Capital Lifecycle Governance Model

Preventive Public Policy (PPP)

Formal Replacement-Cycle Discipline and Capital Sustainability Framework

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1. Purpose of the Model

This document formalises the Capital Lifecycle Governance Model within Preventive Public Policy (PPP). Its purpose is to establish disciplined capital replacement-cycle governance as a core determinant of long-term fiscal efficiency.

Preventive interventions frequently require upfront capital investment. Without structured lifecycle modelling, replacement schedules, depreciation assumptions, and reinvestment discipline, otherwise efficient preventive policies can become fiscally unsustainable.

This model ensures that capital intensity does not undermine preventive viability.

2. Conceptual Foundation

Capital-heavy preventive programmes (health infrastructure, housing upgrades, technology deployment, environmental mitigation systems) involve multi-period cost streams.

Lifecycle capital cost must be expressed as:

Total Lifecycle Cost = $C_0 + \Sigma (C_{rep_t} / (1 + r)^t)$

Where:

C_0 = initial capital investment

C_{rep_t} = replacement or major maintenance cost at time t

r = discount rate

Failure to model C_{rep_t} accurately creates structural overstatement of preventive efficiency.

3. Depreciation and Replacement Discipline

Preventive governance requires explicit modelling of:

• Asset lifespan assumptions

• Depreciation schedules

• Major replacement intervals

• Maintenance cost curves

• Technology obsolescence risk

Replacement cycles must be parameterised rather than assumed.

Optimistic lifespan assumptions artificially inflate NPV projections.

4. Capital Intensity Ratio (CIR)

The Capital Intensity Ratio is defined as:

CIR = Present Value of Capital Costs / Present Value of Avoided Costs

Where CIR > 1 indicates capital dominance relative to benefit stream.

High CIR programmes require stricter viability thresholds and sensitivity testing.

5. Replacement Threshold Sensitivity

Capital replacement modelling must include:

• Partial replacement scenarios (e.g., 30%, 50%, 75% of C_0)

• Variable replacement intervals (5, 10, 15 years)

• Escalation due to inflation or technological upgrade

Threshold analysis identifies the maximum replacement fraction compatible with positive NPV.

6. Interaction with Political Discounting

Capital-heavy programmes are disproportionately vulnerable to elevated political discount rates (r_p).

Where r_p increases:

• Long-horizon benefits compress

• Capital reinvestment burden weighs more heavily

• NPV breakpoints occur earlier

Capital governance must therefore account for both social and political discount regimes.

7. Governance Controls

To maintain lifecycle discipline, preventive governance must include:

• Ring-fenced capital renewal funds

• Multi-cycle budgeting commitments

• Asset-condition reporting requirements

• Independent capital audit mechanisms

• Replacement-trigger transparency

Capital sustainability must be institutionally embedded rather than politically discretionary.

8. Stress Testing Framework

Capital Lifecycle Governance requires hostile scenario modelling including:

• Shortened asset lifespan

• Increased replacement cost percentages

• Lower benefit realisation

• Delayed benefit onset

Only programmes that remain viable under defined stress thresholds qualify as robust preventive investments.

9. Capital Sustainability Frontier

The Capital Sustainability Frontier identifies the boundary at which:

NPFE = 0

Given replacement fraction (f), replacement interval (τ), and benefit stream (A_t).

This frontier defines the parameter space within which preventive capital deployment remains fiscally sustainable.

Mapping this boundary transforms capital risk into measurable governance constraint.

10. Institutional Implications

Preventive policy success is not solely dependent on clinical or behavioural effectiveness. Capital governance quality is equally decisive.

Failure to discipline lifecycle capital can:

• Convert positive NPV into structural deficit

• Crowd out alternative preventive investment

• Generate fiscal instability across cycles

Conversely, disciplined lifecycle governance preserves preventive fiscal efficiency across long horizons.

11. Integration with PPP Architecture

The Capital Lifecycle Governance Model integrates with:

• Preventive Fiscal Efficiency Model (PFEM)

• Political Discounting Framework

• Metrics & Outcome Evaluation Guidance

• Treasury Green Book Alignment Framework

Together, these components ensure preventive policy is economically rigorous, institutionally realistic, and capital-disciplined.

12. Final Conclusion

Capital lifecycle governance is a structural pillar of Preventive Public Policy.

Preventive interventions are conditionally efficient only when replacement cycles, depreciation assumptions, and capital sustainability thresholds are transparently modelled and institutionally

governed.

The Capital Lifecycle Governance Model converts capital risk from an overlooked vulnerability into a formalised fiscal discipline mechanism.

Preventive governance therefore requires not only economic logic, but capital architecture integrity across time.