

Space Data Center (SDC) Constellation with Nuclear-Electric Tug Fleet

Concept • Architecture • Implementation • Financials • Capital Strategy

NASA-Style Technical & Financial Brief (v1.0)

Date: 2025-10-12
Project: SDC & COMMS

1. Overview

Executive Summary: Modular GEO Space Data Center clusters (5 compute + 1 Service Bay Module + 1 COMMS) served by a nuclear-electric tug fleet and a 6-node LEO optical mesh (no ground stations). ISS and Artemis Gateway connectivity via relay links. Standards alignment via DTN (BPv7), optical routing, and timing (AFS) with change-detection automation.

Deployment Plan: 3 SDC clusters in GEO, 6 LEO relays, starter fleet of 6 Midi-NEP tugs, clustered Starship launches.

AHM: Solar-primary with 50–150 kWe fission baseload for eclipse ride-through; electrolyzers provide H₂/O₂ for station-keeping and contingency life support.

SBM: Robotic maintenance and spares inventory enabling <48-hour tug turnarounds and periodic SD servicing.

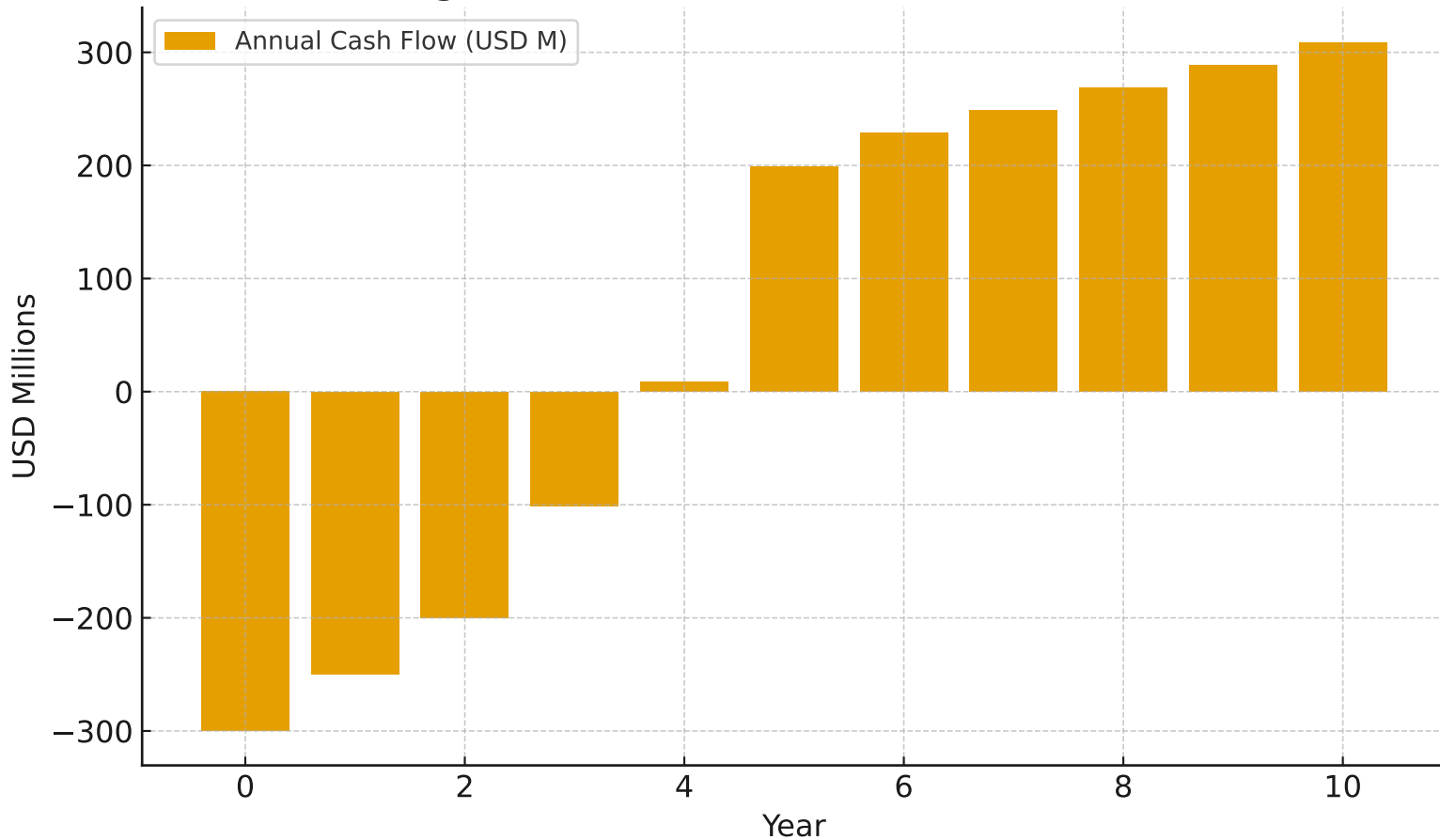
2. Cost Summary

Build Cost (v1.0): ~\$740M including I&T, SE/PM, and contingency for 3 clusters, 6 LEO relays, and 6 Midi-NEP tugs.

Launch & Transfer: ~300–360 *MusingStarship* (667/kg to LEO assumption) and GEO transfer services, for a total initial deployment on the order of ~\$1.04–1.10B.

Steady-State OPEX: ~\$19–23M/yr driven by mission ops, insurance, and reduced resupply mass than AHM baseload power and electrolyzers.

Figure 1. Base-Case Annual Cash Flows



Finance Annex (Base Case)

Discount rate: 10%

NPV (10-yr): \$-14.5M

IRR (10-yr): 9.7%

Figure 2. IRR Sensitivity to Launch Cost Metric

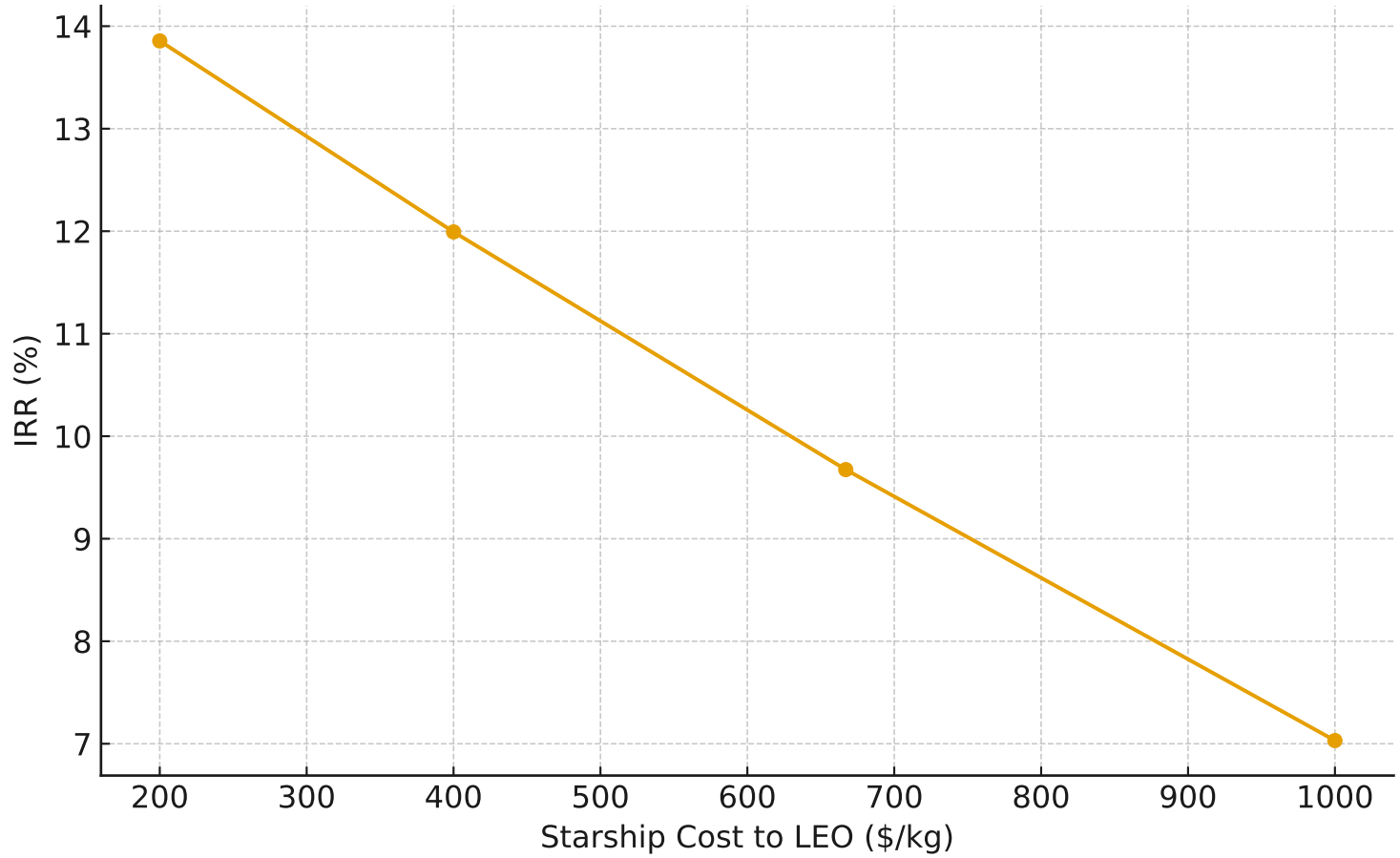
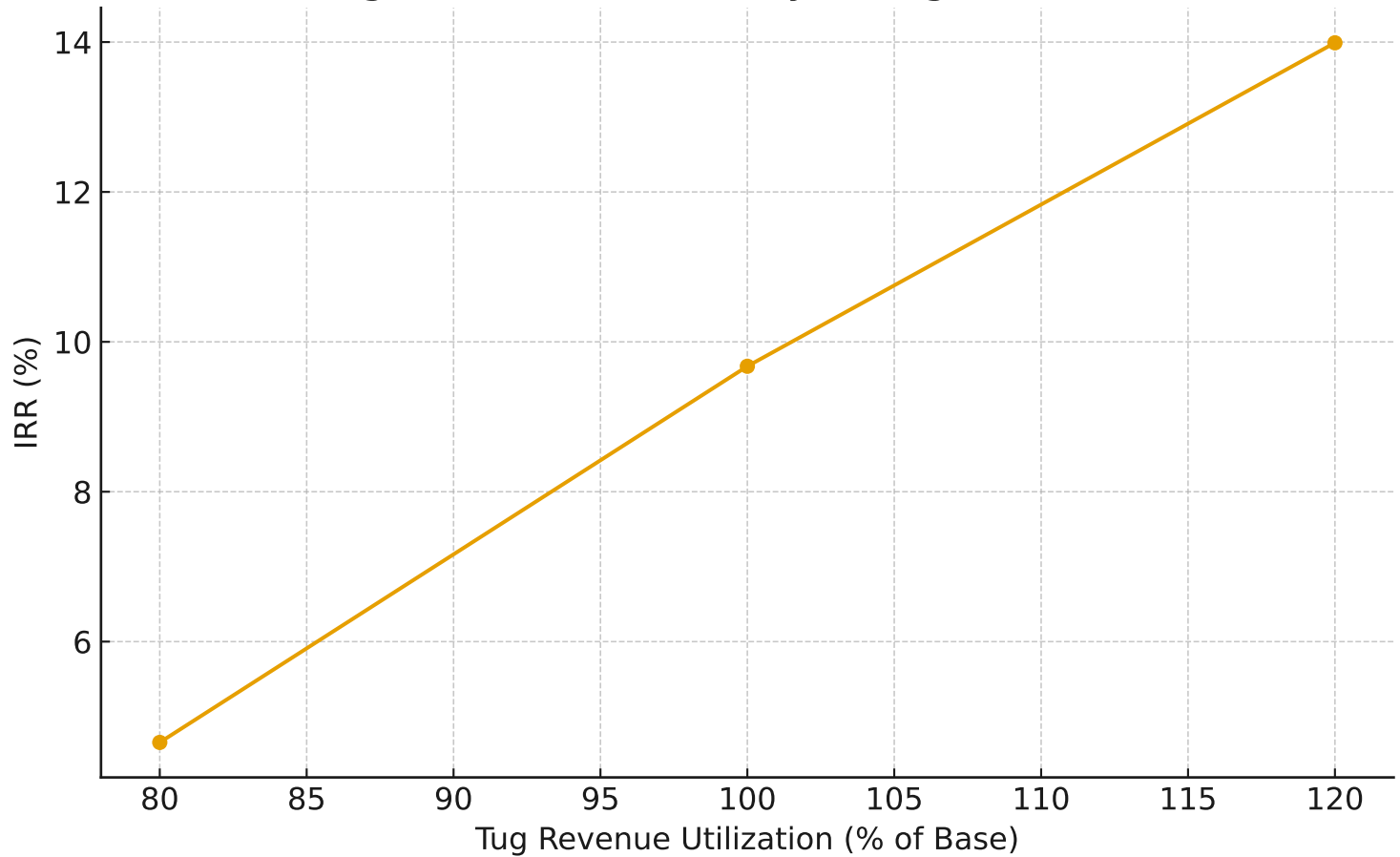


Figure 3. IRR Sensitivity to Tug Utilization



Finance Annex – Sensitivities

Sensitivity Results (10-Year Horizon): Starship \$/kg IRR (%) NPV (USD M) 200												
13.86		159.9	400		11.99		85.2	667		9.67		
-14.5	1000		7.03		-138.8	Tug Utilization		IRR (%)		NPV (USD M) 80		
	4.65		-219.2	100		9.67		-14.5	120		13.99	
190.2												