WWF

DISCUSSION PAPER

AUS

2017

Can technology save the planet?

A discussion paper by WWF-Australia

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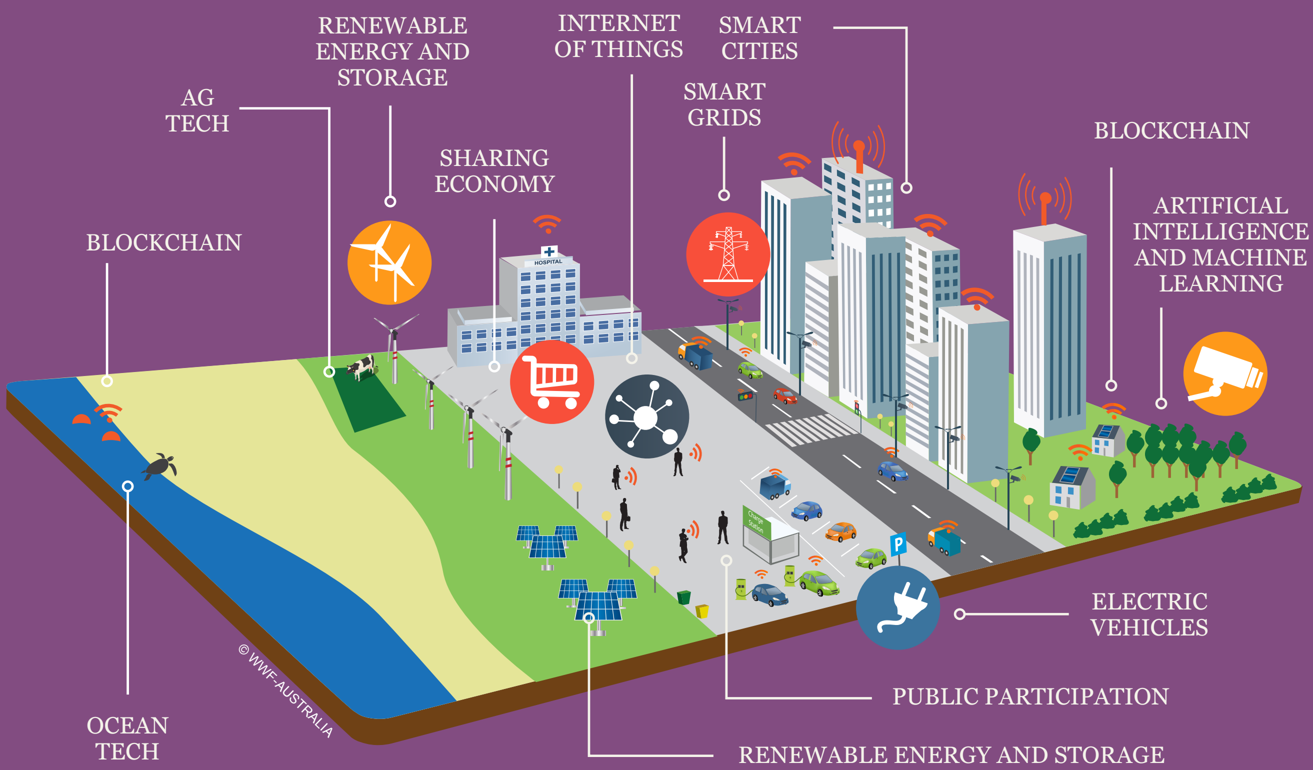
CAN TECHNOLOGY SAVE THE PLANET?



WELCOME
& HOW TO READ THIS PAPER

This discussion paper has been created to stimulate thinking and invite collaboration.

It features some of the trends in technology that excite us (and hopefully you), along with an exploration of how they can be applied to help solve some of the big environmental challenges we face as a society. As such, this paper's interlinked structure attempts to show the connected nature of emerging technologies and their place in conservation (that's code for saying we know there is some overlap between the sections!). So feel free to click the hyperlinks and jump to the chapters you find interesting.

This paper is by no means intended to be a definitive guide to emerging technology, but rather a collection of some of the exciting developments in those technologies that are changing the world.

Where we have included statistics or referenced the work of another author, we have **hyperlinked** to the relevant publication or source. If any of the chapters excite you and you would like to get in touch - please do!
We'd like to hear from you.

1. INTRODUCTION: CAN TECHNOLOGY SAVE THE PLANET?

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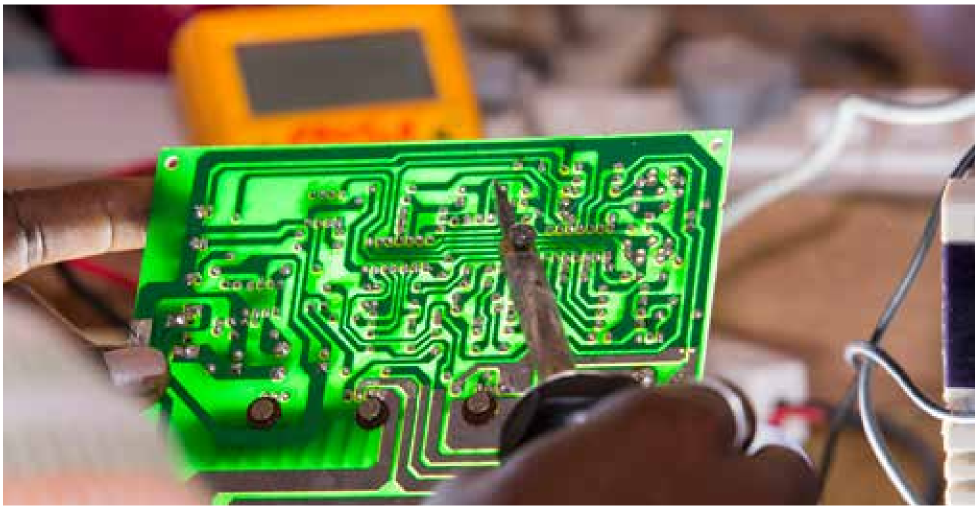
We are living through a period of rapid change

We are living through a period of rapid change. At the same time as exciting global developments in emerging technology are redefining how we live, work and play, megatrends such as climate change and resource scarcity, rapid urbanisation and economic inequality mean new approaches to problem solving are urgently needed.

As technologies including artificial intelligence (AI) and machine learning (ML); Blockchain; the Internet of Things (IoT); autonomous electric vehicles; augmented and virtual reality become mainstream, there is a growing opportunity for conservation organisations and NGOs to channel these technological developments for positive social and environmental impact. With the launch of the ambitious **UN Sustainable Development Goals** in 2015, there is now also an imperative to embrace creativity and innovation in addressing some of the world's biggest social and environmental challenges - to break out of traditional sectoral silos and experiment with new approaches to problem solving.

We're also witnessing seismic changes to the distribution of power.

In addition to rapid advancements in the generation, storage and distribution of renewable energy, social power and economic power are becoming increasingly distributed and democratised. This is aided by technology, and is giving rise to the sharing economy and new forms of public participation. Traditional, top-down hierarchical models are losing favour to bottom-up, collaborative and decentralised models. For organisations and institutions to stay relevant in the 21st century (whether they're banks, media, energy utilities, governments or NGOs), they must see themselves more as facilitators and aggregators for community-based, peer-to-peer and multi-directional activity rather than those models from the last century.



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1. INTRODUCTION: CAN TECHNOLOGY SAVE THE PLANET?

Australia: An innovation hotspot

Although Silicon Valley is the acknowledged epicentre for emerging technology, Australia has a crucial role to play. Significant investment is taking place from multi-national companies in their Australian operations, with particular focus on clean technology, ocean innovation and agricultural technology. Australia also has a burgeoning virtual reality (VR) industry and has leading thinkers in artificial intelligence, blockchain, machine learning and smart cities.

How can we create a platform for collaboration, using it to accelerate technological and environmental transformation - and then channel this innovation towards solving the big problems we're facing as a society?

Peter Schwarzenbauer of the BMW management board recently asked;

"Do we car manufacturers learn to become tech companies more quickly than a tech company learns to be an automotive player?"

With this in mind, how can conservation organisations and NGOs like WWF think more like tech companies who typically innovate fast and take risks with high reward? And how can tech companies think more like NGOs, who approach problem solving through science, rigour and a commitment to impact? And probably most importantly - where are the opportunities for both to collaborate?

What roles should environmental NGOs, social enterprises, big business and startups play in helping to channel and develop new technologies for positive impact? And what are the future trends that will require preemptive leadership from environmental NGOs? For example: once vehicle automation and ride sharing (Uber and Lyft are well known examples) becomes ubiquitous - which some analysts are predicting will be **as soon as 13 years** - will car ownership become a thing of the past and car parks made redundant? What flow-on opportunities will emerge from these developments? Should environmental NGOs be proactive in advocating for city-based car parks to be converted into green space or urban farms, or large-scale battery storage facilities to help power our cities with 100% renewable energy? At WWF, we're exploring these existing and emerging trends in tech and how they can be channeled for environmental protection.

Moreover, WWF aims to play a significant role in this space in 2017/18 and beyond. With a new and ambitious strategic plan, a strong brand, an international network, robust strategic and scientific credentials and the natural role as a convener of unusual allies, we have the mandate - and indeed the imperative - to try new things, take risks, experiment with new approaches to how we solve problems, and collaborate with new allies.

1. INTRODUCTION: CAN TECHNOLOGY SAVE THE PLANET?

We are launching Panda Labs

Into this space, we are launching Panda Labs – a multi-year innovation program to accelerate and amplify emerging technology with positive social and environmental impact.

Technology can be a solution enabler or part of the problem. And with the launch of Panda Labs, WWF-Australia is focused on the role of technology as a solution enabler.

Clay Shirky - author and expert on the social effects of technology, suggested in his book 'The Cognitive Surplus' that the global population has one trillion hours of spare time a year, but up until the development of the internet there was no way to connect individuals to work together on shared causes around the globe. Imagine if even a fraction of that combined capacity was channeled towards working together on innovative solutions to the major social and environmental problems that we face, through digital connectivity and effective coordination. This will be a focus for Panda Labs. We will bring together unusual allies from across environment, business, startup, tech and academic sectors, and channel combined effort to tackle the major technical and environmental issues of our time.

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So, with that in mind, we end this summary with an invitation: there is a ***huge*** opportunity for passionate individuals and their communities to participate in creating these solutions, for conservation organisations and other institutions to support them and for technology to play a connecting, enabling and amplifying role. Will you join us?

2. THE INTERNET OF THINGS (IOT)

2. THE INTERNET OF THINGS (IOT)

We are at the cusp of another communications revolution

Throughout history, communication has played a pivotal role as an enabler of human development. The development of language, paper, the printing press, telegraph, radio, TV and the internet have each ushered in a new era of technological and industrial development.

These have, in turn, revolutionised the way humans have organised themselves and structured their societies. The mass production of books in the 17th century enabled scientists to share their theories with each other. This, in turn, accelerated the Enlightenment - a period of rapid advancement in scientific and philosophical thought - which then gave birth to the Industrial Revolution in the late 18th and 19th century. These technological developments have also come at a cost, with significant social and environmental consequences. The most explicit of these is the devastating effect of the burning of fossil fuels for energy from the industrial revolution onwards and the destabilising effect this has had on our climate - our ultimate planetary life support system.

We are, however, on the cusp of another communications revolution - and one, if harnessed correctly, that could lead to significant positive social and environmental outcomes; The Internet of Things.

It is predicted that by 2020 there will be over six billion smartphone users.

Utility and technology companies are now competing to be the market leader for the next world-leading smart products, giving rise to smart cars, smart houses, and even smart cities. Indeed the 'smart' revolution is well underway. The nervous system for this revolution is the 'Internet of Things' (IoT) - the connection of any machine, human, animal, or indeed anything, to the internet.

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2. THE INTERNET OF THINGS (IOT)

What is the IoT?

The Internet of Things (IoT) is a network of internet-connected objects able to collect and exchange data using embedded sensor technologies. This data allows devices in the network to autonomously 'make decisions' based on real-time information.

For example, a person's wrist-watch could measure body temperature and communicate with air conditioning units to adjust temperature settings. Data generated also contributes to the trend of 'big data', where information streams are analysed by machines to obtain insights not otherwise available to humans.

The rapid development of the IoT has been facilitated by increased connectivity and accessibility to the internet globally. The increased availability of WiFi, Bluetooth and smart sensors in buildings and cities has allowed for the development and growth of smart appliances such as dishwashers, lights, windows and heaters, to name but a few - many of which can now be controlled via the internet from outside the home. In time, a house can learn the habits of its occupants and automatically cater for their needs. This will range from 'simple' tasks such as turning on coffee machines when the morning alarm goes off, to more complex tasks such as using electricity cost forecasts to determine the best (lowest cost) time to charge an electric car. Indeed, experts are predicting that cities of the future will be places where every car, phone, air conditioner, light, solar panel and so much more, are interconnected - the beginning of the **'smart city'** as later discussed.

In addition to this, major logistics and infrastructure is also now being connected via the 'Industrial Internet of Things' - using big data to gain predictive insights into everything from alerting ground crews in advance that an aeroplane engine may need servicing, to helping farmers increase efficiency of their farm equipment and achieve greater yields from their crops.

2. THE INTERNET OF THINGS (IOT)

The IoT for climate change mitigation & the renewable energy transition

The IoT revolution, if allowed to develop to its full potential, could usher in a new post-carbon era. The communications internet, combined with the internet of renewable energy and the internet of logistics and transport is enabling the transition to **decentralised smart, micro-grids** - where renewable energy is shared between local producers (i.e. households) and local users, and is therefore cheap and available based on demand (facilitated through internet connectivity). **The Paris Agreement on climate change in 2015** laid out a framework by which we can (and must) limit dangerous global warming to 1.5 degrees Celsius. To achieve this, major economies like Australia will need to fully decarbonise and transition to renewable energy. The IoT and subsequent development of smart grids will be crucial for this. Governments can aid this transition with appropriate enabling policies.

Uses in conservation

Just as smart phones have forever changed the way we access information and communicate with each other, smart conservation (through IoT technology) has the potential to redesign conservation practices, for example through animal tracking and water management field programs.

Smart sensor technology is also bringing significant improvements to the sustainable production and consumption of goods and services, ranging from food to fast-moving consumer goods (FMCG) to renewable energy.

2. THE INTERNET OF THINGS (IOT)

The internet of waste

One of the many services leveraging the IoT is the collection, processing and recycling of waste. Smart trash compactors (already installed in facilities such as the Atlanta and Las Vegas international airports) decrease the frequency of collections by compressing waste and signaling waste management teams when bins are approaching maximum capacity.

Similar advancements are being made in local councils in Australia which use identification chips on bins to understand the consumption of each household.

These chips are scanned as the garbage truck collects the waste. The weight of each bin is also measured and assigned to its correct household. If the waste in a garbage truck is found to be contaminated, it is also possible to find out which households' rubbish has been emptied into the truck.

Many applications of the IoT make indirect contributions to conservation and ecological sustainability. As processes become more efficient, there will naturally be a reduction in the consumption of resources such as fuel and manufacturing materials. In a more direct manner, IoT technologies can also enhance the on-ground efforts of conservation organisations and improve the accuracy and efficiency of data collection.

The full potential for the IoT in the conservation sector cannot be unlocked without the necessary enabling policies. In a nationwide step towards a digital economy, India has recently developed their first draft **IoT policy** which seeks to develop the rollout, manufacturing and understanding of IoT technologies. Environmental NGOs can also play a central role in advocating for these enabling policies.

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2. THE INTERNET OF THINGS (IOT)

The IoT and WWF

Environmental protection and conservation is a science-based sector built around data collection. The study of animal populations, species migration patterns, fossil fuel emissions and the clean energy revolution, human impacts, soil qualities - all have data generation and analysis at their core.

WWF-Australia, and indeed the WWF global network, has a number of IoT technologies currently deployed in field conservation programs.

One example is the seeOcean explorer - a collaboration between Navama and WWF-Phillipines - which uses real time satellite data and location based information from fishing vessels to improve understanding of good fisheries management.

Information such as global AIS (Automatic Identification System) coverage, individual shared fishery tracks, marine protected areas, wind and waves, track patterns, ports, and economic data are combined and visualized to provide a holistic view of fisheries activities - all contributing to improved fisheries management and sustainable fishing livelihoods.

Conservation organisations who are embracing and champion the IoT revolution are enhancing impact through increased data generation, tracking and analysis capabilities. Many of the latest sensory, tracking or monitoring devices are designed to be connected to the internet. By proactively embracing these technologies, conservation organisations are also able to provide real-time feedback to staff, supporters, investors and other stakeholders.

Collaborate with us!

Interested in the Internet of Things and its applications for conservation? **Let's chat!**

3. SMART CITIES

3. SMART CITIES

"Smart cities are those that plan to experiment. They take risks. As citizens of city regions, we are all now part of that experiment. We all have a duty to work out what we need to do differently in order to address the challenges that we are facing. It's an emerging social contract."

Stephen Hilton, Director of Futures, Bristol City Council

The world's population living in urban areas is expected to increase from the current **54% to 66% by 2050**. Due to continued mass urbanisation, the combined environmental footprint for humanity is highly concentrated into a small percentage of the Earth's surface - mostly coastal areas - resulting in major stresses to our energy, waste and water systems. Our cities need to adapt.

What are smart cities?

A smart city uses information and communications technology (ICT) to enhance its livability, workability and sustainability. The concept of the smart city has been made possible with the ubiquity of big data, interconnected networks, sensor technologies and the IoT- all interacting to produce an entire network of interconnected system components. Roads, buildings, people and utilities work together as one organism. Smartphones will foreseeably act as each citizen's personal node in this network, and furthermore as the system's remote controls.

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2. SMART CITIES

Big data

The coordination of a smart city inherently involves what has been termed 'big data' - extremely large data sets which can be analysed to give insights into how components of systems (such as cities) function and interact. Every day, we generate approximately **2.5 quintillion** (2.5 x 10^{18}) bytes of data.

That's **250,000 Libraries of Congress, or 90 years of HD video** - an amount so great that **90% of all the data in the world today has been created in the last two years**. These insights, aided by **artificial intelligence and machine learning**, can help city planners and policy makers make strategic decisions based on science and statistics rather than assumptions, improving the efficiency of services (such as public transport and waste services) and overall livability and sustainability of the city. If big data is also 'open data' (meaning it has been made accessible to anyone for use or sharing) it has far more potential for widespread use. Big and open data make up the fuel of a smart city and more governments and city councils are now making their data open and inviting members of the community to collaborate (often through Hackathons or **Designathons**) on designing systems and tools to analyse and interpret the data.

The potential of open data has been realised by the NSW Government who have recently 'unlocked' their real-time transport data, including all the timetables and GPS locations of buses, trains, ferries and trams. With this information, software developers have been able to create innovative solutions to improve the efficiency of the state's transport. Mobile apps use this software to make public transport more user friendly by providing commuters with estimated predictive arrival and travel times, and even sitting and standing space available.

Case Study A Smart City: Barcelona, Spain

Barcelona is rapidly transforming into one of the world's leading smart cities. Some of its features include:

- Thousands of sensors throughout the city which measure noise levels, waste management and even street parking (which can be viewed in real-time on the 'ApparkB' mobile app).
- Municipal smart bins which monitor waste from households to optimise collection routes and scan for hazardous material.
- Digital bus stops provide USB charging, WiFi, and updates on bus locations.
- Smart LED street lights dim when the streets are empty and collect data on air quality.

These advancements are simultaneously increasing the livability, and environmental and financial performance of the city - in 2014, the city estimated an annual savings of over US$37 million from intelligent street lighting alone.

2. SMART CITIES

Smart cities and WWF

Conservation organisations can work alongside corporate and civil society partners and governments to ensure that a smart city is a city focussed on sustainability - encompassing sustainable food, waste, water and energy. For example, once autonomous electric vehicles dominate the market and car ownership becomes obsolete (perhaps within a decade or two), how can car parks and other redundant space be re-allocated and re-used to make our cities more livable and sustainable? Could they be used for more urban farms? Or large-scale renewable energy generation and storage? Conservation organisations will have an important role to play in advocating for the correct path to be taken. Today, WWF is playing an important role in this transition through the development of its 'Renewable Energy Buyers Forum' which assists businesses, institutions and governments to increase their uptake of renewable energy in particular through long term power purchase agreements.

Collaborate with us!

Interested in Smart Cities and their applications for conservation? **Let's chat!**

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4. VIRTUAL AND AUGMENTED REALITIES

4. VIRTUAL AND AUGMENTED REALITIES

"Virtual reality was once the dream of science fiction. But the internet was also once a dream, and so were computers and smartphones. The future is coming."

Mark Zuckerberg, Facebook. March 25, 2014

Virtual and augmented reality systems may be to screens what screens were to radios - the next step in the evolution of communication.

These artificial reality systems are able to immerse users into artificial worlds (VR), or alternatively, integrate artificial features into the world of the user (AR) through existing screens (smartphones, tablets). Organisations focusing on social and environmental impact can, and will, use VR and AR to increase empathy of the public for traditionally esoteric issues (like climate change, ocean acidification or biodiversity loss), or at-risk species who have no voice to advocate for themselves.

What is VR and AR?

Virtual reality (VR) systems transport people to an entirely new environment. This new environment is simulated through the use of VR headsets, handsets and wearable gear which alter what the user can see and feel.

In augmented reality (AR) systems, the user's current environment is blended with an artificial world. Unlike VR users, AR users remain conscious of their real surroundings, but are able to view and interact with virtual features through headsets or camera interfaces.

The possibilities for VR and AR are already being largely explored in tourism, architecture, real estate, gaming, education and marketing - as well as conservation. A pop-up VR demonstration hosted by The Economist at the Sydney Opera House for the Festival of Dangerous Ideas gave users the chance to explore the issues of overfishing through an **animated underwater film**. Users were able to 'experience' both the lives of the fish, fishermen and policy makers to better empathise and understand the issues of overfishing.

The applications of AR systems may prove vastly different to that of VR systems. The ability of AR systems to overlay an 'additional world' on top of the current environment could educate users by allowing them to 'look' at features (such as artwork or landmarks) and instantly see or hear information about its history or physical characteristics. This could significantly change the way we experience our surroundings.

4. VIRTUAL AND AUGMENTED REALITIES

Case Study: AR for virtual gaming: Pokémon Go

Within the first week of being launched, augmented reality game Pokémon Go had attracted more downloads from the Apple App Store than any app in history. Pokémon Go players explore their real world in search of Pokémon - virtual entities which can only be seen through the lens of a smartphone camera. Movement through the real world is tracked (using the phone's GPS) and mirrored on the in-game-map. The phone acts as the link between the virtual and real world, with certain Pokémon only found in their corresponding real-world places such as parks, beaches or lakesides. The entire world acts as the game's playing board.

4. VIRTUAL AND AUGMENTED REALITIES

VR, AR and WWF

VR and AR will change how we experience and interact with the world.

The ability of the technology to enhance the learning experience by engaging with the user's emotions can be utilised by conservation organisations to educate the public on current environmental issues.

This has the ability to evoke empathy for hard to conceptualise problems such as how the burning of fossil fuels leads to the bleaching of coral reefs. Though many people may be aware of these issues, there is often a perceived disconnect between the actions of individuals and their environmental impacts - and also how an individual can play a role and be part of the solution. VR and AR can bridge this gap and connect with users to motivate action. WWF-Australia embraced this new technology in 2015 with the **"Reef Goggles"**, which used virtual reality to connect people with the reef through their smart phones.

The cumulative capacity for these technologies is limited by the amount of people with the necessary equipment (such as the VR headsets). As the uptake of this equipment continues to grow (**and it's expected to grow very quickly**), so too does its potential for significant impact at scale.

Collaborate with us!

Interested in VR and AR and their applications for conservation? **Let's chat!**

5. BLOCKCHAIN

5. BLOCKCHAIN

Blockchain facilitates the secure trading of value.

Understanding the exact mechanisms behind Blockchain would be the equivalent to understanding how the internet works – it is not essential knowledge for those who intend to use the platform.

A quick summary of Blockchain is provided which covers the basic mechanisms for those interested in the topic.

What is Blockchain?

"The Blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value."

Don & Alex Tapscott, Blockchain Revolution (2016)

Blockchain: A Deeper Dive

Every transaction that occurs on the Blockchain platform within a 10-minute period is verified and then stored in a 'block'. Each block is then 'attached' to the previous block to form a chronological 'blockchain'. Mathematical laws are used to verify each transaction, hence trust is embedded in the system as corrupt transactions (which do not make mathematical sense) simply cannot occur. As a simple example, if a recipient's account increased by $10, but the donor's account did not decrease by $10, the transaction is not verified and therefore does not proceed.

As an additional security measure, each unit of crypto-currency is fully traceable. Continuing the previous example, the recipient does not just receive an equivalent $10, but instead receives the 'same' $10 removed from the donor's account.

This ultimately solves the 'double spending problem' which has been an issue since the beginning of digital trading. All transactions which occur, and the cryptocurrencies used for it, are stored immutably on the Blockchain. Innate transparency and security throughout the network removes the need for a 'middle man' and hence facilitates peer-to-peer trading.

Blockchain also differs from conventional trading in that the full copy of this 'digital ledger' is owned by, and accessible to, everyone in the Blockchain system – i.e. the system is decentralised and managed by the network instead of a single central authority such as a bank. If someone were to hack a certain block, they must first hack all preceding blocks on the entire blockchain, which would require the hacking of millions of computers... simultaneously.

5. BLOCKCHAIN

The cryptocurrencies used on Blockchain could be equivalent to $1, 1 vote…or 1 kWh of electricity (see the **Clean Energy Generation, Storage and Trading section** for an example of how Blockchain can be used for the peer-to-peer trading of electricity). The emergence of Blockchain has been further facilitated by the sharing economy and Internet of Everything and has contributed to the distribution of power mentioned in the introduction. Blockchain has major implications for how energy is traded (peer-to-peer) and how commodities are tracked along the value chain (See **Blockchain and Fishing**).

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Blockchain and WWF

Through its Market Transformation program, WWF works with large and small-scale producers and businesses along the commodity supply chain to boost transparency, improve efficiencies, decrease environmental impact and ensure equity for small-scale producers in developing countries. Naturally, this includes multiple industry supply chains in food, energy and forestry. To ensure transparency in the supply chain, each process and transaction that occurs in these industries must be both accounted for and immutable - even in the absence of a centralised authority. It's expected that Blockchain will improve transparency and trust in supply chain traceability.

Blockchain also has an exciting role to play in revolutionising our energy systems. This is discussed in more detail in the section on **Peer-to-Peer Trading via Blockchain**.

5. BLOCKCHAIN

Case Study: Blockchain and fishing

Blockchain technology is being trialled as a means of improving transparency and traceability and, therefore, sustainability in industrial-scale fishing. The fish are first registered on the Blockchain-based system by the fishermen using SMS messages or QR codes. This identification is then passed along each step of the supply chain.

Anyone, including end-buyers, can view this record to see where, when, and by whom the fish were caught, processed, and transported. The transparency of Blockchain technology allows anyone to verify and validate if the fish were caught sustainably or if they are linked to human rights violations. This application of Blockchain could be applied to other industry supply chains like recycling, forestry and farming.

A service or product which is environmentally sustainable is worth more when the claim can be validated. The role of Blockchain in supply chain traceability therefore has the potential to be very important.

Collaborate with us!

Interested in Blockchain and its applications for conservation? **Let's chat!**

6. ELECTRICITY GENERATION, STORAGE AND TRADING

6. ELECTRICITY GENERATION, STORAGE AND TRADING

‘Once the renewable infrastructure is built, the fuel is free forever. Unlike carbon-based fuels, the wind and the sun and the earth itself provide fuel that is free, in amounts that are effectively limitless.’

Al Gore, Our Choice

Decentralised renewable energy and storage, combined with digital communications and smart logistics and transport, **has the potential to fundamentally restructure our economic and social models and bring about the rapid decarbonisation of our economy**. And indeed many states, territories and countries around the world are focused on expediting this transition.

Centralised vs. decentralised electricity grids

The electricity supply chain historically involves the generation of huge amounts of electricity by large generators located in rural areas. This electricity is then sent along high-voltage transmission lines - then lower-voltage distribution networks - to the multiple end-users who require power for their houses and businesses. This system design is known as a **centralised energy network.** In a **decentralised network**, the electricity is sourced from multiple smaller generators located closer to the consumers. This greatly reduces the amount of energy lost during transmission. Renewable energy technologies produce zero local emissions and can be deployed in a modular, distributed and small scale fashion. They can therefore be closer to cities and are increasingly being used in decentralised networks.

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6. ELECTRICITY GENERATION, STORAGE AND TRADING

The rise of prosumers

The increased uptake of household-scale clean energy technologies (such as solar panels and battery systems) is affecting how these networks are designed and operated.

The availability of the technology has also led to the rise of **prosumers** - electricity end-users who manage their own energy generation and consumption. A network where energy is able to flow both to and from households facilitates increased public involvement in the energy sector. Community power projects, smart appliances and peer-to-peer trading are becoming more common and will become ubiquitous in years to come, but only if the right policies are in place and governments take action to encourage this shift. Australia has the potential to be a renewable energy powerhouse, but our renewable energy and climate change policies are currently not strong enough to unlock this potential. WWF and other environmental organisations are therefore active in continuing to advocate for stronger policies and greater ambition on climate change and the important transition to 100% renewable energy.

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6. ELECTRICITY GENERATION, STORAGE AND TRADING

Clean energy generation and storage

In the 10 years between 2007 and 2017, the amount of rooftop solar installations in Australia grew from approximately 4600 households to over 1.6 million.

A similar story exists for Australia's uptake of battery storage systems and large-scale solar and wind farms. What started as a niche sector for early adopters has become a dominant worldwide industry driven largely by the ever-more appealing economics of renewable energy technologies. Quite simply; solar panels and battery storage are getting cheaper, **even cheaper than fossil fuels**. What's more, over **28,000 more new jobs will be created in Australia under a 50% RE scenario for 2030** - an increase of almost 50% above the business as usual case.

Wind turbines, hydropower and photovoltaics (solar panels) are currently at the forefront of the large-scale clean energy industry. However, they are not the only competitors in the race to the 100%-renewable finish line. **Recent modelling** suggests that Australia will require a mix of multiple renewable energy technologies such as concentrated solar thermal, biomass, ocean (wave and tidal) and geothermal.

In the world of small-scale renewable energy, photovoltaic (PV) and battery systems are increasingly becoming common household technologies. However, unlike other household technologies (such as TVs, fridges and air conditioners), PV and battery systems have the capability to reduce a household's consumption of electricity from the grid and therefore its electricity bills. This is achieved through both a decreased dependence on grid electricity and the selling of surplus energy back to the grid. What's more, it is now possible to see exactly who is buying our excess energy (see next page).

What's all the fuss about batteries?

Did Tesla's Elon Musk invent battery storage systems? While it may appear to be the case following the seemingly endless media attention, they have actually been around for a while. What has changed though is their price and efficiency.

In the past 5 years, battery costs have fallen 70% (and are expected to fall another 15% over 2017). Household battery systems allow households to store the output of solar panels, meaning they can generate electricity during the day for use at night.

6. ELECTRICITY GENERATION, STORAGE AND TRADING

Peer-to-peer trading via Blockchain

Around the world, locally sourced, sustainable, organic products are hugely fashionable. And now we can add locally sourced energy to the mix. Whilst the concept of locally-grown energy is slightly tongue in cheek, it's not too far off from reality.

Blockchain is particularly suitable for the transfer of energy because the mechanisms of the technology shares many of the physical characteristics of energy transactions. As electronic communication hardware (such as 'smart meters') are rolled out across Australia, the possibilities for peer-to-peer energy trading opens up. These meters will keep track of the electricity generated, imported and exported at a site and assign crypto-currencies to them on the Blockchain system. These exact crypto-currencies could then be sold to a neighbour for a price set by the owner. This is mirrored on the Blockchain which verifies that the buyer now owns the unit of clean energy generated by a local system.

Case Study: Power Ledger

Power Ledger is an example of a Blockchain-based platform which allows people with rooftop solar to decide who their surplus electricity is sold to and at what price. The software is also able to track each kWh of energy from where it is generated to where it is consumed, including from shared solar arrays in apartment blocks to each individual unit.

The technology is already being trialled in Perth's White Gum Valley and in 500 community groups and schools across Auckland.

Clean energy technologies and WWF

WWF is focused on accelerating the uptake of low carbon technologies to reduce fossil fuel pollution and mitigate the effects of dangerous climate change - the single greatest threat to all ecosystems and organisms (including humans!) on the planet.

Environmental organisations like WWF are playing a crucial role in both advocating for the policies needed to support the transition to 100% renewable energy, and supporting the businesses who are working on bringing cheaper and more accessible renewable energy to households and businesses.

WWF and its supporters have a crucial role to play in speeding up this transition - both in calling for elected representatives and decision makers to support pro-renewables policy, and for households and businesses to make the switch to renewables themselves.

Collaborate with us!

Interested in Clean Energy Technologies and their applications for conservation? **Let's chat!**

7. ELECTRIC AND AUTONOMOUS VEHICLES

7. ELECTRIC AND AUTONOMOUS VEHICLES

Electric vehicles (EVs), while buzzword-prone and the focus of recent Silicon Valley attention, are far from new. In fact, of the 4,192 cars produced in the US in 1900, 28% were electric. So, what happened?

As with many market competitions, the race to ubiquity that occurred between electric, steam and gasoline powered cars was based on a mixture of economics and performance - both of which were led by the gasoline vehicles of the time.

However, today's social, political and technological climate is different to that in which the first cars were developed over 100 years ago. Advances in battery technologies and the need to act on climate change awareness are fostering another rise in electric vehicles - and it appears this time they have the advantage. **Since 2014, global annual EV sales have more than doubled** - growth which is not merely attributed to their zero-local emissions, but also their competitive overall performance. And in fact, some analysts predict **market dominance of electric vehicles in 13 years**.

Electric and autonomous vehicles or EVs and A-EVs

All EVs use electricity stored in batteries to power electric motors. The types of EVs can be classified by how much of the energy required to drive the car is sourced from the battery.

Hybrid EVs source their energy from both batteries and petrol. The batteries are charged via a process known as regenerative braking which uses the kinetic energy from the car's braking system to generate electricity. This energy is then used in conjunction with the petrol engine to propel the car. Some hybrids can also be charged via external charging points - these EVs are known as plug-in hybrids.

In Battery EVs, all energy is sourced from the car's batteries which are charged via external charging stations and regenerative braking. The lack of a petrol engine in battery EVs means that the cars produce zero local emissions.

Autonomous driving is a feature available in many modern EVs (termed A-EVs). Levels of autonomy ranges from 'simpler' tasks such as cruise control and automatic parking to full automation where the car can go anywhere, in any conditions, without a driver's input.

7. ELECTRIC AND AUTONOMOUS VEHICLES

How will EVs and A-EVs change the world?

The type of impact that EVs and AVs will have on the world largely depends on who you ask, but what is commonly accepted is that their growth in the market will have wide reaching implications.

For the individual, EVs and AVs will result in less maintenance, better traffic management, additional safety, easier parking and cheaper fuel. However, in a world where cars drive themselves, what will become of concepts such as car ownership, insurance and ridesharing?

To the electricity industry, EVs are batteries on wheels with the potential to either increase stress on the network or, if managed efficiently, increase grid stability by storing surplus energy during times of high generation and discharging during peak demand.

For urban planners, the introduction of EVs and AVs offers a very different set of challenges or opportunities. Many aspects of our cities have been designed around the use of cars for transport - street parking, petrol stations, underground and above ground car parks all take up valuable space in our urban environments. A question for urban planners is therefore what to do if these spaces become redundant? Do petrol stations become supercharging stations? Could street parking spaces become bike lanes? Can underground carparks be used to house large-scale battery storage? Could above ground car parks become urban farms? As with many of the questions posed in this paper, the answer will be influenced by a range of emerging social trends, but conservation organisations and their supporters will have a key role to play in channeling these developments in the right direction.

7. ELECTRIC AND AUTONOMOUS VEHICLES

How clean are electric vehicles?

While EVs are marketed as clean transport, they are only as clean as the electricity they use. If sourced from a household's PV and battery system, this electricity can be both clean and low cost.

The environmental benefits of EVs are greatly reduced if the electricity is sourced from electrical grids with a high dependence on fossil fuel generators.

For example, approximately **53% and 24% of the energy sourced from Australia's National Electricity Market (NEM) in 2016 come from black coal and brown coal respectively**. If we are to transition to clean transport, renewable energy must replace fossil fuel generators as electric motors replace petrol engines.

Car sharing services have the capacity to reduce fuel consumption by only using fuel-efficient cars (including electric cars) and reducing vehicle use of passengers who rely on the service **by up to 60%**. Fewer cars on the road also means a reduction in congestion and hence faster travel times and easier parking. Australia's first car sharing service **GoGet estimates each of their cars to be shared between approximately 23 of their members**.

Car sharing can be further facilitated through the adoption of Autonomous-EVs. Self-driving cars, alongside smart phones, smart cities, and big data, will likely establish the vehicle as a service rather than a product and play a major role in the sharing economy (see **Technology and Public Participation**).

Case Study: Tesla

American-based company Tesla has formulated a one-stop-shop business model to ensure EVs are as clean as they possibly can be.

The company's interest in a range of clean energy technologies, including household battery storage and rooftop solar modules and tiles, demonstrates how EVs are just another component in the electricity industry of the future. Many of Tesla's EV charging stations already incorporate solar modules and battery storage to support their EV superchargers. In the future, such stations could be taken off-grid entirely.

Like all technologies, there are barriers to the uptake of electric vehicles. An example is the concern regarding the safety of automated vehicles and limited charging stations (termed 'range anxiety'). However, this is not the first time these concerns have been raised in the transport sector. Many people were uncomfortable when cars first shared the roads with horse-drawn carriages over a century ago. As for range anxiety, motor fuels were certainly not available in all pharmacies (the first places to sell gasoline) when the first petrol-powered vehicles arrived - analogous to today's relative scarcity of battery chargers.

7. ELECTRIC AND AUTONOMOUS VEHICLES

EVs, AVs and Conservation.

So, what role does an environmental NGO have to play in the world of EVs and AVs?

Many of the benefits offered by electric vehicles align with the objectives of conservation organisations, namely reduced emissions, more efficient use of resources and smarter, more sustainable cities.

As the full potential of these modern vehicles becomes realised, the perceived barriers will decrease accordingly. Environmental NGOs can help raise awareness of this potential, while ensuring governments set the right enabling policies and regulations to ensure the technology is low impact and environmentally sustainable.

Collaborate with us!

Interested in EVs and AVs and their applications for conservation? **Let's chat!**

8. AGRICULTURAL TECH FOOD TECH AND OCEAN TECH

8. AGRICULTURAL TECH FOOD TECH AND OCEAN TECH

Agricultural Technology (Ag Tech), Food Tech and Ocean Tech

Around the globe, food production, distribution, consumption and waste threaten wildlife, water resources and climate stability.

The world's 7.5 billion people currently consume more than 1.6 times what the Earth can supply sustainably, and we will need to produce 70% more food to feed an estimated 9.7 billion people by 2050.

Meeting this demand via environmentally sustainable pathways will require significant advancements in sustainable agriculture technologies. And indeed, many such advancements are well underway.

What is Agricultural Technology (Ag Tech)?

Agricultural technology is used by farmers and producers to increase the efficiency of farming practices. These technologies range from machines like tractors to small IoT-enabled sensors and drones. The use of multiple wireless devices distributed throughout a farm is known as 'smart farming' or 'precision agriculture'. These devices gather real-time data on the health of the soil, air, animals and crops. All of this information is transmitted to web-based interfaces and is analysed using big data techniques to boost farm efficiency and reduce impact.

Advancements in agricultural technology (or Ag Tech) have already transformed farming practices many times over throughout history. Indeed, the initial objective of farming was much simpler - maximise yield with minimal effort. As yields approach theoretical maximums, another dimension is added to the objective - how to achieve this maximum output for a reduction in resources.

The agricultural technologies being developed on land are also making their way into our oceans. Smart sensors, **Aquapods** and **3D Ocean Farms** are but a few of the innovative technologies contributing to our food security whilst simultaneously reducing the requirement of resources. Advancements in communication technologies (see **Internet of Things** and **Virtual and Augmented Reality**) and supply chain tracking (See **Blockchain and Fishing**) are also playing new and important roles in decreasing impact on global fisheries, which are already reaching crisis points due to unsustainable fishing practices.

8. AGRICULTURAL TECH FOOD TECH AND OCEAN TECH

Case Study: Oyster Tech

Farms off the coast of Tasmania are being retrofitted with networks of biosensors which record the heartbeats and metabolism of the oysters. Environmental sensors are also installed throughout the farms to measure the water's salinity, acidity, temperature, and other features. Data collected is used to identify how changes in water conditions affect the health of the oysters. This information is then used to develop management models for the farms and optimise oyster production.

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Through the adoption of Ag Tech and Ocean Tech throughout food supply chains, we can increase efficiencies, increase confidence in supply chain transparency and, in turn, reduce our impacts on the environment while feeding more people. These technologies can not only help food producers acquire sustainable food certifications like the **Marine Stewardship Council (MSC)** and **Forestry Stewardship Council (FSC)** and **Roundtable on Sustainable Palm Oil (RSPO)**, but also guide the assessment criteria for these certifications as more innovative sustainable practices become possible. WWF is playing an active role in supporting the development of these new technologies, and is prioritising Ag Tech and Ocean Tech through Panda Labs.

Collaborate with us!

Interested in the use of innovative technologies in agriculture and ocean conservation? **Lets chat!**

9. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

9. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Artificial intelligence (AI) and machine learning (ML) is sometimes associated with the androids featured in futuristic movies and novels.

Unsurprisingly, artificial intelligence technology has more sophisticated applications than disguising robots as humans.

Also associated with the development of intelligent software is mass automation, leading to greater productivity, efficiency and eventually the anticipated threat of lost jobs. And indeed, governments around the world are taking this threat so seriously that a Universal Basic Income (UBI) is now being openly considered as a response to mass automation and job losses. In short, this is a major technological and social trend that has the potential to fundamentally reshape our society. To better understand this trend, along with the opportunities artificial intelligence and machine learning present for conservation, it is helpful to first understand the scope of work for intelligent software.

What is artificial intelligence and machine learning?

Artificial intelligence (AI) is a branch of computer science which involves the development of intelligent machines which work and react like humans. Everyday examples of AI include Apple's Siri and Microsoft's Cortana which can answer a wide range of questions, recognise voices, offer suggestions and even be taught to correctly pronounce difficult names.

Machine learning (ML) is a type of AI in which the software can develop itself without additional inputs from human programmers. Software is said to have ML capabilities if its performance naturally improves with experience - so it can learn as it goes. Facebook's ability to predict names for faces in photos is an example of ML software. Facebook suggests the names of people to tag based on their previously tagged photos. When people confirm the suggested tag, the software has more photos on which to base the suggestions, and hence performs better.

To date, AI and ML software has often been tasked with jobs that are typically repetitive or laborious by nature (such as **identifying defective products on manufacturing lines** and ordering replacements), or entirely new and sophisticated tasks - such as deep data analysis - which have been designed specifically for the software. As with many of the technologies discussed in this paper, AI and ML has the capacity to influence the dynamics and functioning of society. How the technology is deployed will ultimately decide what type of influence this will be.

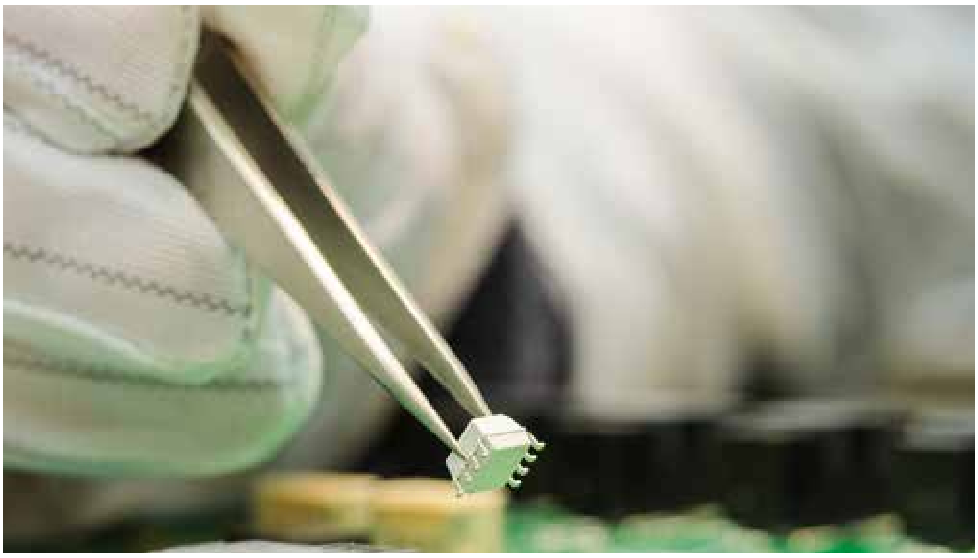
9. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Robot laywers

'Chat Bot' software developed by a student of Stanford University has helped over 160,000 people overturn parking tickets. This has now been expanded to provide free legal advice via Facebook Messenger to people seeking asylum. People can chat with the 'robot lawyer', explain their situations, and receive legal guidance on how they should proceed.

AI and ML have the capacity to improve social equity by providing conventionally high-cost services to lower socio-economic and vulnerable communities for a fraction of the cost or, in some cases, no cost at all. If such technology can be developed for something as complex as legal advice, what applications could it have in other industries? And specifically, for conservation purposes?

Large conservation projects, and indeed environmental protection in general, often involve vast amounts of data, or as it is increasingly being termed, 'big data'. AI and ML offer means of analysing large amounts of data - pictures, pollution levels, legal information, environmental measurements - to discover trends and make predictions much faster (and likely cheaper) than humans are capable of. More efficient conservation practices are a welcome trend for species and ecosystems at risk from imminent and existential threats. For example, **AI developed by computer scientists from the University of Southern California** is being trialled in Malaysia and Uganda to help prevent the poaching of endangered elephants and lions by predicting where it is likely to occur and suggesting patrolling routes.



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9. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Case Study: Recognising and counting animals using AI and ML

Motion sensing cameras are used in Victoria's national parks to monitor animal movement throughout the region. These cameras are designed to be triggered when animals are nearby. Due to the camera's sensitivity, they are also set off by falling branches, stormy weather and even rapid temperature changes. This leads to hundreds of photos being taken which must be sorted through manually. AI developed by the Deakin University IT research team is able to sort through these images to find those with animals. As the algorithm evolves it will also be able to identify the types of animals in the photos and count their populations. This system is expected to be particularly useful in determining how natural disasters and changes to ecosystems (such as the introduction of new predators) impact animal populations.

Said Mkinga, wildlife ranger in Selous Game Reserve, fixes a camera trap to a tree to ascertain the number of black rhinos left in the reserve

10. TECHNOLOGY AND PUBLIC PARTICIPATION IN SOLUTION DESIGN

10. TECHNOLOGY AND PUBLIC PARTICIPATION IN SOLUTION DESIGN

The sharing economy, participatory democracy and citizen science

*“**Old power** works like a currency. It is held by few. Once gained, it is jealously guarded, and the powerful have a substantial store of it to spend. It is closed, inaccessible, and leader-driven. It downloads, and it captures.”*

*“**New power** operates differently, like a current. It is made by many. It is open, participatory, and peer-driven. It uploads, and it distributes. Like water or electricity, it’s most forceful when it surges. The goal with new power is not to hoard it but to channel it.”*

Understanding New Power - Jeremy Heimans & Henry Timms
Harvard Business Review. December 2014

As we witness the democratising and decentralising effect of digital technology on our energy systems, technology is also enabling the decentralisation of social and economic power.

Case in point: the rise of the sharing economy and participatory democracy.

Both of these trends could re-shape our societal and economic structures. Both are enabled by digital tools which allow peer-to-peer transactions, collaboration and participation and both are indicative of the shift towards a distribution of traditional power, away from top down, centralised and hierarchical and to bottom up and decentralised.

What is the sharing economy?

The Sharing Economy (aka ‘collaborative economy’, or ‘peer-to-peer economy’) has the potential to bring about a new era of sustainability in the production and consumption of goods and services. It is enabled by digital technologies and based on sharing assets or services for free or for a fee. The Airbnb platform is an example of the sharing economy. Its website allows homeowners to offer their unused houses/apartments to travellers looking for a place to stay.

Not to be confused with the on-demand economy which includes services such as Uber, AirTasker and Foodora, the sharing economy is an arrangement among citizens to share, swap or trade goods and services, facilitated by digital platforms. In recent times the lines have been blurred with platforms created by companies to facilitate such arrangements (i.e., Uber), which are centralised and do not necessarily empower the citizen ‘producer’ (e.g., Uber drivers).

10. TECHNOLOGY AND PUBLIC PARTICIPATION IN SOLUTION DESIGN

Key ingredients of the sharing economy

Some 'key ingredients' in the sharing economy include full transparency in operations, the provision of goods and services rather than ownership, and the unlocking of unused assets - thereby increasing the life cycle of a product.

This trend has also given rise to the 'Prosumer' - the notion of the citizen as producer. 3D printers are also facilitating this rise, where individuals now possess the ability to design (or download product blueprints) and create them in their own homes. Indeed sometimes **entire houses are being printed by 3D printers**.

Case Study: Sharing economy: The Economy of Hours (Echo)

The Economy of Hours (Echo for short) is an internet based platform which facilitates the trading of skills on an hourly basis. Quite simply, one hour of your time - be it maths or music lessons, photoshoots, coding, personal training or anything else of value - is worth one 'Echo'. Once Echos have been earned, they can be spent in the Marketplace to buy an hour of someone else's time.

The Cognitive Surplus and Citizen Science.

To be sure, individual citizens contributing their time and effort to collective output is not a new phenomenon.

But technology has facilitated this trend on a scale not seen before. The author Clay Shirky calls the propensity for humans to contribute their spare time, creativity and brain capacity to a collective output the 'cognitive surplus'. He suggests that if the spare time of every human on the planet were combined that it would equal one trillion hours, and that this could be channeled towards solving big social and environmental problems (instead of, for example, creating cat videos on YouTube). Shirky also estimates that the average American watches **5 hours of television per day**. This equates to over 500 billion hours of television per year - or 1 million **Galaxy Zoo** projects (see next page). Citizen science (ordinary citizens contributing their time and skills to a coordinated scientific project) has indeed accessed the 'cognitive surplus' effectively by using technology to connect individuals and aggregate their combined output.

10. TECHNOLOGY AND PUBLIC PARTICIPATION IN SOLUTION DESIGN

What is citizen science?

Citizen science involves the participation of non-professionals in crowdsourcing, data analysis, and data collection. Citizen science projects use the views and efforts of huge amounts of people to undertake small tasks which would otherwise be extremely time intensive - if not impossible - for individual research teams.

Case Study: Citizen science: Zooniverse and Galaxy Zoo

Galaxy Zoo - a popular citizen science project on the website Zooniverse - requires volunteers to classify galaxies by answering simple questions about photos taken by Nasa's Hubble telescope. Questions such as "Is the galaxy simply smooth and rounded, or does it have features?" is used by the researchers to catalogue the millions of galaxies in the database. The information collected by the Zooniverse website has already been used in numerous published research papers and open-sourced data sets.

10. TECHNOLOGY AND PUBLIC PARTICIPATION IN SOLUTION DESIGN

What is participatory democracy?

Participatory democracy is the individual participation by citizens in political decisions that affect their lives. Information platforms such as MiVote and Democracy OS provide a range of perspectives on proposals from governments and other organisations. Via websites and mobile apps, citizens can then make informed decisions by voting or providing feedback on these proposals.

Corporations have caught on to the growing demand for co-creation and participation, with many now offering tailored services which allow their customers to modify the products to suit their requirements - customers of McDonald's and Nike are now able to design custom meals and shoes on touch screens in-store or online websites. Evidently, this rise in public participation is facilitated by modern technologies which allow for easier peer-to-peer and individual-to-organisation interactions.

Technology and participatory democracy

Internet based participatory democracy platforms, such as Democracy OS, allows citizens to engage, debate and vote on political issues. Users can also delegate their votes to other site users they believe are more informed on a topic or have views aligned with their own. Governments and other organisations can use these platforms to acquire feedback on proposed policies and projects, thus deepening community engagement in the political process and ensuring genuine participation from those whose lives are affected by government policies.

Case Study: Participatory democracy: MiVote

The blockchain based app MiVote allows citizens to cast their vote in favour of government policies they support. For example, when posed with the question 'How Should We Prioritise Australia's Energy Mix?', 88% of MiVote participants chose an environmentally focused energy policy. But the implications of apps such as MiVote extend beyond just obtaining statistics which influence decision making. Votes casted can ultimately shape the decisions. This occurred during the NASDAQ annual general meeting in Estonia where shareholders could securely cast votes online during or prior to the meeting using similar blockchain software.

10. TECHNOLOGY AND PUBLIC PARTICIPATION IN SOLUTION DESIGN

Public participation and WWF

Technology is also enabling the decentralisation of social and economic power.

The sharing economy, participatory democracy and citizen science - enabled by technology, are enabling deeper and even more impactful participation from supporters.

Conservation organisations have the opportunity to invite supporters further ‘inside the tent’, thereby facilitating greater levels of collaboration with and between supporters - all contributing to a shared goal, that of protecting the planet for future generations. WWF is inviting all supporters to collaborate on the issues that matter to them through Panda Labs, and by getting involved through important advocacy campaigns and animal adoption programs.

Case Study: Earth Hour

Ten years ago, WWF created Earth Hour. It began in Sydney, Australia as a way for ordinary people to demonstrate their support for climate change action. Today, it is the world’s largest grassroots movement for climate change, with over 187 countries and territories taking part. People have campaigned for lasting change under the Earth Hour banner. In the Galapagos Islands, the people sought and received a ban on soft plastics; in Uganda, an Earth Hour forest was planted in 2013; and in Russia, the people spoke out against further drilling of oil wells. In Australia, community leaders who attended Camp Earth Hour in 2013 are working to hasten the transition to a low-carbon, renewable energy future. For example, SHASA in Eurobodalla, NSW, is working with the local community to bulk buy solar panels to power businesses and homes in the area. https://www.shasa.com.au/about_us

IS THAT ALL?

IS THAT ALL?
WHAT ABOUT HOVERBOARDS TELEPORTATION & TIME TRAVEL?

This WWF discussion paper on emerging technology and environmental sustainability was developed to briefly explore some of the emerging technologies that we find exciting. However, this is by no means an exhaustive list - more an exploratory discussion starter. There are many other examples of exciting and innovative technological developments which are revolutionising conservation and sustainability.

Although technology can be exciting, it is ultimately a means to an end - an enabler of change. WWF's mission, and what we are inviting you to join us in exploring, is how emerging technology can be harnessed to help create a future where people can live and prosper in harmony with nature.

WWF is excited about how technology can save the planet - if you are too, let's chat!

A young tiger captured by a sensor camera in Bukit Betabuh Protection Forest, Riau Province, Sumatra, Indonesia.

WWF IS EXCITED ABOUT HOW TECHNOLOGY CAN SAVE THE PLANET - IF YOU ARE TOO, LET'S CHAT!

This report was authored by Reece Proudfoot and Samuel Kelley.
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WWF in numbers

+100

WWF is in over 100 countries, on 6 continents

6,628

WWF has 6,628 staff worldwide

+5.4M

WWF has over 5.4M financial supporters

1961

WWF was founded in 1961

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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