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Surveying Survival: What Experts Think About New Zealand's Resilience to Nuclear War/Winter

Summary Report of Survey Data from the Aotearoa NZ Catastrophe Resilience Project

Adapt Research Ltd

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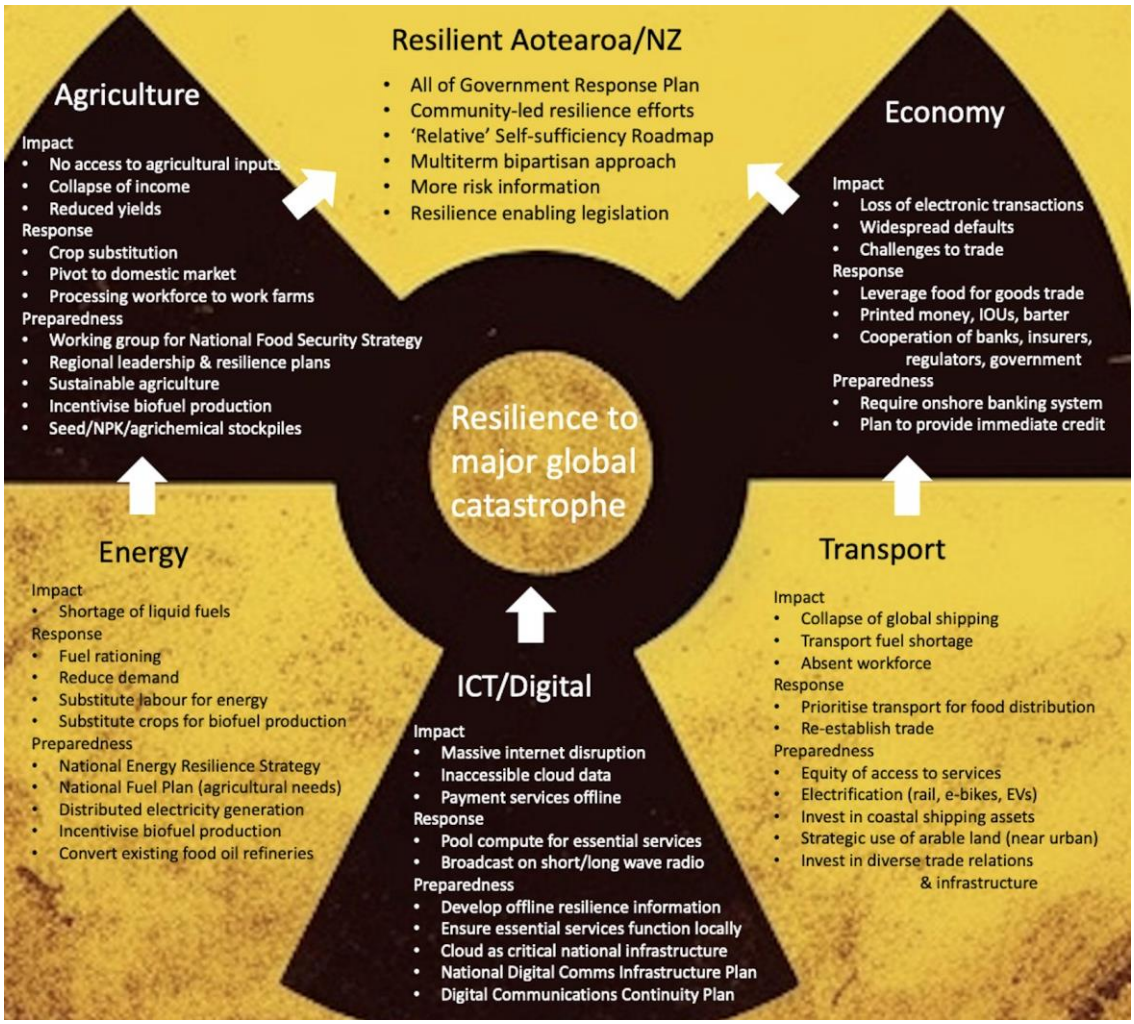
Disclaimer: This report presents results from a single component of an ongoing research project and serves as a basis for further data collection. The views summarised below are those of the survey respondents and their suggestions may not necessarily reflect final project recommendations to be published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

Executive Summary

This report presents findings of the survey component of a research project examining New Zealand's (NZ) vulnerability to a Northern Hemisphere nuclear war/winter scenario. The analysis is based on a hazard profile validated through a workshop with multidisciplinary stakeholders and a scenario-based survey across critical sectors that contemplated catastrophic trade isolation. Survey responses are from diverse professionals representing food & agriculture, energy, transport (including maritime), ICT/digital & communications, economy/finance, water provision, manufacturing, and supply chain sectors.

There are common challenges and interdependencies across sectors, including disruptions in the supply chain, loss of connectivity, financial constraints, social unrest, infrastructure limitations, and food security concerns. Specific impacts and resilience measures were identified for each of four key sectors (food & agriculture, energy, transportation, and ICT/digital communications). These 'Big Four' sectors underpin NZ's current social and economic functioning and interdependencies across other sectors.

For food & agriculture, survey data emphasised measures like sector-led resilience, pre-disaster planning, localisation of food production and energy supply, and workforce mobilisation. In the energy sector, recommendations include a new national fuel plan, transition to sustainable sources, energy demand prioritisation, and infrastructure investment. The transport sector could prioritise crisis management, fuel allocation, and partnerships. The ICT/digital sector requires a coordinated communications plan, improved infrastructure resilience, and enhanced security.



Critical aspects of NZ resilience identified by expert survey respondents.

Survey responses across all sectors emphasised the need for strategic planning, collaboration, and adaptation to address the impacts of global catastrophe such as a Northern Hemisphere nuclear war/winter. Strategy should include the shift towards more self-reliant and secure infrastructure across sectors, immediate resilience measures, and government initiatives.

Supporting quotes from survey responses are provided as endnotes in this report and can be read in the Appendix.

While this report provides the valuable insights of survey respondents, it is part of ongoing research. The findings serve as a foundation for the project team's ongoing benchmarking study and contribute to enhancing New Zealand's preparedness and response strategies for potential catastrophic events.

1 Introduction

The Aotearoa NZ Catastrophe Resilience Project (NZCat) highlights and explores New Zealand's vulnerability to a Northern Hemisphere nuclear war/winter scenario. Our project team developed a Hazard Profile for NZ, which was validated at a Workshop in February 2023 attended by 20 multidisciplinary stakeholders from industry, academia, and the public sector.

Workshop participants rated the nuclear war scenario 'quite plausible' on a formal likelihood scale. The most severe impacts on NZ would likely stem from a collapse of global trade. The monetised impact on NZ, should such a scenario occur, was agreed to be upwards of NZ$1 trillion. Workshop participants identified far-reaching, potentially catastrophic, impacts for NZ underscoring the gravity of the scenario and warned of critical interdependencies across sectors.

Building upon the Hazard Profile, the NZCat team conducted a scenario-based survey to capture further insights and perspectives from respondents across a range of sectors and industries critical to NZ's societal functioning. This report synthesises the analysis of survey findings, mapping impacts and possible resilience measures. Survey respondents identified various 'actionable insights' for industry and government stakeholders to enhance preparedness and response strategies.

2 Methods

The survey was sent to a wide range of potential respondents identified based on sectoral expertise and knowledge. Respondents read a shortened version of the Hazard Profile scenario and answered eight free text questions (Appendix A) about the impact of the scenario and potential mitigation measures. The major impact described in the scenario was catastrophic NZ trade isolation.

Participants were encouraged to answer the survey questions from the perspective of the sector they are 'most familiar with'. However, for 'multi-hatted' participants who did not fit within a specific sector or those with relevant knowledge across multiple sectors, sector agnostic survey responses were collected. The survey was also posted on LinkedIn and within a blog post to increase reach.

Detailed responses from 42 individuals, comprising nearly 20,000 words of text, were received, and analysed. Participants represented the sectors of agriculture, energy, transport, ICT (information and communications technologies)/digital, economy/finance, manufacturing, and supply chain. All had diverse professional backgrounds, ranging from farmers and producers to risk experts, policy directors, CEOs, economists, and more, representing the NZ public sector, academia, industry, and think tanks.

Two NZCat team members examined the raw survey data and identified critical impacts and potential preparedness and response actions within, and across, the selected sectors, as described by respondents. A summary table of key findings across sectors is provided here.

3 High-level Findings

Impacts and issues for NZ across sectors, following a Northern Hemisphere nuclear war and winter, as outlined in survey responses, could include:

- Supply chain disruptions: Shortages of essential goods, fuel, food, raw materials, technology, and componentry due to halted international trade, impacting production and ability to meet demand.
- Loss of connectivity and reliance on offshore technology: Disruption of critical technology services and offshore cloud infrastructure affecting communication, data storage, and business operations.
- Financial constraints and economic impacts: Disruption to economic activities, financial systems, reduced access to funds, and resource constraints for sectors.
- Banking and payment methods: Problems with digital forms of currency and the ability to pay for goods and services.
- Social and societal impacts: Fear, anxiety, social unrest, potential hoarding, increased crime, challenges in maintaining law and order, disruptions in governance and societal dynamics.
- Transportation and logistics challenges: Fuel shortages, disruptions in transportation networks, limited access to essential resources affecting trade, freight movement, and emergency response.
- Infrastructure and technology limitations: Lack of local production capabilities, reliance on imported equipment and supplies, and disruptions in critical infrastructure impacting various sectors, include agriculture and food production, transport, energy, IT, and communications sectors.
- Food security and healthcare challenges: Potential food shortages, increased prices, challenges in healthcare access, medicines, and waste management, requiring adaptation to supply shortages and increased demand.
- Disruptions in the energy sector: Major challenges in fuel supply and some issues with sustainability of electricity generation over medium term. Rationing and reliance on domestic energy resources would be necessary.
- Governance and policy changes: Government response, prioritising survival, policy re-evaluation, potential interventions, and regulations to address critical failures.
- Need for local/national self-sufficiency: Dependence on local food production, energy sources, and data storage solutions, need for self-sufficiency and resilience in key sectors.

These impacts reflect the vulnerabilities and risks that would be experienced across all sectors if the scenario was to occur, highlighting interdependencies and cascading impacts and emphasising the need for preparedness, collaboration, and adaptation to ensure the continuity of essential services to and mitigate critical failures.

Strategies to overcome these impacts and sustain essential services were identified in the aggregate analysis of survey responses across all sectors, these included:

- Stockpiling essential resources: Industries could prioritise stockpiling fuel, raw materials, and critical supplies to ensure availability during disruptions.
- Localisation of production and supply chains: Sectors could shift towards local production and reduce reliance on imports, focusing on essential goods and services. Prioritising local food production and distribution hubs, diversifying crops, and promoting food security could help mitigate shortages and price hikes.

- **Improved collaboration and coordination:** Sectors could collaborate with each other, government agencies, and community groups to share resources and expertise to sustain essential services.
- **Pre-disaster planning:** Developing contingency plans and identifying critical needs (materials, resourcing, capability, and capacity) before a crisis could help mitigate immediate impacts and support resilience.
- **Alternative energy sources:** Exploring alternative energy sources, such as renewables, could mitigate fuel shortages and ensure continuous energy supply.
- **Strengthening infrastructure and backup systems**: Investing in infrastructure resilience, backup systems, and disaster recovery plans could minimise disruptions and ensure essential operations.
- **Workforce reallocation and community resilience:** Engaging the available workforce for local activities, supporting community resilience initiatives, and fostering self-sufficiency could enhance resilience.
- **Enhancing localised communications infrastructure and digital connectivity:** Ensuring internet access, maintaining mobile phone networks, and establishing local data centres could facilitate communication resilience and access to critical services.
- **Adjusting priorities and optimising resources:** Industries should prioritise essential needs, optimise resource allocation, and adapt operations to address immediate challenges.

These strategies aim to address immediate impacts, promote resilience, and sustain essential services across sectors in the given scenario. Sector-specific case studies based on these strategies could now provide valuable insights into practical solutions and best practices that can be adapted and applied in similar scenarios.

4 The 'Big Four' Sectors

The following section presents the major concerns highlighted by survey respondents in the critical sectors the NZCat Project refers to as the 'Big Four'—Food & Agriculture; Energy; Transportation; and ICT/Digital and Communications. The analysis provides a map of respondents' suggested resilience measures that could be implemented (before or after the event as appropriate). These sectors hold particular significance in our analysis due to their profound influence on NZ's societal functioning as well as their interconnectedness with other industries and sectors. Supporting quotes from survey responses are provided as endnotes and can be read in Appendix B.

4.1 Food & Agriculture

Cross-sector impacts outlined in Section 3, plus impacts specific to the food and agriculture sector,[1] meant sector specific respondents identified the following possible mitigation measures:

- **Sector-led resilience:** Create regional community-led resilience leadership structures to understand the risk, identify options to consider, and advise on a roadmap to resilience preparedness.[2] A private/public partnership could fund and co-ordinate this planning.
- **Pre-disaster planning:** Identify options to pivot production to support domestic needs.[3] Planning for potential big scale disasters would help the agriculture sector respond more effectively when smaller / localised events occur.
- **Diversification of energy sources:** The sector could work towards energy diversity, potentially including the development of biodiesel capability for farm machinery operations.
- **Invest in network resilience (especially communications):** Work with telecommunications and data infrastructure providers to build greater resilience for support of essential food production and supply processes.[4]
- **Localised food production and distribution**: The farming sector could pivot to produce a wider range of food for nearby distribution. This could involve refocusing supermarkets to rely less on imported foodstuffs and more on locally produced goods.[5] The promotion and incentivisation of "shop local" initiatives would improve the resilience and availability of domestic products and services.[6]
- **Workforce mobilisation and reallocation:** In the event of widespread unemployment, the government could make a workforce of people available to support local farming activities and community needs.[7]
- **Resilient farming practices:** Respond with practices such as using horses for transport and supply of mechanical power, decentralising livestock slaughter back onto the farm for local supply, and reducing farm stocking rates to take account of lower pasture and crop production.
- **Transition towards a green/circular economy:** Highlighting vulnerabilities to catastrophic events could provide an opportunity to expedite the shift towards sustainable practices and circular economy, supported by appropriate government initiatives.
- **Optimise resource allocation:** Pool resources, machinery, and spare parts to increase efficiency, focus on high-yield production areas, and adapt crop rotations for essential food production.[8]
- **Reduce reliance on imported materials,** including liquid fuels, and encourage innovation in renewable and compostable locally produced food packaging systems.
- **Explore alternative markets:** Identify new, and strengthen links with existing, markets in likely less-affected regions to maintain trade and export opportunities.
- **Collaborate with government agencies and sector-focused organisations to invest in planning:** Improving collaboration with agencies such as the Ministry for Primary Industries (MPI), Ministry of Business Innovation and Employment (MBIE), and the National Emergency Management Agency (NEMA) and sector focused organisations (e.g., NZ Beef & Lamb, DairyNZ, Horticulture NZ, NZ Food & Grocery Council) to map vulnerabilities and support more resilient supply chains and improve communication security and coordination.[9]

These measures would require significant planning and coordination within the agriculture and food sectors, as well as support from government and other sectors.

Overall, strategic planning is needed to understand how to refocus on producing and supplying food to the NZ market following a global catastrophe to ensure a resilient and stable food supply within NZ.[10] Many examples also highlight co-benefits of resilience building across the suite of risks that NZ needs to mitigate, such as avoiding supply chain issues experienced during the Covid-19 pandemic.

4.2 Energy

Survey responses emphasised significant repercussions for New Zealand's energy sector in the event of a Northern Hemisphere nuclear war/winter, with existing deficiencies in resilience and contingency planning.[11] Potential impacts on the energy sector include complete cessation of liquid fuel imports (petrol, diesel, aviation fuel, and bunker oil for shipping), possible disruptions to electricity generation coordination, and challenges in accessing crucial components and international expertise necessary for secure supply.

These energy sector impacts would trigger far-reaching consequences across other sectors, particularly in food production (agriculture, horticulture, and aquaculture) and transportation, which heavily rely on diesel and other liquid fuels.

In response to these potential challenges, survey respondents identified the following resilience measures:

- National fuel plan: Develop a new more comprehensive national fuel plan that sets out specific rationing plans, bolsters local fuel storage capacity, and enhances the resilience of international supply chains to meet lesser contingencies than cessation of imports.[12] Developing a dedicated rationing plan for liquid fuels that is tailored to address the specific scenarios would be advantageous.[13]
- Transition to sustainable onshore transport-energy sources: As well as ensuring diverse energy sources, [14] the energy sector should work towards sustainable onshore transport-energy sources. This may involve electrification of heavy trucking and developing biodiesel capabilities, including for farm machinery and transportation. Additionally, considering the use of food oil for biodiesel production, rather than solely for food consumption, can contribute to addressing fuel supply challenges.[15] Transition to alternative power sources such as geothermal and wind could support the resilience of continuous energy supply, and enabling additional localised generation and on-farm hydro-electric generation could be an effective resilience measure requiring prior planning and investment.[16]
- Energy demand prioritisation: Rigorously prioritise energy demand and curtail non-essential energy usage. Maintain gas, coal, and liquid fossil fuel supplies as options while bolstering sustainable onshore energy sources.
- Infrastructure investment: Significant investment in transport infrastructure is needed to secure energy sector resilience and self-sufficiency. This could include continued investment in road and rail electrification, secure fuel reserves for resilience, and coastal shipping assets including ports. This would require planning for long-term resilience.
- Self-sufficiency roadmap: NZ could develop a self-sufficiency roadmap to prepare for potential isolation scenarios. This could involve stockpiling strategic reserves to survive long periods of isolation.

With sufficient lead time, the government could take a multi-term, bipartisan approach to ensure resilience is promoted through consistent focus on year-on-year energy infrastructure investment and multi-sector resilience planning.

4.3 Transport

The transport sector could be catastrophically impacted if the scenario occurred and resilience measures are not implemented ahead of time. This is partly due to the flow-on effects of potential disruptions to energy supply (Refer Section 4.2) and low resilience to 'shocks', but also a range of wider impacts highlighted in survey responses.[17] Several respondents were uncertain how the sector would perform in the scenario and considered that immediate concerns would focus on self and family.[18]

The maritime transport sector, ports and coastal shipping in particular, were identified as often overlooked, but key resilience assets for NZ. Specific impacts on the maritime sector were identified,[19] and underscore the extensive disruptions and challenges faced by the maritime industry, affecting both its internal workings and broader society.

In light of these potential impacts, survey respondents from the transport sector identified various resilience measures, including:

- Crisis management planning: Implement detailed crisis management planning that provides devolved powers to local government (Councils) who can mobilise and empower the community to address and prioritise needs.[20] Collaborate closely across all transport sectors (maritime, rail, trucking, and logistics) to establish coordinated plans and ensure smooth flow of essential goods.[21]
- Prioritise fuel reserves for critical operations: Planning is needed to manage and allocate resources effectively. Give priority to rail, truck and maritime freight to transport essential supplies in a disrupted environment.
- Form collaborative partnerships: Among local and regional government bodies, the rural food production sector, and the transport sector to foster the advancement of localised food production and optimise food transport planning.[22]
- Infrastructure investment to reduce fuel dependency: Increase the usage of bikes and e-bikes in the community to help reduce reliance on transport fuels that are import-dependent. Increase the capacity of trains to take bikes and increase access for bikes and e-bikes within urban environments.[23] This could help facilitate longer-distance travel without the need for personal vehicles, with an overall transition to reducing nation-wide car dependency.[24]
- Enhance coastal shipping operations and port Infrastructure: To compensate for the absence of international shipping lines, repurpose vessels or explore alternative solutions.
- Local food production: Strengthen local production and supply chains, reducing reliance on international sources and fostering resilience. Require Regional Councils to plan for the provision of sufficient local production of food and transport of that food to sustain the population of the region, including protection of needed rural land from urban development.[25]

These actions would require a coordinated and adaptive response from various stakeholders and sectors to tackle the significant challenges posed by the scenario. With specific emphasis on urban transport, respondents emphasised that resilience measures would require a shift from a car-centric 'freedom of mobility' to a community-centric 'equity of access' with largely fits with current NZ initiatives in urban transport planning. The transport sector could potentially organise itself to deliver community-centric access, connecting across organisations that would need to know how each other operates, and setting up lifeline and support systems.

4.4 ICT/Digital/Communications

The current functioning of NZ society is overwhelmingly reliant on ICT, Digital and Communications systems and infrastructure. Much of this function relies on offshore hardware, software and server systems. Disruption or destruction of these would have catastrophic impacts on NZ in the scenario.[26] Survey respondents from this broad sector identified a range of complex issues that would potentially destabilise ICT, Digital and Communication services with far-reaching impacts.[27] From this it is possible to map the following resilience measures identified by respondents:

- Implement a coordinated national "Digital Communications Continuity Plan": This would provide onshore fallback for core communications, payments, government, food distribution and internet services.[28]
- Evaluate national digital communications infrastructure to identify and address key vulnerabilities and capacity issues: The sector could work towards creating a national digital communications infrastructure that can survive if NZ was to be isolated, and address key capability and capacity gaps.[29]
- Build capability and awareness of security across our own organisations and across the country, including:
    - Data location awareness: Work with international firms to determine where data is held globally (e.g., cloud services that businesses rely on). This would help businesses understand where their key applications are hosted and prepare for potential disruptions.[30]
    - Strengthen security capabilities: Strengthening security capabilities across government and ensuring national networks and intranets are safe and secure could help mitigate the impact of cyberattacks.[31]
- Recognise cloud computing as critical national infrastructure: Invest in resilience measures that enable NZ's digital systems if isolation was to occur.
    - One solution could be to implement an open-source software stack in local data centres to control critical services for national security, communications and resilience, rather than the complacency of outsourcing them to foreign controlled and operated entities and assuming major issues will not occur.[32]
- Alternative energy sources: The sector could invest in resilient energy systems to ensure there is vital/critical infrastructure that can be run without imports, renewably, or even off battery banks as needed.
- Community-led resilience: Create regional community-led resilience leadership structures to understand the ICT/Digital risk, learn the options they need to consider, and advise on a roadmap to resilience preparedness.

These measures would require significant planning and coordination within the ICT/Digital/ Communications sector, as well as support from government and other sectors.

5 Discussion of Survey Results

Survey responses indicate that NZ would be likely to face severe impacts across various sectors in the event of a Northern Hemisphere nuclear war/winter that resulted in catastrophic global trade disruption. These include, but are by no means limited to, disruption of essential services, energy crisis, transport disruptions, supply chain disruptions, cyber threats, economic impacts, food insecurity, breakdown of critical services, and socio-economic instability.

Addressing resilience to this scenario requires self-reliant and secure infrastructure (including enhanced social capability/capacity) across all sectors. Pre-event preparedness could include developing rationing plans, forming crisis partnerships, implementing digital continuity plans, stockpiling raw materials, and fostering collaboration between industry and research sectors. Many participants indicated that the suggested measures would also provide resilience across a wider range of catastrophes and more common disaster events.

Options identified by respondents include establishing community-led resilience structures, developing a self-sufficiency roadmap with strategic reserves, and ensuring consistent government support through long-term investment. [33] These measures necessitate extensive planning, coordination, and collaboration across sectors, supported by the government and other stakeholders.

Industries could prioritise resilience measures as outlined above, including energy efficiency, and stockpiling of critical componentry and inputs; community-centric solutions and enhanced cross-sector networks of collaboration; localisation of supply chains (especially for fuel and food); enhanced digital redundancy and security; establish resilient communication means and implement adjustments to manufacturing supply chains and finance with a view to ensuring national key-need resilience.

Government in NZ (central and local) could support these measures by implementing initiatives such as: rationing plans; support for community resilience and response initiatives including food security promotion; invest in diverse and resilient forms of energy; legislate/improve policy to encourage more resilient and locally nested ICT/Digital and communications systems; establish a centralised/cross sector human resource system to call on in crisis events; and encourage relevant stockpiling and localisation of supply chains and local food production.

5.1 Survey limitations

The analysis of survey responses provides valuable insights, but there are caveats and gaps to acknowledge. These include a limited sample size of 42 respondents, potential biases in subjective responses, uncertainties in the hypothetical scenario, limited capture of complex interdependencies, and potential oversight of specific stakeholder perspectives due to the project's macro nature.

This survey, however, is only one component of the NZCat Project to understand Aotearoa/NZ following nuclear war/winter. Further data gathering and engagement will address these limitations, including triangulation with other data sources such as expert workshops, cross-sector round tables, key informant interviews, and document reviews.

This report maps a range of critical impacts on NZ in the event of a nuclear war/winter and suggests how both industry and government can prepare and respond effectively, which will feed into the wider remit of our ‘bench marking’ study. Based on this, scenario modelling and deeper analysis for specific sectors would yield further insights and potential resilience approaches.

Appendix A: Survey Questions

The substantive survey questions were:

Question 1: Please list the largest likely impacts of this scenario on your sector from day one, through the first year.

Question 2: With current systems/resources, what could your sector do to overcome the largest immediate impacts and sustain essential services in this scenario?

Question 3: How might your sector adapt and work with organisations in other sectors to sustain essential services in this scenario?

Question 4: Reflecting on your previous answers, what current weaknesses do you see within your sector that could contribute to critical failures in this scenario?

Question 5: In this scenario, what are the worst-case impacts for other sectors/industries/organisations of a failure in your sector?

Question 6: With sufficient lead time what could your sector do to minimise the impact of this scenario?

Question 7: With sufficient lead time what could the government do to minimise the impact of this scenario?

Question 8: Would any of the solutions you have mentioned above also help mitigate more common disasters impacting on your sector?

Appendix B: Representative Survey Responses & Quotes

[1] Survey respondents identified various critical impacts on the **Agriculture & Food Sector** in the scenario, including:

- Fuel for tractors, fertiliser and pesticides will run out.
- The farmgate price of livestock will plummet as farmers seek to offload stock they can no longer feed in a market which is already flooded due to no export opportunities.
- Unemployment in the processing industries will climb but demand for on-farm labour will increase.
- Livestock agriculture is almost entirely reliant on export of meat and import of fertilizer such as phosphate and urea nitrogen. [Study investigators' note: NZ actually does manufacture some of its own nitrogen fertiliser at a urea production plant in Taranaki].
- Most farms might go bankrupt because of the debt levels and tight margins they operate within. The ones that survive will be a handful supplying the local markets that are within a short distance.
- Grass growth will be affected by reduced sunlight, potentially leading to a 20 percent reduction in weight gains for beef animals, restocking of animals so less production, less supplementary growth, increased cost to farm.
- Supply of export trade disrupted meaning more products local market putting pressure on food production.

[2] "Work with Fed Farmers to have a doomsday scenario plan for how the primary sector could best pivot to subsistence farming."

[3] "Convert dairy farms back into extensive beef and lamb production and veg and crop production. No need for dairy as it's an export market and product can't be stored. The government could fund/co-ordinate this planning." [Study investigators' note: Some dairy products can actually be stored without refrigeration eg, dried milk powder and some types of hard cheese].

[4] "Incentivise and accelerate the establishment of on-shore data centres to support significant cloud providers, ensuring these utilities can operate independently if connectivity to off-shore resources/ecosystem support is lost."

[5] "The [farms] that survive will be a handful supplying the local markets that are within a short distance (horse and cart most likely, or electric van). The laws currently prohibit this activity so next to nobody is set up for this model… without refrigerator shipping [for meat] I can't access even the domestic market. It will be my local community only."

"[farmers and sector organisations should] identify the food production strengths in their region, and gaps, and create a plan that would provide food security in their region leveraging their strengths and the strengths in the bordering regions first."

"… food safety will be compromised with impacts on ingredients from overseas, packaging (cans/bags/plastics etc)."

[6] "Create financial incentives for domestic sales… need to diversify because we over produce a handful of products but import things [that] we can grow ourselves."

[7] "People out of work for destroyed or severely disrupted industries to be redeployed on farms to do the work previously done by heavy machinery, i.e. return to subsistence farming."

[8] "Would need to stop seed production for non-essential crops, change rotations to essential food production. Pool resources and machinery for localised groups, to increase efficiencies and productivity, and pool spare parts to focus on keeping a few machines running. Focus on harvesting required produce, and on most productive land. Marginal land for production would be left fallow - potential to increase extensive sheep and beef production. Food production would effectively become organic, as there would be no inorganic products available, so would see this impact on yields dramatically." [Study investigators' note: This is perhaps not necessarily true if nitrogen fertiliser production continues – see the comment above].

[9] "Work with Beef & Lamb, forestry and fish and game. Would need to cut supply of grain for dairy industry and use their storage for human capacity and change to beef production over milk."

[10] ".. a working group to develop a food security strategy would enable these issues to be properly considered, investigated and responses planned."

[11] Survey respondents identified wide-reaching impacts on the Energy Sector in the scenario of a nuclear war/winter, including:

- Almost immediate panic-buying of fuel, likely to necessitate a near-instant response from Government and fuel suppliers. The National Fuel Plan will be activated - this will triage access (particularly diesel) to higher priority sectors e.g. emergency services.
- NZ is lucky to have significant domestic energy resources available. Assume that wind/geothermal/hydro generation are undisturbed - likely a drop in solar PV output due to nuclear smog, but this is (currently) a tiny portion of electricity demand (growing).
- Gas can fill the gap but development of existing/new fields takes significant investment, long lead times, and rig accessibility (assume this is disrupted as they'd come from overseas).
- Liquid fossil fuel supply from overseas for energy requirements, in particular transportation, will likely cease and rationing of local reserves will be required to prolong supply for essential services.

[12] One detailed example of a resilience measure in the energy sector, as mentioned by the respondents, is the development and updating of a liquid fuel rationing plan. This plan would be developed with public input and would be the responsibility of the Ministry of Business, Innovation and Employment (MBIE). This measure would help manage the supply of liquid fuels in the event of a nuclear war, ensuring that essential services can continue to operate. The plan would involve rigorous prioritisation of energy demand and curtailment of non-essential uses of energy. This approach is like the response to the OPEC oil crisis in NZ, which involved measures such as car-free days.

[13] "Develop/update the liquid fuels rationing plan for this scenario with public input (an MBIE responsibility)."

"Rigorous (and painful) prioritisation of energy demand and curtailment of 'non-essential' uses of energy. Look to the OPEC oil crisis response in NZ (car free days etc) to get some sense."

"When a government is faced with the prospect of brownouts - let alone total blackout - they will burn the floorboards or tyres and worry about our climate virtue later."

[14] "We are concentrating energy demand toward electricity - this exposes us to physical threats/hazard to the above-ground infrastructure. Maintaining gas, coal, liquid fossil fuels give us optionality. It was LPG tanks that kept people fed when Cyclone Gabrielle knocked out power." [Study investigators' note: We also note that in Cyclone Gabrielle some impacted homes and businesses were supported by electricity supplied by electric vehicles and photo-voltaic cells on roofing].

[15] "We can supply food oil to the public say 20,000,000L and use some of this for biodiesel production as opposed to food."

[16] "Build more micro-hydro (on farm hydro), regulation notwithstanding. With a lack of fuel electricity will be the main supply of energy and may well be constrained. Regulation which is more permissive of micro-hydro would enable these systems to be installed ahead of such a scenario."

[17] Survey respondents identified various critical impacts on the Transport Sector in the scenario of a nuclear war:

- Unavailability or rationing of petrol/diesel transport options, social unrest, food unavailability, lack of devolved local decision making power to Councils to respond to community needs.
- NZ maritime industry would be severely impacted; lack of international ships visits (bulk carriers, Cruise ships, container ships etc) mean most of NZ Port infrastructure becomes 'mothballed'; NZ has NO onshore refining capability with the recent closure of Marsden Point ...without strategic fuel supply, there would be 90%+ disruption to NZ transport system across all modes (land, air, etc)...without AV gas,

emergency rescue and response activity would be greatly curtailed...domestic freight and passenger movement interrupted initially.

- The sector would likely result in a complete halt to business as usual governance and investment. Most people in the sector have direct family connections to the Northern Hemisphere and would immediately reassess their own life priorities, and their survival.

18 "[many people] would prioritise their own survival and that of their families. They will be completely absent from 'the sector' as they navigate life without any of the usual structures and habits that underpin daily life. 'The sector' would cease to exist in the first year. It is entirely unknowable to me how the transport sector might organise itself in this scenario."

19 Impacts on the maritime transport sector include, but are not limited to: disrupted international ship visits and curtailed supply chains; under investment in port infrastructure with emphasis on resilience; strategic fuel supply issues and absence on onshore refining capabilities; curtailed emergency response activities; interrupted domestic freight and passenger movement, further exacerbating supply chain disruptions and impeding economic activities; downgraded policing and regulatory activities (not only in regard to NZ's Exclusive Economic Zone (EEZ).

20 "I do not think that the transport sector in New Zealand is at all well equipped to organise itself in the absence of internet and 'usual' government processes."

"The transport sector has almost no interaction with people on the front lines of health, social support or community services. The transport sector has no connection to support systems or any way to triage itself to deliver in crisis."

"Lack of sufficient investment in transport infrastructure e.g. road and rail electrification, strategic fuel reserves, onshore refinery, coastal shipping assets, ports etc. Planning for short term convenience not long-term resilience...NZ is VERY much the last stop on a very long supply chain route...we can very easily become isolated should these chains break...NZ lacks a self-sufficiency road map (in times of chaos)..."

21 **"**Develop specific contingency plans and crisis management strategies for the maritime industry, addressing unique challenges and ensuring service continuity."

22 "Local and regional government should be forming partnerships now with the rural food production sector, transport sector for crisis preparedness in the event of catastrophic risks. Central government should have plans in place now to devolve power to local government in a catastrophic risk scenario where all of New Zealand is dealing with the fallout (overwhelming the government's ability to be responsive enough)."

23 "a mobility-centric approach to planning and investment in transport, based on assumptions about networks and long-term travel: the sector looks at roads and transport links in terms of flows and speeds. Then it looks down at impacts, or effects, that those attributes generate. The transport sector does not focus on 'access to opportunity' as an outcome that it invests in."

24 "Shift movement of essential goods to rail. Increase rate of bikes and e-bikes in the community. Increase capacity of trains to take bikes. Increase use of cargo-e-bikes for essential last mile deliveries. Detailed crisis management planning that provided devolved powers to Councils who were able to mobilise and empower the community to address and prioritise need. Require Regional Councils to plan for provision of sufficient local production of food and transport of that food to sustain the population of the region including protection of needed rural land from urban development."

25 "Require Regional Council's to plan for provision of sufficient local production of food and transport of that food to sustain the population of the region including protection of needed rural land from urban development."

26 "[The scenario could entail] instant and possibly permanent loss of all systems- government, private sector, and consumer services such as email, social media and messaging - that are hosted by overseas cloud providers."

[27] Survey respondents identified various critical impacts on the ICT/Digital/Communications Sector in the scenario of a nuclear war/winter:

- No internet would mean no access to digital payment systems and the need for an alternative currency/monetary system.
- Ceased global supply lines would mean shortages of imported goods, including digital and tech supplies. "Lack of computer equipment imports. Shut down of the internet and international communications networks. Offshore cloud computing / SaaS [Software as a Service] services inaccessible. Non-local data backups lost irretrievably.
- Logistics would be disrupted impacting the ability to send products to markets and locations.
- "[As a communications business] if links to International POPS - points of presence (and international data centres) [ceased] it would mean many clients couldn't function at all...payroll, databases and ERP [Enterprise Resource Planning software] applications wouldn't be accessible. Cloud applications hosted in NZ would continue - so that would be just luck for businesses. Many of these applications will be hosted in NZ or Australia - but many wouldn't be. In fact, many businesses wouldn't know exactly where their key applications were hosted until such an event happened."
- A rise in cyberattacks globally as cyber-espionage and counterattacks are used to avoid engaging in further kinetic combat.
- A rise in online criminal activity as more organised criminal activity moves online due to it becoming more difficult to operate "in person". [Study investigators' note: This might not occur if the internet in NZ could not be maintained; or if government intensifies control over the functioning and content of the NZ internet].

[28] "Put in place coordinated national "Digital Communications Continuity Plan" which provides onshore fallback for core communications, payments, government, food distribution and internet services. Run exercises where every business needs to be able to operate and rapidly stand up a "Minimum Viable Digital Footprint" onshore."

"I think an overall plan of action would be the best tool. If we all had a website to go to already where everyone can read up on what we can do to prepare and be resilient, but also as a place where we would be able to read what would happen first in case of disaster would be the best thing ever. So, nuclear war happens, what should I do-> Go here!.....www.... Then there one can read as to what is happening at governance level, and local level, and what each person should be doing or planning at that stage. It would say like "The country is now at Level 2, and this emergency protocols have been put in place - please download the following in case the internet goas down."

"Incentivise and accelerate the establishment of onshore data centres to support significant cloud providers, ensuring these utilities can operate independently if connectivity to offshore resources/ecosystem support is lost."

[29] "We are also very much in danger of simply not having enough people that understand what they are using… most organisations have little to no expertise inhouse… what is taken care of within NZ, is usually in the hands of few experts in companies like DATACOM. Even backup centres like CCL [Computer Concepts Limited], while well covered for their few clients - only have a handful of experts on their books."

[30] "The cloud industry that currently serves 99% of NZ's market will not address the impact of this scenario. The answer lies in reducing our dependency on the current US-owned providers, who by their nature and ownership can never provide sufficient resilience to NZ."

"NZ-based cloud services of US-owned cloud providers would therefore be impacted immediately by this scenario, potentially critically, and may never return to normal operation."

[31] "Any event that affects online communications. Natural disasters and pandemics included. Data/IT/Comms - everything relies on that currently. But having said that, beside the comms, when it comes to life and death, there are only few areas there that applies. In time we can get around lack of data and internet. And, in the face of massive catastrophe, things like lost booking records become trivial. Businesses that required IT, cloud/internet etc, might not be relevant for long, and local systems or network should be able to be put in place for things like supermarkets and similar. But, being completely unprepared, both in regards to actions, and stock levels of IT equipment and replacement parts, will make all our responses so much harder."

"During the post cyclone period [referring to Cyclone Gabrielle in February 2023] and the CO2 shortage … it was difficult to see how communications could be coordinated to give the public accurate information other than leaving it in the hands of the media which can be superficial and salacious."

[32] "Need to take a hypothermia analogy: body withdraws blood flow from all but core systems to survive. National digital comms infrastructure needs to be the same."

"Stand up an open-source software stack in local data centres. Ensure everyone has access to a ".NZ" email address or unique messaging address. Keep mobile phone and data networks operational onshore. (Ensure there are no licensing / cloud computing dependencies offshore which mean that the software required would be switched off). Effectively we need to run a [worked exercise of] 'will Aotearoa run disconnected from the internet?'"

"Even if we could fire up all our critical systems on NZ infrastructure in the aftermath of this scenario, we don't have anywhere near enough of it, and wouldn't have any way of buying or building more. It would be like trying to run ANZ bank on a single PC - laughably impossible."

"All spare computing capacity would be prioritised for a handful of critical activities such as government communication and coordination - standing up email and video conferencing services to deal with the aftermath of the scenario, for example."

[33] "They should create a functional body/org that would tackle this from a country level. With the power to impact legislations. Provide the Book on how we can prepare ourselves both as a nation and as organisations and companies and provide the tools to do so - followed by what to do in a case of disaster."

"NZ needs to model the Net Zero Trade Economy… no import, not exports. and where the highest pinch points emerge (diesel a good example)"

"Most pressure [will be] on the 'golden triangle' of Auckland/Hamilton/Tauranga... largest concentration of population and economic activity... biggest demands for food, water, energy."

"Building an expectation that we will have to live without essential things, life will change. People need to look after themselves and each other."

"While there is some proactive work being done to increase readiness for an event (although not on this scale), much of the work is focused on how to react. There are two weaknesses here: response for this particular event isn't really being planned (as far as I'm aware) and also given the scale of the event a reactive approach is going to be far less effective than usual."

"We should be looking to decentralise critical services as much as possible. Answering this question in detail depends on what level of living you are trying to maintain. Essential might mean supermarkets, fuel etc, but based on the scenario you described that is not possible, so "sectors" won't really exist the way I see it. It quite rapidly comes down to individual survival - which means access to knowledge and preparing people early through education in school etc, and through creating resilient decentralised communities." [in the context of emphasising we need to understand how to survive in the 'primate' niche we're naturally adapted to]

"… consideration of a larger scale event or more focus on creating community cohesion, given that what we're already trying to do in terms of preparedness and psychosocial response to a natural hazard event would be necessary just at an exponentially larger scale."