



# Unlocking Infrastructure for Indian Pensions

Lessons from global leaders and a practical roadmap for NPS

₹14.1 Lakh

NPS corpus



2.42 Crore

subscribers



8%

infra allocation



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# Unlocking Infrastructure for Indian Pensions: Lessons from Global Leaders and a Practical Roadmap for NPS



## Abstract

India's National Pension System now manages over ₹14.4 lakh crore for more than 8.4 crore subscribers with investment horizons of 30–60 years, yet infrastructure is largely absent from its asset mix. This session benchmarks global pension funds, back-tests 5–15% infrastructure allocations using Indian NPS and infrastructure return data, and reviews Monte Carlo results over 35- and 45-year horizons. The core finding: infrastructure can improve portfolio efficiency when implemented through yield-oriented instruments such as InvITs and global infrastructure exposure, rather than listed infrastructure equity alone. The session concludes with a phased roadmap for PFRDA and NPS pension fund managers.

# Executive thesis

NPS has the horizon; infrastructure has the duration and cash-flow profile



## THESIS

**₹14.4L Cr+**

NPS AUM

**8.4 Cr+**

Subscribers

**~0%**

Current infra allocation

**5–25%**

Typical global range

## Fit

Long-duration, inflation-linked cash flows can match long-term pension liabilities.

## Evidence

Back-test indicates higher cumulative return and lower volatility at 15% allocation.

## Implementation

Start with listed InvITs and rated infra bonds, then move gradually to pooled and direct models.



# Today's 60-minute flow

Designed to move from actuarial intuition to policy roadmap



## AGENDA

- 1 Why infrastructure belongs in a pension conversation
- 2 Global pension benchmarking
- 3 Data, composite and portfolio scenarios
- 4 Back-test and Monte Carlo evidence
- 5 Regulatory roadmap, risks and closing

## PART 1

# Why this matters

Asset-liability alignment, NPS scale, and the missing infrastructure sleeve.

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## A pension system with a 45-year horizon should invest like one.

### What to take from the next section

- The actuarial idea
- The investment evidence
- The decision implication

# Why this matters now

Three forces are converging in India's pension and infrastructure markets

## CONTEXT

### 1 NPS is scaling

AUM has crossed ₹14.4 lakh crore and subscriber base is over 8.4 crore.

### 2 India needs long-term capital

Infrastructure requirements remain large, with NIP estimates at ₹143 trillion through 2030.

### 3 Regulatory flexibility is emerging

The Multiple Scheme Framework creates a potential route beyond E/C/G/A.

# The actuarial fit: liabilities are long; infrastructure assets are long

Infrastructure can help align duration, inflation sensitivity and cash-flow regularity



## CONTEXT

### NPS liability profile

30–60 year accumulation horizon  
Inflation-sensitive retirement income



### Infrastructure asset profile

25–99 year concessions  
User charges often linked to inflation

### Asset–liability alignment

For a young subscriber, illiquidity is not always a constraint — it may be the source of a return premium.



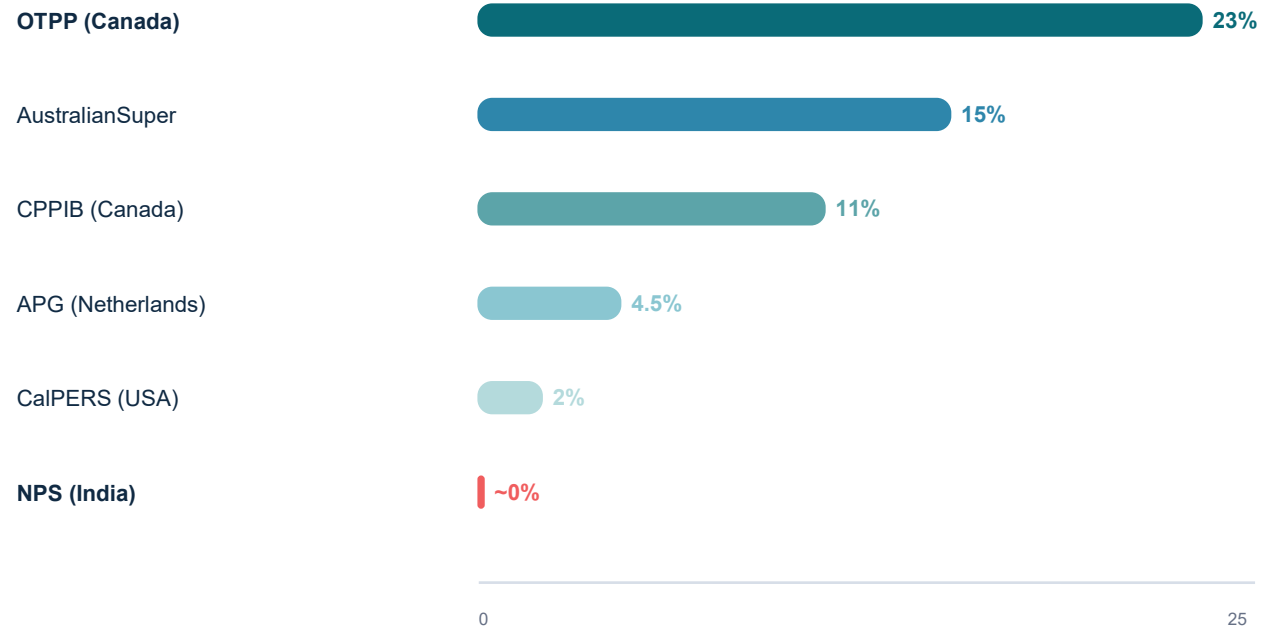
# Global pension funds already treat infrastructure as strategic

NPS has a visible allocation gap versus peer long-horizon pools



## BENCHMARK

### Infrastructure allocation (% of portfolio)



**Global leaders built capabilities gradually — usually starting at 2–5%, then scaling over a decade or more.**

The gap is not proof that NPS should copy Canada or Australia; it is proof that a governed Indian pathway is worth evaluating.



# Five lessons from global leaders

The common pattern is governance-first, allocation-second



## BENCHMARK

- 1 Start small** 2–5% initial allocation, then ramp over 10+ years
- 2 Govern first** investment committee, valuation and risk policy before capital deployment
- 3 Evolve instruments** funds → co-investments → direct platforms as capability deepens
- 4 Diversify deliberately** geography, sector year diversification
- 5 Control fees** avoid multi-layered fee leakage



# India's investible infrastructure ecosystem is now more usable



InvITs, rated infrastructure bonds, NaBFID and GIFT City vehicles form an implementation toolkit



## CONTEXT

| Instrument                 | Why it matters for NPS                             | Risk / control needed                         |
|----------------------------|----------------------------------------------------|-----------------------------------------------|
| Listed InvITs              | Operational assets, distributions, daily liquidity | Market price volatility; sector concentration |
| Infra bonds                | Familiar fixed-income format; AA+ issuers possible | Credit, duration and concentration limits     |
| Category I AIF / IDF       | Access to diversified project pools                | Fees, valuation and J-curve transparency      |
| Global infra via GIFT City | Diversification away from domestic equity beta     | Currency and vehicle governance               |



## PART 2

# The evidence engine

From global benchmarking to back-testing and Monte Carlo simulation.

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**The paper triangulates policy using three distinct forms of evidence.**

**What to take from the next section**

- The actuarial idea
- The investment evidence
- The decision implication

# Research design: three evidence blocks

Benchmark, back-test and forecast before moving to regulation



## METHOD

1

### Global benchmark

CPP Investments,  
AustralianSuper, APG,  
CalPERS, OTPP

2

### Historical back-test

FY2019–FY2026  
actual returns across  
E/C/G and  
infrastructure proxies

3

### Monte Carlo forecast

10,000 paths over 35-  
and 45-year horizons  
under 3 calibrations

4

### Regulatory roadmap

Three-phase PFRDA  
implementation  
framework

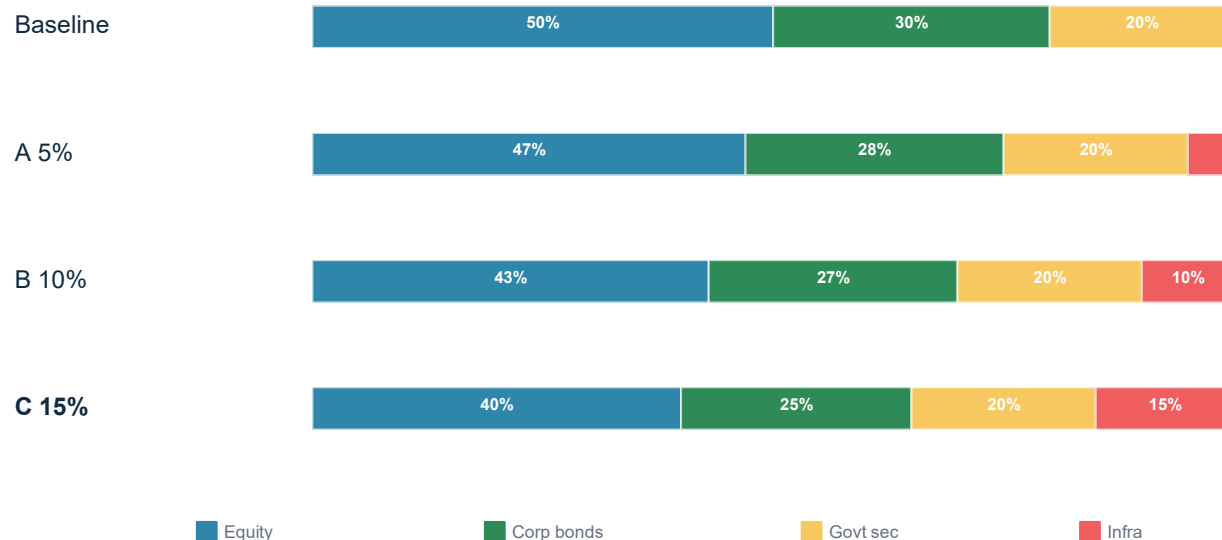


# Data and portfolio scenarios

The paper tests 5%, 10% and 15% infrastructure allocations against a baseline mix

## METHOD

### Portfolio allocation by scenario



## Data sources

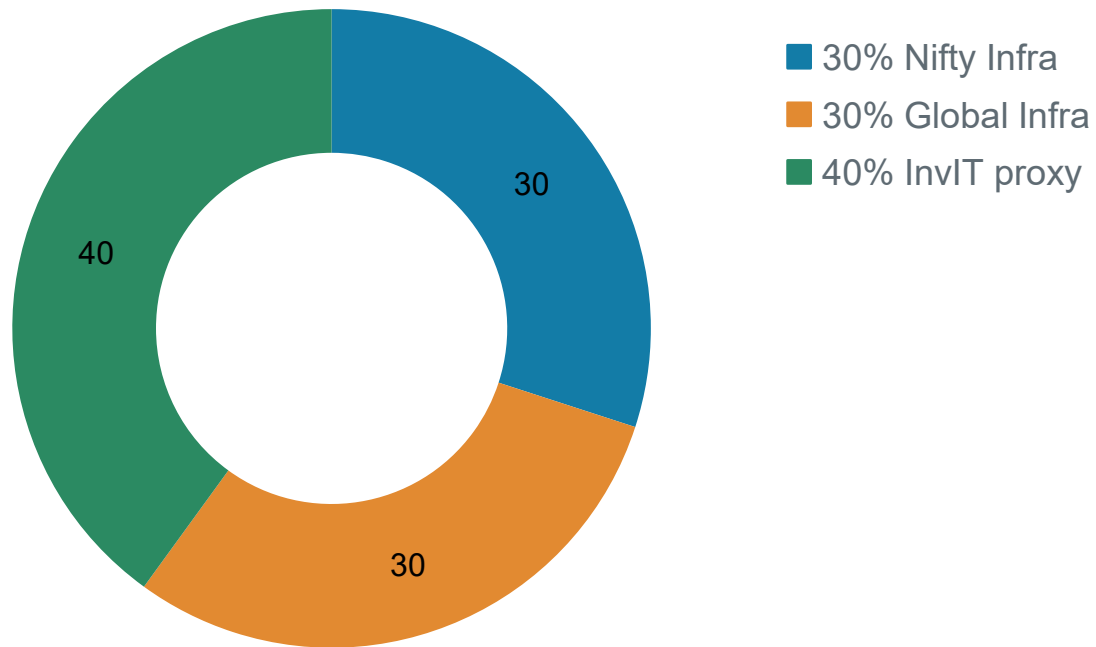
SBI Pension Funds Scheme E, C and G returns  
Nifty Infrastructure Index TRI  
S&P Global Infrastructure Index in INR  
Weighted returns for India Grid Trust, PowerGrid InvIT and IRB InvIT

**Scenario C replaces 10pp equity + 5pp corporate bonds with 15pp infrastructure while keeping government securities at 20%.**

# Infrastructure composite: built to reflect implementable exposure

Not all infrastructure exposure behaves the same way

## METHOD



**InvITs are weighted highest because they are SEBI-regulated, publicly traded and cash-flow oriented.**

Indian listed infrastructure captures domestic growth but is highly equity-like, so it cannot be the only exposure.

Global infrastructure adds sector/geographic diversification and currency effects.

# Infrastructure return behaviour: the constituents diversify each other



COVID year and FY2026 show why a blended proxy matters

## RESULTS

Annual returns by infrastructure component (%)



**FY2020: Nifty Infra -26.2%,  
InvIT proxy +11.0%**

**FY2025: Nifty Infra +1.2%,  
Global Infra +39.2%, InvIT  
+29.6%**

**The composite is designed  
to avoid concentration in  
one infrastructure risk  
channel.**

## PART 3

# What the numbers say

Portfolio efficiency, correlations, subscriber adequacy and sensitivity analysis.

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**The result is not just more return — it is a better shape of risk.**

### What to take from the next section

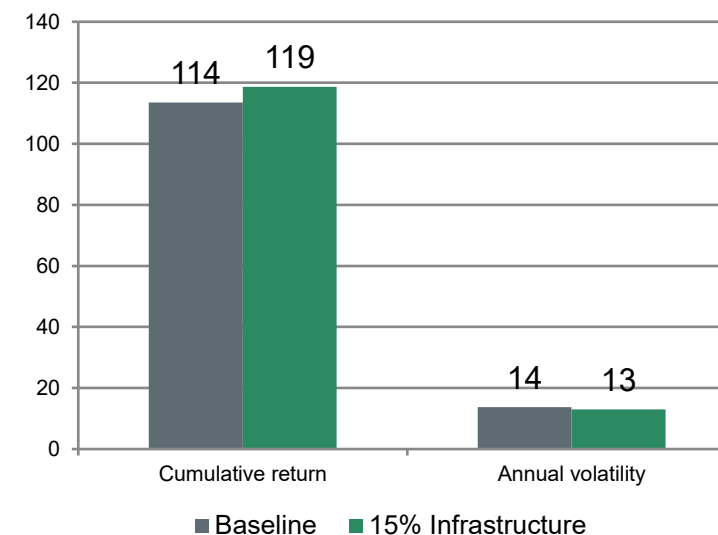
- The actuarial idea
- The investment evidence
- The decision implication

# Historical back-test: 15% infrastructure improves portfolio efficiency

Higher cumulative return, lower volatility, better drawdown profile

## RESULTS

| Metric            | Baseline | C: 15% infra | C vs Base      |
|-------------------|----------|--------------|----------------|
| Annual return     | 10.65%   | 10.91%       | <b>+26 bps</b> |
| Annual volatility | 13.70%   | 13.01%       | <b>-69 bps</b> |
| Sharpe ratio      | 0.22     | 0.25         | <b>+0.03</b>   |
| Max drawdown      | -6.20%   | -5.43%       | <b>+77 bps</b> |
| Cumulative return | 113.5%   | 118.7%       | <b>+5.2pp</b>  |



The headline result is not only return enhancement; it is a more efficient risk-return trade-off.

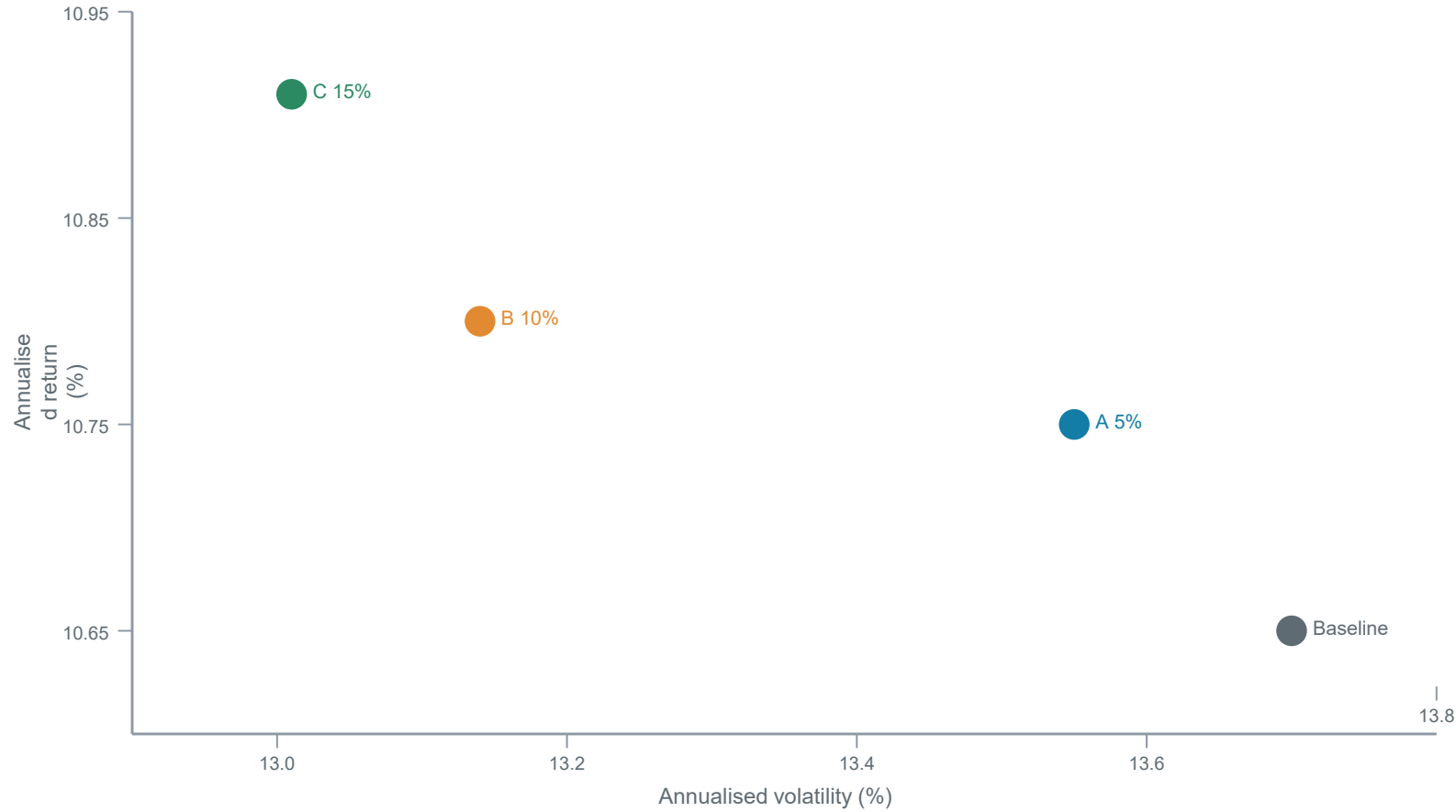
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# Risk-return profile: infrastructure moves the portfolio northwest

The tested allocations reduce risk while preserving or improving return



## RESULTS



**Northwest = higher return and lower volatility. Scenario C is closest to that efficient corner in the historical data.**

**This is a portfolio-construction result, not simply an asset-class return result.**

# Diversification result: the form of infrastructure matters

InvITs and global infrastructure provide the diversification; listed infra equities largely do not



## RESULTS

**0.94** correlation with  
Scheme E

Nifty Infrastructure

Equity-like exposure

**0.47** correlation with  
Scheme E

S&P Global Infrastructure  
(INR)

Geographic / currency  
diversification

**0.29** correlation with  
Scheme E

Weighted InvIT returns

Operational cash-flow profile

Policy implication: do not solve the infra allocation gap by simply buying more listed infrastructure equity.



# Monte Carlo setup: testing long-horizon adequacy

10,000 paths across 35 and 45 years under three calibration scenarios

## FORECAST

| Subscriber assumption | Base case                                     |
|-----------------------|-----------------------------------------------|
| Entry age / horizon   | 25; 35Y and 45Y tested                        |
| Starting salary       | ₹6,00,000                                     |
| Salary growth         | 7% nominal p.a.                               |
| Contribution rate     | 10% private sector; 24% government comparison |
| Annuity factor        | 15                                            |

**Conservative** Infra return 9.0%  
Eq–Infra corr 0.65

**Base** Infra return 10.5%  
Eq–Infra corr 0.50

**Optimistic** Infra return 12.5%  
Eq–Infra corr 0.35

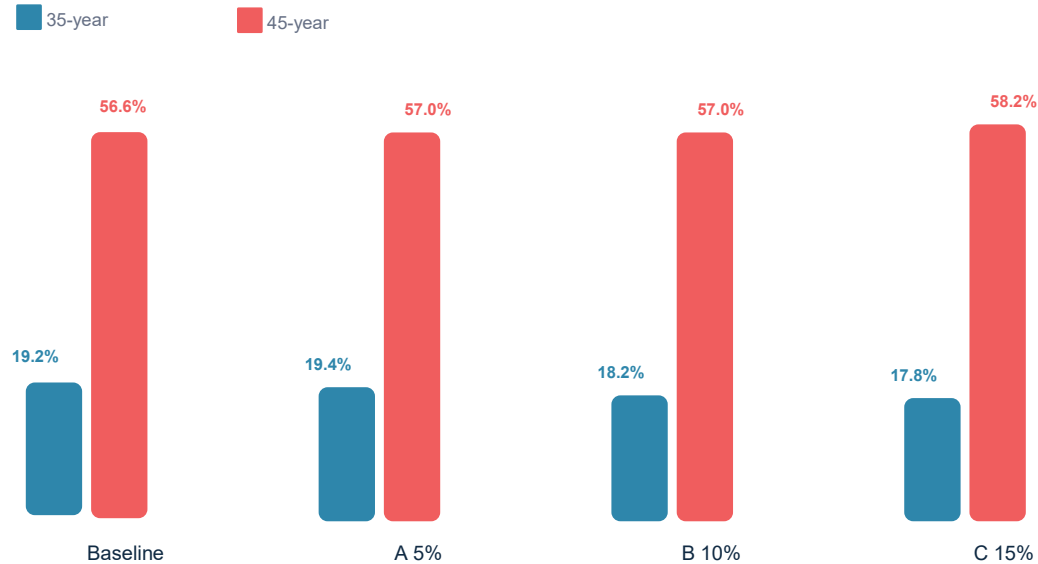
**Adequacy metric: probability of achieving target replacement ratios of 40%, 50% and 60%.**

# Base case: infrastructure helps more over the longer horizon

The 45-year horizon shows stronger diversification compounding

FORECAST

Probability of achieving  $RR \geq 50\%$  — Base scenario



**35Y: benefits are mixed**

**45Y: 15% infrastructure increases  $P(RR \geq 50\%)$  from 56.6% to 58.2%.**

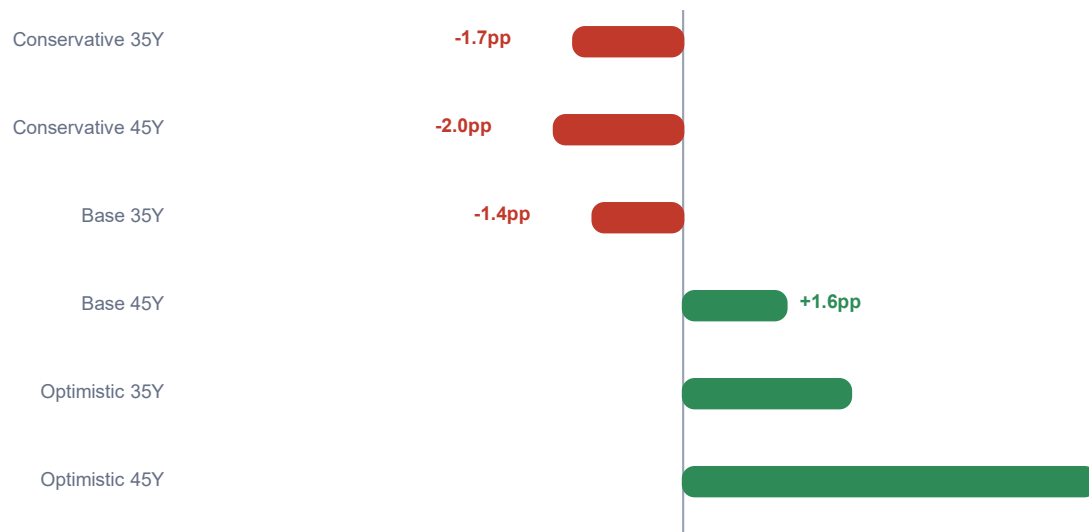
This supports age-sensitive glide paths rather than a flat allocation for everyone.

# Sensitivity: bounded downside, larger upside in realistic cases

Infrastructure allocation has asymmetric impact across calibration scenarios

## FORECAST

### Scenario C minus baseline — $P(RR \geq 50\%)$ impact (pp)



**Conservative stress: -1 to -2pp because infrastructure return is low and correlation is high.**

**Base / optimistic 45Y: +1.6pp to +6.4pp improvement in  $P(RR \geq 50\%)$ .**

**Decision frame: pilot allocation with governance creates option value while limiting early downside.**

# Subscriber impact: the private sector profile is where the question matters most

At 24% contribution, government subscribers already clear adequacy targets in the model

## FORECAST

| Profile        | Contribution | Portfolio | Median RR | P(RR≥50%) |
|----------------|--------------|-----------|-----------|-----------|
| Private sector | 10%          | Baseline  | 53.5%     | 56.6%     |
| Private sector | 10%          | 15% infra | 53.6%     | 57.1%     |
| Government     | 24%          | Baseline  | 129.0%    | 99.2%     |
| Government     | 24%          | 15% infra | 129.0%    | 99.6%     |

The marginal value of diversification is highest where contribution rates are lower.

Policy design should therefore focus on improving default outcomes for private-sector subscribers.

## PART 4

# From evidence to design

The practical question is not whether infrastructure is attractive, but how NPS should sequence it.

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**A phased roadmap converts research into implementable regulation.**

**What to take from the next section**

- The actuarial idea
- The investment evidence
- The decision implication

# So what should NPS do with this evidence?

The result points to a phased, age-aware and instrument-aware allocation design



## IMPLICATIONS

### Not a blanket 15% tomorrow

Begin with a governed pilot. The evidence supports controlled exposure, not a sudden strategic shift.

### Focus on the right instruments

InvITs and global infrastructure contribute more diversification than listed Indian infra equity.

### Use life-cycle design

Younger subscribers have the longest compounding horizon and can absorb liquidity constraints better.

**The policy objective is to add a new risk premia source without importing avoidable construction, valuation or governance risks into default retirement savings.**



# Proposed PFRDA roadmap

A three-phase approach that expands allocation only as governance capacity grows

## ROADMAP

### Phase 1 Years 1–3 **Foundation**

Listed InvITs + rated infra bonds  
Up to 5% allocation  
Daily mark-to-market

### Phase 2 Years 3–7 **Expansion**

Unlisted InvITs, IDFs, green bonds  
Pooled vehicle / IFM model  
Up to 10% allocation

### Phase 3 Years 7+ **Maturation**

Co-investments and direct investment  
Dedicated infrastructure teams  
Up to 15% allocation

**Core governance principle: no expansion in allocation without expansion in valuation, disclosure and risk-management capability.**

# Phase 1: Foundation (Years 1–3)

Make infrastructure investible inside NPS before making it large

## ROADMAP

| Design choice         | Recommended guardrail                                                                   |
|-----------------------|-----------------------------------------------------------------------------------------|
| Eligible instruments  | Listed SEBI InvITs; AA+ infrastructure bonds; Category I AIFs focused on infrastructure |
| Allocation cap        | Up to 5% of scheme assets                                                               |
| Single-instrument cap | 1% of scheme NAV                                                                        |
| Governance            | PFM Infrastructure Investment Committee with relevant expertise                         |
| Valuation             | Daily MTM for listed assets; quarterly independent valuation for unlisted AIF units     |

**Start with operational, visible, regulated assets. Avoid construction risk in the first phase.**

## Phase 2: Expansion (Years 3–7)

Create scale and access through pooled expertise

### ROADMAP

**Eligible instruments expand to unlisted InvITs, infrastructure debt funds, sovereign/quasi-sovereign green bonds and GIFT City infrastructure vehicles.**

### Why pooled vehicles matter

Smaller PFMs may not justify dedicated infrastructure teams

A pooled model can negotiate lower fees and diversify across sectors

Shared governance can mirror the Australian IFM principle in Indian form

Public quarterly reporting to NPS subscribers builds trust

### Allocation and reporting

Infrastructure allocation cap: up to 10%

Independent valuation at least twice annually for unlisted assets

Public disclosure of sector distribution, portfolio composition and performance attribution

# Phase 3 and MSF integration

Mature allocations should be capability-gated and life-cycle aware

## ROADMAP

**Phase 3: up to 15% allocation only for PFMs meeting governance thresholds — minimum AUM, dedicated team, board-approved policy and advisory oversight.**

## Two MSF routes

### Enhanced life-cycle fund

Embed 10–15% infra allocation for younger subscribers; glide down toward retirement.

### Standalone infra scheme

Optional higher infrastructure allocation for long-horizon subscribers with risk and liquidity disclosures.

**The default answer should likely be life-cycle integration; the optional answer can be a standalone infrastructure-oriented scheme.**

# Risk safeguards: what must be added before allocations scale



Infrastructure risk is manageable only if it is explicitly governed



## SAFEGUARDS

### Construction risk

Phase 1 focuses on listed InvITs and rated bonds; no greenfield exposure in defaults.

### Regulatory / tariff risk

Require sector diversification and stress tests for tariff delay, traffic shortfall and rate shock.

### Currency risk

Limit and disclose global infrastructure exposure; define hedging policy.

### Valuation risk

Independent valuations, public reporting, subscriber-level transparency.

### Fee leakage

Cap multi-layered structures; pooled vehicle should negotiate institutional pricing.

**Recommended annual stress tests: +200 bps interest-rate shock, 8–10% inflation, tariff delay and lower traffic volumes.**



# Beyond returns: infrastructure can align pensions with Viksit Bharat 2047



The pension system can support responsible long-term capital formation



## IMPACT

### Renewable energy

Green bonds and renewable InvITs can support India's clean-energy capacity goals.

### Transmission and distribution

Power infrastructure improves access, reliability and transition readiness.

### Roads and logistics

Transport assets support national logistics efficiency and economic productivity.

### Disclosure discipline

NPS can require carbon, social impact and governance reporting from eligible vehicles.



## PART 5

# Challenge & close

The assumptions, limitations and practical conclusion for policymakers and actuaries.

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**A credible recommendation must also reveal where the model is fragile.**

### What to take from the next section

- The actuarial idea
- The investment evidence
- The decision implication

# Limitations: where the evidence should be challenged

Good policy should know where the analysis is strongest and weakest

## LIMITS

### Short history

FY2019–FY2026 provides only eight annual observations; InvIT history is still maturing.

### Composite choice

30/30/40 weighting is a modelling choice; results are directionally stable but benefit depends on InvIT presence.

### Normal distribution assumption

Monte Carlo may underweight tail events and non-normal return behaviour.

### Fees excluded

AlFs, InvIT expense ratios and pooled vehicles can reduce net benefit by 30–50 bps.

### Rebalancing assumption

Annual rebalancing may differ from actual subscriber and PFM behaviour.

**Recommended next research: net-of-fee simulations, bootstrap / fat-tail modelling and decumulation analysis using InvIT distributions.**

# Closing: the practical conclusion

India should not ask whether infrastructure is theoretically attractive; it should design the pathway carefully

CLOSE

- 1 The gap is real**

NPS has long horizons but virtually no infrastructure exposure.
- 2 The evidence is nuanced**

15% allocation improves historical efficiency; forecast benefit is strongest for long horizons and realistic assumptions.
- 3 The instrument choice is decisive**

InvITs and global infrastructure provide more diversification than domestic listed infra equity.
- 4 The roadmap should be phased**

5% foundation → 10% pooled expansion → 15% mature capability-gated allocation.

**The window for action is now: NPS scale, MSF flexibility and India's infrastructure ambition are converging.**

Thank you  
**Q&A**



## Appendix

Detailed data and assumptions from the paper



# Appendix A: Back-test metric table

FY2019–FY2026 actual data



| Portfolio        | Ann. return | Ann. vol | Sharpe | Max DD | Cum. return |
|------------------|-------------|----------|--------|--------|-------------|
| Baseline (0%)    | 10.65%      | 13.70%   | 0.22   | -6.20% | 113.5%      |
| Scenario A (5%)  | 10.75%      | 13.55%   | 0.23   | -6.06% | 115.4%      |
| Scenario B (10%) | 10.80%      | 13.14%   | 0.24   | -5.56% | 116.8%      |
| Scenario C (15%) | 10.91%      | 13.01%   | 0.25   | -5.43% | 118.7%      |



# Appendix B: Forward-looking calibration

Three scenarios used for Monte Carlo analysis



| Parameter                    | Conservative | Base  | Optimistic |
|------------------------------|--------------|-------|------------|
| Equity return                | 10.5%        | 12.0% | 13.5%      |
| Equity volatility            | 20.0%        | 20.0% | 20.0%      |
| Corporate bond return        | 7.5%         | 8.0%  | 8.5%       |
| Government securities return | 7.0%         | 7.5%  | 7.5%       |
| Infrastructure return        | 9.0%         | 10.5% | 12.5%      |
| Infrastructure volatility    | 15.0%        | 13.0% | 11.0%      |
| Eq–Infra correlation         | 0.65         | 0.50  | 0.35       |



# Appendix C: Actual asset-class returns

Annual returns used in the historical analysis

| Year | E      | G     | C     | InvIT | Nifty Infra | Global Infra | Composite |
|------|--------|-------|-------|-------|-------------|--------------|-----------|
| FY19 | 13.1%  | 9.0%  | 8.1%  | 1.9%  | -3.9%       | 15.4%        | 4.2%      |
| FY20 | -25.0% | 14.8% | 11.2% | 10.9% | -26.2%      | -14.5%       | -7.8%     |
| FY21 | 66.3%  | 7.7%  | 10.2% | 28.3% | 73.2%       | 31.8%        | 42.8%     |
| FY22 | 18.0%  | 4.0%  | 6.4%  | 8.7%  | 22.8%       | 19.4%        | 16.1%     |
| FY23 | 1.8%   | 4.6%  | 3.4%  | -4.0% | 1.4%        | 4.1%         | 0.1%      |
| FY24 | 34.0%  | 10.0% | 8.3%  | 0.6%  | 63.7%       | 4.8%         | 20.8%     |
| FY25 | 2.1%   | 10.3% | 9.4%  | -0.2% | 1.5%        | 21.7%        | 6.9%      |
| FY26 | -1.8%  | 0.2%  | 5.9%  | 29.5% | 1.2%        | 39.2%        | 23.9%     |