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New Zealand and Global Catastrophe: A picture of vulnerability, a pathway to improved resilience

Analysis Report of Interview Data from the Aotearoa NZ Catastrophe Resilience Project (NZCat)

Adapt Research Ltd

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Disclaimer: This report presents results from a single component of an ongoing research project and serves as a basis for further data collection. The views summarised below are those of the survey respondents and their suggestions may not necessarily reflect final project recommendations to be published once all project components are completed. Authorship of this report does not imply agreement with all statements provided by interviewees.

Executive Summary

This report presents the findings of an interview-based investigation into Aotearoa New Zealand's (hereafter, Aotearoa NZ) cross-sector resilience in the context of a Northern Hemisphere nuclear war and other Global Catastrophic Risk (GCR) scenarios. This research comprises Phase III of the Aotearoa NZ Catastrophe Resilience Project (NZCat) and builds upon the groundwork laid in Phases I and II.

Phase I of NZCat established a nuclear war/winter Hazard Profile through consultation with expert stakeholders. The Hazard Profile provides information on the global risk of nuclear war and possible high-level impact on Aotearoa NZ. The key impacts include severe trade disruption and the effects of a nuclear winter. Phase II involved a qualitative Survey of Experts based on the Hazard Profile scenario with the aim of better understanding these impacts on Aotearoa NZ and to canvas mitigation strategies.

The survey respondents identified individuals for the subsequent interview study, which utilised a snowballing approach to include additional experts. Interviews were conducted across key industry sectors encompassing agri-food, transport, energy, ICT/digital, economy and society, as well as risk management, planning, and foresight, involving a total of 18 highly knowledgeable key informants.

The following summary outlines the key findings from these interviews, quotes appear in the Appendix:

Agri-food Sector:

Aotearoa NZ's agri-food sector faces substantial challenges in the event of a Northern Hemisphere nuclear war, including trade isolation (with loss of export markets), supply chain vulnerabilities for agricultural inputs, technological fragility, and labour-related uncertainties. Strategic measures to enhance resilience include developing a National Resilience Framework and Food Security Strategy, localising food distribution, addressing fertiliser, fuel, agrichemical, and seed supply, as well as frost resistance, ensuring animal welfare, and fostering trade continuity with key partners, particularly Australia.

Transport Sector:

The nation’s transport sector is vulnerable due to an overreliance on diesel-powered road trucking and limited diversification. Mitigation strategies could involve balanced investment in alternative transport methods such as electric rail, coastal shipping infrastructure, transition to alternative fuel options, improving data security and IT resilience, promoting localised supply chains, accessible urban environments, and planning for a wider range of risks to create a more resilient and self-sufficient domestic transport network.

Electricity and Fuel Security:

While there is a high proportion of renewables (especially hydro-electricity generation) within Aotearoa NZ’s energy profile, there also exist steep resilience challenges in terms of dependence on fuel imports and lack of preparation for crises. Solutions include long-term policy, an improved National Fuel Plan, biofuel development, exploring hydrogen, and electrifying transport. Mitigating fuel import dependency necessitates multi-faceted solutions, effective crisis preparedness, and enduring strategic planning.

ICT, Digital & Communications Sectors:

Critical vulnerabilities in the digital, ICT, and communications sector include the challenge of systems maintenance during trade isolation, reliance on offshore cloud service providers, and limited domestic capacity. To enhance resilience, recommendations include cross-sector collaboration, legal recognition of cloud computing as Nationally Critical infrastructure, a National Digital Communications Continuity

Plan, the establishment of a National Technology Investment Agency, and investment in local capacity and open-source technology to help mitigate any loss of international connectivity.

Economy and Financial Sector:

A GCR could have complex economic and financial implications, including severe economic downturn and failure of critical systems. Concerns encompass economic instability, challenges transitioning to a cash-centric society, limited preparedness for nationwide calamities, and payment/transaction system robustness. Addressing digital security and proactive preparedness for various emergency response scenarios are critical. Building circular, locally-focused, economies is one possible resilience strategy.

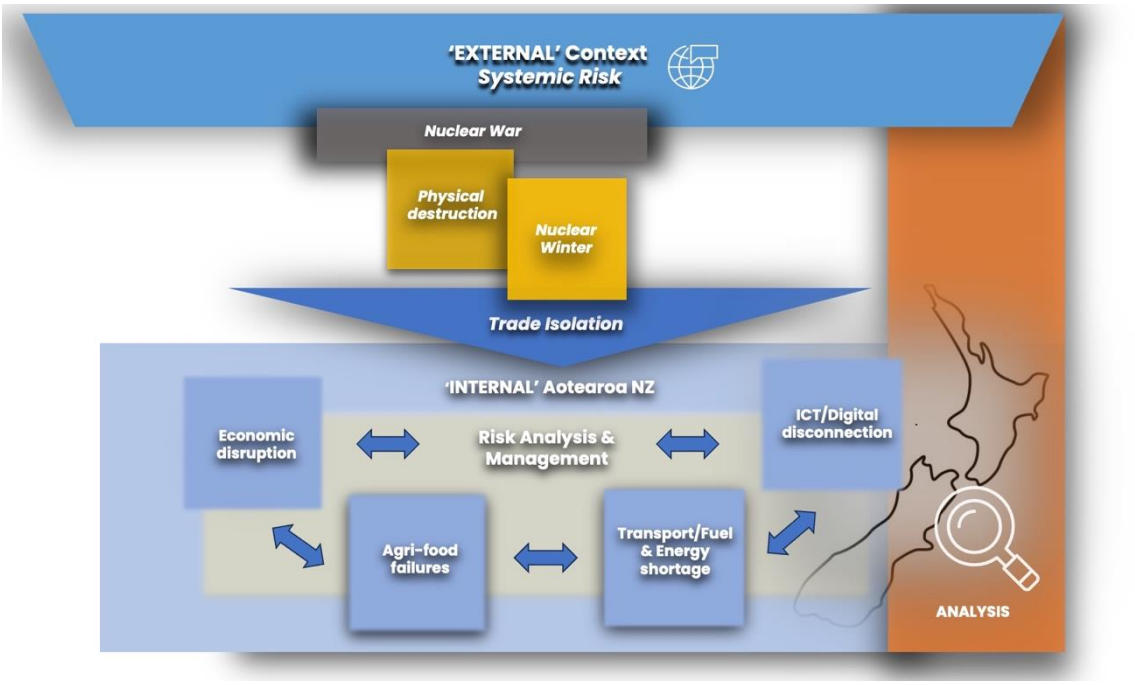
Risk Management and Foresight:

Challenges in Aotearoa NZ's risk management approach include limited preparedness for catastrophic scenarios, the complexity of addressing large-scale risks, and coordination tensions between central and local authorities. Participants advocate for better government collaboration, stronger legal frameworks for emergency management, and improved national security arrangements. Long-term planning, resilience building, non-partisan strategic thinking pathways, and the establishment of an independent think tank or government organisation for risk strategy are proposed solutions to enhance resilience and foresight.

In conclusion, this report underscores the need for broader and deeper planning, cross-sector collaboration, and proactive measures to strengthen New Zealand's resilience in the face of potential nuclear war or other equally significant global catastrophic risks. Building a resilient and comparatively self-sufficient nation demands a strategic and coordinated effort across all sectors, and is critically important for long-term wellbeing, given Aotearoa NZ's significant geographical isolation.

The results of this interview study constitute a call to action. Without intentional and persistent collaborative efforts to enhance the nation's preparedness and resilience against global crises the country remains vulnerable. This research, and the wider NZCat project, provide a first-pass blueprint for safeguarding Aotearoa NZ's future in an increasingly uncertain global environment.

Figure: Complex interdependencies cause cascading impacts in a global catastrophe



Introduction

Global catastrophic risks (hereafter GCR), are an array of potential disasters, threatening human civilisation. From intentional or accidental detonation of nuclear weapons leading to nuclear war, to massive volcanic eruptions, asteroid impacts, solar flares, and extreme pandemics, these risks have the potential to cause civilisation collapse, and even threaten human extinction (Bostrom & Cirkovic, 2008).

Such catastrophes could severely disrupt global trade leading to shortages of critical commodities and immense global upheaval (Boyd & Wilson, 2022; Green, 1989). A 2023 forecasting study suggests these risks are not improbable, with nuclear catastrophe ranked as one of the most likely catastrophic risks, carrying a 4–10% chance of killing more than 10% of the global population by 2100 (Karger et al., 2023).

The disruption to global trade threatens the resilience of nations and underpins a clear need for improved self-sufficiency across critical sectors, especially for island nations like Aotearoa NZ.

It is within this context that the Aotearoa NZ Catastrophe Resilience Project (NZCat) emerged, focusing on Aotearoa NZ as a remote non-combatant island nation. The project seeks to identify the significant impacts that a Northern Hemisphere nuclear war might have on NZ and to explore how these impacts could be mitigated.

The nation's remote location in the South Pacific could be positive in some situations. For example, direct targeting with nuclear weapons is less likely. However, reliance on global trade and potentially catastrophic disruptions to export and import supply chains of commodities, food products, components, technology, and services poses significant issues. Without prior planning or preparation, coping with such a scenario could be an insurmountable challenge.

The research interviews analysed in this report represent Phase III within a wider research programme. Phase I involved development of a plausible hazard profile for Aotearoa NZ in the event of a Northern Hemisphere nuclear war, which was validated at a workshop in February 2023 attended by 20 multidisciplinary expert stakeholders from industry, academia, and the public sector. Phase II involved the distribution of a qualitative scenario-based survey to expert participants across sectors of critical importance to societal function.

Understanding and preparing for catastrophic risks is urgent and important. Our research contributes to a growing body of knowledge that seeks to comprehend these scenarios and equip nations with the tools and insights needed to mitigate their occurrence.

Methods

Ethical Approval

This study was conducted with the approval of the University of Otago ethics committee, adhering to all relevant ethical guidelines and procedures [Reference: HD23/006].

Phase I: Hazard Profile Development

As outlined above, we initiated the study by developing a Hazard Profile for Aotearoa NZ, focusing on the scenario of a Northern Hemisphere nuclear war. The profile was validated through an international and multidisciplinary workshop held in February 2023. The workshop's findings emphasised that an effective response to the scenario would be critically dependent on functional sector-based and cross-sectoral planning for critical industries, including transport, energy and fuel, food, and digital/ICT.

Phase II: Qualitative Survey

Building on the insights from the workshop, we deployed a qualitative survey aimed at compiling a set of impacts and potential pre- and post-catastrophe mitigation measures. The survey collected 42 responses across the key sectors identified, a summary report is provided here. One question specifically prompted respondents to suggest key knowledge holders who might possess deeper insight into the risk and the practicalities of managing the scenario successfully.

Phase III: Interview Study

Following the survey, we conducted the interview component of study to further inform a potential policy agenda for Aotearoa NZ aimed at managing the threat of nuclear war and other GCR. Initial contact was made with potential interviewees recommended by survey respondents. Additional interviewees were added in a snowball fashion, aiming for roughly equal coverage across the four key sectors, as well as including experts in risk assessment, disaster management, and economics.

The interviews were semi-structured with questions developed based on information about impact and mitigation approaches obtained from the qualitative survey. The goal was to delve deeper into the suggestions to understand their logic, feasibility, and priority. Interviewees were also encouraged to contribute any additional insights they felt were relevant to Aotearoa NZ's resilience to this risk.

To ensure candid responses, particularly concerning commercially sensitive matters, interviewees were assured anonymity, identified only by general industry and job title, unless they consented to being named in conjunction with specific quotes.

Transcription and Data Analysis

The interviews were transcribed verbatim using an automated transcription service (Speak.ai). Two researchers (BP, MB) read the raw transcripts to familiarise themselves with the data. Lists of scenario impacts and possible mitigation measures were extracted from the transcripts. ChatGPT was used to summarise the raw transcripts into abbreviated, easily readable versions. The two researchers then independently extracted themes from the data to supplement the compiled lists of impacts and mitigation options, ensuring comprehensive analysis.

This methodological approach provided a robust framework for understanding the potential impacts of a Northern Hemisphere nuclear war on New Zealand and identifying actionable strategies for mitigation, contributing valuable insights to the field of disaster preparedness and resilience planning.

Results

A total of 18 individuals were interviewed, as summarised in Table 1.

This 'Results' section reports the views of these expert participants on the vulnerability and resilience of Aotearoa NZ to the scenario of Northern Hemisphere nuclear war, as detailed in our Hazard Profile, as well as reflections on wider issues about catastrophe resilience. Verbatim quotes are provided where appropriate to illustrate summary themes and key issues.

Results are organised by sector. Some interview participants provided information relevant across multiple sectors, and the report reflects this.

A collection of selected representative quotes from the interviews is provided in the Appendix.

Table 1: Overview of the sector and subject area expertise of each expert participant who was interviewed.

Sector/Organisation	Individual's role
Food/Agriculture	
Food and grocery	Senior management role
Farm holding company	Arable Farmer/Managing Director
Government primary industries	Senior scientific role
Agricultural technology	Former Chairman
Public Service	Former senior leader
Energy	
Petroleum Supplier	Asset Advisor
Government	Former senior scientific role
Transport	
Transport Planning Consultancy	Consultant Engineer
Transport Company	Chief Information Officer
ICT/Digital	
Futures & Technology	Consultant
Cloud Provider	Chief Executive
Network Technologies	Business Development Manager
Economy	
Economics	Senior academic
Economic Consultancy	Founding Director
Risk & Disaster Management	
Local Government	Emergency Management Specialist
Foresight and Futures	Consultant
Urban Planning	Academic
Risk Management	Academic

Vulnerabilities & Resilience in NZ's Agriculture and Food Sector

The Aotearoa NZ agri-food sector confronts substantial challenges in the face of a Northern Hemisphere nuclear war scenario with nuclear winter. These challenges include severe trade disruption (or potentially zero-trade in a pessimistic scenario) of commodities on which agri-food production and supply relies, including but not limited to liquid fuel and diesel, but also veterinary treatments, agri-chemicals, seed, fertiliser and machinery, food additives and processing equipment. Supply chain vulnerabilities leading to potential livestock oversupply and animal welfare concerns, technological fragility, and labour-related uncertainties. To address these risks and bolster resilience, strategic measures are essential. These include the development of a National Resilience Framework and Food Security Strategy, the potential to localise food distribution to reduce transportation needs, addressing seed storage and genetic modification issues, ensuring animal welfare, and fostering trade continuity with key partners, particularly Australia, in a strategic and well-planned way prior to an event of such magnitude occurring. Comprehensive planning and collaboration are vital components in mitigating these risks and enhancing preparedness.

Analysis:

Trade isolation challenges:

The agri-food sector is dependent on functioning global and domestic supply chains. All participants emphasised the complexity of dealing with trade isolation, particularly if exports are limited. Aotearoa NZ's heavy dependence on imported fuels, agrichemicals, fertiliser and other resources makes the agricultural sector vulnerable to global disruptions. Participants thought that even post-catastrophe, NZ has the potential to produce food, but achieving a diverse and balanced diet without imported products, and national distribution of food products are vulnerable.

Several agri-food participants illustrated how vulnerable Aotearoa NZ is to import supply chains. In the context of perceived government inaction towards improving domestic self-sufficiency, or at least reducing increasing vulnerability with increased specialisation and over-emphasis on specific food production in (e.g dairy and milk solids), one stated: "*… it just really pisses me off to be honest, that we're so reliant on everyone else and we're at the bottom of the world*." (Interview 3)

Critical decisions would be needed about production and distribution, such as substitutions to diversify and replace imported products, reallocation of resources, and a pivot to more easily stored produce like butter instead of milk and arable crops instead of intensive meat production.

Liquid fuel dependency and challenges with timely supply and stockpiling:

The reliance on diesel and other fuels for farming operations, coupled with limited on-farm storage, creates a major risk of supply chain interruptions. The lack of strategic stockpiles and the "*hand-to-mouth*" (Interview 5) approach to supply create vulnerabilities in the availability of essential agricultural inputs.

One farmer described the limited amount of fuel typically stored on farms and the heavy reliance on diesel for farming operations. His insights enrich the ongoing discourse concerning fuel dependence and robustness within the agricultural sector, specifically with regard to the domestic fuel reserves compared to current national demand and the limited on-farm fuel storage for meeting seasonal demands (attributable to the associated costs);[1] and the substantial decrease in yields (estimated at 40 to 60%) resulting from the inability to import fuel and other industrial inputs such as agrichemicals and fertiliser.[2] The vulnerability of the agricultural sector to potential disruptions in fuel supply emphasises the need for contingency planning.

Diesel Dependence in Arable Farming: A Fuel-Centric Case Study

Within Aotearoa NZ's wheat-growing season, diesel powers every stage. On average, a hectare of wheat cultivation demands 40-60 litres of diesel, magnifying the industry's reliance. Conventional practices can necessitate up to ten diesel-fueled passes each season, for ploughing, planting, fertilisation, weed control, and harvesting.

Nonetheless, innovation provides a ray of hope for less diesel reliance. No-tillage farming, diesel conservation techniques, and precision agriculture aim to trim fuel usage, reduce soil disturbance, and enhance yields. As New Zealand's agricultural landscape shifts reduce emissions, diesel dependency in agriculture will also hopefully reduce.

Reducing fuel reliance in agriculture bolsters New Zealand against fuel import disruptions – promoting energy resilience, cost-effectiveness, environmental sustainability, and economic stability, while lessening agricultural vulnerability to import disruptions.

Supply chain and the impact of a zero-trade scenario:

The challenge of pivoting the current primary industry sector from export to domestic focused supply was a significant concern for some participants. They described the catastrophic impact of a zero-trade scenario on agriculture and food supply, emphasising that over 90% of the country's food and fiber products are exported. The extraordinary and rapid connectivity of NZ's export industry, particularly in dairy, was highlighted.

Any disruption in this fast-paced system could have significant consequences.[3] For example, the time-bound challenge of stock management, especially many cows during the milking season, in a crisis of such scale was higlighted. The problem of feeding the animals and handling the milk output could become distressing and complex. The scenario could require significant culling of livestock due to the reduced demand and lack of diversification across the agri-system due to the current focus on export markets. One participant warned that a breakdown in the supply chain and the inability to manage the glut of products could lead to rapid economic and societal collapse.

A senior manager within FMCG (Fast-Moving Consumer Goods) sector stated, *"New Zealand produces more food than it consumes, but if export becomes limited and part of the domestic supply is damaged, the government would need to work closely with suppliers to understand their capabilities."* (Interview 17). They further elaborated on the need for strategic planning to understand the inputs into the food chain, including live animals, crops, and dry goods, and what relies on imports. The food sector would have to adapt to a lack of imported parts or ingredients, affecting production, though the exact impact remains uncertain.

Labour availability and willingness:

In the event of a nuclear war or catastrophe, participants also acknowledged the importance of "labour availability and willingness" (Interview 17), with personal and family concerns initially taking precedence over work incentives. However, they also highlighted that, post-initial shock, a functioning labour market could restore social cohesion, albeit in a changed job market. Agri-food production could become a primary source of employment as society adapts to the 'new normal,' aided by resilient and adaptable rural communities, well-equipped to handle crises.

In the post-crisis scenario, addressing potential labour supply challenges would be crucial. Coordination among organisations like the NZ Food and Grocery Council and supermarket chains, as seen during Covid-19, is essential but requires a comprehensive plan. This may involve revising regulations, like food labelling and anti-competition legislation. Collaboration between utility companies and the food system is vital, especially concerning dependencies such as coal supply and electricity to ensure secure cool-chain. Ensuring water supply for horticulture is critical, potentially offering investment opportunities in water storage. Encouraging private sector involvement in anticipatory scenario planning might be challenging, necessitating shared responsibility and information exchange between government and industry, supported by interdepartmental coordination.

Reliance on technology across food production and supply:

Conversations explored technological advancements in primary industries and their growing dependence on digital technology, raising concerns about potential vulnerabilities. Several participants in the primary industries stressed the importance of reducing mechanisation and enhancing human capital in the face of a significant disruption or catastrophe. However, questions arose regarding the remaining reservoir of latent knowledge necessary to enable producers to "step back to a prior era of farming before advancements with precision farming" (Interview 2).

Current adaptation measures remain *ad hoc* and are primarily driven by necessity. For instance, an arable farmer pointed out that breeding seed types for improved yields and frost resistance "would take generations [of seed breeding] under current breeding conditions, let alone under [trade isolation] constraints" (Interview 3). In this context, a crop farmer from South Canterbury discussed the topic of seed stockpiles in Aotearoa NZ's agricultural sector, highlighting the complexity and uncertainty surrounding their necessity, appropriate size, and management. the need for seed stockpiles in NZ.[4]

Enhancing the resilience of technology-driven precision farming and preparing for potential catastrophic events requires further analysis and planning. Key focus areas include securing seed and animal vaccine supplies, advocating for less restrictive genetic modifications (e.g., for frost resistance and other resilience characteristics) and collaborating with global crop science experts. Additionally, addressing animal welfare, particularly in the absence of veterinarian supply imports, and developing high-level plans for transitioning to alternative feed sources, considering the nation's heavy reliance on feed-grain imports, can significantly improve preparedness and enable swift responses to challenges.

Navigating commercial uncertainty in a crisis:

The complexity of envisioning a transformed marketplace for a wide range of goods and services, including labour, agricultural inputs, food products, and commodities, within a compromised domestic economy, underscores the need for preparedness planning. For example, the food sector relies heavily on financial and technological infrastructure, such as digital transactions. Additionally, discussions brought attention to the moral and decision-making challenges individuals and businesses would encounter during a crisis. This underscores the importance of proactive readiness, fostering confidence, building networks and a deep understanding of the intricacies involved in economic transactions for basic needs like purchasing essential food items in a situation of digital collapse.[5]

In addition, expert participants highlighted resilience measures such as:

- Localising food distribution to reduce reliance on supply chains and transport.
- Learning from other countries that maintain stockpiles and are exploring efforts to decrease dependency issues within the agri-food sector.
- Benchmarking current reliance on technology across the sector to understand specific import and export supply chain vulnerabilities / pinch points and how they can be resolved.

Continuing trade with Australia and other trading partners:
In preparation for potential crises participants identified the importance of strategies for continued trade with Australia and other local trading partners. This could involve initiatives like preferential trade agreements, aimed at bolstering existing trade agreements and forging new ones with key partners with clear expectations beyond meeting domestic needs in a global catastrophe. Additionally, creating regional supply networks can provide mutual support during emergencies and include reciprocal agreements for response capabilities (as the case with planning for Alpine Fault event) and ensuring trade of essential goods and services even in challenging times.

National Resilience Framework & Food Security Strategy
To achieve a comprehensive and sector-wide resilience solution, several agri-food participants suggested the importance of implementing a National Resilience Framework and including a Food Security Strategy. A framework like this would encompass various aspects including calculating food need, likely impact of supply chain disruptions and the climate effects of nuclear winter, labour supply, the logistics of pivoting production, regulatory adaptations (for example, underpinning secure transactions and alternative currency options) and strategies for ensuring continued trade. It is essential to engage in thorough planning and collaborative efforts to address these multi-facetted challenges effectively, and this would require national-level leadership, such as a government appointed commissioner or 'think tank' with cross-sector oversight for example.

Enhancing Aotearoa NZ's Food Resilience: A Case for the National Resilience Framework and Food Security Strategy

In an increasingly interconnected world, the need for Aotearoa NZ to bolster its food resilience in the face of multifaceted challenges is paramount. As agri-food participants emphasise, the implementation of a National Resilience Framework and Food Security Strategy is an option to consider.

A framework would offer a comprehensive approach to safeguarding the nation's food security and broader resilience. In a rapidly changing global geopolitical landscape and the need to 'expect the unexpected', a measure like this could be fundamental to readiness, response and recovery from a global catastrophe.

By proactively embracing a framework, New Zealand strengthens its ability to navigate disruptions, be they economic, environmental, or unforeseen catastrophes. While assessing the current state-of-play across the complex dimensions of the agri-food sector and addressing vulnerabilities, it supports the continued provision of essential goods and the protection of livelihoods.

In this pursuit, comprehensive planning and collaborative efforts emerge as the linchpins of resilience for a nation that values its sustenance and security.

Vulnerabilities & Resilience in NZ's Transport Sector, Fuel & Energy Sectors

Overview: Transport

Aotearoa NZ's transport sector faces vulnerabilities in a global catastrophe that severely impacts trade and connectivity. These impacts are primarily due to dependence on liquid fuel imports and an overreliance on diesel powered road trucking with limited diversification, as well as digital infrastructure vulnerabilities. Mitigation approaches involve more balanced investment in alternative transport methods (such as coastal shipping and rail), and transition to alternative fuel transport options like electric rail, electrification of road transport, and investigating hydrogen trucks; improving data security and IT infrastructure resilience; promoting localised supply chains and people-centric accessible urban environments; and planning for a wider range and scale of risks. The goal is to create more resilient and self-sufficient domestic transport, simultaneously advantageous for meeting climate emissions reductions and sustainability objectives.

Analysis

Reliance on road trucking:
Aotearoa NZ's transport sector is heavily reliant on road trucking, which is currently coupled with complete reliance on diesel / liquid fossil fuels as is outlined below in reviewing national fuel security. Maintaining and enhancing investment in rail network usage (including investment in electric trains for urban and longer distance routes) and coastal shipping were considered critical to resilience.

Deemphasis away from rail and local shipping has steadily occurred since the mid-1980s and was perceived as illustrating a lack of foresight and big picture resilience thinking by successive governments driven by free-market neoliberal orthodoxy and privatisation of strategic assets. An overreliance on road transport was perceived to consolidate risk as a major point of possible failure by *"putting all our eggs in one basket"* (Interview 5).

An asset advisor within the fuel sector highlights the need to invest in local shipping (and associated port infrastructure) for national transport resilience, because near shore ships previously used for natural gas and oil distribution have now mostly been decommissioned: *"So we now rely on shipping to do the port distribution and trucks domestically ... when the refinery closed, they sold those ships"* (Interview 9).

Ports and coastal shipping were perceived as especially valuable, but currently under invested in, given that land-based transport infrastructure is also vulnerable to NZ's geohazard context. Geohazard events like Alpine Fault Magnitude 8 (AF8), or an earthquake on the Hikurangi Subduction Zone and subsequent tsunami, could sever road and rail transport for long periods (as was seen following the 2016 Kaikoura Earthquake). Diversifying transportation was therefore an example of improving 'all-hazard resilience' (as outlined previously).

Strengthening Transport Resilience for Aotearoa NZ

Aotearoa NZ's transport sector confronts growing vulnerability due to its heavy dependence on road trucking (especially for bulk transport) and limited investment in alternative transportation modes.

The singular reliance on road transport not only poses operational risks but also amplifies the impact of geohazards like earthquakes and tsunamis, as seen in the aftermath of the 2016 Kaikoura Earthquake and zero-trade scenarios of where diesel supply and availability is curtailed.

To bolster the resilience of New Zealand's transport infrastructure, continued investment in coastal shipping (including the ability to trade with Australia), rail networks, and electrification should be prioritised. Coastal shipping offers a dependable and alternative transportation mode, especially during crisis situations when road and rail networks may become impassable.

Rail, too, plays a critical role in diversifying transport, reducing the environmental footprint, and enabling the efficient movement of goods. Its electrification and expansion for long-distance routes can significantly contribute to the sector's resilience.

By strategically strengthening coastal shipping and rail infrastructure, as well as making urban environments more accessible in the absence of fossil fuel imports, New Zealand not only mitigates risks associated with overreliance on road trucking but also aligns with sustainability goals.

This investment is vital for safeguarding the nation's economic interests and ensuring uninterrupted transportation services in the face of adversity, supporting both short-term recovery and long-term sustainability.

Nationally Critical Infrastructure (NCI):

Expert participants offered ideas pertaining to NCI and the transport sector. They recommended addressing:

Diversification and redundancy:

- Achieve diversification and redundancy within nationally critical transport systems.
- Address over-reliance on road trucking and explore diversified energy sources for bulk road transport (where for example, the agri-food sector is highly dependent on bulk freight).
- Expand electrification beyond urban areas, including electrification of rail of the main trunk railway line in the North Island.

Dependency on Digital Systems:

- Acknowledge the reliance of transportation on IT and digital infrastructure and services, especially for communications. [6] Participants described the importance of critical digital infrastructure underpinning the transport sector and the need to ensure this technological foundation is self-sufficient and resilient to disruptions, which highlights the importance of enhancing data security and localising IT infrastructure.
- Safeguard and invest in options for local manufacturing of components, and technology development. Developing local manufacturing of electronics and battery technology for example, could support resilience and ‘net-zero’ transition in the interim.[7]

Enhancing resilience through localised supply chains and fuel resource management:
Expert participants explained that while it would be a significant shift from the current transport sector approach, transitioning towards localised supply chains could boost resilience and decrease the current heavy dependence on long-distance road transport.

Shifting the transport strategy's focus from attempting to 'do more with less' to prioritising minimum resilience requirements is imperative. This shift emphasises resilience as a necessity rather than an optional goal, necessitating proactive anticipation and planning for a broader range and scale of risks.

Emphasis on Diversification and People-Centered 'Active' Cities:
Expert participants underscored the imperative for reducing fuel reliance by embracing diversification in urban transport systems. This vision encapsulates a comprehensive approach to transform NZ's transport landscape, fostering sustainability, resilience, and a focus on the well-being of citizens This entails greater investment and improving outcomes from existing, and introducing some new initiatives, including:

- Establishing local transportation/mobility hubs in urban centres (with greater integration between food supply, health care and other essential needs).
- Expanding electrification initiatives.
- Incorporating accessibility into urban design.
- Encouraging urban development that promotes 'People-Oriented Cities' that prioritise pedestrians, integrate rail networks, and promote eco-friendly modes of transportation like cargo bikes and e-trucks.

Several participants across the transport planning area articulated a vision for NZ as a "self-sufficient hub" (Interview 6), which encompasses the need for ‘big picture’ and systems focused long-term planning; providing further sustainable energy and fuel options and a more widely entrenched emphasis on national self-sufficiency.

Developing necessary infrastructure requires long-term planning across a wider range and scale of risks, and active steps may involve subsidising electric public and shared transportation, electrifying inter-regional rail routes, and establishing mobility hubs. These measures aim to create a more sustainable and accessible transport network. Community hubs can play a pivotal role in reducing transportation demands by incorporating essential services such as service centers, libraries, and healthcare facilities, making them accessible to residents.

Recognising the intricate interconnections among transport, mobility, community engagement, democracy, transparency, and trust is paramount when constructing a robust and adaptable transport system. These elements are essential for ensuring the system's effectiveness, adaptability, and responsiveness to evolving challenges.

Overview: Electricity & Fuel Security

Nowhere is the intertwining of fuel and energy sources clearer than in Aotearoa NZ's path to net-zero emissions. Despite the complex nature of these sectors independently, this report examines them collectively through the lens of national resilience. While hydroelectricity offers a strong renewable base, fuel import reliance and crisis unpreparedness present major challenges in the face of potential global catastrophes.

Ensuring enduring long-term policy, developing a National Fuel Plan (including comprehensive fuel supply chain and contingency planning), overcoming biofuel challenges, exploring hydrogen, and electrifying urban and inter-regional transport could be part of the solution. However, mitigating fuel import dependency requires multi-faceted and phased solutions. Effective crisis preparedness and enduring strategic planning, resilient to political shifts and populism, are crucial.

Aotearoa NZ's Renewable Energy Resilience in the Face of Global Trade Isolation

In an era of escalating global risks, the need for energy resilience is critical. Significant investment in renewable energy sources has enhanced Aotearoa NZ's sustainability. However, in the event of a catastrophic global trade isolation event, our renewable energy profile stands as both a strength and a potential weakness.

Strengths:
As a nation we boast rich renewable resources, including hydroelectric, geothermal, wind, and solar power. These resources provide a diversified energy mix, reducing vulnerability to supply disruptions. A significant share of our electricity generation already comes from renewables, enhancing energy self-sufficiency and reducing reliance on imported fossil fuels, and as a nation we are committed to advancements in energy storage and grid management, enhancing resilience during crises.

Weaknesses:
Our population and energy demand may outstrip renewable capacity in a crisis, potentially leading to energy shortages. While renewables reduce environmental impact, their construction and maintenance rely on global supply chains, making New Zealand susceptible to disruptions in international trade.

New Zealand's renewable energy profile is a promising foundation for resilience, but careful planning and investment are essential to address potential vulnerabilities.

Analysis:

Electricity resilience:

Aotearoa NZ's renewable energy profile, notably its reliance on hydroelectricity, emerged as a cornerstone of national resilience. Participants expressed confidence that hydroelectric power would persist even in dire scenarios,[i] offering both sustainability and energy security during crises.

[i] Participants expressed concerns about offshore technology, components, and specialised knowledge. However, they generally believed that the hydroelectric systems and the national grid were resilient and could be adapted tp prevent disruptions.

Furthermore, NZ's potential to convert dairy by-products, forestry waste, and organic materials into bio-gas or ethanol in times of crisis was highlighted as potentially bolstering energy resilience. One participant suggested the government should actively promote innovative renewable energy strategies using natural resources and industrial by-products (e.g., forestry slash), positioning Aotearoa NZ as a renewable energy leader and enhancing adaptability to unforeseen events. However, concerns were raised by others about the prevalence of short-term and partisan thinking, hindering forward thinking initiatives, and the assumption that hydro-generation is "bulletproof" (Interview 16).

Fuel import dependency:

NZ's fuel sector faces a critical challenge marked by its heavy reliance on imported oil, gas, and petroleum products. The nation's dependence primarily rests on Northern Hemisphere refineries, notably in South Korea, which, in turn, rely on producers like Saudi Arabia. This reliance introduces vulnerabilities, as agreements may falter during conflicts, crises, or in cases of severe global shipping disruptions. Furthermore, NZ's limited in-country fuel storage, which includes a mere 28 days (about 4 weeks) of domestic backup and an additional 90 days (about 3 months) stored offshore, amplifies its dependence on international shipping, compounded by the high cost of storage.

Participants underscored that mitigating imported fuel dependency is complex and involves a multifaceted approach. This includes scaling up renewable energy sources like wind, solar, and hydroelectric power for electricity generation and promoting the local production of biofuels. Encouraging the adoption of electric vehicles (EVs) and rail through incentives and infrastructure development reduces the demand for imported liquid fuels. Investment in efficient public transportation, hydrogen production, and strategic fuel reserves could further strengthen resilience. For example, pursuing the adoption of Hydrogen or hybrid hydrogen-diesel trucks could enhance transport system, but removing all fuel reliance is difficult. Diversifying fuel suppliers, prioritising fuel efficiency, and fostering research and innovation play crucial roles in achieving a less fuel dependent society. Government policies supporting energy diversification, international cooperation for supply security, and collaborative efforts with neighboring countries can contribute to a more secure and sustainable energy landscape.

Challenges in Local Biofuel Production: Navigating Ways to Reduce Fuel Import Dependency

Aotearoa NZ's quest to reduce its heavy reliance on fuel imports could include a shift to locally produced biofuels. Multiple biofuel initiatives have been attempted and a 2018 Scion report canvassed the options. However, so far this path has been fraught with obstacles. Challenges include the availability of sufficient feedstock, competition with food production, cost-competitiveness, stringent quality requirements, and past failures, as exemplified by the discontinuation of Z-energy's tallow-based biofuel production in Auckland. Introducing government intervention to address these hurdles introduces the risk of unpredictable market dynamics amid heavy political lobbying from fossil fuel enterprise. Possible biofuel blend mandates were scrapped. Meanwhile, alternative options like hydrogen face skepticism about their competitiveness. Yet, efficiency isn't the only requirement, and in a global catastrophe the nation might value every drop of biodiesel production to ensure food production. Achieving fuel resilience in New Zealand remains an intricate puzzle necessitating thoughtful navigation. These complex challenges and considerations should be at the heart of a National Resilience Framework and Food/Energy Security Strategy.

Technological Vulnerabilities:

The fuel supply chain's dependence on offshore data servers poses a significant risk, compounded by the absence of contingency plans for major technological outages. As Interviewee 7 who works within fuel distribution emphasised, "we lack preparation for such scenarios." To mitigate these vulnerabilities, comprehensive backup data storage solutions and cybersecurity measures must be established.

Crisis Preparedness and Strategic Planning:

New Zealand's lack of readiness for large-scale, prolonged energy and fuel crises is evident. Several participants, including Interviewee 7, stressed the need for government policies that transcend political changes and resist populist influences. Collaborative efforts with neighboring countries, like Australia, are deemed essential for effective resource management and crisis preparedness. Proposals, including the development of an improved National Fuel Plan, increased investment in renewable energy, support for resilient local industries, and the establishment of long-term supply chain planning, can help fortify strategic resilience in the face of energy and fuel challenges.

Participants, much like in the electricity sector, emphasised the substantial deficit in government expertise and the formulation of enduring non-partisan policies. They often perceive decision-making as influenced by short-term political objectives, characterised by decisions made to cater to “vote-seeking whims” (Interview 12). This highlights the pressing need for establishing clearer and more resolute pathways to address issues of paramount strategic national significance.

Vulnerabilities & Resilience in NZ's ICT, Digital & Communications Sector

Expert participants across Aotearoa NZ's digital, ICT, and communications sector identified critical vulnerabilities, including communications and critical system resilience including maintenance challenges in a trade isolation context, and a heavy reliance on offshore cloud service providers leading to a lack of domestic capacity and capability. To address these concerns and enhance resilience, key recommendations include enhanced cross-sector collaboration, legal recognition of cloud computing as Nationally Critical infrastructure (NCI), the implementation of a National Digital Communications Continuity Plan, the establishment of a National Technology Investment Agency, and the appointment of a National Chief Technology Advisor. These measures, along with investments in local capacity, rigorous auditing, testing, and a focus on self-reliance and open-source technology, aim to safeguard critical systems and ensure sustainability, particularly in the face of global catastrophes. Interviews with sector experts further underscore the importance of proactive measures to strengthen resilience, promote local expertise, and bolster industry capacity in safeguarding vital Digital and ICT infrastructure.

Analysis

Communication and Critical System Resilience:
Experts voiced significant concerns about the resilience of communication systems and critical infrastructure during catastrophic events, such as cyberattacks and nuclear war. They emphasized the need to safeguard these systems, understand supply chain vulnerabilities, and ensure knowledge about system components.

One participant astutely noted, "it's assumed that these systems will be there … not many people think about what it takes to safeguard these systems, you know, um … where data is located and stored, where components come from … um… the knowledge [of systems]" (Interview 5), highlighting the complexity of ensuring their continued operation and security.

Participants also raised concerns about a shortage of commodities necessary for maintenance, with components taking up to a year to replace, even during normal trade conditions. The looming threat of cyberattacks (particularly in global conflict scenarios) underscored the urgent need for cross-sector collaboration during crises and stress the importance of a comprehensive and proactive resilience approach to ensure digital infrastructure can withstand and recover from unforeseen and potentially devastating events.

Reliance on offshore cloud providers & dependence on global ICT/Digital supplies:
Heavy reliance on global supplies of ICT/digital services, including cloud services, presents significant risks.[8] Experts pointed to limited fiber connections to the world, a lack of redundancy, and a shortage of local expertise as vulnerabilities. Ethical concerns regarding data privacy, consumer protection, and social responsibility in the context of catastrophic events were also raised. The dominance of big multinational corporations in the digital sector was compared to the influence of supermarkets and overseas banks, emphasising the need for legal recognition of cloud computing as critical national infrastructure.[9]

Expert participants expressed concerns about Aotearoa NZ's reliance on the top three tech providers, which may not prioritise the nation's interests in crises. To enhance security in digital service supply and prevent foreign control, experts recommended more government support for developing local infrastructure and supporting 'Kiwi-owned and operated' systems, cautioning against the current market-driven approach. In addition, national spending on overseas services was noted for its negative economic impact, with limited benefits to NZ. This underscores the importance of retaining local control, collaboration, and strategic investment to foster resilience and economic growth.[10]

Call for a National Digital Communications Continuity Plan:

Two participants emphasised the need for a comprehensive and unified National Digital Communications Continuity Plan. Their proposals encompassed granting legal recognition to cloud computing as NCI,[ii] and investing in local capacity, data location awareness, and security. They also recommended the strategic placement of critical data centers in both the North and South Islands and the delegation of responsibilities to knowledgeable entities.

Additionally, participants stressed that such a continuity plan should make explicit decisions and logic-based assumptions, enhancing security awareness and capabilities across organisations. One participant particularly underscored the government's proactive role in this context, advocating for a balanced approach involving incentives and regulations – "the carrot and the stick" (Interview 15), recognising the government's responsibility for national security and resilience, rather than relying solely on market forces.

Regular Auditing and Testing of Infrastructure:

Experts stressed the importance of regular auditing, testing, and continuous evaluation of digital, cloud computing, and critical communications infrastructure. Suggestions included disconnecting from the global internet for testing, conducting simulations, and ensuring transparency in government and commercial decision-making processes, which was identified as lacking currently. One participant highlighted concerns about the "overly cozy" (Interview 13) economic relationship between global corporate cloud service providers and government agencies, potentially sidelining smaller local players more committed to national resilience and citizen interests.

Promoting Local Communications and Self-Reliance:

Experts emphasised the significance of local communications and self-reliance, suggesting the adoption of resilient public Wi-Fi, local fiber, and microwave digital solutions. They also stressed the importance of stockpiling spare parts and expertise, along with the implementation of a low-tech government communications system.[11] This consideration addresses cross-sector vulnerabilities and the potential necessity of maintaining redundant communication systems, including short and long-wave radio and non-digital alternatives. A quoted statement underscores the importance of a resilient telecommunications capability independent of external entities, emphasising the need for a resilient nationwide communication system:

> "Well, we need to make sure that we have some telecommunications capability that isn't dependent on the outside world ... There is no excuse for us not to have a nationwide, you know, communications capability of some sort." (Interview 10).

Additionally, experts highlighted the need for communication methods that are not solely reliant on technology and the importance of proactively building relationships before they are needed.[12]

Technological Resilience Through Open-Source Solutions:

One expert proposed achieving technological resilience through a government-led open-source tech stack shared with like-minded countries. To facilitate this, participants suggest developing a National Technology Investment Agency to promote a strategic and non-partisan approach to national digital resilience, changes in procurement rules, and the introduction of a National Chief Technology Advisor

[ii] NCI encompasses key sectors such as energy, finance, telecommunications, water, transport, food, government, health, and emergency services. Digital infrastructure, vital for communication and connectivity, is recognised as a critical component primarily within the telecommunications and finance sectors, emphasising its importance for national security and continuity planning. At present, cloud computing is not explicitly recognised as NCI.

in alignment with a Digital Infrastructure Resilience Strategy. Considerations for the continuity of citizen records and the development of a 'local GPT-4' were also mentioned.

Ensuring Digital Resilience: A Plan for National Digital and Communications Continuity

Aotearoa NZ's Digital, ICT, and communications sector faces critical vulnerabilities. To effectively mitigate the potentially devastating impact of a global catastrophic risk event involving trade isolation, the nation should prioritise development and effective implementation of a National Digital Communications Continuity Plan.

Such a plan should proactively encompass legal recognition of cloud computing as 'Critical National Infrastructure', making strategic investments in local capacity, data location awareness, and security measures. Critical data centres should be strategically located in both the North and South Islands, with responsibilities delegated to entities possessing expert knowledge of digital sovereignty.

To ensure readiness, the plan demands rigorous audits, testing, and ongoing evaluation of infrastructure, including proactive disconnection from the global internet for testing purposes. Furthermore, it must underscore the critical importance of local self-reliance, the establishment of resilient communication layers, and local availability of spare parts and expertise.

This comprehensive approach not only enhances national security but also serves as an economic catalyst by promoting local expertise, creating jobs, and nurturing a resilient digital economy.

A comprehensive National Digital Communications Continuity Plan is not just a precaution; it's a strategic imperative to safeguard New Zealand's critical systems.

Vulnerabilities & Resilience in NZ's Economy and Financial Sector

The economic and financial implications of a major global catastrophe are complex and potentially dire, stemming from trade and infrastructure disruptions. Experts expressed concerns about the severity of economic instability and downturn following an event of such scale and the need for thorough planning and foresight. They noted challenges of a potential transition to a cash-centric society, limited preparedness for nationwide calamities, and the pivotal importance of payment system robustness. While centralised responses have proven effective in certain instances (like responding to COVID-19), there is an acknowledgment that they may falter in scenarios marked by substantial digital system disruptions. The vulnerability to ICT failures and the potential for the collapse of economic activity underscore the critical importance of addressing digital security, as discussed earlier. It also highlights the need for proactive preparedness for various scales of emergency responses, especially in situations where digital communications and economic transactions are compromised. Additionally, the proposition of adopting a circular, locally-focused economy is introduced as a resilience strategy, aligning with the broader theme of self-sufficiency and community-based solutions.

Analysis

Economic Instability & Downturn:

A global catastrophe involving trade isolation would trigger significant economic challenges for Aotearoa NZ. A severe economic downturn marked by increased unemployment, financial and associated social instability is likely.

In the optimistic case that some trade links with export markets (e.g., Australia, Asia and the Pacific) are retained following the catastrophe, participants agreed that impacts such as the oversupply of primary agricultural products and total export price collapse may be partly mitigated while a new normal is achieved. At the macro-economic scale, the scenario could either introduce exchange rate volatility or potential collapse. A 'blank canvas' scenario involving the total collapse of trade and international financial markets would instantly affect the value of the country's assets and investments abroad, necessitating measures by the Reserve Bank to maintain financial, political, and social stability, requiring decisive leadership, As outlined above, response leadership would be impeded if digital and communications infrastructure was compromised.

At the domestic micro-economic level, ceasing trade would include a complex and interconnected range of challenges (as follows), and would likely lead to inflationary pressures with one expert suggesting that price shocks for essential commodities and services would be "inevitable" (Interview 18), especially if they are limited, without decisive government intervention. Effective response relies on prior sector-focused scenario planning, which government should allocate resources to.

Challenge of 'stepping back' to a cash society and non-digital monetary system:

In a scenario of widespread digital infrastructure disruption and trade isolation, a transition back to a cash-based society might be needed. Such a transition would pose substantial challenges due to potential cash shortages and the possible need for offline digital currency alternatives. A cash reserve may be needed. Interviewees described options such as DAOs and IOUs, but these were recognised as susceptible to fraud or a lack of trust. Additionally, experts indicated there might be the need for orderly closure of financial institutions and manual record-keeping, given the potential for decades-long impacts resulting from the loss of electronic backup.

One participant pointed out that while the Reserve Bank holds cash reserves, doubts exist regarding whether it would have enough physical cash if digital payment systems collapsed nationwide. Acquiring substantial amounts of physical cash could prove challenging, especially considering NZ's reliance on

imported printed notes, potentially disrupted by trade isolation. Transitioning back to a cash-based society would present formidable challenges and require improvisation to safeguard against counterfeiting.[13]

The participant also emphasised the disparity between preparedness for localised events like earthquakes and the preparedness needed for larger-scale global and nationwide catastrophes, such as a Northern Hemisphere nuclear war.[14] They highlighted that current planning measures may be adequate for localised events but fall short in addressing the distinctive challenges of nationwide crises.

These insights underscore the perceived necessity for a more comprehensive risk assessment at the national government level and the adoption of more imaginative and multi-scaled scenario analysis and risk planning. Furthermore, there is a call for the Reserve Bank to conduct an analysis of the scenario involving the collapse of payment systems, and cybersecurity efforts should encompass contingency planning.[15]

Limited preparedness for global & nationwide catastrophes:

Current preparedness and response measures were considered “ad hoc but reasonably adequate” for localised events such as earthquakes where national response mechanism could be activated to supply cash as a backup for digital transactions. However, experts with economic insight expressed growing concerns that NZ is insufficiently prepared for a major nationwide catastrophe, including economic and financial vulnerabilities.

Notably, crucial information regarding national risks is not publicly available, underscoring the perceived need for a more comprehensive and publicly transparent/accountable national risk assessment. Interviewees have voiced their apprehensions about the country's readiness for such an event, citing the potential for cascading economic "chain reactions" following the initial shock.

Valuable lessons can be taken from past experiences, including managing the COVID-19 pandemic, responding to the Christchurch earthquakes, and addressing weather events like Cyclone Gabrielle. To bolster preparedness across a wider suite of risks scales (from localised to disasters of national scale such as a potential earthquake and tsunami on the Hikurangi Subduction Zone, or events originating beyond NZ’s sovereign territory) there is a clear call for an enhanced focus on improving the resilience of payment systems to ensure access to essentials such as food and fuel, as well as strategic planning aimed at maintaining a cohesive market during extended times of significant disruption.

Resilience of Payment Systems and Vulnerability to ICT Failure:

The resilience of payment systems is a critical component for ensuring access to essential resources, particularly food and fuel, during major disruptions. Expert participants highlighted the imperative to proactively plan for potential payment system failures (as above) and enhance cybersecurity measures to prevent and respond to cyberattacks.

However, the vulnerability of economic activity to the failure of information and communication technology (ICT) systems poses a grave risk of significant economic collapse. While this vulnerability was discussed primarily in the context of the food sector (as outlined in Section 3.2), it has broader implications for national resilience, particularly concerning cybersecurity and the potential threat to digital payments and financial infrastructure.

This dual challenge underscores the complexities associated with planning for the collapse of payment systems. In a scenario as multifaceted as a nuclear war, this issue represents just one facet of a web of interrelated and cascading challenges that the government must address comprehensively. Therefore,

a proactive approach to scenario development and comprehensive planning is not only advisable but also essential within the wider context of national risk assessment.

Circular localised economy:

Although challenging within current economic orthodoxy, greater emphasis on a self-sufficient circular economy was proposed to offer significant resilience benefits for Aotearoa NZ. Embracing a circular economy model, characterised by reduced reliance on external resources and a stronger emphasis on local production and consumption, can enhance the nation's resilience in various ways. Firstly, it decreases vulnerability to global supply chain disruptions, ensuring a more dependable and consistent access to essential goods and materials, particularly during crises or trade isolation. Secondly, it promotes resource efficiency and waste reduction, helping to mitigate environmental risks and conserve valuable resources. Moreover, a circular economy encourages local innovation and economic diversification, reducing dependence on a limited range of industries and bolstering overall economic resilience. By prioritising self-sufficiency/reliance, NZ can strengthen its ability to withstand external shocks and challenges.

Aotearoa NZ's Vulnerable Economy Post-Global Catastrophe

Following a global catastrophe, Aotearoa NZ's economic and financial systems are insecure. The nation's geographic isolation amplifies its vulnerability. A severe economic downturn or financial collapse is possible but contingent on multiple factors.

NZ's is highly dependent on imports for essentials, and susceptible to supply chain disruptions. Faltering digital systems due to a breakdown in international connectivity would compound issues, hindering business continuity and crucial dissemination of government information and assistance. Citizens' inability to access funds and perform secure transactions for essential goods would intensify the crisis and magnify economic and social insecurity.

While severe economic downturn or financial collapse is a possibility, it is not inevitable. Proactive measures can make a significant difference to outcomes. This underscores the urgent need for measures to bolster Aotearoa NZ's economic resilience, including cash management and contingencies, emergency response and continuity planning, and investing in research and preparedness efforts based on potential scenarios.

The origins and outcomes of a global catastrophe remain uncertain. Readiness and adaptability emerge however, as critical factors underpinning the nation's ability to navigate these challenges with resilience and resolve.

Risk / Disaster Management & Foresight

This section highlights the challenges identified in Aotearoa NZ's current risk management approach, drawing from discussions with experts in risk and disaster management, as well as strategic foresight. These challenges encompass the nation's preparedness for catastrophic scenarios, the complexities involved in addressing large-scale risks, and the tensions between central and local coordination.

Experts expressed the need for better government collaboration and legislation, due to concerns regarding the adequacy of the 2023 Draft Emergency Management Bill and propose the need for a stronger legal framework. Furthermore, the absence of a statutory foundation for national security arrangements, often reliant on Cabinet decisions, is flagged as problematic, particularly in managing major hazards. Participants also question the effectiveness of national security plans and underscore the prevalence of short-term thinking as a systemic issue. The potential challenges that Aotearoa NZ might face in the event of a Northern Hemisphere nuclear war scenario or other catastrophic events underscore the importance of effective foresight and long-term management.

Two case studies are used to highlight issues with a view to mitigation pathways. Proposed solutions involve long-term planning, building resilience, establishing non-partisan pathways for strategic thinking, and considering the creation of an independent think tank or government organisation for risk strategy. Participants emphasise the importance of resilience beyond specific hazards, emphasising long-term planning, redundancy, and comprehensive scenario analysis.

Analysis

Government Collaboration and Effective Legislation:

The interviews identified challenges in Aotearoa NZ's current risk and disaster management approach, including a lack of attention to preparedness for catastrophic scenarios,[iii] difficulties in broadening risk assessment policies, and tensions between centralised and local coordination.[16] For example, the tension between centralised control and local community coordination is highlighted by acknowledging the difficulty of incorporating large-scale catastrophic risk management (often perceived as 'low-probability risks and therefore less important than more regularly occurring hazards) within the current Emergency Management and Response framework.[17]

Experts raised concerns about the current Emergency Management Bill's suitability in handling the scale and complexity of catastrophic events outlined in the hazard profile.[18] They called for a more specialised and comprehensive approach, involving a robust legal framework and potentially alternative legislative and policy instruments. This approach would require seamless integration with the existing legal and policy frameworks of the National Emergency Management Agency (NEMA) and Department of the Prime Minister and Cabinet (DPMC) for effective risk management, response, and national security.

[iii] A participant expressed this concern, stating, "The biggest risk from a Northern Hemisphere nuclear exchange is that we haven't thought about it, let alone planned for it... we hope it never happens, but it could" (Interview 10). This highlights the need for proactive planning and risk assessment to address GCR scenarios, as assuming they are unlikely to occur is dangerous.

The Emergency Management Bill (2023) could be improved:

Interviewees viewed the current Emergency Management Bill as ill-suited for responding to potential Global Catastrophic Risks (GCRs) due to several factors:

- Scale of catastrophe: The bill may lack the capacity to address a global catastrophe, such as a Northern Hemisphere nuclear war scenario.
- Multi-sectoral complexity: The bill may struggle to tackle the intricate and interconnected challenges spanning various sectors.
- Need for specialised approaches: GCR planning, and response demand a more specialised and independent approach, potentially supported by specific legislation (as is the case in the United States).
- Need for an open and inclusive approach, centred on sustainability and resilience, which should extend beyond government powers to harness the knowledge capital and resources of the private sector and the public.

Participants also highlighted broader issues with New Zealand's national security arrangements, which lack a statutory foundation and often rely on Cabinet decisions executed by various government bodies with ill-defined response roles. This absence of a legal framework is seen as problematic, especially for major hazards and catastrophic risks. To address these concerns, a stronger legal framework with clear guidelines, responsibilities, and mechanisms is needed, including clarification of roles for entities like DPMC and NEMA, as well as state organisations and devolved bodies.

Additionally, some participants questioned the adequacy of national security plans and assessments. They raised doubts about whether these plans cover necessary aspects like detailed risk analysis and worst-case scenario considerations across multiple sectors, posing challenges in preparing for and managing potential catastrophic events.

Expert participants identified a systemic issue of political short-sightedness and responsibility avoidance in both the public and private sectors. This is leading to a lack of long-term planning and foresight. More collaboration is needed between industry sectors, emergency services, and governmental bodies, along with government recognition and resources. Participants noted communication challenges in conveying the importance of planning for catastrophic risks to decision-makers,[19] and the importance of expertly informed Long-Term Insights Briefings (LTIB) to influence policy and provide alternative perspectives on issues to decision makers.[20]

Participants emphasised the importance of finding non-partisan avenues to attain long-term foresight and establish connections between short-term policymaking and long-term outcomes. They acknowledged that the pursuit of strategic thinking based on long-term foresight is frequently hindered by the short tenures of politicians and the segmented nature of policymaking, which inadvertently erodes holistic perspectives. This phenomenon was aptly described as "death by many cuts with poor, reactive, and knee-jerk policy thinking" (Interview 8).

The idea of establishing an independent think tank or government organisation focused on long-term thinking and risk strategy was proposed to overcome politicisation and address challenges and apathy in the public sector related to managing catastrophic risks.

Proposed Future Vision: Establishment of a National Resilience Think Tank

In response to the ever-evolving landscape of complex challenges posed by catastrophic events, a future government of Aotearoa NZ has envisioned the creation of a dedicated entity known as the National Resilience Think Tank (NRTT). This NRTT will provide oversight and a higher-level, coordinated, and strategic approach to resilience.

Objective: The NRTT is envisioned with a clear mandate to proactively enhance national resilience, preparing the country to effectively respond to and recover from various hazards and global catastrophic events.

Composition: Comprising a multidisciplinary team of experts drawn from diverse fields, including global catastrophe research, disaster management, infrastructure, healthcare, economics, social sciences, and more, the NRTT aims to foster an integrated, holistic approach to national security and resilience.

Key Functions:

- Conducting comprehensive risk assessments, encompassing both global and local threats.
- Developing a comprehensive and forward-thinking national resilience strategy across risks.
- Coordinating and facilitating collaboration among government agencies, local authorities, stakeholders across all sectors, and international partners.
- Actively engaging with the public to cultivate awareness, educate, and garner support for resilience initiatives.

Anticipated Impact: The envisioned NRTT is expected to play a pivotal role in establishing a transparent, cohesive, and long-term national direction for resilience. This direction will ensure that resilience-building efforts are not fragmented in isolated silos but are integrated into the fabric of national policy and legislation. Furthermore, the NRTT will promote a culture of resilience at every level of society.

This proposed future vision underscores how the establishment of the NRTT can significantly enhance our nation's preparedness for catastrophic events, fostering a more resilient and secure future.

We can't know what the exact nature of the next global catastrophe, but scenarios reveal the kinds of vulnerabilities that Aotearoa NZ faces. In this context, the interviews underscored the need for a comprehensive, hazard-agnostic approach to resilience in New Zealand, involving legislative reforms, enhanced community engagement, and a focus on long-term planning and foresight to address the challenges posed by the suite of global catastrophic risks.

Participants emphasised the need for resilience that extends beyond specific hazards and aims to enhance readiness and adaptability across various scenarios, ranging from global catastrophes like pandemics, cyber terrorism (potentially AI enabled), and nuclear threats to local hazards like geohazards. They highlighted the inherent challenge in preparing for events of various scales, from local incidents to catastrophic occurrences. This challenge underscores the importance of adopting a "hazard-agnostic" or "all-hazard" approach to resilience. Such an approach recognises the interconnectedness of different sectors and underscores the need for a more comprehensive strategy, involving:

- Long-term planning and redundancy: The complexity of resilience was discussed, but in particular emphasised the importance of long-term planning to create redundancy in systems, supporting the ability to recover after major disruptions.

- Scenario analysis and planning: Participants stressed the need for comprehensive and imaginative scenario analysis that includes large scale global threats, with a focus on critical areas such as payment systems, food production, transport, and fuel supply. Achieving these objectives would necessitate broadening the current national risk assessment approach and increasing transparency in relevant processes.

The interviews identified challenges in NZ's risk and disaster management, including a lack of preparedness for catastrophic scenarios, difficulties in broadening risk assessment policies, and tensions between cen27tralised and local coordination.

Building resilience for large-scale events was seen as offering immediate and long-term benefits, including cross-sector resilience, energy independence, and food security.

An emphasis on enabling community resilience and trusted relationships were highlighted as vital, but participants explained how this needed to be based on a transparent long-term national direction, where, as one participant identified: "resilience being built in specific silos isn't the best approach, there needs to be a system of pulling it all together from a higher-level strategic point of view" (Interview 16).

Holistic Preparedness: Strengthening Resilience in a Changing World

Aotearoa NZ's disaster preparedness, though forward-thinking, currently lacks a focus on large-scale global catastrophes beyond our borders. Strategic planning for such events reveals a significant co-benefit: enhanced resilience against all the risks our nation faces.

This proactive strategy involves comprehensive, multifaceted planning, equipping New Zealand not just for global catastrophes but also for climate change impacts and major geohazard events like earthquakes along the Alpine Fault or the Hikurangi Subduction Zone.

Large-scale disaster planning requires coordination across sectors, fostering a culture of collaboration that transcends boundaries and enhances our nation's response capacity.

A commitment to comprehensive planning optimises resources and expertise, offering a higher return on investment. Skills and systems developed for one scenario often prove invaluable for addressing others, creating a robust and adaptable response framework.

Planning for large-scale global catastrophes leverages a holistic, forward-thinking approach to disaster resilience has far-reaching benefits.

Summary Table

A nuclear war, resulting in severe trade disruption as well as nuclear winter could have wide-ranging and considerable impacts on Aotearoa NZ, but mitigation options exist to limit the impact of this catastrophe and other large scale global risks. The table summarises key messages provided by expert interview participants across sectors.

<table>
<tr><th>Agri-Food</th><th>Transport, Fuel, Electricity</th></tr>
<tr><td>Impact
Collapse of export markets
Shortage of imported diesel
Supply chain issues for agri-inputs
Uncertain labour availability
Failure of essential technologies
Commercial uncertainty
Mitigation
National Resilience Framework
Food Security Strategy
Re-establish regional trade</td><td>Impact
Shortage of imported fuels
Failure of road trucking
Insufficiently diverse transport options
Vulnerability to digital outages
Mitigation
Preparedness & plans
Local supply chains
Alternative fuel supply
Diversify/electrify transport options
People-centered cities
Resilient electricity networks</td></tr>
<tr><th>Economy</th><th>ICT/Digital</th></tr>
<tr><td>Impact
Economic instability & downturn
Failure of digital payments
Impact amplified by limited preparedness
Mitigation
Facilitate cash economy
Digital resilience to enable government
Circular localised economies</td><td>Impact
Failure of communication systems
Disconnection from offshore cloud & suppliers
Mitigation
National Digital Communications Continuity Plan
Scenarios, auditing, and testing
Local communications self-reliance
Open-source digital for resilience</td></tr>
<tr><th colspan="2">Risk Management</th></tr>
<tr><td colspan="2">Key approaches
Include global catastrophe in risk assessment
Multi-layered collaboration
Develop effective emergency management legislation
Preparedness for a broad range of disasters</td></tr>
</table>

Finally, a short preliminary report based on the same interview transcripts was prepared independently from this report, demonstrates convergence with the findings above, and can be accessed here.[iv]

[iv] https://adaptresearch.files.wordpress.com/2023/09/230817-nzcat-preliminary-short-report-on-interviews.pdf

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Appendix: Selected Interview Quotes

[1] On the amount of fuel stored on farms:

"...we can't put 3000 litres of diesel storage on our farm either. Um, just in case, um, you know, it's not a cost we need to be carrying at the moment." (Interview 3 – Arable Farmer)

"It's a difficult one. Probably. Because at the moment, it's always been hand to mouth because no one wants to carry the burden of the financial part of carrying [extra fuel]." (ibid.)

On the typical reserve of fuel on farms:

"Most guys like, um, just speaking about Canterbury or … arable farmers. [There] would be only enough for a week … typically. You know, during peak fuel [use times], harvest time, … planting, for those times of year ... typically I see a fuel truck up our driveway … once or twice a week." (Interview 3).

[2] Without industrial inputs including diesel crop yield could fall ~40-60% :

"That's something that worries me at the moment … [referring to closure of Marsden Point Refinery] we don't get crude, we don't get [it] at all anymore. You know if we don't have diesel. You know, um, it's pretty simple the alternative, isn't it? … [It's the basis] of how we farm at the moment. There's no way to get back to horse … there's no machinery to do it that way … all the mechanisation we use is run on diesel." (Interview 3)

"You know, there might be six passes across a paddock of wheat in a season. By the time you, um, you know, direct drill it, You know, spray it. Whatever you need to do with it, and then harvest it [that requires regular fuel supply]." (Interview 5)

[3] On the catastrophic impact:

"Well, one word would sum it up, and that's catastrophic … you'll know the statistics ... [but] 80 plus percent … actually I think it's over 90 % of what we produce is actually exports of food and fibre." (Interview 4)

"So the connectivity is extraordinary and it's fast. And if you … if you take a very big industry like our biggest one, dairying, … it's slow by [international] standards … because all product is shipped." (ibid.)

[4] On seed stockpiles:

"Yeah, but you know that that's the bloody tough part about it. Because, how big does it [a seed stockpile] need to be? Um, because there's a lot of seed that's stored … in climate-controlled areas and things, but only 10 kg or something. So if we need to go back to a certain line or something like that, or maybe there could be more it could be a couple of tonnes of seeds and things stored, but that's more to replicate out again. That will take time." (Interview 3)

"It's a very good question and something that we're confronting a fair bit, you know? Like what … what do we need? Where do we need it? How rapidly do we need it? Um, yeah, it's like a nuclear warhead off tomorrow, is everyone gonna feed themselves?" (Ibid.)

[5] On economic transactions and moral considerations:

"…that becomes a whole lot of judgment calls ... and moral calls for people to make. Um and that's that's very difficult. Um, so how economies would work ... how transactions would work? I think is an important consideration." (Interview 17)

> "I think … that people look at the priority of needs and say people need shelter and food, and well If there's food there, you'll give it to them. But they forget that there is a transaction there, and there is ownership of that good. And yes, you can wipe it all the way. But in what circumstances is it legitimate to do that? And then how do you recompense for that later?" (ibid)
>
> "[transactions] won't be equitable because some people will be more comfortable doing that than others, … we've seen examples of cafes just giving out free food and coffee to the regulars and say, 'We know they're good for it. If they can afford to pay, they'll pay later, it will come back to us'. But not everybody can do that. And especially if you're running a business on behalf of a corporate, you know, if you're running a Woolworths supermarket that's owned by shareholders, do you have the latitude to do that as the manager, you might do if you are an independent store owner?" (ibid).

[6] "I don't see our telecommunication system shutting down completely, but it would if we lost a bunch of data ... so making sure that we know that we have that secure, um, because if we had electricity, we could pretty much still run lots of things." (Interview 5)

[7] "you know … if we could increase our capability of doing things like that, produce our own cars and trucks and, um, technology, electronics and everything else. So we're less reliant on something coming in and we can do some of it ourselves… that would be a real win" (Ibid.).

[8] "Uh"We're completely reliant on digital ICT, and so many people don't know where... all that's hosted, they don't understand what the vulnerabilities are and that sort of thing." (Interview 13)

"It literally could be cyber warfare that just collapses this one component of New Zealand's cloud reliance and the whole shit storm could unfold." (Ibid.)

[9] , well, it forces them [smaller NZ companies] out, especially if there's no one there from DIA [Department of Internal Affairs] or DPMC [Department of Prime Minister and Cabinet] or … regulations to mandate locally-owned infrastructure and capability. So that's happened throughout the world … in fact, if you look at France, there's been a whole load of antitrust lawsuits. And there's been another one recently, Um, just basically saying these big companies are bullying smaller players out of the market, and that's exactly what they do." (Interview 13)

"It's a lot like the supermarkets. It's a lot like the overseas banks, but it's many times worse because it underpins all of those other sectors and the government. … It's not just one vertical, it's everything. So what can be done about that? As I say, I think the first thing is, uh, legal recognition of cloud as Critical National Infrastructure. In such that the government now has a, uh is mandated to do something about this and to allow regulations and laws which guarantee a certain level of security in the supply of digital services … And I think the other point that I delineate from that but which follows from the first point, is that they need to ensure that there is a vibrant local digital, economy, including the all those lower levels of cloud providers, uh, down to owning data centres and the cloud services on top, then the systems on top so that we're not held hostage by overseas interests, which we are at the moment." (Ibid.)

[10] "We're doing ourselves huge economic harm and missing a huge, huge economic and industry opportunity by continuing down our very poorly chosen path." (Interview 13)

[11] "We've got routing infrastructure. We've got communications infrastructure here... We do run well, and we have some computer [technology and systems] here that is sovereign [but it's not self-sufficient and still vulnerable to external supply chains]." (Interview 13)

[12] "… what you find is in crises decision--making loops drop right down to very small numbers, and you just can't get through those very small numbers unless you've already got a relationship you've built up in advance and it takes a long time." (Interview 16).

"So, even, um, if you have the mobile numbers of senior leaders in a crisis, unless you are one of five or ten people whose numbers you know, they want to talk to even that won't get you through the bubble, you really need to think about building relationships before you need to use them and build trust as an expert" (Interview 10).

[13] Um, because Christchurch [2011 earthquake] gave them [the Reserve Bank] a bit of a chance. Realising that, you know, if the electricity system collapses, you start doing everything in cash. [...] But if the electricity goes down in the whole of New Zealand, I doubt they have enough cash. Hm. Um, and without cash, it will be very difficult." (Interview 12)

"And we don't have the facilities to produce it [cash]. We'll have to improvise something. Um, that will need to be good enough so it wouldn't be able to be counterfeited easily. It's not that easy." (Ibid.)

"We wouldn't have cash or money to do it. We have to print a lot of money down quickly. If we wanted to go back to a physical system, I don't think we'd actually have the, uh, cash and the [cash] floating around in communities to be able to even run it." (Interview 18)

[14] "My guess is that they [the Reserve Bank] are prepared for a local event, say, a Wellington earthquake or something like that. [...] Right now, you know, think of a localised event, but spread over the whole country, that looks very, very different. Um, and I don't think they're prepare[d] for that, they don't think about that" (Interview 12)

[15] "I'm sure the Reserve Bank and so on are working on cyber security … preventing those attacks. But are they also preparing an emergency response to an attack that somehow manages to penetrate the defenses? I don't know. Um but I think planning for the collapse of the payment system is a feasible task, whether it at least it has been undertaken, I'm not sure, Um, but it's easier to deal with than some of the other challenges resulting from a catastrophic event." (Ibid.)

[16] "Where does this kind of problem … this kind of scenario or crisis actually fit within government or within governance? I guess that's absolutely crucial … issue we have to address or think about, .. because maybe there isn't [currently] a place for it and the system needs to change" (Interview 11).

[17] "You need to look at research by the McGuinness Institute... It's not necessarily what information you have, but what relationships you build, where people will have trust in you when the time comes to give them the right information at the right time." (Interview 14).

[18] The following quotes highlight concerns about the current statutory framework's inadequacy in dealing with catastrophic risks, emphasising the need for a more robust and comprehensive approach.

> "Is the Emergency Management Bill in New Zealand adequate to address what we confront in a national catastrophe caused by a global catastrophe … hmm … Or do we need something kind of independent and, yeah, like legislation supported by, say, a think tank or something that's ironing out these sorts of multi-sectoral, super complex issues?" (Interview 11).
>
> "Yeah, that's a really good question, and I don't know if there's an easy answer, but I suspect with this I feel as though the next this iteration of the emergency management bill has brought us forward from the 20-year-old, you know, legislation that we had. So, it's definitely ... heading in the right direction. [But] It's not fit for purpose for a global catastrophe. No, I don't think it is." (Interview ibid.).
>
> "I'd probably drop the current Emergency Management Bill from the legislative programme. Um, it's not fit for purpose for small scale emergencies, let alone large-scale emergencies and the sort of stuff we're talking about here." (Interview 10).

[19] One the challenge of communicating risks to decision-makers:

"Yeah… so there's a couple of things you'll grapple with. One will be, um, alarmism. People just think you're just being so alarmist… right now, people are [argued as] being alarmist around all sorts of things… there's climate change, A.I., driverless cars, um, China competition, you name it. And so how do you frame it up in a way that makes sense? … there's also very scarce attention." (Interview 16).

On the attention deficit of leaders:

"It can be difficult to capture the attention of leaders. The challenge lies in breaking through this attention deficit to ensure that significant threats, such as a nuclear war scenario, are given priority. The emphasis is on finding strategies to penetrate this barrier and prioritise critical concerns". (Ibid.)

[20] "I think you probably … try and get into a Long-Term Insights Briefings. … We looked at doing parallel long-term insights briefings alongside government agencies. So, when they got tabled in Parliament, as they need to be tabled, you could actually go to a select committee and say, 'Actually, … here is what actually should be in the LTIB… and this is from a group of researchers who actually understand this field. Then MPs would have two contrasting sets of information, one of which was rock solid, and the other was paper thin." (Interview 16).