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Enabling positive climate action

The impact of Telstra's digital technologies

Telstra Corporation Limited

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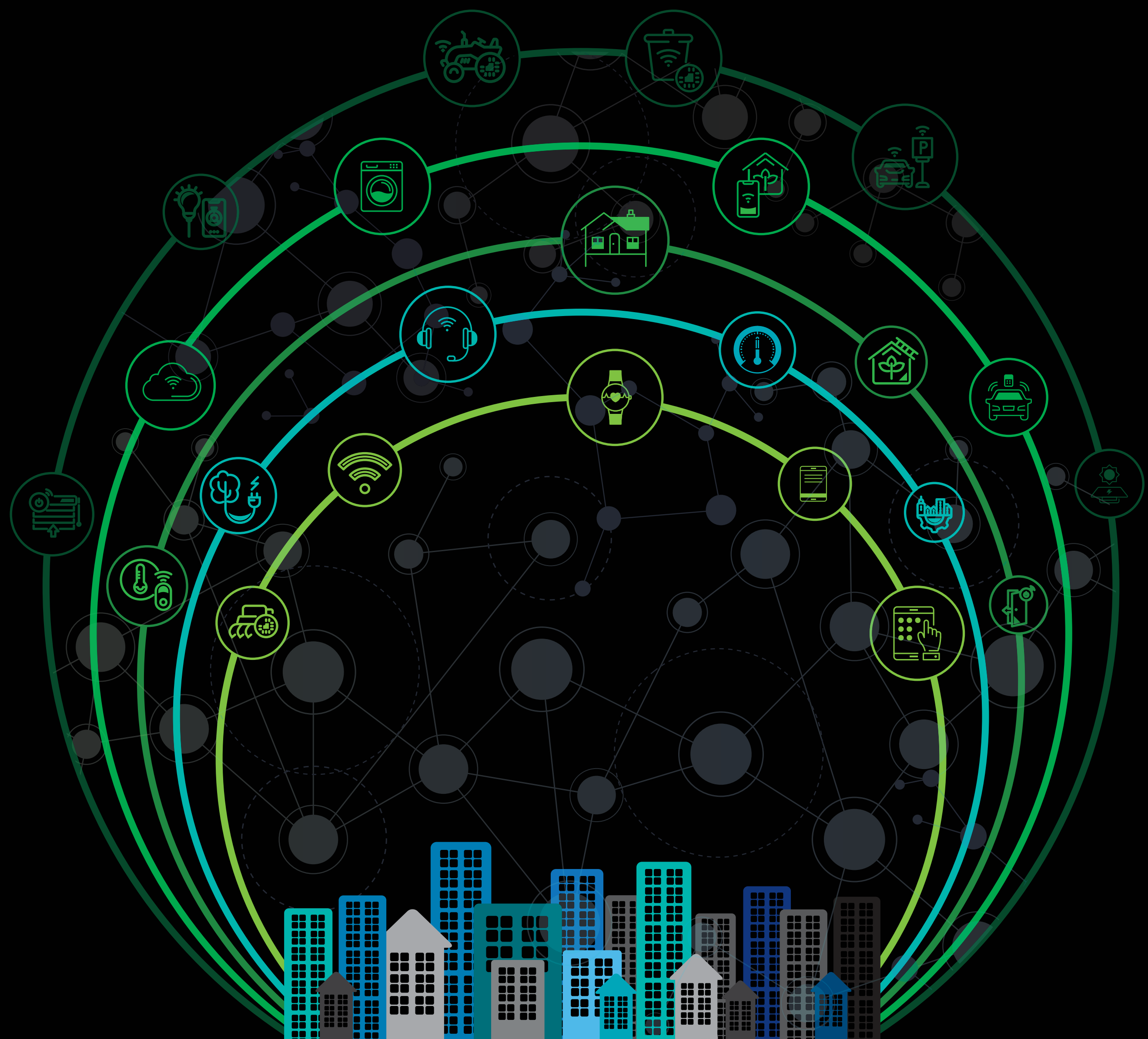
Deloitte Access Economics

Contents

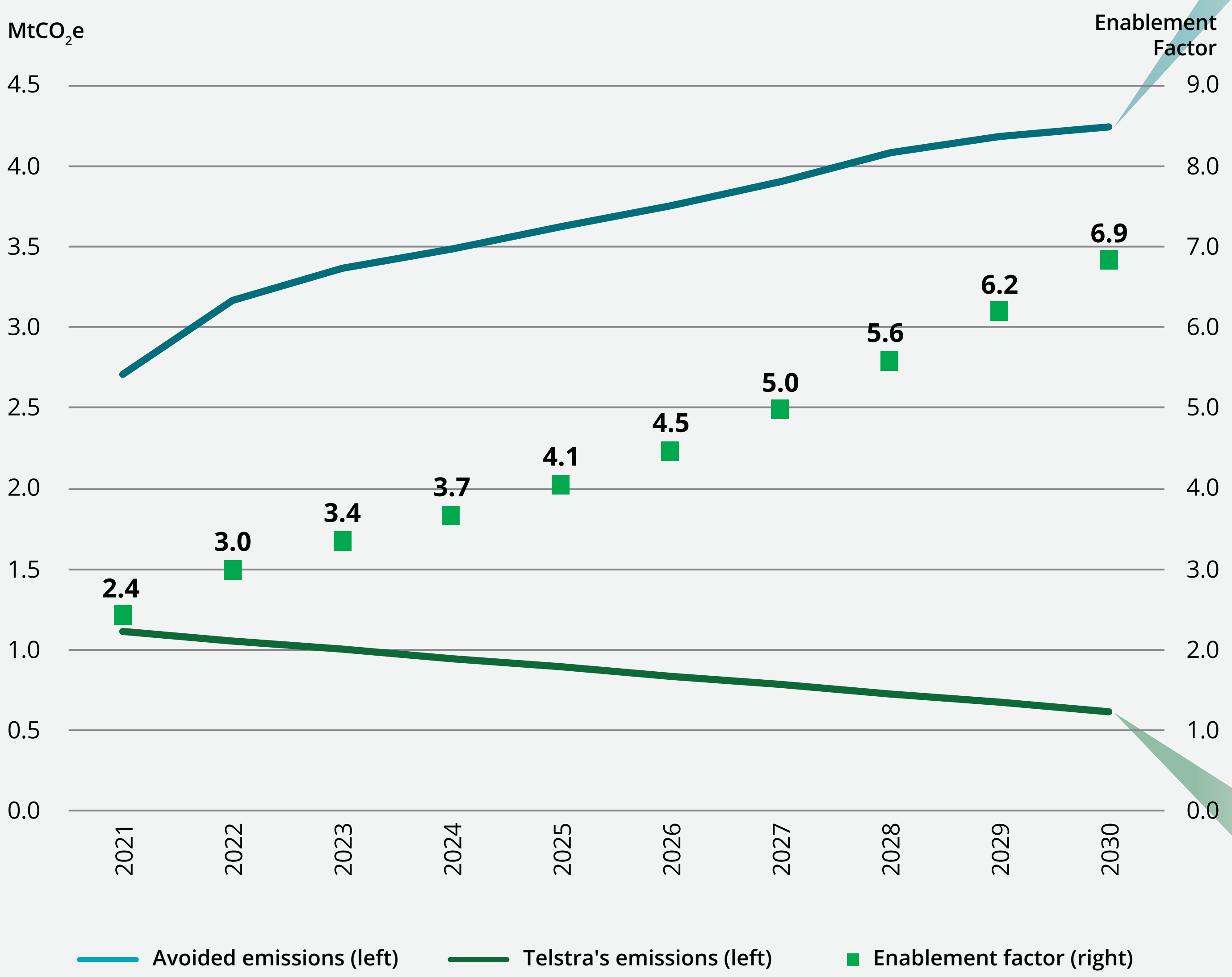


Enabling positive climate action

The impact of Telstra's digital technologies

In 2021, Telstra enabled its customers to avoid **2.4 tonnes of CO_2e for every one tonne** emitted in Australia. By 2030, Telstra's enablement factor will increase to 6.9. That is, **6.9 tonnes of CO2e will be avoided** for every one tonne emitted by Telstra in 2030.

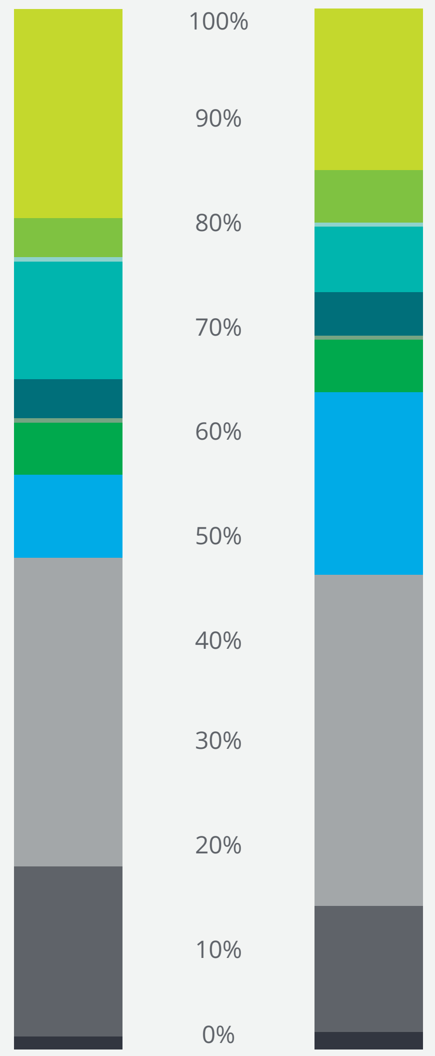
Enablement factor



Enablement framework

Avoided emissions: Telstra enables avoided emissions from 11 key uses of technology. These uses avoid emissions across six major sources of emissions in the economy.

Source of emissions	Use case
Buildings	HVAC control systems
	Residential buildings smart meters
Energy	Smart grids
	Renewable energy
	Cloud technology
Agriculture	Climate Smart Agriculture
Manufacturing	Inventory monitoring
Transport	Fleet management
Lifestyle	Remote working
	Internet banking
	Smart health

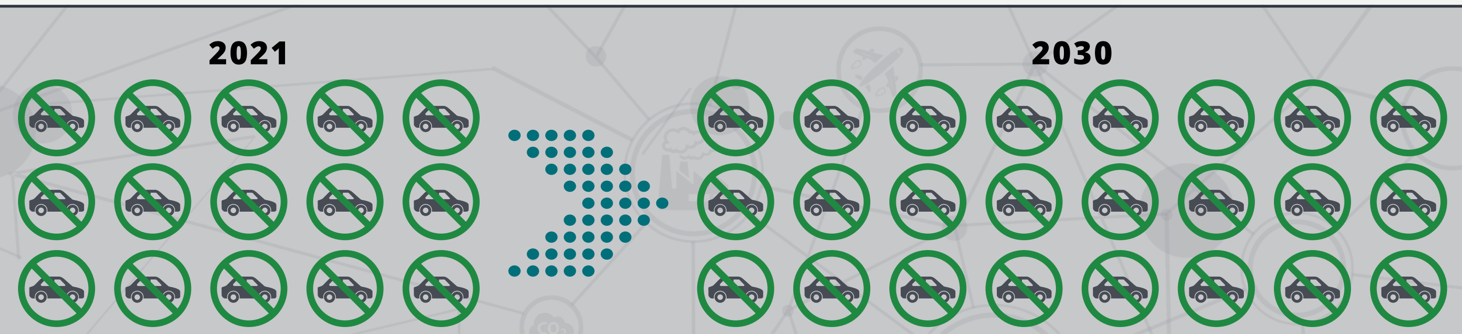


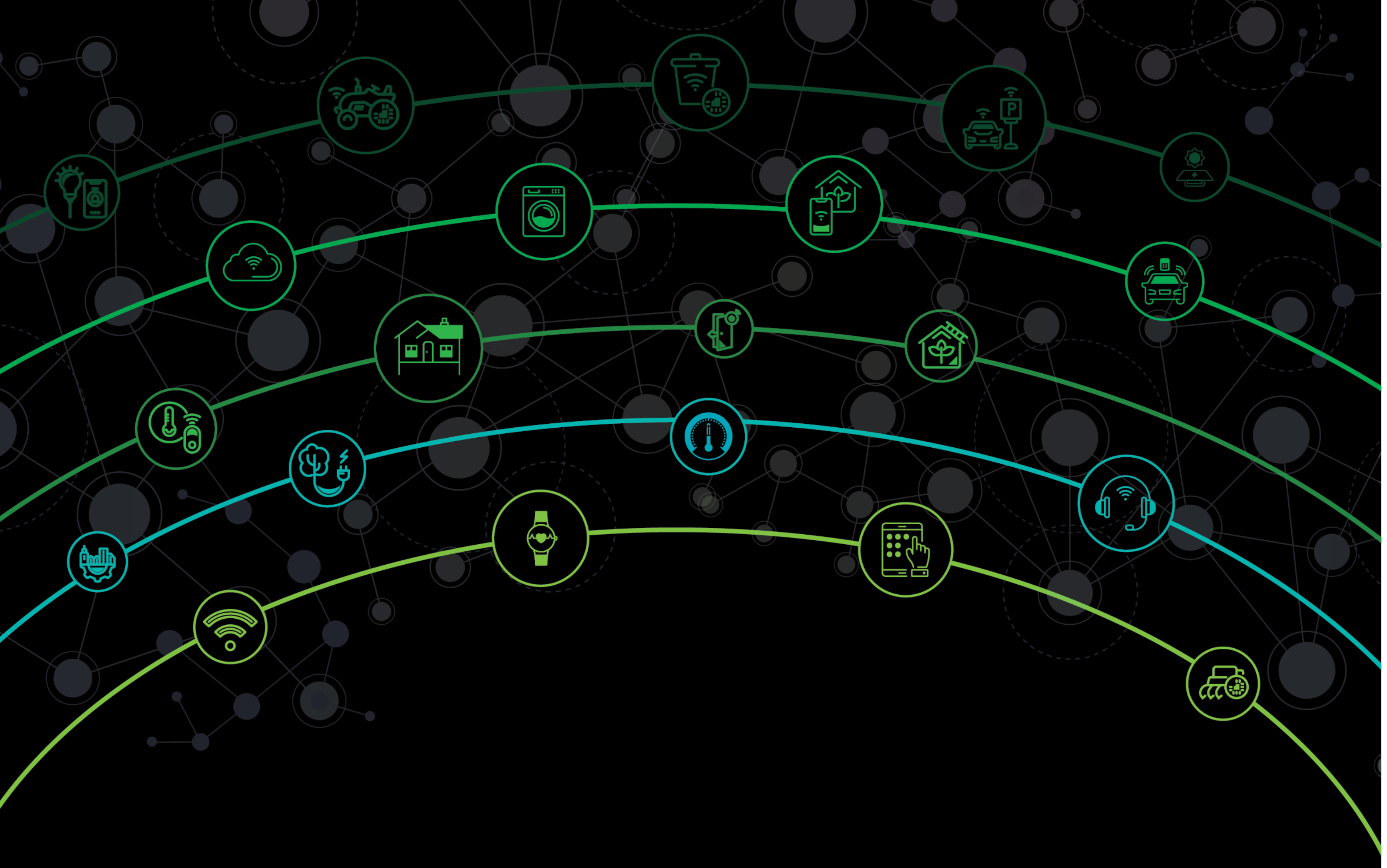
Telstra's emissions: Telstra's Australian scope 1 and 2 emissions decrease from **1.1 $MtCO_2e$** in 2021 to **0.6 $MtCO_2e$ by 2030** to meet its climate targets by 2030

Avoided emissions

In 2021, Telstra enabled its customers to avoid **2.7 $MtCO_2e$,** the equivalent of reducing the number of passenger vehicles on Australian road networks by **820,000** passenger vehicles.

By 2030, avoided carbon emissions enabled by Telstra could reach **4.3 $MtCO_2e$,** the equivalent of reducing the number of passenger vehicles on Australian road networks by **1.3 million** passenger vehicles.





Executive summary

Key findings

1. Over the next 10 years, the total cumulative avoided emissions that could be enabled by Telstra's services and products are estimated at 41 $MtCO_2e$. This could be even larger with greater uptake of Telstra's existing technologies or the implementation of new technologies.
2. By 2030, annual avoided carbon emissions enabled by Telstra could reach 4.2 $MtCO_2e$, the equivalent of reducing the number of passenger vehicles on Australian road networks by 1.3 million passenger vehicles.
3. Telstra's potential contribution to avoiding emissions is nationally significant, the equivalent of about 1% of the average annual reduction in emissions required to meet Australia's reduction target of 43% below 2005 levels by 2030. With the rapid adoption of emissions-avoiding digital technologies, Telstra, as Australia's largest telecommunications provider, has a major role to play in achieving Australia's environmental ambitions.
4. Telstra's own commitments to the climate change agenda include being carbon neutral from 2020, enabling renewable energy generation equivalent to its consumption by 2025 and reducing absolute emissions by at least 50% by 2030.
5. The net impact of Telstra and associated technologies can be analysed by looking at the 'enablement' factor' – that is, comparing avoided emissions with own emissions. This report estimates that by 2030, Telstra's enablement factor will be 7 – seven tonnes are saved for every one tonne emitted.
6. Already, in 2021, Telstra enabled its customers to avoid an estimated 2.7 $MtCO_2e$, the equivalent of reducing the number of passenger vehicles on Australian road networks by 820,000 passenger vehicles. Telstra's enablement factor in 2021 was 2.4.

Australia faces a major challenge to achieve its target of net zero emissions by 2050. While many businesses, especially large businesses, have committed to reduce their emissions to net zero by 2050 or earlier, only a quarter of large businesses are on a trajectory to meet these targets.[1] They will need greater efforts to reduce their energy consumption, shift to cleaner energy and increase their use of technologies to turn their ambitious carbon reduction targets into reality.

Digital technologies have a crucial role to play in helping businesses achieve a reduction in carbon emissions. Since early 2020, passenger vehicle emissions have been avoided thanks to telecommunications-enabled working from home. The adoption of smart heating, ventilation, and air conditioning (HVAC) systems has been used to reduce energy consumption by buildings. Internet of things (IoT) technologies are being applied in farms, mines, factories, and utility plants, to improve operations and reduce burdens on the natural environment.

But much more could be achieved, and in this context Telstra commissioned Deloitte to estimate how much could digital technologies supported by Telstra contribute to Australia's 2030 carbon goals.

The results are impressive: by 2030, Telstra could enable the avoidance of 4.2 $MtCO_2e$, the equivalent of reducing the number of passenger vehicles on Australian road networks by 1.3 million passenger vehicles.

Only a quarter of large businesses are on a trajectory to meet these targets. They will need greater efforts to reduce their energy consumption, shift to cleaner energy and increase their use of technologies to turn their ambitious carbon reduction targets into reality.

To put this in context, Telstra's potential contribution to avoiding emissions is nationally significant, the equivalent of about 1% of the average annual reduction in emissions required to meet Australia's reduction target of 43% below 2005 levels by 2030. With the rapid adoption of emissions-avoiding digital technologies, Telstra, as Australia's largest telecommunications provider, has a major role to play in achieving Australia's environmental ambitions.

What is needed to create this enablement of avoided emissions? Mainly, it is businesses increasing their adoption of new technologies, such as Smart HVAC, fleet management and inventory management systems, so that Australia's offices, supply chains and warehouses can become greener. So, while the arrival of new technologies provides the pathway to lower emissions, it also requires businesses to have the right incentives and ultimately depends on behavioural change. These co-dependencies are important to keep in mind when considering the headline findings in this analysis.

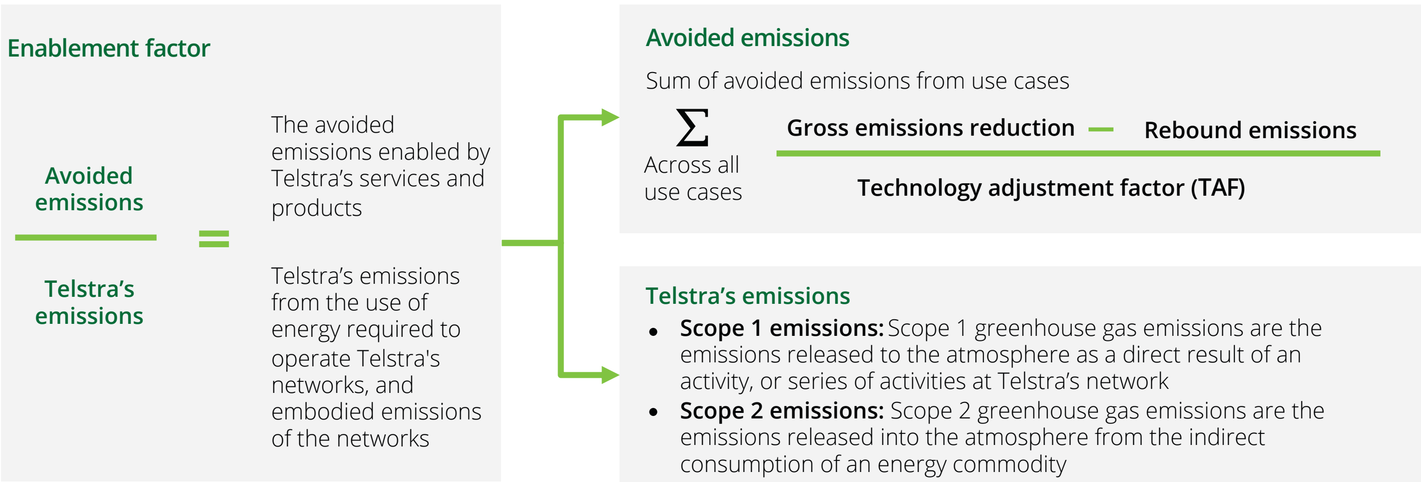
Over the decade to 2030, the total cumulative avoided emissions that could be enabled by Telstra's services and products are estimated at 41 $MtCO_2e$. This could be even larger with greater uptake of Telstra's existing technologies or the implementation of new technologies.

At the same time, it is important to recognise that while the telecommunications sector supports digital technologies, it is also a contributor to Australia's emissions. One report estimates that telecommunications and IT services consumed around 4% of Australia's energy in 2019-20, and that emissions from this equated to around 2.9 $MtCO_2e$. For Telstra, the figure was 1.1 $MtCO_2e$ (of scope 1 and 2 emissions).

The net impact of Telstra and associated technologies can be analysed by looking at the 'enablement factor' – that is, comparing avoided emissions with own emissions, which mostly come from energy consumption from data centres and retail outlets. An overview of the methodology used to estimate the enablement factor is provided in Figure A.

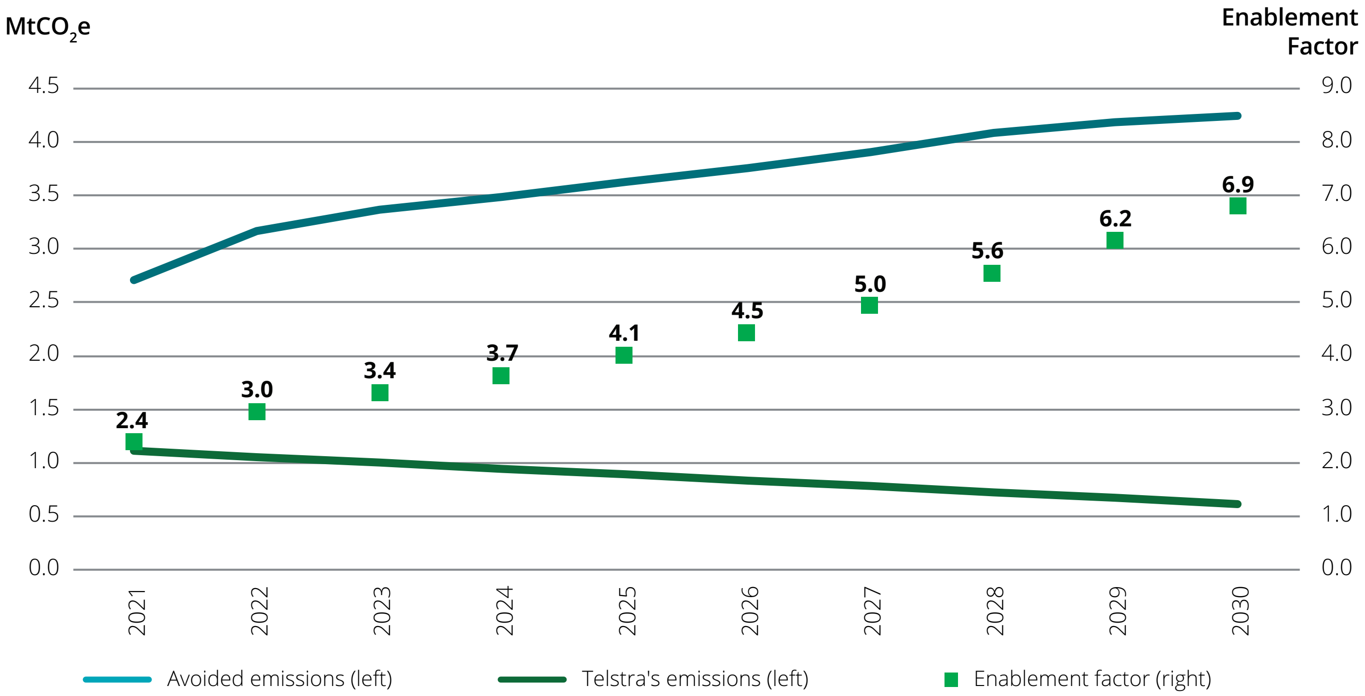
This report estimates that by 2030, Telstra's enablement factor will be 7 (see Chart A). Seven tonnes are saved for each one tonne emitted.

Figure A: Enablement factor calculation



Source: Deloitte.

Chart A: Telstra's emissions, 2021 to 2030



Note: Telstra's emissions are the sum of its Australian scope 1 and 2 emissions.

Source: Deloitte.

The analysis is based on six major sources of emissions – buildings, energy, agriculture, manufacturing, transport and cities and lifestyle, and 11 use cases. These include:

1. HVAC control systems
2. Smart meters in residential buildings
3. Smart grids
4. Renewable energy
5. Cloud technology
6. Climate smart agriculture
7. Inventory monitoring
8. Fleet management
9. Remote working
10. Internet banking
11. Smart health.

The estimated avoided emissions are adjusted for Telstra's market share and contribution to the use of technology, using over 50 different sources of data (including Telstra data, see Table A). The Telstra enablement model has been developed for this report and builds on previous work by the Global Enabling Sustainability Initiative (GeSI), the Global System for Mobile Communications Association (GSMA) and others.

The analysis is conservative insofar as it is based only on the increasing adoption of existing technologies – with new innovations, the impact could be even greater. It also accounts for the proportional share of Telstra's contribution to digital solutions and the fact that Australia's adoption of other green solutions, such as electric vehicles and a smarter electricity grid, partly offsets the role of digital technologies.

For example, the future increase in renewable energy supply to the electricity grid reduces the impact that efficiency-enhancing technologies – such as smart grids – have on reducing emissions. On the other hand, the forecasts depend on assumptions about uptake rates and a range of other parameters.

In 2021, Telstra enabled its customers to avoid an estimated 2.7 $MtCO_2e$, the equivalent of reducing the number of passenger vehicles on Australian road networks by 820,000 passenger vehicles. Almost half of the estimated avoided emissions (47.5%) are attributed to ICT solutions that enable people to reduce emissions in their lifestyle, of which a significant proportion relates to remote working (29.6% of total avoided emissions). This is largely driven by Telstra's significant market share in home internet and mobile data connectivity, which enables millions of Australians to work, bank and consult with medical advisors remotely. Fleet management solutions are also important (7.8% of total avoided emissions) today but set to grow strongly in the next decade given Telstra's position in the telematics market with the acquisition of MTData. Telstra's enablement factor in 2021 was 2.4.

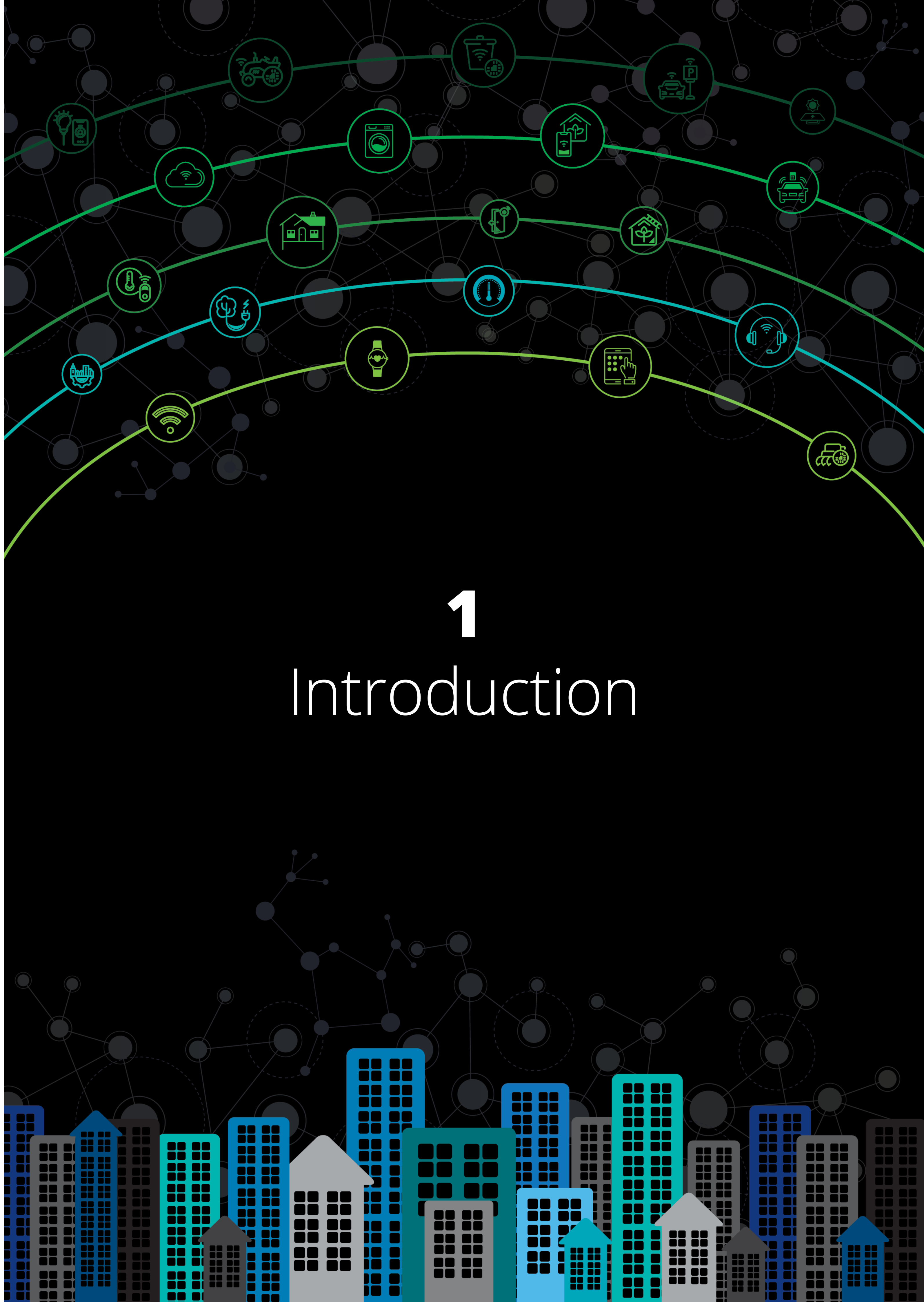
The improvement in Telstra's enablement factor over the decade to 2030 is also because of Telstra's own commitments: being carbon neutral from 2020, enabling renewable energy generation equivalent to its consumption by 2025 and reducing absolute emissions by at least 50% by 2030.

Table A: Enablement use cases

Source	Use case	Core technologies[a]
Buildings	HVAC control systems	Device to control temperature, air quality and humidity (e.g. Phone, tablet or designated device)
		Internet connectivity
		Smart HVAC device (e.g. IoT thermostat, air conditioner, door or window sensor, heat controller, air quality sensor)
	Smart meters in residential buildings	Internet connectivity
		Monitoring device (e.g. phone, tablet or computer)
		Smart meter device
Energy	Smart grids	Internet connectivity (e.g. utility grade fibre broadband)
		Smart distribution board and circuit breakers
		smart metering device
	Renewable energy	PPA adjustment[b]
	Cloud technology	Telstra cloud solution (e.g. CSX platform)
		Public partnership adjustment[c]
		Internet connectivity
Agriculture	Climate Smart Agriculture	Sensor technology (e.g. GPS and RFID sensors attached to animals, water bores/ troughs, or soil sensors)
		Internet connectivity (e.g. Cat M1 or Narrowband)
		Monitoring device (e.g. phone, tablet or computer)
Manufacturing	Inventory monitoring	IoT asset tracking devices (e.g. Cat-M1 Tracking Unit, Cat-M1 Recharageble Tracking Tag)
		Bluetooth or Internet connectivity (depending on tracking device type)
		Monitoring device (e.g. phone, tablet or computer)
Transport	Fleet management	IoT asset tracking devices (e.g. EagleTrack Plug & Play Vehicle Tracking Unit 4G)
		Bluetooth or internet connectivity (depending on device type)
		Monitoring device (e.g. phone, tablet or computer)
Lifestyle	Remote working	Internet connectivity (e.g. 4G or home internet)
		Work device (e.g. computer)
	Internet banking	Internet connectivity (e.g. 4G or home internet)
		Monitoring device (e.g. phone, tablet or computer)
	Smart health	Device on which to talk to doctor (telehealth), device for doctor to view and edit Electronic Medical Record (potentially store data on the cloud)
		Internet to connect with a doctor (telehealth), internet to view and update digital medical records on the cloud

Notes: (a) Core technologies shaded grey indicate the technologies that Telstra contributes to each use case; (b) PPA adjustment refers to the share of renewable energy generated by Telstra's share of the PPA; (c) Partnership adjustment applies to Telstra's public cloud solutions only.

Source: Deloitte.



1 Introduction

As part of its updated submission to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, the Australian Government committed to a target of net zero emissions by 2050.[2]

However, Australia faces a major challenge to match its national targets with actions by individual businesses. While many businesses, especially large businesses, have committed to reduce their emissions to net zero by 2050 or earlier, only a quarter of large businesses are on a trajectory to meet these targets.[3] They will need to make greater efforts to reduce their energy consumption, shift to cleaner energy and increase their use of technologies to turn their ambitious carbon reduction targets into reality.

Digital innovations are already being successfully used to achieve lower carbon emissions. For example, since early 2020, passenger vehicle emissions have been avoided thanks to telecommunications-enabled working from home. The adoption of smart heating, ventilation, and air conditioning (HVAC) systems has been used to reduce energy consumption by buildings. Internet of things (IoT) technologies are being applied in farms, mines, factories, and utility plants, to improve operations and reduce burdens on the natural environment.

Of course, the telecommunications sector supports digital technologies, but it also contributes to global emissions itself. For example, one report estimates that telecommunications and IT services consumed around 4% of Australia's energy in 2019-20, and that emissions from this equated to around 2.9 $MtCO_2e$.

The net impact of a telecommunications provider in terms of enabling avoided emissions can be analysed in terms of its 'enablement factor'. The enablement factor is calculated by dividing the total avoided emissions enabled by a provider's services and products by its own total emissions. Globally, several telecommunications providers have undertaken and commissioned work to estimate their organisation's enablement factor.

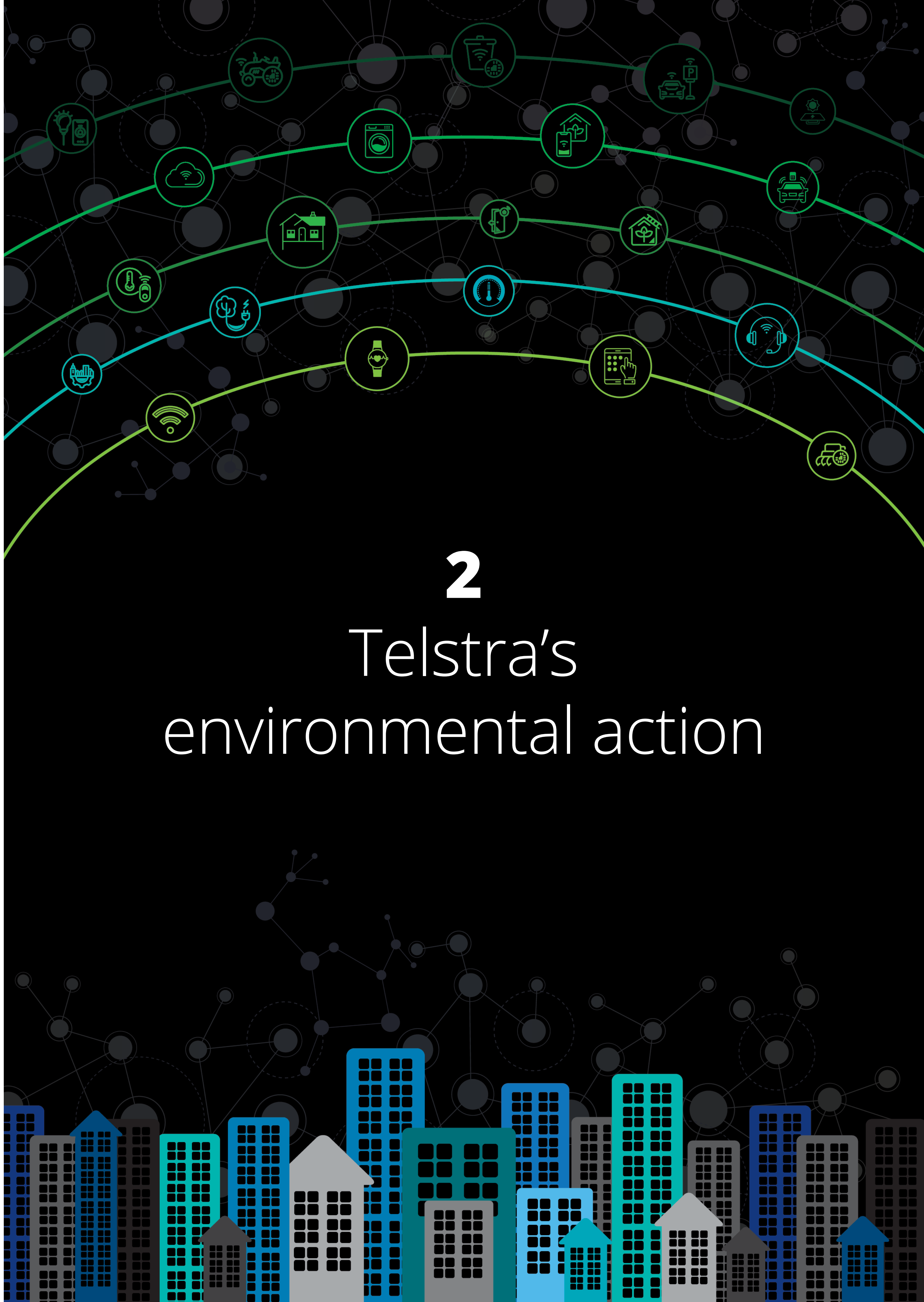
Telstra commissioned Deloitte to answer a key question: How much could digital technologies supported by Telstra contribute to Australia's 2030 carbon goals?

Chapter 2 presents an analysis of Telstra's contribution to Australia's carbon emissions and its targets to reduce this over time.

Chapter 3 outlines the enablement framework for this report, building on previous work by the Global Enabling Sustainability Initiative (GeSI), the Global System for Mobile Communications Association (GSMA) and others.

Chapter 4 estimates the avoided emissions facilitated by Telstra. The analysis is based on six major sources of emissions – buildings, energy, agriculture, manufacturing, transport and cities and lifestyle; and 11 use cases – HVAC control systems, smart meters in residential buildings, smart grids, renewable energy, cloud technology, climate smart agriculture, inventory monitoring, fleet management, remote working, internet banking and smart health. The estimated avoided emissions are adjusted for Telstra's market share and contribution to the use of technology, using over 50 different data sources including Telstra data.

Chapter 5 presents the overall enablement findings, including Telstra's total avoided emissions and enablement factor from 2021 to 2030.



2 Telstra's environmental action

2.1 Reducing Telstra's environmental impact

As Australia's largest telecommunications provider, Telstra has a significant opportunity to help its customers and society transition to a lower carbon future. Telstra plays a considerable role in the Australian telecommunications industry, with its mobile network covering over 99% of the Australian population; as at the end of FY21 it provided 19.5 million domestic mobile retail customer services, 3.6 million retail bundles and standalone fixed data services to customers across the country.[4] Telstra's goal is to ensure a sustainable and connected future for its customers through technological innovation and green initiatives.

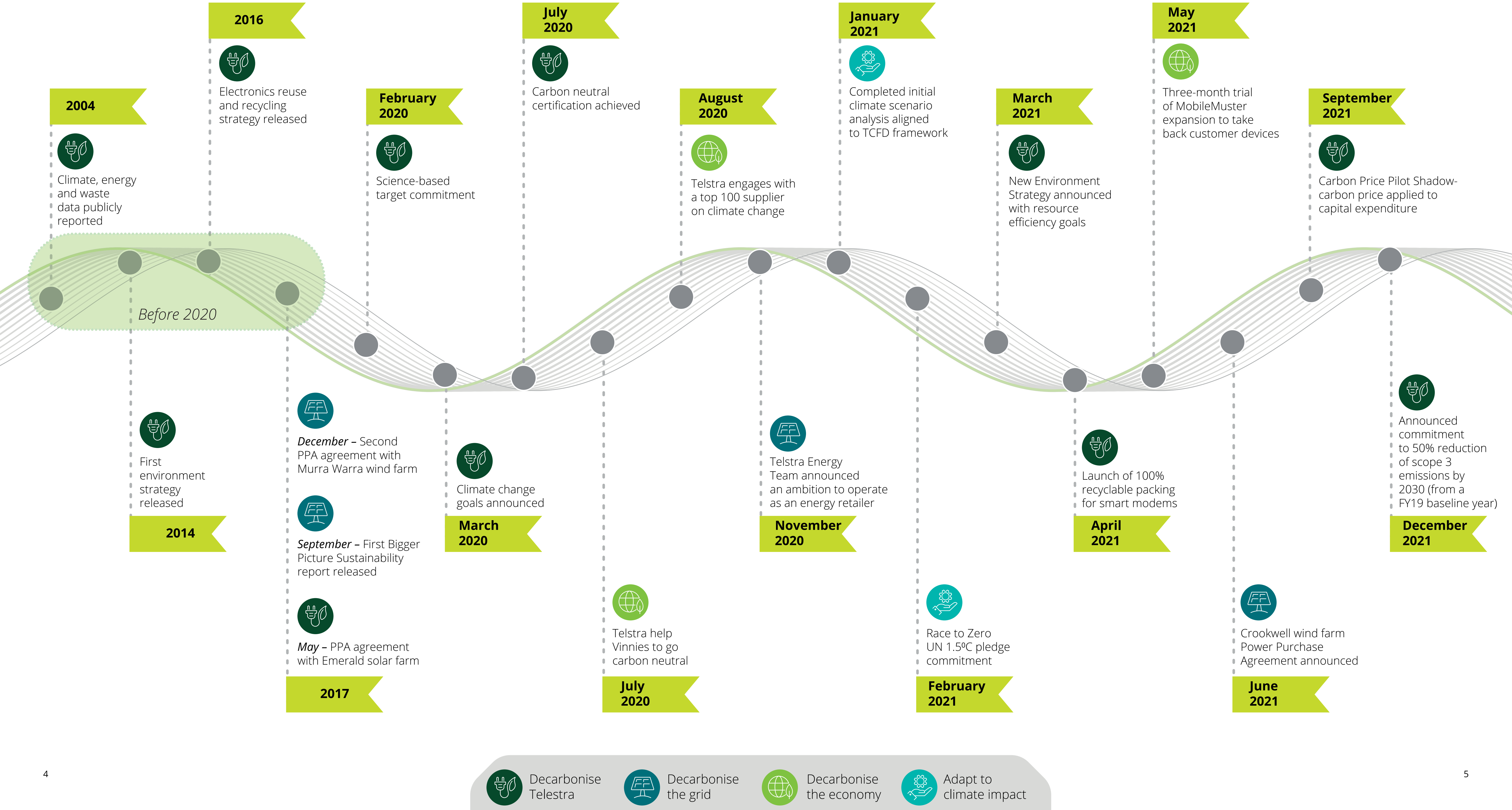
Telstra has been acting on its environmental program for more than 15 years, with the last few years seeing a major acceleration in its ambition. Telstra has set climate action commitments to take ownership of the impact it has on the environment.

This has been reflected through three key climate change goals introduced in 2020:

1. Achieve carbon neutrality in its operations from 2020
2. Enable renewable energy generation equivalent to its consumption by 2025
3. Reduce absolute emissions by at least 50% by 2030.[5]

Telstra frames its environmental strategy by focusing on four key activities. These include decarbonising Telstra, decarbonising the grid, decarbonising the economy and how the business adapts to climate impacts. Telstra's key achievements against these activities are summarised in Figure 2.1.

Figure 2.1: Telstra's key environmental achievements



2.2 Telstra's emissions

Telstra's scope 1 and scope 2 emissions in Australia were reported at 1.1 $MtCO_2e$ in 2021. The majority (97%) of Telstra's emissions are scope 2 emissions, which are emissions from the generation of purchased energy. This includes Telstra's use of electricity at network sites, data centres, and offices, retail and residential sites. The remainder of Telstra's emissions are scope 1 emissions, which are emissions from an owned or controlled source, such as fuel for Telstra-owned vehicles.

Telstra has set a target to halve its FY19 emissions by 2030. Australian scope 1 and 2 emissions were reported at 46,665 and 1,190,787 tCO_2e respectively in FY19. To forecast Telstra's enablement factor to 2030, it is assumed that Telstra will reach its target by 2030, with scope 1 and scope 2 emissions of around 619,000 tCO_2e.

This reflects a reduction in its emissions of around 49,000 tCO_2e per annum, assuming a linear trend.

Since setting its target, Telstra has demonstrated progress toward its 2030 goals. In 2021, Telstra achieved a 7% reduction in its scope 1 and scope 2 emissions from the previous year; this reflects a cumulative 11% reduction against its FY19 baseline. These reductions have been realised as a result of improvements in the energy efficiency of its network, acceleration in the decommissioning of legacy technology, and the reducing emissions intensity of the electricity grid as the use of renewable energy increases (see Box 1).

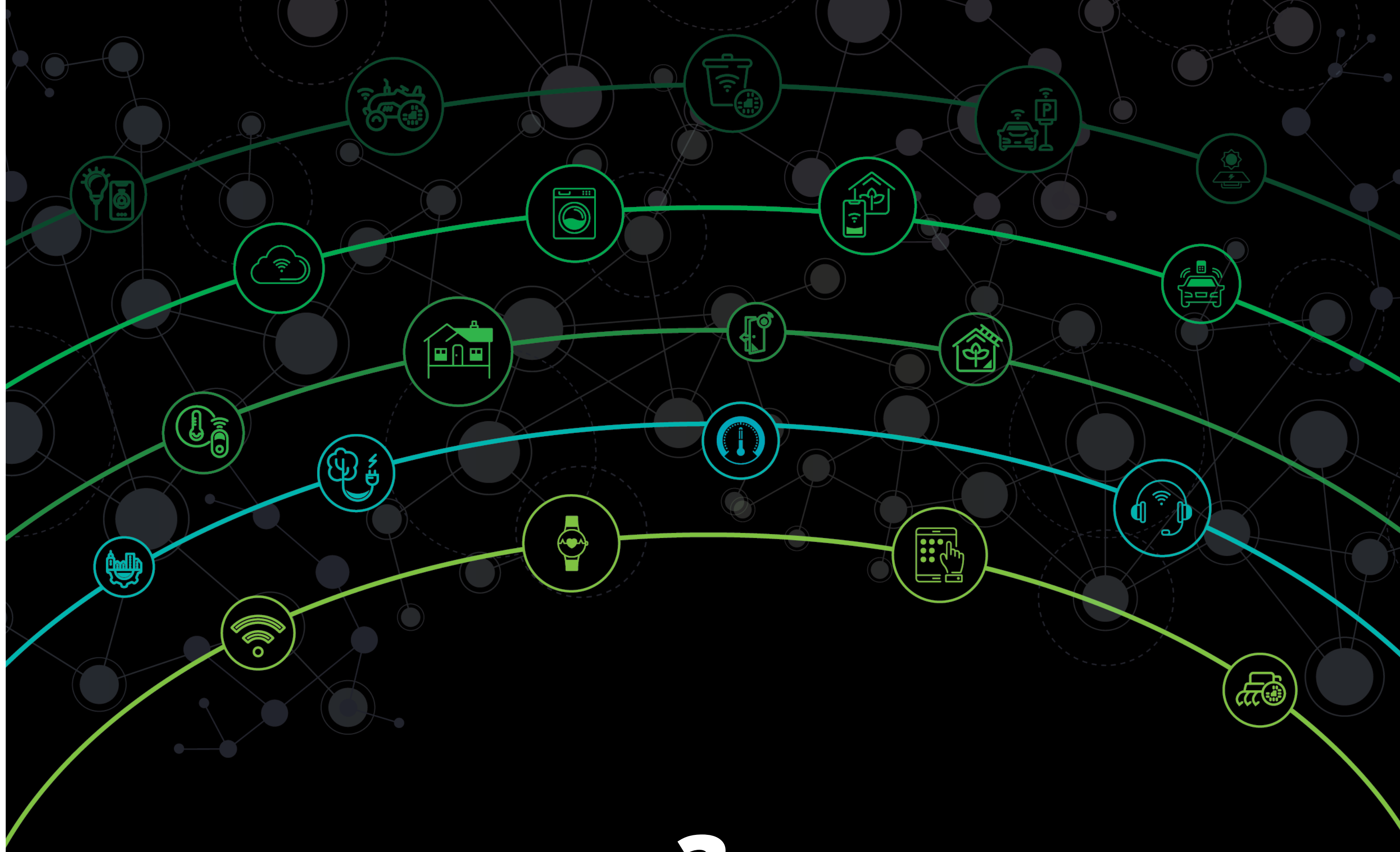
Box 1: Telstra's decarbonisation plan

The primary focus of Telstra's decarbonisation plan is centred on energy efficiency, reduction and optimisation. This includes the following decarbonisation principles:

- **Low emissions decision making:** Incorporate emissions reduction into business processes such as corporate governance, business planning and financial accounting
- **Design out emissions:** Reduce energy consumption through design, planning, operations and decommissioning of buildings, network equipment and customer devices
- **Promote growth with low emissions:** Transition to lower emissions energy including on-site renewable energy, hydrogen, battery storage and off-site renewable energy.

These principles are applied across four key focus areas to reduce Telstra's scope 1, 2 and 3 emissions.

Scope 1 and 2		Scope 3	
Buildings and infrastructure	**Network equipment**	**Supply chain**	**Customer products / services**
• Improve energy efficiency of network building infrastructure • Optimise office buildings • Upgrade backup power generator and storage	• Design future network technology to be low emissions • Optimise network equipment energy consumption in use • Decommission energy intensive technologies	• Contractual emissions reduction targets in supplier agreements • Suppliers transition to using renewable energy	• Design modems to improve energy efficiency • Design future products to be low emissions • Design products to enable emissions reduction



3 Enablement framework

3.1 Summary of framework

Six major sources of emissions were identified to reflect the broad sectors in which digital technologies are applied to reduce carbon emissions. These six sources were based on a similar selection of industries used to forecast Australia's emissions by the Department of Industry, Science, Energy and Resources (DISER),[6] and were refined according to a global telecommunication enablement study by GSMA.[7] This ensured that the sources of emissions are representative of the sectors in which ICT technologies have contributed to reducing emissions.

Based on the sources of emissions, a longlist of 20 use cases was developed to represent the ways in which digital technologies contribute to avoided emissions. From this list, a shortlist of 11 use cases was selected, which represent a range of products and services aligned to Telstra's core business. The criteria considered for selecting these use cases included:

- The use case significantly contributed to national avoided emissions enablement
- The use case reflected an opportunity to enable future avoided emissions in a key source of Australia's emissions
- The use case represented an identifiable share of Telstra's core business, determined by revenue and market share.

For each use case, a selection of required core technologies was identified. This informed the extent that the emissions avoided by each use case could be attributed to Telstra by reflecting the minimum core technologies required to operate a solution. The core technologies were selected based on attribution principles outlined in the Avoided Emissions Framework developed by Mission Innovation.[8]

The enablement framework according to emissions source, use of technology and core technologies that contribute to each use case is outlined in Table 3.1. The highlighted technologies identify technologies provided by Telstra that enable avoided emissions for each use case. Importantly, internet connectivity – central to Telstra's core business – underpins all 11 use cases.

Internet shopping was excluded from the shortlisted use cases due to the variation in available evidence relating to its impact on emissions. Internet shopping can reduce emissions as the use of online and app-based shopping reduces the need to travel to shops, which reduces carbon emissions.[9] However, several recent studies suggest that online shopping results in a greater number of product exchanges and returns, resulting in increased emissions.[10] One study found that the emissions from returns can equate to as much 30% of the emissions associated with delivery.[11] In contrast, other studies suggest that the emissions from return packages are negligible.[12,13]

Table 3.1: Enablement framework

Source	Use case	Core technologies[a]
Buildings	HVAC control systems	Device to control temperature, air quality and humidity (e.g. Phone, tablet or designated device)
		Internet connectivity
		Smart HVAC device (e.g. IoT thermostat, air conditioner, door or window sensor, heat controller, air quality sensor)
	Smart meters in residential buildings	Internet connectivity
		Monitoring device (e.g. phone, tablet or computer)
		Smart meter device
Energy	Smart grids	Internet connectivity (e.g. utility grade fibre broadband)
		Smart distribution board and circuit breakers
		smart metering device
	Renewable energy	PPA adjustment[b]
	Cloud technology	Telstra cloud solution (e.g. CSX platform)
		Public partnership adjustment[c]
		Internet connectivity
Agriculture	Climate Smart Agriculture	Sensor technology (e.g. GPS and RFID sensors attached to animals, water bores/troughs, or soil sensors)
		Internet connectivity (e.g. Cat M1 or Narrowband)
		Monitoring device (e.g. phone, tablet or computer)
Manufacturing	Inventory monitoring	IoT asset tracking devices (e.g. Cat-M1 Tracking Unit, Cat-M1 Recharageble Tracking Tag)
		Bluetooth or Internet connectivity (depending on tracking device type)
		Monitoring device (e.g. phone, tablet or computer)
Transport	Fleet management	IoT asset tracking devices (e.g. EagleTrack Plug & Play Vehicle Tracking Unit 4G)
		Bluetooth or internet connectivity (depending on device type)
		Monitoring device (e.g. phone, tablet or computer)
Lifestyle	Remote working	Internet connectivity (e.g. 4G or home internet)
		Work device (e.g. computer)
	Internet banking	Internet connectivity (e.g. 4G or home internet)
		Monitoring device (e.g. phone, tablet or computer)
	Smart health	Device on which to talk to doctor (telehealth), device for doctor to view and edit Electronic Medical Record (potentially store data on the cloud)
		Internet to connect with a doctor (telehealth), internet to view and update digital medical records on the cloud

Notes: Notes: (a) Core technologies shaded grey indicate the technologies that Telstra contributes to each use case; (b) PPA adjustment refers to the share of renewable energy generated by Telstra's share of the PPA; (c) Partnership adjustment applies to Telstra's public cloud solutions only

Source: Deloitte.

3.2 Calculating Telstra's enablement factor

The enablement framework recognises that while Telstra's potential contribution to avoiding emissions is significant – as measured by the relative contribution of its technologies across the 11 use cases – it also contributes to Australia's emissions (see section 2.2). Telstra's net impact in terms of enabling avoided emissions is estimated by calculating its 'enablement factor' (see Figure 3.2).

The enablement factor is calculated by dividing the total avoided emissions enabled by Telstra's services and products by its own total emissions. The main components of the enablement factor calculation are estimated as follows:

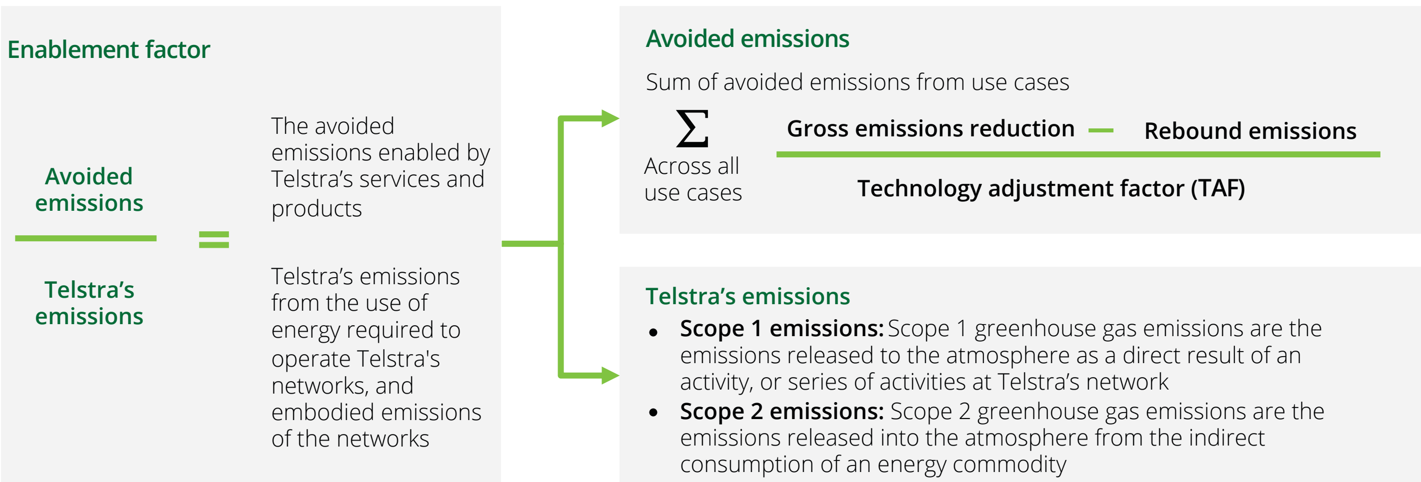
- **Avoided emissions:** Telstra's total avoided emissions are estimated as the sum of gross emissions reductions across the 11 use cases.
- **Rebound emissions:** An adjustment for rebound emissions was included to reflect the potential for the increased use of a technology to result in increased emissions, which partially offset the avoided emissions enabled by the use case. However, limited evidence of rebound emissions related to the 11 identified use cases was available for this study.
- **Technology adjustment factor:** The net emissions reduction was divided by a technology adjustment factor, reflecting the minimum number of core technologies required to operate a solution. This adjustment captured the extent to which the emissions avoided by each use case could be attributed to Telstra. However, in practice, it is inherently difficult to accurately attribute a share of avoided emissions to Telstra; for example, connectivity may be more or less important than other technologies, and most use cases also require effort by people or staff to implement and use the technologies to realise avoided emissions.
- **Telstra's emissions:** Telstra's emissions are estimated as the sum of its scope 1 and scope 2 emissions. This includes Telstra's Australian emissions activity only, which are mainly comprised of electricity consumption from network sites, data centres, and offices, retail and residential sites. Scope 3 emissions are excluded from the analysis as they largely reflect emissions outside of Telstra's control and are subject to double counting. Other global enablement analyses, including those undertaken by the Carbon Trust, use a similar approach.[14]

3.3 Limitations of enablement analysis

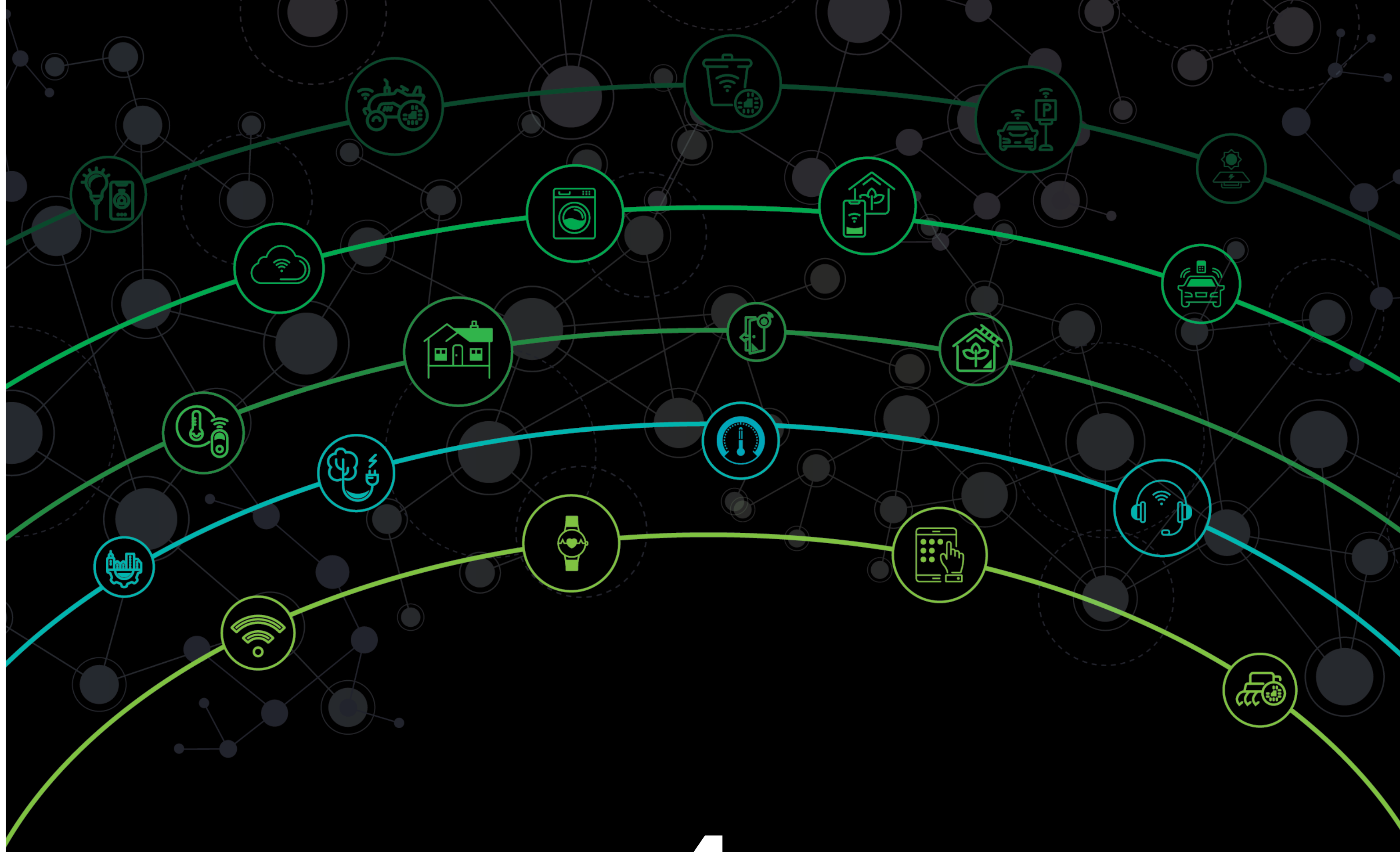
A final point to recognise is the limitations of enablement analysis. It focuses on avoided emissions compared with own emissions. The forecasts presented in chapter 5 recognise general growth in population and energy use. However, enablement analysis is not a full stocktake of the telecommunications sector's impact on the environment. Nor does it measure how the sector enables emissions-intensive industries. Nor does it measure how the sector facilitates economic growth, which can also contribute to greater carbon emissions.

In addition, enablement analysis largely assumes that avoided emissions are entirely driven by the increased adoption of digital technologies. In practice, while the increased adoption of digital technologies is fundamental, there are other relevant factors. For example, businesses must have the right incentives to increase their adoption of new technologies, and must ultimately change their behaviour to realise the avoided emissions. Therefore, enablement analysis may overstate the role of digital technologies in enabling avoided emissions.

Figure 3.2: Enablement factor calculation



Source: Deloitte.



4 Estimating avoided emissions

4.1 Summary of use cases

To estimate the total avoided emissions enabled by Telstra's services and products, 11 use cases were identified (see section 3.1). The use cases are as follows:

1. Smart HVAC control systems
2. Smart meters in residential buildings
3. Smart grids
4. Renewable energy generation
5. Cloud technology
6. Climate Smart Agriculture
7. Inventory monitoring
8. Fleet management
9. Remote working
10. Internet banking
11. Smart healthcare.

For each use case, the estimation of avoided emissions adjusts for the number of technologies required to operate a solution and hence to realise avoided emissions. This adjustment recognises that in most cases, only a portion of the emissions avoided by each use case can be attributed to Telstra, to the extent that other technologies are required to operate a solution. Additional details on the enablement framework are provided in section 3.1.

Telstra's total avoided emissions are estimated for 2021 and forecast over the decade to 2030. Two overall assumptions are applied in forecasting avoided emissions:

- The expected reduction in emissions from non-Telstra enabled sources, such as electric vehicle uptake and the reduction in the emission intensity of the National Electricity Market (NEM), will reduce the impact of technology in terms of future avoided emissions
- The forecasts account for the expected uptake in Telstra's existing products and services. In most cases, this assumes that Telstra's market shares remain constant, although some technologies (such as IoT) experience rapid rates of uptake based on historical and forecast market trends.

In interpreting the forecasts, it should be noted that Telstra's avoided emissions could be larger with greater uptake of Telstra's existing technologies or the implementation of new technologies that do not yet exist, and hence have not been measured in this study.

4.2 Use case 1: Smart HVAC control systems

4.2.1 Summary of use case

Heating, Ventilation and Air Conditioning (HVAC) is responsible for the majority of building emissions due to the significant amount of power required to regulate temperature. It is estimated that HVAC accounts for up to 50% of the total energy consumption in commercial buildings, resulting in emissions of 24.7 MtCO_2e per year on average in Australia.[15]

Building temperature is controlled using a system which adjusts the heating and cooling in an environment to meet a desired state; for example, between 20 and 24 degrees Celsius in a typical indoor commercial setting.[16] The system adjusts the difference between the desired temperature in a setting and the actual temperature as measured by a sensor, for example, by starting a fan.

Smart HVAC systems refer to technologies that automate temperature regulation and increase energy efficiency. For example, smart HVAC enables the automated switching on of air conditioning when a sensor detects that the room is occupied. The automation of HVAC technologies allows systems to immediately respond to changes in a room (such as occupancy and temperature), which reduces energy wastage from delays in monitoring and responding to environmental conditions, thus reducing commercial building emissions.

The key technologies required to operate smart HVAC control systems include sensors to measure a range of conditions – including temperature, air-quality, humidity, occupancy and movement – a control centre to input the optimal HVAC measurements, and connectivity to enable communication between the sensors and the control centre. Although Telstra does not provide HVAC control systems, it provides internet connectivity to thousands of commercial buildings Australia-wide that rely on smart HVAC systems to regulate temperature and increase energy efficiency.

4.2.2 Estimated avoided emissions

In 2021, Telstra provided connectivity to an estimated 33.5% of smart HVAC-enabled buildings in Australia. As a result, it is estimated that Telstra enabled avoided emissions of 552,000 tCO_2e in 2021. Telstra's provision of connectivity to Smart HVAC-enabled buildings is estimated to increase to 43.1% with the expected uptake of Smart HVAC technologies by 2030. This reflects the avoidance of 674,000 tCO_2e in 2030 from Telstra's provision of internet connectivity to smart HVAC enabled buildings. Over the decade to 2030, this reflects total cumulative avoided emissions of 6.7 M tCO_2e .

4.3 Use case 2: Residential building smart meters

4.3.1 Summary of use case

Smart meters for residential buildings digitally record energy usage on-premises and relay this information to energy retailers. This information enables energy retailers to help residents optimise their energy plan to reduce energy wastage, which also reduces the associated emissions. For example, retailers may offer products and services to residents – including energy management applications – that help them to better understand their energy usage. Residents may then adjust their energy consumption behaviour to lower their energy costs, which reduces emissions.

In 2021, 39% of National Electricity Market (NEM) customers adopted residential smart metering capabilities.[17] Like smart HVAC systems, residential smart meters operate on a system of sensors and readers. Smart meters track electricity usage and transmit the data to energy retailers and customer viewing platforms using an IoT network. Customer viewing platforms – including smartphones, tablets and laptops – enable residents to view their energy usage in a user-friendly format, which requires household internet or mobile connectivity to access the portal.

Telstra provides several products and services to support the use of smart meters, including:

- Household and mobile internet connectivity to residential smart meter customers
- IoT connectivity to transfer data from the smart meter device to energy retailers and customer viewing platforms (see Case Study: Intellihub)
- Telstra is currently exploring the market opportunity to provide its energy retail customers with smart meter devices, starting in FY23.

In addition to providing core technologies for smart meter programs, Telstra is also trialling a behaviour change program to encourage the use of household electricity during renewable energy peak periods (see Case Study: Shape Shifters). This is expected to reduce energy consumption during peak periods where the network relies on non-renewable sources of electricity, resulting in reduced household emissions.

4.3.2 Estimated avoided emissions

It is estimated that in 2021, 16% of Australian residences had a smart meter that was supported by internet connectivity provided by Telstra.[18] As a result, it is estimated that Telstra enabled avoided emissions of 92,000 tCO_2e by providing connectivity to these residences in 2021.

Globally, it is estimated that the adoption of smart meters will increase by a growth rate of 6.6% per annum.[19] If smart meter adoption in Australia was to expand at the same rate, it is estimated that by 2030, 29% of Australian residential buildings will have a smart meter supported by household internet connectivity provided by Telstra. This reflects the annual avoidance of 175,000 tCO_2e by 2030 from Telstra's provision of internet connectivity to Australian households with smart meters.

Telstra expects to make smart meters a key component of its energy retail products from FY23, providing smart meter devices to Telstra customers. This offering is expected to enable the avoidance of 35,000 tCO_2e by 2030. Therefore, the annual avoided emissions from Telstra-enabled residential building smart metres is estimated at 209,000 tCO_2e in 2030. Over the decade to 2030, both offerings – Telstra's provision of internet connectivity to Australian households with smart meters and Telstra-provided smart meter devices – are cumulatively estimated to avoid 6.7 MtCO_2e.

Case Study: Intellihub

Intellihub is an innovator in smart meter technology, servicing over 30 electricity retailers across Australia and New Zealand. Since commencing operations in 2018, the organisation manages over one million meters across Australian and New Zealand households and installs approximately 1,000 new smart meters each day. Intellihub provides a range of metering solutions to residential customers, including its Edge Compute smart metering Application Program Interface (API). This solution delivers data to retailers and customers more rapidly compared to basic metering solutions and is able to process 50 metering parameters in less than 10 seconds.

Intellihub's smart meters also provide a connectivity gateway that enables 'behind the meter' energy resources such as hot water systems, solar inverters, batteries and EV chargers to be integrated with virtual power plants (VPP). This facilitates the orchestration of these resources at scale, enabling load to be shifted away from peak times, and rewarding customers for exporting energy into the grid during peak times. This allows the most efficient use of renewables across the home and the grid.

In February 2022, Telstra announced a partnership with Intellihub to provide up to 4 million IoT SIMs over the next decade that will connect Intellihub smart meters to Telstra's IoT network. This will enable Intellihub to enhance its smart meter offering and expand its operations. Intellihub is also a key supplier of smart meters for Telstra Energy.

Each smart meter will contain a Telstra IoT SIM, enabling customers to gather real-time insights and manage energy demand, solar feed-ins and peaks and troughs in energy demand. The rollout of 4.1 million IoT SIMs over the next decade will lead to better managed electricity across a large energy network.

Case Study: Shape Shifters

Telstra recently piloted a program called Shape Shifters to supplement its new Telstra energy meter offering. In November 2021, Telstra undertook a 4-week trial of the program, which involved encouraging 100 Telstra customers to use energy at peak renewable energy supply periods.

The program includes an education module to teach Telstra customers to improve their energy efficiency and demonstrate the implications for reducing household costs, and hence household emissions. The education module is supplemented by text message reminders using Telstra's mobile network to encourage consumers to use appliances during the day. For example, customers are reminded to complete chores using technologies such as dishwashers, washing machines and vacuum cleaners during low energy demand periods (between 10 am and 4 pm), rather than at peak demand periods (between 4 pm and 10 am).

During the pilot, over 60% of participating households shifted their electricity usage toward daytime periods. These households shifted 1084 kWh over a four-week period to peak renewable energy supply periods, or around 1.3 kWh per household per day.

4.4 Use case 3: Smart grids

4.4.1 Summary of use case

Electricity in Australia is generated, bought and sold to match supply and demand in real time. Australia's electricity is supplied by three key electricity markets – the National Electricity Market (NEM), the South West Interconnected System (SWIS) and North West Interconnected System (NWIS). These major grid networks, in addition to other smaller networks, comprise 45,000 km of transmission grids and 850,000 km of distribution grids.[20] The significant geographic coverage of Australia's grid networks presents the potential for large energy losses, which are estimated at around 10% of electricity transported between power stations and market operators.[21] Additionally, the increase in renewable energy supplied to the grid presents integration challenges for market operators, given their limited control over the supply of renewable energy.

Smart grids comprise a range of technologies to automate real-time, two-way data collection between the grid and network providers to mitigate electricity losses. They also include technologies to improve the integration of distributed energy resources (DER), such as solar photovoltaic (PV) systems, with the broader electricity network. They do this by improving networks' ability to accept 'passive' DER, which enables market operators to respond to available resources, such as rooftop solar PV generation responding to sunlight, while maintaining the reliability of the electricity supply.[22]

The key technologies required for smart grids are underpinned by connectivity to relay information to electricity network providers. These technologies include:

- Advanced Metering Infrastructure (AMI) consisting of sensors, communication networks and data management systems to collect information from the grid network
- Real-time monitoring and sensing infrastructure, which relies on internet connectivity to relay information to network providers and the customer
- Fault detection, voltage monitoring and protection technologies, which are also underpinned by connectivity to relay information to controllers.

Telstra provides mobile connectivity, fixed line connectivity and high performance NBN solutions to a significant share of the utilities sector in Australia, enabling network suppliers to relay information to network providers. It therefore plays a considerable role in Australia's transition to a smarter grid network.[23]

4.4.2 Estimated avoided emissions

In 2021, Telstra enabled avoided emissions of 16,000 tCO_2e by providing connectivity to network operators. It is estimated that 40% of the NEM grid network accepts passive DER, which is used to estimate the share of the grid that is 'smart'.[24] Energy Networks Australia's smart grid roadmap aims to achieve a target of 90% passive DER by the early 2030s.[25] Assuming this target is achieved, Telstra's annual avoided emissions increase to 24,000 tCO_2e by 2030. Over the decade to 2030, this reflects total cumulative avoided emissions of 220,000 tCO_2e as a result of Telstra supporting Australia's smart grid transition.

4.5 Use case 4: Renewable energy generation

4.5.1 Summary of use case

The emergence of renewable power purchase agreements (PPAs) has been significant in recent years, enabling the diversification of large-scale renewable energy markets. Business Renewables Centre – Australia estimates that there are 110 corporate PPAs negotiated, contracting over 4GW of renewable energy generation in 2021, up from virtually zero in 2017.[26]

Under a corporate PPA, electricity buyers agree to purchase power and/or large-scale generation certificates (LGCs) from a renewable energy project at a fixed price. While PPAs are not a new concept, key drivers for the significant growth in recent years include:

- Sustainability targets – off-site renewable energy PPAs are a way to achieve ambitious renewable generation targets
- Improving budget certainty in volatile markets – fixed prices are attractive in volatile electricity markets
- Potential cost savings – negotiating a fixed price can reduce the impact of high electricity prices, particularly for organisations with large purchasing power
- Improving the brand or social licence by supporting renewable energy generation.[27]

Telstra has recently entered into three PPAs, including the Murra Warra Wind Farm, Emerald Solar Farm and Crookwell 3 Wind Farm (see Case Study: Murra Warra Wind Farm). Telstra intends to increase the number of PPA agreements to meet its target to enable renewable energy generation equivalent to 100% of its energy consumption by 2025.

4.5.2 Estimated avoided emissions

It is estimated that in 2021, Telstra enabled avoided emissions of 306,000 tCO_2e, which relates only to renewable energy generated by Telstra's shares of PPAs. Energy generated from renewable energy sources is able to substitute unclean sources, and hence avoid CO_2 emissions associated with more traditional forms of energy generation.

Since the Murra Warra Wind Farm and Emerald Solar Farm are now fully operational, renewable energy generation from these projects is capped over the decade to 2030. However, the planned and committed PPA for Crookwell Windfarm is included in the forecasts from FY23.[28] In 2030, annual avoided emissions from renewable energy generation across the three projects are estimated at 263,000 tCO_2e. The estimated avoided emissions in 2030 are lower than in 2021 as a result of the assumption that the emissions intensity of the grid reduces over time, lowering the total emissions avoided from renewable energy generation. Over the decade to 2030, Telstra's committed PPAs are estimated to cumulatively avoid 3.3 $MtCO_2e$. This estimate accounts for production ramp-up periods and on-site generation.

The avoided emissions enabled by Telstra are expected to increase as it enters into additional PPA agreements to meet its sustainability target.

Case Study: Murra Warra Wind Farm

Located 25 kilometres north of Horsham in North West Victoria, the Murra Warra Wind Farm is home to some of the largest wind turbines in Australia. The wind farm consists of 99 wind turbines situated on 4,250 hectares of farmland used for sheep grazing and broadacre cropping. Stage 1 of the project alone will generate around 226 MW.

The Murra Warra windfarm project was funded following a PPA led by Telstra. As part of the agreement, a group of energy users – including Telstra, ANZ, Coca-Cola Amatil, Monash University, the University of Melbourne and Partners Group – entered into agreements that provided Murra Warra Wind Farm with contracting certainty over the output from stage 1, while also allowing group members to secure long-term supply of renewable energy.

Murra Warra supplies renewable energy to the Victorian electricity network. Renewable energy from Murra Warra will assist Victoria to transition its energy infrastructure to a lower emissions base, reducing the emissions produced by the network. This transition will assist the Victorian Government achieve its renewable energy targets of 40% of total energy generation by 2025, as legislated in the *Renewable Energy (Jobs and Investment) Act 2017*. Stage 1 of the project provides energy equivalent to the average needs of 220,000 Victorian households.

Telstra plans to increase the number of PPAs it has written to enable renewable energy generation equivalent to 100% of its consumption by 2025. In addition to Murra Warra, Telstra also has a PPA with Emerald Solar Park, a fully operational 250,000 panel solar farm with a maximum capacity of 72MW, and Crookwell 3 Wind Farm, a 58MW wind farm currently under construction.

4.6 Use case 5: Cloud technology

4.6.1 Summary of use case

Cloud technologies can help businesses achieve sustainability goals, both directly through reduced energy use and indirectly by enabling technologies that have a sustainability dividend, such as big data, AI and machine learning. For example, cloud-enabled technologies have been able to reduce inventory wastage through real-time inventory tracking and have helped consumers make informed choices about goods purchased by increasing supply chain transparency.

Cloud-enabled machine learning tools have also transformed infrastructure inspections, which were traditionally performed physically on-site. With cloud, machine learning drone-based surveillance systems minimise this need, reducing the emissions associated with travel to sites, which are often in remote locations. Given the wide potential applications of data analytics and cloud technology, other use cases considered in this report may also be supported by a combination of these technologies (see sections 4.7 and 4.8).

Telstra's digital consultancy arm, Telstra Purple, specialises in cloud migration and application modernisation for Australian enterprises. There are two types of cloud services offered by Telstra Purple:

- Public cloud – The cloud resources (servers and storage) are owned and operated by a third-party cloud service, typically Microsoft Azure, Amazon Web Services or Google Cloud Platform, and are delivered using Telstra's internet connectivity
- Private cloud – This includes cloud computing resources operated exclusively by Telstra. Telstra offers a range of customer solutions in which cloud resources can be located at the customer's on-site data centre or maintained by Telstra's data centre.

Public cloud services deliver greater energy reductions than other cloud computing models as they allow multiple organisations to share servers in the same data centre. For example, a small organisation (between 1 and 19 employees) transferring data storage from an on-premises facility to a public cloud system is estimated to reduce associated emissions by around 78% per annum, compared to a private cloud solution which reduces associated emissions by 49% per annum.[29] In addition to custom cloud solutions, Telstra also provides internet connectivity required to operate cloud services to 97% of its cloud customers.

4.6.2 Estimated avoided emissions

It is estimated that in 2021, Telstra enabled avoided emissions of 106,000 tCO_2e by providing public and private cloud solutions and supporting internet connectivity. According to ABS data, the use of paid cloud computing by Australian businesses increased from 19% of businesses in FY14 to 55% of businesses in FY20.[32] If this rate of uptake were to continue until 2030, Telstra's annual avoided emissions enabled by its provision of cloud technologies is estimated to increase to 178,000 tCO_2e. Over the decade to 2030, this reflects total cumulative avoided emissions of 1.8 $MtCO_2e$.

Case Study: Visy

Visy is a longstanding provider of packaging solutions and has serviced customers globally for over 70 years. In 2015, Visy commissioned Telstra to modernise its information storage infrastructure, which was largely based on-premises.

Telstra performed an initial migration of on-premises data storage to cloud storage by installing 115 AWS public cloud servers and 260 Telstra CSX/VMC cloud servers. A small collection of existing on-premises servers remained in physical locations, which was required for specific manufacturing operations.

In 2020, Visy again engaged Telstra, this time to optimise its cloud infrastructure. This digital transformation required Telstra to implement a multi-public cloud strategy, integrating multiple cloud computing and storage services in a single network architecture. As part of the solution, Telstra deployed Visy's existing applications to upgraded servers, retired legacy applications and migrated existing cloud servers to Azure. In addition, analysis was performed to determine which public cloud server, Azure or AWS, would enable the highest performance of each cloud application. The final multi-public cloud architecture resulted in significant platform consolidation.

Both cloud transformations improved the performance of Visy's applications and reduced its energy usage from data storage infrastructure. Recent studies suggest that transitioning from on-premises data storage to Azure and AWS cloud solutions is associated with an approximate 80% reduction in datacentre-related emissions.[30, 31]

4.7 Use case 6: Climate Smart Agriculture

4.7.1 Summary of use case

Climate Smart Agriculture (CSA) refers to technological solutions that efficiently manage agricultural assets including land, livestock, forests, and fisheries. The agriculture sector accounted for 14.9% of Australia's emissions in 2021 and is the fourth highest emitting sector in Australia.[33] CSA reduces the sector's environmental impacts by increasing the productivity of existing practices and enhancing the sector's climate resilience to short and long-term climate shocks.

Connectivity provided by telecommunications providers enables technologies such as IoT sensors and robotics to increase production efficiency and reduce wastage. These technologies have been applied to crop genetics, soil and crop monitoring, climate monitoring, and cattle tracking, among other areas. Some examples of climate smart technologies include:

- **Field-deployable instruments** that allow for direct monitoring of root systems, which can help identify optimal soil conditions and water and chemical uptake of crops
- **IoT sensors** that help monitor weather conditions, which can be paired with smart sprinkler controllers to optimise the level of irrigation
- **Drones** for real-time cattle tracking, which can help farmers intervene early when cattle have declining health, nutrition, and activity.

Many of the technologies used to increase efficiency and reduce emissions in the agriculture sector require connectivity to gather and communicate data to farmers. Telstra is a provider of connectivity to agricultural customers who use smart technology, leveraging the Telstra 4G network to power monitors and sensors (see Case Study: Farmbot Monitoring Solutions).

4.7.2 Estimated avoided emissions

In 2021, Telstra enabled avoided emissions of 9,000 tCO_2e by providing IoT sensors and satellite connectivity to Australian farms. The number of IoT sensors purchased globally is estimated to increase by 19% per anum on average.[34] If the rate of adoption in Australia was to increase at the same rate, it is estimated that by 2030, Telstra's annual avoided emissions from CSA increase to 33,000 tCO_2e. Over the decade to 2030, this reflects total cumulative avoided emissions of 255,000 tCO_2e.

Case Study: Farmbot Monitoring Solutions

Farmbot is an Australian Agritech company that helps farmers manage their water assets. Farmbot's monitoring solutions are applied to a range of water storage systems, enabling remote monitoring of water tanks, troughs, pipelines and rainfall. Along with increased water efficiency, remote monitoring solutions reduce the need to travel to check water systems, making farmers more efficient and allowing them to use the time saved on other important jobs.

With 65% of Farmbot customers using at least one 4G monitor that runs on the Telstra network, Telstra has played an important role in Farmbot's technological development over time. Telstra has provided 4G, LTE-M and NB-IoT solutions that enable Farmbot to deliver its monitoring solutions in near real time. Farmbot uses Telstra's IoT networks connected through sims to power its Cellular Farmbot Monitor, which is the remote monitoring device that enables monitoring of water levels, pressure, flow, and rainfall.

The Agritech solutions designed by Farmbot have a range of environmental benefits. For example, by sending smaller packets of information at any given time, the NB-IoT radio extends the battery life of a monitor, resulting in the radio using less power and increasing the duration of the solar-powered monitor during times of less sunlight.

Customer profile

Isis Downs, a beef cattle station in Southeast Queensland, illustrates the benefits of Farmbot's remote monitoring solutions. The cattle station uses 26 Water Level Monitors, two Line Pressure sensors and seven Rain Gauges to ensure its extensive water infrastructure is running efficiently and with minimal wastage. In the absence of monitors to alert bore runners about a problem, it would take up to three days to check and identify the location of any problem. The remote monitoring solutions have reduced the need for physical inspections, which previously cost around $120,000 annually and required a full-time staff member. With remote monitoring, staff can now focus on other aspects of the station and avoid travelling long distances for physical monitoring, which equate to about 1,200 km on average for the bore runner. Monitors to measure water level changes can also help farmers plan and make decisions about the movement of livestock based on water allocation available when there are changes in seasonal conditions.

Achieving cost-effective solutions

Farmbot is currently testing its devices on Telstra's NB-IoT network, which covers almost 4 million square kilometres compared to the 2.6 million kilometres of traditional mobile coverage provided by Telstra. The new NB-IoT enabled Farmbot devices are expected to be released before June 2022.

In addition, Farmbot is working with Telstra on a project that will provide the end user with the ability to remotely respond in real-time. The solution is remote machine control, which will give farmers the ability to turn machinery off and on from anywhere at any time, avoiding emissions from energy consumption for devices not in use. These solutions are estimated to result in efficiency gains for farmers, water and energy savings, and reductions in travel to physical monitor on-farm assets.

Telstra is an investor and strategic shareholder of Farmbot. Along with its services that enable Farmbot to deliver its remote monitoring solutions, Telstra is well placed to support Farmbot as it continues to provide products for Australian farms to become more productive, efficient and environmentally friendly.

4.8 Use case 7: Inventory monitoring

4.8.1 Summary of use case

Billions of consumer goods move through supply chains every day, shipped from international ports onto Australian shores in containers. The majority of these containers contain wooden shipping pallets, whereby one standard 20-metre container contains approximately 10 pallets.[35]

Connected pallets use IoT technology to relay information to asset owners, allowing them to maintain oversight of their inventory. Connected pallets reduce the risk of pallets being lost or broken during trips, which allow users to decrease the raw materials required to produce replacement pallets and increase operational efficiencies, resulting in lower emissions. In addition, connected pallets fitted with IoT technologies are often lighter than wooden pallets, which reduces fuel consumption required to transport them.[36] Although Telstra does not provide the connected pallet infrastructure, it provides connectivity to a number of large shipping organisations who use these pallets in Australia.

In addition, Telstra has been working with organisations to better understand their supply chain concerns and assist them to use data, IoT and network technologies to improve their supply chain efficiency and resilience. Telstra's connected supply chain offering, Telstra Visibility Imports, targets the visibility of containers across shipping networks.

Telstra Visibility Imports software platform is built on Telstra's Azure cloud platform. Customers are able to locate, track and identify freight in transit and take corrective action to optimise their business operations, resulting in more efficient transport within supply chains and lower emissions.

4.8.2 Estimated avoided emissions

It is estimated that in 2021, Telstra enabled avoided emissiosn of 136,000 tCO_2e by providing connected supply chain solutions and internet connectivity to shipping customers who use shipment tracking technologies that rely on IoT sensors. The number of IoT sensors purchased globally is estimated to increase by 19% per anum on average.[37] If the rate of adoption in Australia was to increase at the same rate, it is estimated that by 2030, Telstra's annual avoided emissions increase to 204,000 tCO_2e. Over the decade to 2030, this reflects total cumulative avoided emissions of 1.8 $MtCO_2e$.

4.9 Use case 8: Fleet management

4.9.1 Summary of use case

Telematics solutions use a combination of IoT sensors and mobile communication technology to track and monitor commercial vehicle fleets. Telematics solutions can be used to improve driver behaviour and reduce vehicle idling, thereby reducing fuel wastage. It is estimated that idling for more than 10 minutes per day can use as much fuel as it takes to travel eight kilometres, or around 102 litres of fuel per year.[38] Telematics also allows organisations to have oversight of the location of their vehicle fleet to optimise routing efficiencies, reducing vehicle kilometres travelled. Various sources suggest telematics could deliver fuel savings for vehicle fleets globally of between 5% and 20%, resulting in lower emissions.[39]

Telstra acquired MTData in 2017, which provides IoT-connected fleet management solutions as part of its EagleTrack offering (see Case Study: SRT Logistics), which operates on the Telstra 4G network. In addition, Telstra sells and provides 4G connectivity to global vehicle technology providers FleetComplete, Navman and Mobileye to enable their telematics offerings. The solutions provide real-time vehicle location information, driver performance monitoring and reporting.

4.9.2 Estimated avoided emissions

It is estimated that in 2021, Telstra enabled avoided emissions of 212,000 tCO_2e by providing IoT telematics solutions, connected by Telstra's 4G network. The number of IoT sensors purchased globally is estimated to increase by 19% per anum on average.[40] If the rate of adoption was to increase at the same rate for commercial vehicles in Australia, it is estimated that by 2030, Telstra's annual avoided emissions increase to 762,000 tCO_2e. Over the decade to 2030, this reflects total cumulative avoided emissions of 5.6 $MtCO_2e$.

Case Study: SRT Logistics

SRT Logistics is a transport and distribution company for dry groceries and refrigerated foods in Tasmania and Victoria. In 2017, SRT engaged MTData (a Telstra-owned business) to deploy an integrated telematics solution to enhance its occupational health and safety compliance and target operational efficiencies across its logistics fleet. The solution comprised the Talon GPS Tracking, the Driver Tablet system and an integrated Truck Camera system, with four cameras per truck to monitor driver behaviour.

In addition to the tracking software, Telstra also provides mobile data and SIM plans tailored to SRT's operations and voice requirements across the fleet. This includes GPS tracking, reporting updates and voice calls made via the In Cab Tablet when trucks are parked. The connectivity-enabled solution allows SRT to monitor driving incidents that may lead to increased fuel use and maintenance costs, such as excessive idling or erratic driving.

According to SRT, the solutions have resulted in improved efficiencies in its operations. The organisation has identified a number of opportunities to further realise efficiencies using the Telstra MTData system. Two key initiatives that will enable drivers to reduce fuel usage, and hence reduce emissions, include:

- **Real-Time Connect Project –** This project transforms paper-based workflows for SRT delivery processes to real-time electronic processes. As part of this system, drivers also gain access to live traffic maps, enabling them to avoid congested areas and reduce fuel usage
- **Valet Gate Project –** this project investigates the use of telemetry to open gates earlier for vehicles entering the premises, reducing the fuel consumption associated with stopping and starting vehicles.

4.10 Use case 9: Remote working

4.10.1 Summary of use case

The transition to remote working, accelerated recently by the COVID-19 pandemic, led to widescale changes in the way businesses operate. Technological innovations and enhanced digital capabilities enabled this shift, with colleagues being able to interact meaningfully and work collaboratively despite not being physically collocated (see Case Study: BHP).

Underpinning the transition was internet connectivity. Telstra has facilitated this shift in two primary ways. It provides internet connectivity to millions of Australian homes, where residents can use the network to connect to their workplaces remotely. In addition, Telstra has upgraded network bandwidths for several large Australian businesses to accommodate the increased uptake in remote working. These upgrades improve the speed with which workers can use the internet and access company resources, while also accommodating a greater use of online communication applications. This enhances the efficiency of business processes and improves worker productivity as employees move online.

The increased uptake in remote working also has positive environmental impacts. Remote working results in avoided work trips, which reduces emissions from passenger vehicle usage. There are also consequences to consider, such as emissions from the increase in household heating and cooling as a result of remote working.

Many studies have considered the overall energy impacts of remote working, generally finding that the impact is positive, mostly because of the reduction in emissions from work trips. Other impacts are difficult to disentangle and quantify. A meta-study of 39 papers found that while most studies consider the net energy impacts of remote working, few studies provide estimates of changes in variables such as home energy consumption, and for those that do it is difficult to extract estimates from across different study contexts.[41]

Overall, remote working offers businesses the opportunity to reduce office sizes and energy consumption. However, remote working also likely leads to an increase in energy consumption at home. These impacts are complex and can change over time according to business and household behavioural patterns. As a result, changes in household and office energy consumption are excluded from this analysis.

4.10.2 Estimated avoided emissions

The ability to work remotely was critical to business operations during the COVID-19 pandemic. According to ABS data, approximately 36% of the Australian workforce usually worked from home in 2021.[42] Telstra provided home internet connectivity to millions of these workers, enabling customers to avoid an estimated 806,000 tCO_2e from avoided vehicle trips to work.

As Australia emerges from the COVID-19 pandemic, there is some uncertainty about the extent to which remote working trends will remain. However, research suggests that remote working, or hybrid working, is here to stay.

A study by the Productivity Commission found that employees would prefer to work 2.7 days per week from home, while employers would prefer their workers to work from home 2.3 days per week on average.[43] The study acknowledged that over time, an economy-wide process of testing, negotiation, reallocation and learning will likely serve to partially reconcile the differences in preferences. Assuming that over time employee and employer preferences will align, it is estimated that by 2030, Telstra's annual avoided emissions increase to 1.4 $MtCO_2e$ as a result of connectvity-enable remote working for its customers. Over the decade to 2030, this reflects total cumulative avoided emissions of 13.8 $MtCO_2e$.

Case Study: BHP

BHP has undergone a dramatic shift towards hybrid working in recent years, accelerated by the COVID-19 pandemic. This has required organisational flexibility, job and workspace redesign, updating health and safety guidelines, and managing outputs rather than just supervising staff. However, the biggest change has been cultural, with a managerial shift from tolerance to acceptance.

Historically, BHP has had relatively traditional work arrangements, requiring travel to sites, work relocations, and inflexible working hours. However, following the implementation of a new strategy to make the business more inclusive for women in 2017, almost half of the workforce were working flexibly within a couple of years. Being a global business also gave BHP a head start, as employees already had experience connecting with each other via virtual meetings across multiple time zones. BHP has extended flexibility to site roles, which is approximately 80% of its workforce. Certain jobs such as geologists, process improvers and engineering roles can perform parts of their role remotely. Even staff that work on-site regularly are able to benefit from changes to rosters, career breaks or job share arrangements.

A campaign to shift perceptions was also targeted at business leaders as some were initially apprehensive about hybrid work arrangements. COVID-19 has also helped change attitudes by requiring leaders to adapt to new ways of working, if they weren't already. Benefits from flexible working include empowering BHP employees, as well as higher productivity and better safety outcomes. There have been no obvious business downsides. However, BHP still also sees benefits in coming together. Being connected to the workspace and other colleagues can offer a sense of belonging, support idea generation and drive collaborative innovation. Connecting in-person about 30- 50% of the time is considered optimal in most cases for office-based workers. The next step in BHP's workplace journey is not a return to fixed rules about the location or timing of work, but instead empowering people to make decisions about where and when they work to get great outcomes for them, their teams and the teams they support.

4.11 Use case 10: Internet banking

4.11.1 Summary of use case

The rise of internet banking over the last two decades has significantly reduced the need for retail banking customers to visit a branch in-person. Most Australians prefer paperless payment methods for everyday transactions, reducing the need to withdraw cash from an automated teller machine (ATM). The number of times Australians withdrew cash per year decreased from 40 times per year to 20 times per year in the 10 years to 2018.[44] Moreover, annual online transactions per capita increased five-fold since 2000,[45] resulting from the growth of online payment methods such as BPAY and online transfers, reducing the need to write (and bank) physical cheques.

A recent survey found that while the majority (63%) of respondents engaged in banking activity at least one to two times per week, only 24% of customers visit a physical branch once per week or more.

In Australia, around 83 banking transactions per person per year are undertaken online.[46] The ability to bank online reduces the need to travel to a physical bank branch, avoiding emissions for customers who would otherwise travel to the nearest bank branch by car (see Case Study: Commonwealth Bank of Australia).

4.11.2 Estimated avoided emissions

It is estimated that in 2021, Telstra enabled avoided emissions of 448,000 tCO_2e by providing mobile handheld and home internet services to its customers, thereby enabling them to bank online and reduce the number of trips to the bank. The number of retail customers using internet banking is expected to continue to increase as a result of population growth. Assuming Telstra's mobile handheld and home internet market shares remain constant, it is estimated that by 2030, Telstra's annual avoided emissions increase to 508,000 tCO_2e by 2030. Over the decade to 2030, this reflects total cumulative avoided emissions of 5.2 $MtCO_2e$.

Case Study: Commonwealth Bank of Australia

Commonwealth Bank of Australia (CBA) was one of the first banks in Australia to provide internet banking services at the end of September 1997. This involved the launch of Netbank, a 24-hour online banking service, primarily via desktop computers to its customers.

Since then, it has evolved into mobile digital banking through the CommBank App providing 24/7 core transactional, payment and savings services. The service now includes the ability for customers to purchase 100% carbon neutral energy for home use through a dedicated provider, Amber, and the ability for individuals to measure and manage their own personal carbon emissions through carbon footprint tracker Cogo. Customers can also purchase online low fixed rate sustainable loans to install the next generation of solar panels and solar energy and electricity storage batteries.

Digital banking has been transformative for the group with now more than 6.6 million customers using the app to do their daily banking, up from 4.7 million users in December 2017. Daily customer log-ins now average 9 million with each customer logging on more than 36 times per month. More than 71% of all transactions by value are now completed digitally.

Telstra has been a part of CBA's digital banking journey since 2009, when it first started providing internet services to the bank. However, Telstra has indirectly facilitated internet banking with CBA before that by providing internet services to many of CBA's customers who use internet banking services.

Since 2009, Telstra's public internet network and mobile services have enabled CBA to facilitate critical processes including electronic payments, ATM, EFTPOS and credit card transactions, deposits and insurance claims, and property exchanges and settlements.

In addition, Telstra has enabled connectivity between CBA and cloud providers AWS and Azure, through connectivity for all CBA data centers and connectivity to cloud points of presence. A secure virtual private network (VPN) led gateway has enabled secure data exchange with other financial entities.

Telecommunication and technological developments have also helped to increase the energy efficiency of CBA's buildings (including its Australian data centres) across the country, which has resulted in the reduction of group scope 1 and 2 operational emissions by 40% since 2014. As a result, the bank has set new ambitious targets to further reduce these emissions by 42% by 2030 and to cut its supply chain emissions by 25% by 2030.

CBA now uses renewable electricity equivalent to 100% of the group's Australian power needs and fully offsets any residual emissions in Australia and NZ. CBA is aiming to achieve carbon neutrality by offsetting residual emission from its global operations in 2022.

4.12 Use case 11: Smart healthcare

4.12.1 Summary of use case

Telehealth refers to technologies that facilitate interactions between clinicians and patients to enable the delivery of remote healthcare. This is especially beneficial for patients who live in rural or remote areas, enabling them to consult with a clinician or general practitioner from their home, thereby avoid lengthy trips and increasing access to essential healthcare. In 2021, 27% of telehealth consultations were undertaken in remote locations.[47] One Australian study estimated that on average, each rural telehealth consultation resulted in an avoided 320-kilometre round-trip to attend a consultation.[48]

Internet connectivity for both the physician and the patient is critical to providing telehealth services. Telstra has a long history of providing connectivity to remote locations, and has the highest retail store presence in remote locations of any telecommunications provider in Australia.[49]

The COVID-19 pandemic spurred the expansion of telehealth services in Australia, driven by changes to the Medicare Benefits Schedule (MBS). The Federal Government introduced changes to the MBS to include telehealth services for most major health services, reducing the cost barrier of remote consultations.[50] More than 86.3 million COVID-19 MBS telehealth services were delivered to 16.1 million patients, with $4.4 billion in Medicare benefits paid since the start of the pandemic.[51]

As a result, the telehealth industry expanded from a collection of niche service providers to a multibillion dollar industry, as industry revenue increased to $2.4 billion, up from $899 million in FY20.[52]

In addition to providing connectivity to remote locations to facilitate telehealth consultations for patients, the organisation's digital health services company, Telstra Health, provides a range of customised solutions to enable remote monitoring through its virtual care solutions (see Case study: Remote monitoring for the Tasmanian Government).

4.12.2 Estimated avoided emissions

It is estimated that in 2021, Telstra enabled avoided emissions of 37,000 tCO_2e by providing home internet services to rural and remote customers, enabling them to access telehealth services and reducing the need for them to travel to access healthcare. The telehealth industry is estimated to grow at a rate of 22% per annum on average.[53] This growth may continue to be supported by recent Australian Government commitments to extend the MBS telehealth services beyond the COVID-19 pandemic,[54] and to invest $308.6 million in telehealth.[55] Assuming Telstra's regional home internet market share remains constant, it is estimated that by 2030, Telstra's annual avoided emissions increase to 86,000 tCO_2e. Over the decade to 2030, this reflects total cumulative avoided emissions of 545,000 tCO_2e.

Case Study: Remote monitoring for the Tasmanian Government

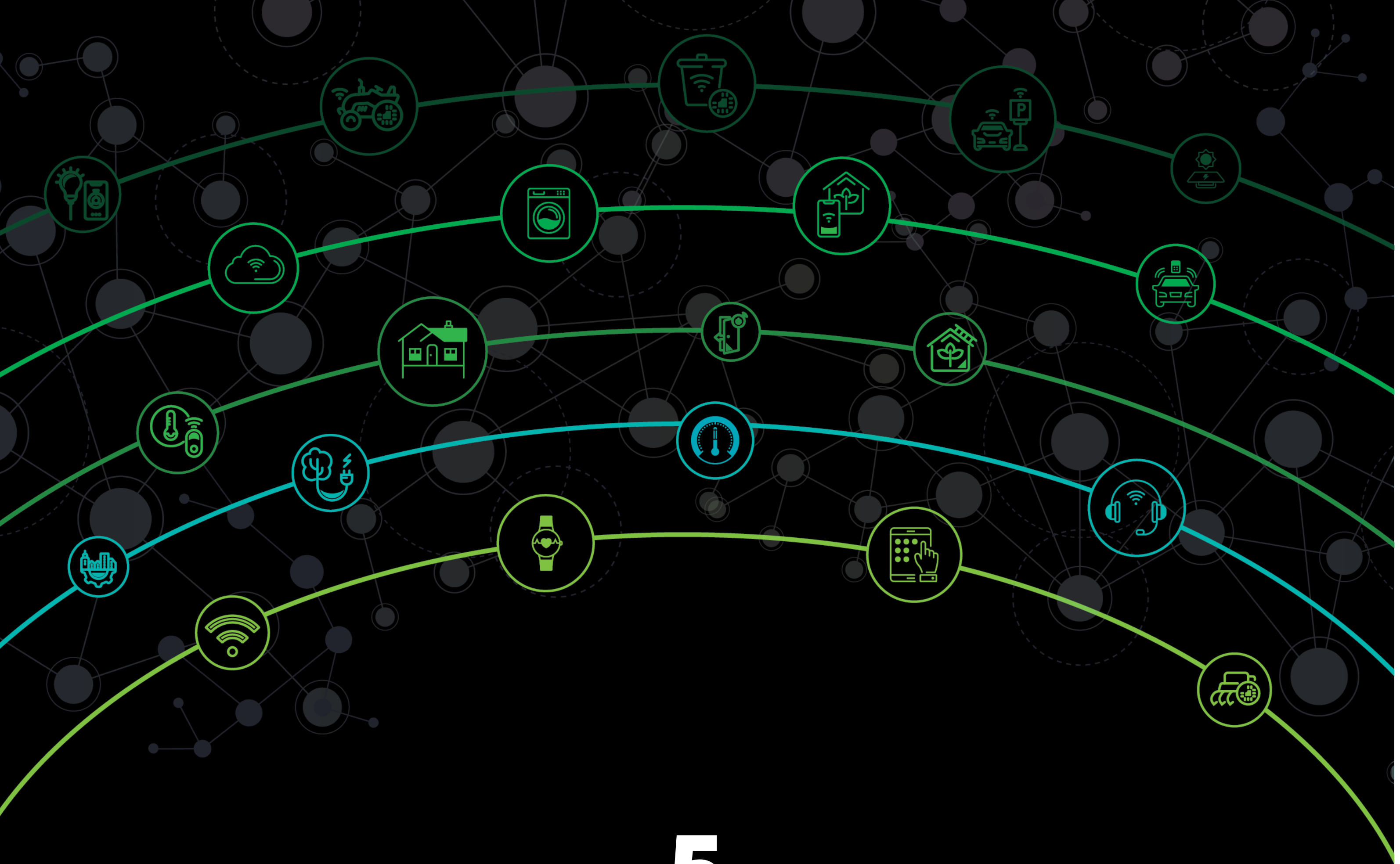
Tasmania supported returning travellers and seasonal workers during their quarantine period following arrival in Australia. Health monitoring of the returned travellers in quarantine was a priority, as was the safety of workers and the broader community. This was made possible by a virtual health monitoring system rolled out by Telstra Health in partnership with the Tasmanian Health Service.

A range of Telstra Health's virtual health monitoring devices were used at hotel quarantine sites in Tasmania. Returned travellers were asked to perform their own daily health checks including temperature, pulse, and oxygen saturations (SPO2) using TGA-approved devices. Undertaking these checks within their hotel rooms helped reduce the opportunity for transmission of COVID-19 to clinical staff, hotel employees and other people in quarantine. Telstra Health's MyCareManager app stored data from the devices in a hosted monitoring platform.

The solution included MyCareManager dashboards that allowed clinicians to review observation trends, variations, alerts, and overall participation by guests with the virtual care devices. Clinical care teams could monitor and intervene with people whose data might indicate a trend or change requiring further action, or who were yet to complete their observations. The solution also involved using secure video conferencing functionality for follow up and to provide mental health support.

The remote monitoring system resulted in the efficient delivery of healthcare to people in hotel quarantine in isolation from the community. More recently, the remote monitoring system and its capabilities have become integral to care pathways used for monitoring triaged COVID@home patients. This approach to care empowers people to play an active role in monitoring and reporting their own health data. All guests and COVID@home patients monitor their SPO2 and temperature; the technology also provides capability to remotely monitor blood pressure, weight, and glucose levels if required.

Telstra Health's virtual health monitoring has implications beyond the quarantine walls and COVID use cases. Patient empowerment in monitoring their own health, and connectivity to remote healthcare providers offers an opportunity for patients to undertake care in an environment that supports their personal circumstances. It also results in a reduction in the need for both patients and clinical staff to travel for in-person healthcare, especially for people in rural and remote areas where health services can be limited. While in-person care is still imperative in many situations, technology has been playing an increasing role in breaking geographical barriers to healthcare, and thus reducing the environmental impacts of long-distance travel.



5
Total enablement

5.1 Avoided emissions

This analysis estimates that by 2030, Telstra could enable the avoidance of 4.2 MtCO_2e (see Chart 5.1). This is the equivalent of reducing the number of passenger vehicles on Australian road networks by 1.3 million passenger vehicles.

Telstra's potential contribution to avoiding emissions is nationally significant, the equivalent of about 1% of the average annual reduction in emissions required to meet Australia's reduction target of 43% below 2005 levels by 2030. With the rapid adoption of emissions-avoiding digital technologies, Telstra, as Australia's largest telecommunications provider, has a major role to play in achieving Australia's environmental ambitions.

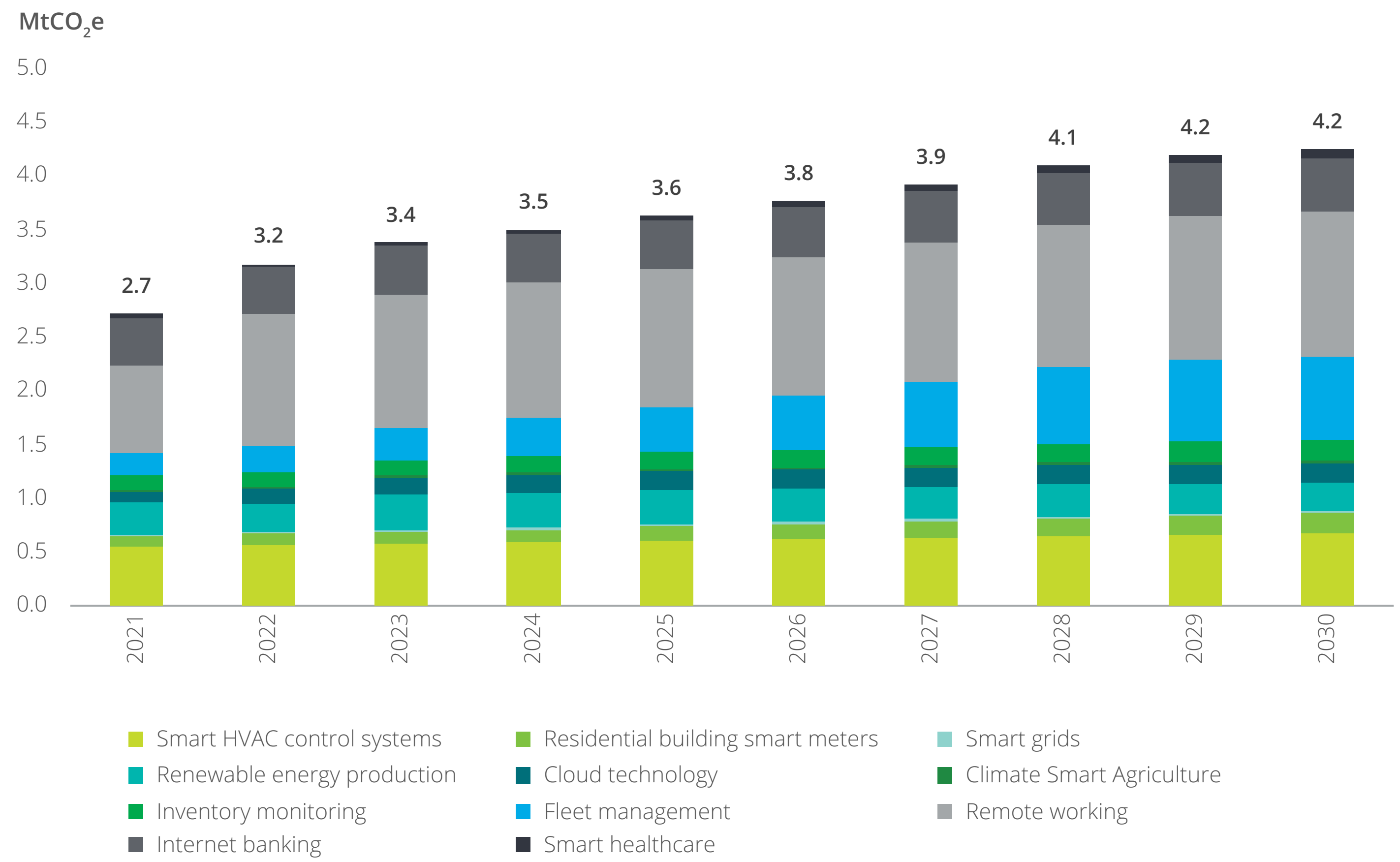
The significant forecast increase in Telstra's avoided emissions over time is largely driven by businesses increasing their adoption of new technologies over time. This includes the increased adoption of Smart HVAC, fleet management and inventory management systems in line with expected rates of uptake over the next decade. There are also other relevant factors that underpin the forecasts, including that businesses must have the right incentives to increase their adoption of new technologies, and must ultimately change their behaviour to realise the avoided emissions.

The total cumulative avoided emissions that could be enabled by Telstra's services and products are estimated at 41 MtCO_2e over the decade to 2030. However, this could be even larger with greater uptake of Telstra's existing technologies or the implementation of new technologies, which have not been measured in this study.

It is estimated that in 2021, Telstra enabled its customers to avoid 2.7 MtCO_2e (see Chart 5.1). This is the equivalent of reducing the number of passenger vehicles on Australian road networks by 820,000 passenger vehicles.

Almost half of the estimated avoided emissions (47.5%) are attributed to ICT solutions that enable people to reduce emissions in their lifestyle, of which a significant proportion relates to remote working (29.6% of total avoided emissions). This is largely driven by Telstra's significant market share in home internet and mobile data connectivity, which enables millions of Australians to work, bank and consult with medical advisors remotely. Fleet management solutions are also important (7.8% of total avoided emissions) today but set to grow strongly in the next decade given Telstra's position in the telematics market with the acquisition of MTData.

Chart 5.1: Telstra's avoided emissions, 2021 to 2030



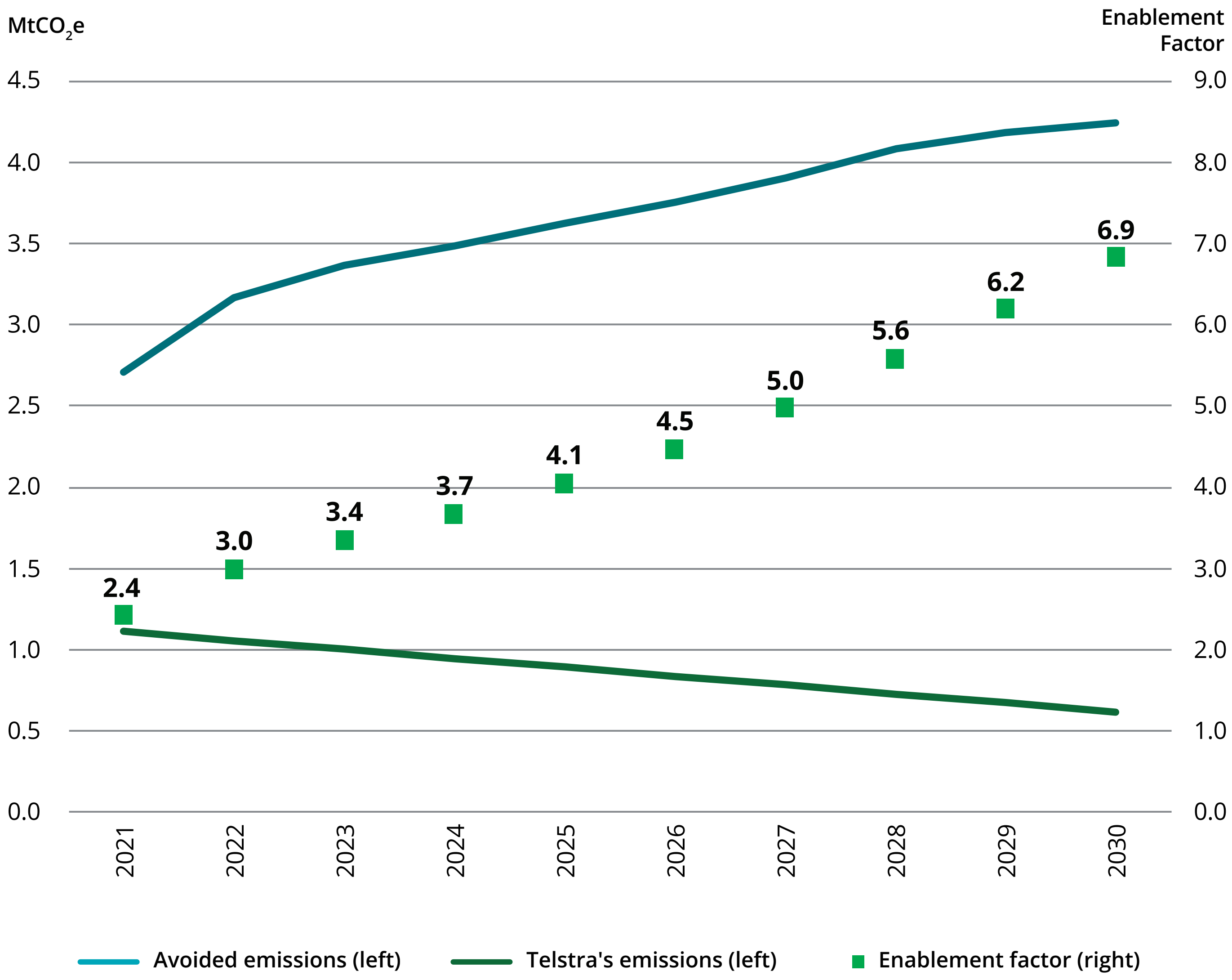
Source: Deloitte.

5.2 Enablement factor

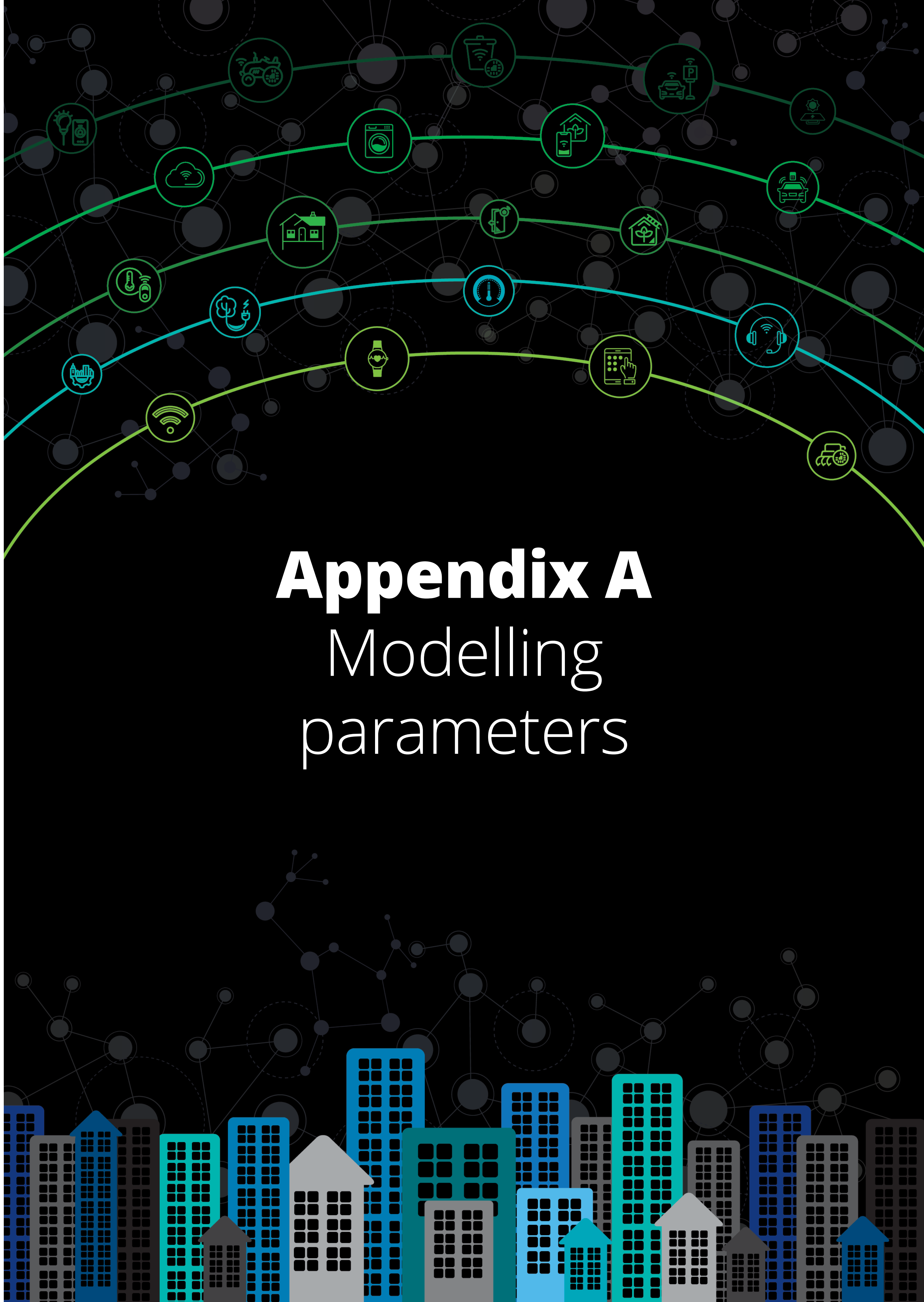
The enablement factor reflects Telstra's net impact, and is calculated by dividing the total avoided emissions enabled by Telstra's services and products by its own total emissions. It is estimated that by 2030, Telstra's enablement factor will be 7 (see Chart 5.2). Seven tonnes are saved for every one tonne emitted. In 2021, Telstra's enablement factor was 2.4.

In addition to the increasing adoption of new technologies over time, the improvement in Telstra's enablement factor over the decade to 2030 is also because of Telstra's own commitments: being carbon neutral from 2020, enabling renewable energy generation equivalent to 100% of Telstra's consumption by 2025 and reducing scope 1 and scope 2 emissions by at least 50% by 2030 to 0.6 $MtCO_2e$ (see chapter 2).

Chart 5.2: Telstra's enablement factor to 2030



Source: Deloitte.



Appendix A Modelling parameters

A.1. Smart HVAC control systems parameters

Table A.1: Parameters used to calculate Telstra's avoided emissions from HVAC control systems

Parameter	Value	Source
Annual carbon emissions in Australia	494 $MtCO_2e$	DISER, *National Greenhouse Gas Inventory Update,* March 2021
Share of energy consumption from commercial buildings	10%	DISER, *Commercial buildings,* 2021
Share of energy building energy consumption from HVAC	50%	DISER, *HVAC,* 2021
Decrease in building emissions to 2030 (compared to 2021)	5%	DISER, *Australia's emissions projections* 2021
Smart HVAC adoption, F21	70%	Industry consultation, 2022
Smart HVAC adoption, F31	90%	Industry consultation, 2022
Reduction in emissions from smart HVAC (compared to standard smart HVAC)[a]	20%	Carbon Trust, *Advanced metering for SMEs,* 2007.
Technology adjustment factor	3 technologies	• Temperature control device • Internet connectivity • Smart HVAC system (e.g. thermostat, air conditioner, heat controller, sensors)
Attribution to Telstra	1 of 3 technologies	Telstra's estimated market share for internet connectivity in commercial buildings

Notes: (a) Another US study, Pacific Northwest National Laboratory 2013, suggests that energy savings can range between 24% and 35%, and therefore 20% is considered a conservative estimate.

A.2. Residential building smart meters

Table A.2: Parameters used to calculate Telstra's avoided emissions enabled by smart meters

Parameter	Value	Source
Annual carbon emissions in Australia	494 $MtCO_2e$	DISER National Greenhouse Gas Inventory Update, March 2021.
Australian households in 2021	9.9m households	ABS, *Household family projections,* 2016
Australian households in 2030	11.4m households	ABS, *Household family projections,* 2016
Share of carbon emissions attributed to Australian residential buildings	12%	DISER, *Residential Buildings,* 2021
Share of households with a residential smart meter, 2021	39%	Australian Energy Regulator, *State of the energy market,* 2021
Share of households with a residential smart meter, 2030	73%	Uptake of 6.6% p.a. Modor, *Intelligence market snapshot,* 2021
Average energy savings from smart meters in residential buildings	3%	DECC, *Smart meter roll out for the non-domestic sector,* 2012; DECC Smart Metering Early Learning Project: Domestic Energy Consumption Analysis, 2015.
Technology adjustment factor	3 technologies	• Smart meter device • Internet connectivity • Monitoring device (e.g. phone, tablet or computer)
Attribution to Telstra	2 of 3 technologies	Residential household internet market share and forecast smart meter sales

A.3. Smart grids

Table A.3: Parameters used to calculate Telstra's avoided emissions from smart grid connectivity

Parameter	Value	Source
Scope 1 emissions from grid connected generators	156.8 $MtCO_2e$	Clean Energy Regulator, *Electricity sector emissions and generation data 2019-20,* 2021
National Electricity Market (NEM) Energy intensity factor, 2021	0.69 tCO_2 per MWh	DISER, Australia's emissions projections, 2020
National Electricity Market (NEM) Energy intensity factor, 2030	0.45 tCO_2 per MWh	DISER, Australia's emissions projections, 2020
Transmission and distribution (T&D) loss as a share of electricity generation	5%	World bank, Electric power transmission and distribution losses (% of output) – Australia, based on IEA Statistics 2018
Share of the NEM grid that is smart, 2021	40%	Energy networks Australia, *Smart grid roadmap,* 2021
Share of the NEM grid that is smart, 2030	90%	Energy networks Australia, *Smart grid roadmap,* 2021
Reduction in transmission and distribution losses from transitioning to smart grids[a]	7%	World Energy Outlook 2005, IEA
Technology adjustment factor	3 technologies	• Smart distribution board and circuit breakers • Internet connectivity (e.g. utility grade fibre broadband) • Smart metering device network[b]
Attribution to Telstra	1 of 3 technologies	Electricity retailer market share for internet connectivity, based on the utility sector

Notes: (a) The SMART 2020 report by the Climate Group, GESI (2008) estimates the total reduction in T&D losses by up to 30%, whereas the US Department of Energy (2012) estimates the potential reduction in T&D losses to be between 5 and 10% from smart grids.
(b) Smart metering devices not included to avoid double counting.

A.4: Renewable energy generation

Table A.4: Parameters used to calculate Telstra's avoided emissions from renewable energy generation

Parameter	Value	Source
National Electricity Market (NEM) Energy intensity factor, 2021	0.69 tCO_2 per MWh	DISER, Australia's emissions projections, 2020
National Electricity Market (NEM) Energy intensity factor, 2030	0.45 tCO_2 per MWh	DISER, Australia's emissions projections, 2020
Renewable energy generated from Telstra's PPA agreements, 2021	454,000 MWh	Provided by Telstra
Renewable energy generated from Telstra's PPA agreements, existing and committed	609,000 MWh	Provided by Telstra
On-site generation for PPAs, 2021	10,000 MWh	Provided by Telstra
On-site generation for PPAs, existing and committed	25,000 MWh	Provided by Telstra

A.5. Cloud technology

Table A.5: Parameters used to calculate Telstra's avoided emissions from enabling to cloud storage

Parameter	Value	Source
Annual emissions saved per Telstra public cloud server (1-19 employees)	24 tCO_2e	Qingtech estimates commissioned by Telstra, Connecting with the Cloud, 2017.[(a)]
Annual emissions saved per Telstra public cloud server (20-500 employees)	36 tCO_2e	As above
Annual emissions saved per Telstra public cloud server (>500 employees)	44 tCO_2e	As above
Annual emissions saved per Telstra private cloud server (1-19 employees)	35 tCO_2e	As above
Annual emissions saved per Telstra private cloud server (20-500 employees)	63 tCO_2e	As above
Annual emissions saved per Telstra private cloud server (>500 employees)	50 tCO_2e	As above
Technology adjustment factor	Up to 3 technologies	• Telstra cloud solution (e.g. CSX platform) • Public partnership adjustment (applicable to public cloud solutions) • Internet connectivity
Attribution to Telstra – Private cloud	2 of 2 technologies	Telstra's private cloud solutions and Telstra's internet connectivity solutions provided to private cloud customers.
Attribution to Telstra – Public cloud	2 of 3 technologies	Telstra's public cloud solutions and Telstra's internet connectivity solutions provided to public cloud customers.

Notes: (a) Values are adjusted to include Telstra's emissions from providing cloud, which was excluded in the Qingtech estimate. These values are accounted for in Telstra's scope 1 and 2 emissions.

A.6. Climate smart agriculture

Table A.6: Parameters used to calculate Telstra's avoided emissions from climate smart agriculture

Parameter	Value	Source
Annual carbon emissions in Australia	494 $MtCO_2e$	DISER National Greenhouse Gas Inventory Update, 2021.
Proportion of total emissions generated by Agriculture in Australia	14.9%	DISER National Greenhouse Gas Inventory Update, 2021.
Number of farms in Australia, 2021	89,400 farms	2021: ABARES, *Our food future: trends and opportunities*, Research Report 20.1, Canberra, 2020
Number of farms in Australia, 2030	83,833 farms	Annual decline of 6% in number of farms based on the Australian Agricultural Snapshot 2021
Proportion of Australian farmers who use sensors and devices or GPS	12.3%	ABARES, *Our food future: trends and opportunities*, Research Report 20.1, Canberra, 2020
Global in IOT device uptake (based on global growth)	19%	Future Forces, *A ten-year Horizon for Australian Agriculture*, 2020
Reduction in emissions due to CSA, 2021	7%	M Arni et al, *IOP Conference Series: Earth and Environmental Science*, 2018
Reduction in emissions due to CSA, 31	13%	Accenture (commissioned by BT), Technology and emissions report, 2021
Technology adjustment factor	3 technologies	• Sensor technology (e.g. GPS and RFID sensors attached to animals, water bores/troughs, or soil sensors) • Internet connectivity (e.g. Cat M1 or Narrowband) • Monitoring device (e.g. phone, tablet or computer)
Attribution to Telstra	2 of 3 technologies	Agriculture customers connected to Telstra's IOT network and Telstra's internet or data services (such as Telstra Fibre or NBN)

A.7. Inventory monitoring

Table A.7: Parameters used to calculate Telstra's avoided emissions from IoT connected inventory monitoring solutions

Parameter	Value	Source
Tonnes of avoided emission per IoT connected pallet	0.71 tCO_2e	AT&T, AT&T 10x Case study: Unlocking the Potential of Connected, Reusable Pallets, 2017.
Global in IOT device uptake (based on global growth)	19%	Future Forces, *A ten-year Horizon for Australian Agriculture,* 2020. (Remains consistent with IoT solution uptake)
Global growth in container shipments	2.4%	BITRE, *Waterline 67,* 2021
Technology adjustment factor	3 technologies	• IoT asset tracking devices (e.g. Cat-M1 Tracking Unit, Cat-M1 Rechargeable Tracking Tag) • Bluetooth or Internet connectivity • Monitoring device (e.g. phone, tablet or computer)
Attribution to Telstra	2 of 3 technologies	Connected supply chain customers who use Telstra's IOT network and internet connectivity provided to wholesale trade customers who use IoT tracking devices to track pallets

A.8. Fleet management

Table A.8: Parameters used to calculate Telstra's avoided emissions from IoT connected fleet management solutions

Parameter	Value	Source
Share of diesel vehicles in Australia	24%	ABS, Motor Vehicle Census, 2021
Emissions per kg of diesel consumption	2.67 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Annual diesel consumption	12,479 ML	ABS, Motor Vehicle Census, 2021
Diesel vehicles in Australia	3,130,905 vehicles	ABS, Motor Vehicle Census, 2021
Emissions per kg of diesel consumption	2.28 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Share of petrol vehicles in Australia	76%	ABS, Motor Vehicle Census, 2021
Emissions per kg of petrol consumption	2.28 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Annual diesel petrol	12,479	ABS, Motor Vehicle Census, 2021
Petrol vehicles in Australia	3,130,905 ML	ABS, Motor Vehicle Census, 2021
Emissions per kg of diesel consumption	2.28 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Global in IOT device uptake (based on global growth)	19%	Future Forces, *A ten-year Horizon for Australian Agriculture,* 2020. (Remains consistent with IoT solution uptake)
Fuel savings from telematics solutions	5%	GSMA, The Enablement Effect, 2019[(a)] Note:
Technology adjustment factor	3 technologies	• IoT asset tracking devices (e.g. EagleTrack Plug & Play Vehicle Tracking Unit 4G) • Bluetooth or internet connectivity (depending on device type) • Monitoring device (e.g. phone, tablet or computer)
Attribution to Telstra	2 of 3 technologies	Telematics solutions connected to Telstra's IOT network (Eagle Track, Fleet Complete) and other telematics who rely on Telstra's mobile network

Notes: (a) GSMA lists a number of fuel savings, ranging from 2% to 20% depending on the advancement of the telematics solution. The parameter, 5%, was based on studies of telematics solutions that were most similar to Telstra's, and reflects a conservative estimate of fuel savings.

A.9. Remote working

Table A.9: Parameters used to calculate Telstra's avoided emissions from remote working

Parameter	Value	Source
Total employed persons, 2021	12.8m persons	Deloitte Access Economics, *Business Outlook,* 2021
Total employed persons, 2030	14.8m persons	Deloitte Access Economics, *Business Outlook,* 2021
Electric vehicle uptake, 2021	3,800 vehicles	ABS, *Motor Vehicle Survey,* 2021
Electric vehicle uptake, 2030	63,000 vehicles	ABS, *Motor Vehicle Survey,* 2021; Electric Vehicle Council, *State of Electric Vehicles,* 2020.
Emissions per kg of petrol consumption	2.28 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Average fuel consumption per 100km	13.1 litres	BITRE, *Fuel economy of Australian Passenger vehicles,* 2020
Average distance to work per day (two-way)	33km	ABS, *Suvey of Motor Vehicle Use (SMVU),* 2020.
Proportion of people travelling to work by car	79%	ABS, Census of Population and Housing: Commuting to Work, 2016
Proportion of total workforce who usually worked from home	36.4%	ABS, C*haracteristics of employment,* August 2020 and August 2021.
Average number of days worked from home per week	4.7	ABS *Characteristics of Employment,* August 2020 and August 2021.
Weighted average days WFH per week (employee preference)	2.73	Productivity Commission, *Working from home,* September 2021
Weighted average days WFH per week (employer preference)	2.32	Productivity Commission, *Working from home,* September 2021
Technology adjustment factor	2 technologies	• Internet connectivity (e.g. 4G or home internet) • Work device (e.g. computer)
Attribution to Telstra	1 of 2 technologies	Telstra's home internet market share

A.10. Internet banking

Table A.10: Parameters used to calculate Telstra's avoided emissions from enabling internet banking

Parameter	Value	Source
Population aged 15 and over, 2021	20.9m persons	Deloitte Access Economics, *Business Outlook*, 2022
Population aged 15 and over, 2030	23.7m persons	Deloitte Access Economics, *Business Outlook*, 2022
Baking transactions that occur by phone and by internet per person per year	83 transactions	Coconut survey, *the 2020 Future Branches Consumer Study*, 2020.
Average distance to cash deposit	5.5 kilometres	RBA, *How Far Do Australians Need to Travel to Access Cash?* 17 June 2021
Average distance to cash withdrawal	4.3 kilometres	RBA, *How Far Do Australians Need to Travel to Access Cash?* 17 June 2021
Emissions per kg of petrol consumption	2.28 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Average fuel consumption per 100km	13.1 litres	BITRE, *Fuel economy of Australian Passenger vehicles*, 2020
Proportion of people travelling to bank by car (assumed to be commuter share)	79%	ABS, Census of Population and Housing: Commuting to Work, 2016
Technology adjustment factor	2 technologies	• Internet connectivity (e.g. 4G or home internet) • Monitoring device (e.g. phone, tablet or computer)
Attribution to Telstra	1 of 2 technologies	Telstra's mobile handheld device market share

A.11. Smart healthcare

Table A.11: Parameters used to calculate Telstra's avoided emissions from enabling smart healthcare

Parameter	Value	Source
Number of rural and remote telehealth consultations, 2021	1,557,633	ABS, *Patient Experiences in Australia: data downloads*, 2021.
Number of rural and remote telehealth consultations, 2030	3,654,544	Forecast uptake based on Ibisworld, *Industry Outlook, Telehealth in Australia*, June 2021
Avoided travel per regional telehealth patient	320 kilometres	Snoswell et al, 'Quantifying the Societal Benefits From Telehealth: Productivity and Reduced Travel', *Value Health Reg Issues*, 2022
Emissions per kg of petrol consumption	2.28 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Average fuel consumption per 100km	13.1 litres	BITRE, *Fuel economy of Australian Passenger vehicles*, 2020
Emissions per kg of petrol consumption	2.28 tCO_2e	ATAP guidelines (Table 39, Appendix B), 2021
Average fuel consumption per 100km	13.1 litres	BITRE, *Fuel economy of Australian Passenger vehicles*, 2020
Technology adjustment factor	2 technologies	• Device on which to talk to doctor (telehealth), device for doctor to view and edit Electronic Medical Record (store data on cloud) • Internet to connect with doctor (telehealth), internet to view and update digital medical records on the cloud
Attribution to Telstra	1 of 2 technologies	Telstra's regional household connectivity market share

Limitation of our work

General use restriction

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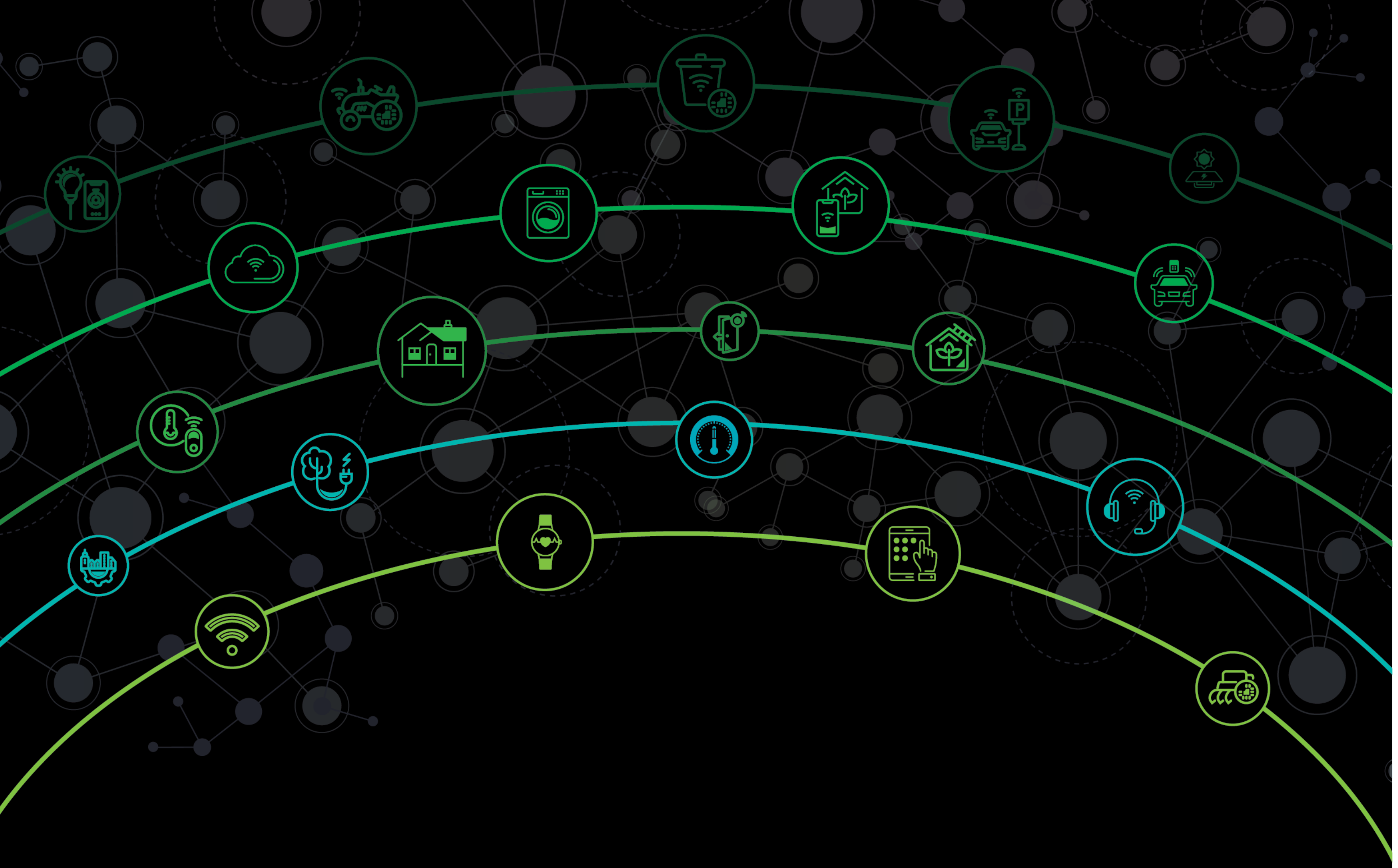

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