

TECHNOLOGY FOR A RESILIENT WORLD

"A BETTER FUTURE
FOR ALL"

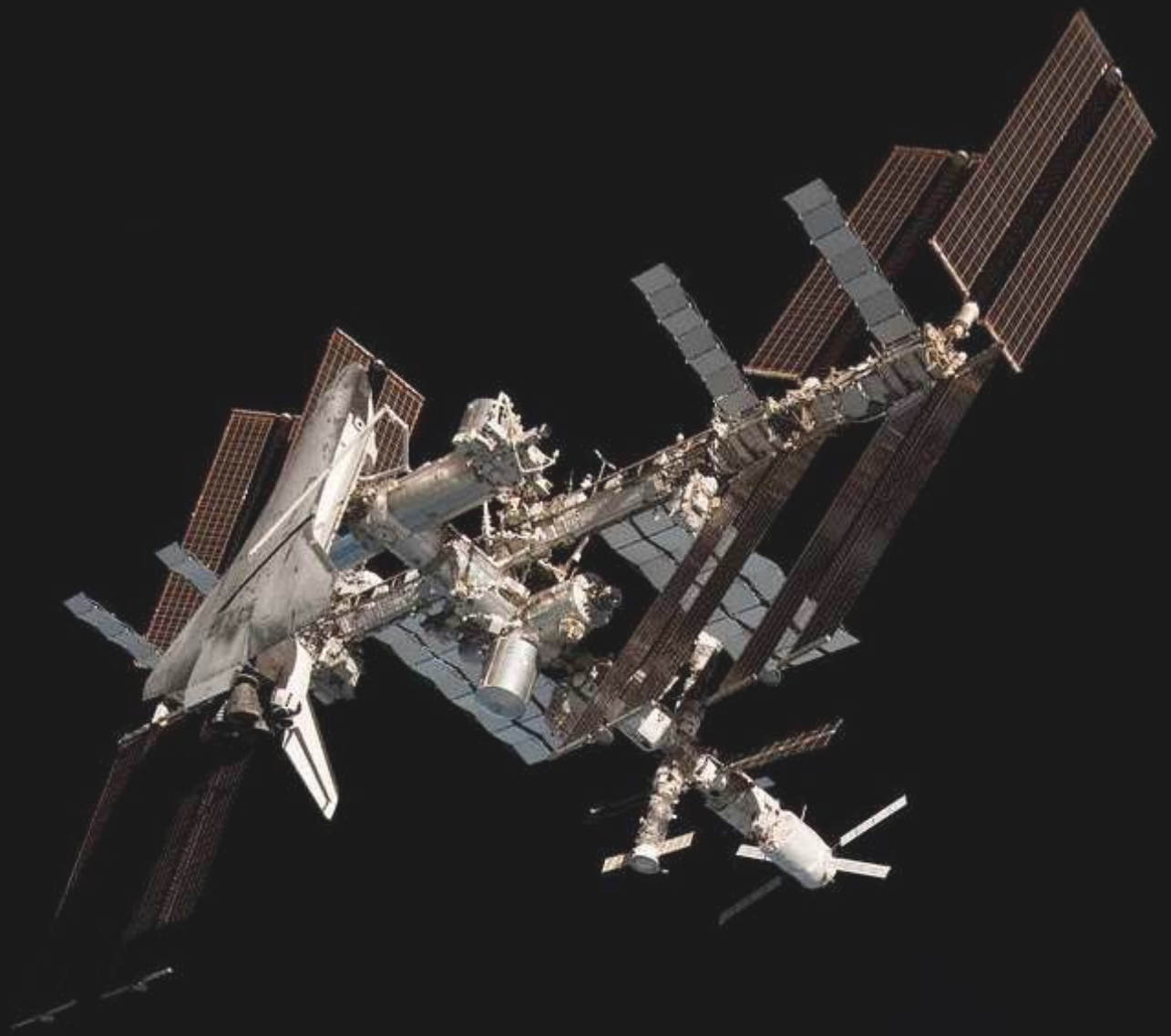


Table of Contents

03	Introduction - The Resilience Challenge
07	Technology for a Resilient World
10	Examples of Exponential Approaches to Resilience
12	Appendices 1-2
16	Contact and Credits



"The world's biggest problems are the world's greatest opportunities." - Peter Diamandis

Introduction

The Resilience Challenge

From chaos comes opportunity and we have a unique opportunity, a window in time, where we can with decisive action implement strategies embracing new technologies to fundamentally improve the lives of every man, woman, and child on the planet. As Abraham Lincoln said, "the best way to predict the future is to create it". The **Technology for a Resilient World (TRW)** platform aims to create a new future for resilience and preparedness practices and for the wellbeing of global communities.

Despite experiencing the SARS, H1N1, MERS, Ebola and Zika epidemics in the last 20 years, the world was not prepared for COVID-19. The crippling US\$multi-trillion impact¹ of this global pandemic alone has made the case for immediate action - for reimagining the quest for global resilience. It's time for change and action!

Pandemics are not the only concern. Natural disasters (including hurricanes, earthquakes, flooding and wildfires), conflicts and a steady increase in impoverished and forcibly displaced people have become the 'new normal', an indefinite crisis. The World Bank: "the impact of extreme natural disasters is estimated to be equivalent to a global US\$520 billion loss in annual consumption and forces some 26 million people into poverty each year"².

There are key issues that need to be addressed. While important gains have been made to improve resilience, efforts have traditionally been primarily focused on response, not preparedness, and on recovery, not resilience. Resilience investment is seen as an 'insurance' burden rather than as a driver of long-term socio-economic growth and wellbeing.

Resilience thinking can be changed and accelerated. It must embrace the transformative power of innovative technologies and internet connectivity that can deliver exponential impact and tremendous returns on each dollar deployed. It must recognize that disaster and change are interdisciplinary events impacting multiple complex ecosystems. It must recognize the need for open source, globally applicable, strategies and educational resources. These tools and approaches are the foundations of a 'new resilience'.

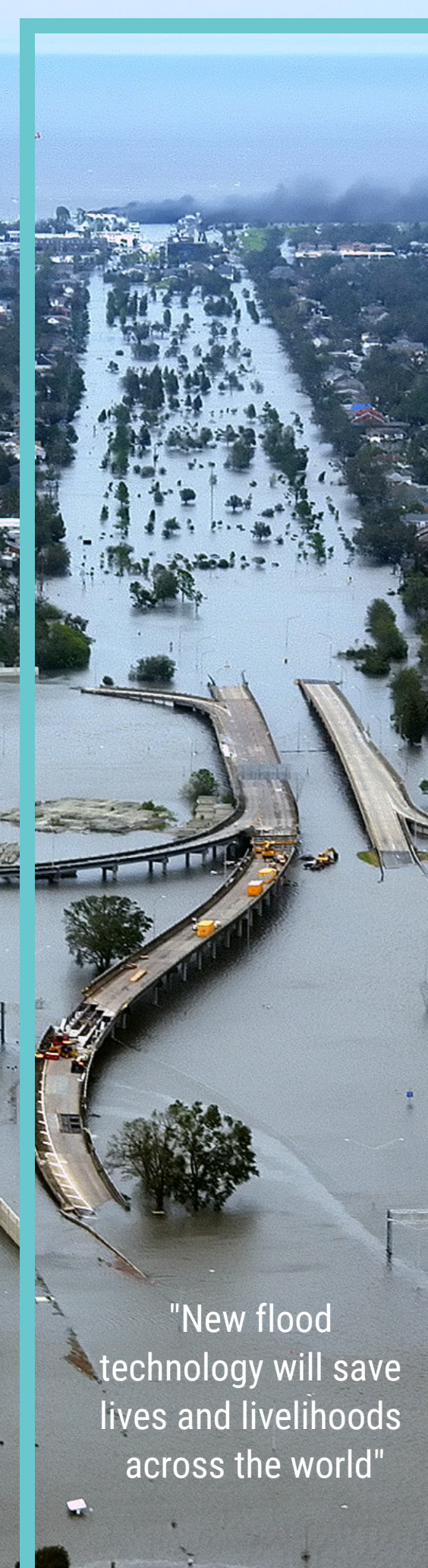
The Resilient Response

Technology for a Resilient World (TRW) is a direct response to these resilience challenges.

TRW's mission is to reimagine resilience by using exponential technologies to accelerate and promote an increased focus on preparedness and to reposition resilience as an investment in long-term growth in order to create more resilient and better prepared societies.

"Canadian start-up spotted coronavirus before everyone else knew about it"

¹ Global impact of COVID
² Impact of Natural Disasters



"New flood
technology will save
lives and livelihoods
across the world"

TRW is a platform focused on innovative technologies that can, for example, predict, detect and track viral outbreaks, wildfires, dam breaches, snowmelt, sea levels and flooding. Whilst critical to preparedness, these technologies are also powerful contributors to socio-economic growth in their own right.

Preparedness is a compelling economic argument. The World Bank: "US\$1 of preparedness saves US\$16 on response"³. Deploying exponential technologies can yield a far greater financial return than 1:16x. For example, Dr Tom Painter, CEO of Airborne Snow Observatories Inc, in discussing using LIDAR technology to measure snow mass and snowmelt, stated that "Each US\$ invested in using this technology to achieve this all round resilience is estimated to yield US\$40 of freshwater supply benefits alone and markedly greater than US\$100 when considering hydroelectric optimization, groundwater storage, hazard avoidance and operational and political flexibility". This 'Exponential Preparedness Multiplier' underpins a fresh approach to regarding investment in preparedness as an investment in long-term socio-economic growth.

"TRW is the agent of change for more resilient and better prepared communities."


Understanding how these technologies can be used is critical to realizing the benefits. For example, satellite data services can support early warning systems for natural disasters, the monitoring and improvement of crop yields and the monitoring of illegal and unreported fishing, ocean health, deforestation and coastal erosion. In addition, fully integrated real-time space data is critical for monitoring aging and failing infrastructure and can serve as an important bridge in the multi-decadal process of rebuilding. This multifunctional efficiency, whilst essential for best practice preparedness, also has many other socio-economic benefits.

To be effective, resilience must be viewed on an interdisciplinary, holistic basis; hazards have environmental, social and economic impact. For example, while scientists aren't certain whether climate change has led to more hurricanes, they are confident that rising sea levels are leading to higher storm surges and more floods⁴. In addition, because technology changes more rapidly than regulation, regulatory innovation is often required to enable technology to operate to its full capacity. Furthermore, to benefit fully from investing in technology assisted preparedness, it is essential to educate existing and future decision makers.

In summary, TRW's strategy for a new resiliency is to deploy exponential technologies, harness their wider economic potential, create holistic global resilience strategies, new regulatory models and related training and educational resources. In doing so TRW can leverage and accelerate the Exponential Preparedness Multiplier to achieve higher impact and returns.

³ World Bank 1:16 preparedness ratio

⁴ Storm Surges and Floods



"Satellite imagery can help predict volcanic eruptions"

Who Will Benefit from TRW?

A broad range of communities worldwide will benefit from the application of exponential thinking and technologies including developing nations, governments, International Non-Governmental Organizations (INGOs), the private sector and academia. Further details are provided in the [Beneficiaries Diagram on page 9](#).

What is TRW?

TRW is an independent project of Geeks Without Frontiers (Geeks), a nonprofit platform for change with broad experience of advising governments on innovative resilience solutions. Founded and run by entrepreneurs, Geeks is based in Washington, D.C. with regional offices in London and Copenhagen and a field manager network that connects the world's major regions. Geeks' resilience background is set out in [Appendix 1](#) and details of the Geeks structure and team in [Appendix 2](#).

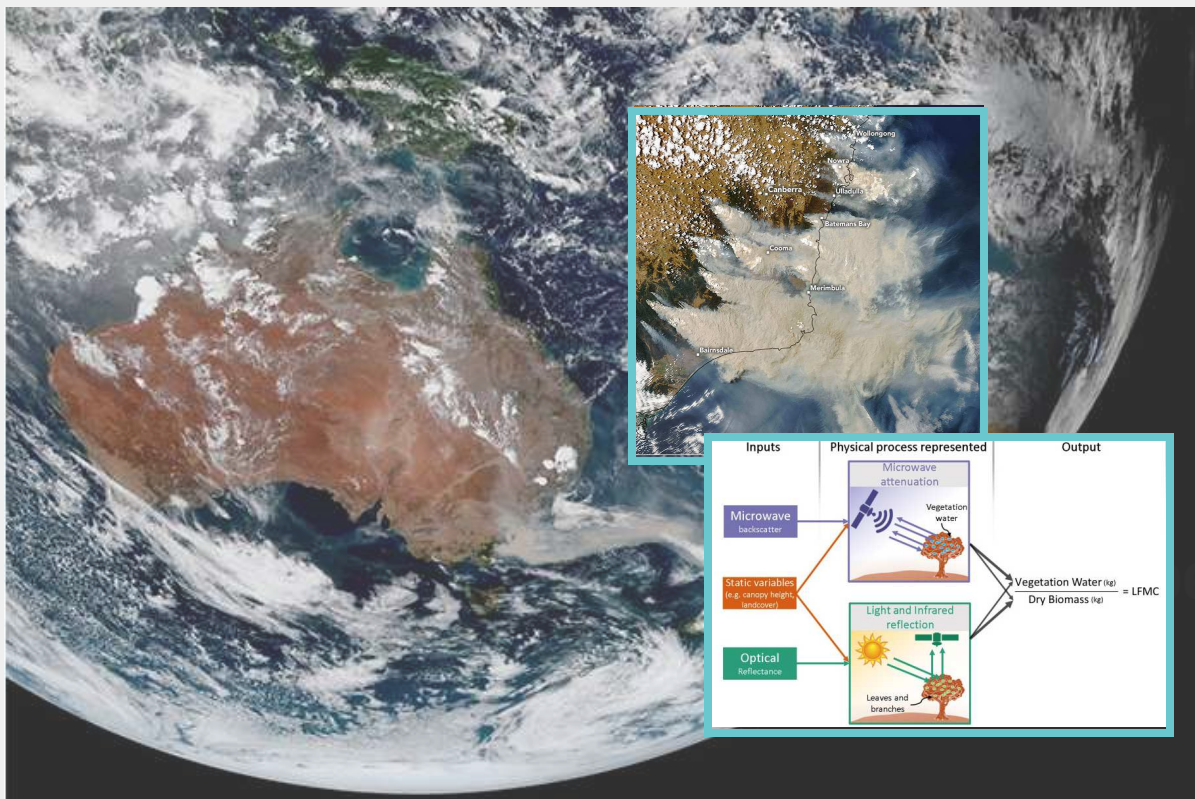
Disaster Trends 1998-2017				
	# of Disasters	People Affected	Deaths	Economic Losses (US\$)
Flood	3,148	2.0 Bn	142,088	656 Bn
Storm	2,049	726 M	232,680	1,330 Bn
Earthquake	563	125 M	747,000	661 Bn
Extreme Temperature	405	97 M	166,346	61 Bn
Landslide	378	4.8 M	18,414	2.7 Bn
Drought	347	1.5 Bn	21,563	124 Bn
Wildfire	254	2 M	750	68 Bn
Volcanic Activity	99	2 M	750	2.7 Bn
Mass Movement	12	2 M	750	2.7 Bn

Source: CRED / UNISDR

Using imaging technology and data analytics, snow melt can now be calculated to within an unprecedented 98% accuracy.



Satellites can be used to predict, detect, and track wildfires.



Technology for a Resilient World

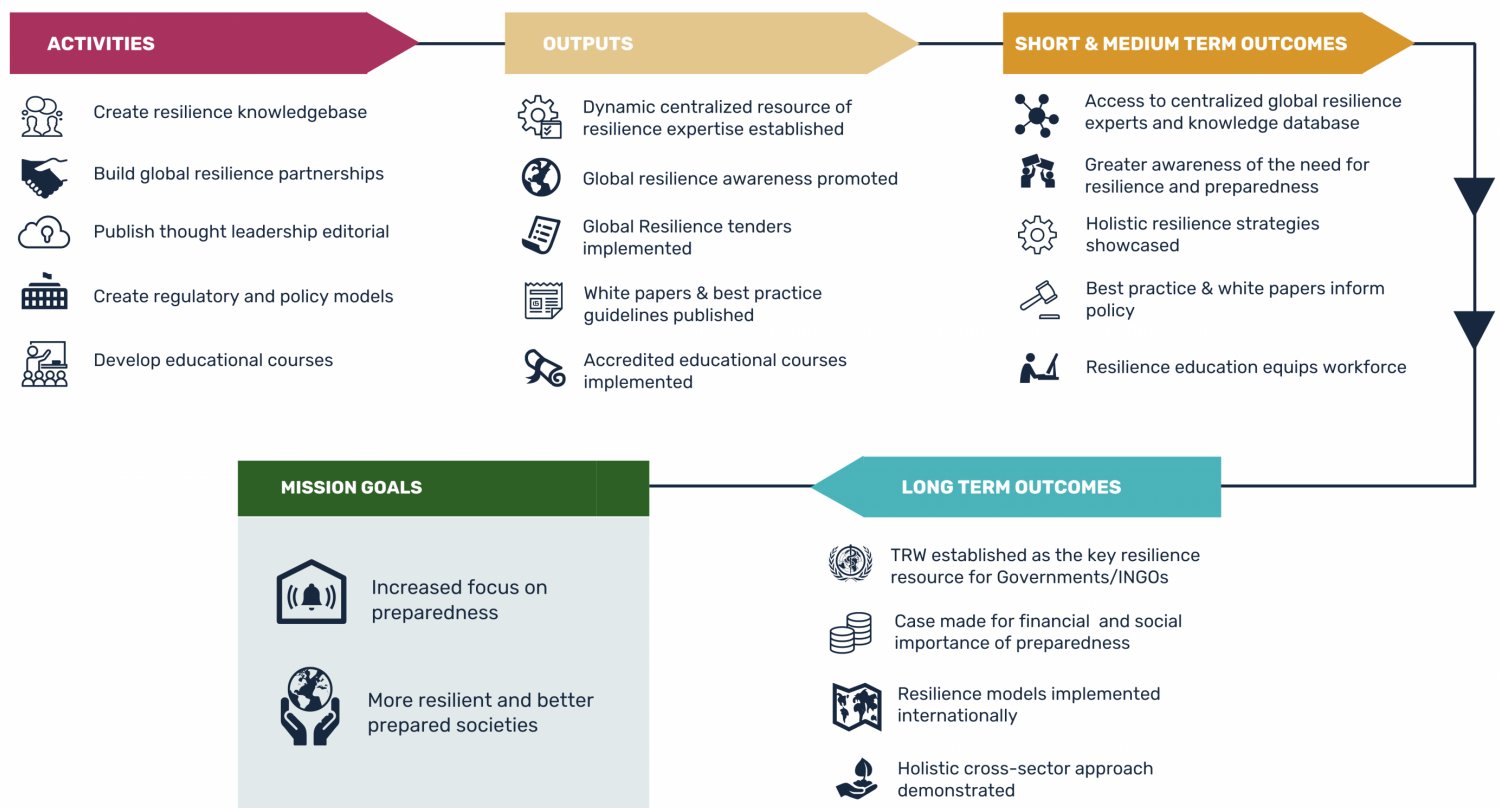
TRW's Mission and Goals

TRW's mission is to reimagine resilience by using exponential technologies to accelerate and promote an increased focus on preparedness and to reposition resilience as an investment in long-term growth in order to create more resilient and better prepared societies.

TRW's goals are:

- To create a platform promoting resilience as a technology driven engine of socio-economic development
- To research, develop and implement interdisciplinary strategies that bridge ecosystems
- To democratize these strategies and their benefits for all communities by making them open source and promoting them globally
- To produce innovative White Papers, regulatory models and research
- To develop training and capacity building programs and educational courses designed to provide the next generation of decision makers with key resilience knowledge and skills

These goals are mapped to TRW's mission impact in the following **Theory of Change** diagram:



In addition, TRW's mission and goals impact on, and map to, all of the UN Sustainable Development Goals.

TRW Three-Year Action Plan

Year 1:

- Identify core exponential technologies that can be accelerated
- Build key international partnerships with resilience stakeholders
- Create online resilience thought leadership editorial
- Create online resilience resource matrix and filter for exponential technologies & applications
- Plan promotion of resilience through conferences, White Papers, regulatory models, best practices and educational and training and capacity building programs
- Promote the benefits of these technologies to the insurance and reinsurance sectors

Year 2:

- Implement a schedule of international thought leadership conferences, training and capacity building programs (on and offline), White Papers, regulatory models, etc.
- Working with leading educational and resilience stakeholders, design on and offline, accredited academic and vocational courses and modules, focused on academic and practical resilience, technology, data analytics and sustainability skills
- Continue to build key international partnerships with resilience stakeholders and seek formal status with major INGO's, United Nations, World Bank and other key influencers

Year 3:

- Start an annual 'Technology for a Resilient World Event' designed to showcase resilience solutions, technologies and models; White Papers and Regulatory and Policy Models; the benefits of resilience training and capacity building; resilience education, and to demonstrate the positive socio-economic impact of preparedness from case studies
- Start to consolidate the long-term financial sustainability of TRW through consultancy; resilience implementations; delivering training and capacity building programs; partnership contributions and sponsorship and events

Who Will TRW's Resilience Partners Include?



Governments, INGOs, & Int'l Aid Organizations

- Governments
- Inter-Governmental Organizations
- United Nations Organizations
- World Bank, IFC, ITU
- Int'l Aid Organizations
- Int'l Health Organizations
- Int'l Finance Organizations
- Environmental/Climate Change Organizations



Internet Connectivity

- Satellite Organizations
- Fiber, Mobile, Internet
- Technology Suppliers
- Space Data Analytics Experts
- Global Telecoms Organizations
- Broadband Commission for Sustainable Development
- IoT



Financial, Academic, Research & Funding

- Global Law & Consultancy Firms
- Global Media Companies
- Foundations & Funders
- Leading Academic Institutions
- Scientific Research Labs
- Health & Pandemic Research
- Financial Services Institutions
- Monitoring & Evaluation Experts



Exponential Technology

- Artificial Intelligence
- Big Data Analytics
- Earth Imaging/Digital Mapping
- Silicon Valley Technologists
- Health Tech, Tracking & Analytics
- Pandemic Analytics & Warning Systems

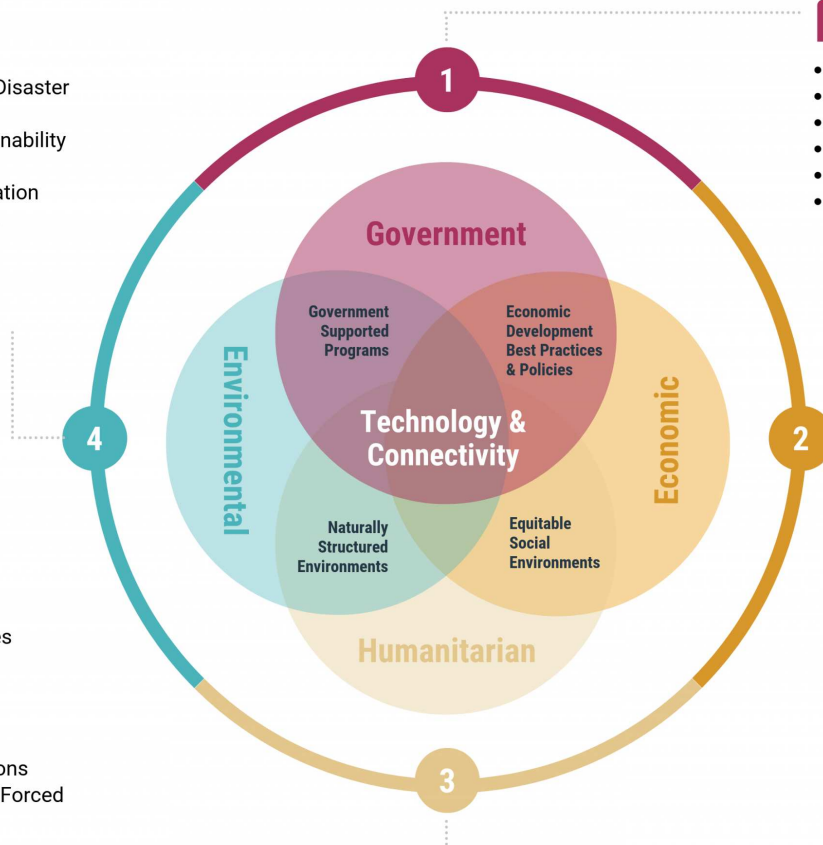
What Strategic Areas Will TRW Operate in?



- Climate and Natural Disaster Resilience
- Environmental Sustainability
- Ocean Health
- Biodiversity Conservation
- Earth Imaging & Data Analytics
- Supply Chain & CSR Management



- Resilient Communities
- E-health & Pandemic Resilience
- Gender Equality
- Remote Education
- Digital Identity Solutions
- Human Trafficking & Forced Labor



- Best Practices White Papers
- Regulatory & Policy Models
- Training & Capacity Building
- Thought Leadership Forums
- Data Driven Digital Solutions
- Consultancy & Advocacy



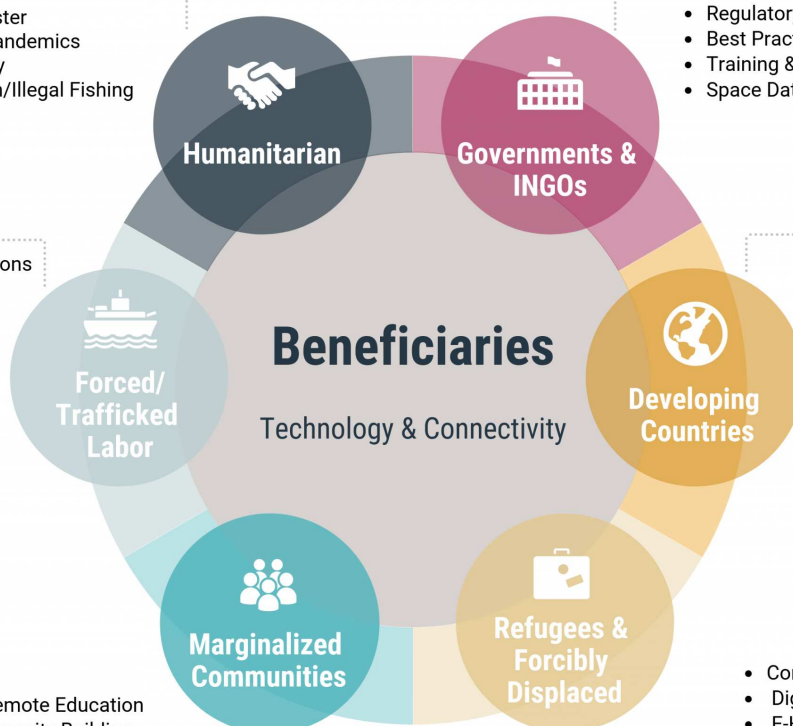
- Bridging the Digital Divide
- Resilient Economies
- Data Analytics
- Demand Aggregation
- Training & Capacity Building
- Leveraging Exponential Technologies & Connectivity

Who Will Benefit from TRW?

- Natural Disaster
- E-Health & Pandemics
- Food Security
- Ocean Health/Illegal Fishing

- Connectivity Based Solutions
- Digital Solutions
- Resilience Models
- Mapping & Tracking

- Connectivity
- E-Health & Remote Education
- Training & Capacity Building
- Gender Equality



- Regulatory & Policy Models
- Best Practice White Papers
- Training & Capacity Building
- Space Data Analytics

- Satellite-Based Early Warning Systems
- Connectivity
- Space Data Analytics
- E-Health & Remote Education

- Connectivity
- Digital Identity
- E-Health
- Remote Education

Examples of Exponential Approaches to Resilience

Resilience through Data Analytics

There is a constant stream of data, whether satellite or airborne generated, carrying important resilience information. For example, recent innovations in Synthetic Aperture Radar (SAR) satellite technology mean that SAR, coupled with artificial intelligence, can be used to detect wildfire risks⁵ and miniscule movements in essential infrastructure such as dams⁶ providing critical early warning and tracking data. Snowpack and snowmelt radar analytics is another example; this technology can help improve water management for 1.5 billion people worldwide whose water supply comes from snowmelt⁷.

Natural Disaster Resilience Infrastructure for SIDS

There are some 58 Small Island Developing States (SIDS) located in the world's oceans. Geeks has developed a base case methodology for introducing sustainable, satellite based early warning systems, focused on monitoring and identifying climate, weather, flooding and tectonic patterns and threats. The same core systems can also be used to address other socio-economic needs including more robust and comprehensive connectivity and Wi-Fi, digital mapping, crop monitoring etc. which helps establish sustainability.

Promoting Resilience through Accredited Education

It is imperative that the next generation of decision makers are aware of the resilience resources at their disposal, cognizant of their capacity for leveraged socio-economic impact and trained in the technologies that drive them. With access to the network of experts in the TRW ecosystem, and in partnership with leading global academic and research institutions, the goal is to design and implement accredited on and offline academic courses and modules.

Resilience through Removing Legal and Regulatory Barriers

Geeks has a history of promoting resilience through legal and regulatory innovation via its DigOnce! and CommunityConnect! initiatives and its Digital Divide work with the US FCC. An example of a TRW focus is refugee identity. There are currently 70 million forcibly displaced people including 25 million refugees⁸. Whilst many have formal UNHCR identification, this is frequently rejected by local and national administrations for failing to satisfy their identity requirements. Consequently, refugees are unable to access the Internet (via SIM cards and Wi-Fi), mobile money or bank accounts or get access to other basic socio-economic rights and services. As a result, this materially reduces the resilience of the refugee community.

Pandemic and Epidemic Resilience

The COVID-19 pandemic was preceded, in the last 20 years, by the 2003 SARS, 2012 MERS, 2014 Ebola and 2015 Zika epidemics and the 2009 H1N1 'Swine Flu' pandemic. Yet despite this recent history, COVID-19 has been a representative case of response and not preparedness. TRW can help to create an infrastructure to support and promote pandemic resilience and preparedness.

⁵ Wildfire Risks

⁶ Early warning for critical infrastructure

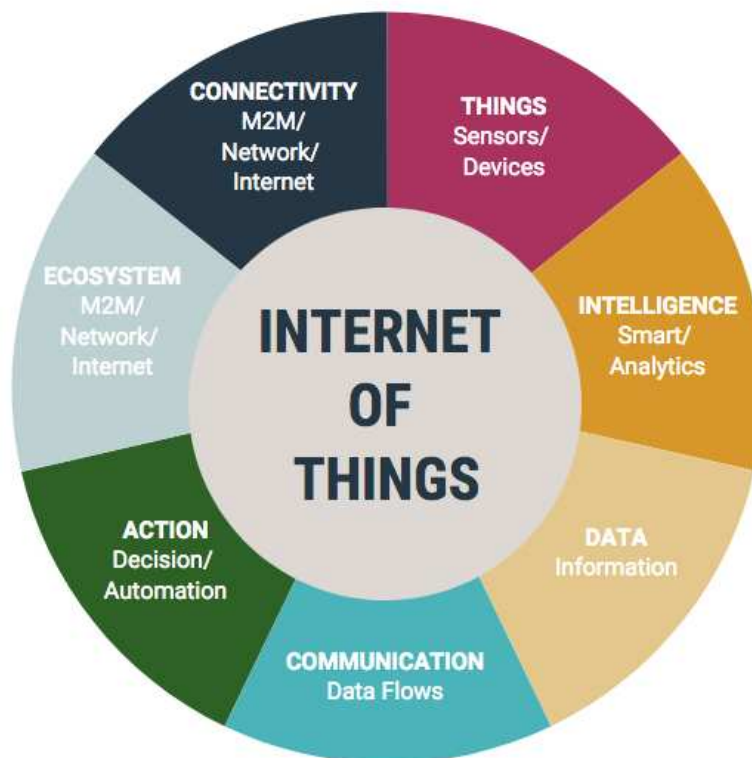
⁷ Help improve water management for 1.5 billion people worldwide

⁸ Forcibly displaced and refugees

Examples of how TRW will do this are as follows:

- Work with artificial intelligence and data analytics 'risk outbreak' specialists⁹ and academic institutions to develop a digital mapping-based information and early warning systems accessible by global communities
- Democratize the learning from COVID-19 by aggregating, in conjunction with leading research and academic institutions, and publishing outcomes based on statistical analysis, in addition to medical and socio-economic practices that have proven to be effective
- Heighten awareness of COVID-response best practices for integration into national emergency communications plans
- Commission White Papers and Best Practice Guidelines for stakeholders based on COVID-19 outcomes
- Promote digital demand aggregation platforms¹⁰ to enable smaller communities to participate in acquiring licences, intellectual property rights and cost-effective vaccines, personal protective equipment and other health related resources that play an essential part in both preparation and response
- Incorporate key pandemic learning outcomes into resilience focused educational courses 274166

The Internet of Things will revolutionize resilience technologies and drive exponential impact for communities worldwide.



⁹ Pandemic risk outbreak

¹⁰ Digital demand aggregation platforms

Appendix 1

Geeks Team's Resilience Track Record

2020:

- Along with Guidehouse (the former US Public Sector business of Price Waterhouse Coopers), Nan McKay (housing and disaster response specialists) and legal experts, Geeks is advising on COVID-19 related distribution of funds for essential services including the need for connectivity driven tele-health and distance-learning in unserved and underserved communities in the USA
- Geeks co-authors, with fellow members of the US Federal Communications Commission (FCC) Disaster Response and Recovery Working Group, the US [Disaster Preparedness Best-Practices Report and Recommendations](#)
- Geeks partners with the Commonwealth Telecommunications Organisation and the International Space University to explore opportunities to develop public policy and training and capacity building courses that enable administrators and industries to leverage space data analytics to achieve public policy objectives (e.g. natural resource management, disaster preparedness, health, education, etc.)
- Geeks partners with Telecoms Sans Frontieres, Eutelsat, Neptune, Aquobex and others to explore options to develop sustainable satellite-based disaster early warning resilience and preparedness plans with a focus on developing a model for Small Island Developing States

2019:

- Geeks, sponsored by government and private sector stakeholders, develops a sustainable resilience model ("Sustainability Models for the Global Fishing Industry") to address human trafficking, forced labor and illegal and unreported fishing in Asia. [The initiative won the Space & Satellite Professionals International \(SSPI\) 'Better Satellite World' award alongside the UK Space Agency and Kyushu Institute of Technology](#)
- In coordination with the International Telecommunication Union and UN Emergency Telecommunications Cluster, and with support from the US Commerce Department, [Geeks provided disaster preparedness capacity building and assistance with development of an emergency communications plan for the government of Afghanistan](#)
- Geeks forms a resilience and preparedness teaming partnership with Guidehouse (the former US Public Sector business of Price Waterhouse Coopers), Nan McKay (housing and disaster response specialists) and legal experts focused on providing resilience and preparedness solutions to Federal Emergency Management Agencies in the US and other government resilience stakeholders
- Geeks joins the Space Safety Coalition, a global ad hoc coalition dedicated to developing and maintaining a set of space-safety best practices that were initiated by Geeks' CEO to underwrite resilience and preparedness in space
- Working in partnership with UNHCR, government agencies and satellite, fiber and mobile network operators, Geeks conducts an assessment of connectivity requirements for Syrian refugees in Jordan and the viability of a global regulatory and policy initiative for refugee socio-economic inclusion

2016 - 2018:

- David Hartshorn, Geeks CEO, appointed to the Disaster Response and Recovery Working Group of the FCC's Broadband Deployment Advisory Committee (BDAC)
- Geek's Co-founders Michael Potter and John Morris appointed by US Federal Communications Commission (FCC) to help draft a 'Model Code for States' to accelerate broadband deployment and investment and to close the Digital Divide
- Geeks publishes [CommunityConnect!](#), a code of best practices for Satellite Operators, Regulators and Service Providers & Integrators, drawn up in conjunction with thought leaders from the satellite and broadband communications industry, and designed to help promote the rapid and cost-effective deployment of satellite broadband. CommunityConnect! won the Pacific Telecommunications Council's 'Best Regulatory Innovation' Award
- Geeks publishes [DigOnce!](#), international model legislation designed to drive and inspire a global policy effort to promote resilience and close the Digital Divide. DigOnce! provides a framework to roll out fiber networks to make broadband internet available to more people more quickly at a lower economic and environmental cost
- Geeks and Cozybit, sponsored by the Tides Foundation (now Google.org), create the world's first Open Source Mesh Network IEEE certified WiFi 802.11s protocol, now in use providing resiliency globally, in partnership with Google, Tides Foundation, Microsoft, Nokia, Erickson, GlobalConnect AS, and ManSat

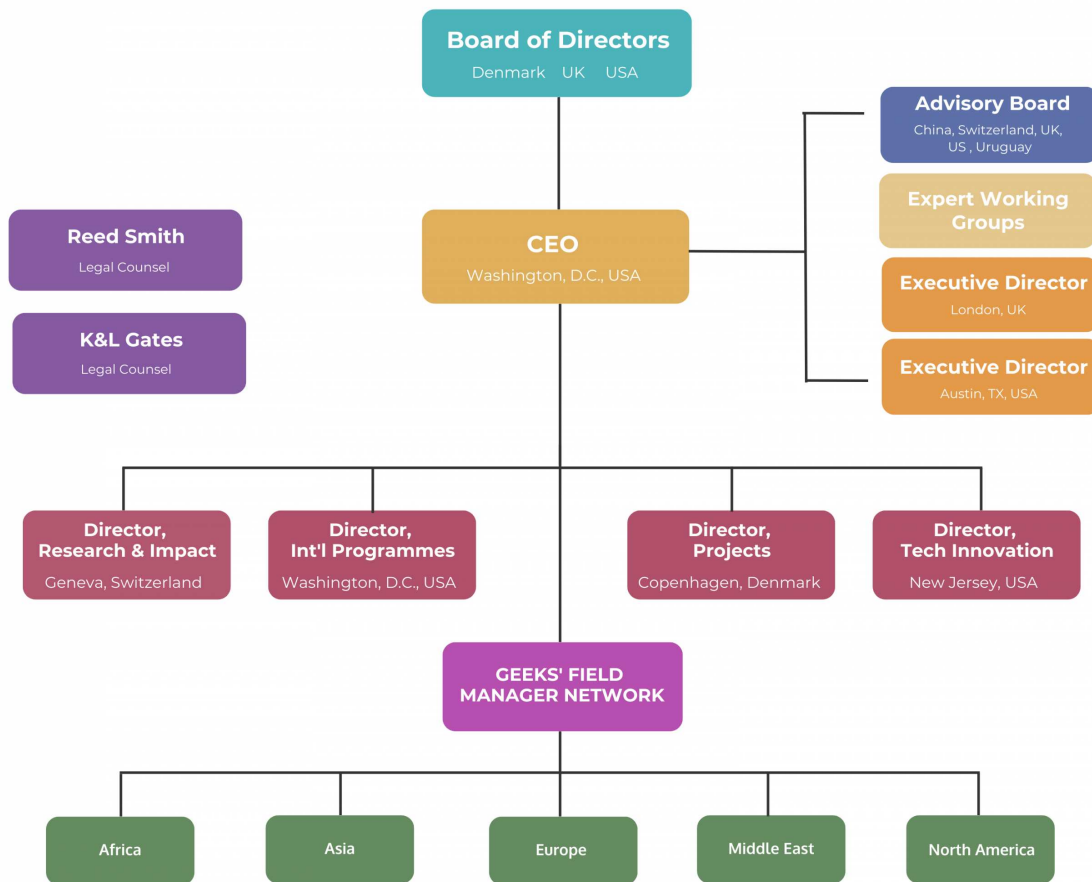
Pre-Geeks Resilience Experience:

David Hartshorn, Geeks CEO, in his previous role as Secretary General of the Global VSAT Forum (GVF), the UK-based association representing the global satellite industry:

- Helped the UN-Emergency Telecoms Cluster (ETC) establish the Crisis Connectivity Charter, an award-winning sustainable preparedness model that has been successfully implemented in multiple disasters
- Supported the UN-OCHA Working Group for Emergency Telecommunications (WGET) with global advocacy for ratification of the UN Tampere Convention (to mitigate regulatory challenges during disaster-relief efforts)
- Served with the International Disaster Response Subcommittee to the US State Department's Advisory Committee on International Communications and Information Policy (ACICIP) in relation to disaster response
- Worked in support of US government disaster preparedness and response initiatives, including coordination of private-sector support for Satcom Endeavor, a bi-annual joint military disaster preparedness exercise
- Coordinated with inter-governmental groups in every major world region relating to spectrum use for disaster preparedness, response and recovery
- Together with Geeks' Tech Innovation Director, Joe Simmons (formerly of NetHope, an association of 60+ NGOs), coordinated preparations for rapid deployment of a first-response broadband network that was first used during the Haiti earthquake-relief efforts by more than a dozen NGOs operating throughout the country

Appendix 2

The Geeks Team



Board:

- **John Morris**, London, UK, serves as Executive Director and co-founder of Geeks. Prior to founding business ventures in telecoms, venture capital and software, John was a barrister and investment banker. John is the architect and main author of Geeks' Model Law on 'DigOnce!' and 'CommunityConnect!' White Paper designed to democratize broadband access. John is also an adviser to the US FCC and helped to draft the 'State Model Code for Accelerating Broadband Infrastructure Deployment and Investment'.
- **Michael Potter**, Austin, Texas, is an Executive Director and co-founder of Geeks. Michael, an active business and social investor, was co-founder of the pan-European telecommunications company Esprit Telecom and a strategic investor and board member of Global Connect which laid 12,500 Km of resilient fiber optic infrastructure in Europe. Michael also advised on the US FCC's 'State Model Code for Accelerating Broadband Infrastructure Deployment and Investment'. Since 2005, Michael has served as an International Space University faculty member and lecturer on entrepreneurship, international relations, technology, strategy and film. Michael has spoken around the world on sustainable strategies and policies for accelerating resilient infrastructure.
- **Niels Zibrandtsen**, Copenhagen, Denmark, Director. Niels founded and built GlobalConnect AS, Denmark's leading provider of B2B communications services which laid 12,500 km of fiber in Denmark and Germany, which was sold to Swedish investor EQT in 2018. Niels also founded inQvation, one of Denmark's largest incubators for tech start-ups and is an active business and social investor in multiple enterprises.

Appendix 2

The Geeks Team

Management:

- **David Hartshorn**, Washington, D.C., serves as CEO. David has 30+ years' international experience of resilience and preparedness and is a member of the US FCC Disaster Response and Recovery Working Group and co-author of the Groups' "Disaster Preparedness Best-Practices Report and Recommendations". David has lived in three continents and worked across the world including advising the United Nations and US State Department on key resilience projects.
- **Teresa Labriola**, Copenhagen, a Geeks Project Director, has worked with sustainable initiatives since 2013. Teresa has a strong background in community engagement, sustainability and CSR and completed a education-project secondment in Kenya. Her main focus at Geeks is strategic partnerships for sustainable resilience.
- **Angie Mar**, Washington, D.C., is Geeks' Director of International Programs and Chairs Geeks' WomenConnect! Working Group, focusing on gender equality and women's empowerment by providing access to connectivity, technology and innovation for sustainable development. Angie has a background in the satellite sector.
- **Dr. Tanya Murphy**, Geneva, is Geeks' Director of Research and Impact. She is a social scientist with an MA in Social and Political Sciences from Cambridge University, and a PhD in Social Anthropology from the London School of Economics. Tanya has 30+ years of M&E experience, particularly with NGOs, refugees and the public sector.
- **Joe Simmons**, Ocean Grove, New York, is Director of Tech Innovation. Joe has 25+ years' experience managing large scale technology projects, technical training and workshops and, most recently, delivering Geeks' disaster preparedness capacity building for the Afghan government. Joe led NetHope's global connectivity & infrastructure initiatives, including leadership of a 20-NGO response in post-earthquake Haiti; the establishment of a training center in Kenya and supported the setup of NGO chapters in Ghana, Kenya and South Africa.
- Board members John Morris and Michael Potter are also members of the day to day management team.

Geeks Advisory Board Members (selection):

- **Gary Fowlie**, New York, an economist specializing in technology, was formerly head of the UN's ITU Liaison Office. He most recently led a UN effort to facilitate the use of ICT for achieving the UN Sustainable Development Goals.
- **Carol Goldstein**, New York, with a background in finance, law, and investment banking Carol has 25 years' experience of providing strategic and financing advice to the telecommunications, satellite and space sectors.
- **Baroness Nicholson**, London, founder of the AMAR Foundation for refugees, a World Health Organisation Envoy for Health as a Tool for Peace and Development, founder member of the Booker Prize Foundation and a sitting Peer in the UK House of Lords.
- **Christopher Schroeder**, Washington D.C., entrepreneur, investor, and Internet/media specialist, Christopher is a leading expert in emerging markets and the Middle East. Co-founder of HealthCentral.com, he was previously CEO and Publisher of The Washington Post, Newsweek Interactive, and LegiSlate.com.
- **Ben Schwegler Ph.D.**, San Francisco, Consulting Professor of Civil and Environmental Engineering at Stanford University and Chief Scientist at Engie Research, China.
- **Chris Stott**, Florida, Geeks Co-founder, satellite and space entrepreneur, founder and CEO of geostationary orbit specialist ManSat Ltd, former chairman of the Manna Energy Foundation and former INGO field manager with Life Education Trust and AMAR Foundation.

Contacts and Credits

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Credits:

Page 1: Girl using a digital tablet, East Africa. *License: iStock by Getty Images.*

Page 2: International Space Station and the docked space shuttle Endeavour. *Photo credit: NASA/ESA.*

Page 3: Bangkok, Thailand - Mar 2020: business people wearing coronavirus masks. *License: iStock by Getty Images.*

Page 4: Flooding in New Orleans, Louisiana, in the aftermath of Hurricane Katrina. *Photo credit: U.S. Coast Guard, Petty Officer 2nd Class Kyle Niemi. US public domain image.* According to a 2015 study carried out by the Institute for Environment and Human Security of the United Nations University. According to a [2015 study carried out by the Institute for Environment and Human Security of the United Nations University](#), there will be between 25 million to 1 billion environmental migrants by 2050.

Page 5: Eruption of Volcan de Fuego, Guatemala. *Photo credit: Paul Newton, Smithsonian Institution. US public domain image.*

In 2018, mortality from volcanoes resulted in more deaths than all the previous years in the 21st century combined. In June 2018, the Volcan de Fuego eruption in Guatemala killed 425 people and affected 1.7 million people in the area.

Page 6: Top Photo Series:

Photo Background: Aerial view of the Sierra Nevada Mountains, California, USA. *Photo credit: Dickylyon, Creative Commons Attribution-Share Alike 4.0 International*

Photo Inset: Uncontrolled snowmelt run-off from the Oroville dam, Feather River, California in 2017 following rain-on-snow and snow melt in the feather river basin of the Sierra Nevada mountains. *Photo credit: California Department of Water Resources.*

Dr Tom Painter, CEO of Airborne Snow Observatories Inc., said, "Using airborne LIDAR and imaging spectrometer technology and data analytics, the antecedent snow mass and consequent snow melt can now be calculated to within an unprecedented 98% accuracy enabling valuable water reserves, yield from hydro-electricity and safety of the local community and the dam infrastructure to be optimized. This transforms communities from being at the mercy of nature to being the beneficiaries of technology driven science. Snowmelt provides freshwater for an estimated 1.5 billion people around the world and its hydroelectric generation reaches to greater populations. Each US\$ invested in using this technology to achieve this all round resilience is estimated to yield US\$40 of freshwater supply benefits alone and markedly greater than US\$100 when considering hydroelectric optimization, groundwater storage, hazard avoidance and operational flexibility, and political flexibility. These benefits, together with potential insurance and reinsurance premium savings, can be seen as part of long-term resilience related investment in socio-economic development."

Page 6: Bottom Photo Series:

Photo Background: Himawari-8 satellite view of the Australian bushfires and smoke clouds. *Photo credit: NASA/EOSDIS.*

Photo Inset: Fires burning across New South Wales, Australia, are still not contained. *Photo credit: NASA/EOSDIS.*

Diagram Inset: Satellites can be used to predict, detect, and track wildfires. [Credit](#)

Page 12: Somali immigrant refugee camp, Mogadishu, Somalia. *License: iStock by Getty images.*

At the end of 2019 as a result of persecution, conflict, violence, human rights violations or events seriously disturbing public order, [UNHCR estimated that there were 79.5 forcibly displaced people worldwide.](#)

Page 13: Connectivity is resilience. A group of people use their smart phones in synchronicity. *License: iStock by Getty images.*

In its statement, "Ensuring that No One is Left Behind", the [UN Broadband Commission for Sustainable Development](#) stated that we "affirm our sincere conviction and belief in the vital role of broadband in building and transforming our economies and societies, and achieving the Sustainable Development Goals".

Page 18: Hydroelectric Séliš Ksanka Ql'ispé Dam (formerly known as Kerr Dam) at Polson, operated by the Confederated Salish and Kootenai Tribes of the Flathead Nation in Montana, USA. *Photo credit: Martina Nolte / Creative Commons CC-by-sa-3.0 de*



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