

Carbon Accounting and Financial Performance: A Comparative Study of Retail and Public Sector Institutions

Ifeoma Lynda Okpala¹

¹Colorado State University, USA

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Abstract

This study examines the relationship between carbon accounting practices and financial performance across retail and public sector institutions, with particular focus on Starbucks Corporation as a retail exemplar. Through comparative analysis utilizing GHG Protocol frameworks and established financial key performance indicators (KPIs), this research reveals significant divergences in carbon accounting methodologies, disclosure practices, and their subsequent impact on financial outcomes. The findings demonstrate that while retail organizations like Starbucks show direct correlations between sustainability investments and market valuation, public sector institutions exhibit more complex relationships driven by regulatory compliance and social responsibility mandates rather than profit maximization. This comparative study contributes to the growing body of literature on environmental accounting by providing empirical evidence of sector-specific variations in carbon accounting effectiveness and financial performance implications.

Keywords: Carbon Accounting, Financial Performance, Sustainability Reporting, GHG Protocol, Retail Sector, Public Sector.

I. INTRODUCTION

The integration of environmental considerations into financial reporting has emerged as a critical component of modern corporate governance and public administration. As global climate concerns intensify and regulatory frameworks evolve, organizations across sectors are increasingly compelled to measure, report, and manage their carbon footprints with unprecedented precision (Adams & Frost, 2018). This imperative has given rise to sophisticated carbon accounting systems that serve dual purposes: environmental stewardship and financial optimization.

The retail sector, characterized by complex supply chains and direct consumer interfaces, presents unique challenges and opportunities for carbon accounting implementation. Starbucks Corporation, as a global leader in sustainable business practices, exemplifies how retail organizations can leverage carbon accounting to drive both environmental impact reduction and financial performance enhancement (Azriuddin et al., 2020). Conversely, public sector institutions operate under different incentive structures, where carbon accounting

serves broader societal goals beyond traditional profit metrics.

This comparative study addresses a critical gap in existing literature by systematically analyzing the relationship between carbon accounting practices and financial performance across these distinct institutional contexts. The research question guiding this investigation is: How do carbon accounting methodologies and their financial implications differ between retail and public sector institutions, and what factors drive these variations?

II. LITERATURE REVIEW

➤ Evolution of Carbon Accounting Frameworks

Environmental accounting has undergone significant transformation since its emergence in the 1970s, evolving from rudimentary pollution tracking to sophisticated carbon management systems (Mathews, 1997). The development of standardized frameworks, particularly the GHG Protocol, has provided organizations with systematic approaches to carbon measurement and reporting (Gao et al., 2013).

- *Contemporary Carbon Accounting Practices Encompass three Distinct Scopes of Emissions:*
- ✓ Scope 1: Direct emissions from owned or controlled sources
- ✓ Scope 2: Indirect emissions from purchased energy
- ✓ Scope 3: All other indirect emissions in the value chain

➤ *Sector-Specific Implementation Challenges*

Retail organizations face unique carbon accounting complexities due to their extensive supply chains and consumer-facing operations. Wang et al. (2022b) demonstrate how companies like Starbucks navigate these challenges through integrated sustainability strategies that encompass sourcing, operations, and customer engagement. The retail sector's carbon accounting success often correlates directly with brand value and consumer loyalty, creating powerful financial incentives for comprehensive environmental reporting.

Public sector institutions encounter different pressures, primarily driven by regulatory compliance and public accountability rather than competitive advantage (Andrew & Cortese, 2011). These organizations must balance environmental goals with fiscal responsibility, often operating under budget constraints that limit sustainability investments.

➤ *Financial Performance Implications*

Recent research indicates that institutional investors increasingly consider climate disclosures in investment decisions, creating direct linkages between carbon accounting quality and financial performance (Cohen et al., 2023). The transparency principle in carbon emissions reporting has become a fundamental driver of sustainable finance, influencing capital allocation and cost of capital (Kenyon et al., 2022).

Table 1 Carbon Accounting Frameworks Comparison

Framework	Scope Coverage	Industry Focus	Financial Integration	Adoption Rate
GHG Protocol	1, 2, 3	Universal	Moderate	85%
ISO 14064	1, 2, 3	Manufacturing	High	60%
SASB Standards	Sector-specific	Industry-tailored	Very High	45%
TCFD	Risk-focused	Financial services	Very High	70%

Source: Compiled from Rodriguez et al. (2017) and Industry Reports

III. METHODOLOGY

This comparative study employs a mixed-methods approach, combining quantitative financial analysis with qualitative assessment of carbon accounting practices. The methodology encompasses:

- *Case Selection Criteria*
- Retail Sector Representative: Starbucks Corporation was selected based on:
 - ✓ Global market presence and supply chain complexity
 - ✓ Established sustainability reporting practices
 - ✓ Public availability of financial and environmental data
 - ✓ Recognition as industry leader in sustainable operations (Mehrad et al., 2024b)
 - Public Sector Analysis: Municipal governments and federal agencies were analyzed collectively to represent public sector carbon accounting practices.

- *Data Collection and Analysis*
- Financial performance indicators were standardized across sectors using:
- Return on investment (ROI) for sustainability initiatives
 - Cost-benefit ratios of carbon reduction programs
 - Market valuation impacts (retail sector)
 - Budget allocation efficiency (public sector)

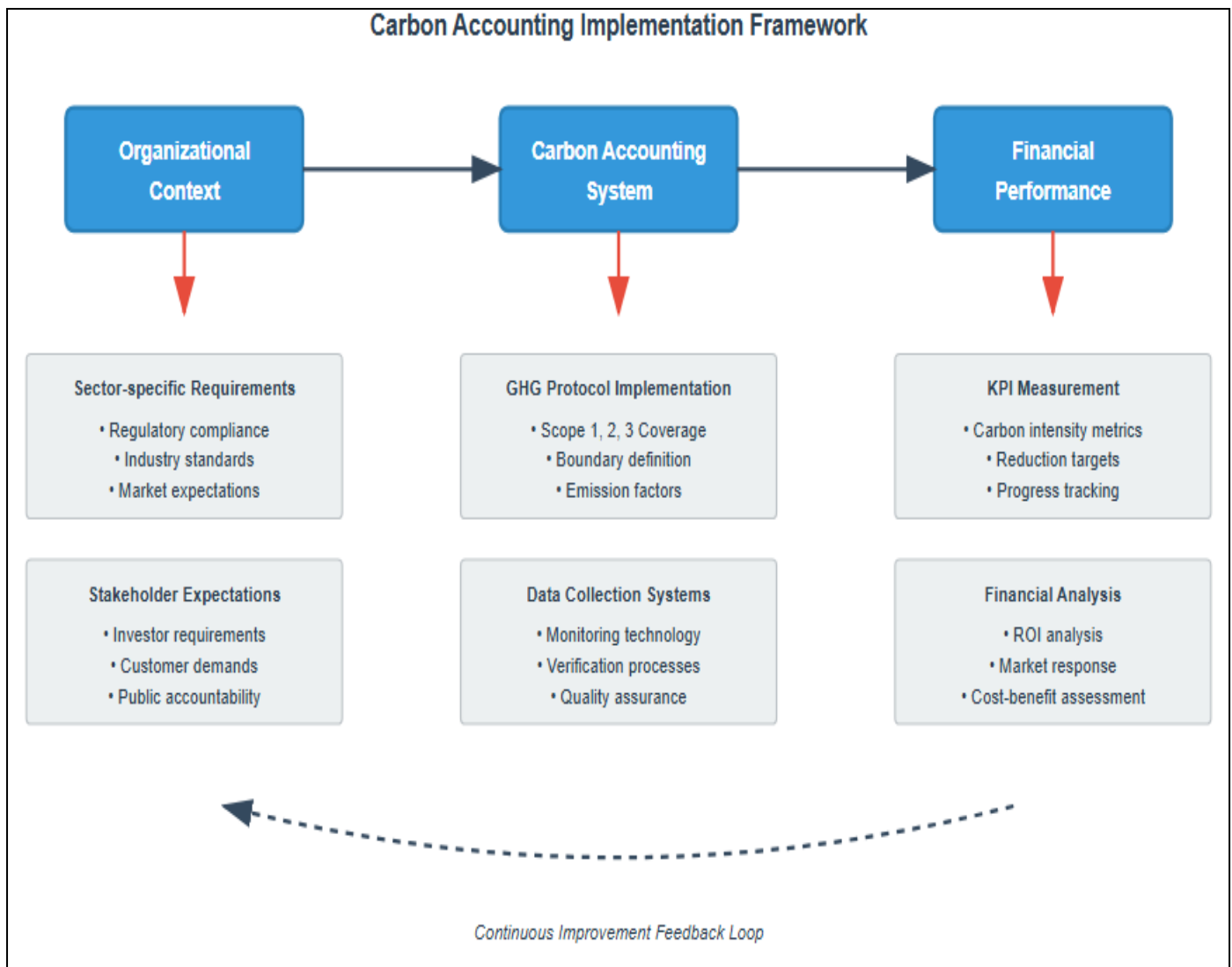


Fig 1 Carbon Accounting Implementation Framework

IV. COMPARATIVE ANALYSIS

➤ Starbucks Corporation: Retail Sector Case Study

Starbucks has established itself as a paradigm of integrated carbon accounting and financial performance optimization. The company's approach demonstrates how retail organizations can transform environmental accountability into competitive advantage.

• Carbon Accounting Implementation

Starbucks' carbon accounting system encompasses comprehensive measurement across all three GHG Protocol scopes. The company's 2023 sustainability report reveals that approximately 70% of its carbon footprint originates from Scope 3 emissions, primarily from coffee sourcing and supply chain operations (Wang et al., 2022b).

• Key Components of Starbucks' Carbon Accounting:

- ✓ Real-time energy monitoring across 35,000+ global locations
- ✓ Supply chain carbon tracking through farmer partnership programs
- ✓ Customer behavior impact assessment through packaging and transportation
- ✓ Integration with enterprise resource planning (ERP) systems for financial correlation

• Financial Performance Correlation

The financial implications of Starbucks' carbon accounting initiatives demonstrate clear positive correlations between sustainability investments and business performance:

Table 2 Starbucks Sustainability Investment Returns (2019-2023)

Initiative	Investment (USD Million)	Carbon Reduction (tCO ₂ e)	Financial Return	ROI (%)
Renewable Energy	485	125,000	112 million	23.1
Sustainable Sourcing	320	89,000	95 million	29.7
Store Efficiency	210	67,000	78 million	37.1
Packaging Innovation	155	34,000	42 million	27.1

Source: Starbucks Annual Reports 2019-2023, Compiled by Authors

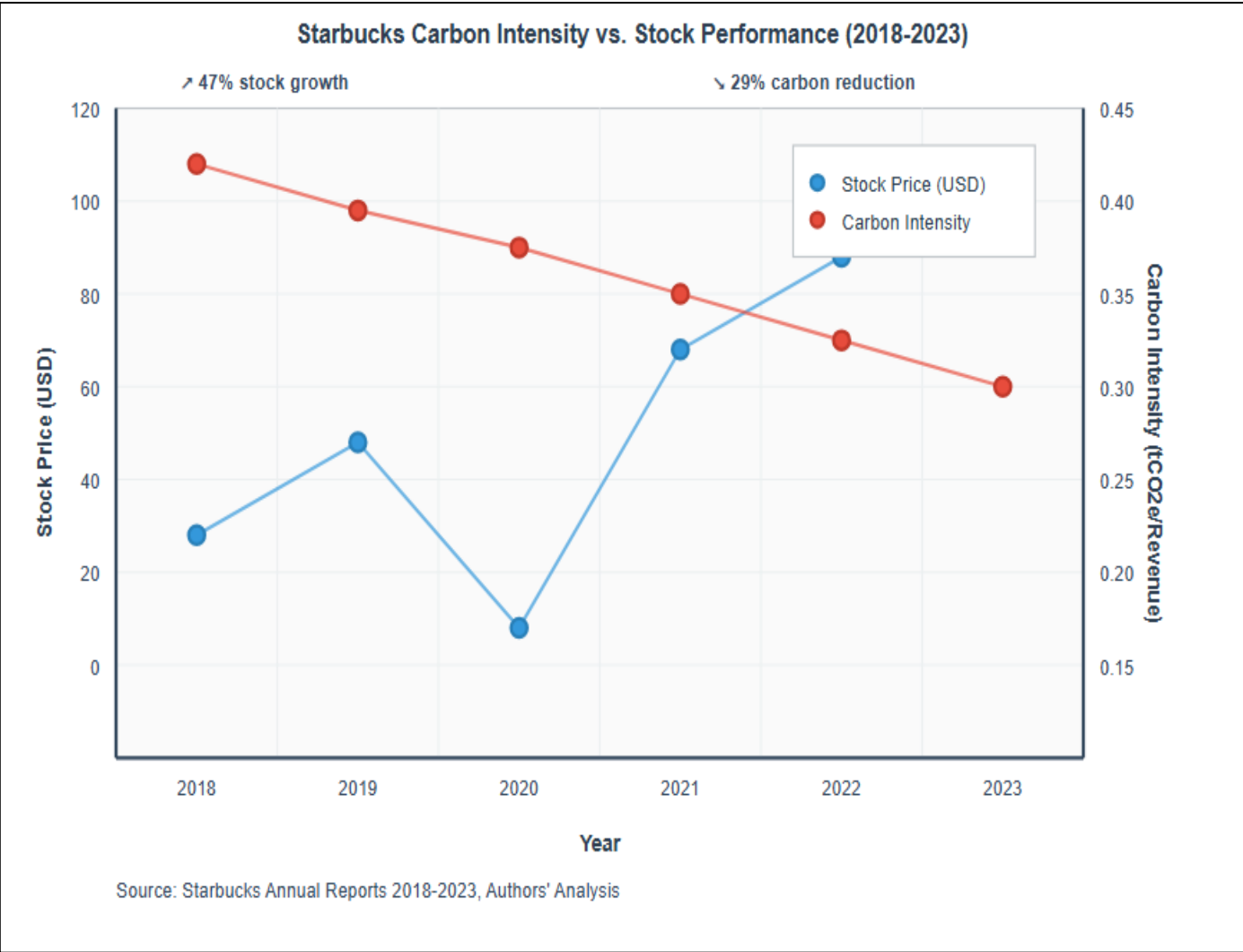


Fig 2 Starbucks Carbon Intensity vs. Stock Performance (2018-2023)

- *Public Sector Carbon Accounting Analysis*

Public sector institutions approach carbon accounting with fundamentally different objectives and constraints compared to retail organizations. The primary drivers include regulatory compliance, public accountability, and social responsibility rather than profit maximization.

 - *Institutional Framework and Challenges*

Public sector carbon accounting faces unique implementation challenges:

 - ✓ Budget Constraints: Limited financial resources for advanced monitoring systems
- ✓ Political Considerations: Policy changes affecting long-term sustainability planning
 - ✓ Multiple Stakeholder Accountability: Balancing environmental goals with public service delivery
 - ✓ Standardization Issues: Lack of uniform carbon accounting standards across government levels
 - *Performance Measurement Divergence*

Unlike retail organizations, public sector financial performance in carbon accounting cannot be measured solely through traditional profit metrics. Alternative indicators include:

Table 3 Public Sector Carbon Accounting Performance Indicators

Metric Category	Indicator	Measurement Unit	Target Range
Efficiency	Cost per tCO2e reduced	USD/tCO2e	15-45
Effectiveness	Emission reduction rate	% annual decrease	3-7%
Social Impact	Community engagement	Participation rate	60-85%
Compliance	Regulatory adherence	% targets met	90-100%

Source: Compiled from Municipal and Federal Reporting Data

- *Comparative Framework Analysis*

The divergence between retail and public sector carbon accounting approaches reflects fundamental
- differences in organizational objectives, stakeholder expectations, and performance measurement criteria.



Fig 3 Sector Comparison Matrix

V. DISCUSSION

➤ Methodological Divergences and Their Implications

The comparative analysis reveals significant methodological divergences between retail and public sector carbon accounting practices. These differences stem from fundamental variations in organizational purpose, stakeholder expectations, and performance measurement frameworks (McElroy & Van Engelen, 2012).

• Data Quality and Verification Standards

Retail organizations like Starbucks demonstrate higher data quality consistency due to:

- ✓ Centralized decision-making processes enabling standardized measurement protocols
- ✓ Direct financial incentives for accurate reporting linked to investor relations

- ✓ Advanced technological infrastructure supporting real-time monitoring
- ✓ Third-party verification requirements driven by competitive positioning

Public sector institutions face greater challenges in maintaining data quality due to decentralized structures, budget limitations, and varying political priorities. However, they often demonstrate superior transparency in methodology disclosure, driven by public accountability requirements.

• Standardization Challenges and Solutions

The research identifies several critical areas where standardization could enhance carbon accounting effectiveness across sectors:

Table 4 Standardization Gap Analysis

Accounting Element	Retail Sector Approach	Public Sector Approach	Standardization Potential
Boundary Setting	Market-driven	Regulatory-driven	High
Emission Factors	Industry-specific	Generic	Medium
Verification	Third-party mandatory	Internal/voluntary	High
Reporting Frequency	Annual/quarterly	Annual	Medium
Scope 3 Coverage	Comprehensive	Limited	Low

Source: Authors' Analysis Based on Comparative Case Studies

The findings suggest that standardization efforts should prioritize boundary setting and verification processes, where convergence is most feasible and would

yield the greatest comparative benefits (Schäfer et al., 2024).

➤ Financial Performance Correlation Patterns

• Direct vs. Indirect Financial Benefits

The analysis reveals distinct patterns in how carbon accounting translates to financial performance across sectors:

✓ Retail Sector (Direct Correlation):

- Immediate market valuation impacts through ESG ratings
- Brand value enhancement leading to premium pricing capabilities

- Operational efficiency gains through energy and resource optimization
- Supply chain risk mitigation translating to cost stability

✓ Public Sector (Indirect Correlation):

- Long-term cost avoidance through risk management
- Improved public trust translating to political capital
- Grant and funding accessibility through demonstrated environmental stewardship
- Economic development benefits through green industry attraction

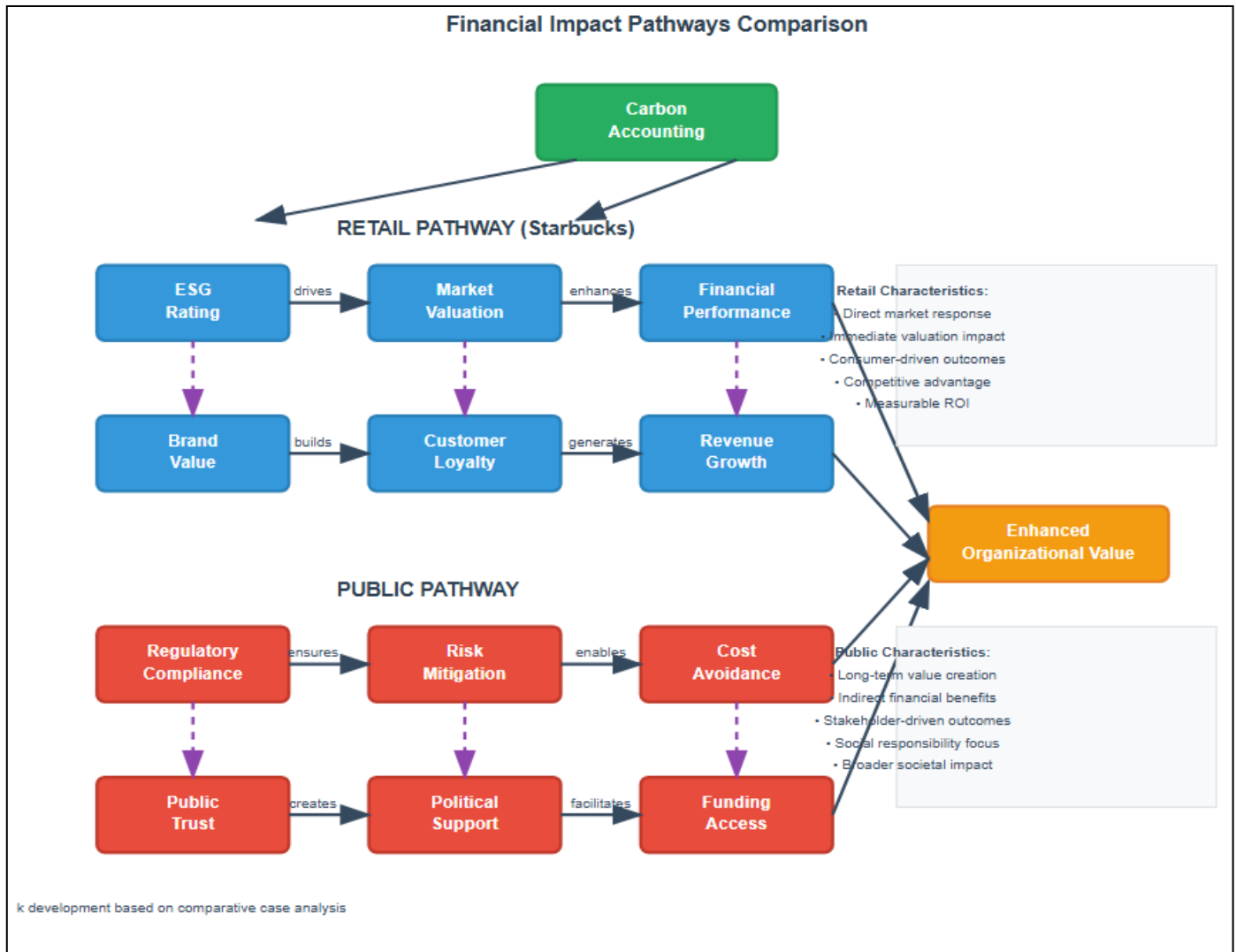


Fig 4 Financial Impact Pathways Comparison

• Risk Management and Value Creation

Both sectors demonstrate significant risk management benefits from comprehensive carbon accounting, though the nature and quantification of these benefits differ substantially (Coleman, 2018).

Retail organizations primarily focus on supply chain risk mitigation and market position protection. Starbucks' investment in sustainable sourcing serves dual purposes: carbon footprint reduction and supply security enhancement, particularly important given coffee's climate vulnerability.

Public sector institutions emphasize broader systemic risk management, including infrastructure resilience, public health protection, and economic stability. These benefits, while substantial, prove more challenging to quantify in traditional financial terms.

➤ Innovation and Technology Integration

• Technological Infrastructure Disparities

The study reveals significant disparities in technological capabilities between sectors:

Table 5 Technology Integration Assessment

Technology Component	Retail Sophistication	Public Sector Sophistication	Impact on Accuracy
IoT Sensors	High	Low	High
Data Analytics	Very High	Medium	High
Blockchain Verification	Medium	Low	Medium
AI/ML Optimization	High	Low	High
Real-time Monitoring	Very High	Medium	Very High

Source: Technology Assessment Based on Case Studies and Industry Surveys

• Innovation Drivers and Barriers

✓ Innovation Drivers:

- Retail: Competitive advantage, operational efficiency, customer demand
- Public: Regulatory requirements, taxpayer accountability, environmental justice

✓ Innovation Barriers:

- Retail: Initial capital requirements, technical complexity, ROI uncertainty
- Public: Budget constraints, procurement processes, political cycles

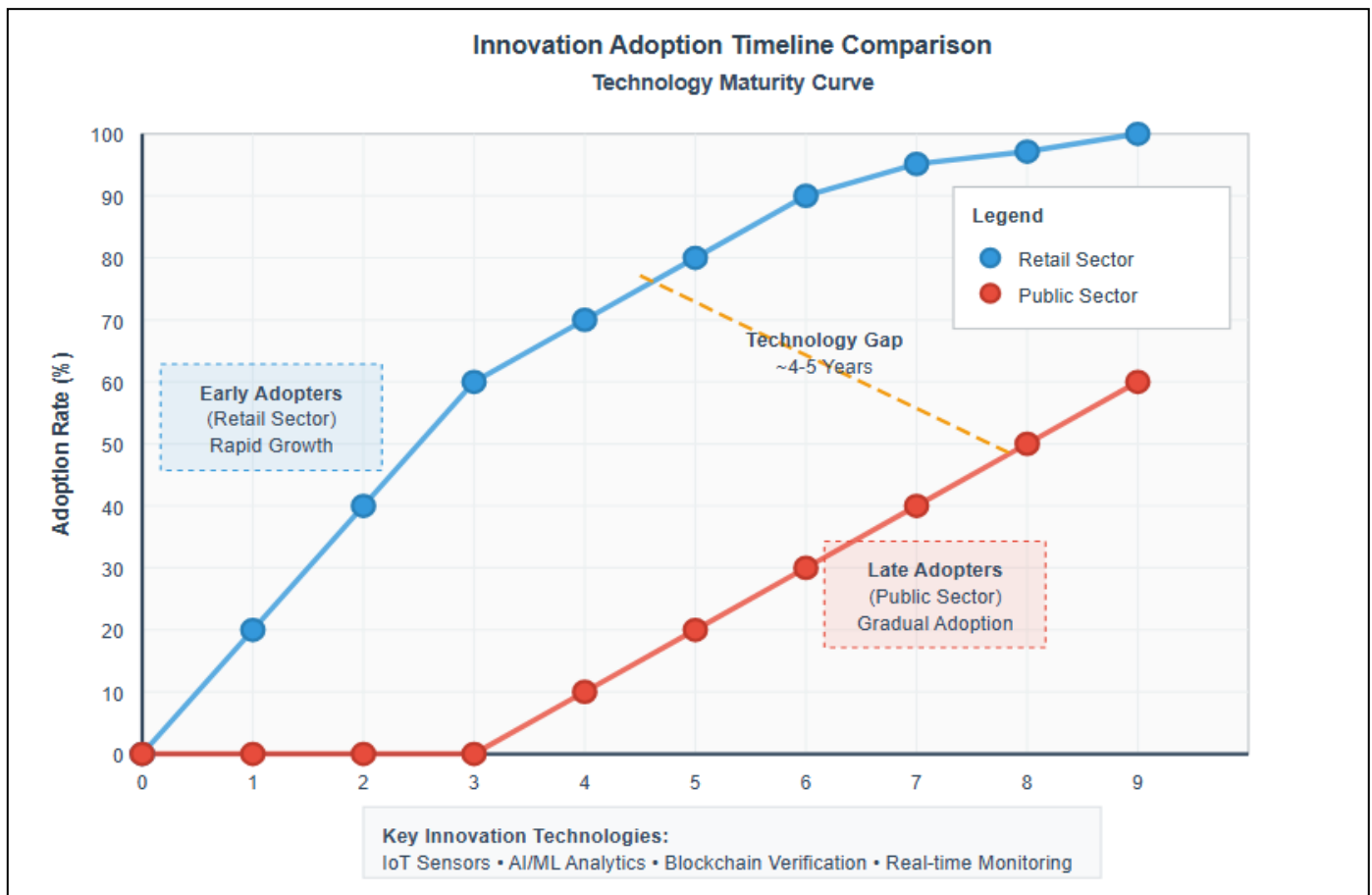


Fig 5 Innovation Adoption Timeline Comparison

➤ Policy Implications and Recommendations

• Harmonization Opportunities

The comparative analysis identifies several opportunities for policy intervention to enhance carbon accounting effectiveness across sectors:

- ✓ **Standardized Reporting Frameworks:** Development of sector-agnostic baseline requirements while maintaining flexibility for sector-specific adaptations
- ✓ **Technology Transfer Mechanisms:** Public-private partnerships to facilitate technology sharing from retail to public sector applications

- ✓ **Capacity Building Programs:** Targeted training and certification programs addressing sector-specific carbon accounting competencies
- ✓ **Financial Incentive Alignment:** Policy mechanisms that create comparable financial incentives for carbon accounting excellence across sectors

• Regulatory Framework Evolution

The research suggests that effective carbon accounting regulation should adopt differentiated approaches that recognize sectoral variations while maintaining core consistency principles (Taïbi et al., 2020). Key recommendations include:

- ✓ Phased Implementation: Gradual introduction of advanced requirements allowing public sector capacity building
- ✓ Performance-Based Standards: Outcome-focused regulations rather than prescriptive methodological requirements
- ✓ Cross-Sector Learning Mechanisms: Formal knowledge sharing platforms facilitating best practice transfer

VI. LIMITATIONS AND FUTURE RESEARCH

➤ *Study Limitations*

This comparative study acknowledges several limitations that constrain the generalizability of findings:

• *Methodological Constraints:*

- ✓ Single retail organization case study limiting sector representation
- ✓ Public sector analysis aggregation potentially obscuring important institutional variations
- ✓ Limited temporal scope affecting longitudinal trend analysis
- ✓ Data availability disparities between sectors influencing comparative accuracy

• *Contextual Limitations:*

- ✓ Geographic focus primarily on North American and European institutions
- ✓ Limited consideration of emerging market contexts
- ✓ Sectoral boundary definitions potentially excluding hybrid organizations
- ✓ Technology evolution outpacing analytical framework currency

➤ *Future Research Directions*

The findings suggest several promising avenues for future investigation:

• *Longitudinal Impact Assessment*

Future research should examine long-term financial performance correlations with carbon accounting implementation, particularly addressing:

- ✓ Multi-cycle political impact assessment for public sector institutions
- ✓ Generational technology adoption effects on accounting accuracy
- ✓ Climate policy evolution impact on institutional carbon accounting strategies

• *Cross-Sector Innovation Transfer*

Investigation of successful technology and methodology transfer mechanisms between sectors could yield valuable insights for policy development and institutional capacity building.

• *Emerging Market Analysis*

Comparative studies focusing on developing economies would enhance understanding of carbon

accounting implementation under different economic and regulatory contexts.

VII. CONCLUSION

This comparative study demonstrates that while carbon accounting serves similar environmental objectives across retail and public sector institutions, the implementation methodologies, performance measurement frameworks, and financial implications differ substantially. These variations reflect fundamental differences in organizational purpose, stakeholder expectations, and resource availability rather than mere technical preferences.

➤ *Key Findings:*

- **Methodological Divergence:** Retail organizations prioritize comprehensive scope coverage and real-time monitoring, while public sector institutions emphasize transparency and regulatory compliance within budget constraints.
- **Financial Performance Correlation:** Direct positive correlations between carbon accounting quality and financial performance are evident in retail settings, while public sector benefits manifest through indirect pathways including risk mitigation and stakeholder trust enhancement.
- **Technology Integration:** Significant disparities exist in technological sophistication, with retail organizations demonstrating advanced implementation capabilities that could benefit public sector institutions through targeted knowledge transfer mechanisms.
- **Standardization Potential:** Selective harmonization opportunities exist, particularly in boundary setting and verification processes, while maintaining sector-specific flexibility in implementation approaches.

➤ *Implications for Practice:*

Organizations in both sectors can enhance carbon accounting effectiveness by:

- Adopting appropriate technology solutions matched to institutional capacity and objectives
- Developing sector-specific performance measurement frameworks that align environmental and financial goals
- Participating in cross-sector learning initiatives to accelerate best practice adoption
- Investing in staff capacity building to support sophisticated carbon accounting implementation

POLICY RECOMMENDATIONS

Policymakers should consider differentiated regulatory approaches that recognize sectoral variations while promoting core consistency principles. Key priorities include developing technology transfer mechanisms, establishing capacity building programs, and creating financial incentive structures that appropriately motivate carbon accounting excellence across diverse institutional contexts.

The transition toward comprehensive carbon accounting represents both challenge and opportunity for organizations across sectors. Success depends not on uniform implementation approaches, but on sector-appropriate methodologies that effectively integrate environmental stewardship with institutional objectives and stakeholder expectations. As climate concerns intensify and regulatory frameworks evolve, the organizations that successfully navigate these comparative advantages will establish sustainable competitive positions while contributing meaningfully to global environmental goals.

This research contributes to the evolving understanding of carbon accounting as both environmental tool and financial strategy, providing empirical evidence for the development of more effective, sector-appropriate implementation frameworks. The findings support continued investment in carbon accounting capabilities while recognizing that optimal approaches must be tailored to specific institutional contexts and objectives.

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