WCTR MANIFESTO 2026

Predicting the unpredictable:
Uncertainty as a state of the art in transport research

Authors:

Denise Beil | University of Applied Sciences Upper Austria

Lander Jacobs | University of Antwerp

Mylena Cristine Rodrigues de Jesus | University of Antwerp

Yubing Lei | University of Antwerp

Submitted to the WCTRS 50th Anniversary Manifesto Competition

World Conference on Transport Research

Toulouse, France, July 6–10, 2026

Table of Contents

Denise Beil, Lander Jacobs, Mylena Cristine Rodrigues de Jesus, Yubing Lei

Why 2076? The 50-Year Horizon

Since the first World Conference on Transport Research in 1976 (WCTR, n.d.), transport systems and transport research have undergone profound transformations. These were not short-lived innovations, but long processes that unfolded over decades and continue to shape transport systems, spatial organization, and economic relations today.

One of these influential developments is containerization. Although introduced in the 1950s, its large-scale adoption during the 1960s and 1970s fundamentally reshaped global supply chains (Stopford, 2010). The standardization of cargo units extended far beyond maritime transport, requiring the redesign of vessels, truck and trailer chassis, terminals, and warehouses. These long-term infrastructural investments locked in logistical practices for decades and influenced transport research on freight, networks, and efficiency.

A similar structural shift occurred with the introduction of Global Positioning Systems (GPS) in the 1990s. Real-time positioning enabled new modelling approaches, improved operational control, and led to rapid growth in GIS-based transport research. Shortly thereafter, the emergence of the World Wide Web further connected transport systems, enabling large-scale data exchange and accelerating data-driven research.

These digital foundations contributed to new business models and research domains. Platform-based mobility services, e-commerce, and business-to-consumer logistics reshaped the final stages of supply networks and increased attention to last-mile delivery and urban freight. As a result, urban and city logistics gained prominence within transport research.

More recently, developments such as electric and autonomous vehicles, alternative fuels, artificial intelligence, and big data analytics have further expanded the scope of the field. These innovations highlight not only rapid technological change but also the growing interdependence between transport, energy systems, digital infrastructure, social behavior, and governance.

Despite these advances, innovation and disruption within the transport sector are not slowing down. On the contrary, the next decades are likely to bring even more profound transitions, accompanied by complex challenges related to sustainability, equity, resilience, and system integration. Addressing these challenges increasingly requires a multidisciplinary perspective that combines engineering, economics, social sciences, environmental sciences, and digital technologies.

A 50-year horizon fits the reality that transport systems and their impacts develop over long periods and are largely derived from demand. As demand evolves in response to broader changes, such as economic development, social context, technological progress, and environmental pressures, transport systems must adapt accordingly. Looking at this longer timescale allows transport

research to move beyond short-term goals and reflect on changes that will shape transport in the decades ahead. This manifesto considers how transport research might or even should develop over the next five decades to respond to these evolving demands.

How to Read this Manifesto

This manifesto is intended as a forward-looking document rather than a prediction of specific future outcomes. Its aim is not to forecast how transport systems or transport research will look in 50 years, but to explore how transport research can respond to potential challenges and identify opportunities over the long term. In doing so, it reflects on how a desired future for transport might be actively shaped.

Over the next five decades, both transport systems and transport research will be influenced by a wide range of internal and external factors. At such a timescale, uncertainty is unavoidable, and the precise prediction of disruptive or unexpected events is neither possible nor intended. Rather than treating uncertainty as a limitation, this manifesto uses it as a starting point to reflect on how research can remain responsive to changing conditions.

To structure this reflection, the manifesto is organized around three scenarios based on six key triggers that are expected to shape future transport demand and, consequently, transport systems themselves. These triggers are not considered in isolation, but as interconnected forces that influence and reinforce one another.

Finally, this manifesto should be read as a normative guideline. It combines analysis with reflection to explore how transport research might navigate long-term transitions and uncertainty, without proposing fixed solutions or detailed policy interventions.

Our Team

This manifesto has been developed by a team of early-career transport economics researchers with backgrounds spanning multiple disciplines, including geography, policy studies, economics, and engineering. As PhD candidates, the team members each conduct research in different domains within transport

Denise Beil	Lander Jacobs	Mylena Rodrigues	Yubing Lei
- International Logistics Management - Austria	- Economics - Belgium	- Transportation Engineering - Brazil	- Geography - China

research, contributing complementary perspectives to this collective work.

The perspectives reflected in this manifesto are shaped by the fact that the futures examined are not abstract or distant scenarios. They correspond to transport systems and research environments in which the authors are likely to live and conduct research over the course of their careers. This proximity encourages close attention to long-term developments and to how current research choices may influence future transport systems and research agendas.

While interdisciplinary collaboration provides a broad and integrative foundation, the manifesto does not seek to capture all possible viewpoints or futures. Rather than offering definitive answers, it aims to frame key questions, values, and directions that may guide transport research as it responds to long-term change and uncertainty over the coming decades.

1 Setting the Scene: Designing for Unpredictable Futures

Three scenarios are developed to explore the long-term evolution of the transport system under uncertainty: the Fragmented World, the Drifting World, and the Cooperative World. Each scenario was initially developed through a structured team brainstorming process, which resulted in the construction of Causal Loop Diagrams (CLDs) capturing the key points (see Appendix). Each scenario is constructed based on the interaction of six key trigger categories: climate, geopolitical context, infrastructure, economy, technology, and social dynamics, which evolve in different directions and intensities over time. The

THE FRAGMENTED WORLD

CLD illustrates how reinforcing and balancing interactions between these triggers generate distinct system trajectories.

Since 2020, the global system has been repeatedly disrupted by a succession of diverse and compounding shocks. The decade began with devastating bushfires across Australia and U.S. drone strikes in Iraq, both occurring within the first month of the year (ABC News, 2020; Galbraith, 2020). Within weeks, these disruptions were eclipsed by the rapid global spread of COVID-19, which triggered the first, and potentially not the last, worldwide pandemic of the 21st century and brought much of the global economy to an abrupt standstill (de Oliveira & Tegally, 2023).

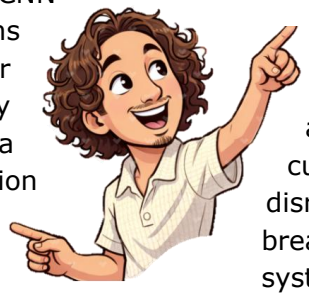
The consequences extended far beyond public health. Periods of lockdown and economic contraction coincided with heightened social unrest, giving rise to widespread protests and new social movements across multiple regions (BBC News, 2020).

Table 1: Short overview of the scenarios

	Phase I: **2026-2035**	*Phase II:* **2035-2055**	*Phase III:* **2040-2060**	*Phase IV:* **2060-2076**
The fragmented world	 Crises cascade & cooperation stalls • Climate shocks • Political tension • No consensus	 Heatwaves & floods hit networks • Modal stress • Vulnerable infrastructure • Limited budget	 Reinforcing loops of decline • Resource crises • Recession ↔ unrest	 Migration & infrastructure collapse • Inequality • Mass migration • Societal collapse
The drifting world	 Disruptions absorbed, not solved • Collaboration • No major shocks • No breakthrough	 Incremental decarbonization • Platform logistics • Resilience is adaptive • Lock-in technology	 Road dominates, rail & IWT lag • Digital and physical divergence • Resilience is reactive	 Partial emissions reduction • Continued vulnerability • Localization
The cooperative world	 Carbon pricing & AI treaty • No major wars • Technology cost reduction	 Wellbeing economy • Human-centered AI • Quantum computing • Institutional cooperation	 Behavioral shift • A-modal booking • Modal shift • Emission reduction	 Net-zero & mobility as a right • Research co-production

At the same time, systematic vulnerabilities became increasingly visible due to recurring cyberattacks, geopolitical tensions and wars, and the re-emergence of terrorism (CNN News, 2023). Disruptions to key chokepoints such as the Red Sea or the Strait of Hormuz underscored the fragility of global supply chains, forcing maritime traffic to reroute around Africa and amplifying delays and costs. In parallel, aviation networks experienced destabilization as strategic hubs, particularly in the Middle East, faced recurring uncertainty.

As the global economy attempted to recover, these overlapping crises generated second-order effects: energy market volatility, inflationary pressures, supply chain fragmentation, and widening socioeconomic inequality (CNN News, 2023). Trade tensions and tariff escalations further complicated recovery trajectories, reinforcing a trend toward fragmentation rather than cooperation (United Nations, 2025).



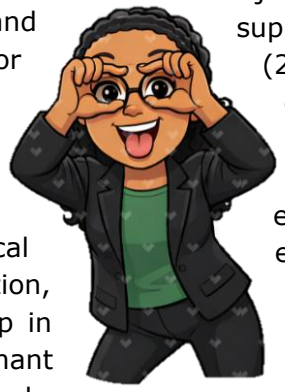
This section develops a fragmented world grounded in the compounding nature of these disruptions. It assumes that mitigation efforts fail or remain insufficient, allowing existing stressors to intensify and interact in destabilizing ways, fragmenting the world. While such an outlook may appear pessimistic, recent developments demonstrate that several of these risk factors are neither hypothetical nor remote. Given the inherent unpredictability of human-driven events, this scenario places greater analytical weight on structural drivers, particularly climate dynamics and geopolitical instability, whose trajectories have been analyzed and effects are still ongoing, respectively.

THE DRIFTING WORLD

The drifting world scenario represents the most likely trajectory, as it reflects the continuation of current trends without major systemic disruptions or transformative breakthroughs. In this world, the global system evolves along its existing path, characterized by gradual adaptation rather than structural change. Global trade continues to expand, although it becomes increasingly regionalized due to geopolitical tensions and risk diversification strategies (UNCTAD, 2022; World Bank, 2020). Supply networks are shifting towards greater resilience, transport systems are becoming more digitally enhanced through the adoption of data-driven technologies and platform-based solutions, but remain fragmented across modes, regions, and institutional frameworks (OECD, 2021; Xu & Chopra, 2023).

The absence of strong triggering events, such as large-scale geopolitical collapse, radical regulatory intervention, or disruptive technological breakthroughs, shapes this trajectory. Instead, incremental adjustments dominate system evolution. The transport sector adapts to increasing environmental, geopolitical, and economic pressures, incorporating technological innovations that improve operational efficiency and support more flexible responses to disruptions (IEA, 2021; OECD, 2021). However, structural challenges persist, including limited interoperability between modes, uneven coordination across

actors, and continued dependence on legacy infrastructure systems (Xu & Chopra, 2023).



In this context, decarbonization progresses, but in an uneven and fragmented manner. The sector faces significant structural and policy-related barriers that hinder a rapid transition to low-carbon systems (Gota et al., 2019). Different technological pathways, including electrification, hydrogen, and biofuels, develop in parallel without a clear dominant solution, while policy frameworks remain moderate in ambition and uneven in implementation (IEA, 2021; OECD, 2021). As a result, emissions reductions occur gradually and vary significantly across regions. Although the system becomes more resilient and capable of absorbing disruptions, it remains largely reactive rather than proactively designed for long-term sustainability (Xu & Chopra, 2023).

Overall, the drifting world leads to a transport system that is more adaptive and digitally advanced, yet still constrained by institutional inertia, infrastructural lock-in, and partial integration. It remains globally connected but increasingly fragmented, with uneven performance across regions and limited alignment with ambitious climate objectives. This trajectory is further supported by findings from Gota et al. (2019) indicating that, under the drifting world conditions, transport demand and emissions may continue to grow beyond current expectations, driven by ongoing economic development, rising mobility demand, and increasing vehicle use.

THE COOPERATIVE WORLD

The cooperative scenario describes a future in which the world of 2076 has successfully navigated the critical tipping points of the 2020s and 2030s, not through technological breakthroughs alone, but through the alignment of governance, human behavior, and institutional cooperation with technological progress. Unlike the previous scenarios, the defining shift lies in the ability of global systems to translate innovation into coordinated action, supported by open trade networks, human-centered artificial intelligence, and effective multilateral governance.

This pathway is triggered by the absence of major geopolitical conflict after 2030, the early implementation of robust and harmonized carbon pricing mechanisms, and relatively fast reductions in the cost of clean technologies. As a result, net-zero emissions are achieved, consistent with the International Energy Agency, which demonstrates that deep decarbonization is technically feasible but requires a complete transformation of energy, transport, and consumption systems (IEA, 2021). Within this context, the transport system becomes fully integrated, decarbonized, and synchromodal, operating as a multimodal network in which decisions are optimized at the system level rather than by individual actors.

This transformation is the result of decades of coordinated and sustained decision-making. Integrated assessment models indicate that transport emissions can be reduced to near zero by mid-century through large-scale electrification, complemented by

hydrogen and sustainable fuels, alongside the deployment of carbon removal technologies to offset residual emissions (Simone Speize et al., 2024). Achieving such a trajectory depends fundamentally on governance rather than technology alone (Robert O. Keohane & Joseph S. Nye Jr., 1973). In this scenario, multilateral institutions are reformed to enable coordinated global frameworks regulating climate action, data governance, infrastructure investment, and cross-border mobility. The World Economic Forum (2025) further underscores that addressing global challenges requires strengthened cooperation, with lessons drawn from past collaboration in areas such as vaccine distribution, scientific research, and renewable energy deployment.

At the economic level, market structures evolve toward collaborative and system-oriented models. Concepts such as the Physical Internet become operational realities, enabling shared infrastructure, interoperable data systems, and system-wide optimization (Simmer et al., 2017). At the same time, the dominant economic paradigm shifts beyond GDP-centered growth toward well-being and circular economy principles, aligning economic activity with social and environmental objectives (Savini, 2024).

Digitalization progresses from operational optimization to a foundational layer of societal organization, with artificial intelligence functioning as a publicly governed infrastructure supporting decision-making across sectors (Dwivedi et al., 2021). Advances in quantum computing enable breakthroughs in complex system optimization, materials science, and logistics planning, while remaining accessible through regulated cloud-based infrastructures rather than being concentrated within a small number of private actors (Müller & Bostrom, 2016).

Moreover, proactive investment strategies address the growing risks associated with climate change, including the potential for significant infrastructure value losses under physical climate stress. Infrastructure is increasingly treated as a global common, planned across borders and supported by coordinated governance frameworks; urban systems integrate nature-based solutions and decentralized energy systems, contributing to climate adaptation and improved quality of life, particularly in rapidly growing regions (WRI, 2026).

Modal shifts toward rail and inland waterways are achieved at scale, supported by carbon pricing, behavioral change, and the widespread adoption of a-modal contracting, enabling logistics networks to optimize for emissions as well as cost and efficiency (Jing et al., 2025). Collaboration between actors becomes standard practice, enhancing flexibility, reliability, and overall system performance. This transformation is reinforced by changes in research and industry practices, where knowledge production becomes more open, collaborative, and impact-oriented, enabling rapid translation of research into practice and ensuring more equitable access to innovation across regions and stakeholders.

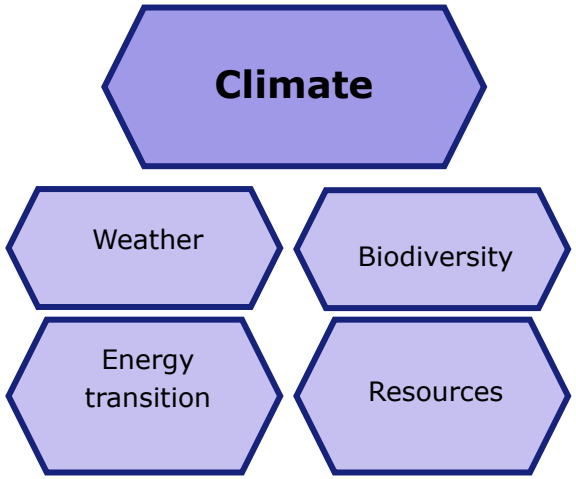
1.1 Key Trigger Categories

The CLD is built on six trigger categories that represent the major systemic forces

shaping global transport and logistics over the next 50 years. Each trigger is formulated as a neutral variable, its direction (positive, negative, or stagnant) determines which scenario unfolds.

CLIMATE

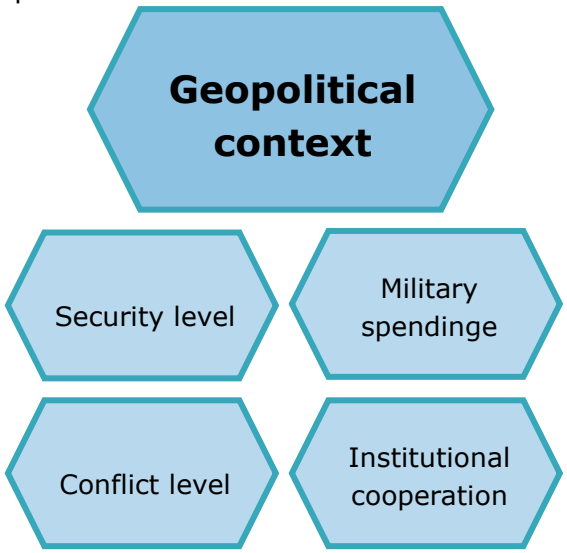
Forces driven by the Earth's changing climate system and humanity's resource base.



- **Weather**
  Frequency and severity of climate-related weather events (storms, heatwaves, floods, droughts), directly affecting transport infrastructure, operability, and reliability
- **Biodiversity**
  State of ecosystems and natural capital; loss undermines nature-based infrastructure solutions and long-term environmental stability
- **Resources**
  Availability of critical raw materials (minerals, water, arable land); scarcity drives conflict, price volatility, and supply chain restructuring
- **Energy transition**
  Pace and scale of the shift from fossil fuels to renewable energy sources; determines decarbonization trajectories across all transport modes

GEOPOLITICAL CONTEXT

The political and institutional landscape governing international relations and cooperation.

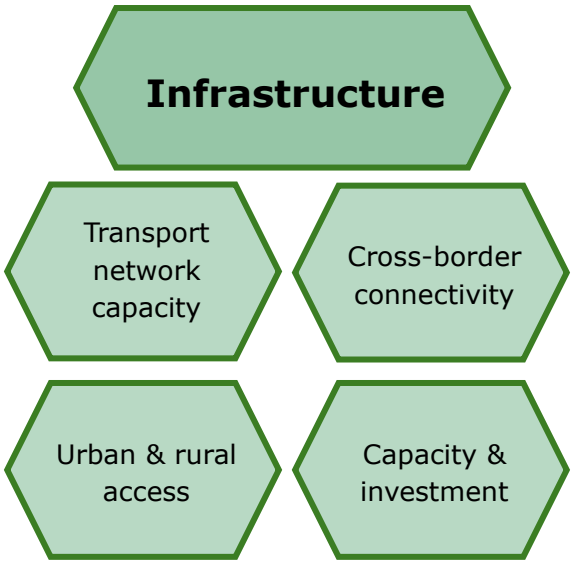


- **Conflict level**
  Intensity of interstate and intrastate conflict; shapes trade routes, defense spending priorities, and cross-border infrastructure investment
- **Security**
  Threat level from terrorism, hybrid warfare, and political instability; affects transport network vulnerability and operational risk
- **Military spending**
  Share of public budgets allocated to defense vs. civilian investment (including transport infrastructure and research)
- **Institutional cooperation**
  Degree of functioning multilateralism and cross-border governance frameworks; the decisive variable separating the cooperative world from the drifting world and the fragmented world.

INFRASTRUCTURE

The physical and digital backbone enabling mobility and freight flows.

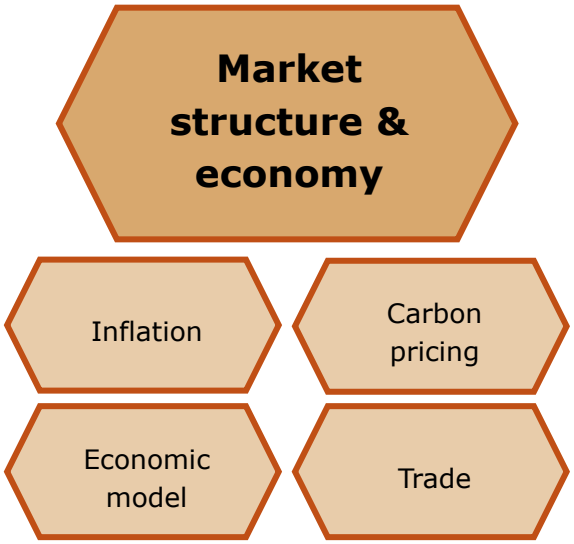
- **Transport capacity**
  Available capacity of road, rail, inland waterway, and maritime networks relative to demand



- **Physical resilience**
  Ability of built infrastructure to withstand climate stress (flooding, heat, erosion); currently underestimated in investment planning
- **Cross-border connectivity**
  Integration level of transnational corridors (e.g., TEN-T); determines interoperability and seamless multimodal operations
- **Urban-rural access**
  Equity of infrastructure provision between metropolitan centers and peripheral regions; critical for social justice outcomes

MARKET STRUCTURE / ECONOMY

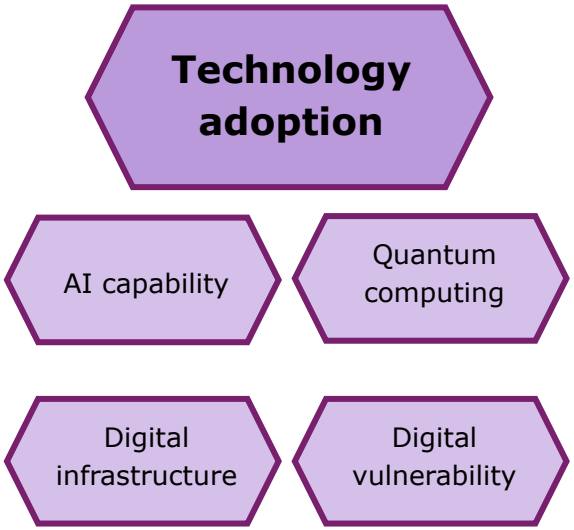
Economic forces shaping trade patterns, market design, and investment logic.



- **Carbon pricing**
  Level and harmonization of carbon costs across jurisdictions; the primary market-based lever for internalizing transport externalities
- **Trade**
  Openness and structure of global trade networks (globalized vs. regionalized vs. fragmented)
- **Economic model**
  Dominant paradigm governing growth logic (GDP-driven growth vs. wellbeing economy vs. post-growth); determines investment priorities and success metrics
- **Inflation**
  Price stability and purchasing power; affects infrastructure investment capacity and freight demand patterns

TECHNOLOGY ADOPTION

Pace, governance, and accessibility of technological change.



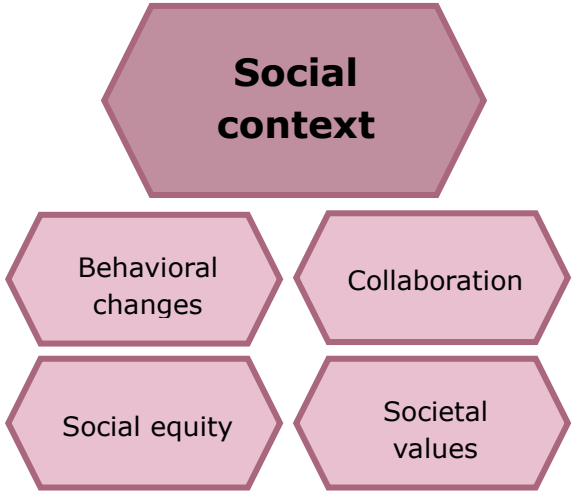
- **AI capability**
  Maturity and deployment scope of artificial intelligence in transport planning, logistics optimization, and autonomous systems

- **Quantum computing**
  Availability of fault-tolerant quantum computation for intractable optimization problems (network design, materials science)
- **Digital infrastructure**
  Quality and coverage of data networks, IoT sensors, and digital twin platforms underlying smart transport systems
- **Data governance**
  Regulatory frameworks for data sovereignty, algorithmic transparency, and interoperability; determines whether digitalization serves public or private interests

SOCIAL CONTEXT

Societal attitudes, equity, and behavioral dynamics shaping transport demand and acceptance.

- **Behavioral change**
  Willingness of shippers, consumers, and citizens to adopt new mobility patterns (e.g., a-modal booking, mode-free contracts)
- **Collaboration level**
  Degree of horizontal cooperation between competing actors (shippers, LSPs, modes); prerequisite for synchromodality and the Physical Internet



- **Social equity**
  Distribution of mobility access, environmental burden, and economic opportunity across income groups, genders, and regions
- **Societal values**
  Prevailing cultural orientation toward individualism vs. collective action, consumption vs. sufficiency; shapes political feasibility of transformative policies

1.2 Key Outcomes by Scenario

The outcomes observed in each scenario are therefore directly shaped by how these underlying triggers interact over time, as shown in Table 2.

Table 2: Triggers of the scenarios	**The fragmented world**	**The drifting world**	**The cooperative world**
Climate	• Frequent and extreme weather events • Loss of biodiversity and vulnerable ecosystems • Unclear energy transition, remaining coal and fossil fuel-based • Depletion of natural resources	• Moderate increase in disruptions • Ongoing but uneven energy transition • Growing pressure on resources	• Stabilized climate impacts • Ecosystem recovery • Rapid and complete energy transition • Sustainable resource management
Geopolitical	• Increased terrorism and political unrest • Higher military spending • International unrest and continuing conflicts • Weakening cooperation	• Persistent tensions and regional conflicts • Moderate military spending • Partial cooperation • Fragmented global governance	• Low conflict levels • Reduced military focus • Strong institutional cooperation • Effective global governance
Infrastructure	• Deterring integration • Capacity vulnerability • Inaccessibility	• Incremental upgrades • Capacity constraints remain • Partial cross-border integration • Uneven accessibility	• High capacity and resilience • Fully integrated networks • Strong cross-border connectivity • Accessibility
Economy	• Trade wars and tariffs • Inflation and losing purchasing power • Patriotism and independence	• Regionalized trade • Moderate carbon pricing • Stable but constrained purchasing power	• Open but resilient trade • Strong, harmonized carbon pricing • Wellbeing / circular economy • Stable and inclusive growth
Technology	• Cyber attacks • Privatization of data and infrastructure	• Gradual digitalization • Uneven access to advanced technologies • Mixed data governance (public + private)	• Advanced AI and quantum systems • Equitable access to technology • Strong public data governance • Human-centered digitalization
Social	• Individualism • Inequality • Polarization	• Moderate behavioral change • Partial collaboration • Persistent inequality • Mixed societal values	• Strong behavioral change • High collaboration levels • Reduced inequality • Collective and sustainability-oriented values

Table 3: Outcomes of the scenarios	**The fragmented world**	**The drifting world**	**The cooperative world**
Climate	• Severe disruptions (warming >1.5°C) • Resource stress and ecosystem collapse	• Increasing disruptions • Partial emission reductions	• Net zero achieved • Stabilized climate and ecosystem recovery
Geopolitical	• Political conflicts and wars • Trade fragmentation • Resource competition	• Increasing disruptions • Partial emission reductions	• Strong global cooperation • Reformed institutions • Stable, open trade systems
Infrastructure	• Infrastructure collapse • Network disruptions • Underinvestment	• Incremental upgrades • Persistent bottlenecks • Partial integration	• Resilient, green infrastructure • Fully integrated networks • Global accessibility
Economy	• Instability and declining trade • Localized economies	• Regionalized trade • Moderate growth • Supply chain diversification	• Circular/wellbeing economy • Open but resilient trade • Inclusive growth
Technology	• Digital vulnerability • Limited innovation diffusion	• Gradual digitalization • Uneven access • Platform concentration	• Advanced AI and quantum • Public digital infrastructure • Human-centered governance
Social	• Inequality increases • Migration pressures • Social instability	• Moderate inequality • Partial behavioral change	• Social equity improved • Universal mobility access • High collaboration

2 What does this Mean for Transport Research over the Next 50 Years?

The various future worlds presented in this manifesto do not tell us what the future will look like. They are a structured acknowledgement that the world transport research and planning serves is genuinely uncertain. Transport research has historically been built around a single assumed future: demand would grow, institutions would function, technology would improve, etc. That assumption is no longer defensible. Climate stress, geopolitical fragmentation, technological disruption, and shifting social values do not move on predictable schedules. A field designed for certainty is a field underprepared for the world it will actually face.

"Why is preparing for certainty unrealistic?"

Our goal is therefore twofold. First, to **build a transport research community that is genuinely prepared for all possible scenarios**, one that can maintain essential mobility under stress, accelerate transformation when conditions allow, and remain analytically useful regardless of which future arrives. Second, to **actively use research to nudge the world toward a better condition**. The triggers in this manifesto are not all beyond human influence. Institutional cooperation, behavioral change, governance quality, and research capacity are variables the research community shapes: through the questions it asks, the partnerships it builds, and the evidence it places in front of decision-makers. This means using research to interrupt the compounding forces that lead toward fragmentation. It also means building in advance the governance models, behavioral evidence, and institutional designs that the cooperative world requires but does not yet have. Transport research that does this, is not describing a better future. It is helping to construct one.

2.1 Three Principles Guiding the Future

This section outlines the core principles that should guide future research. While not rigid rules akin to research integrity standards, these principles are meant to be widely shared and actively embraced, as they are essential for avoiding the emergence of a fragmented world and for fostering pathways towards a more cooperative global future.

A. Design Research for Uncertainty, not for a Single Future

Current transport research tools were built to perform well under stable assumptions, such as cost-benefit frameworks, demand models, and accessibility indices. The problem is that stability is one scenario, not a given future. When infrastructure investment decisions are evaluated against a single demand trajectory, accessibility is measured as a snapshot rather than as vulnerability to loss, and resilience is treated as a secondary criterion after efficiency, the field is underpreparing for the range of futures it will actually face. Uncertainty-literate research does not mean abandoning rigor. It means being explicit about assumptions, testing findings across divergent conditions, and building models that reveal their own limits.

B. Prepare for Collapse, Build for Cooperation

Knowing that uncertainty exists is not enough if research investment remains concentrated on the middle trajectory. The fragmented world requires knowledge that does not yet exist, for example, systematic frameworks for maintaining essential mobility when infrastructure budgets collapse, supply networks fragment, or climate stress renders existing routes inoperable. The cooperative world requires governance models, behavioral evidence, and institutional designs that are not yet operational. The knowledge needs to be built in advance.

C. Equity is not a Best-Case Luxury

Distributional outcomes do not improve automatically when the scenario improves. In the fragmented world, mobility loss concentrates among those with the fewest alternatives. In the drifting world, decarbonization costs fall unevenly across regions and income groups. Even in the cooperative world, the path to integrated networks runs through investment decisions that can entrench or reduce existing inequalities depending on how they are made. Equity requires deliberate research attention in every future, built into research design from the start rather than appended as an impact assessment.

2.2 Five Research Directions for the Uncertain Future

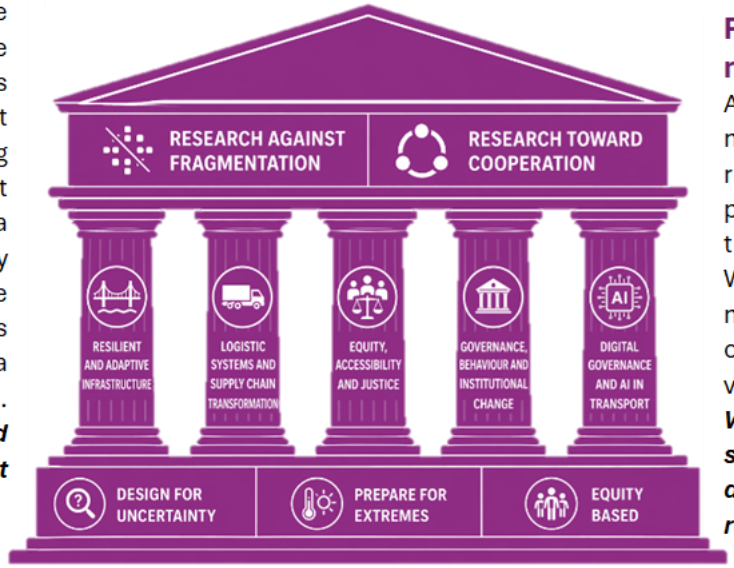
The following five research directions translate the principles above into concrete agendas. **Each direction is relevant across all three worlds**, though the specific questions, urgency, and methods will shift depending on how the triggers unfold. Together, they define what an uncertainty-literate transport research community must prioritize over the next fifty years.

RD1: building infrastructure for unpredictable futures

Transport infrastructure is designed for the world we expect. The scenarios in this manifesto show why that is no longer sufficient. In the fragmented world, infrastructure must survive fiscal collapse, climate stress, and geopolitical disruption. In the drifting world, it must adapt incrementally to growing climate impacts while managing legacy lock-in. In the cooperative world, it must integrate across borders and modes at a scale never yet achieved. Across all three, the underlying research gap is the same: current investment appraisal tools evaluate infrastructure against a single demand trajectory and systematically undervalue resilience. New frameworks are needed that assess infrastructure value across divergent scenarios, making robustness a primary criterion alongside expected return. ***How do we build and govern adaptable and sustainable infrastructure systems that remain functional and equitable?***

RD2: transforming logistics and supply networks beyond efficiency

In the fragmented world, supply networks must operate under conflict, resource scarcity, and trade fragmentation: requiring regionalized modelling, critical resource logistics, and geopolitical risk integration that current methods do not systematically address. In the drifting world, multimodal optimization and platform logistics advance incrementally but remain siloed. In the cooperative world, the Physical Internet and synchromodal contracting become operational realities, but only if the governance architecture that makes system-wide optimization commercially and politically viable is built in advance. ***How can supply networks be designed and governed to be resilient, cooperative, adaptive, and capable of creating shared value?***



RD3: measuring and protecting mobility as a right

Across all three worlds, some people lose access to mobility first and recover last. Current accessibility research largely measures average system performance, obscuring the distributional outcomes that determine who benefits and who is left behind. What is needed are scenario-sensitive accessibility metrics that capture vulnerability to mobility loss, not only current connectivity, but also identifying the vulnerable households, regions, and communities. ***Who loses mobility first when systems come under stress, and what research, policy, and institutional designs can ensure that access to movement remains a right rather than a privilege?***

RD4: governing transport systems and shaping behavior

The trigger framework in this manifesto identifies institutional cooperation and behavioral change as the decisive variables separating the drifting world from the cooperative world. Research is needed on ***what governance structures allow competing logistics actors to share capacity and data without losing commercial viability; on what behavioral conditions enable large-scale modal shift beyond individual nudges and pilot programs; on how multilateral transport governance frameworks can be designed to survive geopolitical stress rather than collapse under it?***

RD5: governing AI and digital infrastructure for public benefit

AI and digital infrastructure exist in all three worlds. In the fragmented world, digitalization is privatized and weaponized, with data as a strategic asset rather than a shared resource. In the drifting world, AI optimizes individual operations without systemic benefit, and governance frameworks lag behind deployment. In the cooperative world, AI is publicly trusted to function as a publicly governed infrastructure: transparent, accountable, and aligned with societal goals across regions and actor types. ***How do we govern AI and digital infrastructure in transport so that technological capability translates into collective benefit?***

3 Concluding Remarks

The five research priorities outlined above are not separate programs. They are interconnected, as interconnected as the scenarios they are meant to shape. Resilient infrastructure cannot be designed without governance frameworks to maintain it. Logistics transformation requires behavioral evidence to succeed. Equity cannot be retrofitted once systems are built. Each priority depends on the others.

In 1976, transport researchers gathered for the first World Conference on Transport Research because they believed that knowledge could improve the systems that move people and goods across the world. That belief has not aged. Over five decades, it has deepened, shaped by the recognition that transport is not merely a technical domain, but a social, political, and environmental one.

Fifty years later, the conference convenes again in Toulouse. The purpose is not to celebrate what has been built, but to ask what must be built next.

Transport systems are not machines to be optimized. They are expressions of collective choices: about who has access and who does not, who bears the cost and who benefits, who is included and who is left behind. They reflect decisions about whether to build for resilience or to optimize for efficiency, whether to govern technology or to let technology govern us. These are not questions that models alone can answer. They are questions that require research communities to engage with governance, with equity, and with the societies they serve.

The future of transport cannot be predicted. But it can be shaped, by the questions researchers choose to ask, by the communities they include, by the governance they help build, and by the research priorities they set today.

Five decades lie behind us. The next fifty lie ahead. Transport research stands at a fork in the road. What we do and how we act, is up to us.

AI Declaration

In line with the WCTR Ethical Declaration requirements, we transparently disclose the tools and resources used in the production of the video. All conceptual work, scenario development, and manifesto content were produced by the registered team members. AI tools were used as production aids, not as authors.

1. Concept and Script Development: The underlying ideas, scenario framework, research principles, and narrative structure were developed collaboratively by the four team members through group discussions and iterative drafting. AI tools (large language models) were used to support brainstorming, structure refinement, and language editing. All intellectual content, argumentation, and conclusions remain the original work of the team.

2. Video Voice-Over: The voice-over narration was generated using **Artlist AI** (text-to-speech). The spoken text itself was written by the team.

3. Visual Material: Video footage was sourced from two channels:

- **Stock footage** from Artlist, used under their standard royalty-free license.
- **AI-generated video clips produced with Google Veo**, used selectively where suitable stock footage was unavailable or where a specific visual was needed to illustrate a scenario.
- **Still images and visual elements** were generated in part using **Nano Banana** (Google Gemini image generation).

4. Music: Background music was obtained from royalty-free sources via Artlist under their standard license.

5. Editing, Typography, and Post-Production: All video editing, color grading, typography, on-screen text, motion graphics, and final composition were carried out by the team using **DaVinci Resolve**.

6. Authorship Statement: All creative decisions, including scenario logic, research directions, narrative arc, and visual framing, were made by the team. AI tools served as production support (voice synthesis, stock-alternative visuals, language polishing, brainstorming aid) and were not used as authors of the manifesto's ideas, arguments, or conclusions. The manifesto and its video representation are original works of the team.

References

ABC News. (2020, January 10). Australia fires photos show startling transformation before and after destruction. ABC News. https://www.abc.net.au/news/2020-01-11/australian-bushfires-photos-before-and-after/11854888

BBC News. (2020, August 17). Belarus protests: Workers boo Lukashenko as election unrest spreads. https://www.bbc.com/news/world-europe-53796436

CNN News. (2023, June 15). Exclusive: US government agencies hit in global cyberattack | CNN Politics. CNN. https://www.cnn.com/2023/06/15/politics/us-government-hit-cybeattack

de Oliveira, T., & Tegally, H. (2023). Will climate change amplify epidemics and give rise to pandemics? Science, 381(6660), eadk4500. https://doi.org/10.1126/science.adk4500

Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A., Galanos, V., Ilavarasan, P. V., Janssen, M., Jones, P., Kar, A. K., Kizgin, H., Kronemann, B., Lal, B., Lucini, B., … Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International Journal of Information Management, 57, 101994. https://doi.org/10.1016/j.ijinfomgt.2019.08.002

Galbraith, J. (2020). U.S. Drone Strike in Iraq Kills Iranian Military Leader Qasem Soleimani. The American Journal of International Law, 114(2), 313–323.

Gota, S., Huizenga, C., Peet, K., Medimorec, N., & Bakker, S. (2019). Decarbonising transport to achieve Paris Agreement targets. Energy Efficiency, 12(2), 363–386. https://doi.org/10.1007/s12053-018-9671-3

IEA. (2021, May 18). Net Zero by 2050 – Analysis. IEA. https://www.iea.org/reports/net-zero-by-2050

Jing, H., Chen, Y., Ma, M., Feng, W., & Xiang, X. (2025). Unlocking global freight transport decarbonization potential: Role of modal shifts. Transportation Research Part D: Transport and Environment, 148, 105025. https://doi.org/10.1016/j.trd.2025.105025

Müller, V. C., & Bostrom, N. (2016). Future Progress in Artificial Intelligence: A Survey of Expert

Opinion. In V. C. Müller (Ed.), Fundamental Issues of Artificial Intelligence (pp. 555–572). Springer International Publishing. https://doi.org/10.1007/978-3-319-26485-1_33

OECD. (2021). Development Co-operation Report 2021: Shaping a Just Digital Transformation. OECD Publishing. https://doi.org/10.1787/ce08832f-en

Robert O. Keohane & Joseph S. Nye Jr. (1973). Power and Interdependence. Survival. https://www.scribd.com/document/807260730/Power-and-Interdependence

Savini, F. (2024). Post-Growth, Degrowth, the Doughnut, and Circular Economy: A Short Guide for Policymakers. Journal of City Climate Policy and Economy, 2(2), 113–123. https://doi.org/10.3138/jccpe-2023-0004

Simmer, L., Pfoser, S., Grabner, M., Schauer, O., & Putz, L.-M. (2017). From horizontal collaboration to the physical internet—A case study from Austria. International Journal of Transport Development and Integration, 1(2), 129–136. https://doi.org/10.2495/TDI-V1-N2-129-136

Simone Speize, Jay Fuhrman, Laura Aldrete Lopez, Mel George, Page Kyle, Seth Monteith, & Haewon McJeon. (2024). Integrated assessment modeling of a zero-emissions global transportation sector.

Stopford, M. (2010). Maritime economics (3e ed). Routledge. https://logistics.nankai.edu.cn/_upload/article/50/93/1cf2097840e8af90af4b19979773/9ce547df-a3e1-493c-a4a3-0ebbfe0669b9.pdf

UNCTAD. (2022). Review of Maritime Transport 2022. https://unctad.org/rmt2022

United Nations. (2025). Global economic outlook worsens amid trade conflict and policy uncertainty.

WCTR. (n.d.). WCTR 2026 | World Conference on transport research. Retrieved 8 April 2026, from https://www.wctr2026.fr/

World Bank. (2020). World Development Report 2020: Trading for Development in the Age of Global Value Chains [Text/HTML]. World Bank. https://www.worldbank.org/en/publication/wdr2020

World Economic Forum. (2025). The Global Cooperation Barometer 2025.

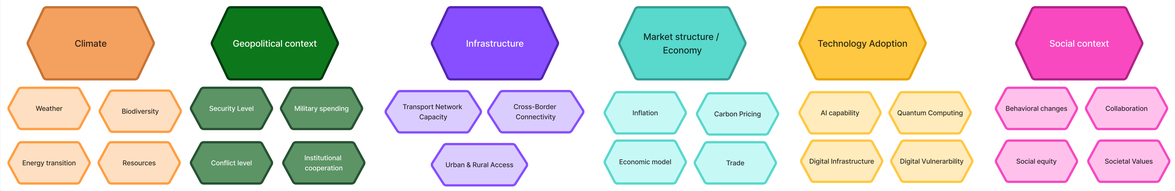
WRI. (2026). Seven Transformations for More Equitable and Sustainable Cities. https://publications.wri.org/r25ab12f8

Xu, Z., & Chopra, S. S. (2023). Interconnectedness enhances network resilience of multimodal public transportation systems for Safe-to-Fail urban mobility. Nature Communications, 14(1), 4291. https://doi.org/10.1038/s41467-023-39999-w

Appendix

KEY TRIGGERS

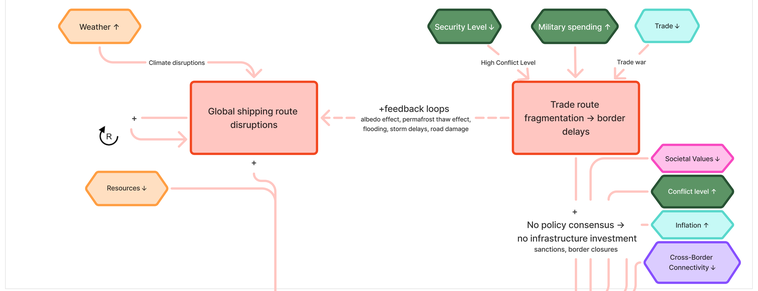
The CLD is built on **six trigger categories** that represent the major systemic forces shaping global transport and logistics over the next 50 years. Each trigger is **formulated as a neutral variable**, its direction (positive, negative, or stagnant) determines which scenario unfolds.



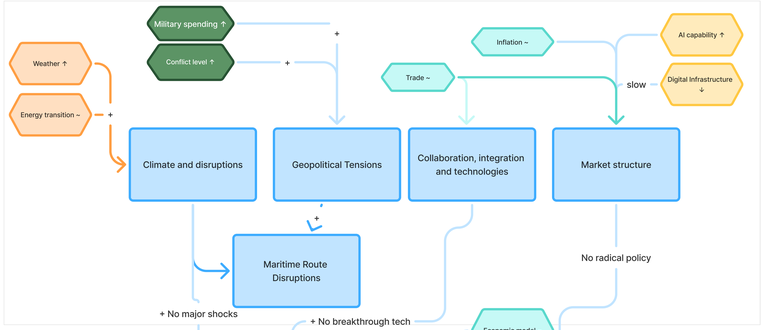
STARTING POINT – Crises of the 2020s

Solid arrows = direct causal impact
Dashed arrows = feedback / cross-branch reinforcement
R1 = reinforcing loop
Climate · Geopolitics · Infrastructure · Economy · Technology · Social

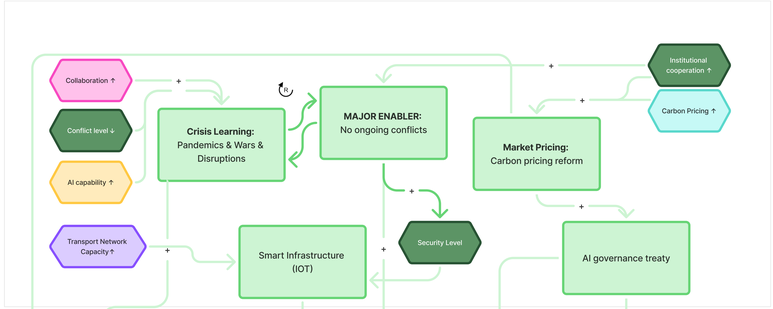
Bad scenario – 2025 to 2035



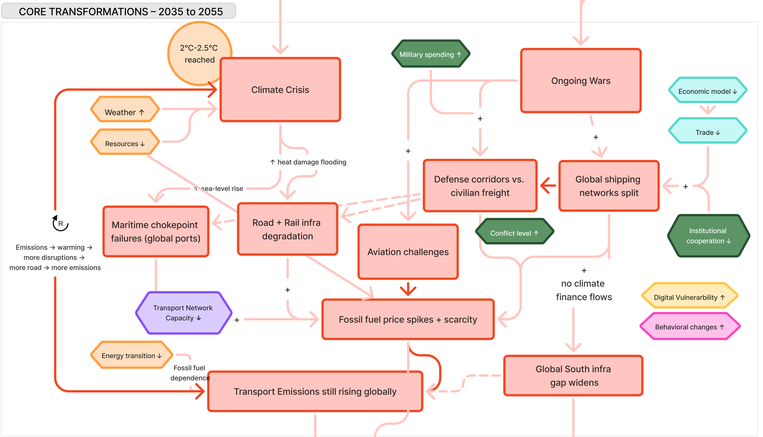
Business as usual scenario – 2025 to 2035



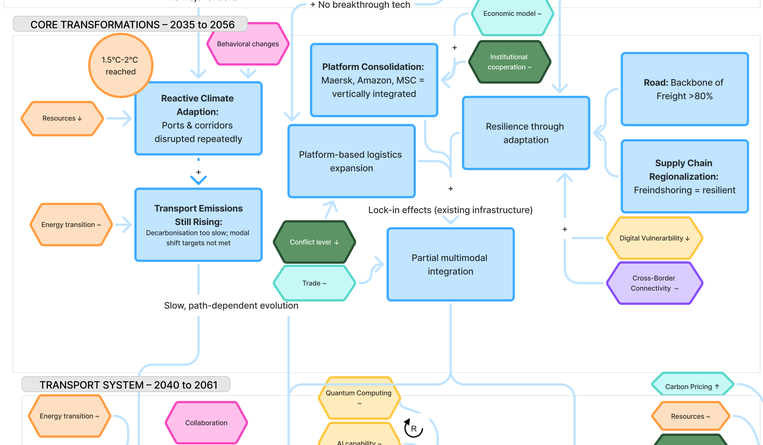
Good scenario – 2025 to 2035



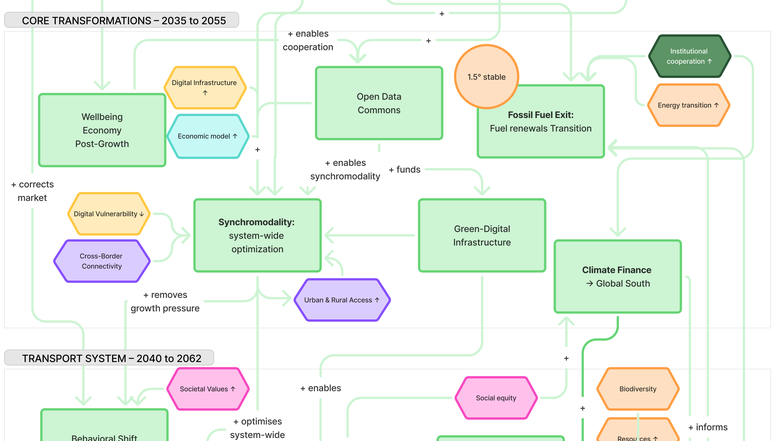
CORE TRANSFORMATIONS – 2035 to 2055



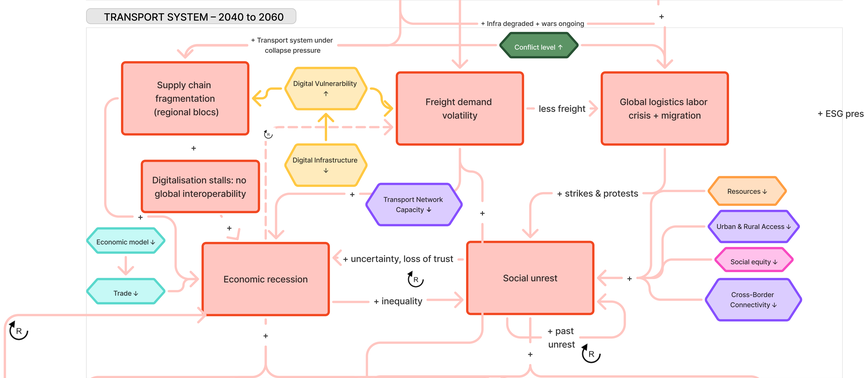
CORE TRANSFORMATIONS – 2035 to 2056



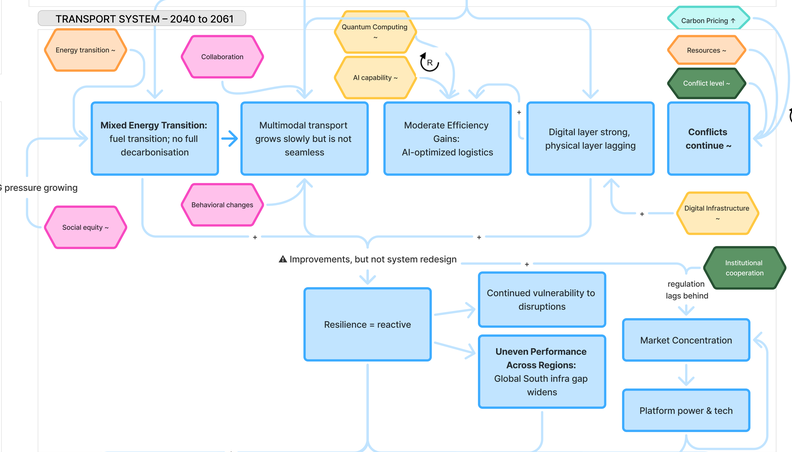
CORE TRANSFORMATIONS – 2035 to 2055



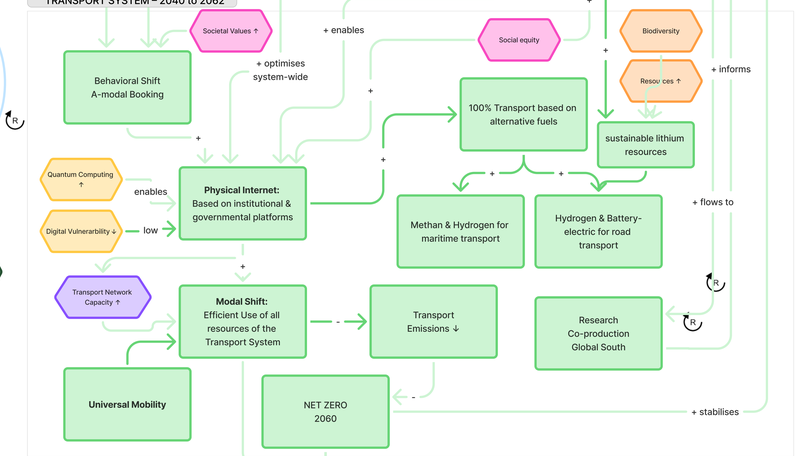
TRANSPORT SYSTEM – 2040 to 2060



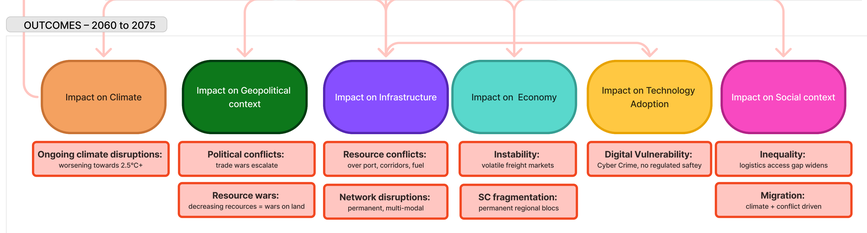
TRANSPORT SYSTEM – 2040 to 2061



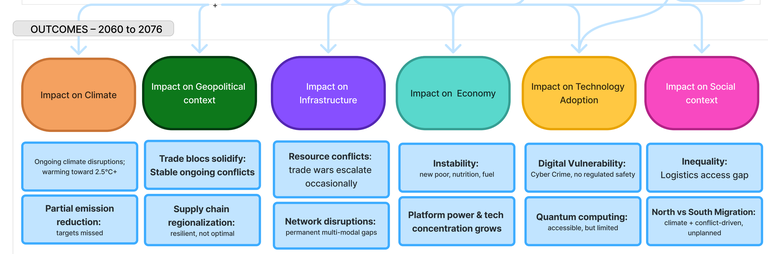
TRANSPORT SYSTEM – 2040 to 2062



OUTCOMES – 2060 to 2075



OUTCOMES – 2060 to 2076



OUTCOMES – 2060 to 2077