



# Tier-1 Budget

Alex Zaytsev, Eric Lancon

ATLAS Pre-Scrubbing Review - June 27, 2022



# Outline

FY21 budget summary

FY22 forecast

FY23 and beyond

# Introduction

Historically, hardware accounting (at BNL) is divided in 2 categories

1. Operation: to maintain the infrastructure
2. Equipment: investments to grow or replace capacity

Individual lines items are usually bigger for equipment



# FY21 Final accounting Operation

v2.106		September 27, 2021					
Sub-category	Group			FY21	FY21	Comments	
				ATLAS Proj. (as of Jul'20)	ATLAS Actuals (as of the end of FY21)		
[1.1] Operations (Equipm	[1.1.1] HPSS Support/Media	[1.1.1.1] HPSS Software Support		\$124,000	\$113,000		
		[1.1.1.2] HPSS Library Support		\$142,000	\$155,000		
		[1.1.1.3] HPSS Upgrade Consulting		\$7,000	\$40,000		Migration to HPSS 8 or 9 required more expert time than anticipated
		[1.1.1.4] Tape (for Media Migration)		\$100,000	\$80,000		Approx. 400 LTO4 Atlas tapes (320 TB) have been repacked to LTO7 media since 9/20. We had to often slow down and stop the process because of Atlas aggressive staging and use of the tape drives. The number of repacked tapes during the previous FY20 was about 1600. We have a total of 990 Atlas LTO4s remaining to repack. The total number of repacked LTO4 tapes since 2016 is close to 12500.
		<b>Group subtotal</b>		<b>\$373,000</b>	<b>\$388,000</b>		
	[1.1.2] General Services & Operations	[1.1.2.1] General Services Support		\$0	\$0		Zero for ATLAS
		[1.1.2.2] Disk Storage Hardware Support		\$150,000	\$150,000		
		[1.1.2.3] Disk Storage Software Support		\$5,000	\$11,000		
		[1.1.2.4] VM Software Support		\$42,000	\$35,000		
		[1.1.2.5] Server Hardware		\$207,000	\$199,000		
	<b>Group subtotal</b>		<b>\$404,000</b>	<b>\$395,000</b>			
	[1.1.3] Network Support/Materials	[1.1.3.1] Network Switch Support		\$165,000	\$119,000		
		[1.1.3.2] Network Firewall Support		\$25,000	\$21,000		
		[1.1.3.3] Network Cabling		\$100,000	\$124,000		
	<b>Group subtotal</b>		<b>\$290,000</b>	<b>\$264,000</b>			
[1.1.4] Facility Operations/Support	[1.1.4.1] Backup Support		\$16,000	\$16,000			
	[1.1.4.2] Facility Software		\$25,000	\$30,000			
	[1.1.4.3] User Software		\$0	\$0			
	[1.1.4.4] Site Shift and Contractors		\$25,000	\$57,000			
<b>Group subtotal</b>		<b>\$66,000</b>	<b>\$103,000</b>				
[1.1.5] Business Expenses	[1.1.5.1] Infrastructure		\$52,000	\$52,000		Fixes, repairs, and rigger operations needed for B515 and B725 data centers.	
	[1.1.5.2] Office Supplies		\$0	\$0		Zero for ATLAS	
	[1.1.5.3] Shipping		\$0	\$0		Zero for ATLAS	
	[1.1.5.4] Infrastructure (F&O)		\$112,000	\$112,000		F&O materials for regular maintenance of the infrastructure for B515 and B725 data centers.	
	[1.1.5.5] Travel		\$75,000	\$0		Travel is now expected to be blocked for the entirety of FY21 due to COVID restrictions, hence zero spending here.	
<b>Group subtotal</b>		<b>\$239,000</b>	<b>\$164,000</b>				
<b>Sub-category subtotal</b>			<b>\$1,372,000</b>	<b>\$1,314,000</b>			
[1.2] Space and Power	[1.2.1] Space and Power	[1.2.1.1] Computer Space and Power		\$818,000	\$818,000		
				<b>\$2,190,000</b>	<b>\$2,132,000</b>		The guidance number set for FY21 ATLAS Operations turned out to be \$2,040,000 w/ OH plus \$75,000 w/ OH = \$2,115,000 w/ OH total. Thus, the increase in spending above guidance is +17k w/ OH.
				<b>\$2,115,000</b>	<b>\$2,115,000</b>		
				<b>-\$75,000</b>	<b>-\$17,000</b>		

# FY21 Final accounting: Equipment

Forecast as of Jul 2020

Actuals end of FY21

Sub-category	Group	Sub-group	ATLAS Proj. (as of Jul'20)	FY21	Comments
				<b>ATLAS Actuals (as of the end of FY21)</b>	<i>Jul'20 projection was based on FY21 pledges set equal to those of FY20 (CPU: 298 kHS06, DISK: 26.5 PB, TAPE: 61 PB - all w/ 20% reserve), while the final projection is based on the most recently announced pledges (CPU: 323 kHS06, DISK: 29 PB, TAPE: 65 PB - all w/ 20% reserve). Adjustments are made to cope with this change while staying within the provided budgetary guidance.</i>
[2.1] Equipment	[2.1.1] HPSS Equipment/Media	[2.1.1.1] HPSS Tape Libraries & Drives	\$0	\$70,000	20 LTO-8 tape drives purchased for the new ATLAS IBM TS4500 tape libraries to be deployed in B725 data center in 2021Q3.
		[2.1.1.2] HPSS Servers	\$197,000	\$194,000	
		[2.1.1.3] HPSS Disk Cache	\$146,000	\$214,000	Spending increased to match the 20 GB/s mixed R/W I/O requirement while staying with NetApp based storage backed.
		[2.1.1.4] Tapes (for New Data)	\$75,000	\$60,000	800 LTO-8 tape cartridges (9.6 PB total) purchased for the new ATLAS IBM TS4500 tape libraries to be deployed in B725 data center in 2021Q3.
		<b>Group subtotal</b>	<b>\$418,000</b>	<b>\$538,000</b>	
	[2.1.2] General Services Equipment	[2.1.2.1] GPFS / Lustre / CVMFS Hardware	\$0	\$130,000	ATLAS Globus Lustre based storage system mostly covered by RBT of \$120k w/ OH allocation made for FY21 (only \$10k w/ OH is included included on the category subtotal below)
		[2.1.2.2] VM Hardware	\$255,000	\$251,000	
		<b>Group subtotal</b>	<b>\$255,000</b>	<b>\$261,000</b>	
	[2.1.3] Network Equipment	[2.1.3.1] Network Switches Hardware	\$78,000	\$77,000	
		[2.1.3.2] Network Firewall Hardware	\$0	\$0	
		<b>Group subtotal</b>	<b>\$78,000</b>	<b>\$77,000</b>	
	[2.1.4] CPU and DISK for Compute	[2.1.4.1] Compute Node Hardware	\$614,000	\$212,000	The retirement of 64 kHS06 CPU integral of ATLAS Tier-1 is postponed until FY22 in order to decrease spending here while still matching the CPU pledge that increased from 298 kHS06 to 323 kHS06 (w/ 20% reserve) since Jul'20.
		[2.1.4.2] Central Storage Hardware	\$703,000	\$998,000	Spending increased to address the increase in FY21 DISK pledge from 26.5 PB to 29.0 (w/ 20% reserve) since Jul'20.
		<b>Group subtotal</b>	<b>\$1,317,000</b>	<b>\$1,210,000</b>	
<b>Sub-category subtotal</b>			<b>\$2,068,000</b>	<b>\$2,086,000</b>	The increase in spending is +18k w/ OH and the guidance number set for FY21 ATLAS Operations turned out to be \$2,068,000 w/ OH as requestd. Total final spending increase between FY21 guidance and final ATLAS Operations + Capital is +\$35k w/ OH.
			<b>\$2,068,000</b>	<b>\$2,086,000</b>	
			<b>\$2,068,000</b>	<b>\$2,068,000</b>	
			\$0	-\$18,000	
			-\$75,000	-\$35,000	

# FY22 Tier-1 Operation & Equipment

Details & explanations are available [here](#) and [here](#)

	FY22 Proj. 2021 scrubbing	FY22 Actual June 2022 proj.	<i>Guidance</i>
<b>Operation</b>	<b>\$2,025,000</b>	<b>\$2,115,000</b>	<i>\$2,115,000</i>
<b>Equipment</b>	<b>\$1,970,000</b>	<b>\$1,981,000</b>	<i>\$2,068,000</i>

Forecast as of Jul 2021

Forecast as of Jun 2022

# FY22 Tier-1 Operation & Equipment

Details & explanations are available [here](#) and [here](#)

Forecast as of Sep 2021	FY22 Proj. (Sep 2021)	FY22 Actuals (Jun 2022 Proj.)
<b>Operation</b>	<b>\$2,239,000</b>	<b>\$2,115,000</b>
<b>Equipment</b>	<b>\$1,992,000</b>	<b>\$1,981,000</b>

Equipment		FY22	FY22
Group	Sub-group	ATLAS Proj. (as of Sep'21)	ATLAS Proj. (as of May'22)
[2.1.1] HPSS Equipment / Media	[2.1.1.1] HPSS Tape Libraries & Drives	\$67,000	\$0
	[2.1.1.2] HPSS Servers	\$0	\$0
	[2.1.1.3] HPSS Disk Cache	\$0	\$0
	[2.1.1.4] Tapes (for New Data)	\$0	\$0
<b>Group subtotal</b>		<b>\$67,000</b>	<b>\$0</b>
[2.1.2] General Services Equipment	[2.1.2.1] GPFS / Lustre / CVMFS Hardware	\$160,000	\$160,000
	[2.1.2.2] VM Hardware	\$100,000	\$100,000
<b>Group subtotal</b>		<b>\$260,000</b>	<b>\$260,000</b>
[2.1.3] Network Equipment	[2.1.3.1] Network Switches Hardware	\$85,000	\$86,000
	[2.1.3.2] Network Firewall Hardware	\$0	\$0
<b>Group subtotal</b>		<b>\$85,000</b>	<b>\$86,000</b>
[2.1.4] CPU and DISK for Compute	[2.1.4.1] Compute Node Hardware	\$1,152,000	\$1,247,000
	[2.1.4.2] Central Storage Hardware	\$428,000	\$472,000
<b>Group subtotal</b>		<b>\$1,580,000</b>	<b>\$1,635,000</b>
		<b>\$1,992,000</b>	<b>\$1,981,000</b>
		<b>\$1,992,000</b>	<b>\$1,981,000</b>
		<b>\$2,068,000</b>	<b>\$2,068,000</b>

Operation		FY22	FY22
Group		ATLAS Proj. (as of Sep'21)	ATLAS Proj. (as of Jun'22)
[1.1.1] HPSS Support / Media	[1.1.1.1] HPSS Software Support	\$124,000	\$114,000
	[1.1.1.2] HPSS Library Support	\$155,000	\$152,000
	[1.1.1.3] HPSS Upgrade Consulting	\$11,000	\$11,000
	[1.1.1.4] Tape (for Media Migration)	\$70,000	\$0
<b>Group subtotal</b>		<b>\$360,000</b>	<b>\$277,000</b>
[1.1.2] General Services & Operations	[1.1.2.1] General Services Support	\$0	\$0
	[1.1.2.2] Disk Storage Hardware Support	\$100,000	\$52,000
	[1.1.2.3] Disk Storage Software Support	\$0	\$11,000
	[1.1.2.4] VM Software Support	\$45,000	\$30,000
	[1.1.2.5] Server Hardware	\$200,000	\$264,000
<b>Group subtotal</b>		<b>\$345,000</b>	<b>\$357,000</b>
[1.1.3] Network Support / Materials	[1.1.3.1] Network Switch Support	\$142,000	\$142,000
	[1.1.3.2] Network Firewall Support	\$25,000	\$23,000
	[1.1.3.3] Network Cabling	\$100,000	\$106,000
<b>Group subtotal</b>		<b>\$267,000</b>	<b>\$271,000</b>
[1.1.4] Facility Operations / Support	[1.1.4.1] Backup Support	\$20,000	\$20,000
	[1.1.4.2] Facility Software	\$30,000	\$30,000
	[1.1.4.3] User Software	\$0	\$0
	[1.1.4.4] Site Shift and Contractors	\$104,000	\$82,000
<b>Group subtotal</b>		<b>\$154,000</b>	<b>\$132,000</b>
[1.1.5] Business Expenses	[1.1.5.1] Infrastructure	\$67,000	\$67,000
	[1.1.5.2] Office Supplies	\$0	\$0
	[1.1.5.3] Shipping	\$0	\$0
	[1.1.5.4] Infrastructure (F&O)	\$100,000	\$100,000
	[1.1.5.5] Travel	\$75,000	\$40,000
<b>Group subtotal</b>		<b>\$242,000</b>	<b>\$207,000</b>
		<b>\$1,368,000</b>	<b>\$1,244,000</b>
[1.2.1] Space and Power	[1.2.1.1] Computer Space and Power	\$871,000	\$871,000
		<b>\$2,239,000</b>	<b>\$2,115,000</b>
		<b>\$2,115,000</b>	<b>\$2,115,000</b>



# FY23-25 projections

FY23 requirements are published by ATLAS [CERN-RRB-2022-050]

FY24-25 requirements are extrapolation from ATLAS HL-LHC baseline scenario of 2021Q2 renormalized using the actual FY22 pledges





# FY22-25 Projection

Details & explanations are available [here](#) and [here](#)

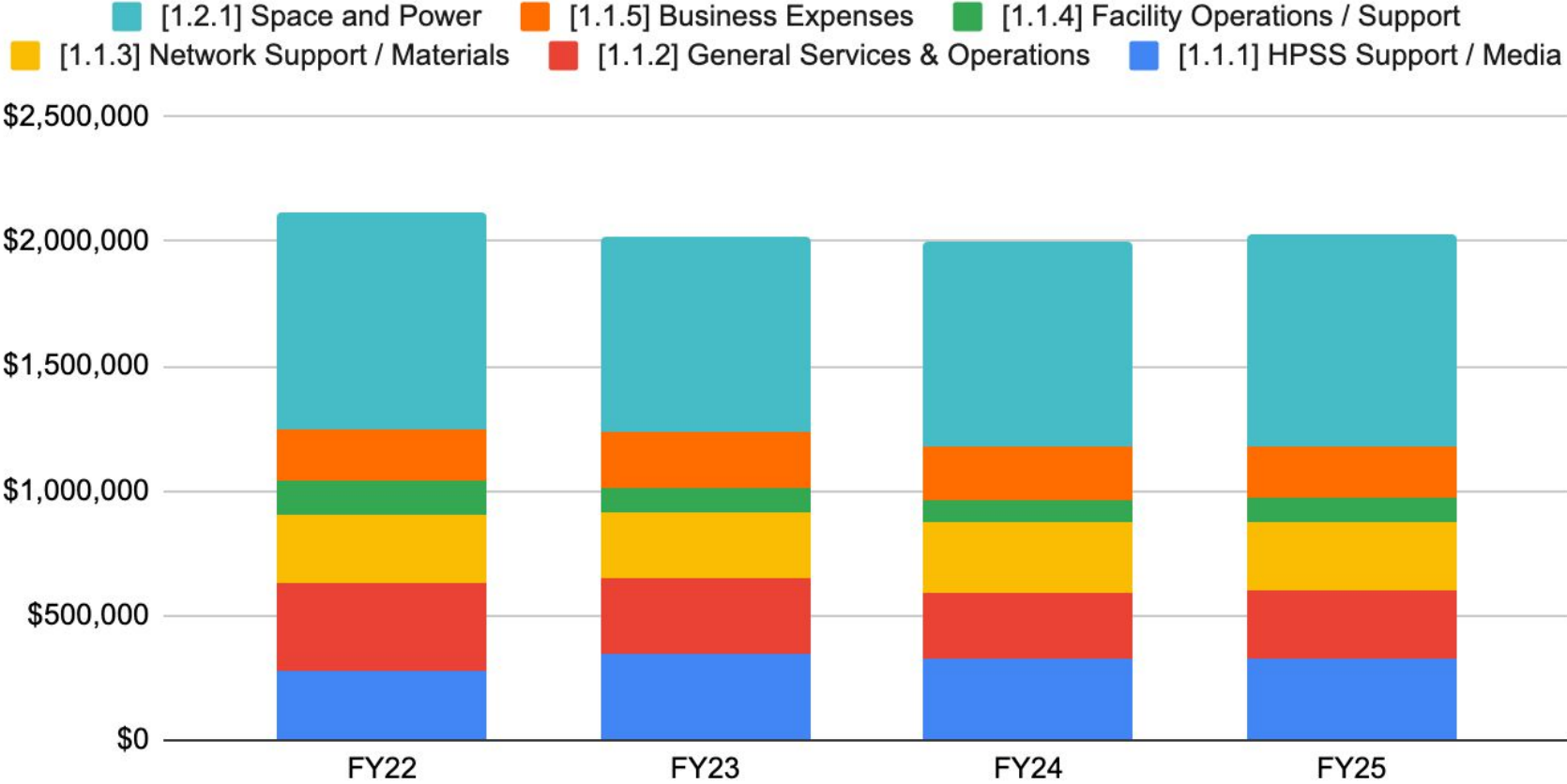
	FY22	FY23	FY24	FY25	Guidance	FY22-25 <av>
[1.1] Operations	\$2,115,000	\$2,020,000	\$2,000,000	\$2,031,000	\$2,115,000	\$2,041,500
[2.1] Equipment	\$1,981,000	\$2,188,000	\$2,306,000	\$2,321,000	\$2,068,000	\$2,199,000
					<b>Sum</b>	
Delta from Guidance	\$87,000	-\$25,000	-\$123,000	-\$169,000	<b>-\$230,000</b>	
<i>Delta from Guidance [%]</i>	<i>2.1%</i>	<i>-0.6%</i>	<i>-2.9%</i>	<i>-4.0%</i>	<i>-1.4%</i>	

Budget balance



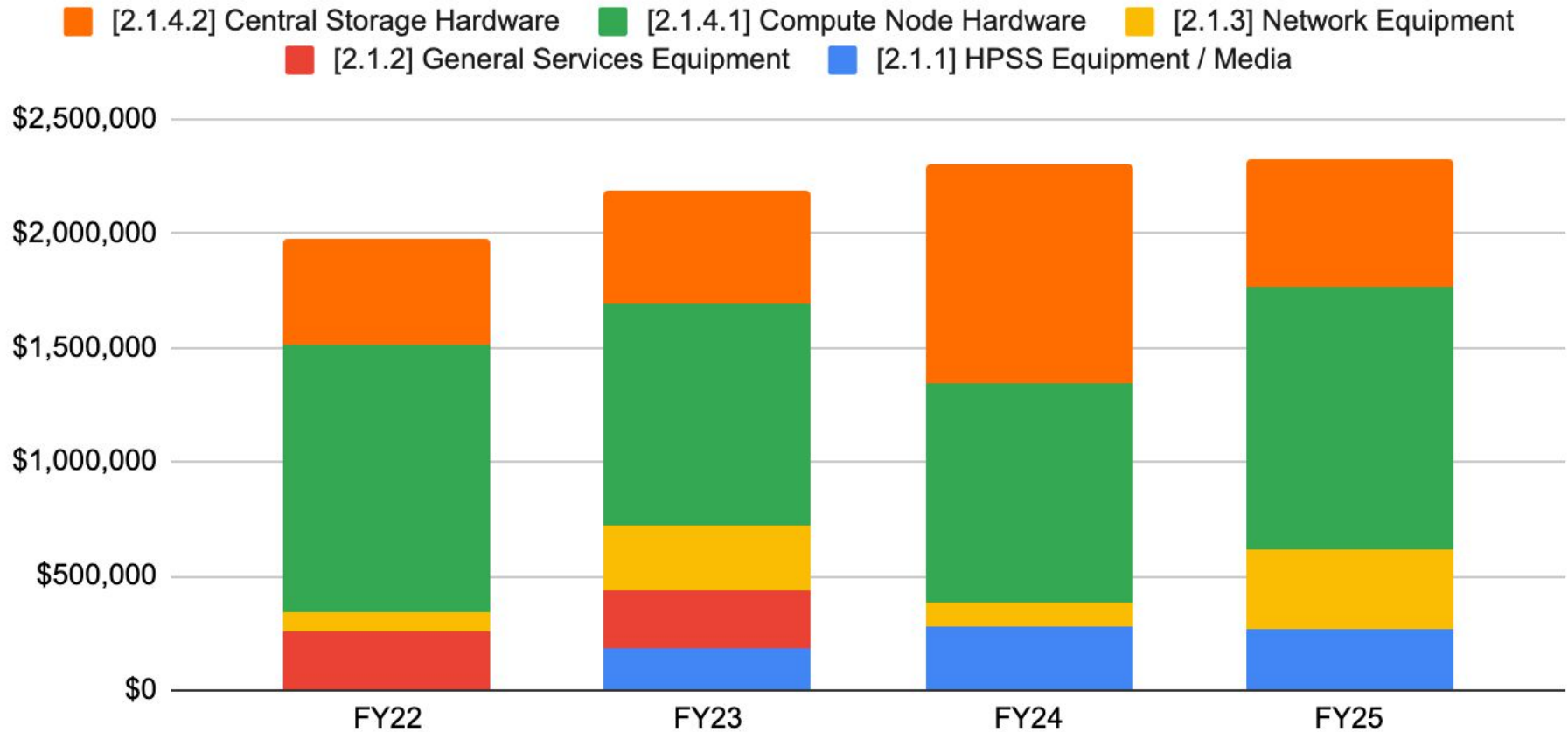
# Operation

## Operations: Support Contracts, Materials, Space and Power



# Equipment

## Equipment



# Backup Slides



# DISK Storage - capacity evolution

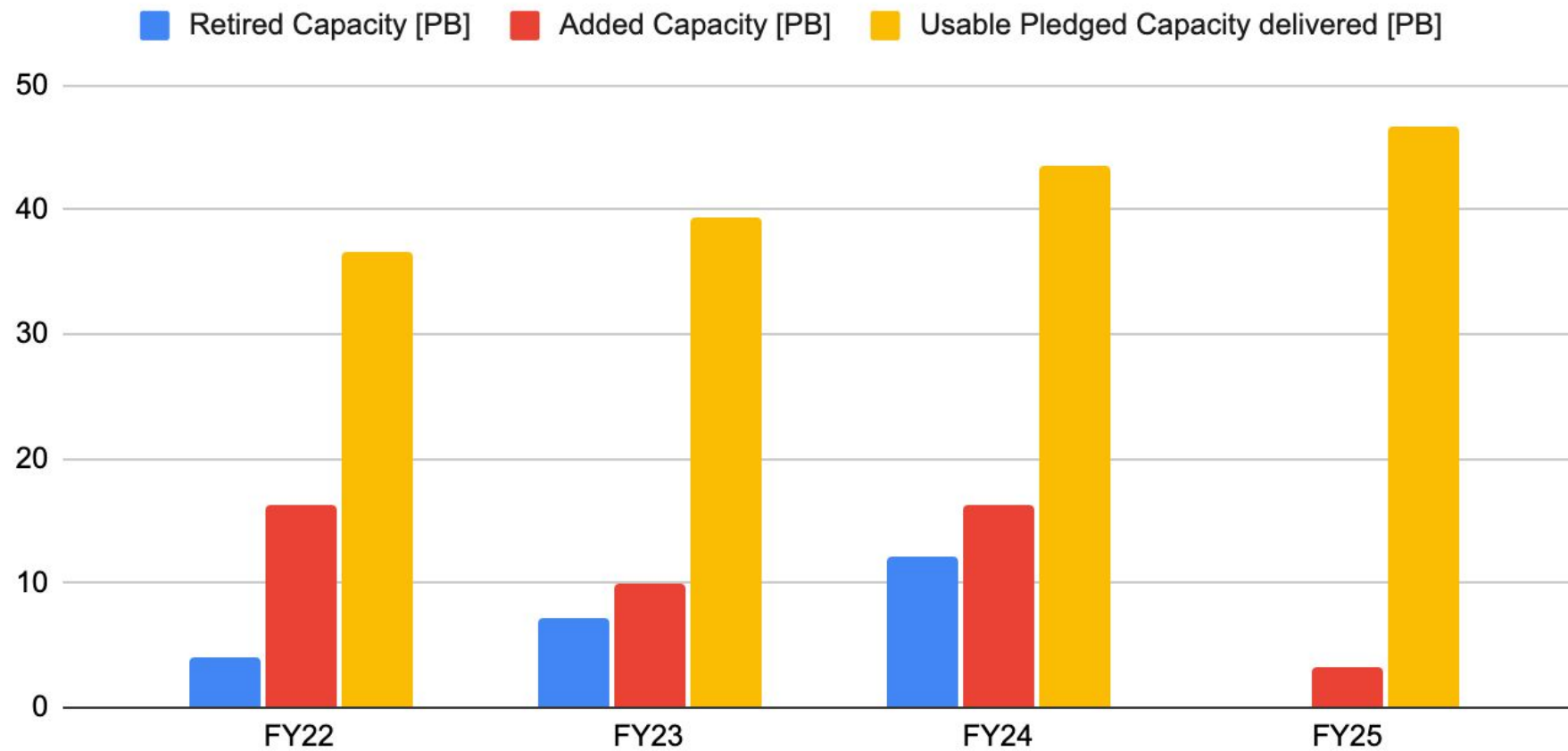
DISK	FY22	FY23	FY24	FY25
Usable Pledged Capacity delivered [PB]	36.6	39.4	43.5	46.8
Added Capacity [PB]	16.2	9.9	16.3	3.3
Retired Capacity [PB]	4.0	7.2	12.1	0
Raw pledge (minimum requirement) [PB]	26.7	31.3	34.8	37.4
Unpledge (RBT funded) [PB]	5.5	5.5	5.5	5.5
Operational margin [PB]	9.9	8.1	8.8	9.4
Operational margin [%] - Target 20%	27.1%	20.6%	20.2%	20.0%

Capacity beyond FY23 are extrapolations using ATLAS computing model

Required for safe operation (hardware failure,...) and unforeseen additional requests

*Unreplicated JBOD based storage (overhead factor 1.29x) configuration is used by default for new DISK deployment starting from FY23*

## DISK



# CPU: capacity evolution

CPU	FY22	FY23	FY24	FY25
CPU retired, kHS06	96	92	40	81
CPU added, kHS06	149	121	141	183
CPU delivered, kHS06	<b>388</b>	<b>417</b>	<b>518</b>	<b>620</b>
Raw pledge (minimum requirement) [kHS06]	<b>299</b>	<b>329</b>	<b>410</b>	<b>492</b>
Operational margin [%] - Target 20%	<b>22.9%</b>	<b>21.1%</b>	<b>20.8%</b>	<b>20.7%</b>

CPU

