

# Risorse di calcolo dell'esperimento ALICE

Mario Sitta – Univ. Piemonte Orientale & INFN Torino  
Rosario Turrisi – INFN Padova

- Organizzazione
- Uso delle risorse
- Richieste per il 2025

# Organizzazione

- Responsabile Nazionale del Calcolo
  - Mario Sitta
- Deputy RNC nel Computing Board e Coordinatore TIER-2
  - Rosario Turrisi
- Referente TIER-1
  - Francesco Noferini

# Organizzazione

- Meeting periodici (via Zoom)
  - ogni ~ 3 mesi
- Workshop annuale
  - ultimi: 2023 Bologna, 2022 Trieste, 2021 Frascati
- Meeting mensile Comitato di Gestione del Tier-1 CNAF
- Resource Computing Board durante le ALICE week

# Risorse ALICE Italia

- 1 TIER-1
  - CNAF Bologna, condiviso con altri esperimenti (LHC e non)
- 4 TIER-2 ufficiali
  - Bari, Catania, Padova-LNL, Torino
- Altre risorse
  - Trieste



# Uso delle risorse al Tier-1

## Wallclock Work in HEPSP06 Days

Search:

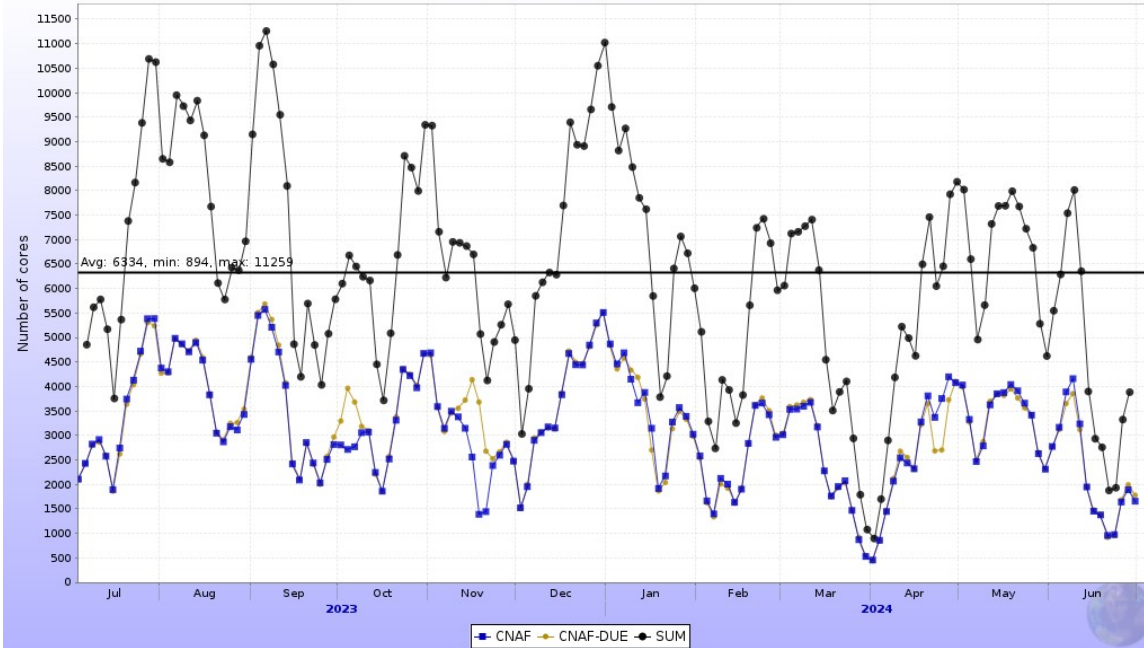
| Wallclock<br>Work in<br>HEPSP06<br>Days | Jul<br>2023      | Aug<br>2023      | Sep<br>2023      | Oct<br>2023      | Nov<br>2023      | Dec<br>2023      | Jan<br>2024      | Feb<br>2024      | Mar<br>2024      | Apr<br>2024      | May<br>2024      | Jun<br>2024      | Total             |
|---|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|
| Total ALICE                             | 3,154,440        | 4,903,643        | 4,818,892        | 4,559,236        | 3,491,828        | 3,653,681        | 3,334,520        | 2,564,281        | 2,376,990        | 2,400,064        | 3,618,371        | 2,564,947        | 41,440,893        |
| <b>Total TOTAL</b>                      | <b>3,154,440</b> | <b>4,903,643</b> | <b>4,818,892</b> | <b>4,559,236</b> | <b>3,491,828</b> | <b>3,653,681</b> | <b>3,334,520</b> | <b>2,564,281</b> | <b>2,376,990</b> | <b>2,400,064</b> | <b>3,618,371</b> | <b>2,564,947</b> | <b>41,440,893</b> |
| MoU pledge*                             | 3,191,760        | 3,191,760        | 3,088,800        | 3,191,760        | 3,088,800        | 3,191,760        | 3,191,760        | 2,985,840        | 3,191,760        | 3,780,000        | 3,906,000        | 3,780,000        | 39,780,000        |

113.5 kHS06 used / 107.1 kHS06 pledged = 106.0%

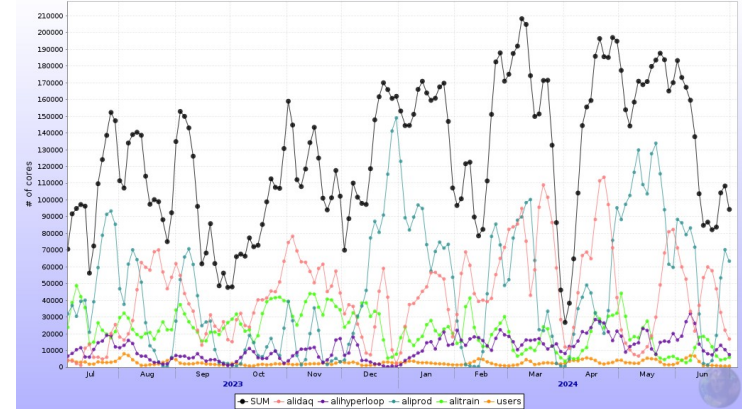


# Uso delle risorse al Tier-1

Total allocated cores per site



CPU Cores in use



# Uso delle risorse al Tier-1

## Disk Space - TBytes

Search: 

| Disk Space - TBytes    | Jun 2024      | Total         | % MoU      |
|------------------------|---------------|---------------|------------|
| ALICE allocated        | 10,845        | 10,845        |            |
| ALICE used             | 9,512         | 9,512         |            |
| <b>Total allocated</b> | <b>10,845</b> | <b>10,845</b> | <b>76%</b> |
| <b>Total used</b>      | <b>9,512</b>  | <b>9,512</b>  | <b>67%</b> |
| installed capacity     | 0             | 0             |            |
| MoU pledge             | 14,300        | <b>14,300</b> |            |

Disco:

Assegnato = 10.8 PB

Pledged (2024) = 14.3 PB

Ass / Pledg = 75.5 %

## Tape Space - TBytes

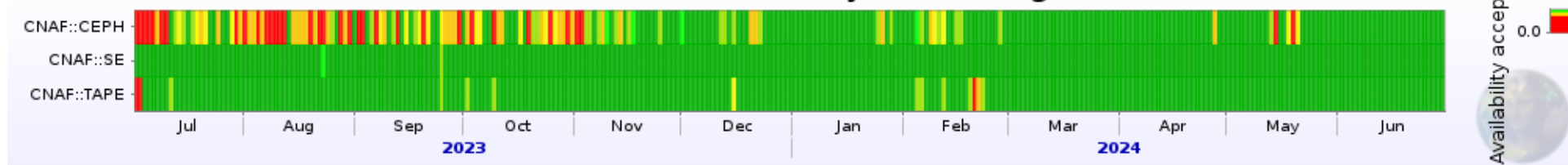
Search: 

| Tape Space - TBytes | Jun 2024      | Total         | % MoU      |
|---------------------|---------------|---------------|------------|
| ALICE               | 16,716        | 16,716        |            |
| <b>Total</b>        | <b>16,716</b> | <b>16,716</b> | <b>50%</b> |
| installed capacity  | 0             | 0             |            |
| MoU pledge          | 33,170        | 33,170        |            |

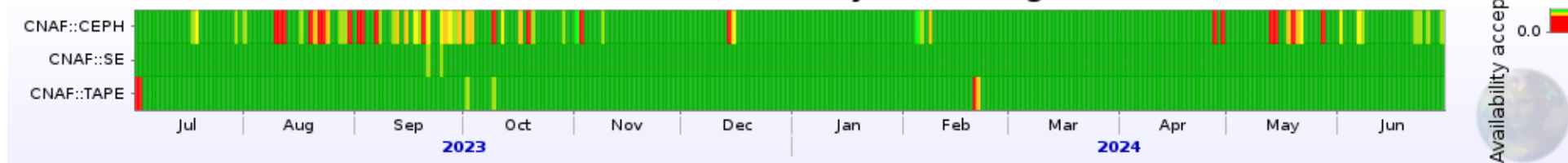


# Uso delle risorse al Tier-1

### AliEn SEs availability for reading



### AliEn SEs availability for writing



# Uso delle risorse al Tier-1

- Dal meeting CdG del 21/06
  - annunciato a WLCG un ritardo di ~30gg per pledge CPU e ~45gg per disco
  - 64 PB da AQ 2023-24 installati e in collaudo, a settembre completamento con 16 PB
  - pledge ALICE mancante disponibile entro fine luglio
  - 10.1 PB (ALICE+AMS) su hw fuori manutenzione da trasferire su hw nuovo a Tecnopolo + migrazione da CEPH a GPFS (tempi da concordare con noi)

# Data Challenge 2024

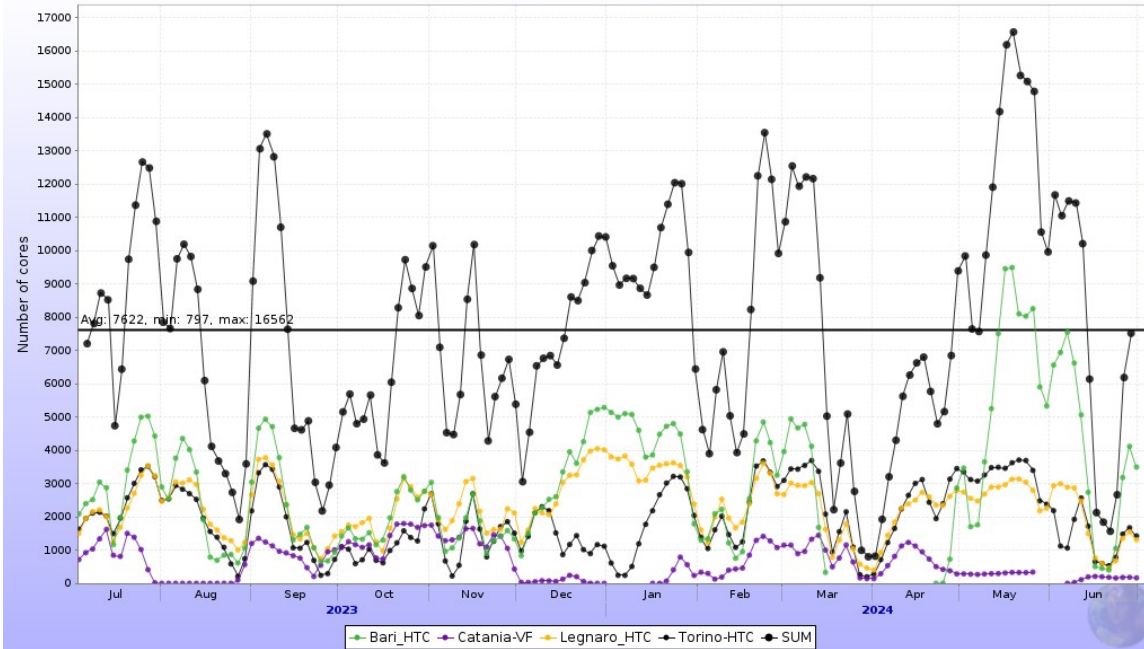
- 4 Esp. LHC + DUNE + Belle-2
- Coinvolti tutti i Tier-0 e Tier-1 + alcuni Tier-2 (nessuno di ALICE)
- Per ALICE:
  - verifica della capacità di sostenere il traffico dati end-to-end
    - target 25% di HL-LHC (minimo 130 GB/s)
    - totale 34 PB di run PbPb 2023

# Data Challenge 2024

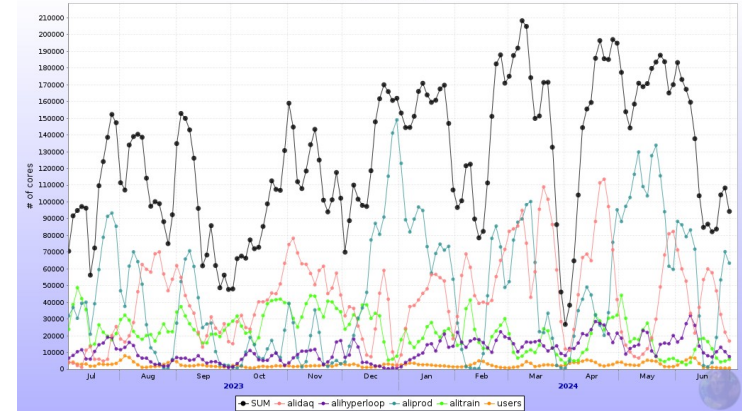
| Centre      | Target rate<br>GB/s | Average<br>achieved GB/s |
|-------------|---------------------|--------------------------|
| CNAF        | 0.8                 | 0.98 (+20%)              |
| IN2P3       | 0.4                 | 0.6 (+40%)               |
| KISTI       | 0.2                 | 0.25 (+22%)              |
| GridKA      | 0.6                 | 1.12 (+90%)              |
| NDGF        | 0.3                 | 0.35 (+15%)              |
| NL-T1       | 0.1                 | 0.25 (+150%)             |
| RAL         | 0.1                 | 0.58 (+500%)             |
| <i>CERN</i> | <i>10</i>           | <i>14.2 (+40%)</i>       |

# Uso delle risorse ai Tier-2

Total allocated cores per site

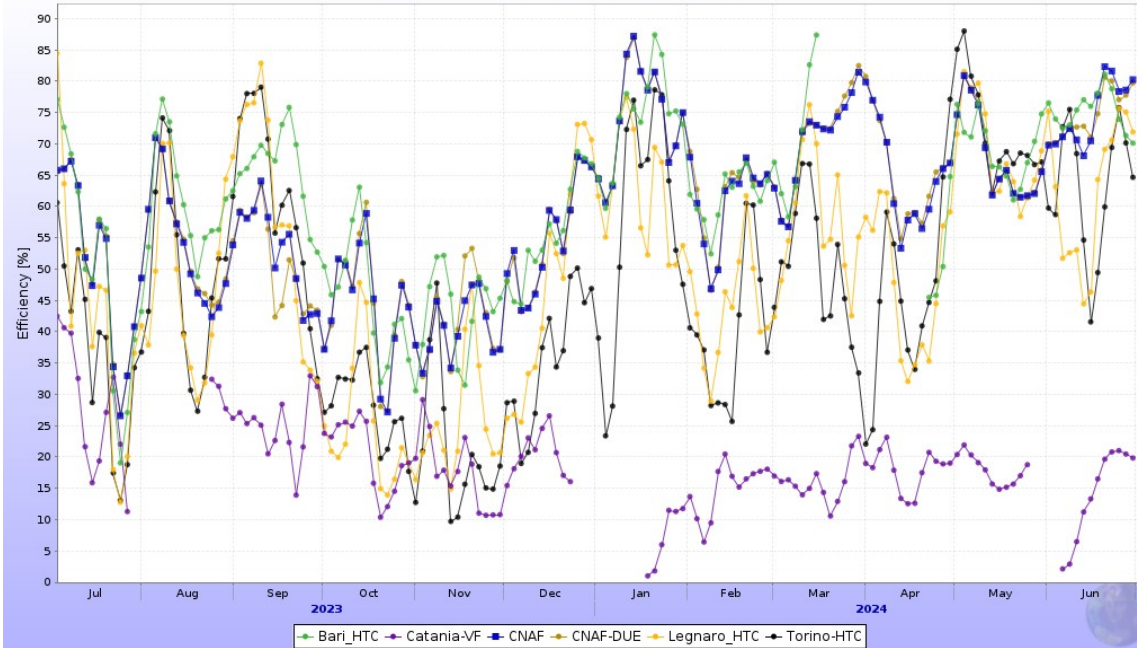


CPU Cores in use



# Uso delle risorse ai Tier-2

Jobs efficiency (cpu time / wall time)



Jobs efficiency (cpu time / wall time)

|              | Series      | Last value   | Min   | Avg          |
|--------------|-------------|--------------|-------|--------------|
| 1.           | Bari_HTC    | 70.12        | 0.033 | 60.45        |
| 2.           | Catania-VF  | 19.85        | 0     | 18.87        |
| 3.           | CNAF        | 80.27        | 0.144 | 59.19        |
| 4.           | CNAF-DUE    | 79.74        | 0     | 59.35        |
| 5.           | Legnaro_HTC | 71.89        | 0     | 49.2         |
| 6.           | Torino-HTC  | 64.66        | 0     | 46.74        |
| <b>Total</b> |             | <b>64.42</b> |       | <b>48.97</b> |

# Uso delle risorse ai Tier-2

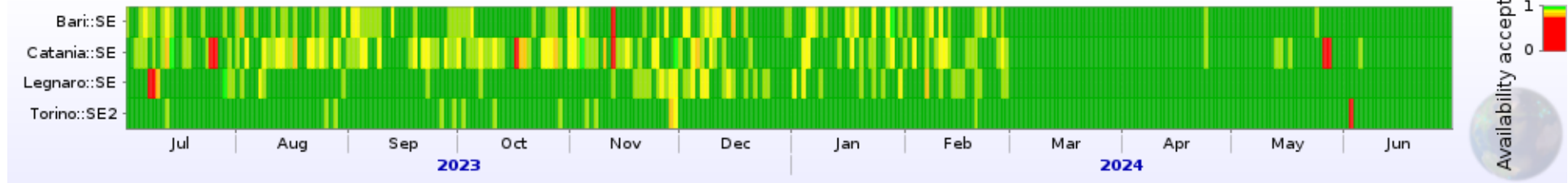
## Disk storage elements

| Bari            |                    |      |                      |                 |                 |        |                   |      |                              |                 |                 |        |                |
|-----------------|--------------------|------|----------------------|-----------------|-----------------|--------|-------------------|------|------------------------------|-----------------|-----------------|--------|----------------|
| AliEn SE        |                    |      | Catalogue statistics |                 |                 |        |                   |      | Storage-provided information |                 |                 |        |                |
| SE Name         | AliEn name         | Tier | Size                 | Used            | Free            | Usage  | No. of files      | Type | Size                         | Used            | Free            | Usage  | Version        |
| 1. Bari - SE    | ALICE::Bari::SE    | 2    | 2.2 PB               | 1.908 PB        | 298 TB          | 86.77% | 34,532,347        | FILE | 2.2 PB                       | 1.914 PB        | 292.3 TB        | 87.02% | Xrootd v5.4.3  |
| <b>Total</b>    |                    |      | <b>2.2 PB</b>        | <b>1.908 PB</b> | <b>298 TB</b>   |        | <b>34,532,347</b> |      | <b>2.2 PB</b>                | <b>1.914 PB</b> | <b>292.3 TB</b> |        |                |
| Catania         |                    |      |                      |                 |                 |        |                   |      |                              |                 |                 |        |                |
| AliEn SE        |                    |      | Catalogue statistics |                 |                 |        |                   |      | Storage-provided information |                 |                 |        |                |
| SE Name         | AliEn name         | Tier | Size                 | Used            | Free            | Usage  | No. of files      | Type | Size                         | Used            | Free            | Usage  | Version        |
| 1. Catania - SE | ALICE::Catania::SE | 2    | 3 PB                 | 2.944 PB        | 57.85 TB        | 98.12% | 29,935,328        | FILE | 3 PB                         | 2.998 PB        | 2.113 TB        | 99.93% | Xrootd v5.5.1  |
| <b>Total</b>    |                    |      | <b>3 PB</b>          | <b>2.944 PB</b> | <b>57.85 TB</b> |        | <b>29,935,328</b> |      | <b>3 PB</b>                  | <b>2.998 PB</b> | <b>2.113 TB</b> |        |                |
| Legnaro         |                    |      |                      |                 |                 |        |                   |      |                              |                 |                 |        |                |
| AliEn SE        |                    |      | Catalogue statistics |                 |                 |        |                   |      | Storage-provided information |                 |                 |        |                |
| SE Name         | AliEn name         | Tier | Size                 | Used            | Free            | Usage  | No. of files      | Type | Size                         | Used            | Free            | Usage  | Version        |
| 1. Legnaro - SE | ALICE::Legnaro::SE | 2    | 2.678 PB             | 2.304 PB        | 382.4 TB        | 86.06% | 33,623,251        | FILE | 2.678 PB                     | 2.437 PB        | 246.5 TB        | 91.01% | Xrootd v5.5.1  |
| <b>Total</b>    |                    |      | <b>2.678 PB</b>      | <b>2.304 PB</b> | <b>382.4 TB</b> |        | <b>33,623,251</b> |      | <b>2.678 PB</b>              | <b>2.437 PB</b> | <b>246.5 TB</b> |        |                |
| Torino          |                    |      |                      |                 |                 |        |                   |      |                              |                 |                 |        |                |
| AliEn SE        |                    |      | Catalogue statistics |                 |                 |        |                   |      | Storage-provided information |                 |                 |        |                |
| SE Name         | AliEn name         | Tier | Size                 | Used            | Free            | Usage  | No. of files      | Type | Size                         | Used            | Free            | Usage  | Version        |
| 1. Torino - SE2 | ALICE::Torino::SE2 | 2    | 1.646 PB             | 1.258 PB        | 397.5 TB        | 76.42% | 19,847,272        | FILE | 1.646 PB                     | 1.322 PB        | 332.2 TB        | 80.29% | Xrootd v4.11.1 |
| <b>Total</b>    |                    |      | <b>1.646 PB</b>      | <b>1.258 PB</b> | <b>397.5 TB</b> |        | <b>19,847,272</b> |      | <b>1.646 PB</b>              | <b>1.322 PB</b> | <b>332.2 TB</b> |        |                |

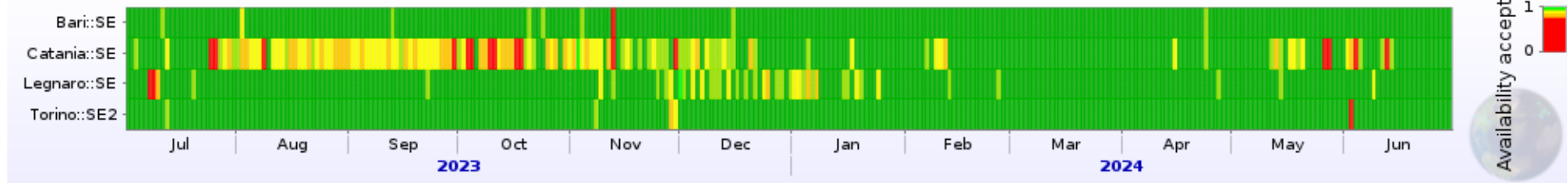


# Uso delle risorse ai Tier-2

### AliEn SEs availability for reading



### AliEn SEs availability for writing



# Risorse PNRR ai Tier-2

- Dai fondi PNRR
  - le quote assegnate ai siti sono le quote pledge per esperimento
  - quanto fornito oltre è del sito non degli esperimenti
  - la Giunta deciderà se anche quest'anno usare i fondi PNRR per le quote pledge

# Richieste 2025

| ALICE       |              | 2024         |              |              |                  |                     | 2025         |              |                        |                                 |  |
|-------------|--------------|--------------|--------------|--------------|------------------|---------------------|--------------|--------------|------------------------|---------------------------------|--|
|             |              | Req.         | C-RSG        | Pledge       | RU + JINR pledge | Pledge - (RU+JIN R) | Prev. Est.   | Req.         | Req. 2025 / C-RSG 2024 | Req. 2025 / (Pledges - RU) 2024 |  |
| CPU [kHS23] | Tier-0       | 600          | 600          | 600          |                  | 600                 | 690          | 680          | 113%                   | 113%                            |  |
|             | Tier-1       | 630          | 630          | 540          | 0                | 540                 | 725          | 690          | 110%                   | 128%                            |  |
|             | Tier-2       | 650          | 650          | 641          | 33               | 608                 | 750          | 730          | 112%                   | 120%                            |  |
|             | <b>Total</b> | <b>1880</b>  | <b>1880</b>  | <b>1782</b>  | <b>33</b>        | <b>1748</b>         | <b>2165</b>  | <b>2100</b>  | <b>112%</b>            | <b>120%</b>                     |  |
| Disk [PB]   | Tier-0       | 67.5         | 67.5         | 67.5         |                  | 67.5                | 78.5         | 78.0         | 116%                   | 116%                            |  |
|             | Tier-1       | 71.5         | 71.5         | 61.9         | 0.0              | 61.9                | 82.5         | 79.0         | 110%                   | 128%                            |  |
|             | Tier-2       | 66.5         | 66.5         | 69.8         | 3.2              | 66.5                | 77.5         | 77.0         | 116%                   | 116%                            |  |
|             | <b>Total</b> | <b>205.5</b> | <b>205.5</b> | <b>199.2</b> | <b>3.2</b>       | <b>195.9</b>        | <b>238.5</b> | <b>234.0</b> | <b>114%</b>            | <b>119%</b>                     |  |
| Tape [PB]   | Tier-0       | 181.0        | 181.0        | 181.0        |                  | 181.0               | 226.0        | 220.0        | 122%                   | 122%                            |  |
|             | Tier-1       | 107.0        | 107.0        | 102.4        | 0.0              | 102.4               | 135.0        | 123.0        | 115%                   | 120%                            |  |
|             | <b>Total</b> | <b>288.0</b> | <b>288.0</b> | <b>283</b>   | <b>0</b>         | <b>283.4</b>        | <b>361.0</b> | <b>343.0</b> | <b>119%</b>            | <b>121%</b>                     |  |

- Standard growth for CPU (+10%) and disk (+14%) in 2024 compatible with flat budget
  - Without the RU+JINR contribution, the estimated growth exceeds the flat budget in particular for the T1 sites
- Large step for tape:
  - Considered compression strategy A
- Priority order for the T1 is 1) Tape 2) Disk 3) CPU.
- The strategy for the missing T1 resources will be to balance them between T1 and T2 sites

# Share INFN 2025

- Basato su M&O-A al 01/09/2023
  - esclusa Russia, incluso JINR (8 M&O-A)

|                                | 2024 | 2025  |
|--------------------------------|------|-------|
| Tier-1 Tape                    | 31%  | 37%   |
| Tier-1 e Tier-2<br>Disco + CPU | 20%  | 21.5% |

# Share INFN 2025

|            |     |
|------------|-----|
| Italia     | 110 |
| Germania   | 68  |
| Francia    | 45  |
| Nordic (*) | 36  |
| Corea      | 19  |
| UK         | 11  |
| Olanda     | 9   |

Share Italia Tier-1:  $110/298 = 36.9\%$

(\*) Svezia, Norvegia, Danimarca, Finlandia

# Richieste 2025

| ALICE |               | 2023             |              |              | 2024             |              | 2025         |                           |                  |       |
|-------|---------------|------------------|--------------|--------------|------------------|--------------|--------------|---------------------------|------------------|-------|
|       |               | C-RSG<br>recomm. | Pledged      | Used         | C-RSG<br>recomm. | Pledged      | Request      | 2025 req. /<br>2024 C-RSG | C-RSG<br>recomm. |       |
| CPU   | Tier-0        | 541              | 541          | 660          | 600              | 600          | 680          | 113%                      | 680              | 21.5% |
|       | Tier-1        | 572              | 506          | 446          | 630              | 540          | 690          | 110%                      | 690              |       |
|       | Tier-2        | 592              | 567          | 555          | 650              | 641          | 730          | 112%                      | 730              |       |
|       | HLT           | n/a              | n/a          | n/a          | n/a              | n/a          | n/a          | n/a                       | n/a              |       |
|       | <b>Total</b>  | <b>1705</b>      | <b>1614</b>  | <b>1661</b>  | <b>1880</b>      | <b>1781</b>  | <b>2100</b>  | <b>112%</b>               | <b>2100</b>      |       |
|       | <i>Others</i> |                  |              | 222          |                  |              |              |                           |                  |       |
| Disk  | Tier-0        | 58.5             | 58.5         | 51.6         | 67.5             | 67.5         | 78.0         | 116%                      | 78.0             | 21.5% |
|       | Tier-1        | 63.5             | 57.6         | 50.2         | 71.5             | 61.9         | 79.0         | 110%                      | 79.0             |       |
|       | Tier-2        | 57.5             | 60.4         | 47.3         | 66.5             | 69.8         | 77.0         | 116%                      | 77.0             |       |
|       | <b>Total</b>  | <b>179.5</b>     | <b>176.5</b> | <b>149.1</b> | <b>205.5</b>     | <b>199.2</b> | <b>234.0</b> | <b>114%</b>               | <b>234.0</b>     |       |
| Tape  | Tier-0        | 131.0            | 131.0        | 115.0        | 181.0            | 181.0        | 220.0        | 122%                      | 220.0            | 37%   |
|       | Tier-1        | 82.0             | 87.7         | 42.5         | 107.0            | 102.4        | 123.0        | 115%                      | 123.0            |       |
|       | <b>Total</b>  | <b>213.0</b>     | <b>218.7</b> | <b>157.5</b> | <b>288.0</b>     | <b>283.4</b> | <b>343.0</b> | <b>119%</b>               | <b>343.0</b>     |       |

**Table 5** ALICE resource requests for 2025 and C-RSG recommendations. For reference, the 2023 utilization and 2024 pledged resources are also given.

# Richieste tape al Tier-1

- Il completo rimpiazzo delle risorse russe richiede

$$123 \times 37\% - 33.17 = 12.34 \text{ PB}$$

- Tuttavia, cruciale è coprire almeno la crescita 2025

$$(123 - 102.4) \times 37\% = 20.6 \times 37\% = 7.6 \text{ PB}$$

- necessari per salvare i CTF della presa dati 2025
- I restanti 4.7 PB possono essere “spalmati” durante il LS3
  - replica dati Tier-1 russo, archivio di ESD e AOD di Run2 per liberare spazio disco



# Richieste tape al Tier-1

- Non rimpiazzare le risorse nastro russe crea dei problemi
  - copia unica di alcuni dati, spazio disco in saturazione,...
- Tier-1 della Germania e di Nordic provvisoriamente hanno messo a disposizione 1.5 PB l'uno per parziale compensazione
- La nostra richiesta primaria è avere tutto il tape necessario
  - ma nel caso possiamo adattarci ad avere la sola crescita rimandando la compensazione delle risorse russe al 2026

# Monetizzazione

|       | 2024      | 2025      |
|-------|-----------|-----------|
| CPU   | 10 €/HS06 | 10 €/HS23 |
| Disco | 120 €/TB  | 120 €/TB  |
| Tape  | 10 €/TB   | 10 €/TB   |

# Tier-1

Piano A: crescita + rimpiazzo T1 russo

|                   | <b>Pledge 2024</b> | <b>Installato 2024</b> | <b>Richieste 2025</b> | <b>Delta</b> |     |
|-------------------|--------------------|------------------------|-----------------------|--------------|-----|
| <b>CPU (HS23)</b> | 126000             | 126000                 | 148500                | 22500        | 18% |
| <b>Disco (TB)</b> | 14300              | 14300                  | 17000                 | 2700         | 19% |
| <b>Tape (TB)</b>  | 33170              | 33170                  | 45510                 | 12340        | 37% |

Il CNAF ha dichiarato che le dismissioni saranno coperte internamente (su Leonardo) senza richieste aggiuntive

# Richieste Tier-1

Piano A: crescita + rimpiazzo T1 russo

| Capitolo   | Richieste kE | Descrizione  |
|------------|--------------|--|
| Inventario | 225.0        | Crescita netta CPU Tier-1<br>22500 HS23 x 10 Euro/HS23 |
| Inventario | 324.0        | Crescita netta Disco Tier-1<br>2700 TB x 120 Euro/TB   |
| Inventario | 0.0          | Dismissioni CPU Tier-1                                 |
| Inventario | 0.0          | Dismissioni Disco Tier-1                               |
| Consumo    | 123.5        | Crescita TAPE Tier-1<br>12340 TB x 10 Euro/TB          |
| G.Totale   | 672.5        |  |

# Tier-1

Piano B: solo crescita

|                   | <b>Pledge 2024</b> | <b>Installato 2024</b> | <b>Richieste 2025</b> | <b>Delta</b> |     |
|-------------------|--------------------|------------------------|-----------------------|--------------|-----|
| <b>CPU (HS23)</b> | 126000             | 126000                 | 148500                | 22500        | 18% |
| <b>Disco (TB)</b> | 14300              | 14300                  | 17000                 | 2700         | 19% |
| <b>Tape (TB)</b>  | 33170              | 33170                  | 40790                 | 7620         | 23% |

Il CNAF ha dichiarato che le dismissioni saranno coperte internamente (su Leonardo) senza richieste aggiuntive

# Richieste Tier-1

Piano B: solo crescita

| Capitolo   | Richieste kE | Descrizione  |
|------------|--------------|--|
| Inventario | 225.0        | Crescita netta CPU Tier-1<br>22500 HS23 x 10 Euro/HS23 |
| Inventario | 324.0        | Crescita netta Disco Tier-1<br>2700 TB x 120 Euro/TB   |
| Inventario | 0.0          | Dismissioni CPU Tier-1                                 |
| Inventario | 0.0          | Dismissioni Disco Tier-1                               |
| Consumo    | 76.5         | Crescita TAPE Tier-1<br>7620 TB x 10 Euro/TB           |
| G.Totale   | 625.5        |  |

# Tier-2

|                   | Pledge 2024 | Installato 2024 | Richieste 2025 | Delta |     |
|-------------------|-------------|-----------------|----------------|-------|-----|
| <b>CPU (HS23)</b> | 130000      | 130000          | 157000         | 27000 | 21% |
| <b>Disco (TB)</b> | 13300       | 13300           | 16600          | 3300  | 25% |

| Dismissioni    | CPU (HS) |          |           | Disco (TB) |          |           |
|----------------|----------|----------|-----------|------------|----------|-----------|
|                | 2024     | I sem 25 | II sem 25 | 2024       | I sem 25 | II sem 25 |
| <b>Bari</b>    | 3576     | 0        | 0         | 498        | 0        | 325       |
| <b>Catania</b> | 0        | 0        | 0         | 0          | 0        | 0         |
| <b>PD/LNL</b>  | 11910    | 5310     | 0         | 850        | 340      | 0         |
| <b>Torino</b>  | 3748     | 0        | 0         | 0          | 672      | 0         |



# Richieste Tier-2



ALICE

| Capitolo   | Richieste kE | Descrizione  |
|------------|--------------|--|
| Inventario | 666.0        | Crescita netta risorse Tier-2 italiani<br>27000 HS23 x 10 Euro/HS23 +<br>3300 TB x 120 Euro/TB |
| Inventario | 94.0         | Dismissione risorse Tier-2 Padova LNL<br>5310 HS23 x 10 Euro/HS23 +<br>340 TB x 120 Euro/TB    |
| Inventario | 39.0         | Dismissione risorse Tier-2 Bari<br>325 TB x 120 Euro/TB  |
| Inventario | 81.0         | Dismissione risorse Tier-2 Torino<br>672 TB x 120 Euro/TB                                      |
| Consumo    | 61.5         | Overhead server 7%   |
| Consumo    | 47.5         | Overhead rete (6% CPU+5% disco)  |
| G. Totale  | 989.0        |  |