrics. The TCFD framework forms the basis for our disclosure of any material climate-related drivers and impacts on Singtel Group. We disclose a range of metrics to give our stakeholders a better understanding of our efforts and progress in managing our key climate-related risks and opportunities.

Metrics

Our key metrics, including emissions, energy consumption, capital deployment, internal carbon price and remuneration, are detailed in Table 7. We have set our targets according to our strategic priorities and roadmap towards TCFD alignment.

More information on the initiatives that have contributed to our performance across these areas is on page 12 to 15. Other environmental metrics can be found in our Sustainability Report 2022.

Targets

Singtel Group has set ambitious sustainability targets including climate-related ones.

We have also set sustainability performance targets (SPTs) KPIs for emissions intensity and absolute emissions reduction for our sustainability-linked loans and bonds as part of our Sustainability-Linked Bond Framework which can be found [here](#). These targets are aligned to various mid term 2025 sustainability targets committed by the Group.

Here is a summary of our climate-related targets:

Focus areas	Targets and commitments	FY22 progress
Driving decarbonisation in our business	<p>Reduce absolute carbon emissions by 25% for Scope 1 and 2 by 2025, using 2015 as baseline, in line with our 2030 SBTi targets of 42% reduction and 2050 net-zero ambitions</p> <p>Achieve 100% of electricity use to be backed by renewable sources in Australia by 2025</p>	<p>494,680 tCO₂e carbon emissions in FY2022 or 3.3% reduction since FY2015, and 7.2% reduction since FY2021</p>
Increasing our climate resilience	<p>Continue to invest in network adaptation and resilience, while stress testing and disclosing long term climate change risks and mitigation based on various scenarios and in line with the TCFD framework</p>	<p>Total capital investment of \$2.2 billion in our networks</p>
Driving accountability within organisation	<p>Obtain a CDP rating of A-</p>	<p>Maintained A- in CDP rating for FY2022</p>

Table 7: Singtel Group Metrics

Metrics	Performance	
	FY2022	FY2021
Greenhouse gas (GHG) emissions		
Total GHG emissions (tCO ₂ e) ¹	7,811,358	8,449,990
Scope 1	6,322	7,643
Fugitive emissions - refrigerants	3,379	4,584
Fuel combustion - stationary	1,345	1,192
Fuel combustion - mobile	1,598	1,867
Scope 2		
Electricity purchased (location-based)	534,550	536,856
Electricity purchased (market-based)	488,358	525,218
Scope 3	7,316,678	7,917,129
Cat 1: Purchased goods and services	4,173,709	4,774,080
Cat 2: Capital goods	1,880,644	1,906,642
Cat 3: Fuel- and energy-related emissions	61,197	60,264
Cat 4: Upstream transportation and distribution ²	0	0
Cat 5: Waste generated in operations	901	877
Cat 6: Business travel	918	99
Cat 7: Employee commute	3,308	4,958
Cat 8: Upstream leased assets ³	0	0
Cat 9: Downstream transportation and distribution	5,690	9,385
Cat 10: Processing of sold products ⁴	Not applicable	Not applicable
Cat 11: Use of sold products	232,236	270,647
Cat 12: End-of-life treatment of sold products	1,361	1,545
Cat 13: Downstream leased assets	127,578	113,252
Cat 14: Franchises	2,710	2,844
Cat 15: Investments	826,426	772,536
GHG emissions intensity (tCO ₂ e/\$million revenue)	509	540
GHG emissions intensity (tCO ₂ e/TB) ⁵	0.035	0.045
Avoided GHG emissions (tCO ₂ e)	10,042	73,226
Energy		
Total energy use (MWh)	818,979	808,072
Electricity use	805,170	793,672
Fuel use	11,373	11,942
Solar energy	2,436	2,458
Building energy intensity (kWh/m ²)	1,466	1,445
Climate-related opportunities		
Key data centres certified to SS564 Green Data Centre Standard, ISO 50001 Energy Management System and BCA-IMDA Green Mark Platinum Award for existing Data Centres	Kim Chuan Telecommunications Complex 2 and DC West in 2021	
Capital deployment		
Investment in climate adaptation and resilience measures (total capital investment in our networks)	\$2.2b	\$2.2b
Investment in climate mitigation measures (2015 to 2022)	\$126.84m	-
Internal carbon price		
Internal carbon price (\$/tCO ₂ e)	50	-
Management Remuneration relating to ESG KPIs		
Weighting of all ESG-related KPIs on long (LTI) and short (STI) term incentive scorecards for executives and management	LTI: 20% STI: 10%	LTI: 20% STI: 10%
Weighting of Climate-related KPIs on long (LTI) and short (STI) term incentive scorecards for executives and management	LTI: 4% STI: 2%	LTI: 4% STI: 2%

1. GHG emissions are derived in accordance with the requirements of the “GHG Protocol Corporate Accounting and Reporting Standard” and “Corporate Value Chain (Scope 3) Accounting and Reporting Standard” by World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD). The equivalent CO2 emissions for electricity used are calculated based on the updated simple operating margin grid emission factors from the National Environment Agency, Energy Market Authority and electricity supplier emission factor in Singapore for the relevant time period and from Australian National Greenhouse Gas Account factors for grid emissions relating to the corresponding states in Australia. Scope 1 direct emissions and Scope 3 indirect emissions are calculated using: Supplier specific emissions factors, updated BEIS (Department for Business, Energy & Industrial Strategy) Greenhouse Gas reporting: conversion factors, National Greenhouse and Energy Reporting Scheme (NGERS), USEPA GHG Emission Factors (April 2022) and Singapore’s Fourth Biennial Update Report. Relevant emission factors were sourced from: Life Cycle Assessment (LCA) report on Singapore NEWater, various Australian and international Life Cycle Inventory (LCI) databases (Aus LCI Version 1.31 and Australasian LCI Version 2014.09 databases), and Australian Mobile Telecommunications Association (AMTA)’s End-of-Life Management Options for Mobile Telephones in Australia were applied to consumption category of primary data to calculate Scope 3 indirect emissions. For spend based category data, emissions factors from the LCI database Exiobase (v3.3) implemented in SimaPro 9.1.1.1 were applied by economic sectors and geographic regions to calculate the Scope 3 indirect emissions.

2. Reported in Scope 3 Category 1 and 2 emissions.

3. Reported in Scope 1, 2 and Scope 3 Category 1 and 2 emissions for any upstream leased assets.

4. Not applicable as Singtel Group does not manufacture any products or sell products that require additional processing by the customer to use.

5. Covers Scope 1 and 2 only.

Note: GHG Emissions and Energy indicators are subjected to external assurance by EY in the [Singtel Group SR2022](#)

05.

Summary and next steps

This report marks the first comprehensive TCFD report for Singtel Group where all 11 aspects of the four core elements are disclosed, since we started supporting TCFD in 2018. Completing our first climate scenario analysis for both physical and three material transition risks on organisation-wide basis allows Singtel Group to identify areas to focus and mitigate the materials risks further while leveraging on the opportunities presented in offering ICT solutions to enable a low carbon transition.

This also sets the basis for us to continue to sharpen our approach and strengthen our integration of climate-related matters into our core strategic focus.

This is only the beginning and we will continue to build on it. We will review and update at least on an annual basis our TCFD progress with progressive iteration and refinement of scenarios as well as financial impact analysis. We aspire to accelerate our pace where possible towards net-zero. Some of our next steps are listed below:

01.

Develop a roadmap to net-zero and review our SBTi near term targets to align to 1.5°C scenario
02.

Continue to build climate knowledge at all levels of Board and management through introduction of formalised ESG and climate-related training for them
03.

Refine respective term of reference (TOR) of relevant governing bodies in relation to climate matters for more clarity
04.

Conduct further analysis of climate opportunities for our business
05.

Enable deeper integration of climate risk assessment and management into the Group Risk Management Framework
06.

Engage value chain stakeholders on climate-related risks and opportunities



06.

Appendix

Appendix 1: Methodology, assumptions and limitations

Transition risk modelling

The modelling was based on best available information; however, the results are subject to certain assumptions and limitations set out below:

	Carbon pricing	Capital risk and risk of stranded assets	Counterparty risk
Methodology	We modelled a set of carbon prices against our projected emissions trajectory and decarbonisation targets, including a combination of mitigating measures such as Power Purchase Agreements (PPAs) for renewable energy and purchase of carbon offsets for a more holistic picture of cost impacts.	Singapore: We modelled the scale of abatement measures required between overall energy efficiency improvements and PPA procurement for each data centre. Australia: We modelled the retirement of network assets failing to meet our energy intensity targets.	Suppliers: We assessed the climate transition readiness of each of our critical suppliers against the Climate Bonds Initiative’s Principles for Transition. Enterprise customers: We assessed the exposure of enterprise customers at risk based on the climate transition pathway of their sector. Individual consumers: We assessed the exposure of individual consumers at risk based on the current makeup of economic activities within each area, and the climate transition pathway of those employment sectors.
Key assumptions	A linear emission reduction pathway was assumed to achieve 2030 and 2050 targets, with a small amount of residual emissions in 2050 across all scopes of emissions despite our current strategy to achieve our 2030 SBTi targets and 2050 net-zero ambitions. A further breakdown of the residual emission assumptions is provided in Appendix 2. We obtained carbon prices from the Network for Greening the Financial System (NGFS), International Energy Agency (IEA) and Singapore legislation. To be conservative, the model assumed Category 13 (Downstream leased assets) and 15 (Investments) of Scope 3 emissions would be taxed, and there was no ability to pass the carbon pricing onto customers. Other Scope 3 categories are currently not assumed to be subject to carbon tax, as these are related to imported goods and services, and market acceptable standards around the issue of double counting are evolving.	The model assumed that any capital upgrades implemented in future as part of our business-as-usual technology migration would be aligned with energy efficiency targets or benchmarks.	Our selection of critical suppliers for the analysis was based on factors of Singtel Group’s total spend, the supplier’s emissions intensity and product category. We prioritised suppliers who have critical business model dependence on fossil fuels (example: transportation and power generation) and commodities expected to be in high demand in a net-zero economy (example: electronics).
Limitations	We kept future electricity prices at a constant due to significant uncertainty and a range of other non-climate-related influences in the market. Lack of reliable projections on carbon offset pricing for a range of offset projects resulted in a simplistic assumption of aligning offset pricing with carbon pricing levels.	Singapore: We have only conducted a high level Marginal Abatement Cost Curve (MACC) analysis for our data centres to estimate the potential cost impacts for each energy efficiency abatement opportunity. Australia: Energy intensity was tracked on the basis of the site, rather than the asset (limited smart meter coverage).	The analysis was based on inherent risk and relied on public disclosures, which are not always available. Individual consumers: Sector adjacencies and knock-on effects have not been considered in the analysis.

Physical risk modelling

The physical risk modelling is subject to certain assumptions and limitations described in the table below.

Methodology	The assessment modelled both direct (relating to damage and loss of real assets) and indirect (relating to insurance premiums) physical impacts on two elements of an asset cost: 1. Technical Insurance Premium (TIP) – a risk indicator expressed as an absolute dollar number, derived by multiplying three elements: a) an asset’s full replacement cost, b) the proportion of that full asset replacement cost assigned to each element that might get damaged and, c) the probability of that damaging event occurring in a given year. 2. Value at Risk percentage (VAR) – an asset’s TIP expressed as a percentage of its replacement cost. The climate contribution to the VAR was overlaid with our internal dependencies on the asset to understand our overall exposure to risk for that asset.
Key assumptions	Controlled Environmental Vaults (CEVs) in Singapore were modelled using a default prototype for control rooms. Due to the relatively low heat thresholds assumed for control rooms, the probability of heat failure was deemed to be significant in Singapore.
Limitations	The assessment focused on current assets and did not account for planned assets as a result of the 5G rollout.

Appendix 2: Residual emissions approach

The residual carbon liability for each emissions scope in 2050 for Singtel and Optus as a proportion of 2021 emissions and rationale is outlined below:

	Singtel		Optus	
	Residual emissions (% of FY2021 emissions)	Rationale	Residual emissions (% of FY2021 emissions)	Rationale
Scope 1 emissions	<=5%	Despite our net-zero target, a small proportion of residual Scope 1 emissions has been included in the modelling to be conservative.	<=5%	Despite our net-zero target, a small proportion of residual Scope 1 emissions has been included in the modelling to be conservative.
Scope 2 emissions	<=5%	Residual proportion of Scope 2 emissions in 2050 is derived from the 2022 Singapore Energy Market Authority (EMA) report stating the aim of the Singapore electricity grid to be powered by 95% renewable energy by 2050.	<=15%	Residual proportion of Scope 2 emissions in 2050 is derived from the Australian electricity generation mix from the NGFS.
Scope 3 emissions	<=40%	Residual proportion of Scope 3 emissions in 2050 is derived from Singapore’s National Climate Change Secretariat emission targets which state that total national emissions will be 33 MTCO ₂ e in 2050 after peaking in 2030 at 65 MTCO ₂ e.	<=15%	Residual proportion of Scope 3 emissions in 2050 is derived from Australia’s 2021 Long Term Emissions Reduction Plan which relies on purchasing offsets for 10-20% of total emissions in 2005(610 MTCO ₂ e) to achieve net-zero in 2050.



Singapore Telecommunications Limited
(CRN: 199201624D)

31 Exeter Road, Comcentre
Singapore 239732
T +65 6838 3388

www.singtel.com

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