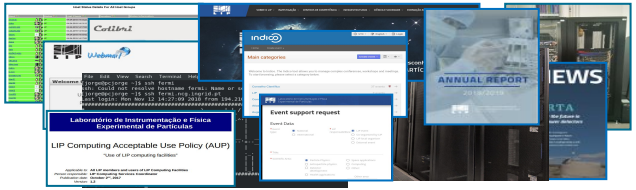
LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia

Distributed Computing and Digital Infrastructures

Delivering IT services
Computing and data

- LIP internal core IT services and networks
- LIP users support
- LIP software development for administration
- LIP web, design, awareness and communication
- LIP general computing and data storage services
- LIP WLCG Tier-2s for ATLAS and CMS
- CNCA/INCD management of HPC services
- CNCA/INCD management of HTC services
- CNCA/INCD management of cloud services
- CNCA/INCD management of data services
- CNCA/INCD user support incl. sw setup
- CNCA/INCD infrastructure development projects
- EGI, IBERGRID, WLCG, EOSC, RNCA
- Projects for innovation and research
- Contracts to provide research services
- Partnerships apply and exploit knowledge

LIP core IT



CNCA

Computing and data services for the academic & research community

LIP | FCT | LNEC | ...

Participation in Infrastructures and initiatives

EGI · IBERGRID · WLCG Worldwide LHC Computing Grid · EUROPEAN OPEN SCIENCE CLOUD · RNCA REDE NACIONAL DE COMPUTAÇÃO AVANÇADA

Projects

ENVRI-Hub NEXT · EGI-ACE · C-SCALE · EOSC Future · BIG HPC · pcient repositório · EURO² · interTwin · eosc BEYOND · DT-GEO · AI4 eosc · iMagine

IT services for LIP

Institutional: @ LIP

- Login
- Mail
- Web
- AAI
- other

- LIP Storage (NFS)
  HOMES and GROUP
- Group Servers
  (privacy sensitive data)
- Administrative Services
  (secretariat, accounting)
- Desktops, Laptops
- Printers, Multimedia

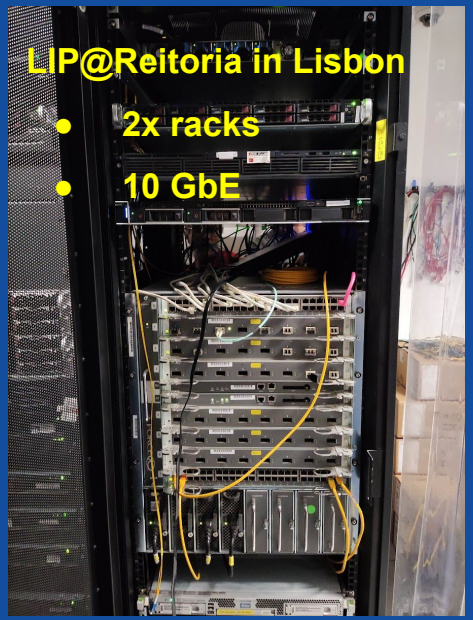
Computing & Data: @ CNCA (previously known as INCD)

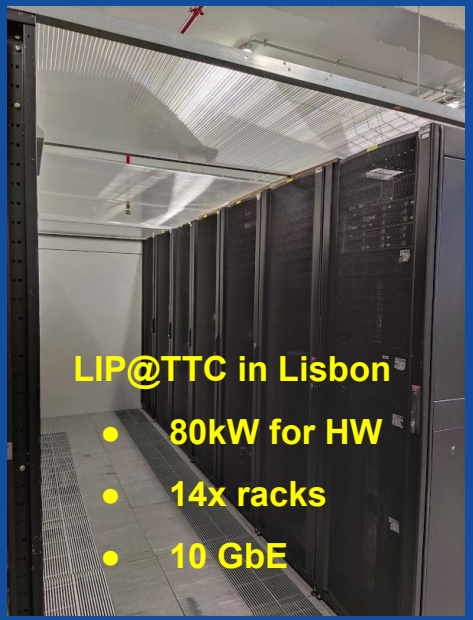
- Login
  Pauli
- Grid Services
  ARC-CE, webdav, XRootD, StoRM, etc
- Other Services
  Virtual / Physical

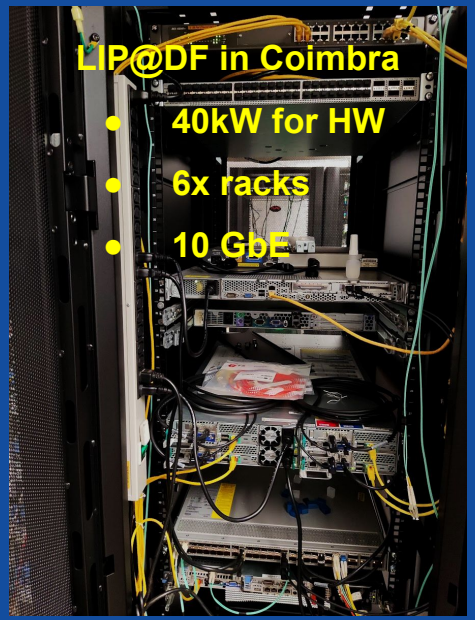
- Computing Farm (Slurm)
  INCD + LIP worker nodes
- Tier-2 storage (Lustre)
  INCD + LIP
- Homes and Group storage
  (Lustre) LIP
- Software File System (CVMFS)
  INCD
- Some group machines
  LIP

- Cloud (Openstack)
  INCD
- Block Storage (Ceph)
  INCD
- Object Storage (Ceph+MinIO)
  INCD
- Containers (Kubernetes)
  INCD

LIP
Computer Rooms for the institutional services







Some upgrades @LIP

Funding for some LIP equipment 2025/2026

- AgriData
- Associated Laboratory
- Equipar+2

Agridata

- Storage for the Project

Associated Laboratory

- Fibre network in Coimbra

EQUIPAR+2

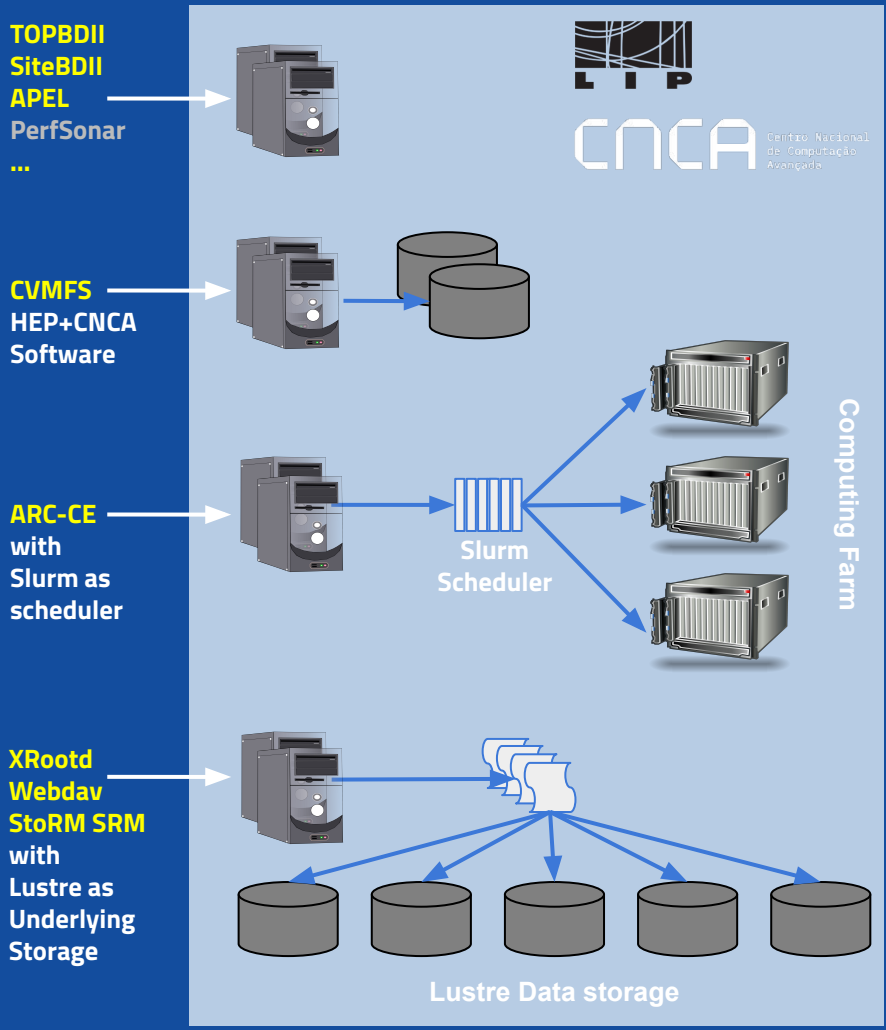
- PDUs
- Virtualization servers
- GPU and FPGA servers
- Tape library for backups
- Network equipment

- Storage for AGRIDATA project
  - NVME storage server
- Virtualization servers
  - 4x servers with NVMEs and HDDs
- PDUs
  - 16x Metered
- GPU servers
  - 3x servers with Nvidia H200
- Tape Library
  - 250 slots
  - 2x LTO-9 drives
- Network switches
  - Revamp of the Coimbra datacenter
  - New Coimbra fibre network
  - Upgrade Lisbon network

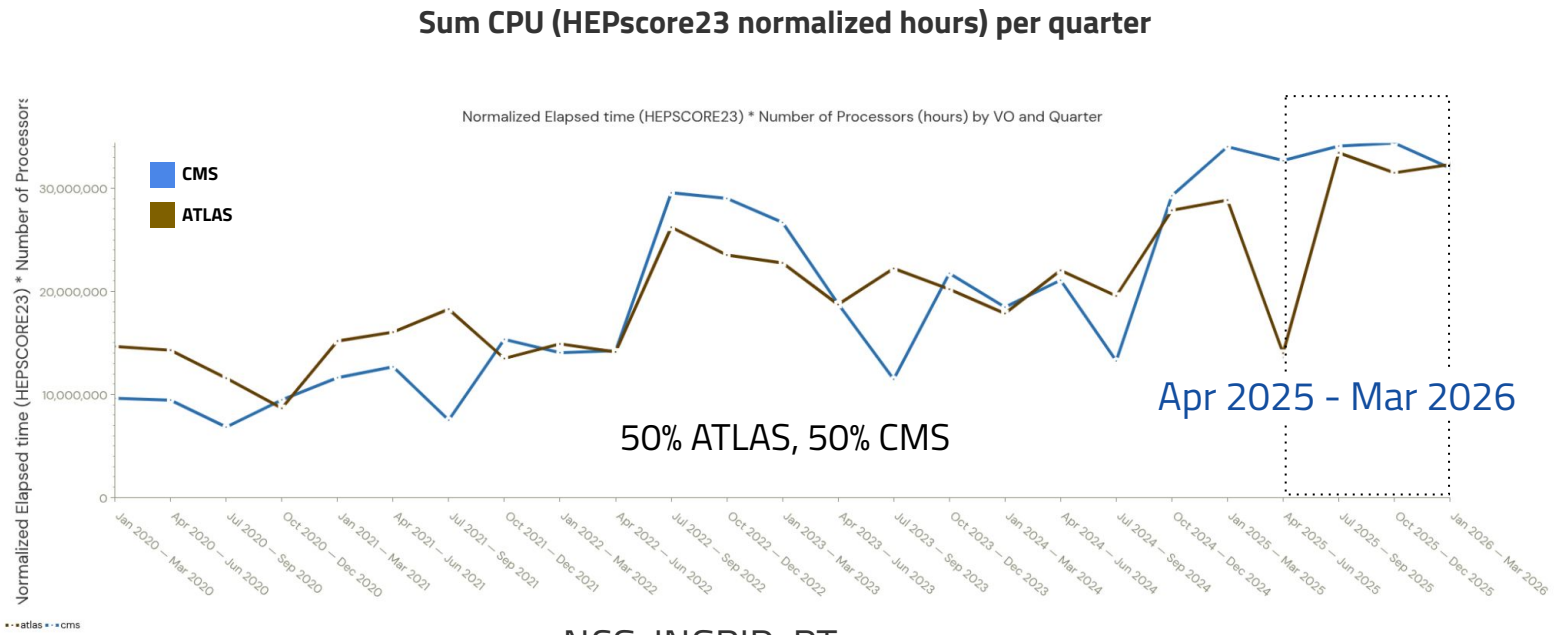
WLCG Tier-2
ATLAS and CMS

The **Tier-2 / Tier-3** uses the CNCA infrastructure and is **operated by the LIP** computing team.

- High Throughput Computing facility
  - Integrated in WLCG and EGI
  - ATLAS + CMS
  - Other smaller user communities
- Based at CNCA using the Lisbon site
  - Shares the CNCA Slurm batch system
  - Shares the CNCA Lustre storage system



Portuguese WLCG Tier-2 for ATLAS and CMS



NCG-INGRID-PT
224,391,483 HS23 hours over last 12 months
390,867 jobs over last 12 months

Period	HS23
Jan2026 Mar2026	64,270,381
Oct2025 Dec2025	65,893,227
Jul2025 Sep2025	67,535,986
Apr2025 Jun2025	46,691,889
Jan2025 Mar2025	62,886,788
Oct2024 Dec2024	57,141,417
Jul2024 Sep2024	32,807,998

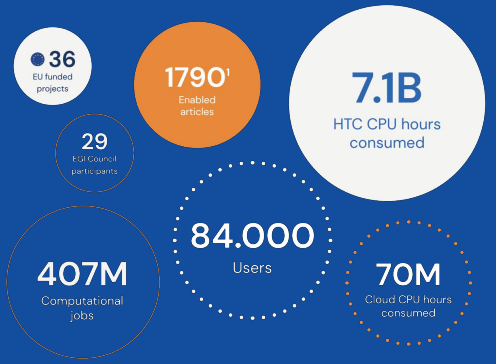
Portuguese WLCG Tier-2 for ATLAS and CMS

NCG-INGRID-PT the main CNCA site is member of the IBERGRID federation

PLEDGES	2020	2021	2022	2023	2024	2025	2026
ATLAS HS23	4000	4000	8000	9000	10000	10000	10000
CMS HS23	4000	4000	8000	9000	10000	10000	10000
ATLAS TB	280	280	400	500	600	600	600
CMS TB	260	260	400	500	600	600	600

- ATLAS
  - STORAGE min 1000TB we have 600TB
  - CPU min 10000 HS23 breaks even
- CMS
  - STORAGE min 500TB we have 600TB
  - CPU min 15000 HS23 we have 10000

LIP in **IBERGRID and EGI**

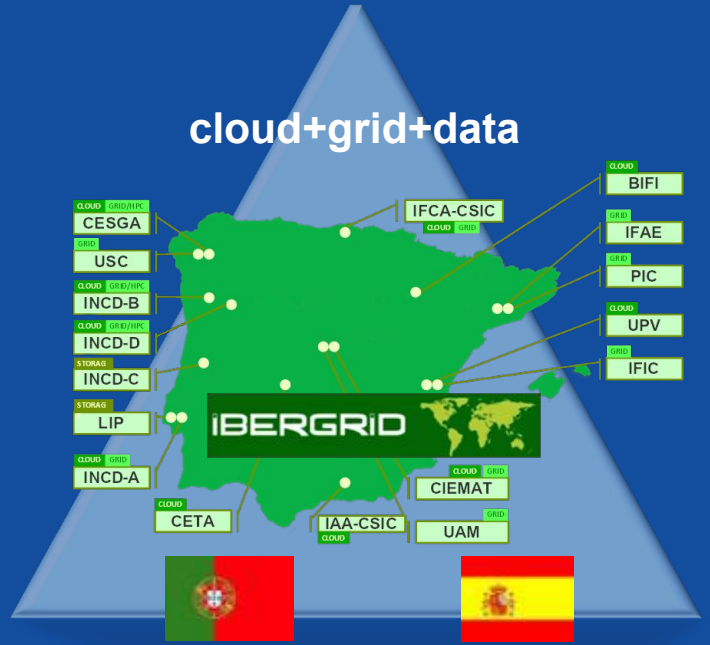


The EGI infrastructure federates hundreds of data centres worldwide:

- Including WLCG European sites
- IBERGRID and EGI provide the backbone for WLCG in PT+ES

LIP responsibilities and activities:

- Infrastructure operations coordination at Iberian level
- Interface with EGI operations
- Software management for the EGI and IBERGRID federations
- National technical contact point
- Security contact for Portugal
- Support to user communities
- Developing and operating core services e.g. software repositories for the EGI federation
- Integration of thematic and/or user services



From grid computing to CNCA
More than 20 years of computing

2000 — LIP Participation in computing projects, grid for the LHC

2006 — National grid initiative is launched. IBERGRID joins Portuguese and Spanish centers. LIP as technical coordinator. WLCG MoU is signed LIP+CERN+GRICES/FCT

2008 — National grid consortium LIP, LNEC and FCCN.

2009 — The sala-grid datacenter is built by FCCN+LIP+LNEC. The Portuguese Tier-2 starts deployment. First HPC public service in the country becomes operational.

2010 — LIP in WLCG. Initial Tier-2 deployment. EGI, IBERGRID. Supporting national users

2013 — LIP, LNEC and FCCN. propose a national distributed computing infrastructure (INCD) for all research domains.

2014 — Creatio of INCD as a national distributed computing infrastructure is approved.

2015 — INCD is established as legal entity with LIP, LNEC and FCCN as associates. Partial upgrade of the Tier-2.

2016 — Projet to fund INCD is submitted to the national roadmap of research infrastructures.

2017 — The project to establish INCD starts. LIP assumes the technical coordination of INCD.

2018 — First contracts for equipment and personnel. Upgrade of the HPC infrastructure.

2019 — National Advanced Computing Network is established

2021 — INCD funding project is extended

2022 — Upgrade of computing and storage equipment. Setup of a second site at Vila Real. Tier-2 partial renewal.

2023 — The second site at Vila Real becomes operational.

2024 — INCD becomes CNCA. The national Advanced Computing Centre. Merging national HPC, HTC and cloud resources.

LIP in **CNCA**

INCD had a change of name

- CNCA - Centro Nacional de Computação Avançada
- National Advanced Computing Centre

Change of statutes

- Wider role and responsibilities
- Encompassing all computing models
- Encompassing research data

Enlarging associates

- Welcoming national academic and research organisations as associates
- Associates will pay a fee in-cash or in-kind
- Associates will get computing capacity
- LIP will continue being an associate

- **Management**
  - General Assembly (FCT, **LIP**, LNEC)
  - Leading the directorate (**LIP**: Nuno Castro)
- **Technical coordination of distributed computing in CNCA** (**LIP**: Jorge Gomes)
  - Planning
  - Development and Innovation
  - Management and Operations
  - Support
  - Technology Transfer
  - Data Networks
- **Participation in the other technical areas**
  - High Performance Computing
  - Research Data
- **Participation as CNCA in the RNCA panels**
  - Setup of FCT calls for computing time
  - Evaluation of FCT computing projects
  - Coordinating provisioning of computing time

CNCA LIP managed resources

Cloud Computing	HTC Computing	HPC Computing
cloud computing	high throughput computing (GRID)	high performance computing

INCD-D @ UTAD Vila Real

- High Performance Computing
- Distributed computing
  - Cloud Openstack
  - HTC
- 5000 CPU cores
- 4 Petabytes (disk + SSD)
- 2x 10 Gbps

INCD-C @ UC Coimbra

- Tape Library
- 20 Petabytes
- 10 Gbps

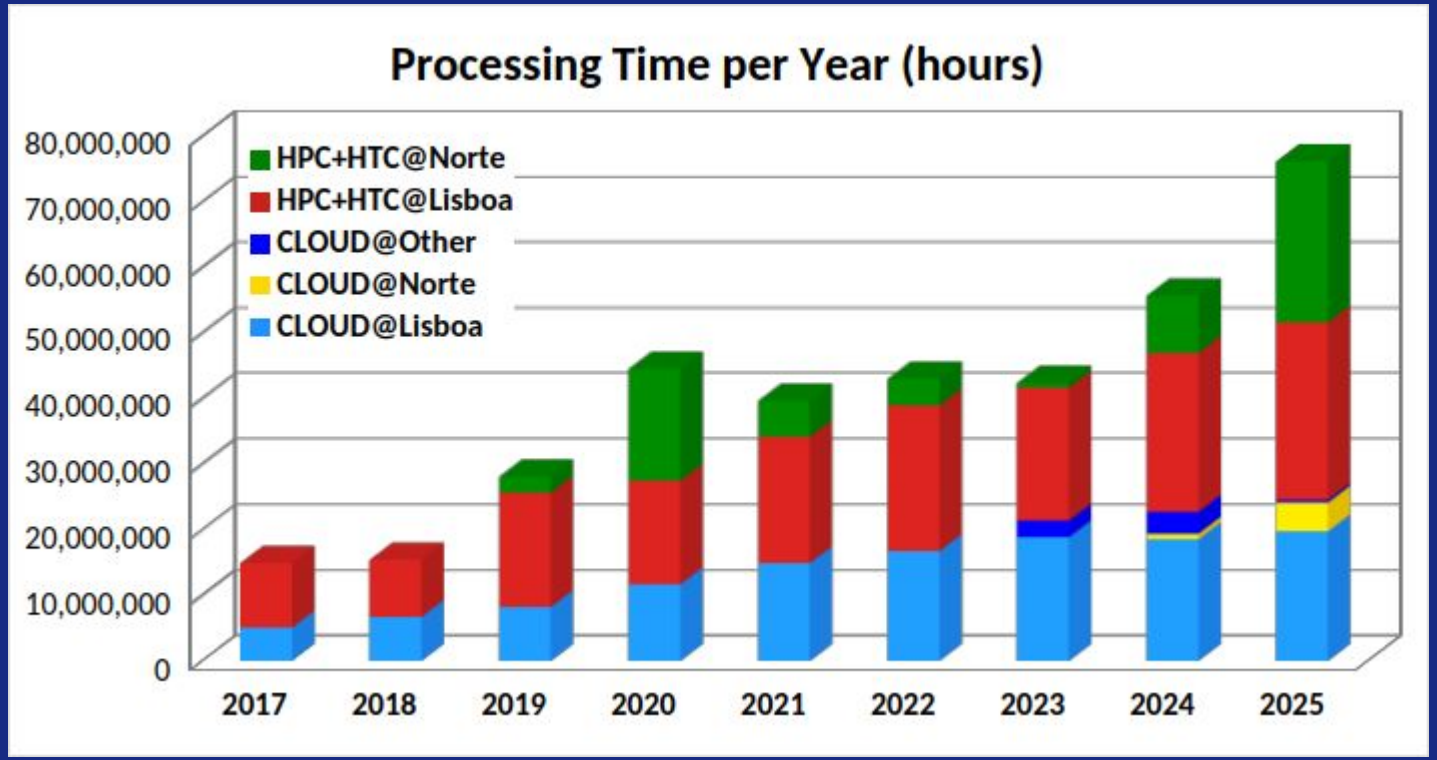
INCD-A @ LNEC Lisboa

- High Performance Computing
- Distributed computing
  - Cloud Openstack+K8s
  - HTC
- 7500 CPU cores
- 5 Petabytes (disk + SSD)
- 2x 100 Gbps + 1x 10 Gbps

INCD-L @ LIP Lisboa

- Tape Library
- 1 Petabyte
- 10 Gbps

Usage 2017-2025 Capacity delivered from LIP managed services



Distributed Computing Metrics detailed

	2017	2018	2019	2020	2021	2022	2023	2024	Total
Papers direct	52	79	59	97	89	126	111	120	733
Conference papers	24	0	47	25	32	22	21	5	206
Books	0	0	0	2	0	0	0	0	2
PhD Thesis finished	8	4	3	7	9	5	11	3	50
PhD Thesis ongoing				16	10	34	72	73	205
MSc Thesis finished	10	5	17	12	19	23	49	54	189
MSc Thesis ongoing				1		38	3	46	88
Conference posters	9	12	2	24	39	8	42	35	171
Patents					2	1	0	0	3
Datasets				1	2	19	11	3	36
Total	**103**	**130**	**128**	**185**	**202**	**276**	**320**	**339**	**1683**

Data reported by the users at the yearly data collection

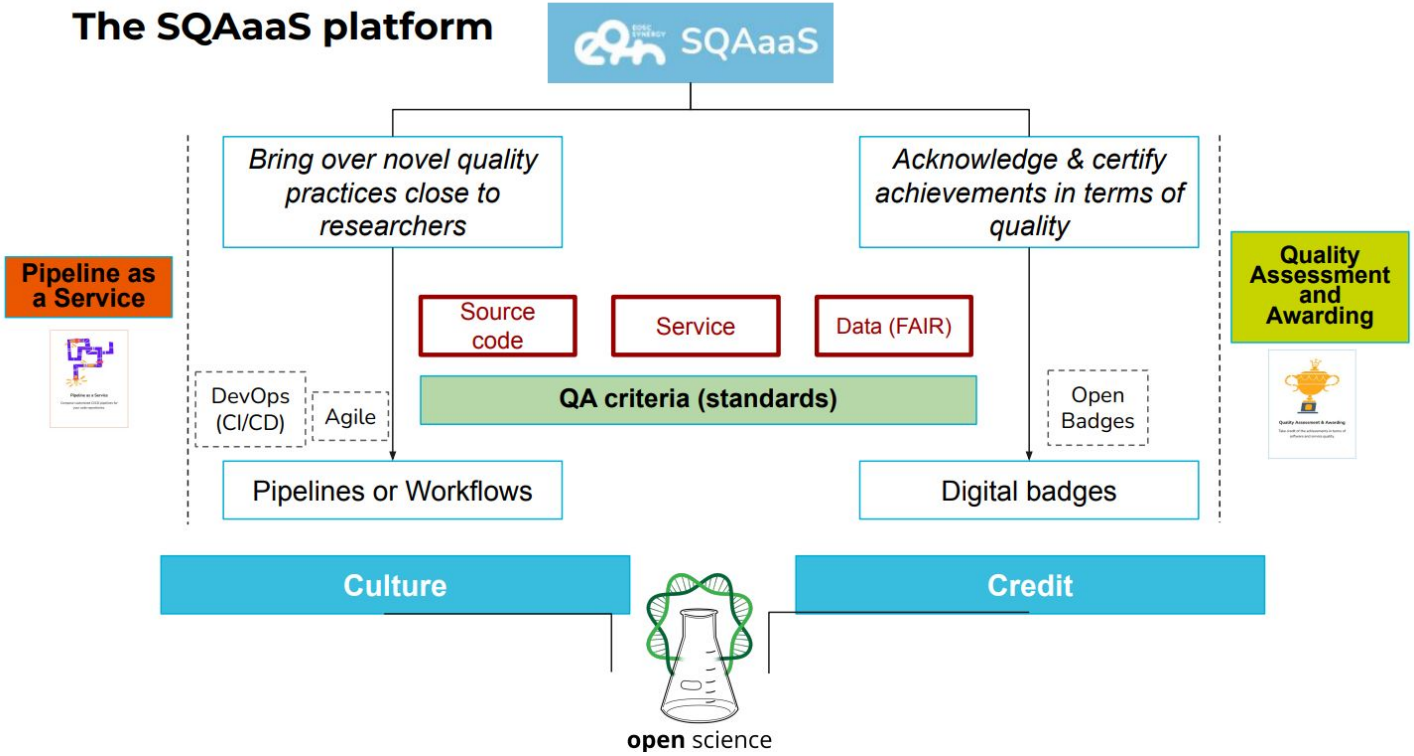
Projects and activities @ LIP

- DT-GEO (EC)
  - Digital Twin of geophysical extremes dealing with geohazards earthquakes, volcanoes, and tsunamis
  - Software and Service Quality assessment
  - udocker integration with workflow managers in HPC
  - Application containerisation
- InterTwin (EC)
  - Common approach to the implementation of DTs applicable across scientific disciplines
  - Software release and management
  - Quality and validation for applications and services
- iMagine (EC)
  - Imaging data and services for aquatic science
  - Federated computing infrastructure
  - Supporting the DEEP AI platform service
- DGT Sentinel and OrtoSat (DGT)
  - Build storage and caching infrastructure for Sentinel data
  - Create new derived products from Sentinel data
  - Platform for data products delivery
  - ML applied to OrtoSat for soil occupancy identification
- DGT LiDAR (DGT)
  - Platform for delivery of LiDAR data from 1st national coverage
  - API for LiDAR data access and exploitation
  - Visualization of LiDAR data - 3D/2D
- AI4EOSC (EC)
  - Advanced services for AI, ML and DL models and applications.
  - Software quality, data FAIRness
  - Integration of udocker for serverless computing
- EuroCC 2 (EuroHPC JU)
  - Awareness and communication
  - Training and skills
  - Interaction with academia and public sector
  - Support to public administration and research
- Research Data Management Centre (FCT)
  - Open data for HEP, Social Sciences and compute intensive sciences
- Contract with FCT - data repositories (FCT)
  - Pilot for a national research data repository
  - Integration and service provisioning
- AGRISPACE (FCT)
  - Pilot of a data space for agriculture related data
  - Use cases exploiting and demonstrating the data space
  - Includes ML applications
- EOSC Beyond (EC)
  - Release management and Software Quality Assurance
  - Process, CI/CD tools and support for QA
- ENVRI-Hub-NEXT (EC)
  - CI/CD integration, including agile software development
  - Release process, automated QA, environment for integration

LIP Projects and funding in 2025 and ongoing

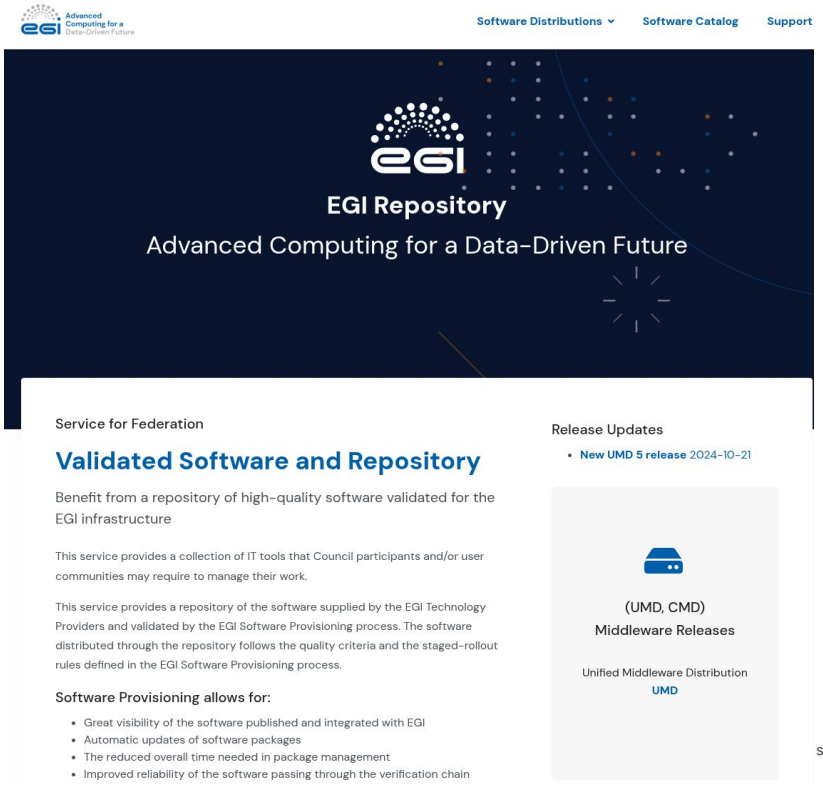
LIP Computing Projects	Source	Start	End	Funding
iMagine	EU H.Europe project	2022	2025	222 125€
DT-Geo	EU H.Europe project	2022	2025	542 875€
AI4EOSC	EU H.Europe project	2022	2025	350 250€
interTwin	EU H.Europe project	2022	2025	342 812€
Research Data Management for Open Science	FCT R&D contract	2025	2025	120.000€
CNCA-LIP DADOS	FCT R&D contract	2025	2026	126 000€
EuroCC 2	EU/FCT EuroHPC	2023	2026	146 000€
SMOS Sentinel and OrtoSat data delivery/processing	DGT R&D contract	2025	2026	139 131€
SMOS LiDAR data delivery and visualization	DGT R&D contract	2025	2026	139 709€
AGRISPACE - Partnership Agriculture of data pilot	FCT R&D contract	2025	2026	105.000€
EOSC-beyond	EU H.Europe project	2024	2027	182 750€
ENVRI-Hub NEXT	EU H.Europe project	2024	2027	225 302€
EARTH-AID	EU H.Europe project	2026	2029	230 036€
EOSC-MESH	EU H.Europe project	2026	2029	120 000€
FLUID-AI	EU H.Europe project	2026	2029	233 460€
EuroCC 3	EU/FCT EuroHPC	2026	2029	185 538€

Software Quality
LIP in EC projects

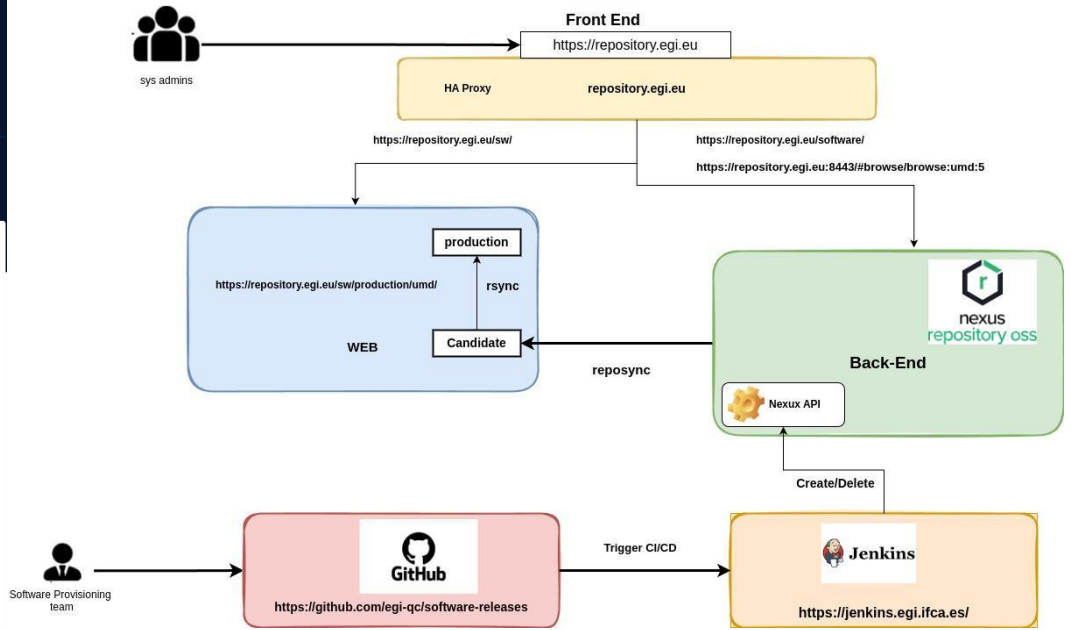


- Development of the platform core
- Cooperation with CSIC and UPV
- Being exploited in projects
- interTwin
- DT-Geo
- EOSC Beyond
- CESSDA
- EOSC-Beyond
- ENVRI-HUB-Next
- etc

EGI UMD / CMD software repository is managed by LIP + CNCA



repository.egi.eu
Developed by LIP
Housed at CNCA



Research data
LIP + CNCA + ICS

FCT contract under INCD/CNCA activities.
National catchall data repository (LIP+CNCA):

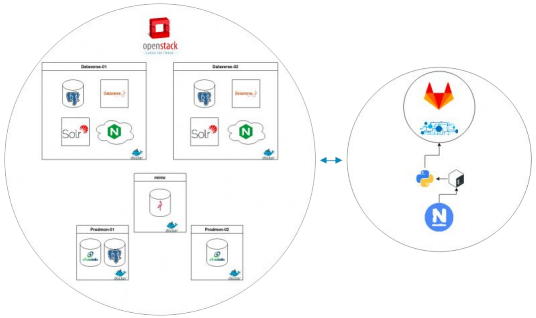
- Leverage EOSC-Synergy work on thematic data repositories and FAIR quality indicators.
- Productization and automation of Dataverse based data repositories.
- Integration (Ciência ID, Ciência Vitae, OIDs, etc)

FCT contract under PNCADAI. Research Data Management Centre (LIP+ICS+CNCA):

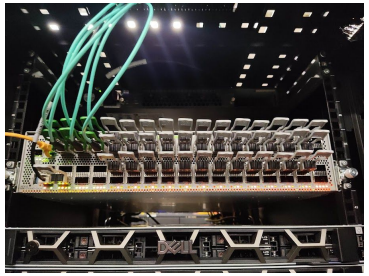
- Creation and improvement of area specific repositories (social sciences, physics, etc)
- Curation of datasets
- Training on research data management

New FCT data management services built on CNCA:

- Expansion of FCT data storage capacity
- New services (Data management Plans, sync&share, long term storage etc)



The Dataverse® Project



31x server SSD
1.5 PB capacity

64x server HDD
12 PB capacity

U	O27	N22	M22	L22
48	SW MGMT	SW MGMT	SW MGMT	SW MGMT
47				
46				
45				
44				
43	SWITCH 400GbE	SWITCH 400GbE	SWITCH 400GbE	SWITCH 400GbE
42				
41				
40	SSD	SSD	SSD	SSD
39	SSD	SSD	SSD	SSD
38	SSD	SSD	SSD	SSD
37	SSD	SSD	SSD	SSD
36	SSD	SSD	SSD	SSD
35	SSD	SSD	SSD	SSD
34	SSD	SSD	SSD	SSD
33	SSD	SSD	SSD	
32	HDD	HDD	HDD	HDD
31				
30	HDD	HDD	HDD	HDD
29				
28	HDD	HDD	HDD	HDD
27				
26	HDD	HDD	HDD	HDD
25				
24	HDD	HDD	HDD	HDD
23				
22	HDD	HDD	HDD	HDD
21				
20	HDD	HDD	HDD	HDD
19				
18	HDD	HDD	HDD	HDD
17				
16	HDD	HDD	HDD	HDD
15				
14	HDD	HDD	HDD	HDD
13				
12	HDD	HDD	HDD	HDD
11				
10	HDD	HDD	HDD	HDD
9				
8	HDD	HDD	HDD	HDD
7				
6	HDD	HDD	HDD	HDD
5				
4	HDD	HDD	HDD	HDD
3				
2	HDD	HDD	HDD	HDD
1				

EuroCC
HPC Competence Center

EuroHPC supported project series (2020-2029)

High Performance Computing National Competence Center in EuroCC.

- **Boost European HPC knowledge**
- European network of national HPC competence centres (NCCs)
- Support public administration, research and private
- Bridge the skills gaps and promote cooperation

LIP participation

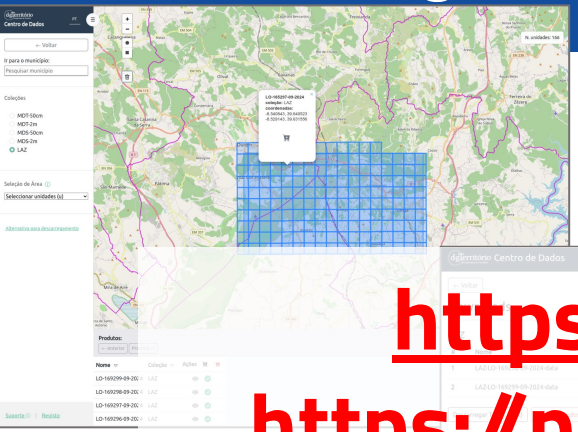
- Technology transfer and consultancy
- Training and skills development
- **Awareness and collaboration**
- Access to expertise and knowledge
- Research, industry and public sector

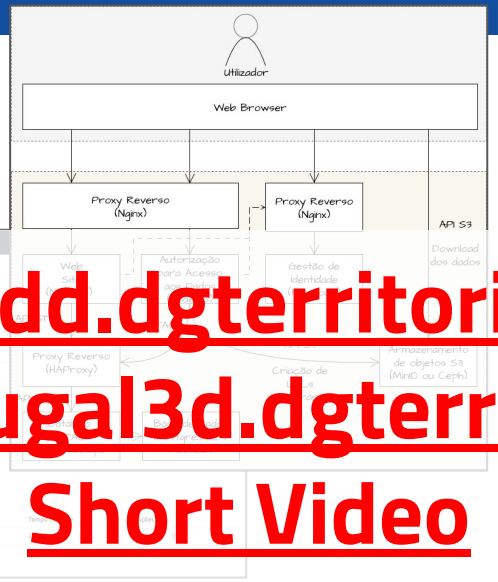
Now in 2026 starting EuroCC 3 Project

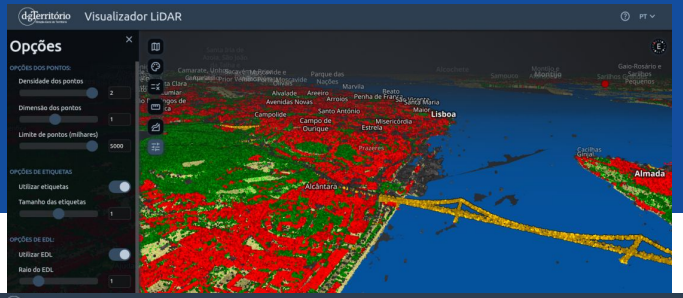
https://eurocc.fccn.pt / contacto@eurocc.fccn.pt

Data for earth observation

LiDAR coverage of Portugal





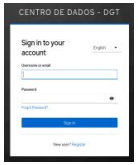


https://cdd.dgterritorio.gov.pt

https://portugal3d.dgterritorio.gov.pt

Short Video

Login SSO
OAuth2.0



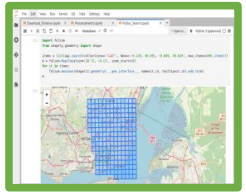
Notebooks na
cloud do CNCA

jupyterhub

Ambientes
Contentorizados

kubernetes

Execução de
scripts Python



Armazenamento
eoAPI / STAC + S3

SpatioTemporal
Asset Catalog

S3

Human resources 2024 / 2025

LIP
Staff / Contracted Personnel

Lígia Melo	Communication	LIP Lisboa - Communication, dissemination, outreach for computing+LIP
Davi Parma	Technician	LIP Lisboa - Web development for internal and administrative services
Carlos Manuel	Technician	LIP Lisboa - Design, web development, events, multimedia, communication
Hugo Gomes	Technician	LIP Lisboa - Web development, IT support, events, multimedia, communication
João Martins	Researcher	LIP Lisboa - Fabric mgmt, storage, computing, HPC, grid, virtualization, support
João Pina	Researcher	LIP Lisboa - WLCG Tier-2, software management, user support, grid
Jorge Gomes	Researcher	LIP Lisboa - Projects mgmt, network mgmt, computing, sw development, security
Mário David	Researcher	LIP Lisboa - Cloud computing, containers, sw quality assurance, development
Samuel Bernardo	Engineer	LIP Lisboa - Development, sw quality, AAI, computing, cloud, containers, DevOps
Zacarias Benta	Engineer	LIP Minho - HPC, fabric mgmt, computing, virtualization, support, data services
Nuno Dias	Researcher	LIP Lisboa - Security, data protection, network services, desktops, support
José Aparício	Engineer	LIP Lisboa - Datacenter, networks, notebooks, desktops, hw maintenance, support
Miguel Viana	Engineer	LIP Minho - Cloud, containers, softw. integration and validation (part time)
Henrique Carvalho	Engineer	LIP Minho - Multimedia and GeoSpatial (partial time)
Gonçalo Barradas	Engineer	LIP Lisboa - DGT+AGRISPACE contract, GeoSpatial
Pedro Pinheiro	Engineer	LIP Lisboa - DGT+AGRISPACE contract, GeoSpatial

Communication

Core Computing Services

EXTERNAL
Collaborators

Rui Pedro	Engineer	INCD - Kubernetes, Cloud, Containers, DevOps, Software development
César Ferreira	Engineer	INCD - HPC/HTC, computing, data, virtualization, containers, support
João Machado	Researcher	INCD - Software development, Software quality assurance, Cloud, Containers

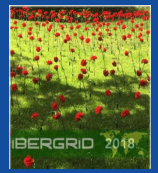
CNCA

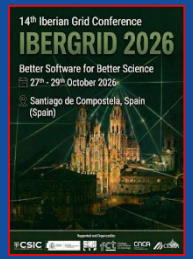
LIP
Computing Events

EGI 2025 conference is organised by the EGI Foundation, and **hosted by CSIC and LIP** in Santander.
https://www.egi.eu/event/egi2025/

IBERGRID 2026 Santiago de Compostela

October 27th-29th **https://ibergrid.eu**





HEPiX 2026 In Lisbon

114 participants
16 countries
39 institutes
4 sponsors
12 tracks
73 contributions

HEPiX brings together worldwide IT staff from High Energy Physics and Nuclear Physics laboratories and institutes, to foster learning and sharing of experiences between computing centres. **https://hepix.org**

LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia

Thanks!

Discovery through science

Innovation through technology

Sharing with People

SWOT

Strengths

- Expertise in scientific computing, software integration, management and quality assurance, etc.
- Participation in international research e-infrastructures and initiatives (WLCG, EGI, IBERGRID and EOSC).
- Participation in European and national projects and collaborations.
- Operating the Portuguese WLCG Tier-2 under the CERN LHC computing MoU.
- Founding member of CNCA providing technology, support and development.
- Technological partner of CNCA managing computing and data services.

Weaknesses

- Lack of compute and storage resources.
- Too many activities supported on a voluntary and/or best effort basis.
- Highly overworked team.
- Difficulty in addressing internal and external demands.
- Huge dependency on projects and external contracts to pay staff salaries.
- Heavy administrative burden.
- Capacity wise becoming irrelevant at national level.
- Less influence in the future CNCA.

Opportunities

- Participation in activities related to High Performance Computing.
- Participation in research data and digital repositories related activities.
- Potential for public sector applications.
- Evolution from INCD to CNCA.
- Possible exploitation of the group expertise in projects and collaborations.

Threats

- Lack of sustainable funding for human resources.
- Lack of hardware capacity for the experiments.
- Competitive market makes contracting and retaining IT personnel difficult.
- Exacerbated focus on supercomputing at national and European level.
- Increasingly higher competition in projects and infrastructures.
- Future evolution of CNCA.

Human resources

- **LIP staff**
- **INCD staff**
- **Collaborators**

- **4x PhDs**
  - 2x LIP staff
  - 1x CNCA staff
  - 1x External collaborators
- **11x BSc/MSc**
  - 7x LIP staff
  - 2x LIP fixed term contracts
  - 2x CNCA staff
- **3x Technicians**
  - 3x LIP staff

	Staff salaries
LIP (computing **projects**)	**88%**
LIP (own funds)	2%
CNCA (**projects** and protocols)	10%

- **High sustainability risk**
- **Services on best effort**

Goals and strategy

- **Participate in R&I projects, mainly EU**
  - To develop new competences and service functionalities
  - To obtain funding to sustain the IT personnel
  - To establish a good reputation and links at international level
  - To have interesting activities to help retain the IT personnel
- **Participate in e-infrastructure initiatives at international level (EGI, WLCG, IBERGRID)**
  - To federate, operate and maintain the compute and data intensive services
  - To support LIP users and other research communities and bring added value to these activities
  - To establish and develop international networking and long term collaborations
- **Participate in e-infrastructure initiatives at national level (research infrastructures, RNCA, CPCA, CNCA ...)**
  - To support the operational costs and improvement of the computing and data infrastructure
  - To support other research communities hence further justifying the need of funding for OPEX and CAPEX
  - To establish LIP as a relevant stakeholder in the area

LIP strategy and WLCG

- Follow computing CERN/WLCG activities towards the HL-LHC
- Enlarge the Tier-2 capacity according to the pledges closing the gap as much as possible
- Having the Tier-2 as a flagship service provided by CNCA
- Ensure the Tier-2 sustainability via CNCA
- Promote distributed computing as an essential service
- Collaborate with other research and academic organisations
- Seek for complementary opportunistic computing capacity from e.g. CLOUD and HPC
- Align our actions with the funding authorities strategies to facilitate access to funding
- Collaborate with FCT and with FCT-FCCN in delivering computing and data services

LIP strategy and CNCA

- CNCA as the main provider for compute and data intensive services for LIP
- Consolidate CNCA as a reference organisation with sustainability
- Promote CNCA in the scope of the creation of a national advanced computing center
- Seek for a common umbrella for distributed computing, HPC, cloud and data infrastructures with support at national level
- Expand the LIP capabilities through a tight collaboration between the CNCA and LIP teams
- Collaborate with other research and academic organisations in the scope of CNCA
- Collaborated with the funding agencies in the scope of CNCA
- Support other communities via CNCA and make visible the LIP value and impact

Projects and funding

INCD Projects	Source	Start	End	Funding
iMagine	EU	2022	2025	50 414€ / 3 years
Climate-Adapt4EOSC	EU	2024	2027	193 500€ / 4 years
Centro de Dados de Inovação e Ciência	CCDR-N+FCT	2026	2027	2 998 863€ / 2 years

INCD Protocols	Source	Start	End	Funding
Institutional scientific employment position	FCT	2023	2029	285 000€ / 6 years
RNCA Protocol 3rd and 4th CPCA calls	FCT	2025	2025	80 000€
RNCA Protocol housing	FCT	2025	2025	243 000€
RNCA Protocol data services	FCT	2025	2025	40 000€

- The LIP computing and data intensive resources are largely owned and/or operated and housed by CNCA.
- The CNCA housing costs including the LIP WLCG Tier-2 have been until now supported by FCT.