

The Next Food-as-a-Service Approach for
Independent Hospitality Sector

DESIGNING THE SWEET SPOT



Zareen Tse

Image generate by Midjourney

DESIGNING THE SWEET SPOT

Exploring how Food-as-a-Service systems can balance economic survival, social good, and ecological sense for small - medium size Quick Service Food Establishments (QSFEs) in Toronto



By Zareen Tse

Submitted to OCAD University in partial fulfillment of the requirements for the degree of Master of Design in Strategic Foresight & Innovation.

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Parantap Bhatt
MRP Advisor

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Abstract

This research explores how emerging technologies can support Toronto's Quick Service Food Establishment (QSFE) SME (Small and Medium Enterprises) in adopting circular economy practices to tackle key sustainability challenges such as excessive food waste, slow digital adoption, and shifting regulatory landscapes.

Focusing on the intersection of technology, business resilience and urban food systems development, the study explores how digital tools can help small food businesses transition toward more regenerative models while remaining economically viable. A mixed-methods approach combining design thinking and strategic foresight grounded in Dator's Four Futures framework was used to conduct user research, stakeholder analysis, and systems mapping to identify root causes and future opportunities.

The research proposes a Food-as-a-Service (FaaS) model that leverages shared infrastructure, AI-enabled local production, and blockchain-driven transparency to reduce waste, engage consumers, and lower operational costs. A backcasting framework charts a realistic pathway toward 2035, aligning technological shifts with policy evolution and behavioural change.

By connecting speculative futures to grounded design interventions, this research demonstrates how foresight-driven strategies can inform actionable, scalable solutions for circular food systems, starting in Toronto and extending to other urban environments navigating similar transitions.

Keywords: Circular Economy, Smart Food System, Strategic Foresight, Innovation Business Model, Digital Transformation

Land Acknowledgement

As a guest on this land, I acknowledge that I live, learn, and create on the traditional territory of many nations, including the Mississaugas of the Credit, the Anishnabeg, the Chippewa, the Haudenosaunee, and the Wendat peoples, which is now home to many diverse First Nations, Inuit, and Métis communities. Toronto is covered by Treaty 13, signed with the Mississaugas of the Credit, and the Williams Treaties signed with multiple Mississaugas and Chippewa bands.

I recognize that the histories, cultures, and contributions of Indigenous peoples are deeply woven into this land, and that their stewardship continues today. As a newcomer to these lands, I commit to listening, learning, and building meaningful relationships rooted in respect, reciprocity, and responsibility. I understand that I have an active role to play in advancing reconciliation and contributing to a more just, inclusive, and sustainable future for all.

I offer my sincere respect and gratitude to the Indigenous peoples who have cared for this land for thousands of years, and I honor their enduring legacy and knowledge.

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Executive Summary

Toronto's QSFE (Quick Service Food Establishments) sector faces a critical challenge in transitioning from its fragmented linear system to a sustainable circular economy model without access to municipal subsidies or rural land resources available to programs. The research presents a methodological framework which combines systems thinking with strategic foresight and human-centred design to create scalable solutions for SMEs (small and medium enterprises) who struggle to balance sustainability demands with economic survival.

Design-Led Methodological Innovation

Rather than applying traditional siloed approaches to sustainability challenges, this research pioneers an integrated design methodology that reveals opportunities invisible to conventional analysis:

- Systems Mapping & Causal Loop Analysis: Visualizing the interconnected barriers trapping SMEs in unsustainable practices identified four key reinforcing feedback loops and their strategic intervention points.
- Strategic Foresight Through Alternative Futures: Using Dator's Four Futures framework to project multiple 2035 scenarios revealed divergent pathways and unexpected opportunities, particularly in Food-as-a-Service (FaaS) models.

Transformative Solution Architecture

The research reveals how the Food-as-a-Service (FaaS) model can serve as a transformative platform for circular food systems. The proposed architecture includes

Shared Infrastructure, AI-driven ordering platforms that optimize resource use across multiple establishments while dramatically reducing waste. Hyperlocal Production Networks with technology-enabled local farming and production systems that minimize transportation emissions while providing fresher ingredients. Blockchain-Enabled Transparency that create consumer engagement through verifiable sustainability metrics and community credit systems.

The solution architecture addresses both operational and experience design, creating seamless interactions between physical and digital touchpoints across the food ecosystem. The resulting implementation framework presents a phased transformation strategy with specific intervention points and metrics to achieve circular practices as the industry standard.

Implications for Design Practice

The last part of the research demonstrates how design strategy can bridge sustainability objectives with economic imperatives by framing circular economy transitions as design opportunities and creating symbiotic relationships between technology innovation and human experience. Through this integrated approach, Toronto can become a global leader in circular food innovation while providing a replicable model for similar urban centres worldwide.

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Introduction

Context & Background

Research Question & Objectives

Context & Background

Definition and Context of QSFES in Toronto's Urban Food System

Quick Service Food Establishments (QSFES) refer to food service businesses that provide fast food and minimal table service, falling under NAICS code 722512 (Limited-Service Eating Places). These establishments typically offer:

- Limited menus: These businesses serve food that they have already made or create fast when customers place their orders.
- Food prepared in advance or prepared quickly upon ordering
- Food served in disposable containers
- Payment generally expected before eating

In Toronto, the QSFE sector includes fast-food restaurants and quick-service cafés as well as food court vendors, takeaway shops, small pizzerias and sandwich shops which all focus on delivering fast service.

According to Statistics Canada (2022), small to medium enterprises represent more than 95% of Canadian food service businesses in Toronto with each operation having less than 100 employees. These SMEs significantly impact Toronto's food infrastructure by serving affordable and fast meals to thousands of patrons each day while generating revenue of approximately CAD 20 billion every year and supporting over 150,000 positions throughout Ontario according to Restaurants Canada (2023).

Tensions Between Traditional Operations and Sustainability Imperatives

QSFES contribute substantially to the economy but they struggle significantly with financial difficulties. According to Restaurants Canada (2024) findings, 62% of Canadian eateries function at a loss or manage to stay barely solvent which represents a substantial increase compared to pre-pandemic data. The current unstable financial state has forced most QSFE owners to focus on conventional operational practices which emphasize short-term

survival instead of planning for long-term sustainability.

Most SMEs follow a linear "take-make-dispose" business model which generates substantial food waste and single-use packaging alongside inefficient resource use that contradicts emerging sustainability requirements. The existing operational approach which appears necessary for immediate survival creates a gap between business goals and environmental responsibilities.

Why the City Needs a New Food System?

Because their businesses present everywhere and have extensive reach, QSFE SMEs serve as ideal agents for systemic change throughout Toronto's food network. Current financial limitations prevent QSFE SMEs from actively participating in sustainability transitions because these activities seem to be either too costly or disruptive to their operations. The city must develop new business frameworks which combine technological advancements with circular economy values to fill existing system deficiencies. These business models should incorporate sustainability into enhanced operational efficiency and strengthened business resilience instead of treating it as a competing priority. Integrating intelligent systems including AI, IoT, and blockchain can help decrease inefficiencies while enhancing transparency and creating shared infrastructures that yield environmental and economic benefits.

Toronto is potential to exploring innovative food service systems that balance business success with urban sustainability objectives. If the QSFE sector redefines its focus from meeting compliance requirements to recognizing business opportunities, it will become a key player in developing scalable circular systems.

Research Question & Objectives

Primary Research Question

How can intelligent systems facilitate the adoption of circular food principles in Toronto's small Quick Service Food Establishments (QSFES) within the city's urban context?"

The study explores the potential of AI, IoT, and blockchain technologies to implement circular practices including waste reduction and resource reuse in small fast food businesses across Toronto. Through the lens of Food-as-a-Service (FaaS) as an integrative framework, this research offers methods that enhance environmental outcomes and economic resilience while building social flexibility within Toronto's competitive urban food service market.

Research Objectives

Strengthen Business Resilience:

Assess how intelligent systems can simultaneously improve SME operational performance while helping them manage supply chain disruptions, labor shortages, and economic pressures.

Design for Systemic Change:

Investigate how ecosystem-level design approaches using modern technologies can develop sustainable business practices throughout Toronto's food service sector while creating collaborative advantage.

Uncover Barriers and Design Opportunities:

Identify challenges to technology adoption through human-centered research and demonstrate economically viable integration methods tailored to the unique constraints of small businesses.

Develop the FaaS (Food as a Service) Framework:

Create a comprehensive Food-as-a-Service framework with SME-targeted implementation plans that connect technology solutions with Toronto's sustainability aims and real-world operational demands.

The research merges advanced innovation with practical sustainability approaches to provide actionable solutions that will transform Toronto's small restaurants into a circular ecosystem prepared for the future.



Literature Review

Circular Economy in Food Systems

Technical Foundation: Intelligent Systems for Circularity

Circular Food Systems in Policy Frameworks

Socio-Technical Transitions: Applying the Multi-Level Perspective (MLP)

Quick Service Food Establishments of small to medium size in Toronto face tough business conditions similar to other SMEs around the world where daily operational survival and profitability stand as their main objectives. Sustainability initiatives become secondary priorities which compete against limited available resources and attention within this context (Dora et al., 2020; Saidani et al., 2019). Current research shows that circular economy models which are customized to suit food service SMEs operational conditions can effectively tackle business viability as well as environmental sustainability issues together.

The Ellen MacArthur Foundation [EMF] (2023) reports that the circular economy (CE) model has become a popular global sustainability framework for separating economic growth from resource usage and waste production. Toronto's QSFE sector can reduce operational costs by adopting circular approaches that enhance resource efficiency and build resilience to supply chain challenges while meeting consumer demand shifts. Implementing practical and financially sustainable operational models from these advantages proves difficult especially for independent entities that possess scarce financial resources and limited digital skills.

The circular food system implementation in Toronto's QSFE industry depends on strategic guideline development. The implementation of circular food systems requires a comprehensive transformation that includes business model innovation and digital infrastructure upgrades within supportive policy environments and behavioral adjustments to match business needs. This study analyzes how multiple elements

interact within the unique environment of small food service businesses operating under financial constraints.

Although major foodservice chains have started to implement circular methods using sophisticated logistics and smart systems, independent QSFEs encounter structural and financial barriers along with digital capacity issues that hinder their ability to adopt these practices. Recent studies demonstrate that intelligent CE solutions have largely ignored SMEs within the food industry even though these companies play a crucial part in both urban food systems and waste management (Ghisellini et al., 2016).

This review synthesizes existing research across four interconnected domains: This research review evaluates four interrelated areas including circular economy theory within food systems and SME-aligned sustainable business models along with technical intelligent systems and supportive policy frameworks for transition. This review evaluates the four interconnected domains to discover opportunities and gaps for developing context-specific circular solutions that support Toronto's diverse QSFE needs while achieving sustainability gains.

Circular Economy in Food Systems

The circular economy establishes sustainable methods that transform the classic "take-make-waste" economic model into a regenerative system which enhances resource efficiency and minimizes waste while keeping materials in continual economic circulation (Ellen MacArthur Foundation, n.d.). Circular food systems necessitate inventory management improvements to reduce food waste as well as food waste recovery through methods such as composting, redistribution, upcycling and local sustainable sourcing. The Ellen MacArthur Foundation (n.d.) delivers a strong foundational framework that incorporates three essential principles.

Design Out Waste and Pollution:

Businesses can prevent waste generation through improved inventory management and procurement practices.

Keep Products and Materials in Use:

Managing food waste involves implementing composting programs and upcycling waste materials while redistributing surplus food.

Regenerate Natural Systems:

The Ellen MacArthur Foundation promotes sustainable agriculture alongside local sourcing while supporting biodiversity and natural resource renewal.

These principles play a significant role in shifting the global approach towards sustainable food systems. The EMF's Cities and Circular Economy for Food report presents a framework where soil receives nutrient restoration while smart supply chains decrease food waste and cities transform into centers that regenerate resources (EMF, 2022).

Moreover, the ReFED Roadmap to 2030 in the United States demonstrates tangible proof of

CE's potential through real-world initiatives. The ReFED study from 2021 found seven essential interventions including standardized date labelling and food donation platforms that can reduce national food waste by 50% before 2030. EIT Food executed multiple pilot projects for circular food systems throughout Europe which confirmed that decentralized composting and alternative protein cycles along with surplus redistribution logistics can function effectively in both urban and rural environments (EIT Food, 2023). The organization implements supply chain interventions to address food waste while developing sustainable circular food systems that integrate production, distribution, consumption, and waste management (EIT Food, 2023).

The strategic principles and frameworks for food system interventions exist in abundance but there is minimal research available regarding their practical application within fast-paced urban food enterprises that operate with limited resources. Many models are designed based on the assumption of scalable infrastructure availability or capital reserves which Toronto's QSFE SMEs typically do not possess. Current studies show a significant void in knowledge regarding CE adaptation to SME settings with constraints such as limited space, variable customer populations, and restricted back-end storage and processing capabilities. To fill this gap we need to connect CE theory with SME-focused business design which we examine in the next section.

Technical Foundation: Intelligent Systems for Circularity

AI-Enabled Circular Supply Chains

AI-Enabled Circular Supply Chains

Food service operations stand to greatly benefit from AI and blockchain intelligent systems because they enable resource circularity by transforming allocation and redistribution processes. Small QSFE businesses in Toronto require special designs for these technologies to handle limited historical data and adapt to the rapidly shifting consumer preferences originating from the city's diverse demographics.

The OECD (2019) reported that AI and blockchain digital technologies can substantially boost connectivity and intelligence within infrastructure systems such as agriculture and food logistics. Recent work by Sánchez-García et al. The research of Sánchez-García et al. (2024) shows how AI enables real-time consumption monitoring while facilitating rapid production changes and resource efficiency throughout product lifecycles to support sustainable food systems.

Deloitte's 2023 industry forecast introduces a three-phase digital maturity model called Illuminate, Optimize, and Orchestrate that explains how restaurants can progressively establish self-driving supply chains. Although big food chains have started using advanced technologies such as RFID tracking and AI for demand planning to cut waste and logistics costs smaller QSFEs struggle because they lack funds and are dependent on unreliable third-party logisticians.

Still, these constraints open up design opportunities. We should see intelligent systems as modular tools that we can adapt to meet SMEs' specific requirements and capabilities instead of viewing them as distant cutting-edge innovations. According to OECD (2019), blockchain technology helps unlock infrastructure value through step-by-step solutions which smaller businesses can access. Similarly, Sánchez-García et al. According to Sánchez-García et al. (2024), effective circular systems depend on technological progress being paired with community integration to achieve not only operational effectiveness but also social utility and collective sustainability benefits.

Technical Architecture: Designing for Modularity & Scalability

Building intelligent systems for SMEs demands unique design strategies which differ from the approaches used for large enterprises. QSFE SMEs require modular and interoperable designs instead of full enterprise solutions because these systems allow gradual implementation that matches their financial and operational circumstances. Studies show that successful implementation of technology by SMEs requires an incremental strategy that starts with precise solutions for particular operational difficulties (Dora et al., 2020).

However, Toronto's independent restaurants face multiple structural barriers such as operational system data silos and limited technology platform standardization in addition to outdated POS systems that lack

modern integration features. Careful evaluation of technical architecture and optimizing user interfaces along with customized implementation pathways is essential to create solutions that SMEs can use to overcome existing constraints.

Technology Capabilities: Human-Centred System Design for SMEs

AI Applications:

Designing for Limited Data Contexts

AI systems do not require advanced technology to produce values. Many small scale AI integrations have demonstrated potential to cut down inventory waste by 20–25% while delivering clear advantages without requiring complex systems (Dora et al., 2020). Toronto QSFE SMEs that are newly established and lack more than two years of historical data find typical AI models inaccessible. Design solutions should focus on being simple to implement while ensuring they remain adaptable and affordable. Transfer learning together with lightweight models makes reliable forecasting feasible in scenarios with limited data availability. New findings by Sánchez-García et al. The research by Sánchez-García et al. (2024) shows that these models can enhance resource use efficiency and improve circular operations using minimal historical data which makes them indispensable in environments lacking extensive data.

Blockchain Implementation:

Designing for Collaborative Adoption

Blockchain shows potential when implemented across shared infrastructure

systems. Saberi et al. (2019) reported SMEs achieve up to 60% cost savings through blockchain system collaboration which demonstrates the effectiveness of cooperative business models. Therefore, For Toronto's food entrepreneurs, this means designing participatory platforms that build on existing networks rather than asking each business to implement standalone systems. Transparency, auditability, and process automation—core features outlined by the OECD (2019)—can be achieved more accessibly when technical complexity is stripped back without compromising trust.

Still, barriers remain. According to Sánchez-García et al. (2024), organizations face continuous difficulties including system legacy integration problems, insufficient technical expertise in their personnel and regulatory frameworks that fail to keep pace with new technological developments. To overcome these obstacles businesses need to develop user-friendly interfaces alongside SME-centered training programs and work cooperatively with local governments to create supportive policies. Technology can enable circular food system transformation when system design matches the everyday realities of QSFE owners.

Food Systems in Policy Frameworks

Toronto's QSFE SMEs could benefit from circular food systems but current policies lack practical and specific assistance for small, fast-paced food businesses. The national programs A Food Policy for Canada and Love Food Hate Waste Canada (Agriculture and Agri-Food Canada, 2023; National Zero Waste Council, 2023) demonstrate sustainable goals yet they do not provide direct operational paths or funding solutions specifically designed for food service businesses.

By contrast, the Our Food Future initiative in Guelph-Wellington demonstrates the integration of intelligent technologies within policy frameworks to produce concrete results by redirecting over 10,000 tonnes of food waste through collaborative community and business programs (National Zero Waste Council, 2023; Circular Innovation Council, 2022). Toronto possesses an excellent opportunity to establish a comparable system because of its organic waste systems like the Green Bin program and its location near Ontario's agricultural centers (City of Toronto, 2022).

Toronto's current circular economy policy structure lacks the extensive SME-targeted initiatives seen in international cities such as Amsterdam and Copenhagen (OECD, 2021; Ellen MacArthur Foundation, 2019). Although grants and subsidies exist, they do not usually support intelligent circular technologies like AI-driven waste analytics and IoT monitoring systems—technologies which provide significant benefits to SMEs. The adoption of new technologies faces additional difficulties because of regulatory complexity across municipal, provincial, and federal levels (Environment and Climate Change Canada, 2023) while inadequate training and technical

support obstruct implementation progress (Federation of Canadian Municipalities, 2023).

Nonetheless, there are signs of alignment. QSFE SMEs could achieve environmental and economic benefits through the use of digital tools as demonstrated by findings from the Canada Plastics Pact (2022) and Circular Innovation Council case studies (2023). Appropriate design strategies enable SMEs to connect policy goals with practical operations.

Yet, existing academic and policy research seldom examines how small independent QSFE enterprises in complex multicultural urban settings can apply circular economy strategies together with business model innovation and digital transformation. Current frameworks presume advanced infrastructure availability and neglect the specific resource restrictions and need for flexibility within Toronto's food sector.

The absence of practical strategies reveals a need for innovative design approaches that apply CE principles to everyday business practices. The research methodology that follows demonstrates our response to this need using systemic inquiry methods and scenario exploration alongside participatory prototyping with SMEs.

Socio-Technical Transitions: Applying the Multi-Level Perspective (MLP)

To further ground the strategic implications of circular transition, the research explores from the Multi-Level Perspective (MLP) developed by Geels (2002). MLP conceptualizes how large-scale socio-technical transitions unfold across three interrelated levels: landscape, regime, and niche. These levels interact over time, shaping the conditions under which new systems emerge and incumbent structures either adapt or decline.

In the context of Toronto's QSFE sector, they refer to:

- Landscape refers to broad, external forces such as urbanization, climate change, and policy shifts like Toronto's Circular Economy Roadmap. These slow-moving pressures set the context for change but are beyond the control of individual actors.
- Regime represents the dominant system—including entrenched business models, regulatory structures, financial institutions, and cultural norms. In Toronto's QSFE landscape, the regime manifests in the form of linear operations, tight profit margins, short-term survival logic, and limited access to tailored policy support.
- Niches are protected spaces where radical innovations can develop outside the pressures of the dominant regime. This research positions Food-as-a-Service (FaaS) as a niche innovation—one that combines shared infrastructure, digital platforms, and AI-driven sustainability to demonstrate alternative modes of operation.

By developing the FaaS framework across the MLP layers, we can better understand how to support its growth. FaaS does not replace the regime in a short period, it evolves through strategic interventions, supported pilots and aligned landscape shifts such as regulatory reform or public demand for transparency. MLP thus informs not only how to analyze current challenges, but also how to plan sequenced action, nurturing niche spaces (2025–2027), nudging regime shifts (2028–2031), and responding to landscape alignment (2032–2035).

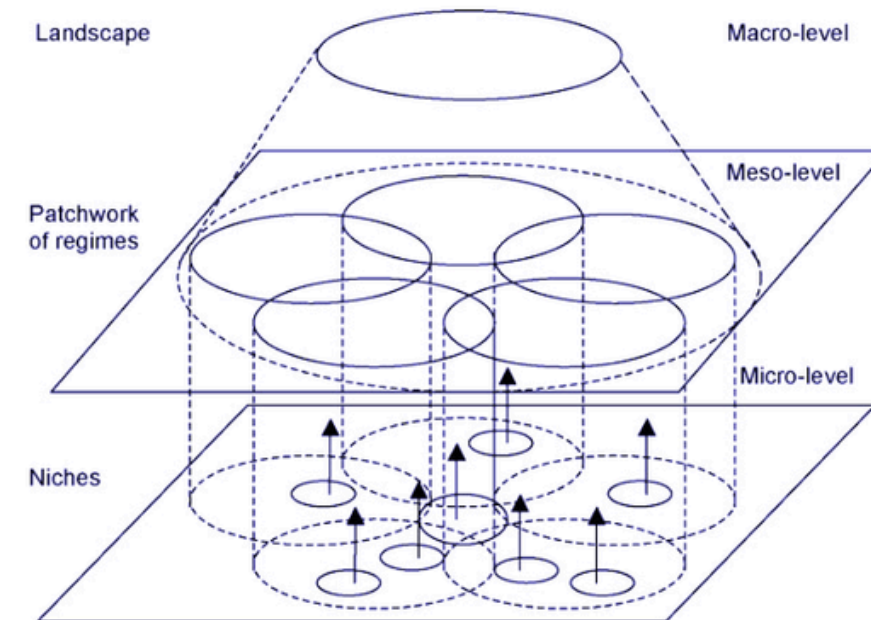


Fig.1: Multi-level framework for the analysis of socio-technical transitions. Source: Adapted from Geels (2002).



Research Methodol- -gies

User Research

Understanding the System

Developing Plausible Futures

A Strategy-Led Mixed Methods Approach

The study uses a design strategist's perspective to examine the systemic obstacles that small Quick Service Food Establishments in Toronto face when adopting circular food practices. The approach combines systems thinking, user research and strategic foresight to discover deep-rooted limitations and develop context-specific solutions through co-creation. This research investigates how business innovation along with circular economy principles and intelligent technologies can merge to facilitate transformational change in small and medium enterprises.

At this core, I use mixed-methods and human-centred approaches to understand SME owners and customers' real-world experiences while integrating systems-level analysis and speculative design techniques. The methodology unfolds in three integrated layers:

User Research uncovers both emotional and operational challenges encountered by small food businesses and their customers during sustainability implementation and technology integration.

Systems Thinking maps interdependencies across the QSFE ecosystem, surfacing leverage points and reinforcing loops that constrain circular transitions.

With Dator's Four Futures framework, it explores foresight and scenario planning to examine potential development paths for Toronto's QSFE sector toward 2035 landscape while addressing the systemic barriers surfaced in the early research phases, empower SMEs and policymakers to discover new risks and tensions while revealing hidden opportunities that would have remained unseen. While these scenarios broaden the horizon of what could happen, speculative design approach offers a directional guide for desirable outcomes while these scenarios expand the potential range of future events. The interventions aim to create potential futures while stimulating discussions that guide stakeholders toward better decisions.

To support both engagement and decision-making, the study combines AI-assisted storytelling for creating immersive scenario narratives with data visualizations that make systemic patterns clear and interactive tools for initiating stakeholder conversations to enhance decision-making and engagement. These methods enable participants to experience findings through interaction which makes complex systems more understandable and actionable.

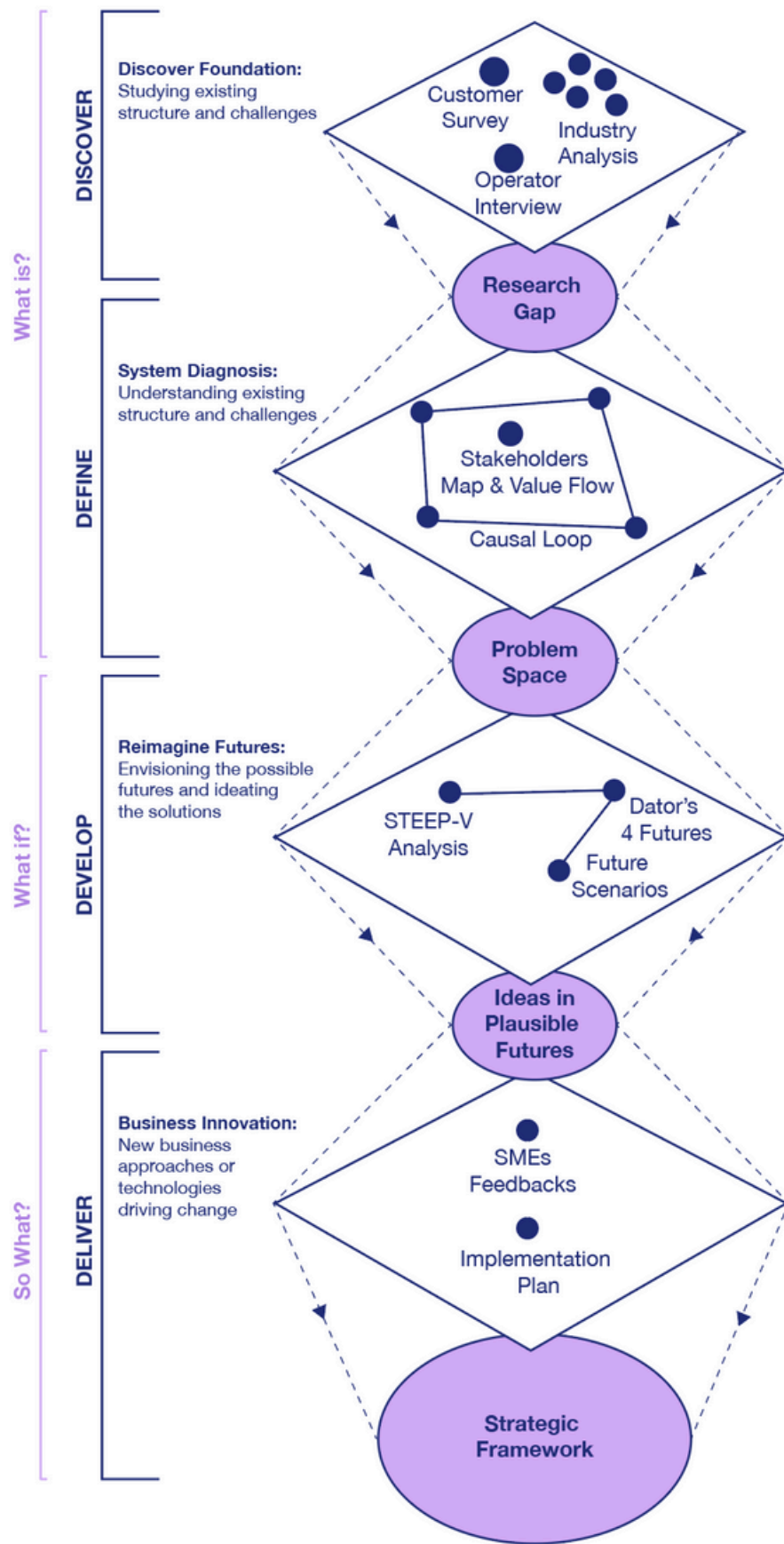


Fig.2: Research process diagram illustrating the methodological approach. Diagram created by author.

User Research

User research includes consumer online survey, operator interviews and concept tests, forms the foundational element of this study, employing multiple methods to explore the real-world experiences of Toronto QSFE SMEs.

Consumer Survey

The survey with 50 Toronto consumers generated quantitative data on quick-service food establishments' sustainability practices while examining future customer preferences. The survey consisted of six crucial sections.

Demographics:

Data collection included respondent age brackets (18-55+), education attainment levels, and how often they visited coffee shops and fast-food restaurants

Patronage Patterns:

Gathered data on factors influencing venue choice (quality, price, location, atmosphere) and types of establishments frequented (chain vs. independent).

Sustainability Awareness:

The research evaluated respondents' understanding of sustainability matters specific to the industry such as waste management and energy efficiency along with ethical sourcing practices water conservation and packaging solutions.

Knowledge of Local Practices:

The study evaluated how well individuals understood sustainability actions taken by nearby businesses.

Sustainability Importance:

Evaluated the importance of sustainability in consumer decision-making, including willingness to pay premium prices (5-15% more).

Future Preferences: Explored preferences among four future scenarios (Tech-Driven, Hyper-Personalized, Sustainable & Circular, Community Hub) and specific features desired.

Survey data was analyzed through a structured process involving:

- Frequency analysis of categorical variables to identify dominant trends in behavior and preferences
- Likert scale analysis of sustainability importance and awareness metrics
- Cross-tabulation to identify relationships between demographic characteristics and sustainability attitudes
- Thematic coding of open-ended responses regarding desired sustainability practices and communication preferences

SME Operator Interviews

QSFE operators provided insights into operational challenges and opportunities through twelve in-depth onsite interviews. The research team deliberately chose participants through purposive sampling to achieve representation across different business types, geographic locations within Toronto, business sizes and maturity levels, and current sustainability engagement levels.

Business type (coffee shops, noodle restaurants, bakeries, pizza restaurants, boba tea bars, Italian cuisine)

Geographic location within Toronto

Business size and maturity

Current level of sustainability engagement

Interview data was analyzed through:

- Transcription and systematic coding of responses
- The thematic analysis method was used to uncover common patterns and difficulties.
- Integration with survey findings to identify areas of alignment and divergence between consumer demand and operator capability.

Concept Testing: SME Operator Feedback

After building the framework, a structured concept testing was deployed to determine solution feasibility. Operators used a 1-5 scale to express their interest levels for different circular business model options. The ideas were selected from the plausible future scenario.

Subscription-based models

Shared food service platforms

Digital dining credits

Zero-waste meal kits collaboration

Automated inventory systems

Government-subsidized sustainable logistics

Innovation food hubs

The concept testing data was analyzed by:

- Calculating mean scores and standard deviations for each concept
- Identifying correlations between business characteristics and concept preferences
- Qualitative analysis of operator feedback on implementation barriers
- Prioritization of concepts based on combined feasibility and impact scores

Onsite Interviews and Observations



Fig 3, Appendix H. A 10+ year-old Asian takeaway restaurant. Students and residents are their key customers. Photo by author.



Fig 4, Appendix H. A new barista rents a shared space to run market tests during weekends. Photo by author.



Fig 5, Appendix H. A shared kitchen space available for lease in west downtown Toronto, with optional equipment rentals. Photo by author.



Fig 6, Appendix H. A shared fridge used by multiple businesses in the unit. Photo by author.

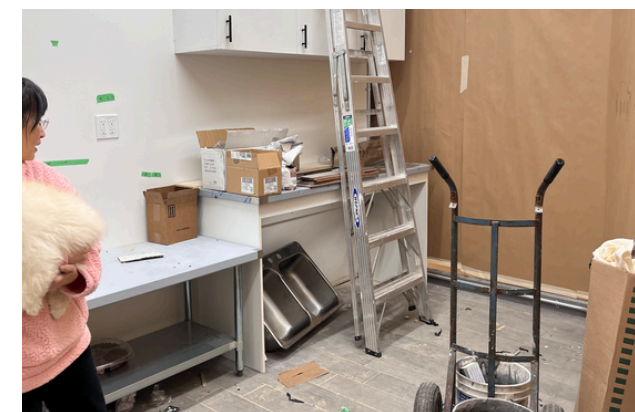


Fig 7, Appendix H. A new ramen restaurant owner checking renovations. Photo by author.

Understanding the System

The process builds directly from secondary research and user research findings to deliver a comprehensive view of Toronto's QSFE ecosystem by using three interconnected analytical methods.

Stakeholder Analysis

A stakeholder analysis was conducted using the power-interest matrix framework. This approach helped identify key actors, assess their relative influence, and map the nature of their engagement in the transition toward circular food systems.

The process began with stakeholder identification, drawing from both literature review and primary interview data. Stakeholders were then categorized within a 2x2 power-interest matrix, enabling a clear visualization of which groups hold decision-making power, who has a stake in sustainability outcomes, and where leverage or resistance might arise. All the actors are connected to visualize stakeholder relationships while identifying four distinct value flow types.

By combining the stakeholder map and value flow, we can see the understanding of hierarchy and lateral relationships among stakeholders, which establishes a complete basis for system leverage point identification.

Causal Loop Diagram

Developing causal loop diagrams was the method used to analyze and reveal the underlying systemic barriers to sustainability in Toronto's QSFE sector

through systems thinking. The selected method allowed stakeholders to visualize the complex network of relationships that influence small food businesses' ability to implement circular practices.

The process involved:

- The analysis identified major factors through both interview and survey data collection.
- Mapping causal relationships between those variables
- Highlighting reinforcing and balancing feedback loops
- The diagrams demonstrated four linked reinforcing loops which maintain sustainability obstacles.

The loops highlight critical tensions within the system caused by operational restrictions combined with inadequate capital resources and insufficient market recognition. The analysis revealed strategic leverage points which well-placed interventions like targeted policy incentives and consumer education can exploit to produce significant positive outcomes for circularity adoption.

Developing Plausible Futures

The final methodological phase utilized strategic foresight techniques to develop actionable pathways, building directly upon the system understanding developed in the previous phases.

Integrated STEEPV x Iceberg Scan

The research deployed a STEEPV horizon scan combined with the four-layer Iceberg Model of systems thinking to reveal the forces influencing Toronto's QSFE landscape.

The STEEPV sweep approach involved collecting signals from six domains including Social, Technological, Economic, Environmental, Political and Values/Culture followed by colour-coding for quick visual analysis.

Through horizontal structuring each signal received an initial classification as either Event, Pattern/Trend or Structure to identify which drivers present immediate flashes and which demonstrate longer-term momentum. After vertical layering in the Iceberg model the same signals were distributed throughout the Iceberg's depth.

Events – observable happenings

Patterns & Trends – recurring signals indicating momentum

Structures – policies, infrastructures, and market logics that shape the patterns

Mental Models represent the deep-seated beliefs and assumptions which maintain structural stability.

The combined insights from STEEPV's broad view and the Iceberg's deep analysis

would deliver a comprehensive understanding of change while tracing contemporary events to the hidden structure of the food system.

Scenario Development with Dator's Four Futures

According to the STEEP-V analysis, the signals are exported to plausible futures and built the scenarios.

Growth: Market-driven expansion, deeper digital integration

Collapse: Economy, supply-chain shocks disrupt food access

Disciplined Society: Regulation pushes strict sustainability compliance

Transformation: Community-centred circular economy reshapes ownership and value

Each future was written as an immersive “day-in-the-life” narrative of a QSFE owner, translating systems insights into stories stakeholders can feel and debate.

Future Cone and Backcasting for Implementation Plan

The Future Cone diagram displayed each scenario along a spectrum ranging from plausible possibilities to preferable outcomes. Through back-casting exercise, researchers examined the steps backwards from 2035 to 2025, which SMES can pilot these quick-start business model modifications.

Through this integrated approach, the research delivers concrete outcomes that bridge today's realities with tomorrow's possibilities while remaining grounded in the lived experiences of Toronto's food service operators.



Research Findings & Analysis

Current Landscape of QSFE Industry

The Interconnected Map

Identifying the Systemic Barriers

Current Solutions in Canada

This section explores the QSFE industry in Toronto through a comprehensive analysis of the current market landscape, key challenges and emerging trends. Understanding the operational context of QSFE businesses is crucial for identifying opportunities where technological innovation, particularly AI-driven solutions, can address critical pain points and enhance sustainability.

The analysis draws on both secondary research from industry reports and primary research conducted through interviews with QSFE operators across Toronto. By triangulating multiple data sources, this section aims to provide an accurate portrayal of the industry's present state while highlighting areas where strategic intervention could yield significant improvements in both business performance and environmental outcomes.

Current Landscape of QSFE Industry

Quick-service outlets are woven into almost every Toronto streetscape, from high-volume chains on Yonge Street to single-counter pizzerias in suburban plazas. More than 95 % are small- and medium-sized enterprises, preparing thousands of budget-friendly meals each day and operating on the classic “order-pay-go” model. Their lean format—limited seating, rapid turnover, heavy reliance on takeaway—makes them agile trend-responders yet also leaves them exposed to razor-thin margins, labour shortages, and supply-chain shocks. Because these businesses sit at the crossroads of culture, convenience, and entry-level employment, understanding their day-to-day constraints is essential to any effort to embed circular practices in Toronto’s food system.

Economic Contribution

Quick-service restaurants in Canada are predicted to achieve CAD 44.69 billion in sales revenue for 2024 which marks a 5.3% increase from the previous year and constitutes the largest portion of commercial foodservice earnings. Spending in restaurants drives substantial spillovers: Each Canadian dollar spent in restaurants generates CAD 0.80 in additional economic activity through indirect means, creating an overall economic impact of CAD 1.80 (Restaurants Canada, 2024). The industry generates approximately CAD 26 billion in federal, provincial, and municipal taxes every year at scale which demonstrates why policymakers see QSFEs as key economic drivers for local development. (Restaurants Canada, 2024).

Restaurants are Canada's leading gateway to employment. The sector employs 1.2 million workers which represents 6% of national workforce total and creates more than 520,000 positions for young people who compose one-fifth of youth employment (Restaurants Canada, 2024). Locally, momentum is visible: The Accommodation & Food Services sector in Toronto expanded by 10,220 jobs during 2024 which represents a 9.5% yearly increase making it the second highest among all NAICS sectors (City of Toronto, 2024). The labour intensity of 17.6 jobs per CAD 1 million in output which exceeds twice the average for all industries makes QSFEs a crucial point for promoting inclusive growth and circular-economy solutions to protect local supply chains and livelihoods (Restaurants Canada, 2024).

Social and Cultural Relevance

QSFEs function as both economic catalysts and important social entities. Time-pressured students, professionals, and families depend more on quick meals at grab-and-go counters in urban environments. They also serve as cultural ambassadors: QSFEs make global cuisines accessible and affordable to Toronto's multicultural population through the city's food scene.

These establishments serve as vital community centres. These establishments are situated in transit-connected high-traffic zones that help create lively streetscapes and enhance the public's sense of safety because of their extended service hours alongside substantial pedestrian activity (City of Toronto, 2024). QSFEs serve as essential food providers in lower-income neighbourhoods where full-service restaurants are unavailable.

Despite facing challenges like labour shortages and rising costs, the sector remains a pivotal starting point for broad system transformation through its adaptive capabilities. Through its unique convergence of affordability and cultural diversity with user convenience Toronto's QSFE sector becomes an effective proving ground for the development of circular business systems and smart technologies designed to address the specific challenges faced by small businesses.

Key Challenges: Critical Hurdles Facing Toronto's Food Service Entrepreneurs

Toronto's QSFE SMEs operate in a fiercely competitive market shaped by operational inefficiencies, tight margins, shifting consumer preferences, labour shortages, and stringent regulations. Because most ordering, forecasting, and inventory checks are still manual, perishable stock is frequently over-purchased and wasted—hurting both profits and the environment. Early pilots demonstrate that AI vision systems can cut waste by double digits (e.g., Winnow Vision reduced food waste by 35 % in just twelve weeks; see § 6.1.3), showing the technology is becoming financially viable even for small operators. Yet high-energy equipment, limited urban square footage, and unreliable cash flow still make it hard for SMEs to invest in sustainability upgrades, despite growing public demand for eco-conscious dining options.

Operation insights :

Interviews with QSFE owners (Appendix B) confirm these day-to-day pain points. Respondents repeatedly cited “finding a chef,” “attracting customers,” “sourcing reliable suppliers,” and “high staff turnover with no time for training.” Limited floor space—especially in food courts and compact storefronts—adds further strain. One coffee-shop owner summed up the first six months of trading as a constant battle to “promote the brand and calculate costs,” with environmental concerns ranking far below

basic survival. Owners also stressed the need for government incentives to offset the cost of green initiatives; location choices were driven more by short-term rent discounts or personal connections than by long-term sustainability.



Financial and workforce pressures:

The wider Canadian food service sector faces a dire workforce shortage, with 100,000 vacant positions reported in early 2024, reducing Toronto restaurants' operational capacity to 80%. Financially, the situation has worsened, with 62% of establishments reporting losses or barely breaking even in 2024, compared to just 10% pre-pandemic (Restaurants Canada, 2022). Besides, the emerging business cloud / shared kitchens offer a potential remedy with reduced operational costs, yet their high initial capital requirements—ranging from CAD 7,310 to CAD 10,965, with monthly expenses possibly hitting CAD 5,699 in downtown Toronto pose significant barriers for many SMEs. These estimates, though unverified, align with Toronto's costly market dynamics.

Consumer behaviour:

This factor adds another layer of complexity. Young Canadian adults exhibit strong support for sustainable practices like ethical sourcing and waste reduction, yet limited food literacy stifles broader adoption. My survey of 50 Toronto consumers (Appendix C) revealed that more than 60% would pay more for sustainable options (Fig. 8,9), presenting SMEs with opportunities to differentiate through transparent labelling and local sourcing.

Would you be willing to pay more from a restaurant with strong sustainability practices?

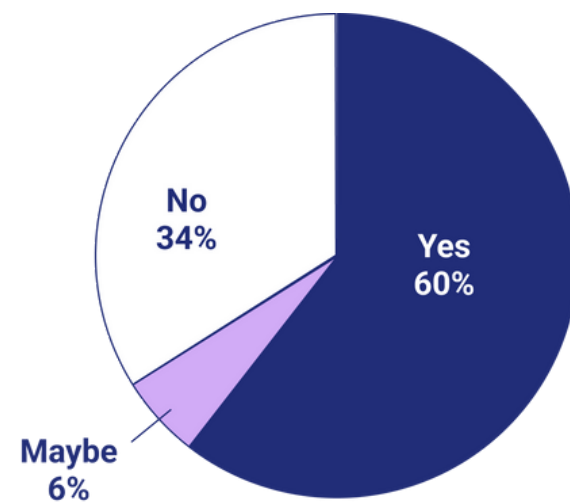


Fig 8. Willingness to pay more for sustainable practices at restaurants. Based on data collected by author.

If yes, how much will you pay more?

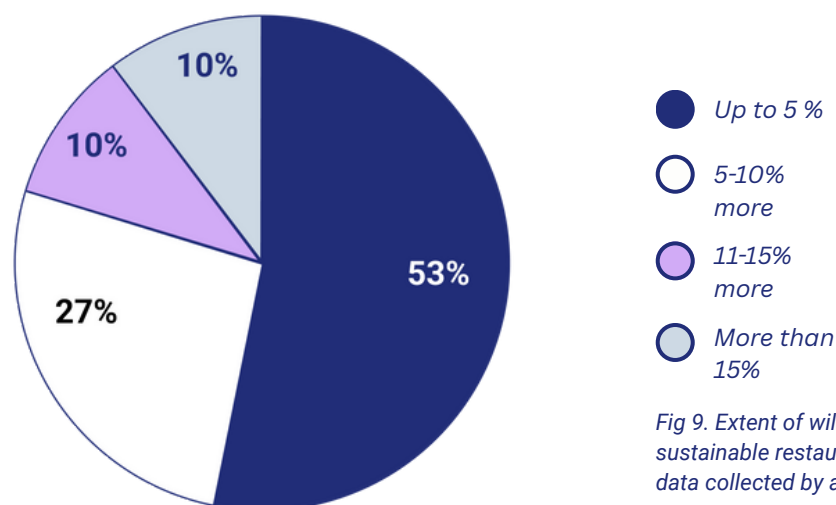


Fig 9. Extent of willingness to pay more for sustainable restaurant practices. Based on data collected by author.

Despite young Canadians' willingness to embrace sustainable food options, many consumers have a limited understanding of food innovations, sustainability metrics, and certification labels. (Fig.10).

Are you aware of any sustainability practices implemented by your local coffee shop or quick service restaurant?

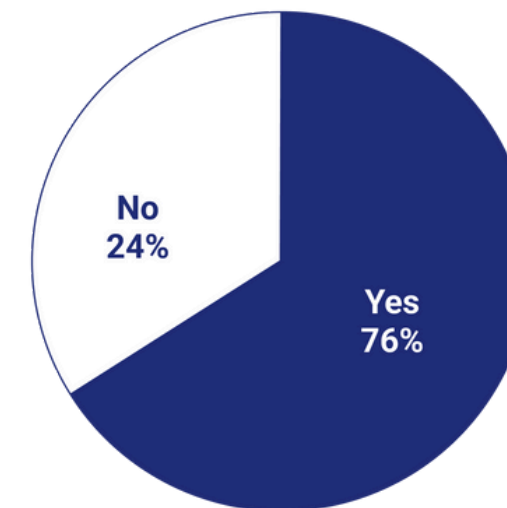


Fig 10. Consumer awareness of sustainability practices in local coffee shops or quick service restaurants. Based on data collected by author.

If yes, what practices have you noticed (open question)

10 Responses

Waste Sorting & Recycling

Includes general waste sorting, recycling, compostable items, and donation-related sorting.

6 Responses

Local & Sustainable Sourcing

Local ingredients, organic, farm-to-table, Made in Canada, support local farms.

5 Responses

Reusable & Refillable Items

Reusable cups, bringing mugs, refillable options, etc.

5 Responses

Food Waste Reduction

Food waste posters, Too Good to Go, food waste notifications, reduce waste messages.

3 Responses

Community Engagement

Supporting community or artists, event spaces.

2 Responses

Packaging (General)

Mentions of packaging or degradable plastic, without further detail

Digital gap:

Technology adoption remains slow. Small businesses continue to use manual methods, while large retailers adopt digital technologies for customer engagement and inventory management. My interviews strongly confirmed this technology gap, with all 12 participants (see Appendix B) reporting minimal technology use, primarily "POS machine" and basic "social media" platforms like Instagram and TikTok. As a coffee shop owner believe they know their customer preferences well, according to their business experiences. One bagel shop manager stated, "We do all the things manually," while another noted they use "mainly the POS machine" for digital operations.

Despite recognizing operational inefficiencies, with staff acknowledging "there is too much human error in the management" and expressing interest in technology that could "help me to prepare the ingredient efficiently, SME owners resist adopting data-tracking technologies due to their expenses and doubts about effectiveness. The need to adhere to HACCP protocols and Ontario's Food Premises Regulation places additional strain on SME resources which demand substantial time and effort from these already stretched businesses. When asked about the potential adoption of new technologies, respondents consistently cited "learning time" and "cost" as major barriers. The evident practical barriers serve to moderate the potential benefits of circular economy interventions.

Rising from the Pandemic

"Customer behavior has changed since the pandemic, making it challenging to predict their demands."

"During the pandemic, thanks to social media, we were able to keep our customers updated on our operation schedule. Otherwise, we wouldn't have survived."

Despite numerous difficulties Toronto's QSFE SMEs have shown remarkable endurance throughout post-pandemic times. During the year from May 2020 to May 2021, Li, Sungur, Jimenez, and Brail (2022) found that Toronto experienced a greater number of restaurant openings (516) compared to closures (429) demonstrated business adaptability in the face of crisis conditions. During lockdowns, establishments shifted towards takeout and delivery operations by implementing digital ordering systems and third-party platforms, while government initiatives for temporary takeaway alcohol sales generated essential revenue streams.

In my user interviews, it was also revealed that SME owners continue to struggle with unpredictable customer behaviours post-pandemic. Several interviewees mentioned that dining patterns have become increasingly erratic, making it difficult to forecast demand accurately. Some noted, "People order differently now", more takeout, less dine-in, even when they can eat here. It's hard to plan staffing and inventory." This unpredictability further strains already limited resources and complicates inventory management, potentially increasing food waste.

Ghost kitchens, small restaurants in food halls and pop-up restaurants in shared spaces represent emerging operational models that have become popular due to their reduced overhead costs. These models emerged as a trend after COVID-19, with many entrepreneurs utilizing these formats to test their market viability before committing to larger investments. Financial strain and labour deficits continue alongside regulatory demands making sustainable circular strategies essential for resilience with technology integration and waste reduction as key components.

The Interconnected Map

Define the Power Players in Toronto's Food Service Ecosystem

The QSFE ecosystem in Toronto consists of a diverse set of stakeholders, each situated across a power-interest spectrum that shapes the sector's transition toward circular food systems. Instead of isolating each actor, this analysis emphasizes relational dynamics, flow patterns, and strategic leverage points within the system.

Power-Interest Dynamics

The stakeholder map highlights key power-interest configurations that influence system behaviour. QSFE owners/managers and customers sit in the high-power, high-interest quadrant, holding the authority to drive operational decisions and the motivation to prioritize sustainable practices. Regulatory agencies and waste management providers also demonstrate high power and interest, shaping outcomes through policy and infrastructure.

Flow Patterns and Interconnections

The system reveals four primary flow types: financial, product/service, informational and regulatory. These interdependencies illustrate how interventions in one area such as procurement or financing, can trigger cascading effects throughout the ecosystem. The financial institutions and property landlords wield considerable power through their control over funding and access to physical space. Their placement in the “keep satisfied” quadrant signals a critical gap in engagement, one where better alignment could unlock system-wide gains.

Stakeholders such as staff, environmental consultants, and technology providers demonstrate high interest but limited power. These actors are enablers of change, introducing IoT innovations, data insights, and waste sorting protocols. Their role in the “keep informed” quadrant highlights their potential as partners in implementation, especially when paired with more powerful actors.

Peripheral actors such as local residents, food banks, and competitors may have limited formal power, but they still shape system dynamics through community expectations, surplus food redistribution, and competitive pressure. These nested roles reflect a multi-scalar system in which small changes, when strategically placed can ripple outward to influence broader transformation.

System Leverage Hints

The potential intervention opportunities lie where multiple flows converge. Suppliers and industry standards organizations occupy pivotal positions by influencing sustainability benchmarks that directly affect QSFE operations. Similarly, waste management firms and QSFE operators represent a critical relationship where collaborative redesign of waste flows could unlock meaningful circular outcomes.

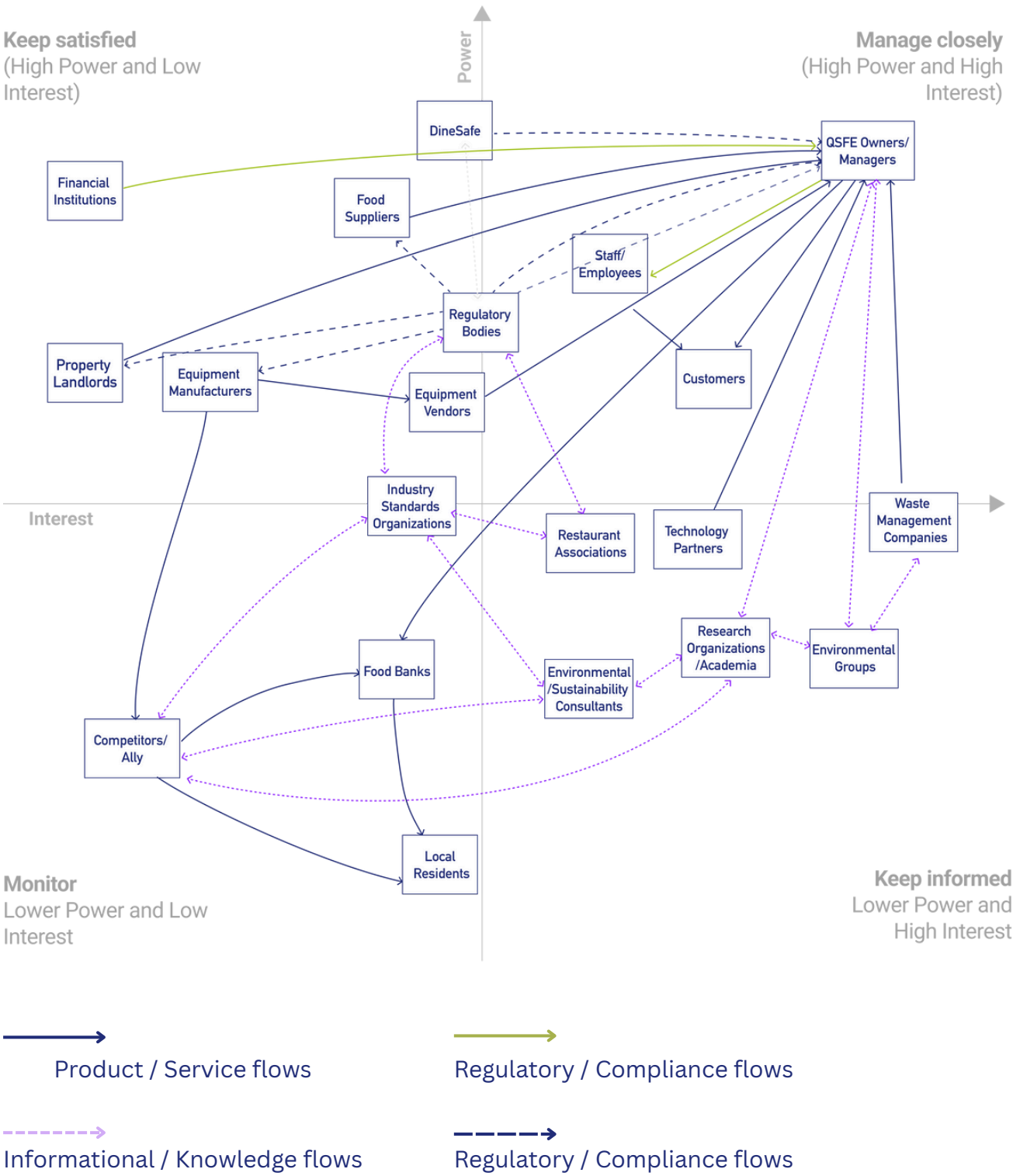


Fig 11. Stakeholder Map and Value Flow create by author (Please see Appendix D for more details)

Identifying the Systemic Barriers

System mapping of Toronto's Quick Service Food Establishment (QSFE) SMEs reveals interconnected barriers preventing circular food practice adoption, explaining why sustainability efforts struggle to scale. The causal loop diagram identifies four reinforcing loops that emerge directly from the stakeholder dynamics previously identified.

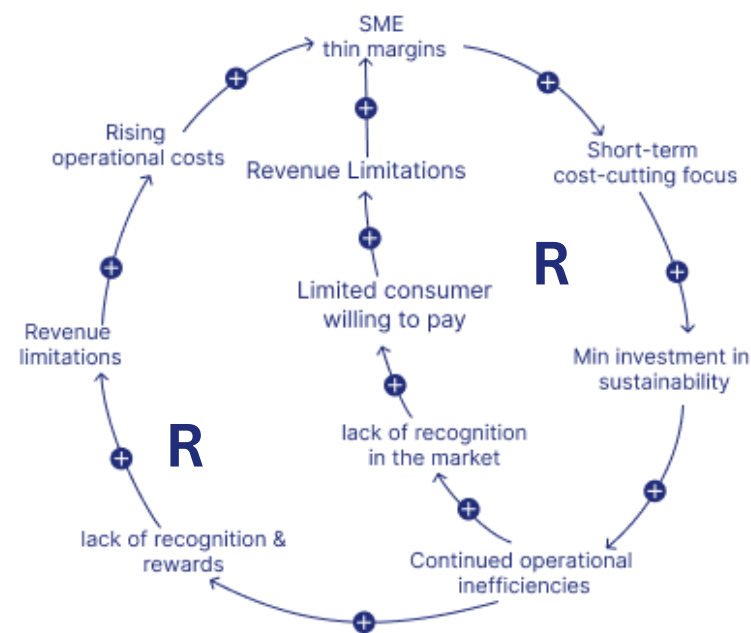


Fig 12. Financial Survival Loop create by author (Please see Appendix E for more details)

The Financial Survival Loop demonstrates how the power-interest dynamics between financial institutions (high power, low interest) and QSFE owners create systemic constraints. With Canadian restaurants operating on declining profit margins (4.5–6.5% pre-pandemic to 3–5% currently) and 62% merely breaking even (Restaurants Canada, 2023), the financial flows identified in our stakeholder analysis create structural barriers to sustainability investment. This financial pressure is compounded by rising operational costs, including commercial property rent (averaging 4.3% annually in Toronto) (CBRE, 2023) and minimum wage increases, now at \$16.55/hour (Ontario Ministry of Labour, 2023). Commercial insurance premiums have also surged since 2020, with the hospitality sector—including restaurants—facing average rate increases of 10.4% in 2022, 8.11% in 2023, and 5.77% in 2024 (Canadian Underwriter, 2024). These compounding cost pressures create a perfect storm that forces SMEs to prioritize immediate survival over long-term circularity investments.

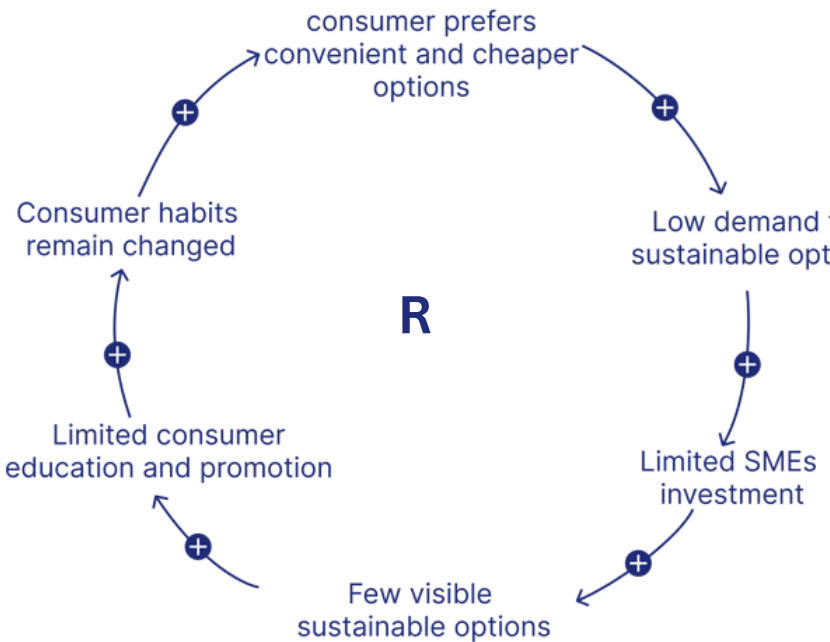


Fig 13. Consumer Awareness and Demand Loop create by author (Please see Appendix E for more details)

The **Consumer Awareness and Demand Loop** highlights the disconnect between stakeholder interests and actions. While my survey shows 78% of Toronto consumers verbally support sustainable options, only 42% willingly pay even a 5% premium. This gap directly relates to the product/service flows mapped between customers (high power, high interest) and QSFE owners, creating a feedback loop where low demand reinforces limited sustainable offerings.

It is a cross-level phenomenon, influenced by both regime practices (pricing strategies, packaging norms) and evolving landscape-level trends such as shifting generational values.

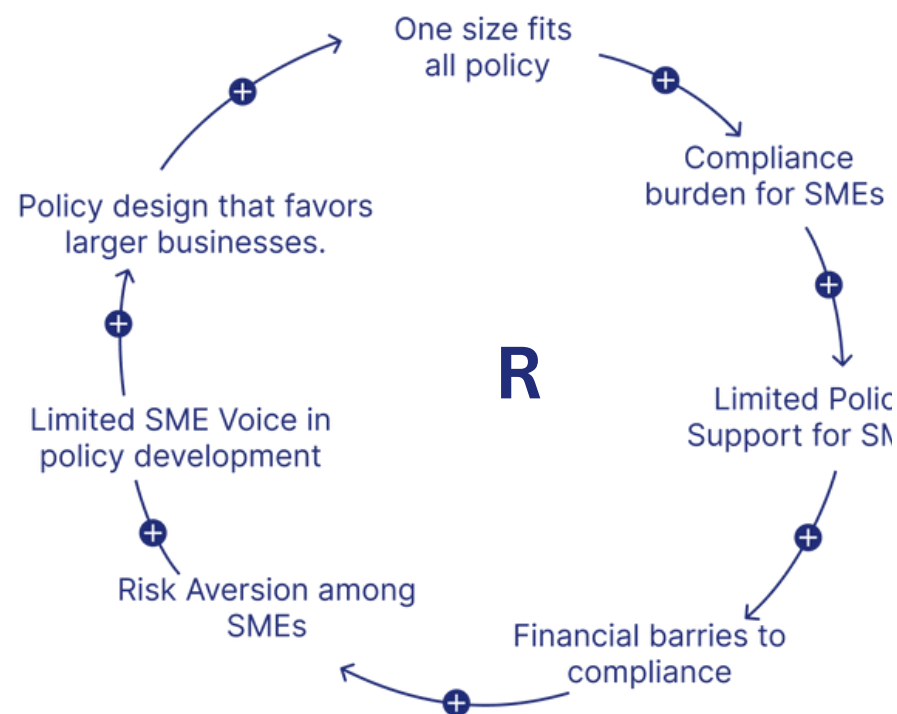


Fig 14. Policy Inaction and Regulatory Burden Loop create by author
(Please see Appendix E for more details)

The **Policy Inaction and Regulatory Burden Loop** emerges from the regulatory/compliance flows identified in our stakeholder map. Regulations designed for large businesses create disproportionate burdens for SMEs, with insufficient support mechanisms. This reflects the imbalanced power dynamics between regulatory bodies and industry standards organizations observed in our stakeholder analysis.

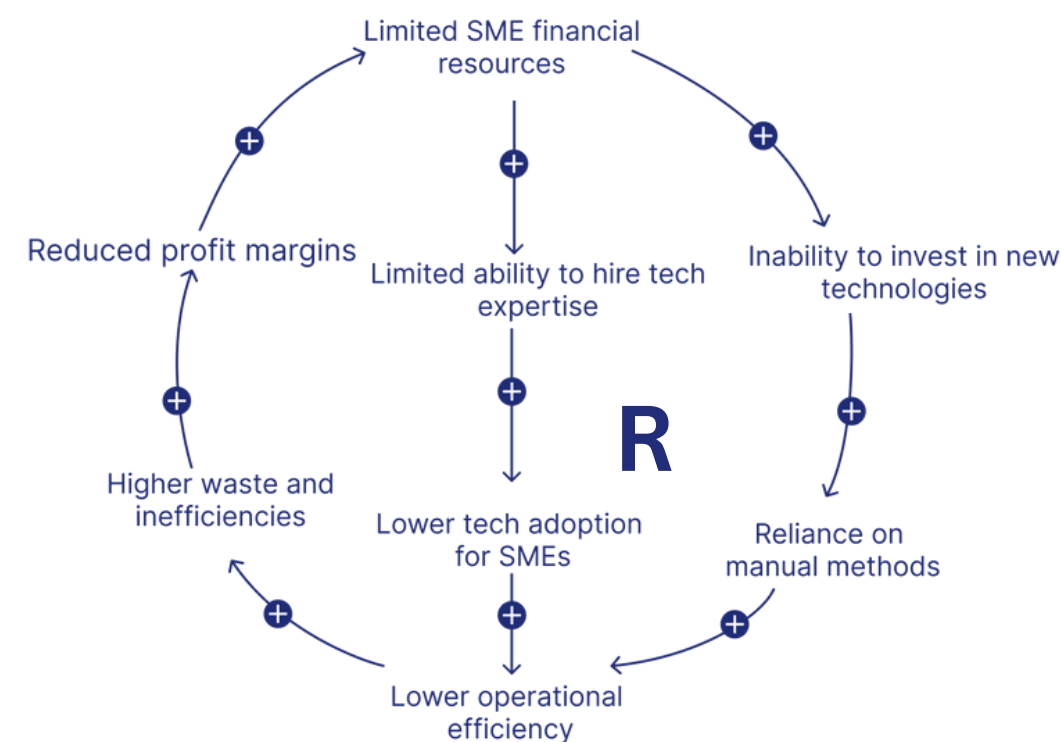


Fig 15. Technology and Knowledge Loop create by author (Please see
Appendix E for more details)

The **Technology and Knowledge Loop** demonstrates how the informational/knowledge flows between technology partners, large corporations, and SMEs create structural barriers. With 75% of interviewed Toronto QSFE owners expressing technology adoption concerns, we see how stakeholders in the "keep informed" quadrant struggle to influence system transformation. As one Little Italy restaurant owner explained, "I know AI inventory systems could help reduce our waste, but between subscription fees and staff training time, it's not feasible for our size."

This system mapping built directly from our stakeholder analysis, identifies key leverage points where interventions could break these reinforcing loops. By understanding both the stakeholder relationships and their resulting system dynamics, we pinpoint root causes beyond individual actor behaviours, revealing the structural barriers to circular food systems in Toronto's QSFE sector.

Leverage Points Within an Interconnected System

The four reinforcing loops—Financial Survival, Consumer Awareness & Demand, Policy Alignment, and Technology & Knowledge Access do more than expose constraints; together they reveal where carefully placed interventions can trigger outsized, system-wide change.

Financial Survival : Cash-flow fragility shapes every QSFE decision. When owners operate at break-even, sustainability investments even modest risk. Mechanisms such as cost-sharing, upfront subsidies, or targeted tax credits loosen that constraint, freeing capital that can then reinforce the other three loops (e.g., funding a digital tracking tool or marketing a circular menu).

Consumer Awareness & Demand: Demand signals dictate menu design, supplier choice and packaging. The gap between consumers' stated intent and actual purchase behaviour is a leverage point: clear eco-labels and behavioural nudges (discounts for reusable containers, default smaller portions) convert curiosity into action. Stronger demand feeds back into financial health (higher margin items) and creates political cover for supportive policy.

Policy Alignment : Current regulations often suit large chains, leaving SMEs to shoulder disproportionate compliance costs. SME-specific standards, simplified reporting, micro-grants, and technical help desks turn policy friction into policy lift. When regulation lowers barriers, SMEs are more willing to adopt tech solutions and to market circular practices reinforcing the other loops.

Technology & Knowledge Access: Data-driven tools are critical to scaling circularity but remain costly and complex for small operators. Open-source platforms, shared IoT infrastructure, and co-creation hubs make intelligent systems affordable and relevant. Better data illuminates financial gains, supports compliance reporting, and feeds real-time sustainability metrics back to consumers.

These leverage points function best as a coordinated bundle: financial incentives seed adoption, tech tools prove value, consumer pull sustains demand, and policy alignment locks in gains. Addressing them in isolation delivers incremental improvements; addressing them together rewires the entire system, paving the way for a resilient, inclusive, and truly circular QSFE sector in Toronto.

Current Solutions in Canada

Technology offers promising pathways to address the systemic barriers identified in our system mapping. This section examines existing technological solutions and their potential to disrupt the reinforcing loops constraining Toronto's QSFE SMEs, with comparative examples from across Canada.

Financial solutions

Technology platforms are emerging to address the financial constraints identified in the Financial Survival Loop. Digital financing platforms like Toronto-based Greengage offer microloans specifically for sustainability investments, with repayment terms aligned to projected cost savings. This innovative approach directly targets the financial flows between institutions and QSFE owners identified in our stakeholder analysis. However, adoption remains limited among Toronto SMEs, with many still unaware of these specialized financing options.

Besides, smart utility monitoring systems from Canadian companies like Manifest Climate help restaurants reduce operational costs through automated energy and water usage tracking. These systems typically demonstrate positive ROI within the first year through meaningful utility bill reductions, though results vary by establishment size and operational patterns. By directly addressing profit margin concerns, these technologies begin to break the Financial Survival Loop.

Consumer awareness solutions

To bridge the gap between consumer interest and action, digital transparency tools are gaining traction. Toronto-based Foodprint allows customers to scan QR codes to view

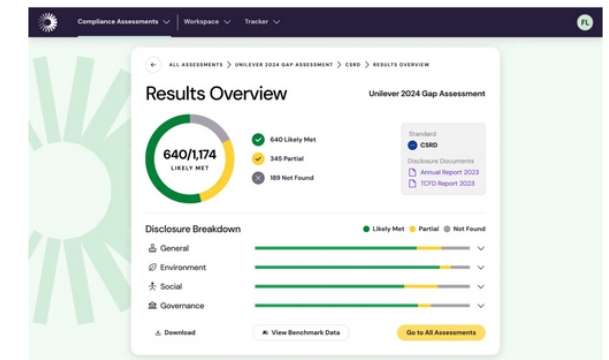


Fig 16, Appendix I. Manifest Climate's AI engine delivers rapid, reliable, and actionable compliance insights tailored to the regulatory needs Adapted from Manifest Climate (n.d.)



Fig 17 Appendix I. Foodprint Project exploring food and cities. Adapted from Foodprint Project (n.d.).

sustainability metrics for menu items. While still limited to a small number of establishments city-wide, early adopters report increased customer selection of menu items labelled as sustainable.

Montreal's LOOP Mission has successfully scaled its food waste reduction model through consumer-facing technology, using blockchain to verify waste diversion claims and engaging consumers through gamified mobile experiences. Their approach has achieved wider adoption than comparable Toronto initiatives based on participant numbers reported in their public materials. This highlights how technology can effectively reshape the product/service flows between customers and QSFE owners identified in our stakeholder mapping.

Policy and Regulatory Burden Solutions

Vancouver's CoFood platform demonstrates a more advanced approach, offering a compliance-as-a-service model that automatically integrates with point-of-sale systems to track and report sustainability metrics required for municipal regulations. Based on publicly available information, adoption rates appear higher in Vancouver than comparable Toronto solutions, though exact figures would require further research. This model shows promising potential to break the Policy Inaction Loop by simplifying regulatory engagement.

Technology Solutions

Open-source platforms are beginning to address the technology adoption barriers

identified in the Technology and Knowledge Loop. A start-up, FoodBytes network offers free inventory management and waste tracking software specifically designed for digital and food manufacturing, with simplified interfaces and minimal training requirements.

Gaps and Opportunities

Despite the various technological solutions emerging in Canada, significant gaps remain in addressing the systemic loops identified in our mapping. Rather than examining each loop individually, a holistic analysis reveals common patterns that cut across all four system barriers.

System-Wide Technology Gaps

There is limited adoption of sustainability technologies among Toronto's QSFE SMEs stems from several interconnected challenges. First, most available platforms operate in isolation rather than as integrated food ecosystems, forcing time-constrained business owners to manage multiple disconnected tools. Second, existing technologies frequently overlook the social and cultural dimensions of implementation. Many platforms assume technical barriers are the primary hurdle, trust networks, knowledge-sharing communities and cultural contexts often determine adoption success. This gap is particularly evident in Toronto's diverse QSFE landscape, where multilingual teams, varied cultural practices and high staff turnover create implementation challenges beyond the technical realm. Third, most current solutions fail to address the power imbalances identified in our stakeholder analysis. Technologies tend to be developed without meaningful SME involvement, resulting in platforms that inadvertently reinforce rather than disrupt the existing system dynamics. This top-down approach contributes to the persistent disconnect between technological capabilities and on-the-ground implementation.

Cross-Cutting Opportunities

Current Toronto's technology solutions ultimately lag behind other Canadian cities in adoption rates and system impact because they remain siloed, rarely integrating across value chains (e.g., waste tracking + financing + compliance). Most tools also fail to embed social infrastructure like peer support, collective bargaining, or narrative building, which is essential for sustained adoption.

Transformative opportunities exist in platform cooperatives that create shared ownership models for food data platforms. Positioning circularity tech within Toronto's smart city strategy could enable APIs across food, waste, and finance sectors. AI could serve as a collective enabler, anticipating waste patterns, optimizing purchasing, or simulating circular system scenarios. The path forward requires technological innovations that explicitly target the intersection points between the four reinforcing loops identified in our system mapping. By designing solutions that simultaneously address financial constraints, consumer behaviour, regulatory burdens, and knowledge gaps, technology can serve as a catalyst for system transformation rather than merely an additional tool.



Emerging Futures

Drivers and Signals

Projecting the Futures

Scenario Planning

Ideas from the Futures

To navigate the complex challenges facing Quick Service Food Establishments (QSFEs), particularly SMEs, it is no longer sufficient to only address present-day inefficiencies in the system. This section introduces a futures-oriented perspective that moves beyond reactive problem-solving. By exploring plausible futures for 2035, I aim to uncover emerging risks, opportunities, and systemic shifts that may impact the QSFE sector. This long-term view enables a “future-back” approach: identifying the structural conditions that shape tomorrow's outcomes and tracing them back to strategic actions we can take today.

Drivers and Signals

Key Forces Reshaping Toronto's Food Landscape

STEEP-V and Iceberg Analysis

Toronto’s Quick Service Food Establishments (QSFE) made up of small and medium-sized enterprises are at a crossroads. Although there’s growing interest in sustainable practices, the path toward a circular food system is fraught with barriers: high costs, complex logistics, and unclear business incentives all make it difficult for these businesses to adopt circular models. This moment of tension signals the need for strategic foresight. Using Dator’s Four Futures framework (Growth, Collapse, Discipline, and Transformation), we can imagine diverse possibilities for overcoming these obstacles by 2035.

To understand the forces shaping this future, a STEEP-V analysis (Please see the details in Appendix F) helps illuminate the broader landscape:

- **Socially**, QSFE owners are navigating an increasingly diverse customer base. Diners want transparency and novelty but still prioritize speed and affordability. Meanwhile, many food entrepreneurs are seeking more inclusive economic opportunities.
- **Technologically**, innovations like AI and smart supply chains promise efficiency but are often out of reach for smaller businesses due to upfront costs. This creates a case for shared infrastructure that lowers the barrier to entry.
- **Economically**, rising costs for ingredients, labour, and third-party delivery fees are squeezing already thin margins. Consumers remain price-sensitive, making it even harder to justify sustainability investments unless they deliver tangible savings.

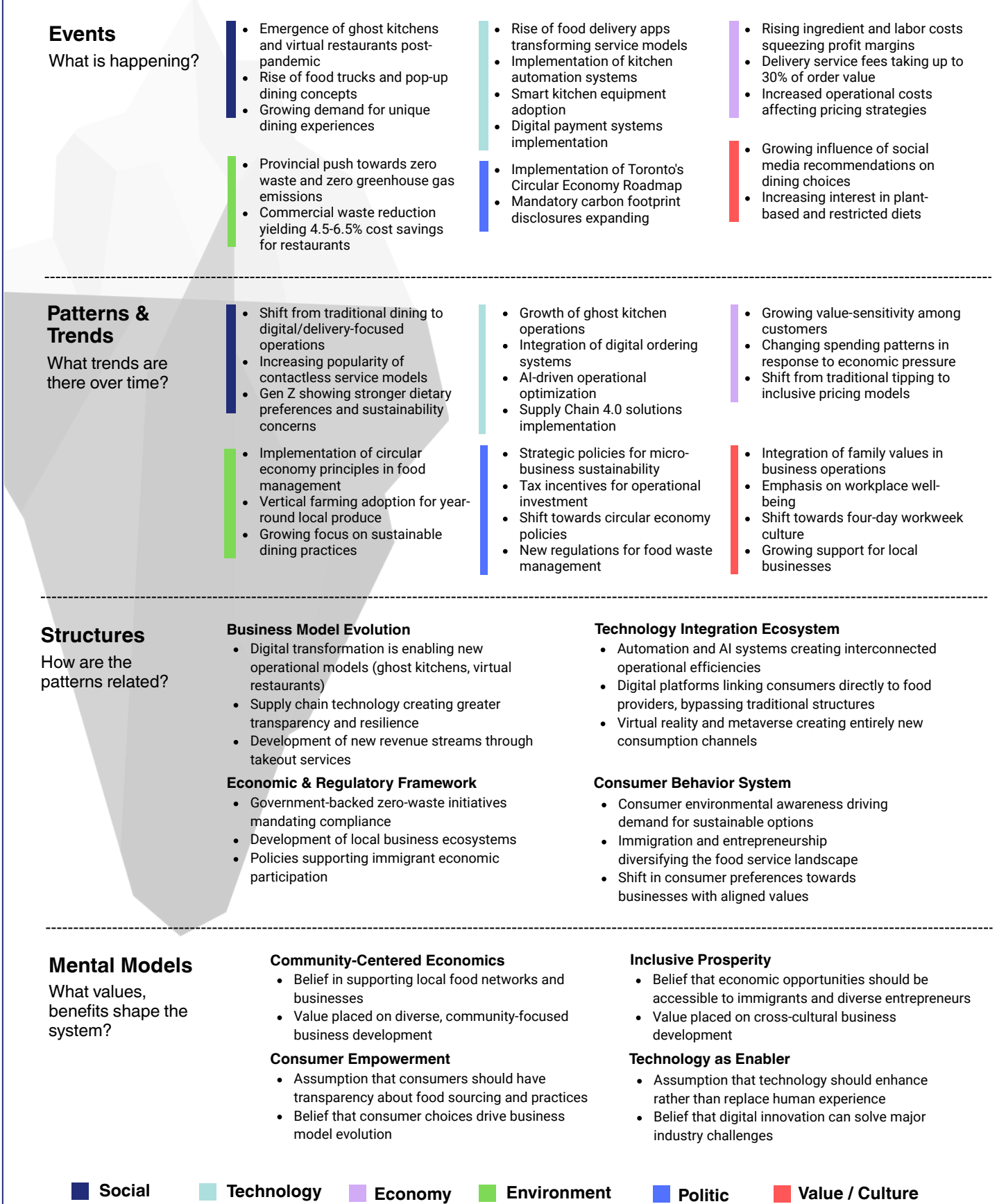
- **Environmentally**, there's mounting pressure to reduce waste and emissions. Yet, scalable solutions like urban farming still face infrastructure and policy limitations.
- **Politically**, Toronto's Circular Economy Roadmap signals progress — but its benefits often skew toward larger corporations, leaving smaller players under-supported.
- **Values and culture-wise**, Gen Z consumers are pushing for deeper alignment with ethical, local, and sustainable business practices. This shift offers an edge for SMEs ready to engage.

To move beyond surface-level trends, the Iceberg Model adds a systems (Fig. 18) thinking lens to reveal what's driving these patterns beneath the surface:

- **Events (Level 1)** include visible developments like the rise of ghost kitchens, surging costs, and growth in plant-based menus.
- **Patterns (Level 2)** show consistent behaviors such as digital-first operations, heightened consumer value-consciousness, and early experimentation with circular models.
- **Structures (Level 3)** expose the systems enabling or impeding change — like digital ecosystems designed for short-term profit, patchy regulatory support, or misaligned resource flows.
- **Mental Models (Level 4)** uncover the underlying beliefs shaping all of this: the idea that sustainability is no longer optional but essential; that community and business success are interconnected; that work should support, not consume, our lives; and that technology should empower people, not replace them.

Taken together, this integrated analysis lays the groundwork for strategic foresight. Dator's Four Futures will help explore how intelligent systems, policy shifts, and business model innovation could work together to shape a thriving circular food system.

Fig 18. Integrating STEEP-V and Iceberg Model create by author



Projecting the Futures

Four Paths Forward: Contrasting Scenarios for QSFE Evolution

QSFE SMEs in Toronto struggle to implement circular food systems because high expenses, logistical difficulties, and uncertain business advantages drive sustainability resistance. The application of Dator's Four Futures framework within strategic foresight aims to create a plausible transformation which projects by 2035 to address existing challenges beyond simple prediction. QSFE SMEs' progress through Growth (Business as Usual), Collapse (System Decline), Disciplined Society (Regulated Transformation), and Transformation (System Revolution) stages depends on their adaptation of resilience strategies and circular practices for the unique demands of each scenario.

Parameter	Growth	Collapse	Disciplined Society	Transformation
Core business environment	Steady AI-led growth, globalised supply chains, light oversight	Economic turmoil, black-market food, policy vacuum	State-mandated sustainability, tightly regulated local supply	AI-managed post-scarcity food web, peer-to-peer networks
Technological foundation	Trend-forecasting AI, corporate data silos, low upskilling	Digital infrastructure failing, manual fallback, data loss	AI optimises for sustainability, blockchain traceability, universal training	Autonomous AI production, open-source data commons, full literacy
Environmental impact	Profit-led carbon labels, voluntary recycling	Severe scarcity, climate shocks, landfill overflow	Carbon-neutral laws, regenerative farming, strict waste rules	Regenerative zero-waste circularity, renewable hubs
Social framework	Influencer cuisine, hyper-personal dining, weak community ties	Survival diet, cultural erosion, food insecurity	Ethical eating as civic duty, co-ops & behaviour nudges	Food as creative medium, flourishing food movements, local sovereignty
Business operation	AI demand forecasting, ad-hoc circular pilots	Cost-cut survival sourcing, circularity sidelined	Mandatory green-tech compliance & reporting	AI-orchestrated resource loops where waste = value

Fig 19. Dator's 4 Futures create by author (Please see more details in Appendix G)



Fig 20, Appendix L. Growth scenario visualization for Toronto's QSFE SMEs in 2035. Visualization generated by MidJourney based on author's prompt.



Fig 21, Appendix L. Collapse scenario visualization for Toronto's QSFE SMEs in 2035. Visualization generated by MidJourney based on author's prompt.

Growth: Business as Usual

The Growth scenario shows Toronto's economy expanding through technological innovation and increasing consumer demand for quick sustainable options. SMEs could channel investments into AI-based demand forecasting tools and immersive social media solutions to match market trends. New technologies allow followers to be more engaged from social media that drives instant purchases, while restaurants leverage data from thousands of social media influencers to develop food innovations that are guaranteed to succeed before launch.

Collapse: System Decline

The Collapse scenario foresees economic collapses and resource shortages resulting from instabilities leading SMEs to adopt hyper-local sourcing through low-cost technologies such as composting for resale to maintain business continuity. Labour shortages become severe, with family-run establishments depending on owners' children helping. The traditional dining becoming unaffordable for consumers, some small quick-service food establishments survive by offering basic nutrition at accessible prices. Meanwhile, SMEs develop creative survival strategies, including B2B operations selling products to remaining supermarket chains.



Fig 22, Appendix L. Disciplined Society scenario visualization for Toronto's QSFE SMEs in 2035. Visualization generated by MidJourney based on author's prompt.

Disciplined Society: Restricted Changes

A Disciplined Society imposes strict rules that require zero-waste production and renewable energy usage along with composting and these regulations are enforced through audits and fines which force SMEs to adopt green technologies and train their staffs. Supply chain management becomes particularly challenging as subscription models, they automatically halt deliveries of ingredients that become restricted or banned. As the result, The menus change in real-time due to supply issues. These disruptions frustrate loyal customers who expect consistency.



Fig 23, Appendix L. Disciplined Society scenario visualization for Toronto's QSFE SMEs in 2035. Visualization generated by MidJourney based on author's prompt

Transformation: System Revolution

It envisions a complete overhaul to a sustainable society centred around communities with AI-managed networks which optimize resources while SMEs partner at local food hubs. Key innovations emerge through models like directly from farmers, who can control supply and provide instant orders to restaurants via blockchain-verified smart contracts. This system enables communities to close nutrient loops by turning food waste into compost or animal feed used by local farms, which then supply produce back to food establishments. Revolutionary approaches to waste management include pay-per-use models where heavy producers pay more while minimal waste generators pay less, creating financial incentives for waste reduction. Government and community partnerships enable circularity systems to convert waste into energy which helps level the playing field for SMEs through fair models .

The implications of equity and size factors create noticeable differences across potential future outcomes. During Growth larger companies outperform SMEs with their advanced AI and social media capabilities while Collapse benefits smaller firms because of their local focus and adaptability. The compliance costs of Disciplined Society may disproportionately burden SMEs in contrast to larger organizations while Transformation's AI integration stands to advantage technologically proficient companies except where community-based frameworks offer solutions. SMEs must develop innovative approaches such as technological advancement for Growth scenarios, local focus for Collapse situations, regulatory adherence for Disciplined Societies or collaborative efforts for Transformations in order to succeed in a circular food system by the year 2035. SMEs will achieve success if they effectively address technological advancements and resource shortages as well as regulatory requirements while adapting to community changes which will turn circular practices into essential survival methods or obligatory systems with the help of customized support and flexible strategies.

Scenario Planning

Life in Toronto's Alternative Food Futures

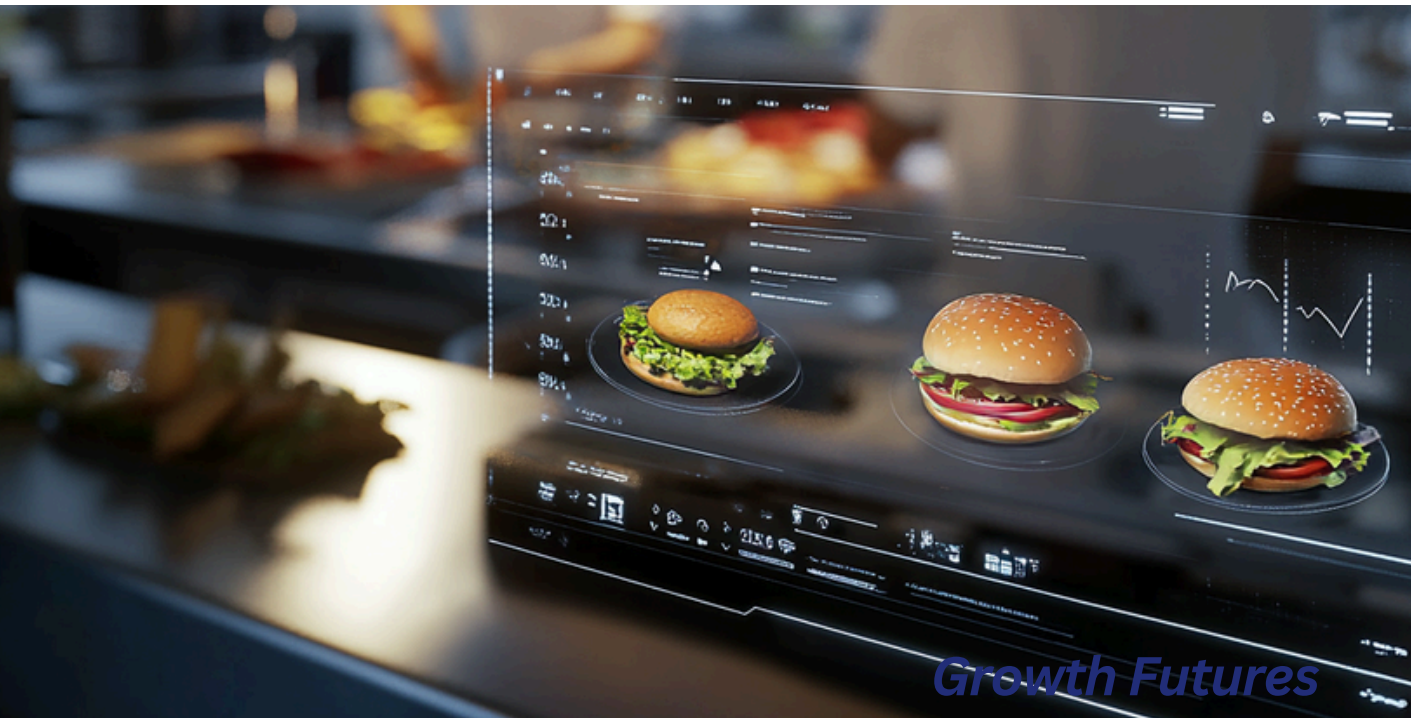


Fig 24, Appendix L. Growth scenario: Future food-tech restaurant landscape. Visualization generated by MidJourney based on author's prompt.

Emerging Tech Driven Efficiency in Toronto's Food Sector

Toronto's downtown has evolved into a flourishing tech hub, propelled by economic stability and market-driven innovation. Food-tech accelerators and venture capital funds targeting restaurant innovation have created a competitive landscape where technological advancement defines success.

For young consumers, convenience has expanded to include AI-driven ordering, robotic kitchens, and hyper-personalized experiences. Social media influence has transformed dining, with virtual food influencers driving explosive demand for photogenic menu items and creating overnight viral sensations.

Food innovation labs analyze influencer data to develop menu items with predictable success rates. This "data-to-plate" approach

uses AI to identify viral-worthy combinations before ingredients are purchased. Customer data has become the most valuable currency, with facial recognition and social credit scoring systems optimizing experiences based on spending patterns and influence potential.

Large chains and SMEs approach technology differently. Major chains develop proprietary metaverse dining experiences, while SMEs form tech cooperatives to create shared virtual spaces and AR-enhanced dining that require less capital investment.

This is about half the original length while still capturing the essential technological themes and competitive dynamics that define this Growth future scenario. It flows well into your "Day in the Life" section with Liam, which provides a good concrete illustration of how these technologies manifest in everyday experiences.

Key Takeaway in the Growth World:

The future emphasizes cost-effective operations and technological innovation instead of deep environmental principles. SMEs grow through affordable technology-based solutions and strategic data utilization. Toronto's downtown emerges as a technological hub supported by a stable economy and driven by Generation Z's preference for quick, economical, and highly personalized food options.

People find convenience in advanced quick service restaurant that use AI to customize orders, robotic kitchens that ensure consistency, and predictive social media deals that anticipate his preferences. The integration of sensory technologies like aroma receivers has transformed passive content consumption into multi-sensory experiences that drive purchasing decisions with unprecedented effectiveness. In this future, sustainability exists primarily as a marketing element rather than a core business value, subordinate to the priorities of speed, price, and digital engagement that drive consumer behaviour.

Business Development Insights for QSFE SMEs:

QSFE SMEs should strengthen their resilience within this growth-focused environment by implementing these strategies:

Technology Pooling:

Form cooperatives with other small businesses to share costs of advanced technologies like delivery drones, aroma broadcasting systems, and AR experience development that would otherwise be accessible only to larger chains.

Data-Driven Product Development:

Leverage aggregated social media data through third-party analytics platforms to identify emerging food trends and optimize menu development. Small businesses can subscribe to influencer reaction databases that provide predictive analytics on menu item success potential without requiring the massive data collection infrastructure of major chains.

Viral Marketing Strategies:

Capitalize on social media trends through predictive algorithms which allow the creation of visual, shareable, and multi-sensory menu items that attract Gen Z consumers like Liam without large advertising costs. Partner with mid-tier influencers for affordable promotion.

Operational Streamlining:

Implement modular automation solutions that can be scaled according to budget—starting with partial kitchen robotics or self-service kiosks before full automation.

Strategic Partnerships:

Form alliances with third-party tech providers that offer "automation-as-a-service" and "sensory-marketing-as-a-service" models to compete with the proprietary systems of larger chains.

A Day in the Growth Future: FeedStream

Liam, a 28-year-old young professional, his day in 2035 is a whirlwind of work, social media, and quick food stops. Here's how it plays out at a quick food restaurant built for his fast-paced, budget-friendly lifestyle:

Morning Commute (7:30 a.m.)

Liam's AI assistant starts his day with a breakfast suggestion based on his tight schedule. At a transit-stop QSR kiosk, it detects his smartwatch to order coffee. It's ready in seconds. At \$5, it's cheap and fast—perfect for his rush to work.

Midday Break (11:30 p.m)

At noon, Liam's phone lights up with a trending alert: a new AI-crafted burger is blowing up online, pushed by influencers. He opens his app, customizes it (extra pickles, hold the sauce), and pre-orders. The QSR's AI has the kitchen ready, so it's waiting when he walks in—no delays, no hassle.

Lunch Experience (1:00 pm)

In the central kitchen from uptown, the QSR is all about efficiency, clean lines, robotic arms assembling his burger. In the restaurant, facial recognition confirms his order. An AR screen at his table offers a quick game and a filter for his burger pic, which he posts for instant likes. It's tasty, affordable, and done in 10 minutes.

Afternoon Boost (3:00 p.m.)

Liam browses his social media about the hit smoothie. One of his favorite influencers is a cat-faced AI, and the influence is introducing a new matcha smoothie made with vegetables and grasshopper protein in a live stream. The followers flood the influencer with "likes" and virtual gifts. Intrigued, Liam taps to order the trending item for immediate drone delivery to his office balcony.

As a premium subscriber to SmellFeed, Liam activates his desk's aroma receiver, instantly filling his workspace with the sweet, earthy scent of the matcha smoothie being showcased in the livestream. This sensory preview convinces him to complete his purchase, earning him social points and a discount on his next order for participating in the live launch event. The aroma technology—once a luxury for high-end establishments—has become a standard feature in mid-tier food marketing, with compatible receivers now built into most smart home devices and office environments.

1. At a transit-stop QSR kiosk, it detects Liam's smartwatch to order coffee. It's ready in seconds.
2. Window displays customized advertisement when Liam closes the restaurant
3. Bio data is more accessible. Liam is scanned to get his lunch.
4. An AR screen offers a quick game and a filter for his burger pic, which he posts for instant likes.
5. Central kitchen from uptown makes the production more efficiently.
6. Liam pushes his review on the media wall in the restaurant to earn more credits.
7. A influencer is a cat-faced AI, and the influence is introducing a new matcha smoothie made with vegetables and grasshopper protein in a live stream.
8. Liam taps to order the trending item for immediate drone delivery to his office balcony.

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Fig 25-32, Appendix L . Daily life scenes in the Growth scenario. Visualizations generated by MidJourney based on author's prompt.





Collapse Futures

Fig 33 Appendix L. Collapse scenario: Urban decay and hyper-local food survival systems. Visualization generated by MidJourney based on author's prompt.

Resource Scarcity and Local Resilience in Toronto's Food Sector

Toronto's downtown areas stand as hollow shells of their former vibrancy, emptied by cascading economic crises and climate disasters. The Great Lakes flooding of 2029 and North American agricultural blight of 2031-2033 shattered supply chains, transforming once-common food items into luxuries. Municipal waste management collapsed after consecutive budget crises, leaving neighborhoods to create their own solutions.

Surviving QSFEs operate with skeleton crews—often family members working multiple roles out of necessity rather than choice. Severe labor shortages have made hiring nearly impossible, forcing restaurant owners to rely entirely on family to maintain operations. Soaring costs have driven a desperate

transition toward hyper-local sourcing. Rooftop and vacant lot urban farms have become critical supply nodes rather than sustainability showcases.

SMEs have turned necessity into innovation: converting food waste into compost for local farmers and processing grease into generator fuel—not as environmental initiatives but as survival tactics. Meanwhile, major chains maintain operations in select locations with private security, independent power systems, and privileged access to scarce imports.

In this harsh economy, traditional dining has become unaffordable for most. Ironically, this creates a niche for QSFEs offering budget alternatives. Many owners have pivoted to B2B models, producing ready-to-cook products for supermarket chains as a crucial secondary revenue stream.

Key Takeaway in the Collapse World:

In this bleak transactional foodscape, survival drives the irregular emergence of circular practices while localism and frugality form the foundational pillars of resilience. As economic challenges and resource shortages combine with climate disruptions, Toronto's downtown becomes barren and global supply chain failures make burgers luxury items. The strongest QSFEs endure through family-run operations where owners work alongside their children, with traditional employment relationships largely replaced by kinship bonds and necessity.

Dining in standard restaurants has become unaffordable for many people, creating a niche for small quick food establishments that can provide affordable alternatives. The B2B pivot—selling ready-to-cook products to supermarket chains—has emerged as a crucial survival strategy, allowing these small businesses to diversify their revenue streams beyond unpredictable foot traffic.

Business Development Insights for QSFE SMEs:

Family-Based Operational Models:

Restructure business operations around family units to address labour shortages, with clearly defined roles for family members and contingency planning for when school schedules or other commitments interfere with availability.

Waste-to-Resource Conversion:

Generate additional income streams by marketing repurposed byproducts such as garden compost and grease-based fuel through

necessity-driven circular economic practices. Develop simple, low-tech systems for biogas production from food waste to reduce dependency on unreliable utility infrastructure.

Hyper-Local Supply Networks:

Forge direct relationships with urban farmers and local producers, potentially investing in shared growing spaces to secure priority access to limited harvests while reducing transportation vulnerabilities.

Adaptive Repurposing:

Develop expertise in equipment repair and adaptation, creating functional operations from salvaged components when new replacements are unavailable or prohibitively expensive. Maintain simplified technologies that can be repaired with locally available materials and skills.

A Day in the Collapse Future: One Last Bite

Toronto downtown is a patchwork of shuttered stores and flickering lights, worn down by years of economic decline and climate chaos. Tucked between empty storefronts is The Last Bite, a small, family-owned burger shop fighting to survive. The owner, Mr. Miller, runs the business with his teenage son who helps after school since the crippling labour shortage that has made hiring staff nearly impossible. Alex, a 29-year-old family friend, is the only non-family employee and backbone of the place.

Pre-Dawn Prep (5:30 a.m.)

Alex arrives before sunrise, he hauls in the day's ingredients: a crate of knobby potatoes from a rooftop farm nearby, some wilted greens, and a few precious slabs of lab-grown meat traded from a local co-op. It's a lean haul, but Alex has learned to make do. Near the back door sits their DIY biodigester, cobbled together from salvaged plastic containers and piping, slowly converting yesterday's waste into usable cooking gas.

Morning Rush (7:00 a.m.)

The first customers trickle in—essential workers mostly, clutching crumpled bills or barter goods. Today's menu is simple: potato patties or a thin vegetable soup. Alex calls out prices"\$15 for the patty". Mr. Miller, busy in the back preparing a large batch of burger patty mix destined for a local supermarket chain, this B2B side business selling ready-to-cook products to the few functioning grocery stores has become their financial lifeline.

Afternoon Barter (2:00 p.m.)

A rare quiet moment lets Alex step outside to meet Maria, who runs a tiny urban farm down the street. They trade a bag of ingredients with yesterday's potato peels and scraps for a handful of fresh herbs and a shaky promise of eggs next week. Some vegetables are ordered from Mexico, they are costly but not that much. Alex notices the corporate supply truck making its weekly delivery to the chain restaurant several blocks away.

Evening Wind-Down (6:00 p.m.)

As dusk falls, the shop empties out. Mr. Miller and his son prepare the next batch of pre-made burger patties and marinated protein packs for tomorrow's supermarket delivery. This pivot to B2B has been their salvation—while dining in restaurants has become unaffordable for many, people still crave restaurant-quality food they can prepare at home. The ready-to-cook products require less energy to produce than serving hot meals and create a reliable income stream that helps offset the unpredictability of daily customer traffic.

1. The power suddenly cuts out. Alex mutters a curse and switches to the backup gas stove.
2. Outside the back door sits their DIY biodigester, cobbled together from salvaged plastic containers and piping, slowly converting food waste into usable cooking gas.
3. Farmers trade in the afternoon, while some vegetables are ordered from Mexico.
4. A waste tracker system is installed on the blue bins to monitor and manage waste more effectively.
5. Price inflation has made dining in restaurants a luxury for most people.
6. On the rooftop farm, one of the fresh food sources for The Second Bite, mini detectors monitor the plants' condition.

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Fig 34-39, Appendix L. Daily life scenes in the Collapse scenario. Visualizations generated by MidJourney based on author's prompt.





Disciplined Future

Fig 40, Appendix L . Discipline Society scenario: AI-regulated food sustainability operations. Visualization generated by MidJourney based on author's prompt.

Algorithmic Governance of Food Sustainability in Toronto

By 2035, Toronto operates under a Disciplined Society where a centralized AI system, manages city resources and mandates sustainability practices. Food establishments function within a strict regulatory framework that monitors, measures, and controls every aspect of their operations.

The system's subscription-based supply chain model automatically adjusts ingredient availability based on real-time sustainability metrics. When the government flags ingredients due to carbon threshold violations or resource constraints, business owners must quickly adapt their menus. The system continuously calculates carbon footprints and can suspend ingredients with immediate effect, as happened with avocados due to water stress in their region of origin.

All food establishments operate under a tiered compliance structure with food inspections verifying that AI monitoring systems haven't been tampered with. Daily compliance scores must stay above threshold levels to avoid reviews and potential fines. While government funding provides financial relief through sustainability transition grants and tax incentives, the constant need to retrain staff and adapt to changing regulations consumes time.

Municipal GrowPods, standardized urban cultivation modules installed outdoor provide some stability in this volatile ingredient landscape. These climate-controlled transparent pods housing herbs and microgreens have become common fixtures since the government launched its "Hyper-Local Health Initiative" to increase urban food resilience and reduce transportation emissions.

Key Takeaway in the Discipline World:

In a tightly regulated Toronto, a centralized AI governs food sustainability through algorithmic control and strict compliance. Quick Service Food Establishments (QSFEs) must adapt to real-time data mandates—automatically revising menus when flagged ingredients like imported avocados exceed carbon thresholds.

A government-regulated, subscription-based supply chain plays a pivotal role in stabilizing this ecosystem. It adjusts ingredient availability and distribution based on sustainability metrics, offering predictability amidst shifting resource policies. This model supports operational continuity while reinforcing ecological accountability.

While public subsidies ease the financial burden, time-consuming audits, ongoing employee retraining, complex bureaucratic procedures dominate daily operations.

Municipal GrowPods at every street corners offer localized resilience, but the tension between compliance and consistency often frustrates loyal customers expecting reliable service.

Business Development Insights for QSFE SMEs:

Compliance Automation Infrastructure:

SMEs should invest in compliance automation infrastructure that integrates directly with TRON to reduce manual reporting requirements, while considering forming cooperatives with other small

businesses to share costs of compliance technology. Developing subscription models necessity-driven circular economic practices. Develop simple, low-tech systems for biogas production from food waste to reduce dependency on unreliable utility infrastructure.

Hyper-Local Supply Networks:

Forge direct relationships with urban farmers and local producers, potentially investing in shared growing spaces to secure priority access to limited harvests while reducing transportation vulnerabilities.

Adaptive Repurposing:

Develop expertise in equipment repair and adaptation, creating functional operations from salvaged components when new replacements are unavailable or prohibitively expensive. Maintain simplified technologies that can be repaired with locally available materials and skills.

A Day in the Discipline Future : Green Code

Business Preparation (6:00 a.m.)

Evelyn, a café owner makes a quick stop at her restaurant's sidewalk GrowPod—one of thousands of standardized urban cultivation modules funded through Toronto's "Hyper-Local Health Initiative." The pod glows softly in the early morning light, its climate-controlled interior housing neat rows of herbs and microgreens. Using her ID badge, she unlocks the pod and steps inside, breathing in the humid, earthy air as she carefully harvests basil, mint, and microgreens for the day's menu.

These municipal GrowPods have become a common fixture outside restaurants since 2031, when the government launched the subsidy program to increase urban food resilience and reduce transportation emissions.

Morning Compliance Check (7:00 a.m.)

Evelyn starts her day early in her small café's back room, double espresso in hand. She powers on AI dashboard pulses to life with the control panel. A green status indicator flashes briefly before turning yellow. "Notice: Chicken-based items have been restricted today due to a carbon threshold violation in your district. Suggested substitute: Lab-grown protein patty with turmeric glaze. “

The breakfast rush is in full swing when two Municipal Compliance Officers enter, "Routine verification," the lead officer announces, scanning the QR code that connects to Evelyn's profile. They inspect the indoor waste separation stations and verify that the packaging matches approved materials.

Lunch Rush (12:00 p.m)

Digital menus update in real time across tablet stations and wall displays as it calculates the carbon footprint of each dish. Suddenly, Evelyn's smartwatch pings with a priority alert : “Avocados are suspended due to water stress in their region of origin for 5 months”. The guac toast vanishes from the display, replaced by a carrot-cashew pâté alternative .

Community Compliance Training (4:00 p.m.)

Evelyn joins a video call with other local business owners. The monthly strategy session for navigating government’s requirements. Today's topic: the new Carbon-Neutral Kitchen certification that will become mandatory next quarter. A black market dealer briefly joins to offer "compliance workarounds" before being removed from the call.



Fig 41-46, Appendix L . Daily life scenes in the Disciplined Society scenario (e.g., municipal GrowPods, real-time ingredient bans, compliance monitoring). Visualizations generated by MidJourney based on author's prompt.

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1. Avocados are suspended due to water stress in their region of origin for 5 months due to its farming method and long distance logistics
2. The sleek, transparent pod glows softly in the early morning light, its climate-controlled interior housing neat rows of herbs and microgreens.
3. Evelyn joins a video call with other local business owners—their monthly strategy session for navigating TRON's ever-changing requirements.
4. Two Municipal Compliance Officers head to the back alley to check the outdoor garbage bins
5. Evelyn starts her day early in her small café's back room, double espresso in hand. She powers on her tablet—the AI dashboard pulses to life with the TRON interface.
6. Under subscription model, the supplier stops supplies chicken. Dashboard shows the chicken-based items have been restricted today.



Transformation Future

Fig 47, Appendix L. Transformation scenario: Community-centred food hubs and circular economy practices. Visualization generated by MidJourney based on author's prompt.

Community-Powered Food Systems in Toronto

Toronto has evolved into a community-driven ecosystem where QSFEs operate as multi-purpose food hubs owned by local entrepreneurs. These hubs leverage AI-optimized networks, serving professionals during weekdays while transforming into community spaces on weekends, utilizing digital community credits to incentivize sustainable behaviour.

The Food-as-a-Service (FaaS) model connects farmers directly to restaurants through blockchain-verified smart contracts, giving agricultural producers control over distribution while providing establishments with fresher ingredients and enhanced traceability. Small urban farms within Toronto thrive through guaranteed purchase agreements with neighbourhood food hubs.

Hyperlocal production combines with waste-to-resource systems like on-site biodigesters that transform food scraps into biogas, establishing closed-loop nutrient cycles reinforced through government incentives. Communities convert waste into compost or animal feed used by local farms, then supply produce back to food establishments.

Waste management has evolved from flat fees to dynamic models based on real-time data. Heavy waste generators pay more, while minimal producers pay less.

Cooperative ownership enables SMEs to share risks and decision-making responsibilities while addressing digital security challenges and regulatory uncertainties. This technology-enabled equitable model demonstrates how small businesses thrive through collaboration and innovation.

Key Takeaway in the Transformation World:

Through community and sustainability efforts by 2035, Toronto becomes a hub where small quick food restaurants are reimagined as multi-purpose food hubs owned by local entrepreneurs. AI-optimized networks keep these hubs operational for professionals during weekdays and transform into community event spaces over weekends through the use of digital community credits to acknowledge eco-friendly behaviours.

The combination of urban farm vegetables with on-site biodigesters that transform waste into biogas forms a closed-loop system supported by government subsidies. The FaaS model connects farmers directly with food hubs through real-time ordering systems, providing unprecedented supply chain control. Food waste becomes valuable input in closed nutrient loops, transformed into compost and animal feed for local farms, which then supply fresh produce back to the hubs that creating true circularity.

The dynamic waste management pricing that shifts from flat fees to pay-per-use models creates powerful financial incentives, particularly benefiting SMEs by reducing costs for minimal waste producers. SMEs benefit from shared risk management and decision-making in cooperative ownership structures but must confront ongoing digital security threats and regulatory ambiguities. The technology-focused equitable model demonstrates how SMEs achieve success through collaborative innovation which transforms Toronto's food industry.

Business Development Insights for QSFE SMEs:

Space Flexibility Design:

Invest in modular infrastructure that allows quick reconfiguration between different functions, maximizing usage hours and revenue streams. Design spaces that can transition seamlessly from daytime dining to evening events or weekend workshops with minimal staff intervention.

Community Ownership Transition:

Explore graduated approaches to cooperative ownership that allow traditional owners to maintain guidance while bringing in community stakeholders. Develop clear governance protocols that balance inclusive decision-making with operational efficiency.

Closed-Loop Systems:

Implement integrated waste-to-resource technologies like biodigesters that convert organic waste into energy or fertilizer, creating multiple value streams while reducing disposal costs. Form partnerships with complementary businesses to create material exchange networks that maximize resource utilization.

Dynamic waste management pricing:

Added information about how real-time data allows waste management fees to shift to a pay-per-use or subscription tier model, where heavy waste generators pay more while minimal users pay less.

Farmer-integrated FaaS platform:

Added details about how farmers connect directly to restaurants through the FaaS model, giving them greater control over supply and providing restaurants with fresher ingredients.

A Day in the Transformation Future: Looptopia

Modular Space Transformation (6:30 a.m.)

Jordan, a shared owner of a food hub, arrives early to witness the hub's daily metamorphosis. A ramen booth that served late-night diners yesterday is now transforming into a juice bar for the morning crowd. The modular design allows spaces to shift functions with minimal effort—panels slide, counters rotate, and digital displays instantly update with new menus. By 6:45 a.m., the transformation is complete, and the first customers are already ordering fresh-pressed juices from ingredients harvested just hours ago on the rooftop farm.

Morning Harvest and Menu Planning (7:00 a.m.)

Jordan starts his day at the urban farm connected to the hub, meeting with the farm's manager to review the day's harvest. The AI system, which tracks soil health and weather patterns, suggests a kale Caesar wrap as today's special, optimized for nutrition and resource use. Jordan approves and updates the digital menu board, which syncs with the city's food network, alerting nearby hubs to his surplus tomatoes for potential trade.

Supply Management (9:00 a.m.)

At his workstation, Jordan opens his laptop to process the day's orders from his order plan in this month. The screen displays a map of Toronto with all partner farms highlighted, their current harvests and availabilities clearly visible. He orders fresh carrots from UrbanRoots Farm in the east end, selecting a delivery time that coincides with another hub's delivery to optimize transportation efficiency. The system automatically calculates the carbon footprint of the transaction and allocates community credits to reward the low-impact choice.

Community Credit Workshop (10:00 a.m.)

Jordan hosts a workshop for new co-owners and local entrepreneurs on earning and redeeming digital community credits. He explains how the decentralized currency rewards actions like sourcing locally or reducing waste, and how credits can be used for purchasing ingredients or accessing shared equipment. When asked about security, Jordan highlights the blockchain system ensuring transparency and trust.

Lunch Rush and Resource Optimization (12:30 p.m.)

As the lunch crowd arrives, Jordan monitors the AI dashboard on his tablet, tracking energy use, waste generation, and customer flow. When the system detects a spike in kale wrap orders, it adjusts the next day's harvest request. A notification offers surplus compost from another hub's biodigester, which Jordan claims for the farm, earning extra community credits.

1. In the kitchen, a screen on the fridge displays a notification: "Eggplant is arriving." This highlights the efficiency of the supply chain, seamlessly connecting the local farm network to the kitchen in the hub.
2. A large screen in the food hub displays upcoming events for the next two weeks, including a cooking class and a running club.
3. On a laptop screen, Jordan places an order for fresh carrots from a farm in Toronto. Technology enables direct connections between urban consumers and regional farmers.
4. A customer taps their smartwatch on a POS system to pay 10 credits. In the hub, physical currency is no longer used—credits are the standard mode of payment.
5. A mother introduces the farmer data and purchases fresh from the hub with her kid
6. A restaurant staff places her kitchen waste to the food hub garage bin. It directly claims the community credits to her account.
7. In the morning, a ramen booth transforms into a juice bar. The multi-functional design of food stations in the hub

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Fig 48-54, Appendix L. Daily life scenes in the Transformation scenario (e.g., modular food hubs, rooftop farms, community credit system). Visualizations generated by MidJourney based on author's prompt.



Ideas from the Futures

Extracting Actionable Insights from Multiple Futures

Selected Innovations Across Futures

Drawing from the exploration of Dator's Four Futures—Growth, Disciplined Society, Transformation, and Collapse, I identified several innovative business models that could empower QSFE SMEs to adopt circular food practices. These ideas represent the most promising elements from each future scenario that could be implemented in Toronto's urban food system.

Rather than predicting a single outcome, the approach acknowledges that multiple futures are possible. By exploring diverse scenarios, I have extracted valuable innovations from each potential trajectory and synthesized them into strategic pillars that help SMEs navigate toward preferred outcomes regardless of which future emerges.

The strategic pillars range from technology-driven solutions like automated inventory systems (from Growth futures) to collaborative models like shared food hubs (from Transformation futures) and regulatory-supported approaches like subsidized sustainable logistics (from Disciplined Society futures). Each pillar addresses specific barriers identified in our systems mapping while offering practical pathways toward circularity that benefit Toronto's unique QSFE landscape.

These strategic pillars were prioritized based on four key criteria:

- (1) addressing critical barriers identified in the systems mapping;**
- (2) demonstrating financial viability alongside environmental benefits;**
- (3) implement ability with reasonable resource requirements for SMEs; and**
- (4) alignment with Toronto's existing policy direction.**

While all four futures contained valuable insights, Transformation and Disciplined Society scenarios yielded more applicable strategic pillars due to their stronger emphasis on systemic change and collaborative structures. The pillars draw from across future scenarios to ensure resilience regardless of which trajectory emerges.

Pillar 1

Shared & Collaborative Infrastructure

Modular, Circular Infrastructure Leasing:

SME-focused leasing services providing modular, sustainable equipment (hydroponics modules, vertical farming units, composting systems). This reduces upfront investment, enabling SMEs to adapt their business models and scale as needed.

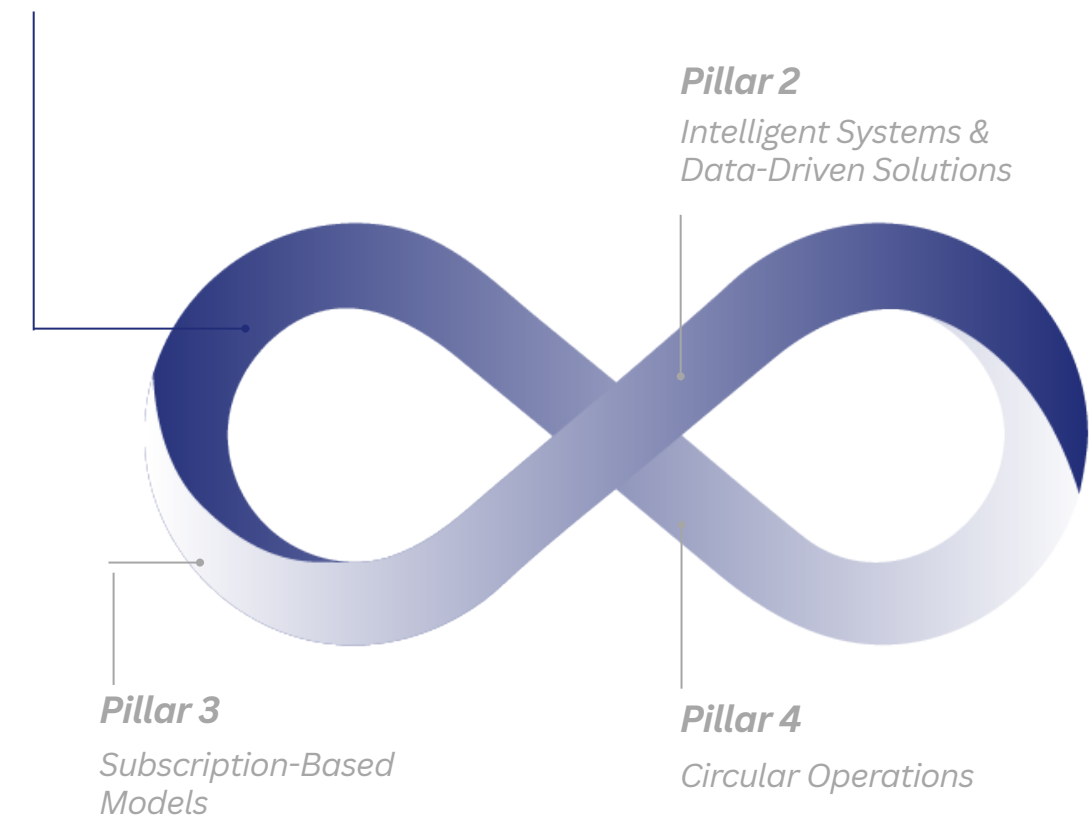
Sensory Exchange Platforms:

Besides just bartering goods, create systems where restaurants can "trade" uniquely developed flavours, fermentation cultures, or proprietary techniques through secure digital rights management.

Local Currency and Barter Systems:

Creation of local currencies or bartering platforms allowing SMEs to exchange surplus products or services within communities during disruptions. This strengthens local economies, fosters business continuity, and builds tight-knit economic ecosystems.

Micro-Manufacturing Food Nodes: Distributed micro-production facilities where SMEs can access bioreactors for creating alternative proteins or cellular agriculture components, dramatically reducing food miles.



Pillar 2

Intelligent Systems & Data-Driven Solutions

Adaptive Circular Menu Design:

AI-driven platforms that analyze seasonal data, local climate conditions, and consumer preferences to help SMEs rapidly redesign menus using surplus ingredients, enhancing resilience to supply fluctuations.

Blockchain-based Resilience Credits:

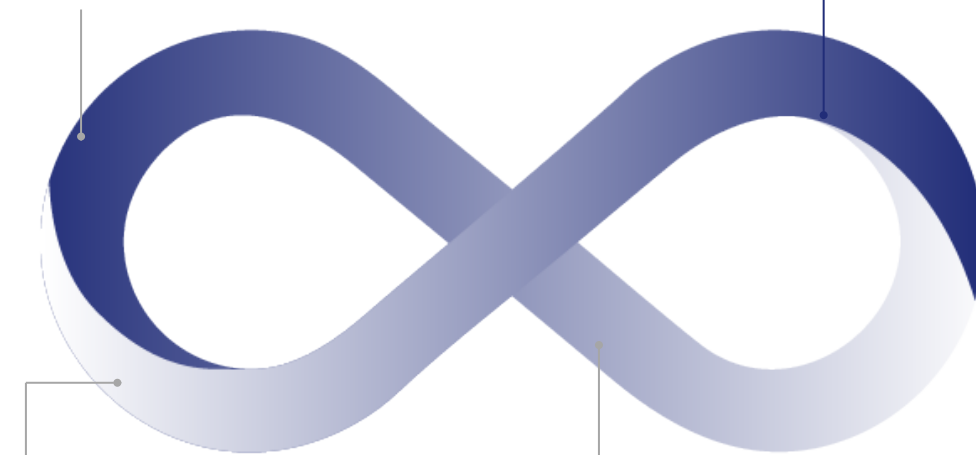
SMEs rewarded with digital resilience tokens for actions enhancing circularity (e.g., composting, waste reduction, local sourcing). Tokens become redeemable for tax incentives, subsidies, or peer-to-peer SME services.

Predictive Supply Chain:

AI-driven supply chain analytics specifically tailored for SMEs, predicting supply disruptions and suggesting alternative local circular suppliers, stabilizing procurement processes.

Pillar 1

Shared & Collaborative Infrastructure



Pillar 3

Subscription-Based Models

Pillar 4

Circular Operations

Pillar 1

Shared & Collaborative Infrastructure



Pillar 2

Intelligent Systems & Data-Driven Solutions

Pillar 4

Circular Operations

Pillar 3

Subscription-Based Models

Supply Chain Optimization:

Subscription services provide predictable demand patterns, enabling AI-driven inventory and logistics management and reducing overproduction waste to allow precise ordering from suppliers.

Community-supported Circular Food Subscriptions:

Subscription models offering stable revenues by connecting SMEs directly with local communities. Customers regularly receive sustainable, circular-produced food items, ensuring stable cash flow and mitigating market volatility.

Customer Loyalty and Engagement:

Subscription models build lasting relationships with customers committed to sustainability. Digital community credits integrated with subscriptions could reward customers for sustainable behaviours like returning reusable packaging.

Time-Shifted Consumption:

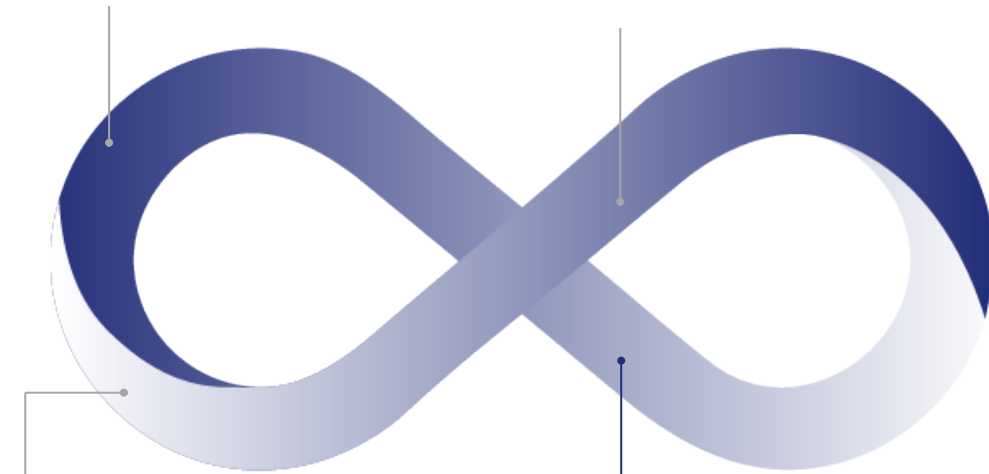
Models where customers subscribe to future harvests at discounted rates, providing immediate capital for SMEs while creating financial incentives for long-term ecological stewardship.

Pillar 1

Shared & Collaborative Infrastructure

Pillar 2

Intelligent Systems & Data-Driven Solutions



Pillar 3

Subscription-Based Models

Pillar 4

Circular Operations

Upcycled Food Products:

Systems to transform potential food waste into valuable menu items, creating new revenue streams while reducing disposal costs.

Waste-to-Energy-to-Food Loops:

Integrated systems where organic waste generates energy that powers indoor growing systems providing ingredients back to the same food businesses.

Composting and Nutrient Recovery:

Methods to capture and process organic waste, returning nutrients to local food production systems.

Concept Testing with SMEs

To validate these ideas, I presented seven core business model innovations to 12 Toronto QSFE operators during interviews to gauge their interest (on a scale of 1-5) and identify potential implementation barriers. Their feedback revealed varying degrees of receptiveness:

Ideas / Applications	Description	Associated Future(s)	Rating	Interest By Business Type
Automated Inventory & Waste Reduction System	Use AI-driven technology to optimize food inventory and minimize waste, automatically adjusting purchasing based on demand forecasts.	Growth, Transformation	4.3/5	Bakery, Asian Fast Food
Government-Subsidized Sustainable Logistics / waste management	Receive financial incentives or tax benefits for adopting sustainable logistics (e.g., electric delivery vehicles, reusable packaging, composting systems).	Discipline, Transformation	3.9/5	Pizza and Italian Restaurant
Shared Infrastructure Leasing	Join a platform where multiple restaurants share delivery and logistics infrastructure, reducing costs and increasing efficiency.	Transformation	3.4/5	Pizza and Italian Restaurant
Community-supported Circular Food Subscriptions	Offer customers meal plans or prepaid credits for recurring purchases (e.g., a café offering a monthly coffee subscription or a bakery delivering weekly fresh bread).	Growth, Transformation	3.3/5	Bakery, Asian Fast Food
Zero-Waste Meal Kits Collaboration	Partner with local grocery stores and producers to create ingredient kits that use surplus food, reducing waste and offering sustainable meal options.	Growth, Disciplined	3.3/5	Pizza Restaurant, Bakery
Adaptive Circular Menu Design	Analyze seasonal data, local climate conditions and consumer preferences to rapidly redesign menu	Transformation	3.2/5	Pizza Restaurant, Bakery
Circular Skills Development Hubs	SME-oriented learning and innovation centers focused on circular economy skills training and sharing	Transformation	3.0/5	Pizza and Italian Restaurant
Digital Dining and Operational Credits	Customers earn and redeem credits for sustainable behaviors and SMEs reward with the tokens for actions enhancing circularity.	Transformation	3.0/5	Pizza Restaurant, Bakery

Automated Inventory & Waste Reduction Systems ranked highest (average 4.3/5) across business types. The bagel shop manager explained it "will help me a lot" with ingredient management, while the boba tea manager valued its potential for "smart inventory" to reduce waste. This enthusiasm suggests immediate operational pain points that technology could address.

"Automated Inventory & Waste Reduction Systems will help me a lot"

"Currently we have to manage the inventory manually"

"Connecting the small suppliers will be helpful. There are many small farms even we can only make orders by phone."

"I don't have time to learn new technology. It feels too overwhelming for me, and I'm not part of the younger generation."

Government-Subsidized Sustainable practices (average 3.9/5) resonated particularly with established businesses struggling with costs. The coffee roaster explained that "incentive will help" overcome their "limited budget," revealing how financial support could bridge the gap between sustainability aspirations and economic realities.

Subscription-Based Models showed varied interest (average 3.3/5), with notable differences by business type. The bakery's enthusiasm (4/5) contrasted with the noodle restaurant's hesitation (2/5), demonstrating how business models must be tailored to specific operational contexts.

Other concepts received moderate ratings, with Digital Dining and Operational Credits scoring lowest (3.0/5). The noodle restaurant owner's comment that she had "no time to learn, I am not young" highlights how generational and technical literacy factors must be considered in any digital innovation strategy.

It's important to acknowledge the inherent present bias in these concept evaluations. Business owners naturally filter future possibilities through their current operational challenges, financial constraints, and technological comfort levels. This creates a preference for innovations that address

immediate pain points (like inventory management) over more transformative but less familiar concepts (like digital dining and operational credits). While this bias limits the predictive validity of such concept testing, it simultaneously provides crucial insights into the practical adoption barriers that any future implementation strategy must address to succeed.

The interviews revealed significant knowledge gaps and practical challenges. One restaurant owner candidly admitted, "I don't know what is circular economy, but I believe I have sustainable practices for my community," highlighting how sustainability often exists in practice without formal frameworks. The Italian restaurant owner emphasized the importance of supplier relationships, noting, "There are many small farms even we can only make orders by phone," pointing to the persistence of traditional supply chains despite digital transformation opportunities.

Three consistent implementation barriers emerged across concepts:

Cost concerns: Nearly all respondents emphasized financial constraints, with the coffee roaster noting their "limited budget to start business." This reveals how circular innovations must demonstrate clear financial returns to gain traction.

Learning curves: The age and technical comfort of owners significantly influenced receptiveness. As one owner candidly stated, "I am not young," suggesting that implementation strategies must account for varying digital literacy levels.

Operational flexibility: Owners prioritized adaptable solutions, with the coffee roaster specifically emphasizing "flexibility of the application" as crucial for their diverse operational needs.

Human resource challenges emerged as a significant underlying factor affecting technology adoption. As one restaurant owner stated, "Training staffs are the biggest challenges," indicating that even promising innovations face practical implementation hurdles in high-turnover environments with limited training resources.

These implementation barriers could be addressed collaborative infrastructure pillars and skills development Hubs, which reduce financial burden through shared resources and build necessary capabilities.

Toward an Integrated Approach to Food System Change

The four strategic pillars identified through our futures exploration provide valuable elements for circular transformation, but need to be integrated into a cohesive framework to achieve systemic change. The concept testing with SMEs revealed that while individual pillars have merit, they would be most effective as part of an integrated approach that addresses multiple barriers simultaneously.

Analysis of the strategic pillars reveals natural synergies between them. For instance, subscription-based models create financial stability that can fund intelligent systems, while shared and collaborative infrastructure reduces the financial barriers to implementing circular operations. These interconnections suggest the need for a comprehensive framework that leverages these synergies rather than implementing pillars in isolation.

In Section 6, I introduce Food-as-a-Service (FaaS) as the integrative strategic framework that synthesizes these pillars into a coherent implementation pathway for Toronto's QSFE sector. This framework transforms individual strategic pillars into interconnected components of a holistic circular food system model.



Pathways to Transform QSFE Futures

FaaS as a Transformative Model for Circular Food Systems

Precedent Analysis

From Vision to Reality

Risk Assessment & Mitigation Strategies

Key Performance

The Path Forward

Food-as-a-Service (FaaS) as a Transformative Model for Circular Food Systems

The Food-as-a-Service (FaaS) model originated from the broader "as-a-service" revolution that transformed numerous industries—from Software-as-a-Service (SaaS) to Transportation-as-a-Service (TaaS). FaaS represents a paradigm shift that reimagines food not as a product to be purchased and discarded, but as a managed service integrated into circular systems.

At its core, FaaS is a business approach where food is provided as a managed, often subscription-based service, contrasting with traditional food acquisition methods. It integrates technological solutions for convenience, customization, and reduced planning burden while creating predictable revenue streams for businesses.

Global market validation supports this approach. The foodservice industry is projected to reach USD 1 trillion by 2028 with fintech integration playing a transformative role in enabling subscription-based business models (Grand View Research, 2022). Consumer readiness for subscription services in food is growing, with digital payment methods facilitating recurring transactions and building predictable revenue streams. The FaaS concept extends beyond traditional offerings to include ghost kitchens, smart vending, and collaborative food platforms, offering flexible implementation options for diverse QSFE business models.

FaaS Strategic Framework Addressing the Systemic Challenges

The Food-as-a-Service (FaaS) framework represents a niche-level innovation intentionally designed to challenge the entrenched dynamics of Toronto's Quick Service Food Establishment (QSFE) regime. Informed by the Multi-Level Perspective (MLP), this strategy acknowledges that regime transformation depends on interactions between grassroots experimentation (niche), prevailing institutional structures (regime), and larger societal trends (landscape). Landscape pressures such as climate targets, evolving SMEs and customers values, and smart city policies are increasing misalignment within the current regime—creating windows of opportunity for niche innovations like FaaS to scale.

Each of the four components below—shared infrastructure, intelligent systems, subscription models, and circular operations—targets a specific feedback loop embedded in the regime. Together, they form an integrated pathway toward systemic change. The accompanying diagram (Figure X) visualizes how these niche interventions engage with regime-level challenges while responding to external landscape trends.

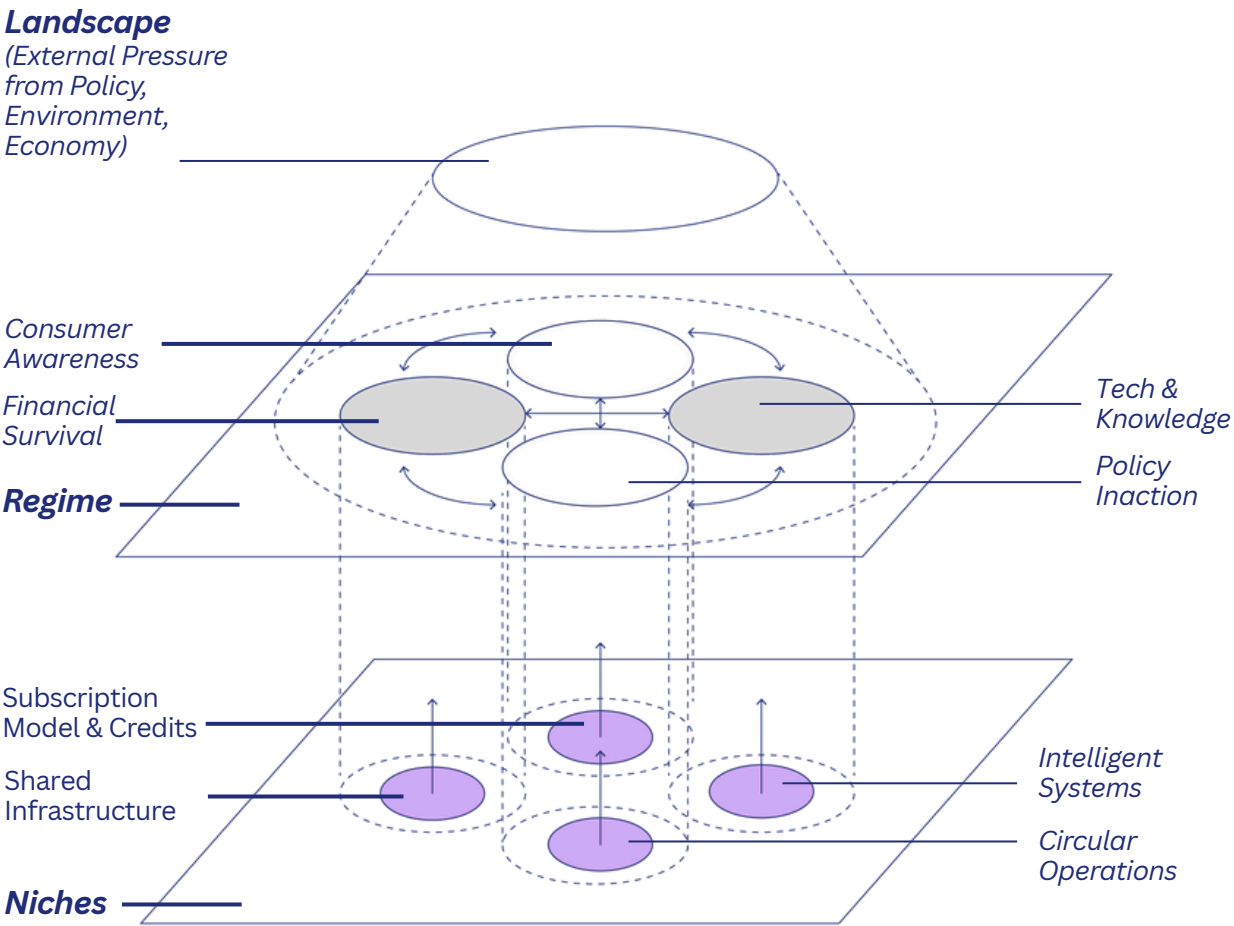


Fig 55. A Multi-Level Perspective view of Toronto's Food-as-a-Service pathway: niche innovations (bottom) align with landscape-level sustainability drivers (top) to re-configure the incumbent QSFE regime (middle)

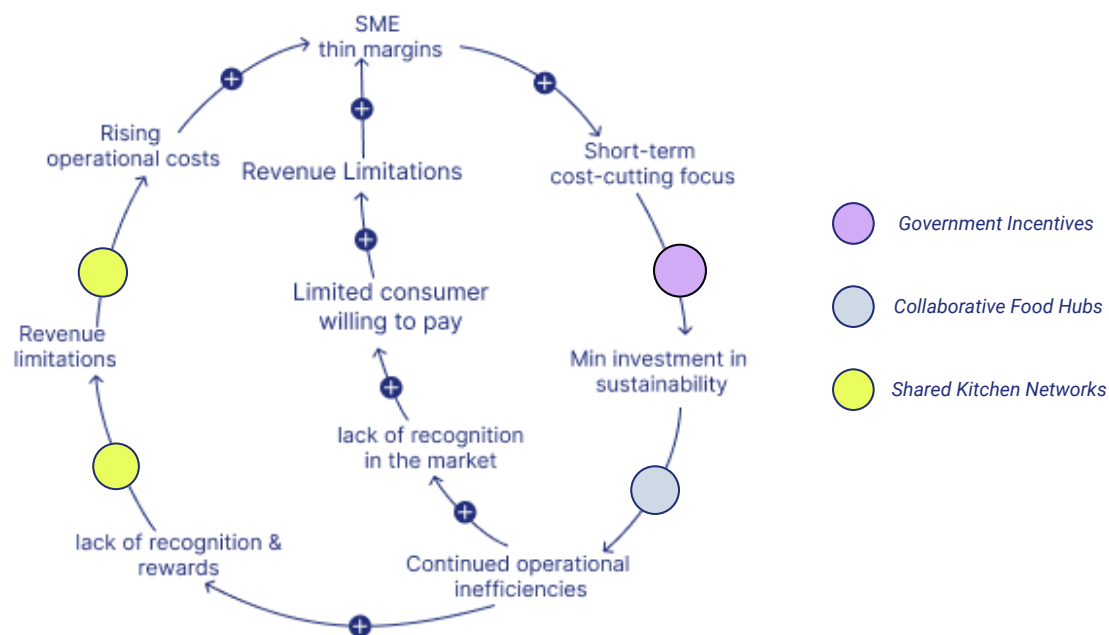


Fig 12a. Financial Survival Loop create by author (Please see Appendix E for entire causal loop)

Intervention 1: Breaking the Financial Survival Loop Shared and Collaborative Infrastructure:

The Financial loop shows how thin margins drive short-term cost-cutting, minimal sustainability investment, continued operational inefficiencies, market differentiation challenges, and revenue limitations. The Shared Infrastructure component disrupts this cycle through:

- **Government Incentives:** Providing financial support that counteracts the short-term cost-cutting focus and enables sustainability investments despite thin margins
- **Collaborative Food Hubs:** Multi-purpose spaces where resource-sharing eliminates redundancies and creates economies of scale that make circular practices financially advantageous
- **Shared Kitchen Networks:** Distributed production facilities that reduce individual overhead costs while maximizing operational efficiency through specialized equipment and expertise

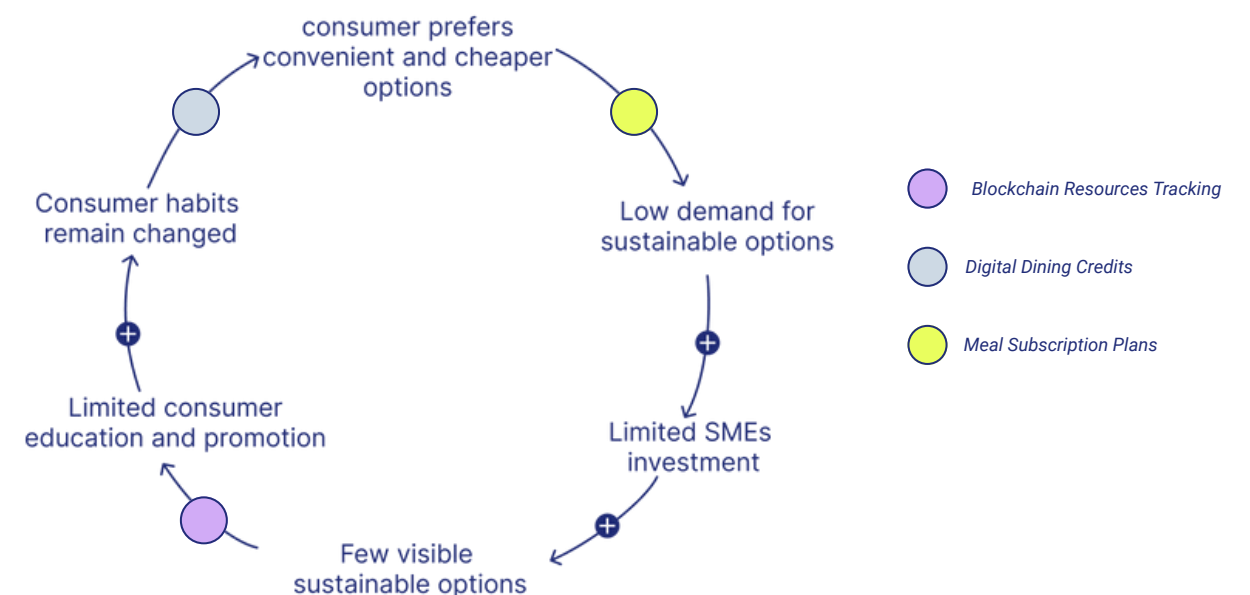


Fig 13a. Consumer Awareness and Demand Loop create by author (Please see Appendix E for entire causal loop)

intervention 2: Addressing Demand and Supply by Subscription Models

The Consumer Awareness loop demonstrates how consumer preference for convenience and cheaper options leads to low demand for sustainable options, limited SME investment, few visible sustainable options, limited consumer education, and unchanged habits. The Subscription Models component targets this through:

- **Blockchain Resources Tracking:** Enhancing consumer education by making sustainability transparent and visible
- **Digital Dining Credits:** Shifting consumer habits by rewarding sustainable choices through integration with popular payment methods and emerging fintech solutions (refer to Euromonitor, it is possible to leverage existing digital wallet adoption and Buy-Now-Pay-Later services to incentivize sustainable purchasing) (Euromonitor, 2024)
- **Meal Subscription Plans:** Creating convenient, affordable and sustainable options that align with consumer preferences while providing predictable revenue streams for SMEs.

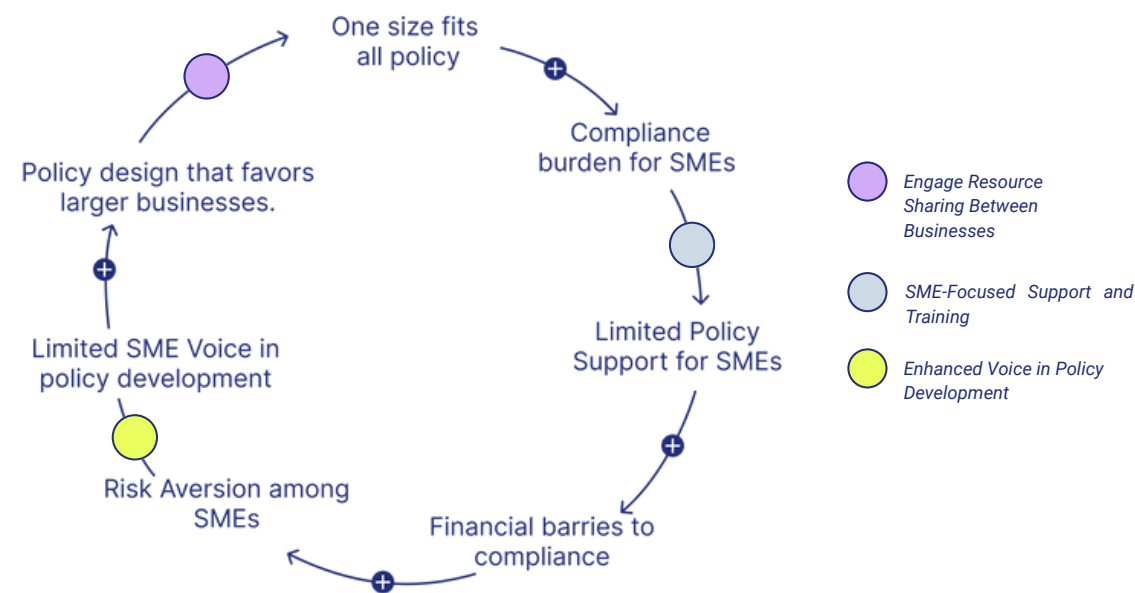


Fig 14a. Policy Inaction and Regulatory Burden Loop create by author
(Please see Appendix E for entire causal loop)

Intervention 3: Reforming the Policy Framework Loop with Circular Operations Initiatives

This loop illustrates how one-size-fits-all policies create compliance burdens for SMEs, limiting policy support, creating financial barriers to compliance, increasing risk aversion, limiting SME voice in policy development, and perpetuating policies that favor larger businesses. The Circular Operations component addresses this through:

- **Engage Resource Sharing Between Businesses:** Countering the bias toward larger businesses by enabling SMEs to pool resources for upcycling, composting, and packaging systems
- **SME-Focused Support and Training:** Reducing compliance burdens through targeted assistance programs for waste reduction and circular practices
- **Enhanced Voice in Policy Development:** Creating mechanisms for SMEs to collectively demonstrate successful circular approaches that inform policy creation

These interconnected components transform the strategic pillars identified in Section 5.4 into a comprehensive framework for Toronto's transition to a circular food system by 2035. Rather than proposing isolated pillars or incremental improvements to the current system, the FaaS strategic framework integrates these elements into a transformative redesign the system simultaneously.

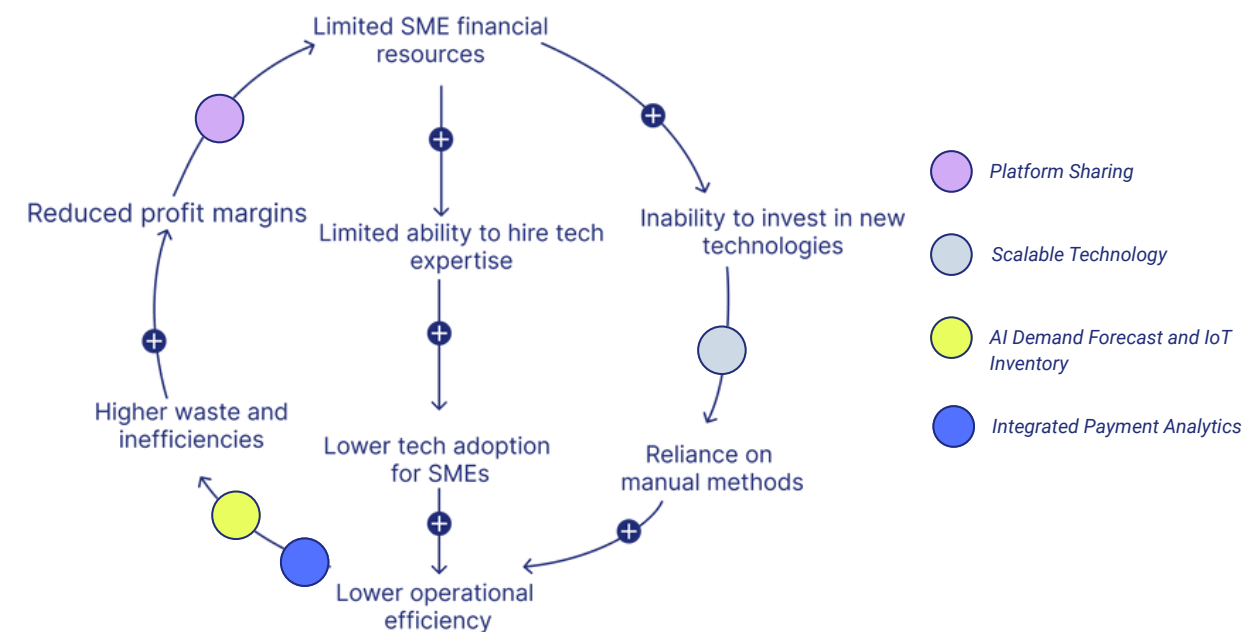


Fig 15a. Technology and Knowledge Loop create by author
(Please see Appendix E for entire causal loop)

Intervention 4: Disrupting the Technology Adoption Loop from Scalable Intelligent Systems & Data-Driven Solutions

The Technology and Knowledge loop reveals how limited SME financial resources prevent investment in new technologies, leading to reliance on manual methods, lower operational efficiency, higher waste, and reduced profit margins. The Intelligent Systems component addresses this through:

- **Platform Sharing:** Distributing technology costs across multiple businesses to overcome limited financial resources and improve profit margins
- **Scalable Technology:** Implementing right-sized solutions that transition SMEs from manual methods to appropriate digital systems
- **AI Demand Forecast and IoT Inventory:** Advanced systems that enable even the smallest operations to eliminate overproduction and optimize resource use
- **Integrated Payment Analytics:** Leveraging transaction data to generate insights on consumer behavior that can be used to optimize menus and reduce waste

Precedent Analysis

Global Success Stories of Circular Food Innovation

Berlin: Tech-Driven Shared Infrastructure

Delivery Hero's Virtual Restaurant Platform: Berlin-based Delivery Hero has implemented a data-driven shared kitchen concept that allows SMEs to operate multiple digital restaurant concepts from a single kitchen. Its AI-powered demand forecasting reduces inventory waste, while participating restaurants report 30% increase in kitchen capacity utilization. The platform's shared last-mile delivery logistics decrease delivery emissions compared to individual operations. Delivery Hero's technology stack includes sophisticated database solutions that enable real-time operations monitoring and performance optimization through gamification interfaces for restaurant partners (Delivery Hero Sustainability Report, 2023; Amazon Web Services, 2022).

KitchenTown Berlin:

This food innovation hub combines shared production facilities with digital integration, providing tech-enabled kitchen infrastructure that significantly reduces startup costs for food entrepreneurs. Its integrated IoT monitoring system tracks resource usage and waste in real-time, with participating SMEs reporting notable reductions in operational costs compared to individual facilities. The hub's digital marketplace platform connects producers directly with consumers, streamlining supply chains and reducing intermediaries.

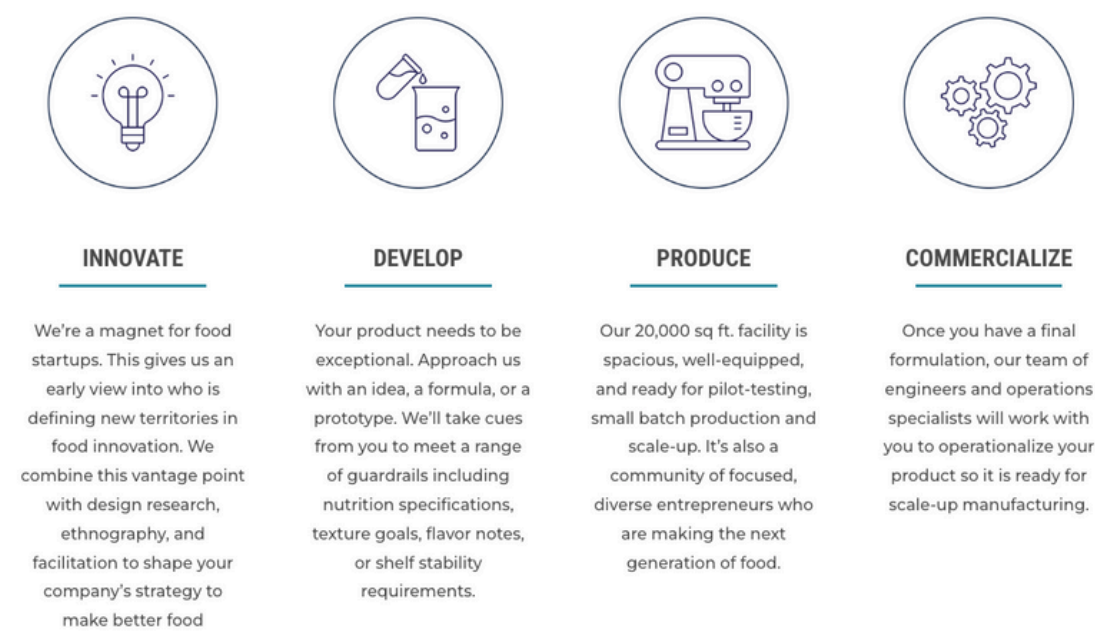


Fig 56. Co-innovation services provided by KitchenTown Berlin. Adapted from KitchenTown (n.d.).

Singapore: Technology-Driven Urban Food Production

Singapore has established global leadership in integrating advanced technology with urban food systems:

ComCrop's Rooftop Hydroponics:

Singapore's first commercial rooftop farm supplies restaurants with locally grown produce using IoT-monitored hydroponic systems. The operation reduces water usage by 90% compared to conventional farming and decreases food miles by up to 99% for participating restaurants. The farm achieves yields up to 4kg of vegetables per square meter (compared to 2-3kg for traditional farming), and partner restaurants report 15-25% reduction in produce spoilage due to freshness and reduced transport time (Godge , 2022, Tan 2022).

Insectta's Biological Waste Processing:

This innovative operation uses IoT-monitored systems to convert food waste into value through black soldier fly larvae, processing up food waste daily and transforming it into agricultural inputs. The system uses digital sensors to optimize conversion rates, achieving a 15% improvement over manual methods. Partner QSFs using the platform report waste management cost reductions of 15-20% through the technology-enabled circular approach (Chan & Nair, 2021)



Fig 57, Appendix J. Singapore's first commercial rooftop farm, ComCrop. Adapted from ComCrop (n.d.).



Fig 58, Appendix J. Insectta startup: Using black soldier flies to convert food waste into biomaterials. Adapted from Insectta (n.d.).

United States: Blockchain-Enabled Food Transparency

Regen Network's Farm-to-Restaurant Platform:

This US-based initiative uses blockchain technology to connect food establishments with regenerative farms through a transparent digital ecosystem. The network has created significant environmental impact, with 588,448 carbon credits retired and over 2 million new credits created in 2023 alone. Their platform encompasses more than 15 million hectares of land globally, working with high-impact ecological project developers. Through 40+ innovative methodologies under development, Regen Network measures improvements in ecological state, enabling restaurants to confidently source and market ingredients from farms with verified regenerative practices and quantifiable environmental benefits. (Regen Network, 2024)

ECOLOGICAL CREDITS IN THE DIGITAL VOLUNTARY CARBON MARKET

Regen Marketplace allows project developers to sell their ecological credits to buyers around the world.



PROJECT DEVELOPERS

Enroll with Regen Registry

Finance your ecological regeneration project by enrolling in a crediting program and access demand

EXPLORE REGEN REGISTRY



BUYERS

Purchase innovative ecocredits

Seamlessly purchase, trade, and retire digital ecological assets with transparency & accountability

LEARN ABOUT BUYING

Fig 59. Regen Marketplace platform for trading digital carbon and ecological credits. Adapted from Regen Network (n.d.).

London: AI-Powered Waste Analytics for SME Kitchens

Winnow Vision smart-bin network:

Deployed across 23 mid-scale fast-casual kitchens, the AI camera + scale system identified avoidable prep waste in real time. Over a 12-week test period kitchens cut food waste 35 % and saved an average GBP £19 000/site (≈ CAD \$32 000) in ingredient cost. Subscription pricing now starts below CAD \$180/month, bringing advanced waste analytics into the SME affordability band (Winnow, 2024; TechNation UK, 2024).

These global precedents demonstrate that the three core components of our FaaS model—shared infrastructure, digital integration, and subscription models—are not merely theoretical concepts but proven approaches with measurable impacts. By adapting these technology-driven models to Toronto's unique context, we can achieve similar benefits while creating locally relevant implementations.



Fig 60, Appendix J. Winnow Vision's AI-enabled smart bin solution for food waste tracking. Adapted from Winnow Solutions (n.d.).

Note on data limitations: While these and other precedents demonstrate promising proof of concept for the FaaS model, it is important to acknowledge that detailed operational data and specific impact metrics are often proprietary or not consistently reported in publicly available sources. This highlights a broader challenge in the circular economy field, where comprehensive implementation data that would enable rigorous comparative analysis is limited. The examples provided illustrate the directional benefits of these approaches based on available information, though specific performance metrics would require primary research access to these organizations.

From Vision to Reality

Plotting the Course to 2035

By 2035 Toronto's Quick Service Food Establishments (QSFE) SMEs will transition to a circular food system through a structured backcasting framework that utilizes systemic insights from System Mapping to address financial survival, consumer awareness, waste management, and policy inaction via phased interventions.

Phase 1 (2025-2027): Breaking the Financial Survival Loop

Key Stakeholders:

Local tech startups, Toronto Food Policy Council, Waste Diversion Task Force, Restaurants Canada, City of Toronto Economic Development

Strategic Interventions:

Tech-enabled waste tracking solutions; "Low-Waste Certified" labels; QR carbon footprint trackers; shared composting infrastructure; surplus redistribution platforms similar to Too Good To Go.

Targets:

20% increase in waste diversion; FaaS implementation in 5 pilot SMEs; 10-15% operational cost savings for early adopters.

Technology-driven interventions validate the business case first, demonstrating ROI before policy support and financial incentives are introduced. This creates a market-based foundation for subsequent system changes.

Phase 1: 2025-2027

Technology-driven interventions validate the business case first, demonstrating ROI before policy support and financial incentives are introduced.

Key Stakeholders:

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- Tech-enabled waste tracking solutions
- "Low-Waste Certified" labels
- QR carbon footprint trackers
- Shared composting infrastructure
- Surplus redistribution platforms

Targets:

- 20% increase in waste diversion
- FaaS implementation in 5 pilot SMEs
- 10-15% operational cost savings for early adopters

2025

Technology Foundation

- Tech startups deploy initial AI waste tracking pilots in 15 SMEs
- Liberty Village Business Improvement Area launches tech-enabled "Low-Waste Certified" label program
- First cross-business surplus food marketplace app connects 25 restaurants with local shelters

2026

Proof of Concept

- AI waste tracking data demonstrates 15% cost savings potential, attracting City economic development attention
- Tech companies partner to establish first shared composting hub in Food Building at Exhibition Place
- QR carbon footprint trackers implemented in 40 QSFEs showcase consumer engagement and marketing benefits

(View entire plan in Appendix K)

Phase 2 (2028-2031): Addressing Consumer Awareness and Waste Management Loops

Key Stakeholders: Ontario Green Economy Fund, Ministry of Small Business, QSR industry leaders, cooperative SME initiatives, consumer apps (UberEats, Ritual).

Strategic Interventions: Blockchain-supported community credit systems; AI-powered demand prediction algorithms; surplus redistribution networks; sustainable dining cashback incentives; expansion of shared infrastructure networks.

Targets: Implementation across 15+ SMEs citywide; 50% improvement in resource efficiency; 30%+ of consumer transactions incorporating sustainability considerations.

Phase 2: 2028-2031

With financial viability established, Phase 2 creates the technical infrastructure and consumer engagement mechanisms needed for widespread adoption.

Key Stakeholders:

Ontario Green Economy Fund, Ministry of Small Business, QSR industry leaders, cooperative SME initiatives, consumer apps (UberEats, Skip)

Strategic Interventions:

- Blockchain-supported community credit systems
- AI-powered demand prediction algorithms
- Surplus redistribution networks
- Sustainable dining cashback incentives
- Expansion of shared infrastructure networks

Targets:

- Implementation across 15+ SMEs citywide
- 50% improvement in resource efficiency
- 30%+ of consumer transactions incorporating sustainability

2028

Technology Integration

- Pilot of blockchain-based community credit system in Queen Street West and Ossington food district
- Ritual and UberEats launch sustainable dining rewards program with 30 QSFE partners
- First AI demand prediction tools deployed in 8 different food establishments

Policy Support Introduction

- Based on tech-validated ROI data, City of Toronto introduces targeted QSFE circular business tax incentives
- First 5 SMEs achieve full Food-as-a-Service (FaaS) implementation with tech startup partnership

2029

Network Expansion

- Toronto Food Surplus Network connects 75% of downtown QSFEs
- Second shared composting facility opened in Scarborough Town Centre area
- Ontario Green Economy Fund allocates \$3.5M for QSFE transition projects

2030

Network Scale Up

- Blockchain credit systems expanded to 100+ establishments across 5 districts
- 35% of all QSFE transactions now incorporate sustainability considerations
- Resource efficiency across participating businesses reaches 47% improvement
- Expansion to 15 neighborhood-based circular food districts citywide

(View entire plan in Appendix K)

Phase 3 (2032-2035): Overcoming Policy Inaction and Establishing Circularity

Key Stakeholders:

Federal Sustainable Jobs Plan, Canada Infrastructure Bank, private circular economy funds, citywide food networks, and commercial real estate developers.

Strategic Interventions:

Urban farming integration; AI-powered waste tracking; carbon labeling requirements; financial penalties for non-circular operations; rewards for zero-waste practices; specialized circular economy financing instruments.

Targets:

Circularity as industry standard with 75%+ QSFE SME participation; integration of circular principles in policy frameworks at all government levels; 60%+ waste diversion across the sector.

This phase leverages the evidence base created in earlier phases to implement policy changes that make circular practices the new standard for Toronto's urban food system, positioning the city as a North American leader in circular food systems. The sequential nature of this approach recognizes that addressing one systemic barrier creates the conditions necessary to tackle the next. By strategically sequencing interventions that beginning with technology-driven solutions that demonstrate business value, then building consumer and waste management systems, and finally implementing supportive policy frameworks

Phase 3: 2032-2035

This phase leverages the evidence base created in earlier phases to implement policy changes that make circular practices the new standard.

Key Stakeholders:
Federal Sustainable Jobs Plan, Canada Infrastructure Bank, private circular economy funds, citywide food networks, commercial real estate developers

Strategic Interventions:

- Urban farming integration
- Mandatory AI-powered waste tracking
- Carbon labeling requirements
- Financial penalties for non-circular operations
- Rewards for zero-waste practices

Targets:

- Circularity as industry standard with 80%+ QSFE SME participation
- Integration of circular principles in policy frameworks
- 60%+ waste diversion across the sector

2032

Policy Implementation

- City of Toronto introduces AI-powered waste tracking for all QSFEs
- First commercial development with integrated vertical farming opens in East Bayfront
- Federal Sustainable Jobs Plan allocates \$5M for QSFE circular training programs

Standards Development

- Carbon labeling becomes mandatory for all menu items in establishments over 10 employees
- Circular Economy Financing Hub established with Canada Infrastructure Bank backing
- Non-circular operations face first wave of environmental impact fees

2034

Infrastructure Completion

- Urban farming integration reaches 40% of QSFE establishments
- Zero-waste certification achieved by 200+ Toronto food businesses
- Waste diversion reaches 55% across the sector

2035

System Transformation

- Circular practices become industry standard with 75% QSFE participation
- Full integration of circular principles in municipal, provincial and federal policy frameworks
- Toronto recognized as North American leader in circular food systems

(View entire plan in Appendix K)

Risk Assessment & Mitigation Strategies

The shift toward this model offers Toronto’s QSFE SMEs a compelling pathway toward circularity—but it's not without real risks. If we want this transition to succeed, we need to anticipate the systemic frictions that could arise across technological, financial, regulatory, and behavioural dimensions—and design strategies that work with those dynamics, not against them.

Technological risks come first. Platform fragmentation could lead to data silos, blocking the kind of integrated information flow that circular systems depend on. One solution is establishing open API standards and shared data protocols for Toronto’s food sector, supported by a cross-sector technical working group to co-develop them. At the same time, the digital divide among SMEs could create a split system, where only tech-forward businesses benefit from circular innovations. To address this, we need tiered digital solutions with varying complexity and strong onboarding support tailored for less digitally mature operators. As more operations go digital through IoT or blockchain, new vulnerabilities emerge too, particularly around cybersecurity. Here, sector-specific guidelines and subsidized risk assessments can provide essential safeguards.

On **the financial side**, the barriers are just as critical. Many SMEs won’t have the runway to wait for long-term gains from circular shifts. Staggered implementation strategies that include early wins and rapid-return pilots can help maintain momentum. Offering bridge financing mechanisms for these early phases adds another layer of support. We also have to address value chain imbalances—where some actors may carry more cost than benefit. Rebate schemes or data-sharing incentives can help even this out. And to maintain long-term investment, especially across political cycles, a Circular Food Innovation Fund supported by both public and private actors could offer sustained and diversified funding streams.

Regulatory complexity is another friction point. Policies shift, often unpredictably, across municipal, provincial, and federal levels. Without early policy engagement, uncertainty can stall progress. A dedicated multi-stakeholder advisory group could help align incentives and smooth out these transitions. In addition, many current food regulations were built for linear models and may inadvertently hinder circular practices. A systemic review of regulatory barriers, paired with the creation of “regulatory sandboxes,” would allow for controlled experimentation. Since compliance can disproportionately burden small businesses, it’s essential to create simplified compliance tools and consider tiered regulatory models based on SME capacity.

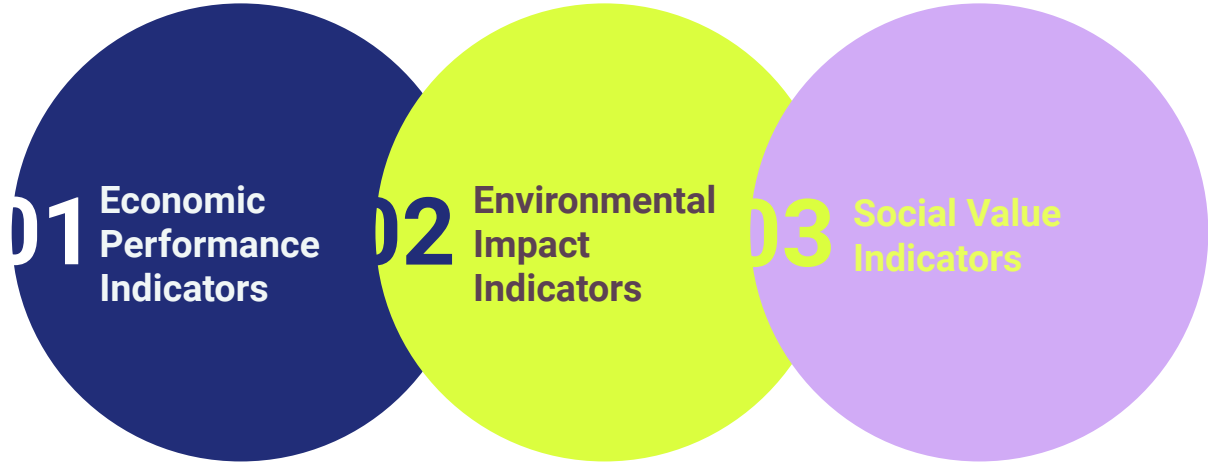
Finally, the **human side** behavioural and cultural factors can’t be overlooked. Consumers may hesitate to adopt new circular offerings, especially if they come with a premium. Awareness campaigns that center not only on sustainability but also on taste, health, or value can make circular choices more relatable. Internally, change fatigue or habitual workflows within SMEs may block innovation.

Practical change management toolkits and peer-led learning networks can support smoother transitions. Misaligned stakeholder incentives can also quietly derail collaborative efforts. That’s why clear governance with transparent roles and shared decision-making protocols—is essential from the start.

To keep things on track, a structured and ongoing risk management process should be embedded within the initiative’s governance. This includes quarterly assessments of key risk indicators, stakeholder feedback loops, adaptive management processes, and transparent annual reporting.

By treating risk management not as a barrier but as a design opportunity. Toronto has the chance to build a circular food model that’s not just visionary, but resilient, grounded, and ready to scale.

Key Performance Metrics for True Food System Success



Cost reductions achieved through food waste minimization and resource optimization	Food waste diversion rates (percentage diverted from landfill)	Job creation and quality of employment in circular operations
Revenue generated from circular products, services, and upcycled materials	Carbon footprint reductions through improved logistics and local sourcing	Food accessibility improvements for underserved communities
Return on investment timeframes for circular technology and infrastructure investments	Resource efficiency metrics (water, energy, land use per unit of food produced)	Community engagement levels in circular food initiatives
Market differentiation and competitive advantage gained through circular practices	Packaging reduction and transition to reusable or compostable alternatives	Skills development and knowledge transfer among QSFE workers
Operational resilience improvements during supply chain disruptions	Biodiversity impacts from sourcing practices	Health and wellbeing impacts from improved food quality and safety

This evaluation framework enables SMEs, policymakers, and other stakeholders to select and prioritize relevant metrics based on their specific roles and objectives. By measuring across these four dimensions, organizations can ensure their transition to circular food systems delivers comprehensive value rather than simply shifting problems from one area to another. We recommend establishing baseline measurements at the outset of any circular initiative to enable meaningful progress tracking over time.

The Path Forward

Toronto's Opportunity to Lead a Global Food Revolution

Toronto stands at a pivotal moment. The city's diverse people combined with its solid technology base and forward-thinking policies make it an ideal location to lead the world in circular food system innovation for small and medium Quick Service Food Establishments (QSFE SMEs). This report establishes an inclusive framework which enables local food businesses to transition from linear waste-heavy systems to sustainable circular operations.

The Food-as-a-Service (FaaS) model combines collaborative infrastructure with intelligent systems to create a flexible framework that supports SMEs regardless of their size or technological capabilities. This model represents a strategic shift that enables economic resilience while promoting environmental regeneration and social cohesion.

Economic Resilience: Lower operating costs, diversified revenue streams, and greater agility

Environmental Regeneration: Reduced food waste, more efficient resource use, and expanded local production

Social Cohesion: Stronger community ties, improved food access, and new employment pathways

The accompanying backcasting framework offers a phased roadmap that moves from near-term enablers to system-level transformation. Implementing readily accessible interventions such as automated inventory tools and shared food hubs lays the groundwork for progressively reshaping Toronto's food ecosystem.

Each of the three actions described above is anchored in the Food-as-a-Service strategic framework introduced in Section 6, "Food-as-a-Service as a Transformative Model for Circular Food Systems" (see Figure 55). While the framework has been validated through small-scale pilot tests with a limited cohort of QSFE SMEs, its full effectiveness will emerge only as it is implemented, evaluated, and iteratively refined across neighbourhood, city-wide, and provincial scales. Accordingly, the action plan should be regarded as a living roadmap—one that evolves in response to evidence and stakeholder feedback as Toronto's circular food ecosystem takes shape.

From Strategy to Implementation

To move from strategy to implementation, several immediate actions are necessary to activate the proposed vision. First, establishing a Circular Food Innovation Consortium, comprising QSFE SMEs, technology providers, policymakers, and academic institutions will be critical for coordinating implementation, securing funding, and fostering cross-sector alignment. Second, launching pilot projects focused on two high-impact strategic pillars such as automated inventory systems and shared infrastructure, it will enable early experimentation, generate critical insights, and showcase practical success stories. Third, the development of modular toolkits tailored to different QSFE business models will support diverse operators in overcoming specific barriers identified through this research, making circular practices more accessible. Finally, the creation of a centralized digital knowledge platform will facilitate the sharing of practices, outcomes, and lessons from early adopters, accelerating learning and encouraging broader adoption throughout the sector.

Looking Ahead

The time for action is now. Cities that pioneer circular innovation will lead not only in environmental balance but also in economic resilience and social well-being amid growing global pressures on food systems. Toronto is positioned to lead this transformation by piloting practical, inclusive, and scalable solutions that can serve as models for other cities and beyond.

While we move from strategy to implementation, selecting the right pilot sites is critical to success. Ideal candidates will be SMEs that reflect Toronto's geographic and cultural diversity, demonstrate openness to digital tools, and operate in contexts where small interventions can drive outsized system impact. Priority will be given to businesses with committed leadership, baseline digital readiness, and potential for collaboration within shared infrastructure networks. This ensures early pilots generate tangible results, validate feasibility, and surface learnings that inform broader adoption.

Through deep collaboration between QSFE owners, technology providers, community organizations, and public institutions, Toronto can create a food system that not only reduces landfill waste but also sustains livelihoods and fosters regenerative growth. Circular practices, when implemented strategically, can deliver environmental returns while reinforcing economic vitality and this transformation begins with the pilot projects we choose to launch today.

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Appendix A

Concept Testing Feedback on FaaS Models

Research Objective

The concept testing phase aimed to assess how receptive QSFE (Quick Service Food Establishment) owners and managers were to future-oriented business models that integrate sustainability and technology. This activity followed qualitative interviews and provided participants with short descriptions of emerging concepts for reaction, evaluation, and discussion. The goal was to understand perceived feasibility, value, and barriers—insights that helped prioritize solutions in the proposed Food-as-a-Service (FaaS) framework.

Key Sections and Insights

- 1. Demographics & Visit Patterns**
- Age Range: Majority between 26–45
 - Education: Over 70% held a Bachelor’s degree or higher
 - Visit Frequency: Most visited coffee shops 1–6 times a week
 - Preferred Shops: Independent local fast food restaurants ranked highest, followed by chains and coffee kiosks

- Testing Overview**
- **Participants:** Same 12 SME operators interviewed previously
 - **Method:** Scenario-based concept ratings (1–5 scale) with follow-up open-ended questions
 - **Concepts Tested:**
 - A. Subscription-Based Model
 - B. Shared Ordering & Delivery Platforms
 - C. Digital Dining Credits (Blockchain Local Currency)
 - D. Zero-Waste Meal Kit Collaboration
 - E. AI-Driven Inventory & Waste Optimization
 - F. Government-Subsidized Sustainable Logistics
 - G. Innovation Food Hubs (Knowledge development + Data Coop)
 - H. Automated Inventory & Waste Reduction System
 - I. Adaptive Circular Menu Design

Ideas / Applications	Rating	Key Insight
Automated Inventory & Waste Reduction System	4.3/5	Most highly rated. Seen as directly helpful to manage ingredient waste, reduce human error, and improve prep planning. Strong support from bakeries and Asian fast food operators.
Government-Subsidized Sustainable Logistics / waste management	3.9/5	Viewed positively, especially by pizza and Italian restaurants. Operators appreciated the idea of government incentives but flagged cost and learning curve as concerns.
Shared Infrastructure Leasing	3.4/5	Perceived as efficient but potentially complicated to coordinate.
Community-supported Circular Food Subscriptions	3.3/5	Mixed interest. Operators liked stable revenue ideas, especially in bakeries, but some were unsure about how to manage logistics or customer commitment.
Zero-Waste Meal Kits Collaboration	3.3/5	Concept was supported in theory but seen as logistically complex. Pizza restaurants showed interest due to high ingredient turnover.
Adaptive Circular Menu Design	3.2/5	Appreciated by bakery owners for its potential to align with customer data and reduce overproduction.
Circular Skills Development Hubs	3.0/5	Valued as a support idea, especially by operators newer to sustainability. Limited understanding.
Digital Dining and Operational Credits	3.0/5	Least understood. Most operators found blockchain and digital credits abstract or irrelevant to their daily operations.

Implementation Barriers Identified

- Cost and ROI uncertainty (especially for AI tools and subscriptions)
- Learning time and limited technical literacy
- Staff training needs
- Unpredictable customer behavior
- Physical space constraints in small kitchens and food court stalls

Motivators for Adoption

- Government incentives and shared infrastructure
- Customer demand signals, especially if supported by digital platforms
- Peer support and training (e.g., case studies, communities of practice)
- Scalability and flexibility for solo operators or early-stage businesses

Appendix B

SME Operator Interviews : Operation Study

Research Objective

This interview study aimed to uncover the real-world sustainability practices, operational challenges, and perspectives on customer behaviour from the viewpoint of coffee shop and small food business operators. The objective was to identify patterns, barriers, and opportunities that shape circularity adoption in Toronto’s quick-service food ecosystem.

Interview Overview

- **Participants:** 12 operators (owners, managers, and staff)
- **Business Types:** Independent cafés, bakeries, noodle restaurants, pizza shops, tea bars, and fast-casual eateries
- **Location:** Toronto (downtown and suburban neighbourhoods)
- **Format:** In-depth semi-structured interviews (with optional on-site observations)
- **Tools Used:** Thematic coding, qualitative comparison

Key Themes & Insights

1. Motivation and Business Origin

- Many operators had personal or family-related reasons for opening their shops (e.g., continuing a coffee business from overseas, running a restaurant with a sibling, or fulfilling a long-term passion for food).
- Several participants entered the business after immigrating or transitioning from other industries, often with limited startup resources.

2. Initial Challenges

- Common early struggles included:
 - Finding staff or a reliable chef
 - Sourcing quality ingredients
 - Managing high turnover and limited training capacity
 - Building customer awareness
 - Navigating Toronto’s complex operating environment (permits, costs, and rent)

3. Existing Sustainability Practices

- Implementation levels varied widely:
- Some had basic sustainability practices like donating leftovers or using TGTG (Too Good To Go).
- Others relied mainly on manual operations and expressed confusion about what "sustainability" entailed.
- A few made conscious sourcing decisions (e.g., all ingredients from local farms).

4. Attitudes Toward Technology

- Most used only basic POS systems and social media.
- Interest in tech was tempered by:
 - Budget limitations
 - Learning curve and lack of time
 - Concerns about value versus cost
- One owner noted: “We do all the things manually... I know AI could help but I don’t have the time or money to figure it out.”

5. Customer Behavior Perception

- Operators noticed customers showing interest in sustainability but making decisions primarily based on cost, taste, and convenience.
- Many owners felt they lacked tools or staff time to educate customers effectively.

6. Transition Readiness

- Most participants were open to change if incentives or shared platforms lowered risk.
- A few emphasized the importance of flexibility and incremental transitions.
- One manager said: “If it doesn’t add cost and helps reduce waste, I’d definitely consider it.”

Sample Interview Questions (Extract)

1. What inspired you to open or manage your coffee shop or restaurant?
2. What sustainability practices, if any, have you implemented?
3. What are your biggest operational challenges right now?
4. How do customers respond to your sustainable practices?
5. Would you consider adopting new circular or tech-driven business models in the next 5 years?

Appendix C

Online Survey : Coffee Shop Customers

Research Objective

The aim of this survey was to explore consumer awareness, attitudes, and expectations regarding sustainability practices in local quick service restaurants in Toronto. As part of a broader investigation into how small food service businesses can adopt circular economy principles, this survey provides insight into the behaviours and preferences of customers. The findings helped shape future scenarios, design concepts, and strategy recommendations in the broader Food-as-a-Service (FaaS) framework.

Key Sections and Insights

1. Demographics & Visit Patterns

- Age Range: Majority between 26–45
- Education: Over 70% held a Bachelor’s degree or higher
- Visit Frequency: Most visited coffee shops 1–6 times a week
- Preferred Shops: Independent local fast food restaurants ranked highest, followed by chains and coffee kiosks

2. Drivers of Coffee Shop Selection

- Top factors: Quality, price, and location
- Sustainability ranked below atmosphere and service, showing moderate influence on consumer choice

3. Awareness of Sustainability Issues

- Most recognized issues: Waste management, ethical sourcing, energy efficiency
- 76% reported being aware of at least one sustainability practice at their local coffee shop, such as:
 - Use of reusable cups
 - Food waste reduction
 - Compostable packaging

4. Importance of Sustainability

- 76% said sustainability influenced their decision to visit a café
- 60% expressed willingness to pay 5–10% more for sustainable practices
- Trust-building signals included:
 - Third-party certifications
 - Transparent reporting
 - Staff-led initiatives and visible sorting bins

5. Desired Sustainability Practices

Respondents wanted to see:

- Fair-trade or organic coffee
- Plant-based menu options
- Plastic-free packaging
- Discount or reward programs for bringing reusable items
- Food donation and composting programs

6. Communication Preferences

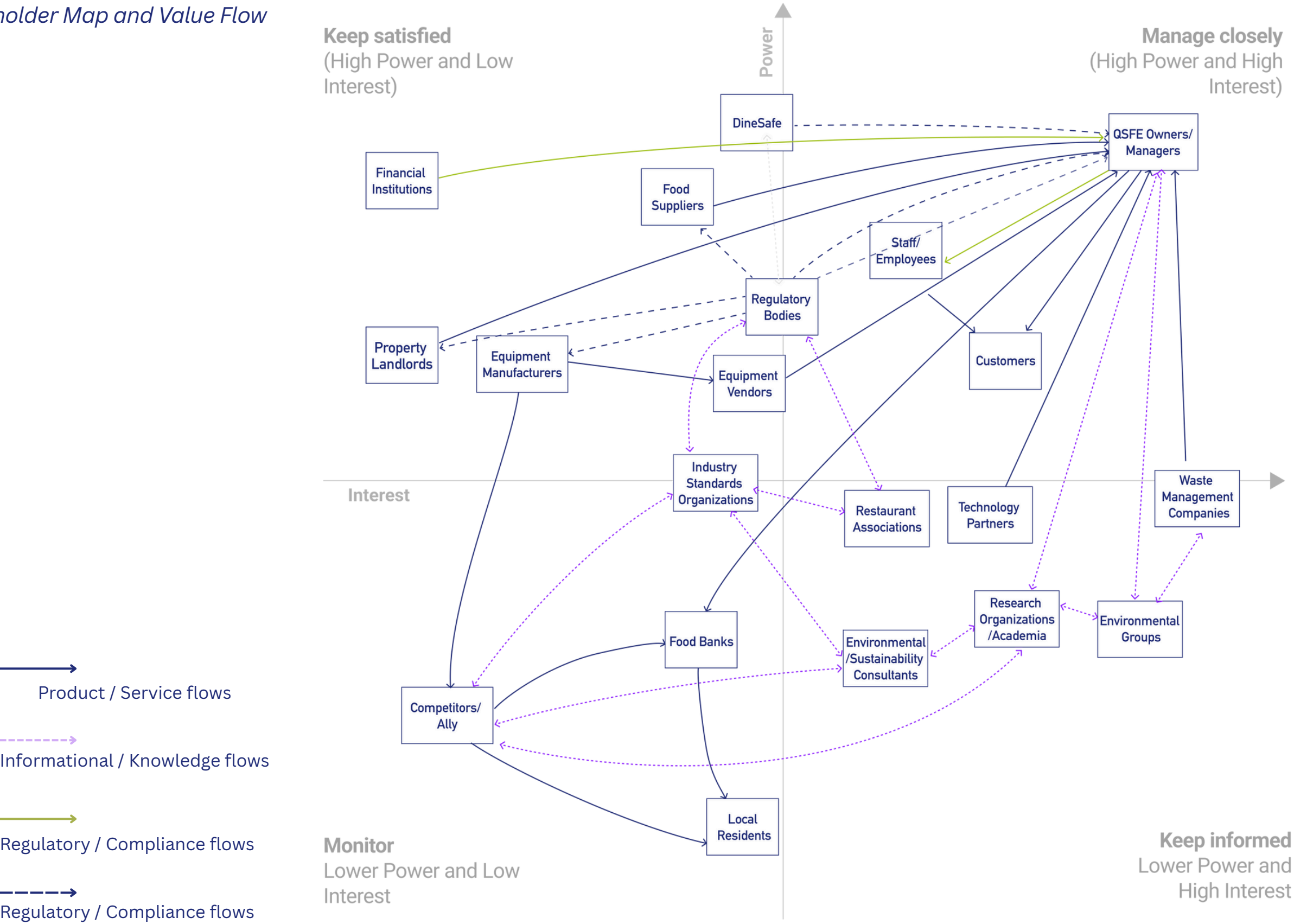
Suggested strategies to better communicate sustainability included:

- Clear signage and icons on menus
- Staff badges or roles focused on sustainability
- Updates via email, social media, or digital receipts
- Community events and behind-the-scenes transparency

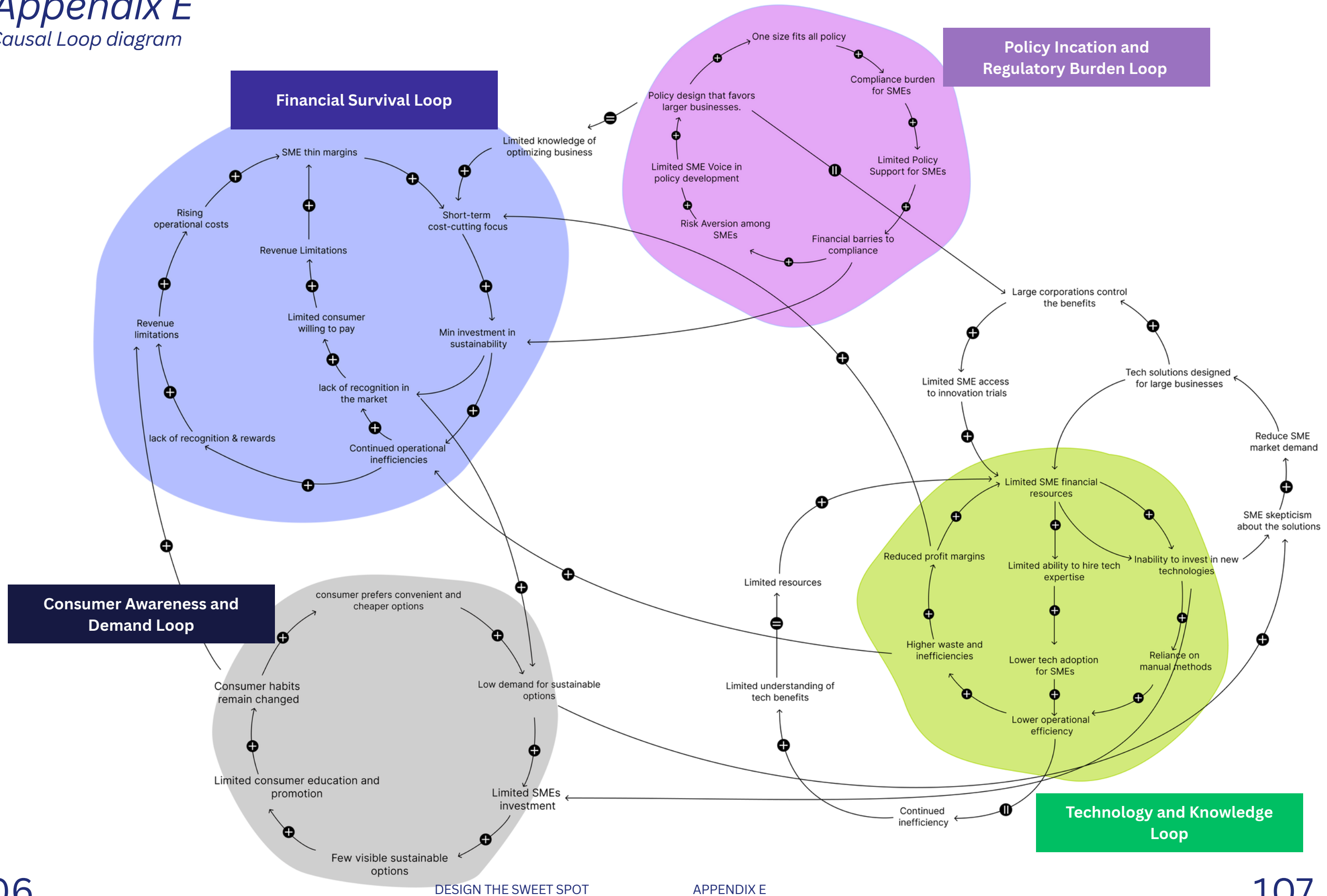
7. Future Preferences & Concerns

- Most preferred futures: Sustainable & Circular and Community-Centred
- Concerns about the future of food services included:
 - Loss of human interaction due to automation
 - Food quality in tech-heavy environments
 - Privacy with AI and data tracking
- Comfort factors for future adoption included clear communication, affordability, and customization

Appendix D
Stakeholder Map and Value Flow



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Appendix F

STEEP-V Analysis

Social	Technology	Economy	Environment	Political	Value/Culture
<p>Business Model Evolution</p> <ul style="list-style-type: none"> Emergence of ghost kitchens and virtual restaurants post-pandemic Rise of food delivery and takeout-focused operations Increasing popularity of food trucks and pop-up dining concepts <p>Consumer Behaviour & Preferences</p> <ul style="list-style-type: none"> Growing demand for unique dining experiences Gen Z showing stronger dietary preferences Increasing interest in plant-based and restricted diets Rising resentment toward tipping culture, especially in quick-service settings The rise of pop-ups, communal dining, and chef-curated menus Influenced by celebrity chefs, sustainability influencers, and viral food experiences <p>Food Sourcing Change</p> <ul style="list-style-type: none"> Consumers are prioritizing local food networks Younger consumers expect carbon labelling, waste transparency, and sustainability commitments in their dining choices 	<p>Digital Platforms & Delivery</p> <ul style="list-style-type: none"> Rise of food delivery apps transforming service models Integration of digital ordering systems Growth of ghost kitchen operations Emergence of drone and autonomous delivery <p>Automation & AI</p> <ul style="list-style-type: none"> Implementation of kitchen automation systems AI-driven operational optimization Enhanced process efficiency through robotics Automated inventory management systems <p>Supply Chain Technology</p> <ul style="list-style-type: none"> Supply Chain 4.0 solutions implementation Enhanced traceability and transparency systems Digital supply chain resilience tools <p>Virtual Reality & Metaverse</p> <ul style="list-style-type: none"> Virtual restaurant experiences emerging Virtual food purchases for avatars Integration of VR in customer engagement <p>Operations Technology</p> <ul style="list-style-type: none"> Smart kitchen equipment adoption Digital payment systems 	<p>Cost Pressures</p> <ul style="list-style-type: none"> Rising ingredient and labor costs squeezing profit margins Delivery service fees taking up to 30% of order value Increased operational costs affecting pricing strategies <p>Consumer Consumption Decision</p> <ul style="list-style-type: none"> Growing value-sensitivity among customers Increased demand for deals and promotions Changing spending patterns in response to economic pressure <p>Business Model Evolution</p> <ul style="list-style-type: none"> Shift from traditional tipping to inclusive pricing models Adaptation to digital and delivery-focused operations Development of new revenue streams through takeout services <p>Government & Economic Support</p> <ul style="list-style-type: none"> Mandatory carbon footprint disclosures are expanding. By 2030, carbon labelling may be legally required for QSRs in major Canadian cities Development of local business ecosystems Government-backed zero-waste initiatives are mandating compliance 	<p>Waste Management & Reduction</p> <ul style="list-style-type: none"> Provincial push toward zero waste and zero greenhouse gas emissions Implementation of circular economy principles in food management Commercial waste reduction yielding 4.5–6.5% cost savings for restaurants <p>Sustainable Technology Integration</p> <ul style="list-style-type: none"> Smart appliances optimizing energy consumption Intelligent ovens with load-based temperature adjustment Advanced composting and food scrap repurposing systems <p>Business Model Evolution</p> <ul style="list-style-type: none"> Shift from traditional tipping to inclusive pricing models Adaptation to digital and delivery-focused operations Development of new revenue streams through takeout services <p>Local Food Production</p> <ul style="list-style-type: none"> Vertical farming adoption for year-round local produce Reduced transportation emissions through hyper-local sourcing Controlled indoor environment farming solutions <p>Consumer Environmental Awareness</p> <ul style="list-style-type: none"> Limited adoption of plant-based diets among Gen Z Growing focus on sustainable dining practices Increased demand for environmentally conscious food options 	<p>Government Support & Incentives</p> <ul style="list-style-type: none"> Strategic policies for micro-business sustainability Tax incentives for operational investment Toronto's Circular Economy Roadmap is driving food policy change Targeted relief measures for cost management <p>Immigration & Entrepreneurship</p> <ul style="list-style-type: none"> Double rate of business creation by immigrant entrepreneurs Integration challenges for newcomer business owners Skill utilization barriers in immigrant communities Diversity-focused business development programs <p>Environmental Regulations</p> <ul style="list-style-type: none"> Shift toward circular economy policies New regulations for food waste management Resource recovery requirements for IC&I sector Sustainability compliance measures <p>Economic Integration</p> <ul style="list-style-type: none"> Policies supporting immigrant economic participation Programs addressing skill recognition Market access initiatives for diverse entrepreneurs Cross-cultural business development support 	<p>Work-Life Integration</p> <ul style="list-style-type: none"> Integration of family values in business operations Emphasis on workplace well-being Shift toward four-day workweek culture <p>Generational Values (Gen Z)</p> <ul style="list-style-type: none"> Influenced by social media recommendations Strong influence of celebrity chefs/influencers <p>Community Connection</p> <ul style="list-style-type: none"> Growing support for local businesses Consumers prefer brands aligned with local economies & circular practices <p>Entrepreneurial Demographics</p> <ul style="list-style-type: none"> Increased diversity in business ownership Rise in immigrant entrepreneurs Growing participation of women Multi-generational business leadership <p>Personal Values in Business</p> <ul style="list-style-type: none"> Priority on autonomy and flexibility Customization of business models Focus on life satisfaction metrics Integration of personal goals with business success

Appendix G

Dator’s 4 Futures

PARAMETERS		GROWTH (Business as Usual)	COLLAPSE (System Decline)	DISCIPLINED SOCIETY (Restricted Changes)	TRANSFORMATION (System Revolution)
Core Business Environment	Economy	<ul style="list-style-type: none">Steady market growthAI-driven personalizationSubscription-based models	<ul style="list-style-type: none">Economic instabilityExtreme food inflationBlack-market food trade	<ul style="list-style-type: none">Government-enforced sustainability mandatesCorporate accountability	<ul style="list-style-type: none">Post-scarcity food economyDecentralized AI-managed food distribution
	Government	<ul style="list-style-type: none">Moderate government oversightTransparency laws favor corporate growth	<ul style="list-style-type: none">Regulatory breakdownWeak governanceFood policies inconsistent	<ul style="list-style-type: none">Strict AI governance on food policiesNational food security prioritized	<ul style="list-style-type: none">Global food governanceAI-optimized policy decision-making
	Food Systems	<ul style="list-style-type: none">Globalized supply chains,Reliance on importsCloud kitchens expand	<ul style="list-style-type: none">Fragmented food networksSurvival-based agricultureTrade collapses	<ul style="list-style-type: none">Highly regulated local food systemsAlternative proteins dominate menus	<ul style="list-style-type: none">Self-sustaining local food hubsCecentralized peer-to-peer food networks
	Compliance	<ul style="list-style-type: none">Standardized compliance protocolsMinimal enforcement on sustainability	<ul style="list-style-type: none">Food safety protocols failContaminated food and counterfeit goods rise	<ul style="list-style-type: none">Stricter compliance rulesHeavy fines for non-sustainable practices	<ul style="list-style-type: none">Fully autonomous food safety systemsAI predicts and prevents contamination
Technological Foundation	Technology Adoption	<ul style="list-style-type: none">AI-driven food trend forecasting,AR/VR dining,Cloud kitchens dominate	<ul style="list-style-type: none">Digital infrastructure crumblesAI development haltsManual food systems return	<ul style="list-style-type: none">AI optimizes food systems for sustainabilityRegulated food trend forecasting	<ul style="list-style-type: none">AI autonomously governs food productionBlockchain ensures full transparency
	Data infrastructure	<ul style="list-style-type: none">Centralized corporate control over consumer dataInfluencer-led trends	<ul style="list-style-type: none">Data security crises, loss of recordsUnreliable supply tracking	<ul style="list-style-type: none">Decentralized blockchain for food traceabilityEnforced transparency	<ul style="list-style-type: none">Decentralized, open-source food data networksCollective food innovation
	Digital Literacy	<ul style="list-style-type: none">Basic digital literacy for consumersFood tech training for industry workers	<ul style="list-style-type: none">Declining digital literacy as systems failReliance on traditional food knowledge	<ul style="list-style-type: none">Mandatory training in circular food economyAI-driven sustainability learning	<ul style="list-style-type: none">Universal AI-driven food literacyDigital food education embedded in society
Environmental Impact	Environmental Systems	<ul style="list-style-type: none">Sustainability is profit-drivenCarbon labeling adopted but minimally impactful	<ul style="list-style-type: none">Severe resource scarcityAgricultural collapseWorsening climate impact	<ul style="list-style-type: none">Carbon-neutral food production enforcedRegenerative agriculture required	<ul style="list-style-type: none">Regenerative, zero-waste food systemsDigitalized circular economy
	Energy use	<ul style="list-style-type: none">Minimal regulatory pressure on energy useAI optimizes efficiency for costs	<ul style="list-style-type: none">Energy shortagesHigh utility costsBusinesses unable to maintain operations	<ul style="list-style-type: none">Mandated energy efficiency quotasPenalties for high-carbon operations	<ul style="list-style-type: none">Renewable-powered food systemsDecentralized energy generation
	Waste management	<ul style="list-style-type: none">Recycling promoted but voluntaryCircular food economy remains niche	<ul style="list-style-type: none">Minimal waste processingLandfill overflow, lack of composting systems	<ul style="list-style-type: none">Strict waste-tracking systemsComposting & upcycling become legal requirements	<ul style="list-style-type: none">Waste-free food ecosystems, upcycling and bioconversion dominate
Social Framework	Culture	<ul style="list-style-type: none">Food trends dictated by influencers, fusion cuisine dominatesHyper-personalization	<ul style="list-style-type: none">Food reduced to survivalLoss of culinary diversityErosion of traditions	<ul style="list-style-type: none">Ethical food consumption as a civic dutyCultural food traditions preserved	<ul style="list-style-type: none">Food as an expressive mediumAI collaborates with humans on culinary creativity
	Social Dynamics	<ul style="list-style-type: none">Consumer-centricExperience-driven diningSocial media amplifies trends	<ul style="list-style-type: none">Fragmented communitiesUrban-rural divideCultural food establishments vanish	<ul style="list-style-type: none">Government incentives for sustainable food cultureBehavior nudging in policies	<ul style="list-style-type: none">Social food movements flourishCollective eating experiences drive change
	Community relationships	<ul style="list-style-type: none">Limited community engagementFood access based on purchasing power	<ul style="list-style-type: none">Social isolationHigh food insecurityInformal food-sharing networks emerge	<ul style="list-style-type: none">Food cooperatives emergeCollective food decision-making in communities	<ul style="list-style-type: none">Local food sovereigntyAI-optimized food sharing in community hubs
Business Operation	Resilience Strategies	<ul style="list-style-type: none">Investing in AI for demand forecasting to reduce wasteHeavily relay on social media to make decision	<ul style="list-style-type: none">Focusing on local sourcing to ensure food security and food safetyMinimize the operational cost	<ul style="list-style-type: none">Complying with sustainability regulations through green technologies.Mandatory business operational training	<ul style="list-style-type: none">Integrating with AI-governed systems for efficient resource management.SME owner aware community-based business
	Circular Economy Practices	<ul style="list-style-type: none">Voluntary circular practices like recycling.Limited fund program to the business	<ul style="list-style-type: none">Inconsistent circular practices due to CE deprioritized	<ul style="list-style-type: none">Mandated practices like composting and waste reductionRegular checking by health and food department	<ul style="list-style-type: none">Fully technologic integrated, with waste as a resource in productionKey actors care about the CE development

Appendix H

Research Images



Fig 3. A 10+ year-old Asian takeaway restaurant. Students and residents are their key customers.



Fig 4. A new barista rents a shared space to run market test during weekend



Fig 5. A shared kitchen space is available for lease in west downtown, with the option to include cooking equipment as an additional rental.



Fig 6. The shared fridge is shared with all the businesses in the unit

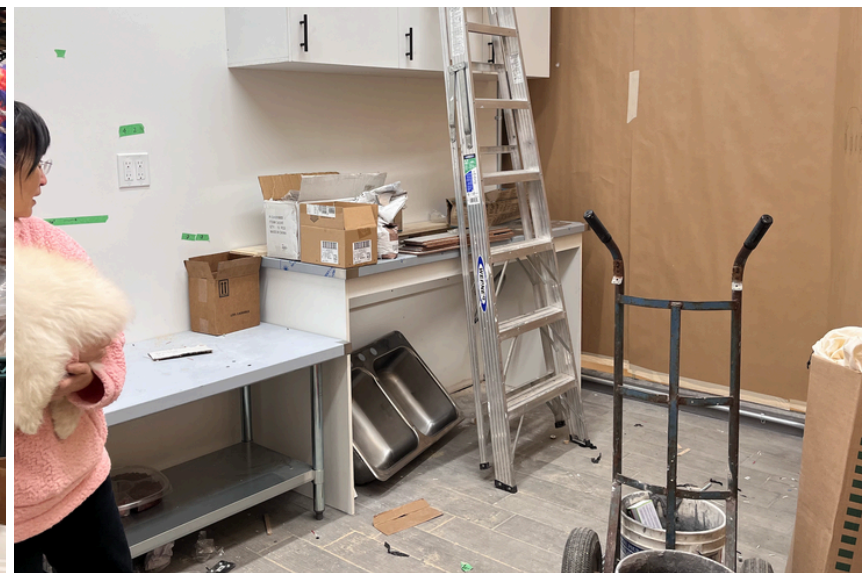


Fig 7. A new ramen restaurant owner was checking her renovation. She mentioned it was out of her budget

Appendix I

Images from current solutions

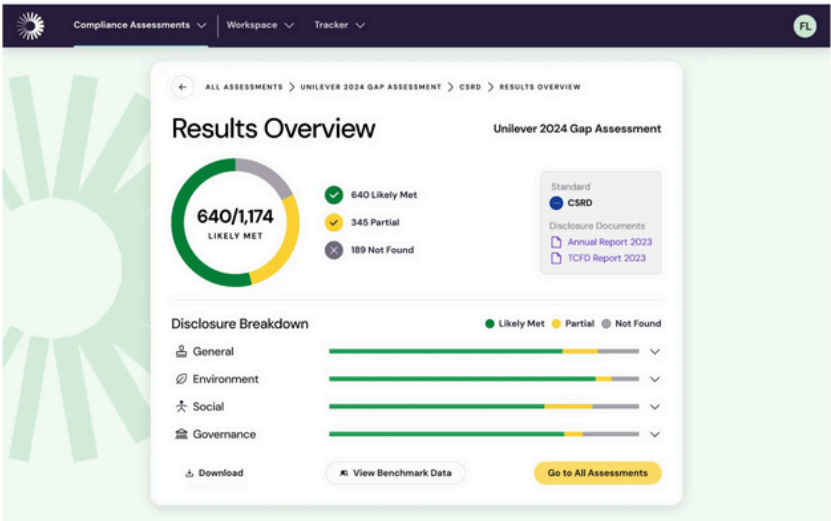


Fig 16. Manifest Climate’s AI engine delivers rapid, reliable, and actionable compliance insights tailored to the regulatory needs Adapted from Manifest Climate (n.d.)



Fig 17. Foodprint Project exploring food and cities. Adapted from Foodprint Project (n.d.).

Appendix J

Images from precedent analysis



Fig 57, Singapore’s first commercial rooftop farm, ComCrop. Adapted from ComCrop (n.d.).



Fig 58, Insectta startup: Using black soldier flies to convert food waste into biomaterials. Adapted from Insectta (n.d.).



Fig 60, Winnow Vision’s AI-enabled smart bin solution for food waste tracking. Adapted from Winnow Solutions (n.d.).

Appendix K

Plotting the Course to 2035

Phase 1: 2025-2027	Phase 2: 2028-2031	Phase 3: 2032-2035
<p>Technology-driven interventions validate the business case first, demonstrating ROI before policy support and financial incentives are introduced.</p> <p>Key Stakeholders: Local tech startups, Toronto Food Policy Council, Waste Diversion Task Force, Restaurants Canada, City of Toronto Economic Development</p> <p>Strategic Interventions:</p> <ul style="list-style-type: none">Tech-enabled waste tracking solutions"Low-Waste Certified" labelsQR carbon footprint trackersShared composting infrastructureSurplus redistribution platforms <p>Targets:</p> <ul style="list-style-type: none">20% increase in waste diversionFaaS implementation in 5 pilot SMEs10-15% operational cost savings for early adopters	<p>With financial viability established, Phase 2 creates the technical infrastructure and consumer engagement mechanisms needed for widespread adoption.</p> <p>Key Stakeholders: Ontario Green Economy Fund, Ministry of Small Business, QSR industry leaders, cooperative SME initiatives, consumer apps (UberEats, Skip)</p> <p>Strategic Interventions:</p> <ul style="list-style-type: none">Blockchain-supported community credit systemsAI-powered demand prediction algorithmsSurplus redistribution networksSustainable dining cashback incentivesExpansion of shared infrastructure networks <p>Targets:</p> <ul style="list-style-type: none">Implementation across 15+ SMEs citywide50% improvement in resource efficiency30%+ of consumer transactions incorporating sustainability	<p>This phase leverages the evidence base created in earlier phases to implement policy changes that make circular practices the new standard.</p> <p>Key Stakeholders: Federal Sustainable Jobs Plan, Canada Infrastructure Bank, private circular economy funds, citywide food networks, commercial real estate developers</p> <p>Strategic Interventions:</p> <ul style="list-style-type: none">Urban farming integrationMandatory AI-powered waste trackingCarbon labeling requirementsFinancial penalties for non-circular operationsRewards for zero-waste practices <p>Targets:</p> <ul style="list-style-type: none">Circularity as industry standard with 80%+ QSFE SME participationIntegration of circular principles in policy frameworks60%+ waste diversion across the sector
<p>2025</p> <p>Technology Foundation</p> <ul style="list-style-type: none">Tech startups deploy initial AI waste tracking pilots in 15 SMEsLiberty Village Business Improvement Area launches tech-enabled "Low-Waste Certified" label programFirst cross-business surplus food marketplace app connects 25 restaurants with local shelters <p>2026</p> <p>Proof of Concept</p> <ul style="list-style-type: none">AI waste tracking data demonstrates 15% cost savings potential, attracting City economic development attentionTech companies partner to establish first shared composting hub in Food Building at Exhibition PlaceQR carbon footprint trackers implemented in 40 QSFEs showcase consumer engagement and marketing benefits	<p>2028</p> <p>Technology Integration</p> <ul style="list-style-type: none">Pilot of blockchain-based community credit system in Queen Street West and Ossington food districtRitual and UberEats launch sustainable dining rewards program with 30 QSFE partnersFirst AI demand prediction tools deployed in 8 different food establishments <p>Policy Support Introduction</p> <ul style="list-style-type: none">Based on tech-validated ROI data, City of Toronto introduces targeted QSFE circular business tax incentivesFirst 5 SMEs achieve full Food-as-a-Service (FaaS) implementation with tech startup partnership <p>2029</p> <p>Network Expansion</p> <ul style="list-style-type: none">Toronto Food Surplus Network connects 75% of downtown QSFEsSecond shared composting facility opened in Scarborough Town Centre areaOntario Green Economy Fund allocates \$3.5M for QSFE transition projects <p>2030</p> <p>Network Scale Up</p> <ul style="list-style-type: none">Blockchain credit systems expanded to 100+ establishments across 5 districts35% of all QSFE transactions now incorporate sustainability considerationsResource efficiency across participating businesses reaches 47% improvementExpansion to 15 neighborhood-based circular food districts citywide	<p>2032</p> <p>Policy Implementation</p> <ul style="list-style-type: none">City of Toronto introduces AI-powered waste tracking for all QSFEsFirst commercial development with integrated vertical farming opens in East BayfrontFederal Sustainable Jobs Plan allocates \$5M for QSFE circular training programs <p>Standards Development</p> <ul style="list-style-type: none">Carbon labeling becomes mandatory for all menu items in establishments over 10 employeesCircular Economy Financing Hub established with Canada Infrastructure Bank backingNon-circular operations face first wave of environmental impact fees <p>2034</p> <p>Infrastructure Completion</p> <ul style="list-style-type: none">Urban farming integration reaches 40% of QSFE establishmentsZero-waste certification achieved by 200+ Toronto food businessesWaste diversion reaches 55% across the sector <p>2035</p> <p>System Transformation</p> <ul style="list-style-type: none">Circular practices become industry standard with 75% QSFE participationFull integration of circular principles in municipal, provincial and federal policy frameworksToronto recognized as North American leader in circular food systems

Appendix L

AI Image Generation Prompts



Cover image:
Inside a cozy small restaurant kitchen in 2035, a chef balances a plated sustainable dish, a sprouting plant, and a community loyalty card, soft futuristic holograms suggesting local menu updates, eco-friendly design, real human touch, warm cinematic lighting, hopeful atmosphere, cyber-organic aesthetic, artistic cover style.

MidJourney, ver 6.1 10 March. 2025,
<https://www.midjourney.com/>



Fig 20, Fig 28:
AR-enhanced dining table in the burger shop, young white man with brown hair in a white hoodie is sitting in front of a table. He wears a pair of smart glasses. the table is a gamified interface, Liam is touching the table interface and playing to win a discount, fast food with digital rewards. A burger on a tray is next to him on the table. minimalist glass architecture, futuristic service design, under lunchtime in day time, the interior is bright color.

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>



Fig 21, Fig 38:
Close-up of a digital menu on the cashier desk in a small burger shop in Toronto, 2035, the screen displaying '\$40 for real', worn and flickering digital display with a cracked edge, sparse and gritty counter with a few crumpled bills and barter goods,

MidJourney, ver 6.1, 3 April. 2025,
<https://www.midjourney.com/>



Fig 22, 44:
Ultra-realistic scene in a clean, organized back alley behind a 2035 coffee shop two uniformed food safety officers speak with a short-haired 35-year-old woman staff member they are calmly discussing a detail about food waste compliance three sleek waste bins are lined up nearby, each labeled clearly (compost, recycling, landfill) and equipped with large and glowing digital dashboards displaying fill levels or compliance data the alley is unusually tidy, with smooth pavement, vertical greenery, and no litter ambient daylight reflects off the bins, soft shadows cast on walls mood is professional

MidJourney, ver 6.1, 3 April. 2025,
<https://www.midjourney.com/>



Fig 23, 51:
An ultrarealistic cinematic scene in a futuristic food hub in Toronto, 2035. A front view of a sleek, futuristic POS machine on a minimalist coffee bar made of polished wood with recycled-material accents. The POS machine has a curved, high-resolution screen displaying "You Paid 10 Good Credits" in bold white text, with a bright green checkmark ticking into place. The machine's design is modern, with smooth metallic edges and a subtle glow.

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>

Appendix L

AI Image Generation Prompts - Growth Future

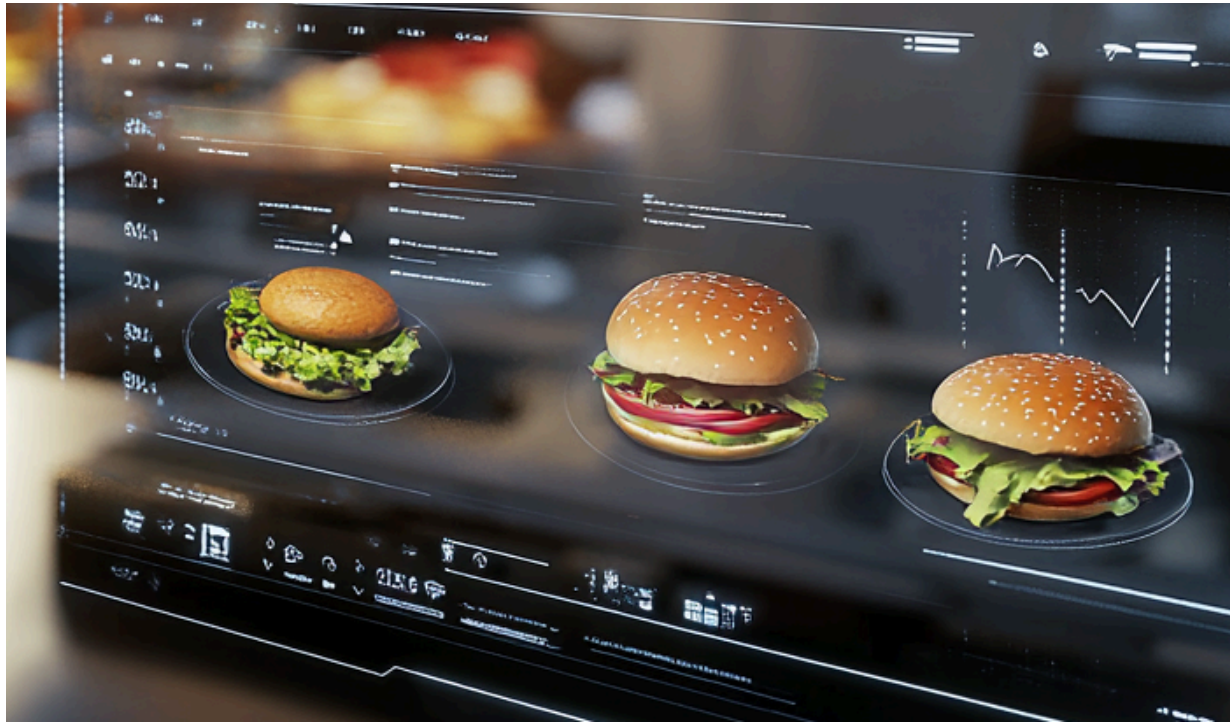


Fig 24:
Close look to Small burger restaurant back-of-house with glowing inventory dashboard, AI calculating resources. In the background, a staff is making burger in the kitchen. Photo shows under lunchtime in day time, tech-focused design, cyber-minimalist style, ultrarealistic.

MidJourney, ver 6.1 29 March. 2025, <https://www.midjourney.com/>



Fig 25:
An ultrarealistic cinematic scene on a city street, 2035. A young male, with white hoodie, with his smart glasses. Grabbing his in a vending coffee machine on the street. Background is a morning street view. The vending coffee machine is a white and hi-tech machine, with a big screen. The big screen shows coffee is ready. The screen is in a clean futuristic UI, cinematic lighting

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>



Fig 26:
A view from smart glasses stands in front of a burger shop on a street, view through the len, showing translucent social media trend alert, a reel from someone eating the burger with translucent image, bright city background, digital energy, foodtech advertisement. tech-focused design, cyber-minimalist style, ultrarealistic

MidJourney, ver 6.1, 8 April. 2025,
<https://www.midjourney.com/>

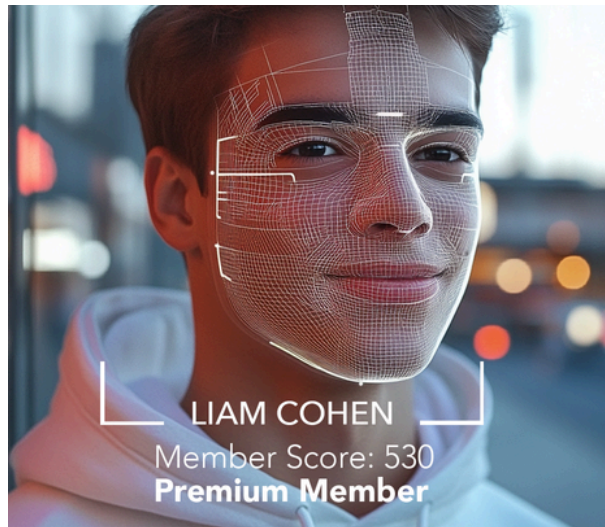


Fig 27:
A view from a face scanning camera, with a smiling young male face in white hoodie. digital outline of his face match his profile. The background is morning street, tech-focused design, cyber-minimalist style, ultrarealistic

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>



Fig 29:
A close look of a robot arm making burgers in a restaurant kitchen, tech-focused design, cyber-minimalist style, ultrarealistic, bright colour image

MidJourney, ver 6.1, 10 April. 2025,
<https://www.midjourney.com/>



Fig 30:
Super close look of a hand holding a phone, airdropping a customer review to the AI wall. The wall is showing user review photos and personalized drink badges, futuristic café interior with minimalist glass architecture, under lunchtime in day time, tech-focused design, cyber-minimalist style, ultrarealistic

MidJourney, ver 6.1 , 29 March. 2025,
<https://www.midjourney.com/>



Fig 31:
A view from a mobile, with a young male hand holding the phone, about a Californian social influencer in a cat face but human body selling a bottle of green juice, the package of the juice is insect and veggie and food innovation, influencer looking happy, TikTok interface with a grasshopper and showing a reel where many people are liking the video, tech-focused design.

MidJourney, ver 6.1 20 April. 2025,
<https://www.midjourney.com/>



Fig 32:
A photorealistic scene of a 26-year-old man in a casual hoodie, standing on a bustling street in Toronto Downtown, 2035, at dusk. He's speaking a voice command into his smartphone, ordering a custom electrolyte drink as he holds a half-eaten AI-crafted burger. A sleek drone server descends from above, dropping a glowing drink container into his hand. The background features a vibrant cityscape with smart infrastructure and glowing lights, ultra-detail.

MidJourney, ver 6.1 20 April. 2025,
<https://www.midjourney.com/>

Appendix L

AI Image Generation Prompts - Collapse Future



Fig 33:

Ultra-realistic close-up, low-angle shot of a person's rough, weathered hands sorting food waste in a gritty back alley one hand dropping potato peels into a compost bin, faint steam rising compost bin features a cracked digital screen flickering with faded UI icons for compost, plastics, and oil, styled in a worn-down government interface a worn-out smart band or patchy biometric scanner barely working on the person's wrist faint smog in the air

MidJourney, ver 6.1, 3 April. 2025, <https://www.midjourney.com/>



Fig 34:

A photorealistic close-up of a 30-something man with sweat on his brow and a clenched jaw, working in a grimy kitchen of a collapsing restaurant, Toronto Downtown, 2035. He's using a sputtering fryer and an old grill to cook synthetic protein patties, surrounded by stained counters and broken appliances. Dim overhead lighting casts shadows

MidJourney, ver 6.1 10 April. 2025, <https://www.midjourney.com/>



Fig 35:

Ultra-realistic close-up, low-angle shot of a person's rough, weathered hands sorting food waste in a gritty back alley one hand dropping potato peels into a compost bin, faint steam rising compost bin features a cracked digital screen flickering with faded UI icons for compost, plastics, and oil, styled in a worn-down government interface a worn-out smart band or patchy biometric scanner barely working on the person's wrist faint smog in the air

MidJourney, ver 6.1, 3 April. 2025, <https://www.midjourney.com/>



Fig 36:

A young urban farmer woman and a man exchanging a box of fresh leafy greens on a rooftop garden, surrounded by lush planter boxes, with mid-rise city buildings in the background and a tall tower in the distance, overcast but warm sky, detailed environment, cinematic lighting, realistic texture.

MidJourney, ver 6.1 3 April. 2025, <https://www.midjourney.com/>



Fig 37:
A street scene outside 'The Last Bite' in Toronto, 2035, a close-up of two blue recycling bin with a cycle logo on it, a cracked screen on the bin displaying 'FULL' in red letters, the bin overflowing with waste like food scraps and plastic on a busy street, crumbling urban setting with boarded-up shops in the background, gritty and dystopian atmosphere.

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>



Fig 39:
Close-up of a messy urban farm on a Toronto rooftop in 2035, makeshift planters made of old crates and buckets scattered chaotically, knobby potatoes and wilted greens growing unevenly, three of 11"-sized screen are installed and inserted at the soil, showing the state of the plant. Dirt and tools strewn around, crumbling cityscape faintly visible in the background, tense yet hopeful atmosphere, futuristic vibe, hyper-ultrarealistic

MidJourney, ver 6.1 10 March. 2025,
<https://www.midjourney.com/>

Appendix L

AI Image Generation Prompts - Discipline Future



Fig 40, 42:
An ultra-realistic early morning scene in 2035 Toronto a clean, sustainable coffee shop exterior bathed in bright natural sunlight with soft golden rays and long shadows a staff member in uniform with short hair is retrieving fresh herbs or beets from a transparent greenhouse delivery container the container glows faintly with internal grow lights, condensation on the glass, and visible environmental sensors the modern urban farm setup is integrated into the sidewalk or storefront distant skyline in soft focus, green touches from vertical plantings mood is calm.

MidJourney, ver 6.1 20 April. 2025, <https://www.midjourney.com/>

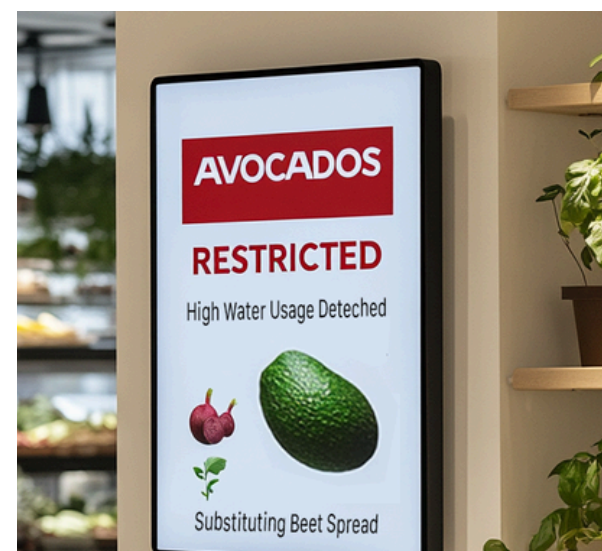


Fig 41:
Ultra-realistic digital wall poster in a 2035 Toronto coffee shop glowing smart display screen embedded in a clean white wall, showing an AI-generated government compliance alert: "AVOCADOS RESTRICTED" in bold red text, with a note underneath: "High water usage detected. Substituting beet spread." poster styled with minimalist UI, clean fonts, sustainability iconography.

MidJourney, ver 6.1, 3 April. 2025,
<https://www.midjourney.com/>

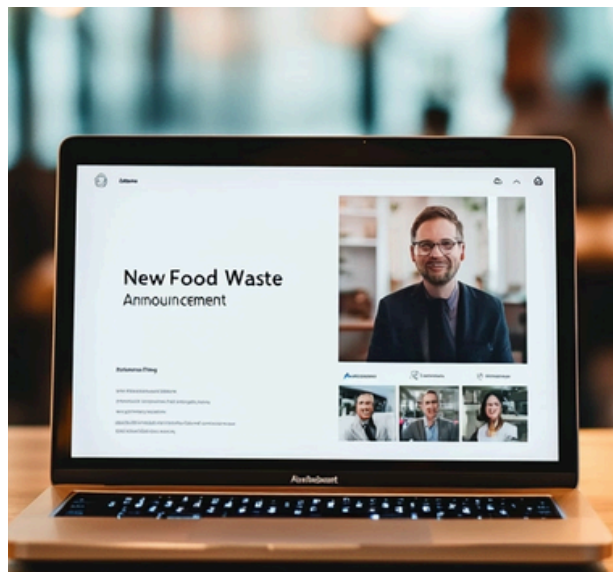


Fig 43:
Ultra-realistic front-facing view of a laptop on a wooden coffee shop counter, bright ambient lighting, modern interior with bokeh blur on the laptop screen, a Zoom-style video call is in progress with 15 participants in small windows one window shows a government health official speaking, while a presentation slide on the screen reads "New Food Waste Policy Announcement" with bullet points and clean infographics realistic screen glare, modern minimal interface

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>



Fig 45:
Ultra-realistic early morning coffee bar kitchen scene in 2035 Toronto, bright, clean, and sustainability-focused a tired but focused 35-year-old woman with short hair stands in the coffee bar kitchen, next to the coffee machine, holding a ceramic coffee mug in one hand and reviewing a sleek AI compliance dashboard on a tablet in the other close-up focus on the glowing screen showing food inventory data, ingredient quotas, and sustainability alerts in a clean futuristic UI.

MidJourney, ver 6.1 , 3 April. 2025,
<https://www.midjourney.com/>

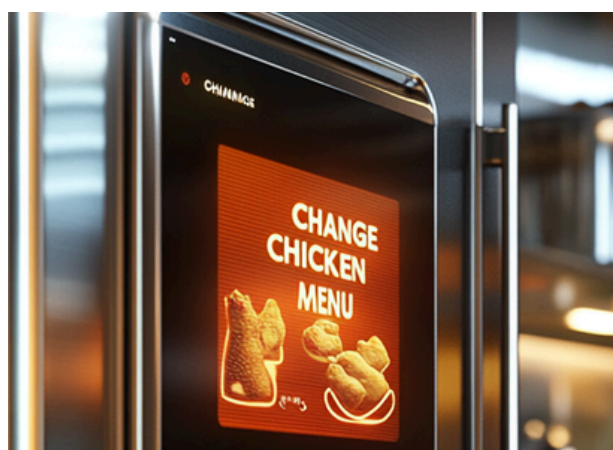


Fig 46:
Ultra-realistic modern QSR kitchen scene in 2035 Toronto a clean, organized, stainless steel kitchen. Close up to a glowing digital kitchen board on the wall that flashes a red "CHANGE CHICKEN MENU" alert ambient lighting is cool and dim, practical overhead LEDs create soft reflections on metal surfaces subtle tension in body language, early morning briefing mood cinematic lighting

MidJourney, ver 6.1, 3 April. 2025,
<https://www.midjourney.com/>

Appendix L

AI Image Generation Prompts - Transformation Future

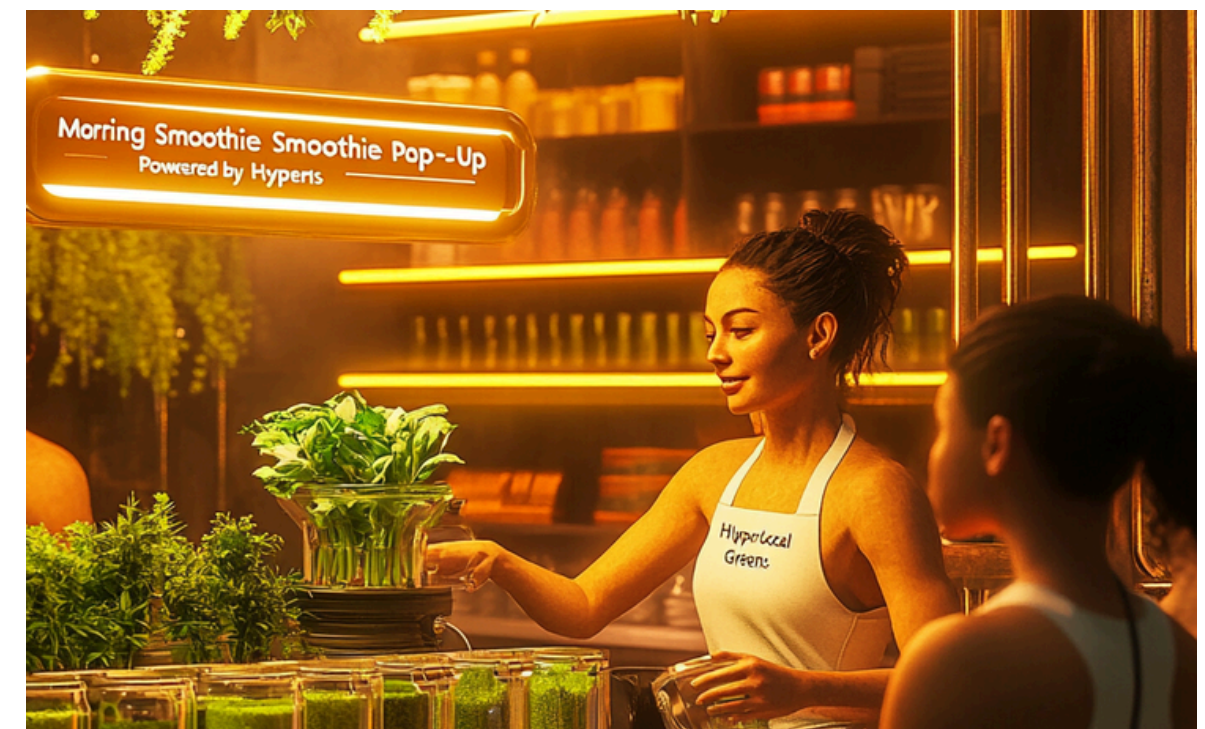


Fig 47, 54,
A pop-up brewery bar changes to a smoothie station, features a staff member in an eco-friendly apron blending a vibrant green smoothie behind a sleek wooden bar counter with upcycled decor, recycled glass jars holding fresh herbs and a small digital sign displaying "Morning Smoothie Pop-Up - Powered by Hyperlocal Greens." Cinematic lighting with warm morning sunlight and cool LED tones from the herb wall, hyper-detailed textures on the smoothie, bar counter

MidJourney, ver 6.1 3 April. 2025, <https://www.midjourney.com/>



Fig 48:
An ultrarealistic cinematic scene in the kitchen of a restaurant within a futuristic food hub in Toronto, 2035. A sleek, modern kitchen fridge with a transparent screen door displays a real-time inventory tracking system, showing "Eggplant is on the way" in bold white text, alongside a digital map tracking a drone delivery from a nearby urban farm. The fridge's interior reveals neatly organized shelves with hyperlocal ingredients--kale, herbs, and carrots--under soft LED lighting.

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>



Fig 49:
Ultra-realistic mid-morning scene in a spacious, community-run food hub in 2035 midtown Toronto the open space is naturally lit and surrounded by greenery, with small restaurant stalls around a shared dining area Jordan, a 42-year-old mixed-race woman, is leading a community credit workshop with 10 to 15 SME owners listening or chatting around her a screen or digital board displays "Community Credit System" with icons for waste reduction

MidJourney, ver 6.1 , 3 April. 2025,
<https://www.midjourney.com/>

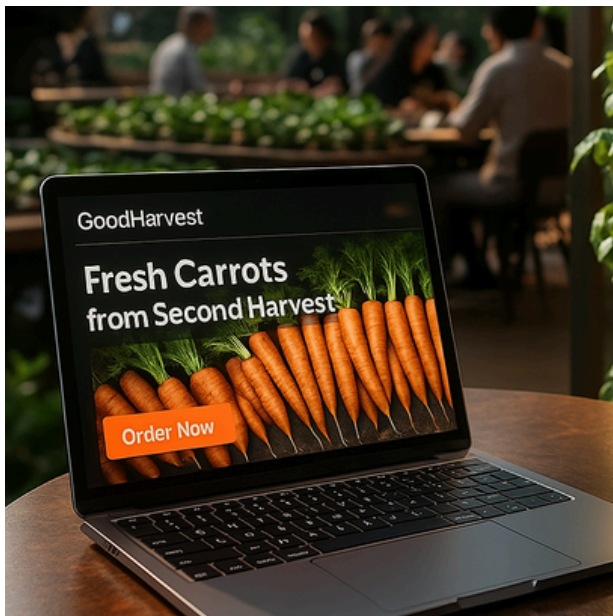


Fig 50:
An ultrarealistic cinematic scene set in a futuristic food hub in Toronto, 2035. On a laptop on the kitchen, the dashboard screen is in sharp focus: a vibrant graphic shows a local urban farm with rows of lush carrot tops under a digital sun, text reads "Good Harvest Forecast: Fresh Carrots Available Next Week - Click to Order" in bold green. A network widget glows beside it, showing "6 Nearby Hubs Connected" with icons of other hubs and their surplus (tomatoes, kale).

MidJourney, ver 6.1, 3 April. 2025,
<https://www.midjourney.com/>



Fig 52:
An ultrarealistic cinematic scene inside a futuristic food hub in Toronto, 2035. A mother, in her 30s, and her young son, around 6 years old, stand together observing a towering vertical vegetable wall. The wall is lush with vibrant greens--lettuce, herbs, and kale--growing in sleek hydroponic panels, illuminated by soft LED lights casting a gentle green glow. Each plant cluster has a small digital display glowing with farmer information: "Grown by Farmer Lisa - Urban Farm #3 - Harvested Today"

MidJourney, ver 6.1 3 April. 2025,
<https://www.midjourney.com/>



Fig 53:
An ultrarealistic cinematic scene in a futuristic food hub in Toronto, 2035, at 3:00 p.m. A 42-year-old race-mixed woman with a confident demeanor, wearing causal with a tee and jeans, stands in a utility room in back street of the restaurant. She adjusts a setting on a gleaming steel biodigester

MidJourney, ver 6.1,3 April. 2025,
<https://www.midjourney.com/>

