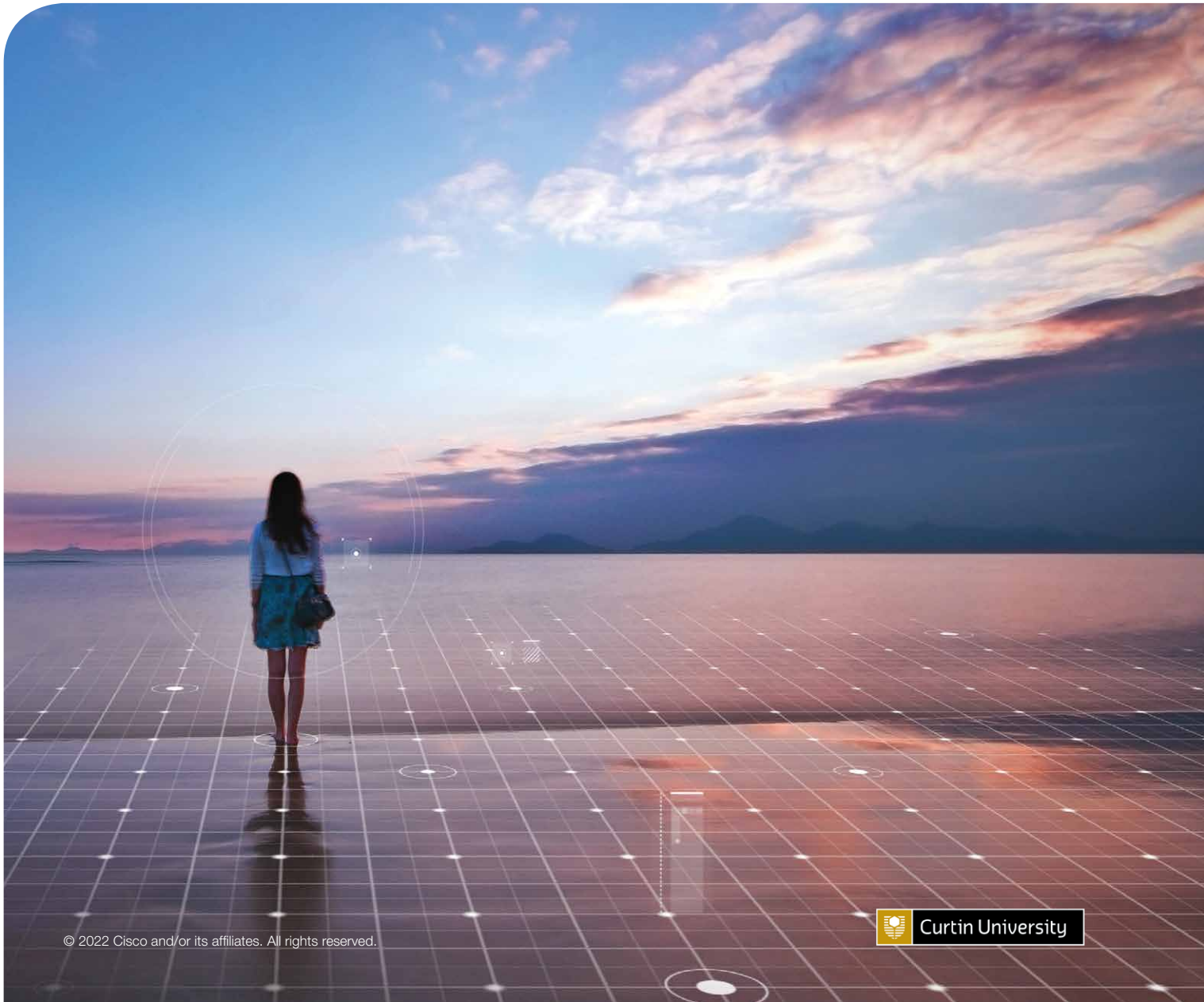
The bridge to possible

Smart Zero

Using advanced networks to accelerate progress towards Net Zero



Curtin University

Foreword

Two of the major disruptions gathering pace in the Australian economy are digital transformation and reducing greenhouse gas emissions to Net Zero.

Momentum has already been established in relation to digital. Australia has a strong track record for early adoption of technology across a range of industry sectors, as well as creation of new products and services for the global market. The depth of specialist capability inside Australian universities has been a major factor in Australia's capacity to participate in and benefit from digital.

The scale and depth of the environmental threat posed by human induced emissions are universally accepted. Globally, governments have expressed the urgency required to minimise climate change, however the translation of targets into outcomes will require increased efforts across many sectors. The task is huge, requiring an enormous investment into alternative energy sources to replace fossil fuels while expanding the energy services that underpin our modern civilisation. The opportunity for Australia to create new industries is equally large.

Australia's progress on dealing with climate change is gathering pace. To ensure that the ever-increasing investment in net zero activities driven by government and the private sector is maximally efficient, we must implement smart digital approaches to operate the new and emerging zero emissions technologies, integrate them into our complex society and accurately collate the data that gives us confidence that our efforts are delivering results. We must step beyond manual, analogue processes to a technology-based approach that is more scalable, accurate and secure.

This report, prepared by global IT leader Cisco and innovative global university Curtin, explores how digital and net zero converge and poses the question: *can we accelerate Australia's progress to net zero by leveraging digital technologies and advanced networks?* The answer is resoundingly yes. Australia needs to mobilise all its resources in the quest for net zero and we deserve to know that the anticipated benefits are real. Solving problems at the intersection of digital and net zero will require collaborative action from government, universities and the private sector to harness Australia's collective research capability.

Dr Alan Finkel AC

The bridge to possible

Executive summary

Quantifying emissions and related offsets to comply with Net Zero targets has attracted the focus of governments and industry[1]

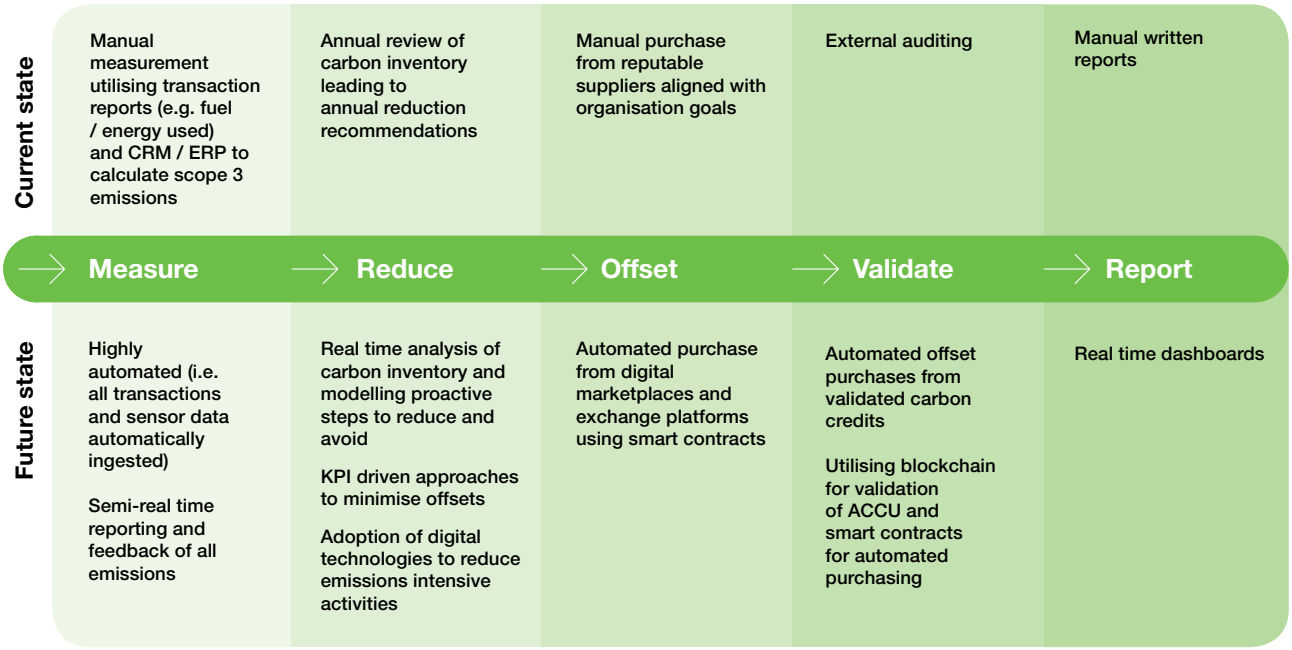
As the urgency of the environmental crisis builds, and tolerance for 'greenwashing'[2] evaporates, sustainability is a mainstream business function. Financial performance may be directly impacted by an organisation's environmental track record and Net Zero targets.

Digital technologies have impacted organisational strategy and performance, with high-speed connectivity, Internet of Things (IoT), cloud, artificial intelligence (AI) and advanced networks applied to many public and private sector functions. Convergence of Net Zero and Digital – or Smart Zero as Cisco and Curtin have termed it in this report – not only represents a path to addressing the urgent environmental crisis but also providing major economic opportunity. The network is the point at which all Net Zero technologies can coalesce. The network connects computers, servers, mainframes, peripherals and other devices to allow data sharing. With applications migrating to the cloud, millions of devices coming online and an expanding threat landscape, the network has never been more important. Using the power of advanced networks and digital, Australia needs to urgently embrace and invest in Smart Zero.

Australia won't meet targets with current technology

Modelling suggests Australia's transition to Net Zero could generate $2.1 trillion in new economic activity by 2050, create 672,000 new jobs across the economy, and enable Australia to capture a greater share of the growing global climate tech investment market.[3] There are likely to be economic risks if Australia does not follow through with – and embrace – its commitment to Net Zero. The Business Council of Australia in its 2021 paper has stated that unchecked climate change over the next 50 years would amount to a $3.4 trillion loss to Australia's GDP[4] and impact quality of life. The current process in Australia for measuring, offsetting and reporting on emissions is managed by Climate Active (funded by the Federal Government). That process is currently manual and analogue. Technology innovation and targeted research is required at every stage of the Net Zero lifecycle to efficiently process and automate complex tasks, as shown in Figure 1.

Figure 1: Digital transformation across the Net Zero lifecycle



Examples of digital technologies that would accelerate progress towards Net Zero include:

Smart environment monitoring systems

Low-cost Internet of Things (IoT) sensors to capture and analyse data, including air quality / pollution, dust and humidity, radiation and soil.

Smart cities

Cities consume 78% of the world's energy and produce more than 60% of emissions. Over 500 smart city projects exist globally worth over $100 billion.

Digital collaboration for hybrid working

Using virtual conferencing rather than travel is an example of how technology can reduce or avoid emissions. One hour of video conferencing generates 0.0025% of the emissions created by a face-to-face involving long-haul air travel.

Digital twins

Virtual models (digital twins) can simulate scenarios that may occur in the physical world, including environmental impacts of different interventions and climate adaptability.

Blockchains

The future trading and verification of offsets will likely include use of blockchain and smart contracts to automate trading of carbon credits and other environmental currencies.

Integrating CRM systems to calculate carbon emissions

New applications automate the capture of scope 1, 2 and 3 emissions by leveraging data within CRM systems.[5]

Advanced networks will need to evolve to meet Net Zero requirements

The transition from manual to automated processes, human to machine scale and analogue to digital is driven by one critical factor: networked data. In a world where almost everything in the network is an enabler and potential point of failure, networks must evolve in two ways: 1) Become even more intelligent, secure, transparent, resilient and capable of meeting privacy obligations, and 2) Become more energy efficient in their own right (particularly given ICT usage is forecast to represent 21% of global energy consumption by 2030[6]) and produce less waste by embracing circular economy principles.

Organisations that embrace advanced networks today are likely to have a natural advantage

Investing in advanced networks today provides immediate benefits associated with increased reliability, scalability and security. Net Zero represents a new, and compelling, use case for deployment of advanced networks. It allows organisations to move more quickly, embrace automation and optimisation and build the processes and workflows required to effectively measure, monitor and report on emissions. By moving to advanced networks earlier, organisations will also manage critical risks and more rapidly develop and support new technologies to digitise the Net Zero life cycle in operations.

Australia must ensure it has the research capability and skills needed to support Australia's transition to Net Zero

Accelerating the pace of — and improving outcomes from — the convergence of Net Zero and digital requires a combination of applied research and new skills, and an industry-driven focus.

To truly accelerate the transition to Net Zero, Australia needs:

→ Applied research that is collaborative, industry-led and globally relevant.

At the heart of digital / Net Zero convergence is the need for interdisciplinary research, at scale. Collaborative research needs to be industry-driven and grounded in global best practice.

→ Specialist skills to meet the digital / Net Zero challenge.

Each industry sector will require a unique set of new skills relevant to specific markets but all will be underpinned by digital capability to measure, reduce / avoid, offset and report on Net Zero.

→ Exploration of the convergence of digital and Net Zero from a policy / funding perspective.

It is widely believed Australia does not have the time to retrofit digital solutions after the fact – it needs a 'digital first' approach to Net Zero from the outset. Not only will this accelerate Australia's progress towards Net Zero, it also offers an opportunity to develop technologies, policies and skills for the world and make its economy more complex and resilient.

The Federal Government plans to reduce Australia's emissions by 43% by 2030. Creating an environment that encourages private sector investment and maximises the returns from research funding is critical to achieving this target.

Investments in research need to be industry-led and globally relevant

The National Industry Innovation Network – anchored by Cisco and Curtin – is an example of delivering on Australia's national innovation and science agenda by strengthening the translational research pipeline and helping to drive economic growth in the digital economy. The network is well placed to drive the interdisciplinary research at scale that will be at the heart of digital / net zero convergence.

Introduction

Purpose of this report

This report explores how digital technologies and the network specifically can accelerate Australia's progress towards Net Zero. It also highlights how advanced networks will need to evolve to meet functional demands but also to become more energy efficient in their own right.

The convergence of Net Zero and digital technologies is a new frontier. The most comprehensive exploration of the opportunities and risks associated with this convergence was from the Royal Society[7] in its seminal report *Digital technology and the planet: Harnessing computing to achieve net zero*.[8] The report stated that "nearly a third of the 50% carbon emissions reductions the UK needs to make by 2030 could be achieved through existing digital technology – from sensors to large-scale modelling". Digital technology adoption and innovation accelerated during the global pandemic, fuelled by new ways of working, learning and communicating. The underlying network also rose in prominence as a platform for enabling secure, scalable and reliable business functions.

This report is divided into five chapters, as highlighted in Figure 2, that creates a line of sight between the Net Zero opportunity through to recommended actions.

Figure 2: Structure of this report

Chapter 1: The mainstreaming of Net Zero: From corporate social responsibility to core business

Insights:

- **Environmental sustainability has been 'mainstreamed' by most organisations: it has moved from a corporate and social responsibility (CSR) agenda to business-critical and a source of competitive advantage.**
- **Industry is leading Australia's transition to Net Zero, supported by renewed commitments by the Federal Government.**
- **Most targets focus on the more direct Scope 1 and Scope 2 emissions but focus is shifting to Scope 3 emissions generated by an organisation's end-to-end supply chain.**
- **The Net Zero challenge is more acute for different sectors, such as resources and transport.**

Environmental sustainability is becoming a core function in organisations

Environmental, Social and Governance (ESG) is becoming a strategic business imperative and includes Net Zero accreditation. Net Zero, verified by an independent third party, is also becoming a must-have for many businesses (e.g. selling into European markets). ESG recognises an organisation's financial performance is directly impacted by its environmental ambitions and performance, and includes consumers and investors basing decisions on a company's ESG record.

Net Zero accreditation extends beyond simply reporting emissions. In a Net Zero world the value of inputs (dollars spent and projects implemented) is subsidiary to the outcome (greenhouse gas emissions which are expressed using three 'scopes':

Scope 1

Covers those emissions released at the site as a result of direct on-site activities.

Scope 2

Covers indirect emissions principally as a result of electricity consumption, but may also include emissions from heating, cooling or steam consumed at a facility but produced elsewhere.

Scope 3

Emissions are all indirect emissions – not included in scope 2 – that occur in the value chain of the reporting company, including both upstream and downstream emissions.

Industry and universities are setting more aggressive Net Zero targets, supported by government.

Australia is in the 'target setting' phase of its transition to Net Zero. Early movers announced their targets in 2010 when the Australia National Carbon Offset Standard (now Climate Active Carbon Neutral Standard) was formed and many have gradually followed. The resources sector has been particularly aggressive in its Net Zero targets. Most resources companies have interim 2030 targets. Many have also set Scope 3 targets, creating pressure on suppliers to reduce their scope 1 and 2 emissions to ensure they can maintain supply contracts in the medium term. With the change of government - and the commitment to reduce Australia's emissions by 43% by 2030 - the national target is more in line with that of major industry players.

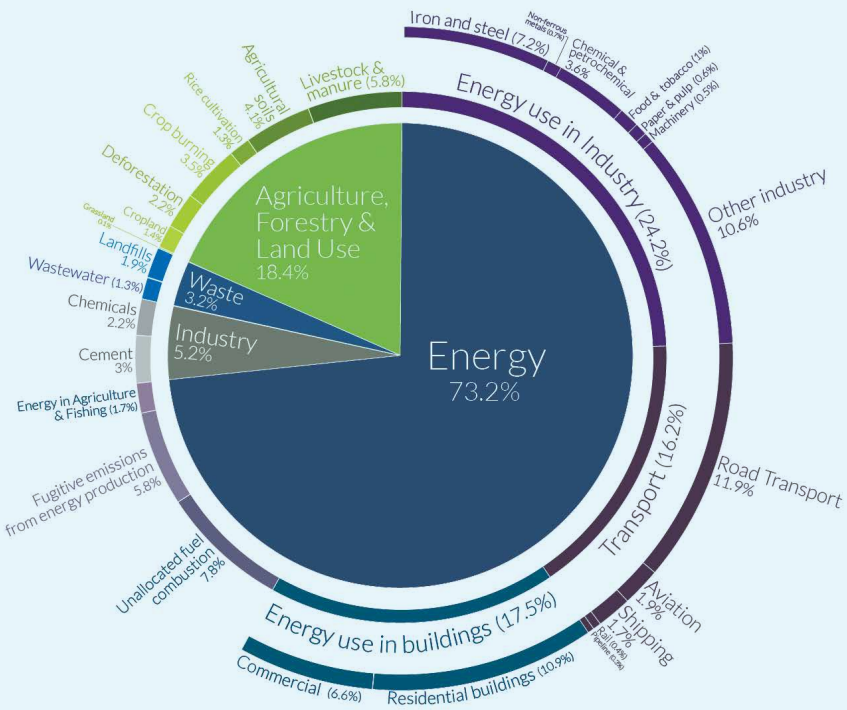
The 'mainstreaming' of Net Zero makes it fast becoming a non-negotiable business requirement

As sustainability policies move out of the shadows, organisations are considering how to use all available levers to achieve Net Zero goals. Rather than simply 'showing up' in organisational strategies, Net Zero is starting to materially influence the strategy itself in the same way that digital has done in recent years. Corporate functions such as facilities management, production, information and communication technology, and finance will have no choice but to accept Net Zero as a core business requirement.

The challenge of achieving Net Zero varies by industry

The cost of achieving Net Zero is greater for some industries than others. Globally, most emissions come from energy use, of which road transport produces 11.9% of global emissions. This is closely followed by residential buildings (10.9%), unallocated fuel combustion (7.8%) and iron and steel (7.2%).

Figure 3: Global greenhouse gas emissions by sector[9]



Different strategies are being adopted in pursuit of Net Zero, including urgent renegotiation of power supply agreements, investment in alternative energy and exploration of myriad decarbonisation initiatives. It is widely believed new technological advances and tools such as IoT, digital twins and blockchain will be a crucial lever in achieving and accelerating decarbonisation.

"With larger companies increasingly required to report on indirect emissions from their value chain, their suppliers will need a clear understanding of their own emissions."

– WSP Global 2020[10]

Chapter 2: Net Zero is a $2.1 Trillion Opportunity

Insights:

- **Embracing Net Zero will create economic benefits for Australia including new jobs, greater capital and foreign direct investment flows and improved economic complexity.**
- **The economic risks of not embracing Net Zero include declining investor confidence and economic isolation.**
- **Advances in underlying digital technologies (IoT, AI, cloud and advanced networks) are unlocking new possibilities.**
- **Digital will play a critical role in capturing the economic benefits of Net Zero, with technologically advanced economies best placed to capitalise on emerging opportunities.**

The economic opportunity presented by Net Zero

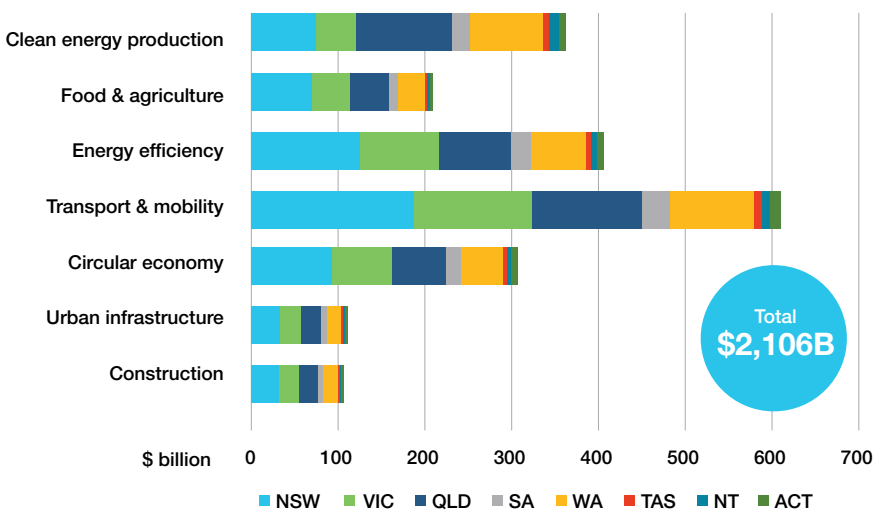
Global reduction of greenhouse gas (GHG) is vital to reducing the impact of climate change. Global GHG emissions in 2020 were approximately 50 billion tonnes, with Australia producing 0.63 billion tonnes (1.2% of the global total). Despite being a low emitter as a proportion of global tonnage, Australia's annual per person emissions are five times greater than the global average and 40% higher than any other major coal power user.[11] Embracing Net Zero is both a necessity and an opportunity, with Australia having more to gain than most. Australia has natural advantages (capacity to capture hydrogen, wind, solar and other fossil fuel alternatives) and a record of innovation in target industry sectors.

Australia is poised to reap several economic benefits from Net Zero:

Creation of almost 700,000 new jobs in Australia

Low emissions technologies could deliver $30 billion a year of new export revenue by 2040.[12] A recent report by Accenture states that the non-direct economic impact of Net Zero is even greater, with Australia poised to benefit from Net Zero transition to the tune of $2.1 trillion in additional economic activity by 2050.[13] Modelling suggests that 672,000 jobs can be created across the economy but anchored by opportunities in transport / mobility, energy efficiency and clean energy production. The economic benefits to individual states and territories are broadly correlated to population size, with opportunities for individual states to capture a disproportionate share of jobs from decisive action.

Figure 4: The economic opportunity of Net Zero for Australia[14]



Greater capital and foreign direct investment flows

Net Zero is becoming a magnet for capital and foreign direct investment flows. More than US$60 billion was invested in climate tech in the first half of 2021 alone. This is a 210 per cent increase from the $28.4 billion invested in the 12 months prior with around 14 cents of every dollar of venture capital investment now going to climate technologies.[16]

At COP26, over 450 financial institutions overseeing $130 trillion in assets committed to aligning their portfolios with the goal of achieving Net Zero by 2050.[17] The US has now committed to re-join the Paris Agreement and cut greenhouse emissions to 50-52% below 2005 levels by 2030, reaching 100% carbon pollution-free power sector by 2035 and Net Zero no later than 2050. These commitments add to Bloomberg forecasts which identify that investment in ESG assets would reach $53 trillion globally by 2025, or a third of global assets under management.[18] There is an opportunity for Australia to capture an increasing share of this investment being directed into Net Zero initiatives, particularly in export sectors such as hydrogen.[19]

> "Although getting there won't be easy — Net Zero emissions will require $50 trillion in investment by 2050 — accelerating the adoption of these technologies could remove 25Gt of emissions annually by 2050." **- Morgan Stanley[15]**

Improved economic complexity

Economic complexity is a measure of the productive capabilities of large economic systems including cities, regions, or countries. It calculates the knowledge accumulated in a population and is a proxy for measuring economic diversity and capacity to enter new sectors. Economic complexity is measured on two dimensions: (i) The 'diversity' of products that a country exports, and (ii) the 'ubiquity' of products that the country exports. Germany ranks high in economic complexity because it exports sophisticated products that are produced by only a handful of other countries. Economic complexity correlates strongly with innovative capacity; the more complex the economy, the greater the potential for innovation / benefit from innovation. Net Zero presents an opportunity for Australia to diversify its goods and services offering, with a greater share of GDP contributed from new and diversified sectors.

A double dividend: reduced emissions and lower costs

Reducing carbon emissions can make organisations more cost efficient and productive. MaxMine used Artificial Intelligence (AI) and Machine Learning (ML) to optimise Haul pack usage by conserving momentum, reducing diesel use (and costs) by 6%.[20] The double dividend is evident in energy usage for buildings, which make up 17.5% of global emissions (of which residential buildings make up 10.9%). Basic automated building controls can save 10-15% of energy costs in commercial buildings, with more advanced functionality such as demand-controlled ventilation saving an additional 5-10%. It is estimated that integrating building systems can yield incremental energy savings of 8-18% over basic HVAC (heating, ventilation and air conditioning) and lighting control.[21]

The economic risks of not embracing Net Zero

There are significant economic risks to Australia if it does not follow through with – and embrace – its commitment to Net Zero. Unchecked climate change over the next 50 years would amount to a $3.4 trillion loss to Australia's GDP[22] and also result in:

Declining investor confidence

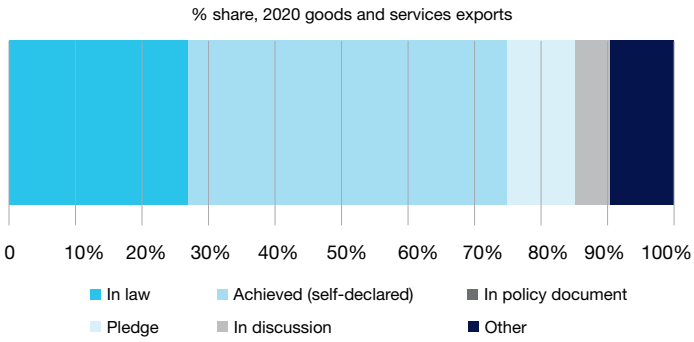
Reducing greenhouse gas is a global imperative and the recent 2021 United Nations Climate Change Conference (COP26) pact saw 130 members sign up to the Nationally Determined Contributions (NDCs) with the likely impact of this rippling through all aspects of our society and economy. Australia's targets and timelines reflect political compromises that have been made. Australia's Net Zero targets lag most of its OECD peers including the US and UK. Many may feel that Australia's global credibility as a responsible, progressive and safe place to invest is potentially at risk because of this. Australia could face rising costs of capital and divestment by offshore funds if it is not seen to be doing more to address climate change. Reserve Bank of Australia (RBA) Deputy Governor Guy Debelle said foreign investors increasingly raised the issue of climate change with the RBA, Australian corporates and government debt managers.[23]

Economic isolation

The adoption of Net Zero targets for international organisations and governments is predicted to have a major impact on Australian exporters. Figure 5 shows 85% of Australian exports went to countries with set Net Zero targets.[24]

In July 2021 the European Commission adopted the Carbon Border Adjustment Mechanism (CBAM) which will allocate a carbon price for imports to protect carbon leakage. Companies that wish to continue exporting goods to Europe and not be subject to tax will need to align with European emissions trading schemes.[25] The US proposes a 'polluter import fee' as part of its $3.5tn budget.[26]

Figure 5: Exports by countries' commitment to Net Zero emissions



Source: Energy and Climate Intelligence Unit, DFAT and Export Finance Australia

Unlocking Net Zero and digital opportunities

Current technologies will not be sufficient for Australia to meet its targets. Current technologies will deliver only 85% of reductions needed to achieve net zero by 2050. Breakthrough technologies are needed to deliver the 15% balance.

Most of the current focus is on alternative energy technologies (hydrogen, bioenergy, critical minerals, waste, energy productivity and future fuels). However, innovation and rapid technology development are required in a broad range of areas, including digital technologies that optimise systems and processes as well as automate measurement and monitoring.

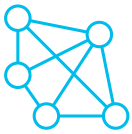
Digital – the mass adoption of connected digital services by consumers, enterprises and governments – boosts productivity, creates new jobs, and enhances the quality of life for society. This is driven by technology advances in several domains:

High-speed connectivity and mobility

Average US internet speeds increased by 40% (from 84.5Mbps to 118.4Mbps) during the pandemic, fuelled by technology advances and the rollout of 5G. The focus is already shifting to 6G using higher-frequency radio bands to deliver higher speeds and lower latency capable of supporting new applications.

Artificial Intelligence (AI) and Machine Learning (ML)

The market for ML is increasing at a CAGR of 38.6%[27] and is being applied to an expanding number of complex problems. AI/ML will be used to model complex systems to estimate carbon inventory and footprint with the use of IoT to 'ground truth' the result.



The Internet of Things

Physical objects are being embedded with sensors and actuators to connect and exchange data with other devices and systems. Ten billion active IoT devices or 'things' were connected to the internet in 2021 and forecast to surpass 25.4 billion by 2030. Data from these sensors will be used to enrich complex system models and enable optimisation.

Cyber security

New in-built cyber security defences and Zero Trust security models are helping to instil trust in critical systems and establish chains of confidence across vast data ecosystems.

Cloud

The transition to cloud has accelerated during the pandemic. Gartner forecasts that the proportion of global IT spending shifting to cloud will grow from 9.1% in 2020 to 14.2% by 2024.

Advanced networks

The subject of an entire chapter of this report, networks have undergone a major change to become software-defined, intent-based and highly automated.

Web3

Represents a decentralisation of the internet underpinned by blockchains. Web 3 is a nascent technology with the potential to transfer power and control from individual firms and individuals to the collective. Its high-profile application has been to cryptocurrencies but it has also been embraced for its security benefits.

Digital collaboration

A new generation of digital collaboration tools emerged from the pandemic with the potential to reduce transport-related carbon emissions. Nearly 80% of workers are using collaboration tools for work in 2021, a 44% increase from 2019.[28]

While each of these digital shifts is significant in its own right, it is their collective impact and collisions between discrete technologies that are having the most profound impact. The digital infrastructure for Net Zero will be shaped by the convergence of IoT, networks and processing technologies.

Digital plays a critical role in capturing new economic benefits, and is likely to do the same in relation to opportunities arising from Net Zero

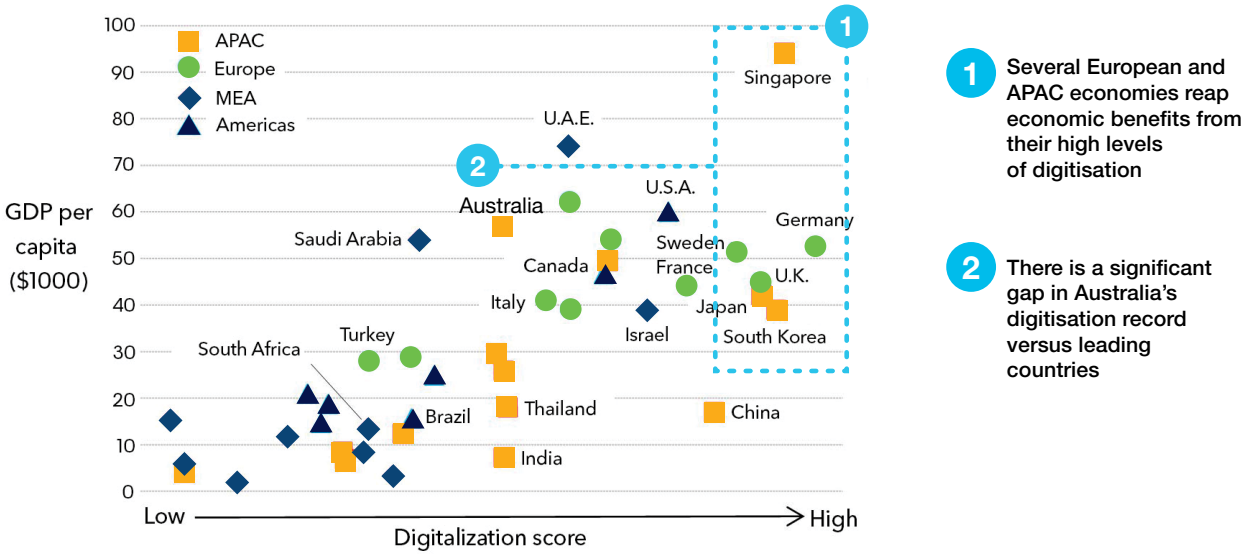
The past decade of digital disruption is a case study in how quickly the fortunes of nations that adopt digital can change. Technologically progressive economies out-perform the average, led by economically complex countries such as Singapore, Germany, the UK and South Korea.

Investment in digital also delivers higher economic returns than investment in traditional infrastructure. Increasing investments in roads, transmission lines and bridges by 1% would increase productivity by 0.23%.[30] In contrast, researchers estimated if the European Union built out its digital infrastructure to the level Norway achieved in 2011, GDP would rise by $355B, or 2.4% of Europe's GDP.[31]

The opportunity for Australia is to become a Net Zero leader by embracing digital:

"Over the coming years Australia has a $315B economic opportunity enabled by data and digital technologies. From a societal standpoint our growing and ageing population, ongoing urbanisation and concerns about our environment all present opportunities for Australia to demonstrate leadership domestically and on the global stage." – CSIRO

Figure 6: BloombergNEF digitalisation score vs GDP per capita[29]



Future of Net Zero Accreditation

The increased use of digital technologies, enabled by networks that provide trust, security and scalability, provide the potential to fully automate many of the manual processes used today. Annual reporting of emissions to the Clean Energy Regulator could be fully digitised leading to higher frequency and more accurate reporting, which would result in improved planning and faster responses.

Use of trusted information from sensors and approved reporting systems will enable future regulation as code to automate Net Zero accreditation. Proof of emissions matched with proof of offsets stored on public ledgers (Consensus Control Status Machines[32]) will allow smart contracts to be written that enforce regulation and technical standards i.e. regulation as code. Using these technologies will enable the scale required as a higher percentage of the circa one million Australian companies transition to Net Zero.

Chapter 3: Net Zero and digital are converging

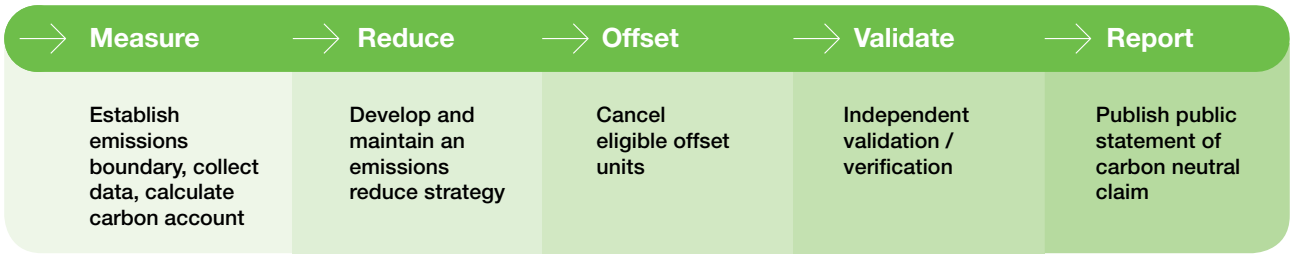
Insights:

- **The current process for measuring and reporting on Net Zero is manual and analogue**
- **Digital can be applied to every stage of the Net Zero conformity assessment process to make it more efficient, accurate and timely**
- **Specific roles for digital include automating the measurement process, modelling decarbonisation solutions, trading offsets, certification and dynamic reporting of emissions.**
- **Leveraging digital will improve the speed with which organisations can transition to Net Zero.**
- **Countries and organisations that embrace Smart Zero will get to zero emissions faster.**

Net Zero and digital are converging, with a role for digital at every stage of the Net Zero lifecycle.

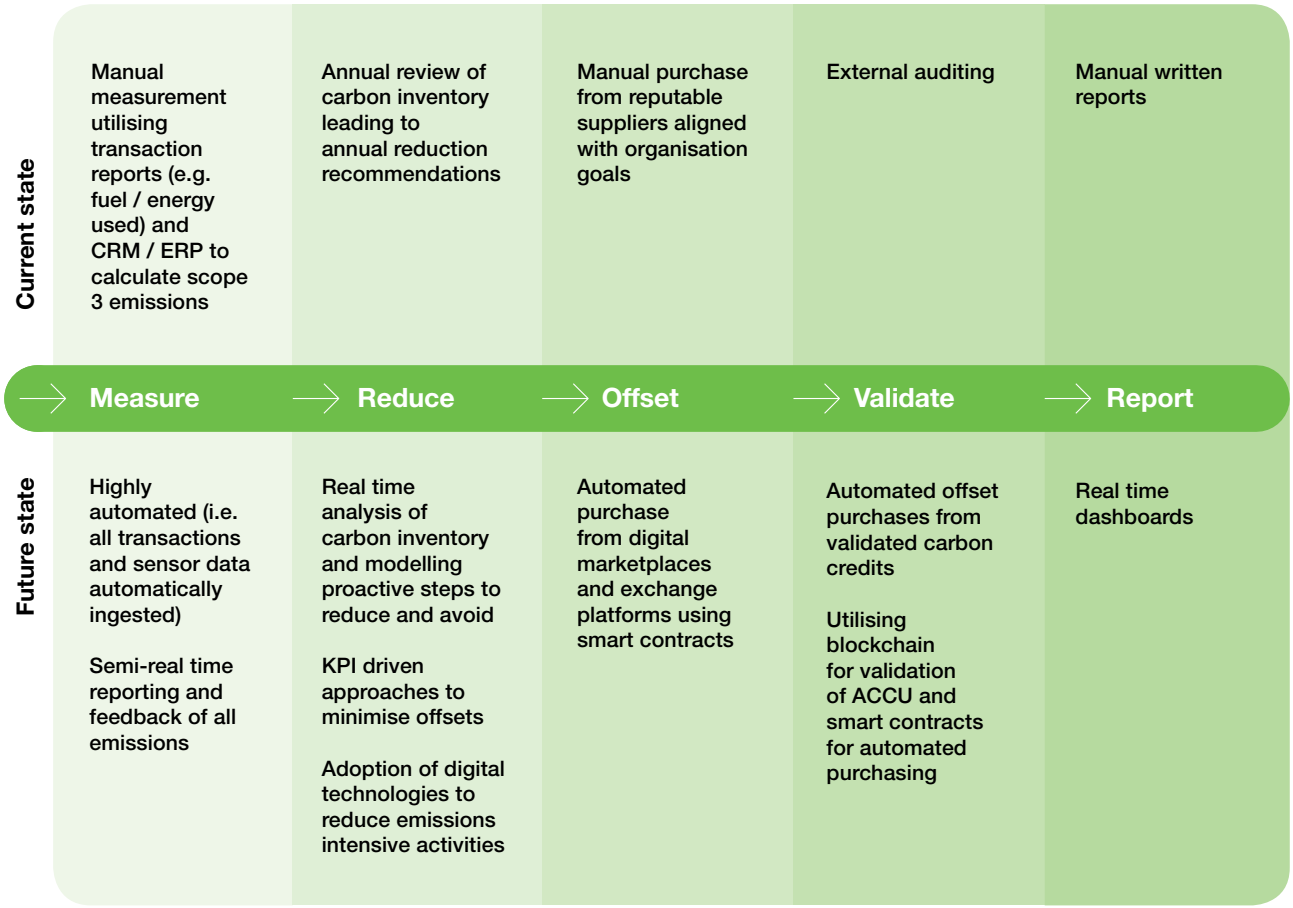
Net Zero and digital are converging, with a role for digital at every stage of the Net Zero lifecycle. Australian agency Climate Active uses a five-step process to guide Net Zero certification, from measurement through to reporting emissions to accrediting authorities and indirectly to Boards, shareholders and customers. Climate Active is funded by the Federal Government to oversee the accreditation of Net Zero for Australian businesses. This process is manual and analogue in nature, reflecting that most of the effort to date has gone into developing the accreditation process. Applying digital to every stage of the lifecycle will not only make the process more efficient for end users it will also improve accuracy, allow more regular reporting (including real-time) and allow data to be interrogated in new ways. A more digitised process will enable better and more timely decisions.

Figure 7: Net Zero lifecycle



As the Net Zero process is digitised new demands will be placed on underlying technology platforms – primarily the network. These demands include the need for greater speed, processing more complexity, requirements for scalability (more data, richer data and more distributed data) and improved security. Each step in the Net Zero lifecycle will change to deal with these demands (see Figure 8).

Figure 8: Digital transformation across the Net Zero lifecycle



This chapter analyses the impact of digital through each stage of the Net Zero lifecycle.

Measure

Current approach

The first step for businesses towards achieving Net Zero is to calculate the amount of greenhouse gas emissions they currently produce (carbon inventory). As it stands today, their carbon inventory is calculated indirectly via responses to questionnaires and, where applicable, from input fuel burn estimates. Australia's Clean Energy Regulator provides guidelines to assist in preparation of carbon inventory (National Greenhouse and Energy Reporting Technical Guidelines). Companies are also using Enterprise Resource Planning (ERP), Carbon Emissions Accounting Systems and Customer Relationship Management (CRM) platforms to assist with Scope 3 reporting, including employee travel.

How digital can improve this part of the process

The physical world is being digitised at a rapid rate through the proliferation of 'things' (including sensors and actuators). Sensors generate data relating to the environment (temperature, humidity, wind speed and direction), physical processes (vibration, acoustic, temperature), motion (image, video, LIDAR, or Light Detection and Ranging), chemical and other inputs. These connected assets often serve multiple purposes, and Net Zero is emerging as an important one. Data is transmitted to knowledge systems using communication networks and an important part of the measurement and monitoring process is being able to trust the data that is being captured for measurement and monitoring. Accurate digital measurement is a foundation for Net Zero reporting, but also for other critical systems and infrastructure.

Digital examples in measurement

Low-orbiting satellites:

GHGSat is an example of how technology has evolved to detect fugitive methane and carbon dioxide emissions. The low-orbiting satellites can measure any site in the world every two weeks and detect ~50% of methane emissions by volume in the US. The satellite instrument measures the absorption spectrum in targeted spectral bands with a spatial resolution < 50m, which is approximately two orders of magnitude better than other state-of-the-art satellites.[33]

GHGSat microsatellite:

Systems such as Climate Trace are using AI to analyse images of assets emissions in order to predict how much any given asset is emitting. These systems analyse images rather than pulling data from real systems and meters attached to buildings. It may become necessary to provide a more accurate ground truth to ensure these types of systems are not used to form emissions controls that may not be based on accurate data. The network does this and provides a more robust auditing platform.

Smart Environment Monitoring Systems:

The development in low-cost IoT sensors and the ability to capture and analyse data has enabled environmental monitoring to transition into Smart Environmental Monitoring Systems. A plethora of sensors now exist to measure marine environments, air quality and pollution, dust and humidity, radiation and soil monitoring.[34] Industry has also embraced the use of IoT technology to assist in the optimisation and automation of plants. The technology that is being used to improve efficiency is also providing invaluable data on the carbon inventory and pollution.

Reduce and avoid

Current approach

The second step involves reducing emissions where possible, commonly referred to as decarbonisation pathways. Switching to renewable energy, electrifying systems and making efficiency improvements can reduce a large proportion of carbon emissions. Business partnerships have a key role to play in reducing waste and accelerating low-carbon technology solutions, as well as exploring circular economy initiatives. Companies are already leveraging digital technologies to avoid travel and are also exploring the use of optimisation techniques to improve efficiencies across their business. These are manual, and measured annually or as part of an agreed reporting lifecycle.

How digital can improve this part of the process

The simplest way to decrease emissions is to not generate them in the first place. Digital technologies offer a broad range of substitutes for activities that contribute to an organisation's carbon emissions. These span all organisational functions including creating digital twin models of physical spaces (creating far lower emissions), using collaborative tools to create new ways of working (e.g. hybrid and remote working) and leveraging data to develop more carbon-efficient methods of production (e.g. moisture sensors to improve agricultural yields).

Digital examples in reduce and avoid

Digital twins and modelling:

Reducing emissions by optimising a system (e.g. city, plant, mine) requires a virtual model of the physical entity. Virtual models (digital twins) are used to simulate scenarios that may occur in the physical world, such as an environmental health decisions platform developed by AusEnHealth. A Liveable City Digital Twin project in Sydney is also being used to understand, model and improve urban liveability and climate adaptability.

Smart cities:

Cities are major contributors to climate change and investment is being directed towards making every aspect of a city's operation smarter and more efficient. There are now over 500 smart city projects globally, with annual technology spending of over $100 billion. The market opportunity for smart cities is forecast to reach over $3 trillion by 2025.[35] Cities consume 78% of the world's energy and produce more than 60% of greenhouse gas emissions but account for less than 2% of the earth's surface.[36]

Digital collaboration for hybrid working:

Using virtual conferencing rather than travel is an example of reduction. The meeting still takes place but the greenhouse emissions are limited to those generated by the IT infrastructure vs the use of transport, including vehicles and planes. To provide some perspective on the difference, researchers calculated that one hour of video conferencing generates 157g CO2 equivalent an hour (-e/hour) vs ~9,000g CO2-e/hour for vehicle use.[37] If air travel is included, the carbon inventory for the face-to-face meeting would increase to 3,153,000g CO2-e assuming a London-Perth flight, while a video call will generate just 0.0025% of that amount. This is reinforced by cleaner skies during the peak of COVID-19 in 2020.

Offset

Current approach

The offset process ensures any remaining emissions (after attempts to reduce or avoid) need to be cancelled out or retired[38]. These offset or retired units take different forms and cannot be used again. The benefit of carbon offsets is they enable the organisation to pay someone else in order to reduce their own emissions to achieve Net Zero. As an example, if an organisation takes its offsets in forestry the new trees need to be sequestered for 100 years to complete the 'cancelling out' process. These trees could be digitally tagged and monitored for that period as part of the offset process. There are a range of offset units available and they differ in quality.[39]

How digital can improve this part of the process

Digital technologies open up new possibilities for automating the purchase, verification and reporting of offsets, and ensuring that data is fully secure. This will help to reduce burdensome processes, reduce compliance and regulatory costs, improve accuracy, streamline workflows and improve transparency. Digital also offers the potential to enable new marketplaces for the trading of offsets.

Digital examples in the offset process

Digital exchange platforms:

Offsets are currently purchased manually using online auctions, typically via brokers. The Australian Government announced in 2020 $40m to fund ways to reduce regulatory burdens, including development of a new Exchange Platform for Emissions Reduction Units. The platform will increase transparency and make it easier to purchase Australian Carbon Credit Units, or ACCUs.[40]

Digital marketplaces for voluntary trading:

Global progress is being made to make the trading of voluntary carbon offsets simpler and more transparent. The Taskforce on Scaling Voluntary Carbon Markets is sponsored by the Institute of International Finance and includes more than 40 leaders from six continents, including representatives from the Bank of America, BlackRock, Bloomberg's New Energy Finance, BNP Paribas, BP, Boeing, Goldman Sachs, Tata Steel, Total, IHS Markit, and London School of Economics.

Blockchains:

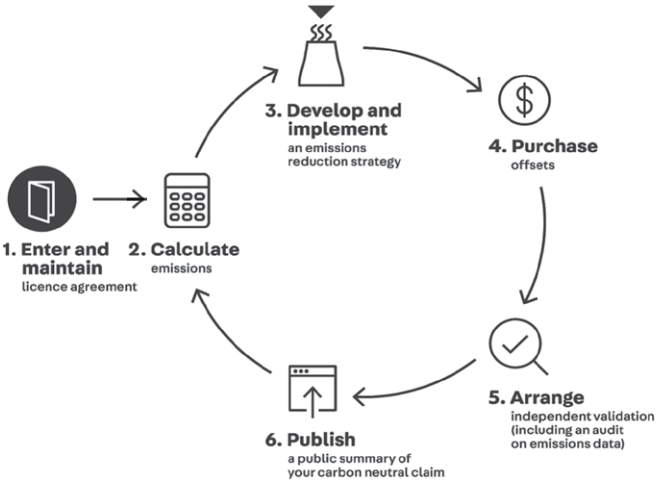
The future trading and verification of ACCUs and other offsets globally will likely include the use of blockchain and smart contracts to automate the trading process. The role of digital technologies in scaling and automating these processes will only increase over time.

Validation

Current approach

The validation of a Net Zero claim is conducted by a trained accountant, or for larger organisations a Climate Active registered consultant.[41] The consultant will provide an independent validation, including an audit of the emission data. Climate Active provides training and the necessary tools to conduct the assessment.

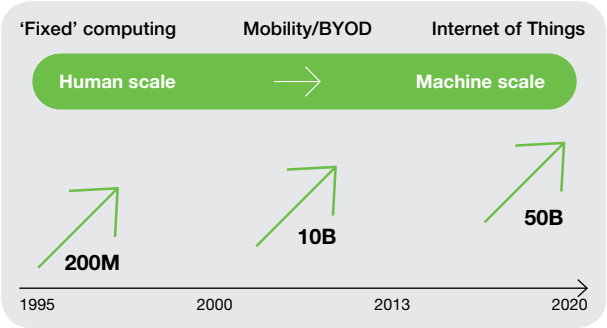
Figure 9: Getting and staying certified



How digital can improve this part of the process

Validating the veracity of data is becoming more important as systems become automated and dynamic. Decision-making for industrial systems is being transformed by intelligent systems, recognising humans cannot process the sheer volume and complexity of data generated by IoT (Figure 10).

Figure 10: Role of intelligent systems[42]



These decisions are typically being made within an organisation's boundary but this will change as datasets from multiple organisations, including the supply chain, will need to be harvested and analysed. This will require technologies such as blockchain to secure data and signal the data can be trusted.

Digital examples in reduce and avoid

Internet of Things in managing shipping and logistics:

The Port of Rotterdam is an example of where trusting the data from IoT devices is critical in the move to a fully autonomous port. The IoT data includes water temperature, tidal conditions, salinity (which affects buoyancy), wind direction and speed. This data is used by the Port's real-time big data analytics process to optimise vessel flows in and out of the port, improving the efficiency of infrastructure usage at the port.[43]

> "What the maritime industry of the future will demand is hyper-precise, standardised, secure and reliable port data with real-time information about the conditions in the port, whether it is the water heights, tidal streams, or wind conditions."
>
> **Erwin Rademaker, Port of Rotterdam Program Manager[44]**

Smart contracts to track energy use and GHG emissions:

There is an emerging market for automating the reporting and validation of energy use and GHG emissions. For example, the STRATO blockchain tracks energy and carbon usage on an immutable ledger with better frequency and automation using IoT devices and APIs.[45] Benefits include precise tracking of CO2 activity, automation of time-based events / smart contracts and giving regulators the ability to approve device readings.

> "Smart contracts are simply programs stored on a blockchain that run when predetermined conditions are met. They typically are used to automate the execution of an agreement so that all participants can be immediately certain of the outcome, without any intermediary's involvement or time loss. They can also automate a workflow, triggering the next action when conditions are met."[46]

Reporting

Current approach

Public reporting against an organisation's carbon neutral claim is an integral part of the Net Zero certification process. In Australia, Climate Active requires the organisation publish an annual report to communicate progress on emissions reduction activities and offsetting as part of a carbon neutral claim.[47] These biennial reports are published on the Climate Active website.

How digital can improve this part of the process

A challenge with the manual reporting process that is valid for two years is that it adds additional reporting burden onto the organisation and, once submitted, is likely out of date. Digital technologies will enable real-time dashboards that demonstrate how the organisation is tracking on its commitments rather than a summative method.

Digital examples in reporting

Living campus dashboard:

Curtin University is capturing data from over 1000 sensors across its campus and providing a real-time view of energy usage. The platform aggregates data from AEMO and the Bureau of Meteorology to provide a holistic view of the campus, its power consumption and generation.

UC Berkeley engagement dashboard:

The dashboards show real-time energy use, steam and water use for campus buildings. Leveraging sensors across 137 buildings the dashboard provides visualisation of energy water use. Visualising usage helps staff and students see the impact of energy-saving measures.

Integrating customer relationship management systems to calculate carbon emissions:

Vendors are providing applications that can automate scope 1, 2 and 3 emissions by leveraging data within CRM systems. Emissions from travel, including domestic and international flights, can be calculated directly.

Chapter 4: Net Zero Requires an Advanced Network

Insights:

- **Transitioning to Net Zero places new demands on the network.**
- **Future networks need to enable digital technologies to support the Net Zero lifecycle.**
- **Future networks will need to use less energy and produce less waste.**

The network is critical in a world where everything is connected

The transition from manual to automated processes, human to machine scale and analogue to digital is driven by one critical factor: data. Or more specifically, networked data. In a world where almost everything is connected – both people and things – the network is both a potential point of failure and an enabler for Net Zero. The network enables the collection of data and validates its trustworthiness.

Organisations that embrace advanced networks will have advantages over those that don't:

Faster pace of digital technology adoption across the Net Zero lifecycle

Ability to absorb and analyse high volumes of environmental data being generated

Improved accuracy by leveraging the network to increase trustworthiness of environmental data.

Every stage of the Net Zero lifecycle offers opportunities for digital innovation, but also places additional pressure points on the network (Figure 11).

Figure 11: Additional demands being placed on network by Net Zero

Pressure points created by Net Zero	Examples of specific Net Zero demands
More and more demanding users and devices Net Zero is leading to more data, richer data, and more devices coming online	• Sensors (e.g. air quality, dust, humidity, radiation, soil monitoring) to collect surface level data • Low-orbiting satellites to collect atmospheric data • Actuators to reconfigure operations based on real-time data
New and complex applications and services New applications for measurement, monitoring and decarbonisation including blockchain are being developed, e.g. cloud native is the new rapid application development framework	• Digital twins to monitor decarbonisation impacts • Smart contracts / blockchain to automate offsets and validate reporting • Applications for real-time reporting
Outcome-based security and compliance IT / OT convergence and the need for real-time visibility including across supply chains is creating new security demands	• Balancing confidentiality, integrity and availability • Ensuring availability of operational technology
Continuous innovation Enterprise is trending to rolling out AIOps tooling, access to data and insights	• Research systems • Solving short and medium-term challenges related to digital and Net Zero at every stage of the lifecycle

The digital infrastructure for Net Zero will be shaped by the convergence of a range of technologies such as AI and Machine Learning, IoT, cyber security, and Web3. Major shifts are happening in the way that networks are designed and operated to respond to this convergence including the 'softwareisation' and 'cloudification' of networks. The border between the network and the cloud is likely to disappear, with devices, machines and 'things' becoming terminals that store data locally and deliver network functionality. The relationship between the network and cloud will be so embedded that it will appear only if it's not working properly.

How advanced networks will support the transition to Net Zero

There are two distinct roles that advanced networks will play in the transition to Net Zero:

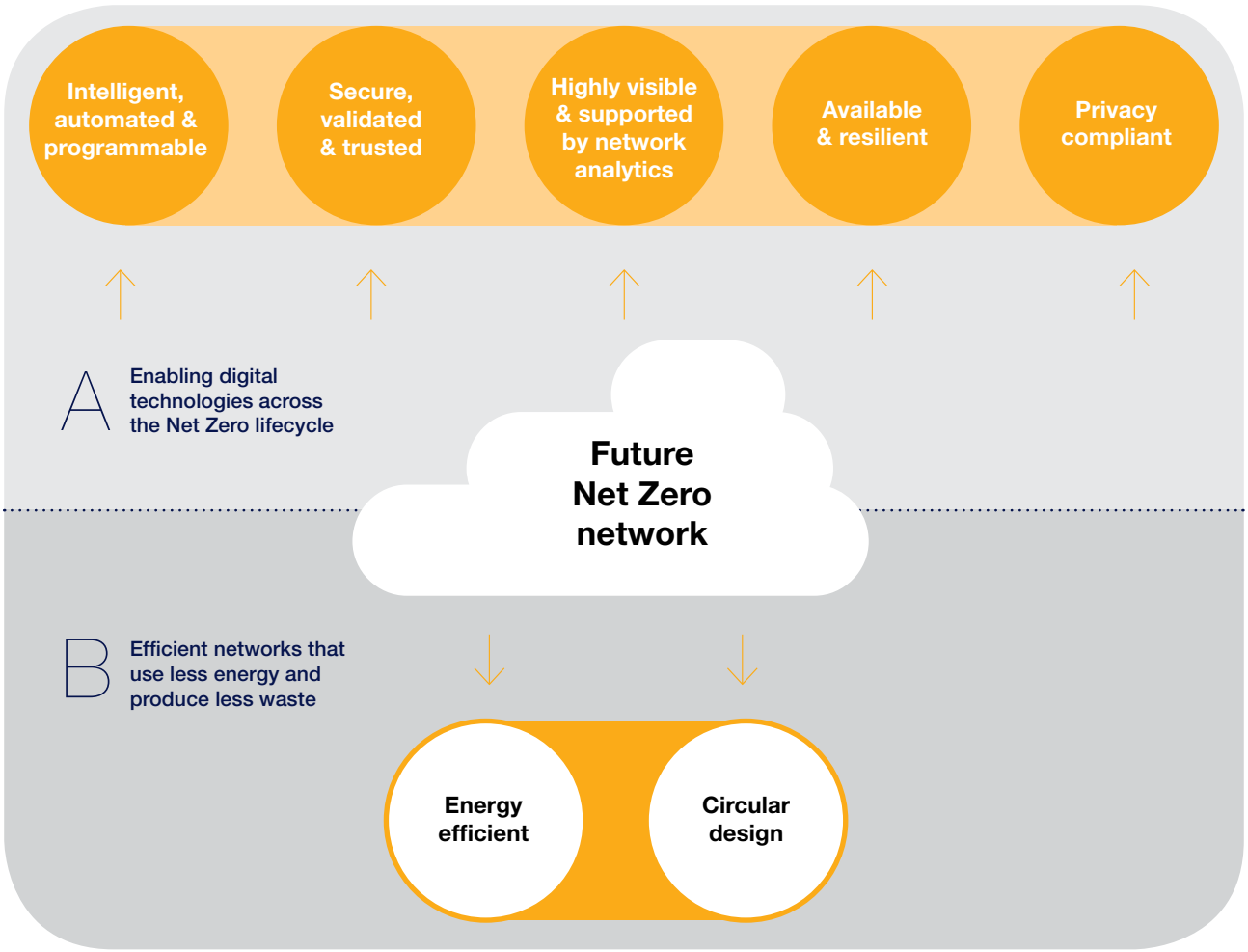
A Advanced networks will need to be optimised to functionally support Net Zero

Advanced networks must continue to evolve if they are to support the full range of digital services detailed in chapter three. The network will need to cope with higher data volumes, increased complexity and more sophisticated and better resourced cyber attackers.

B Advanced networks will need to be more energy efficient and minimise waste

Advanced networks will become major consumers of energy as a proportion of global demand. Net Zero networks will need to be designed to consume less energy and create less waste.

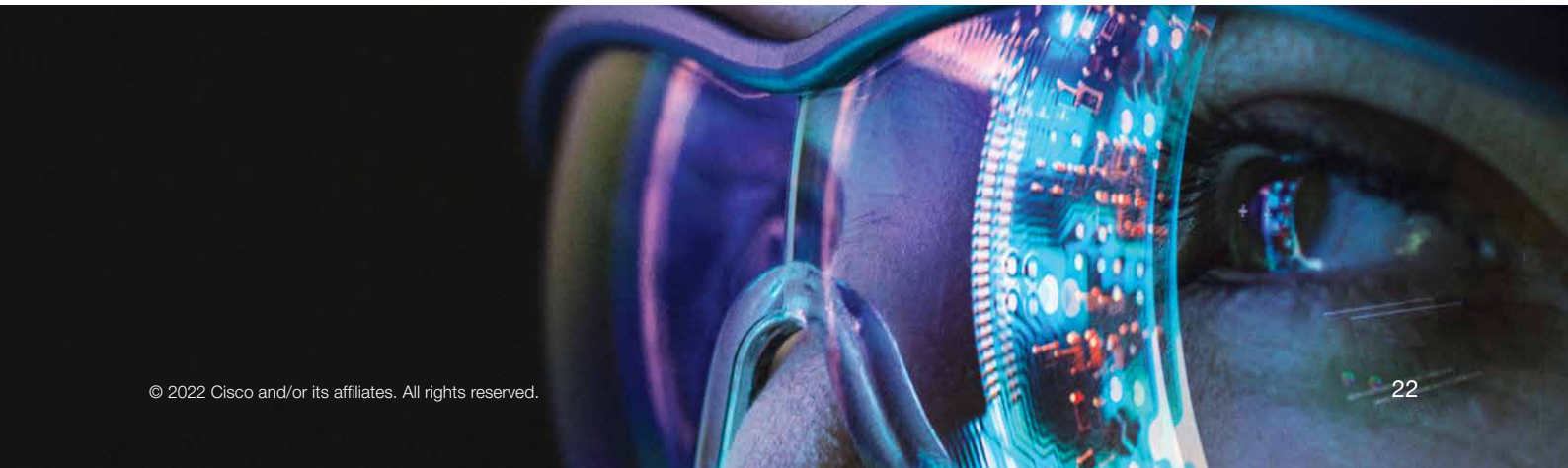
Figure 12: Future Net Zero Network

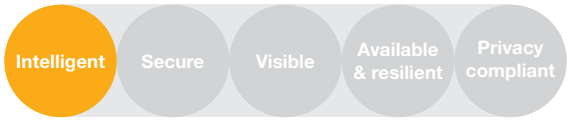


Advanced networks will need to be optimised to functionally support Net Zero

The primary benefit of advanced networks is the capacity to optimise functions and automate processes. Advanced networks can be applied to a range of industry sectors and business functions. This allows organisations to optimise all aspects of their operations and infrastructure to save costs, remove complexity, create new sources of value and improve productivity. The network's capacity to support optimisation at scale will enable a range of Net Zero innovations that make Australian industry more productive, responsive and transparent.

To capture Net Zero opportunities, advanced networks must have the following characteristics:



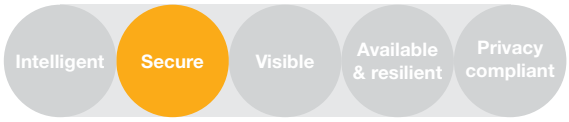


Intelligent, automated and programmable

Advanced networks require high levels of intelligence and automation to deal with volume and complexity. This includes the capacity to segment users and devices based on prescribed policies. As an example, the policy for a CO2 sensor would be highly restrictive and very different from the policy prescribed for a site operator. These policies need to be dynamic and software-defined. Intelligence in advanced networks automates the connectivity process and enables detection of flaws in configuration, provisioning, managing and programming anything connected to the network. They also have the capacity to prioritise workloads based on size and profile, e.g. from low bandwidth Internet of Things (IoT) sensors through to streamed 4K video, and are able to adapt to the intent of the user as part of the policy-setting process.

In the future, networks will need to meet a range of Net Zero use cases and complexities, including building inter-network communications to create the 'Global Control Loop' recommended to support the convergence of digital and Net Zero.[48] Digital twins could generate rich data flows enabling a 'control loop' for the planet's emissions, which would allow much better planning, monitoring and control of the world's pollution.

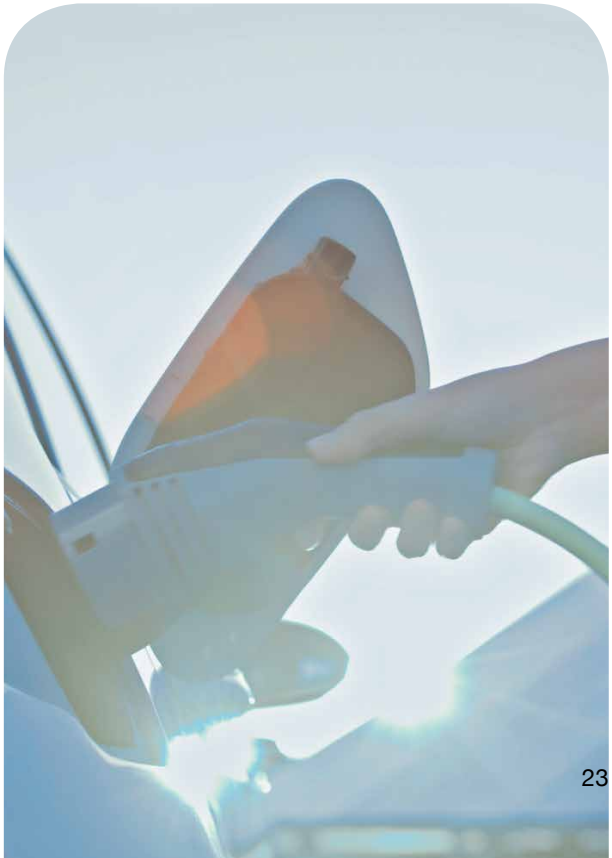
This includes inter-network programmability that allows other networks to interrogate data flows and other functions to compile policies and make adaptations. Self-healing and self-optimising algorithms will be leveraged to support the control loop with each node on the network being capable of learning and predicting its own traffic. This will introduce new frontiers of applied research, including use of materials such as silicon to forward packets and drive Artificial Intelligence (AI) algorithms required by Net Zero.



Secure, validated and trusted

The capacity to assess trust is vital given data flowing over the internet – sometimes into a provider's cloud – includes login credentials, government ID numbers, financial information, trade secrets, business plans and critical infrastructure details. Trust is not about only one thing (e.g. encryption, certification or supply chain oversight); it is about a combination. Advanced networks use intelligence to automatically prevent, detect and respond to threats and segment users and things based on their potential threat level. This includes in-built defences against modification by unknown parties, adherence to standards and Zero Trust security models, establishing chains of confidence, building trust into contracts and capacity to undertake vulnerability testing.

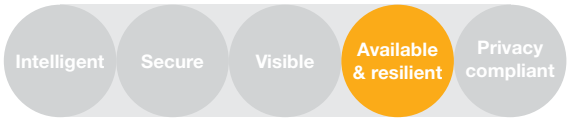
Trust is a cornerstone of future networks, which will need to provide greater insight to deliver contestation, provenance, explainability and auditability of data. This includes verifying data from sensors using location data within the network as part of the 'chain of trust' (for both inter-and intra-network traffic). Advanced techniques will need to be developed so the network can establish latency between network locations to ensure the end point is where it says it is, automating writing into blockchains, capturing data for smart contracts and enabling mutual authentication of environmental sensors and actuators to ensure created can be trusted by analytics engines.



Highly visible and supported by network analytics

Network analytics are crucial to gauging how well the network is operating and whether it's meeting organisational needs. These analytics are being used to predict issues before they happen or trigger automatic remediation using machine learning. Full visibility through the technology stack creates a basis for troubleshooting, full stack visibility, data analytics and automation.

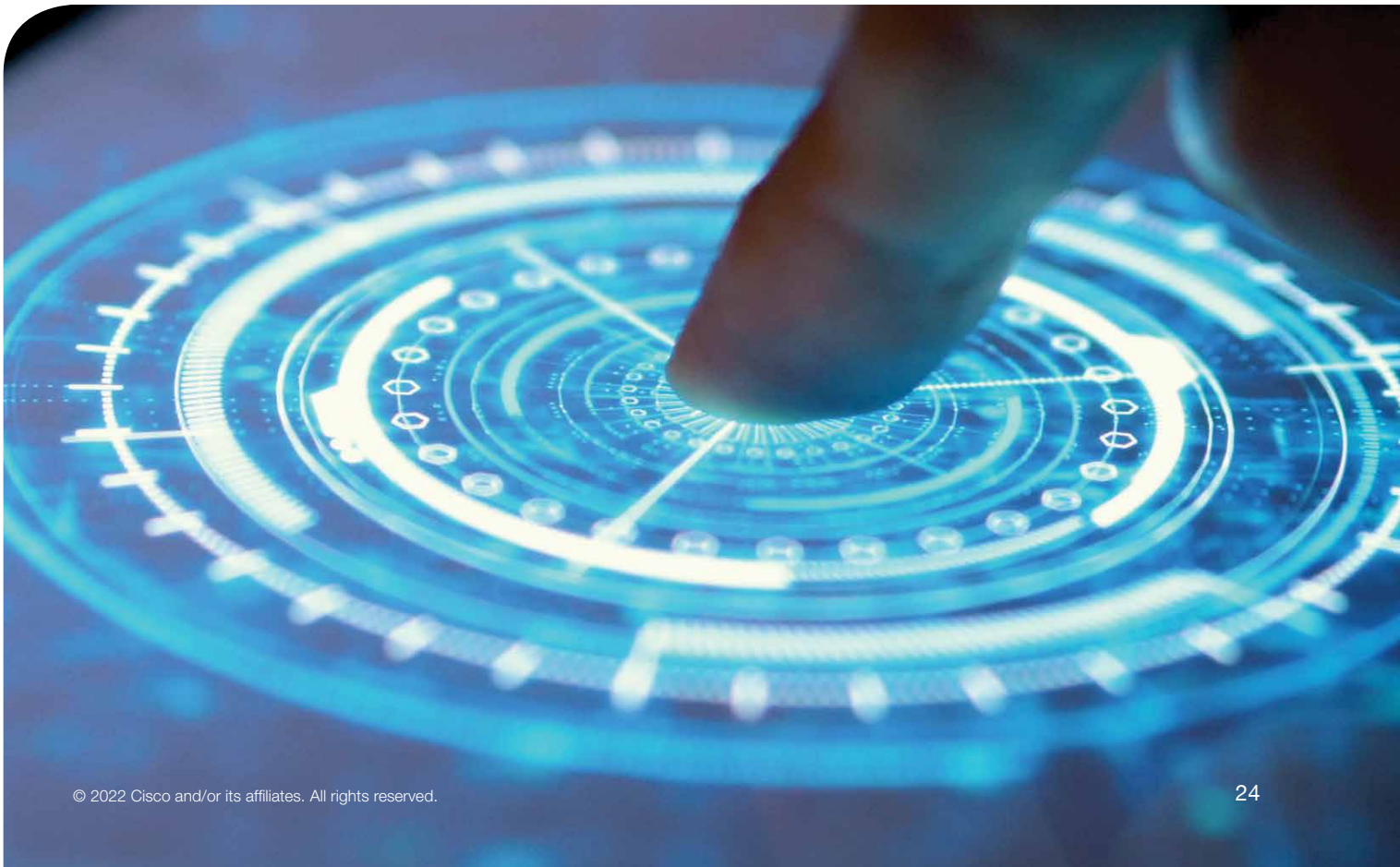
Networks analytics will take on even greater importance in a Net Zero world where data collected by the network will be triangulated with other data sources across the lifecycle. These analytics will include the capacity to help predict issues before they happen, triggering automatic remediation for Net Zero KPIs that are programmed into the network. The inter-relationship between network analytics and machine learning will be a major opportunity for applied research and innovation.



Available and resilient

In a world where everything is networked, people, processes and technology need a reliable, persistent connection enabling workers, customers and partners to connect to data and devices. Advanced networks suffer fewer unplanned outages and interruptions, and reduce time needed to address problems that occur. They can also help to limit the impact and risk of disruptions. The cost of losing business continuity is significant, with one study estimating the cost at $700,000 per outage.[49]

In the future, open networking international standards will play an important role in improving availability and resilience. Standardisation will help to improve interoperability between networks and create a more effective platform for innovation. Another area of exploration is related to 5G networks, which will include stringent requirements on reliability, availability and resilience.[50] In practical terms, this means that enterprises with business-critical use cases in segments such as manufacturing and transport – which are high emitters of greenhouse gas – will be major beneficiaries.



Privacy compliant

Privacy is a fundamental human right in the digital economy. Increased use of IoT, 5G, AI and other technologies will require more sophisticated, comprehensive and interoperable data protection laws to secure those rights. Legislation must ensure interoperability between privacy protection regimes, avoiding fracturing of legal obligations for privacy. In a dynamic environment, multiple stakeholders will be involved in privacy design and enforcement. Critical privacy considerations include:

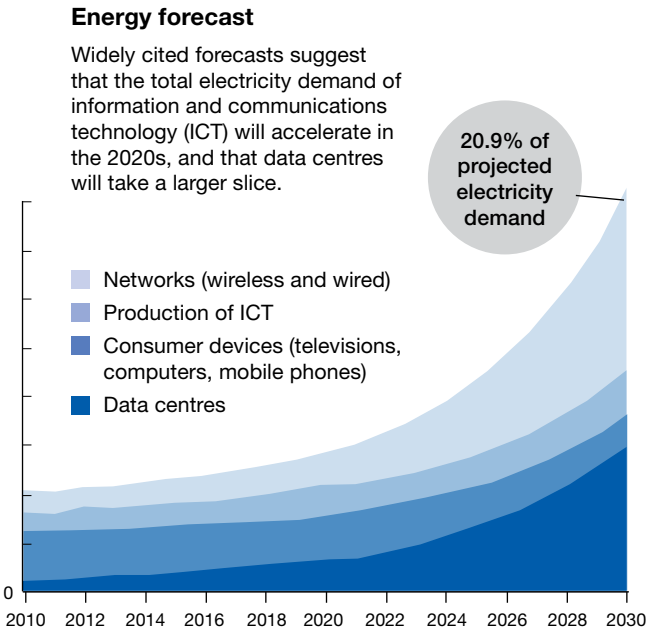
- **Security:** protecting the confidentiality, integrity, availability and resiliency of data
- **Transparency:** explaining how data is collected, used, transferred and disclosed
- **Accountability:** assigning a data protection team capable of applying a risk-based approach.

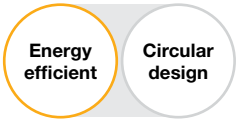
Privacy will take on an even greater importance in a Net Zero context. As the requirement for more data grows to support automation and optimisation of cities, as an example, massive amounts of Personally Identifiable Information will be generated. It is important that energy consumers, third-party suppliers, regulators and policy makers can trust that their data is safe across the Net Zero lifecycle. Future networks will need to provide enhanced services in protecting users' information by anonymising data at the edge. A range of potential applied problems are emerging, including how to protect data being generated, how to support data anonymisation and the role of networks in trust brokerage.

Advanced networks will need to be energy efficient and minimise waste

The proportion of electricity used by information and communications technology (ICT) is projected to grow to almost 21% of the world's electricity by 2030[51], compared with just 1% of global electricity demand in 2018. More than a third of the demand will be created by networks (wired and wireless), in part to power the decarbonisation solutions across the economy. Data centres are the next highest in terms of energy output, followed by production of ICT and consumer devices.

Figure 13: Energy forecast[52]

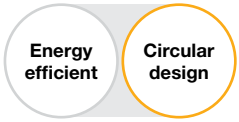




Energy Efficient

The largest share of emissions for networking companies comes from the use of its products rather than the manufacture or fulfilment of those products. Action is therefore required to ensure that as networks become more advanced, they also become more sustainable. Cisco is pioneering innovations such as Silicon One, a programmable chip in its latest router that consumes 26 times less power than its predecessor.

Cisco's Smart Building solutions also help reduce energy use through low-voltage Power over Ethernet (PoE) switches that provide network-based monitoring and control of temperature, lighting, air quality, and other building characteristics. This enables facilities operators to monitor systems and devices, manage energy use, track occupancy levels to protect occupants' health and safety, and troubleshoot issues that have the potential to use unnecessary energy. Operational efficiency will become a default KPI for network operation, including leveraging advanced artificial intelligence and machine learning to create a 'predictive network' that strives to minimise power consumption. The benefits of accelerating innovation in this area are compelling, given the best-case scenario is almost two-thirds less than 'likely'– i.e. ICT could represent as little as 8% of total energy demand by 2030 rather than the 20.9% forecast.[52]



Circular Design

Circular design aims to limit the extraction of raw materials and the production of waste. It does this by recovering and reusing products and materials. There are four primary areas of circular design: designing for reuse, designing for refurbishment, designing for remanufacture and designing for recyclability. It is based on three principles: design out waste and pollution; keep products and materials in use and regenerate natural systems. The circular design of ICT products and equipment will be increasingly important given the ubiquitous of technology and proliferation of devices.

Cisco case study

Cisco's Net Zero response involves moving away from a linear economy, where products are used and thrown away, to a circular economy that makes better use of natural resources. Commitments include:

- **100% product return and all new products and packaging to incorporate circular design by 2025**
- **70% of Cisco component and manufacturing suppliers by spend will achieve a zero-waste diversion rate at one or more sites by FY25**
- **50% improvement in product packaging cube efficiency by FY25**
- **75% reduction in Cisco packaging foam use, measured by weight, by 2025.**

In 2021 Cisco committed to reaching Net Zero greenhouse gas (GHG) emissions by 2040, 10 years ahead of when climate scientists say the planet must reach Net Zero to avoid the worst impacts of climate change. This covers all scopes of emissions, including those from Cisco's direct operations, its supply chain (i.e. Scope 3), and from the use of our products. Cisco also plans to achieve Net Zero for its global Scope 1 and 2 emissions, which covers direct operations, by 2025.

Chapter 5: Smart zero research and skills are needed

Insights:

- **Research is needed to develop Net Zero Networks to support new demands. This includes research to overcome technical, operational and market challenges.**
- **New skills will be required to design and implement future Net Zero networks if Australia is to capture the full economic benefits of Net Zero.**

Demand is building for new solutions to the climate change challenge.

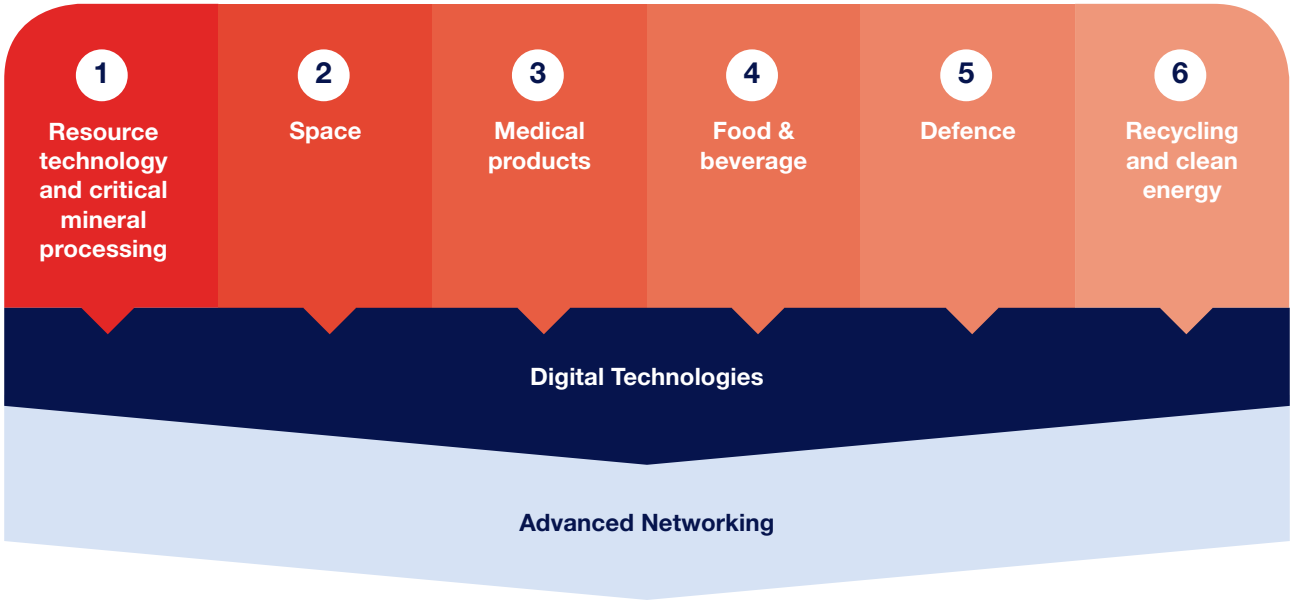
To date, the focus has been on the development of alternative energy technologies (solar, wind, hydrogen, blue, green, carbon capture sequestration and battery technology). The role of digital in reducing or avoiding emissions has been largely ignored or unknown.

This report demonstrates the convergence of digital and Net Zero is a new economic and scientific frontier for Australia. Accelerating the pace of – and improving outcomes from – this convergence requires a combination of applied research and new skills, and an industry-driven focus. Curtin University is well placed to lead the digital aspects of this given its academic credentials, research capabilities, industry partnerships and the Centre for Networks. Cisco, as its strategic partner, provides global network leadership and a track record of innovating at scale. Net Zero will place enormous demands on underlying networks from a technical, operational and market lens. To truly accelerate the transition to Net Zero, Australia needs:

1. Applied research that is collaborative, industry-led and globally relevant

Research into digital and Net Zero convergence has the potential to contribute to all six of the Australian Research Council (ARC) priorities, but particularly priorities one and six.

Figure 14: Australian Research Council (ARC) priorities



The ARC's investment criteria are closely aligned to the purpose and approach of the Cisco-Curtin Centre for Networks. The Centre provides an innovative approach to solving large-scale problems that will deliver community impact. At the heart of digital and Net Zero convergence is the need for interdisciplinary research, at scale. Collaborative research needs to be industry-driven and grounded in global best practice. Cisco's involvement in the Centre for Networks provides access to an ecosystem of partners and customers that will need to set and meet Net Zero targets, underpinned by advanced networks.

Clear research questions and priorities are already emerging:

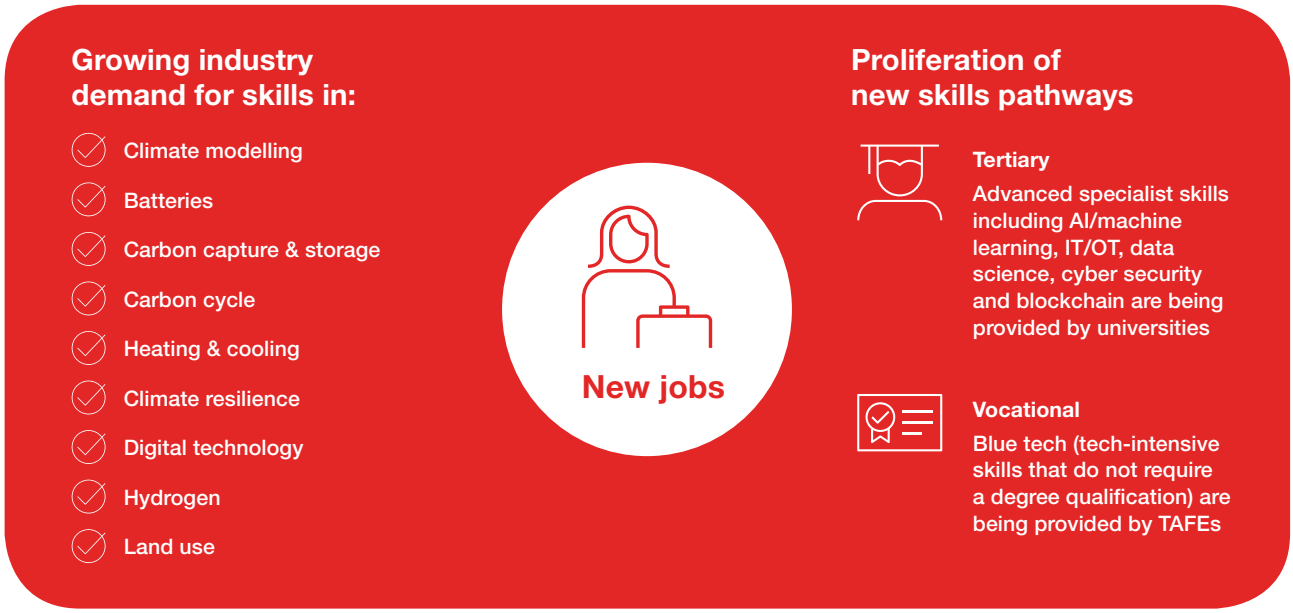
- Digital and Net Zero convergence in high-emitting industry sectors
- Net Zero use cases for advanced networks
- Use of Artificial Intelligence and Machine Learning for predicting energy consumption
- Transforming energy and digital systems to allow greater integration and optimisation
- Creating a data infrastructure for Net Zero
- Optimising 5G technologies to support Net Zero
- Architecting 6G to embed support for Net Zero in telecommunications infrastructure
- Energy-aware disaggregated and virtualised RAN
- Energy-aware distributed edge computing
- Developing safe and robust core digital capabilities towards a 'control loop' for Net Zero
- Developing new green computing approaches
- Developing digital technology to enable other mitigation activities
- Fair distribution of the costs and benefits of the data-led Net Zero transition.

There is significant scope for research into market dynamics relating to the convergence of digitisation and Net Zero. Vendor diversification is an emerging priority for governments globally, prompted by a lack of competition in the 5G market, which Ericsson and Nokia dominate. Governments will need to develop standards to allow multiple vendors and exploration of Open RAN (O-RAN) and virtual RAN technologies built on open interfaces and community-developed standards.

2. Specialist skills to meet the digital / Net Zero challenge

If Australia is to create and fill 672,000 new jobs – and deal with the turbulence that's likely to occur within existing roles – it will need a clear plan and the capacity to accurately forecast and respond to skills demand. The Federal Government has already outlined a plan to invest in 10,000 New Energy Apprentices and a New Energy Skills Program. But this is just the beginning. The Royal Society's analysis of how science and technology can assist climate change highlighted 12 areas that will lead to new skills, new industries and new jobs. The highlighted areas include climate modelling, carbon cycle, digital technology, batteries, heating and cooling, hydrogen, carbon capture and storage (CCS), climate resilience and land use.

Figure 15. The skills opportunity for Australia



Each sector will require a unique set of new skills relevant to specific markets but all will be underpinned by digital capability to measure, reduce or avoid, offset and report on Net Zero

These skills include:

- Advanced specialist skills including Artificial Intelligence and Machine Learning, Information Technology and Operational Technology, data science, cyber security, blockchain and are typically provided by universities
- Blue tech (tech-intensive skills that do not require a degree qualification), likely provided by TAFE
- Basic literacy in digital and Net Zero required for most roles.

3. Exploration of the convergence of digital and Net Zero from a policy and funding perspective

Digital technologies will be vital to establishing baselines for measurement, monitoring of emissions, supporting applications that will help industry to decarbonise, and collecting data across the entire emissions spectrum that will help us make more informed decisions. This capability will be reliant on a digital backbone and that backbone will take the form of an advanced network. Networks have evolved significantly in the past decade in response to the existing demands required to support digital technologies and they will need to evolve even more, and faster, to meet the future demands.

A risk for Australia is designing and developing its Net Zero response in silos, one technology at a time. The question for governments is not whether to prioritise investment in digital or renewables research, but rather invest in understanding how they converge. It is believed Australia does not have the time to retrofit digital solutions after the fact – it needs a 'digital first' approach to Net Zero response from the outset. Australia has an opportunity to be one of the global leaders in research that sits at the intersection of digital and Net Zero. Not only will this accelerate Australia's progress towards Net Zero, it also offers an opportunity to develop technologies, policies and skills for the world and make its economy more complex and resilient.

There is a critical role for the Federal Government to play

The Federal Government has a major role to play in bringing forward the economic benefits of Net Zero. Using its purchasing, funding, policy and regulatory levers, the government can create an environment that will encourage private sector investment and maximise the returns from research funding. Recommended actions needs to be taken across four areas:

Figure 16: Recommendations for government

Role of government			
Procurement & public sector investment	**Research funding**	**Skills development & industry policy**	**Regulatory & policy**
1. Lead by example in terms of the Federal Government's own targets, language and international profile on the issue of Net Zero 2. Ensure Government agencies embed ESG-related criteria - including a supplier's planned pathway to Net Zero - in government technology contracts 3. Create funding incentives at department and agency levels to develop new Net Zero use cases leveraging government's technology investment including in advanced networks	3. Develop a national centre of excellence focused on leveraging digital technologies to accelerate the transition to Net Zero 4. Develop a nationwide Digital Twin strategy for built infrastructure to enable Net Zero collaboration at the data layer 5. Fund applied research that explores how digital technologies / networks can be more sustainable in their own right 6. Ensure funding guidelines acknowledge the importance of universities investing in and leveraging their own technology assets for Net Zero research 7. Make targeted investments in digital infrastructure at economic precincts to ensure they model progressive workplaces and enable Net Zero innovation in different sectors	8. Undertake a detailed analysis of the role digital will play in helping specific industry sectors / public sector reach Net Zero 9. Map and develop a plan for developing the skills required to meet Net Zero obligations, including advanced and blue-tech skills	10. Create a national approach to digitising the Net Zero lifecycle including reporting and incentives for key agencies (Climate Active, Clean Energy Regulator) to automate the reporting and accreditation functions 11. Ensure government departments and agencies lead by example in digitising Net Zero monitoring and reporting

Conclusion

Net Zero is a mainstream organisational challenge and will drive quantifiable accountability

Achieving Net Zero will assist in mitigating environmental risks and help Australia capture economic opportunities: new jobs, exports, foreign direct investment and improved economic complexity.

Leveraging digital technologies can accelerate Australia's progress to Net Zero. However, current technologies will not be sufficient for Australia to meet its collective targets. Innovation and rapid technology development is required in a broad range of areas, including how digital technologies will assist in reaching Net Zero ambitions. Digital technologies will help optimise systems and processes and create value at every stage of the Net Zero lifecycle.

In a converged digital-Net Zero world the network becomes a critical enabler. The volumes of data required to capture, monitor, measure and report on Net Zero will place additional requirements on advanced networks to ensure that data can be collected, analysed, secured and enable automation. Networks will also need to be more energy efficient in their own right, and lead to less waste. They will embrace circular economy principles, as a minimum, and potentially be redesigned in ways that prevent emissions being generated in the first place. Major research and skills challenges must be navigated if Australia is to reap the economic opportunities from digital-Net Zero convergence.

Next steps emerging from this report include:

- Development of a Commonwealth Government submission that synthesises major findings and identifies priority recommendations
- Collaboration between members of the National Industry Innovation Network on themes arising from the report. This is likely to include joint funding bids among NIIN members in research areas such as use of Artificial Intelligence and Machine Learning algorithms for predicting energy consumption of a digital service, Net Zero 6G architecture, energy-aware distributed edge computing, disaggregated and virtualised RAN and 5G orchestration supporting Net Zero
- Staging a national roundtable series focused on the implications of Net Zero for different industry sectors
- Creation of a short video to take the Net Zero report and its implications to new audiences.

Appendix

References

1 For example, as part of the recent UN Climate Change Conference (COP26), countries were asked to come forward with 2030 emissions reductions targets that align with reaching net zero by the middle of the century.

2 Greenwashing is a form of marketing spin that is deceptively used to convince the general public of the veracity of an organisation's claims it is environmentally responsible.

3 Accenture. 2021. "Mission Zero: Australia will achieve $2.1 trillion future with 672,000 jobs." Daily Telegraph. https://www.news.com.au/national/australias-21-trillion-future-with-672000-jobs-and-net-zero-emissions/news-story/c1c943fc13ce526be2533d896f6ff9e8.

4 Business Council of Australia 2021. "Achieving a net zero economy". Business Council of Australia Newsroom. https://www.bca.com.au/achieving_net_zero_with_more_jobs_and_stronger_regions

5 Greenhouse gas emissions are expressed using three 'scopes': Scope 1 covers those emissions released at the site as a result of direct on-site activities. Scope 2 covers indirect emissions principally as a result of electricity consumption, but may also include emissions from heating, cooling or steam consumed at a facility but produced elsewhere. Scope 3 emissions are all indirect emissions – not included in scope 2 – that occur in the value chain of the reporting company, including both upstream and downstream emissions.

6 Hoefflinger, Bernd. 2020. "High-Performance Computing Trends." NANO-CHIPS 2030, (June), 269-273. 10.1007/978-3-030-18338-7_16.

7 The Royal Society is an independent scientific academy in the UK that promotes excellence in science.

8 Royal Society. 2020. "A net zero climate-resilient future: science, technology and the solutions for change." Royal Society. https://royalsociety.org/-/media/policy/projects/climate-change-science-solutions/climate-science-solutions-overview.pdf

9 Ritchie, Hannah, and Max Roser. 2020. "Emissions by sector." Our World in Data. https://ourworldindata.org/emissions-by-sector.

10 WSP Global. 2020. "Net Zero: Are SMEs The Missing Link In The Chain?" WSP. https://www.wsp.com/en-AU/insights/net-zero-are-smes-the-missing-link-in-the-chain.

11 Broadbent, Hannah. 2021. "New analysis shows that the world's richest countries are among the worst coal power emitters when you adjust for population size." Ember. https://ember-climate.org/commentary/2021/11/11/per-capita-coal-power-emissions-show-australia-and-south-korea-far-beyond-india-and-china/

12 Business Council of Australia 2021. "Achieving a net zero economy". Business Council of Australia Newsroom. https://www.bca.com.au/achieving_net_zero_with_more_jobs_and_stronger_regions

13 Accenture. 2021. "Mission Zero: Australia will achieve $2.1 trillion future with 672,000 jobs." Daily Telegraph. https://www.news.com.au/national/australias-21-trillion-future-with-672000-jobs-and-net-zero-emissions/news-story/c1c943fc13ce526be2533d896f6ff9e8.

14 Accenture. 2021. "Mission Zero: Australia will achieve $2.1 trillion future with 672,000 jobs." Daily Telegraph. https://www.news.com.au/national/australias-21-trillion-future-with-672000-jobs-and-net-zero-emissions/news-story/c1c943fc13ce526be2533d896f6ff9e8.

15 Morgan Stanley. 2019. "Decarbonization: The Race to Zero Emissions." Morgan Stanley. https://www.morganstanley.com/ideas/investing-in-decarbonization.

16 PricewaterhouseCoopers. 2021. "State of Climate Tech 2021." PwC. https://www.pwc.com/gx/en/services/sustainability/publications/state-of-climate-tech.html

17 Forbes. 2021. "Mark Carney's Ambitious $130 Trillion Glasgow Financial Alliance For Net-Zero." Forbes. https://www.forbes.com/sites/jillbaker/2021/11/08/mark-carneys-ambitious-130-trillion-glasgow-financial-alliance-for-net-zero/.

18 Bloomberg. 2021. "ESG assets may hit $53 trillion by 2025, a third of global AUM." Bloomberg.com. https://www.bloomberg.com/professional/blog/esg-assets-may-hit-53-trillion-by-2025-a-third-of-global-aum/.

19 Australia is investing in a series of new initiatives to accelerate the development of a hydrogen industry. For more information, see: https://www.pm.gov.au/media/australia-and-germany-partner-hydrogen-initiatives

20 Plessis, Coert d. 2021. "Net Zero is only possible if mining gets Net Zero." Rottofest. WA, Australia.

21 Nesler, Clay, Khee Poh Lam, and Bertrand Lasternas. 2021. "How to build smart, zero carbon buildings - and why it matters." The World Economic Forum. https://www.weforum.org/agenda/2021/09/how-to-build-zero-carbon-buildings/.

22 Business Council of Australia 2021. "Achieving a net zero economy". Business Council of Australia Newsroom. https://www.bca.com.au/achieving_net_zero_with_more_jobs_and_stronger_regions

23 Wayne Cole. 2021. "Australia risks offshore investment drought from climate change." Reuters. https://www.reuters.com/world/asia-pacific/australia-risks-offshore-investment-drought-climate-change-rba-2021-10-13/

24 Export Finance Australia. 2021. "Australia—Net zero emissions by 2050 would alter export profile." Australia—Net zero emissions by 2050 would alter export profile. https://www.exportfinance.gov.au/resources-news/news-events/world-risk-developments/2021/world-risk-developments-november-2021/australia-net-zero-emissions-by-2050-would-alter-export-profile/.

25 European Commission. 2021. "EU's Carbon Border Adjustment Mechanism (CBAM)." Carbon Border Adjustment Mechanism. https://ec.europa.eu/taxation_customs/green-taxation-0/carbon-border-adjustment-mechanism_en

26 Business Standard. 2021. "Democrats propose tax on imports from countries without climate lawss." Business Standard. https://www.business-standard.com/article/international/democrats-propose-tax-on-imports-from-countries-without-climate-laws-121072000157_1.html

27 Fortune Business Insights. The global machine learning market is projected to grow from $15.50 billion in 2021 to $152.24 billion in 2028 at a CAGR of 38.6% in forecast period... Read More at:- https://www.fortunebusinessinsights.com/machine-learning-market-102226. [Online] June 2021. [Cited: 20 Jan 2022.] https://www.fortunebusinessinsights.com/machine-learning-market-102226

28 Gartner. 2021. "Gartner Survey Reveals a 44% Rise in Workers' Use of Collaboration Tools Since 2019". Gartner Newsroom. https://www.gartner.com/en/newsroom/press-releases/2021-08-23-gartner-survey-reveals-44-percent-rise-in-workers-use-of-collaboration-tools-since-2019

29 Bloomberg. 2019. "BloombergNEF's Country Ranking Reveals Models of Industrial Digitalization." BloombergNEF. https://about.bnef.com/blog/bloombergnefs-country-ranking-reveals-models-industrial-digitalization/.

30 ITIF. 2020. "Does Investment in Physical Infrastructure Really Drive Growth?" Information Technology and Innovation Foundation. https://itif.org/publications/2020/04/20/does-investment-physical-infrastructure-really-drive-growth.

31 Katz, Raul, Pantelis Koutroumpis, and Fernando M. Callorda. 2014. "Using a digitization index to measure the economic and social impact of digital agendas." Emerald Insight 16 (1): 42. https://doi.org/10.1108/info-10-2013-0051

32 Also known as blockchain.

33 GHGSat. 2017. "GHGSat." Annual Natural Gas STAR Workshop. https://www.epa.gov/sites/default/files/2017-11/documents/18.germain_2017aiw.pdf.

34 Ullo, Silvia L. 2020. "Advances in Smart Environment Monitoring Systems Using IoT and Sensors." NCBI. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7309034/.

35 AsianInvestor. 2021. "Smart cities: invest today, live better tomorrow | Partner Content." AsianInvestor. https://www.asianinvestor.net/article/smart-cities-invest-today-live-better-tomorrow/470412

36 United Nations. 2021. "Cities and Pollution | United Nations." the United Nations. https://www.un.org/en/climatechange/climate-solutions/cities-pollution

37 Obringer, Renee, Benjamin Rachunok, and Debora Maia-Silva. 2021. "The overlooked environmental footprint of increasing Internet use." Resources, Conservation and Recycling 167, no. 1 (April): 1. https://doi.org/10.1016/j.resconrec.2020.105389.

38 The offset process is not without its challenges. Some argue that enabling offsets provides a 'free pass' to emitters and that the focus should be less on offsets and more on reducing to zero rather than net zero. Given the challenges of moving completely away from burning fossil fuels, it is likely that offsets and Net Zero will be a necessary transitional approach.

39 In Australia, eligible units suitable for Climate Active certification are: Australian Carbon Credit Units (ACCUs) issued by the Clean Energy Regulator in accordance with the framework established by the Carbon Credits (Carbon Farming Initiative) Act 2011; Certified Emissions Reductions (CERs) issued as per the rules of the Kyoto Protocol from Clean Development Mechanism projects; Removal Units (RMUs) issued by a Kyoto Protocol country on the basis of land use, land use change and forestry activities under Article 3.3 or Article 3.4 of the Kyoto Protocol; Verified Emissions Reductions (VERs) issued by the Gold Standard; and Verified Carbon Units (VCUs) issued by the Verified Carbon Standard.

40 Australian Government. 2020. "Cutting red tape to support emissions reduction | Ministers for the Department of Industry, Science, Energy and Resources." Minister for Industry. https://www.minister.industry.gov.au/ministers/taylor/media-releases/cutting-red-tape-support-emissions-reduction.

41 Climate Active. 2021. "Home Be Climate Active Certification Register of consultants for Climate Active certification." Climate Active. https://www.climateactive.org.au/be-climate-active/certification/register-consultants-climate-active-certification.

42 Cisco. 2018. Human Scale to Machine Scale

43 For a further example of a smart port initiative, see: https://www.linkedin.com/pulse/improving-congested-maritime-supply-chain-time-slot-management-lind/

44 ESRI. 2018. "The Largest Port in Europe Enlists Location Technology to Host Self-Sailing Ships." Esri. https://www.esri.com/about/newsroom/publications/wherenext/rotterdam-autonomous-ships-and-digital-twin/.

45 BlockApps. 2021. "Energy Usage Tracking and Carbon Credit (CO2) Calculation." BlockApps. https://blockapps.net/solution/energy-usage-tracking/.

46 IBM. 2021. "What are smart contracts on blockchain?" IBM. https://www.ibm.com/topics/smart-contracts.

47 The annual report must include: the greenhouse gas emissions for the base year; emissions sources and total emissions for each source type; disclosure of excluded emissions sources within the emissions boundary; disclosure of non-attributable emissions that would be expected; summary of the emissions reduction strategy; and records to prove sufficient eligible offset units have been cancelled (including registry and units cancelled, vintage year, the project type and serial numbers of the relevant units).

48 Royal Society. 2020. "A net zero climate-resilient future: science, technology and the solutions for change." Royal Society. https://royalsociety.org/-/media/policy/projects/climate-change-science-solutions/climate-science-solutions-overview.pdf

49 Cisco. 2020. "Advanced Networks Help Organizations Identify, Address, and Win More Business Opportunities." Cisco. https://www.cisco.com/c/dam/en/us/solutions/collateral/enterprise-networks/nb-06-idc-benefits-advanced-networks-analyst-rpt-cte-en.pdf

50 Ericsson. 2021. "Robustness evolution: Building robust critical networks with the 5G System." Ericsson. https://www.ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/building-robust-critical-networks-with-the-5g-system?gclid=Cj0KCQiAk4aOBhCTARIsAFWFP9HTwGvd8sGq5qByGcWWlMAum0eCHEluZDnFzr1C26bbP6uQAqnGOmgaAmDmEALw_wcB&gclsrc=aw.ds.

51 Nature. 2018. "How to stop data centres from gobbling up the world's electricity." Nature. https://www.nature.com/articles/d41586-018-06610-y

52 Hoefflinger, Bernd. 2020. "High-Performance Computing Trends." NANO-CHIPS 2030, (June), 269-273. 10.1007/978-3-030-18338-7_16.

Methodology and approach

This report was developed as a collaboration between Cisco and Curtin University. It draws on the perspectives of Cisco's local and global team of engineers and vertical experts, as well as Curtin researchers across a range of disciplines.
The Cisco-Curtin Centre for Networks was established to explore the cutting edge of network technologies for the future internet through blue-sky and long-term academic research as well as short-term industrial-focused research and projects. It is also a centre of excellence for educational offerings to train next-generation network engineers with advanced networking technology skills.

About the centre for networks

The Centre is based at Innovation Central Perth (ICP) at Curtin University and sits within the School of Electrical Engineering, Computing and Mathematical Sciences. The Centre leverages the Cisco Digital Network Architecture (Cisco DNA) for applied, experimental and blue-sky research in fundamental topics for building network infrastructure for the future internet. The academic research focus includes autonomous network, beyond 5G, intent-based networking and quantum internet. Industrial research is around the needs of industry with a focus on 5G, health, mining, education and defence.

In partnership with the Faculty of Science and Engineering, the education component of the Centre includes professional-level training courses, undergraduate and postgraduate units and three Massive Open Online Courses (MOOCs). All courses focus on network programmability, automation and analytics with the teaching and learning being performed on Cisco DNA networking technology.

The bridge to possible

Acknowledgements

This report was commissioned by Cisco and Curtin University and prepared by Vector Consulting and Trestle Digital. Cisco ANZ Chief Technology Officer Carl Solder and Curtin's Visiting Professor Reza Nejabati (co-chair of the Centre for Networks) were instrumental in the report's development.

Cisco and Curtin acknowledge the contribution of the National Industry Innovation Network (NIIN), including input from:

- La Trobe University
- Queensland University of Technology

Learn more about NIIN at cisco.com/au/niin

Curtin University