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**From Cost Center to Profit Center: Leveraging the Saudi Voluntary
Carbon Market to Fund Energy Retrofits in Commercial Real Estate**

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1. Introduction

The transition toward a decarbonized economy is reshaping the operational and financial strategies of commercial real estate. In Saudi Arabia, this shift is formalized through Vision 2030 and the Saudi Green Initiative (SGI), which mandates the abatement of 278 million tons of carbon emissions annually. The built environment is a major focal point of this mandate, given that commercial buildings—driven largely by extreme cooling requirements—account for a disproportionate share of the Kingdom’s total electricity consumption.

Historically, the Gulf Cooperation Council (GCC) Facility Management (FM) sector has functioned primarily as a cost center. Traditional contracts prioritize reactive maintenance, standard cleaning, and basic security, treating energy expenditures as fixed overhead. However, the introduction of carbon pricing mechanisms has initiated a market shift. While carbon reporting in Saudi Arabia is currently voluntary, regional regulatory trends indicate an impending change. The United Arab Emirates (UAE) has already begun implementing mandatory carbon compliance frameworks, signaling that stringent carbon footprint reduction mandates will likely become a strict compliance requirement in KSA in the near future.

The Public Investment Fund (PIF) recently established the Regional Voluntary Carbon Market Company (RVCMC), successfully hosting auctions that established a premium clearing price for voluntary carbon credits. Recent macroeconomic studies underscore that verified carbon credits will serve as a foundational currency in the global "new economy." This introduces a distinct opportunity: the direct monetization of energy efficiency. By executing deep energy retrofits—such as HVAC optimization, Building Management System (BMS) integration, and LED transitions—FM companies can generate verified carbon emission reductions. If successfully registered and sold on the RVCM, the FM function transforms into a strategic profit center. This aligns private sector financial incentives directly with national decarbonization goals, while simultaneously future-proofing real estate assets against incoming compliance penalties.

2. Problem Statement

Despite the strategic alignment between national climate goals and the financial potential of carbon markets, a critical viability gap prevents widespread adoption within the Saudi commercial real estate sector. The RVCM has established a highly attractive premium price for carbon credits, clearing at SAR 37.50 per ton of CO₂e (RVCMC, 2024). However, this price point presents a severe financial paradox for individual facility managers.

Preliminary market analysis indicates that a standard Grade A or B commercial office asset in Riyadh (approximately 20,000 square meters) undergoing standard operational retrofits would generate roughly 500 tons of carbon abatement annually. At current market rates, this yields an annual revenue of only SAR 18,750. This theoretical revenue is vastly insufficient to cover the high transaction costs associated with third-party Monitoring, Reporting, and Verification (MRV). International verification standards (such as Verra or the Clean Development Mechanism) require rigorous, independent auditing that routinely exceeds SAR 40,000 per issuance.

Consequently, the cost of proving sustainability currently exceeds the financial reward for achieving it at the individual building level. This structural market barrier prevents the Saudi built environment from participating in the carbon economy, leaving millions of potential energy-saving retrofits unexecuted.

3. Importance of the Study

This study offers strategic value across four distinct macroeconomic and industry-specific domains:

- **Macroeconomic Impact (Vision 2030 & Fiscal Policy):** Achieving SGI targets requires mobilizing private sector real estate. This research models how targeted government interventions—specifically, subsidizing MRV costs—can accelerate retrofit adoption. This aligns with national fiscal goals by reducing the domestic consumption of subsidized oil currently utilized for electricity generation, freeing those resources for global export.
- **Meso-level Impact (The Facility Management Industry):** This study outlines a quantifiable roadmap to transition FM into a strategic partner. By demonstrating how to unlock carbon revenue, FM companies can justify higher Capital Expenditure (CAPEX) for smart building technologies, shifting the industry toward value-driven energy performance partnerships.

- **Global Market Export & Price Appreciation (The "New Economy"):** Beyond domestic markets, there is significant potential for carbon credit price appreciation. Stringent European Union regulations (such as the EU ETS and the Carbon Border Adjustment Mechanism) are forcing European multinational corporations to purchase high-quality, verified carbon credits from international markets. Saudi FM companies that aggregate verified credits will possess a highly liquid financial asset positioned to capture this European demand.
- **Micro-level Impact (Real Estate Valuation & Compliance):** For asset owners, this study offers a financial framework to de-risk green retrofits. By incorporating carbon credit revenue streams into asset valuation models, developers can improve the Net Present Value (NPV) of their portfolios and command a "Green Premium" in Riyadh's commercial leasing market, while proactively shielding owners from future compliance taxation.

4. Research Objectives

This dissertation aims to design a commercially viable, data-driven financial framework enabling the Saudi Facility Management sector to monetize energy efficiency through the Regional Voluntary Carbon Market. To achieve this, the study is divided into primary and secondary objectives.

4.1. Primary Objectives

- I. **To Quantify the Carbon "Viability Gap":** To empirically calculate the scale—measured in Gross Leasable Area (m²) and carbon yield (tCO₂e)—required for commercial real estate to profitably participate in the RVCN. This utilizes a streamlined executive financial model to prove that current third-party MRV transaction costs create a market failure for individual buildings.
- II. **To Model the Financial Impact of "Aggregation":** To evaluate how transitioning FM providers into "Carbon Aggregators" resolves the Split-Incentive dilemma. The objective is to calculate the specific improvements in Return on Investment (ROI) and Simple Payback Period (SPP) when multiple commercial assets are pooled into a single Program of Activities (PoA).
- III. **To Assess Policy Interventions and Future-Proofing:** To model the financial impacts of a proposed 5-year, government-subsidized "Verification Fund." This objective also evaluates how proactive carbon monetization shields asset owners from impending mandatory carbon taxation while generating an appreciating asset.

4.2. Secondary Objectives

- I. **To Map the Transition to Performance-Based Contracting:** To outline the operational shift required for FM companies to move away from headcount-based maintenance contracts toward Energy Performance Contracts (EPCs).
- II. **To Evaluate International Export Potential:** To assess the strategic viability of Saudi FM companies aggregating verified carbon credits to capture surging European corporate demand driven by the CBAM.
- III. **To Analyze the "Greening Grid" Risk Factor:** To project how the ongoing integration of utility-scale renewable energy into the Saudi national grid (which lowers the Grid Emission Factor) will impact the long-term carbon yield of commercial building retrofits over a 10-year investment horizon.

5. Research Questions

This study addresses the following core questions to achieve these objectives:

- **RQ1 (The Baseline Barrier):** To what extent do current third-party MRV transaction costs on the Regional Voluntary Carbon Market create a financial viability gap for individual commercial facilities in Riyadh?
- **RQ2 (The Aggregation Solution):** How does the strategic aggregation of multiple commercial assets into a unified Program of Activities (PoA) impact executive financial metrics, specifically the Return on Investment (ROI) and Simple Payback Period (SPP), for Facility Management providers?
- **RQ3 (The Policy Impact):** What is the projected macroeconomic and project-level impact if the Saudi government fully subsidized carbon verification costs for the FM sector over a 5-year inception period to accelerate the Saudi Green Initiative?
- **RQ4 (Future-Proofing & The New Economy):** How does the proactive generation of verified carbon credits strategically position Saudi real estate assets to mitigate impending mandatory compliance taxation and capture international export demand driven by the European Carbon Border Adjustment Mechanism (CBAM)?

6. Research Hypotheses

The empirical analysis and financial modeling within this study are guided by three primary hypotheses:

- **H1 (The Transaction Cost Barrier):** At the current RVCN clearing price of SAR 37.50/tCO₂e, the fixed transaction costs of third-party MRV verification create a negative annual net cash flow for individual commercial buildings, rendering participation mathematically unviable without achieving economies of scale.
- **H2 (The Executive Financial Return):** By aggregating multiple commercial real estate assets into a unified Program of Activities (PoA), Facility Management providers can successfully dilute MRV transaction costs, achieving a Simple Payback Period (SPP) of under 5 years and a highly positive 10-year Return on Investment (ROI) that satisfies private developer hurdle rates.
- **H3 (The Strategic "New Economy" Premium):** Early adoption of carbon monetization—accelerated by a proposed 5-year government MRV subsidy—will strategically position Saudi real estate portfolios to command a price premium from European corporate buyers while mitigating the financial risk of impending domestic mandatory carbon compliance.

7. Previous Research

The transition of the built environment toward decarbonization operates at the intersection of real estate finance, environmental policy, and operational facility management. To provide context for carbon monetization in Saudi commercial real estate, this section reviews literature across five key areas.

7.1. The Paradigm Shift in GCC Facility Management

Historically, the FM sector within the GCC has been characterized by a commoditized, reactive approach to building operations. According to the Middle East Facility Management Association (MEFMA, 2023), FM contracts in the region have traditionally been awarded based on the lowest bid, emphasizing basic maintenance and security. Utility consumption—driven by heavy HVAC loads in an arid climate—was viewed by asset owners as an uncontrollable overhead cost.

However, recent literature highlights a paradigm shift. JLL's research on sustainability in the built environment (2024) indicates that institutional investors in the Middle East are increasingly

demanding Environmental, Social, and Governance (ESG) compliance. JLL documents the emergence of a "Green Premium" in GCC real estate, where buildings with high energy performance and sustainability certifications command higher rental yields and experience lower vacancy rates. Yet, as Al-Mofeez and Nait-Sidnas (2025) note in their review of building retrofits in arid climates, while the engineering solutions are mature, the financial mechanisms to fund these initial capital expenditures (CAPEX) remain a significant barrier for legacy buildings.

7.2.Mechanics of Global Carbon Pricing and Markets

To understand the financial opportunity for Saudi FM, it is essential to distinguish between Compliance Markets and Voluntary Carbon Markets (VCM). The World Bank's State and Trends of Carbon Pricing (2025) extensively details Compliance Markets, such as the EU ETS. These are regulatory cap-and-trade systems where heavy emitters are legally mandated to surrender emission allowances. Prices in these markets are driven by regulatory scarcity and often exceed USD 80-100 per ton. However, commercial real estate is largely excluded from these compliance schemes due to the diffuse nature of building emissions.

Conversely, Voluntary Carbon Markets (VCM) allow organizations to purchase carbon credits proactively to meet corporate targets. Historically, the global VCM has been plagued by oversupply and varying quality standards, leading to depressed global average prices (USD 1 to 5 per ton). At these low prices, monetizing energy efficiency in a single commercial building is mathematically unviable, as the revenue cannot offset the administrative cost of participation (World Bank, 2025).

7.3.The Saudi Arabian Context: Vision 2030 and the RVC

Recent studies highlight a rapid convergence between voluntary and compliance markets, forming the basis of the "new economy." GCC nations are transitioning toward strict compliance-driven frameworks, evidenced by the UAE's integration of carbon reporting mandates. Furthermore, European corporations, facing tightening domestic emission caps, are increasingly looking to the Global South to purchase verified voluntary credits to offset their footprints. This incoming wave of European capital is projected to drive a significant increment in the valuation of high-quality RVC credits, transforming carbon from a niche environmental metric into a primary, appreciating commodity of the future global economy.

7.4.Theoretical Underpinnings of Financial Barriers

Despite the high clearing price on the RVCM, widespread adoption of carbon monetization in the Saudi commercial real estate sector remains stagnant. This paralysis can be explained through two primary economic theories.

7.4.1. Transaction Cost Economics (TCE) and MRV Barriers

Transaction Cost Economics, originating from Coase's theorem, posits that market transactions incur intrinsic costs (search, negotiation, and enforcement) that can prevent otherwise efficient trades from occurring. In the carbon market, "enforcement" takes the form of Monitoring, Reporting, and Verification (MRV). To ensure carbon credits are real and additional, projects must be audited by internationally accredited third-party bodies. PwC Middle East (2024) notes that the administrative and auditing fees to register a single project can routinely exceed SAR 40,000 to SAR 80,000. Applying TCE to the FM sector reveals a critical market failure: a standard Riyadh office building saving 500 tons of carbon per year generates roughly SAR 18,750 on the RVCM. Because the transaction cost exceeds the asset value, the rational economic actor opts not to participate.

7.4.2. Agency Theory and the Split-Incentive Dilemma

Further compounding the transaction cost barrier is the "Split-Incentive" dilemma, rooted in Agency Theory. Al-Surf and Al-Fagih (2024) document this phenomenon in GCC commercial buildings. In a standard multi-tenant office tower, the landlord finances the CAPEX required for energy-efficient retrofits. However, the resulting financial savings (reduced OPEX through lower electricity bills) are captured entirely by the tenants. Carbon credits theoretically offer a mechanism to solve this agency conflict by creating a new, direct revenue stream that bypasses the tenant, thereby justifying the initial CAPEX. However, this solution brings the landlord right back to the MRV transaction cost barrier.

7.5.Identification of the Research Gap

Current literature presents a distinct gap. Existing macro-level research adequately describes the structure of carbon markets and the policy goals of Vision 2030. Conversely, technical literature exhaustively details the engineering potential for energy savings in arid climates.

However, there is an absence of applied, micro-level financial modeling that bridges these two domains within the Saudi Arabian context. Specifically, no existing literature empirically models the exact scale at which "Aggregation" overcomes the Transaction Cost barrier on the Saudi RVCM. This dissertation addresses this gap by providing a deterministic financial framework for Facility Management companies and Saudi policymakers.

8. Theoretical Framework

This research relies on two foundational economic theories to evaluate carbon credit viability: Transaction Cost Economics (TCE) and Agency Theory. Together, these theories explain the current market failure and provide the rationale for the proposed solutions.

8.1.Transaction Cost Economics (TCE) and the MRV Barrier

Originating from Coase (1937) and expanded by Williamson (1981), Transaction Cost Economics dictates that participating in a market carries inherent costs beyond the physical price of a good. For the Regional Voluntary Carbon Market (RVCM), the asset is the Carbon Emission Reduction (CER). To mint a CER, an FM company must undergo Monitoring, Reporting, and Verification (MRV) by accredited third parties. The core theoretical problem arises when the transaction cost (TC) exceeds the anticipated revenue (R) generated by the asset.

Currently, for a standard Riyadh office building, the fixed MRV cost is disproportionately large compared to the quantity of carbon saved. TCE provides the theoretical justification for Aggregation (the pooling of multiple buildings). By increasing the carbon yield across a portfolio while sharing a single audit, the transaction cost per unit is minimized, thereby correcting the market failure and making the exchange viable.

8.2.Agency Theory and the Split-Incentive Dilemma

Agency Theory examines the conflicts of interest that occur when the principal (asset owner) and the agent (tenant) have misaligned financial incentives. If a landlord invests capital expenditure (CAPEX) into high-efficiency HVAC chillers, the primary financial return manifests as a reduction in operational utility costs (OPEX). However, in standard GCC commercial leases, tenants pay their own electricity bills. Thus, the landlord bears 100% of

the CAPEX risk, while the tenant captures 100% of the OPEX reward. Carbon monetization theoretically resolves this agency conflict by establishing an independent revenue stream that legally belongs to the principal, bypassing the split-incentive barrier entirely.

9. Research Methodology

The study applies a quantitative deterministic modeling approach. To answer the research questions, the study constructs a simulated financial environment utilizing technical energy baseline data and current carbon market pricing.

9.1. Research Design and Data Collection Strategy

The methodology simulates the lifecycle of an energy retrofit project over a standard 10-year investment horizon. Secondary quantitative data is sourced from established regional authorities to ensure the model reflects the realities of the Saudi Arabian market.

- **Building Prototype Definition:** The model utilizes a "Grade A" commercial office building in Riyadh with a Gross Leasable Area (GLA) of 20,000 square meters.
- **Energy Baseline Data:** The Energy Use Intensity (EUI) is established using the Saudi Energy Efficiency Center (SEEC) benchmarks for commercial offices in Climate Zone 1B (Riyadh).
- **Carbon Market Data:** Revenue projections utilize the clearing price from the most recent RVMC auctions (SAR 37.50 / tCO₂e).
- **MRV Cost Estimates:** Transaction costs are estimated based on standard fee schedules for international registries combined with local third-party auditor day rates in the GCC.

9.2. Mathematical Modeling of Carbon Yield

Before financial metrics can be calculated, the model converts raw energy savings into tradable carbon assets using the Clean Development Mechanism (CDM) standardized baselines.

- **Equation 1: Total Energy Savings ($E_{\{saved\}}$)**

$$E_{\{saved\}} = A \times (EUI_{\{base\}} - EUI_{\{target\}})$$

(Where A is the total floor area, $EUI_{\{base\}}$ is the current energy use intensity, and $EUI_{\{target\}}$ is the anticipated post-retrofit energy use intensity).

- **Equation 2: Carbon Emission Reduction (CER) Yield**

$$CER = E_{\{saved\}} \times EF_{\{grid\}}$$

(Where $EF_{\{grid\}}$ is the Saudi Arabian Grid Emission Factor, utilized to calculate the amount of carbon emitted per kWh. The standard estimate for the Saudi grid is approximately 0.58 kgCO₂e/kWh).

To evaluate the financial viability of carbon monetization, the study employs a streamlined Executive Financial Modeling framework (detailed in Section 10) replacing traditional, complex Discounted Cash Flow analysis with actionable corporate metrics.

9.3.Scenario Definitions

The formulas outlined above will be stress-tested against three distinct operational scenarios to directly answer the research hypotheses:

- **Scenario A: The Single Asset (Baseline Market Failure):** Models a single 20,000 m² building. The project bears 100% of the MRV transaction costs independently. Purpose: To empirically prove Hypothesis 1.
- **Scenario B: The Aggregated Portfolio (The Business Solution):** Models a portfolio of 15 commercial buildings (Total GLA: 300,000 m²) managed by a single FM provider under a Program of Activities (PoA). The MRV transaction costs are pooled and shared. Purpose: To identify the exact point of economies of scale where the 10-year ROI becomes attractive for private investors.
- **Scenario C: The Subsidized Portfolio (The Policy Solution):** Models the Aggregated Portfolio, but assumes a 100% government subsidy on MRV transaction costs for the first 5 years of the project lifecycle. Purpose: To empirically prove Hypothesis 2, verifying that government intervention accelerates cash flow and shortens the payback period.

10. Research Instruments / Tools

To operationalize the theoretical framework, this study relies on a specific suite of analytical tools and standardized datasets designed to bridge technical engineering outputs with streamlined, executive-level financial investment metrics.

10.1. Executive Financial Modeling Framework (MS Excel)

The primary analytical instrument is a customized, multi-scenario financial model constructed in Microsoft Excel. To ensure the findings are actionable for Facility Management executives, the model utilizes a streamlined 3-Step Financial Evaluation Framework focusing on Capital Expenditure (CAPEX), Operational Expenditure (OPEX) savings, and Return on Investment (ROI).

- **Step 1: Annual Carbon Revenue Calculation**

$$\text{Carbon Revenue} = E_{\{saved\}} \times EF_{\{grid\}} \times P_{\{carbon\}}$$

(Where $E_{\{saved\}}$ is the annual electricity saved, $EF_{\{grid\}}$ is the Saudi Grid Emission Factor, and $P_{\{carbon\}}$ is the RVCM clearing price).

- **Step 2: Total Net Cash Flow (Integrating OPEX)**

$$\text{Total Net Cash Flow} = (\text{Carbon Revenue} + \text{OPEX Savings}) - TC_{\{MRV\}}$$

(Where OPEX Savings equals $E_{\{saved\}}$ multiplied by the local commercial electricity tariff, and $TC_{\{MRV\}}$ represents the fixed annual transaction costs for third-party carbon auditing).

- **Step 3: Executive Investment Metrics (Integrating CAPEX)**

To assess the attractiveness of the investment, the model evaluates the Total Net Cash Flow against the initial CAPEX required for the smart building retrofits.

- **Simple Payback Period (SPP):**

$$SPP = \frac{\{CAPEX\}}{\{Total\ Net\ Cash\ Flow\}}$$

- **Return on Investment (ROI):**

$$ROI = \frac{\{(Total\ Net\ Cash\ Flow \times 10) - CAPEX\}}{\{CAPEX\}} \times 100$$

10.2. Carbon Baseline and Monitoring Calculators

To ensure the financial model is based on scientifically rigorous emission reductions, the study utilizes calculators derived from the United Nations Framework Convention on Climate Change (UNFCCC) methodologies.

- **CDM Methodology AMS-ILE:** This Clean Development Mechanism tool is used as the mathematical instrument to calculate the baseline emissions and the project emissions.
- **Grid Emission Factor (GEF) Matrix:** A dynamic variable tool that inputs the Saudi Arabian grid's carbon intensity. For this study, the instrument locks the GEF at approximately 0.58 kgCO₂e/kWh.

10.3. Benchmarking Datasets

The financial and carbon calculators are fed by two primary sets of standardized data instruments:

- **SEEC Commercial Building Benchmarks:** Official datasets from the Saudi Energy Efficiency Center defining the Energy Use Intensity (EUI) limits for existing commercial buildings in Riyadh.
- **RVCMC Auction Data Ledger:** Historical clearing data from the Regional Voluntary Carbon Market Company, utilized to establish the fixed revenue assumption of SAR 37.50 per ton of CO₂e.

11. Research Limitations

The deterministic models utilized in this study are subject to specific technical, financial, and geographic boundaries.

- **Data Confidentiality and Proxy Reliance:** A primary limitation in commercial real estate research is the strict confidentiality surrounding private operating budgets. Asset owners rarely disclose proprietary CAPEX costs for equipment upgrades or exact OPEX utility ledgers. Consequently, this study relies on Representative Prototype Modeling based on SEEC averages and publicly available vendor quotes. While this accurately models the macro-trend, the specific ROI for a real-world building will vary based on its unique age, design, and existing equipment degradation.
- **Carbon Market Price Volatility:** The financial models assume a static or slowly appreciating carbon price based on the recent RVCM clearing price. However, voluntary carbon markets are historically subject to volatility driven by global corporate ESG sentiment. A sudden oversupply of credits or a drop in corporate demand would fundamentally alter the payback period of the aggregated portfolio.
- **The "Greening Grid" Paradox:** As Saudi Arabia successfully integrates massive solar projects into the national grid, the Grid Emission Factor will mathematically decrease over the next decade. Saving a kilowatt-hour of electricity inside a building will displace less carbon in the future than it does today. This dynamic degradation of carbon yield is complex to forecast accurately and represents a limitation in the 10-year flat-yield projection.
- **Geographic and Sectoral Constraints:** The findings of this study are geographically bound to Riyadh (ASHRAE Climate Zone 1B) and sectorally bound to Grade A/B commercial offices. The framework cannot be universally applied to coastal cities with high humidity (latent cooling loads) or industrial facilities driven by manufacturing process loads.

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