



The Portuguese National Distributed Computing Infrastructure and Related Activities

INCD Advisory Board 2022/2023

Cofinanciado por:





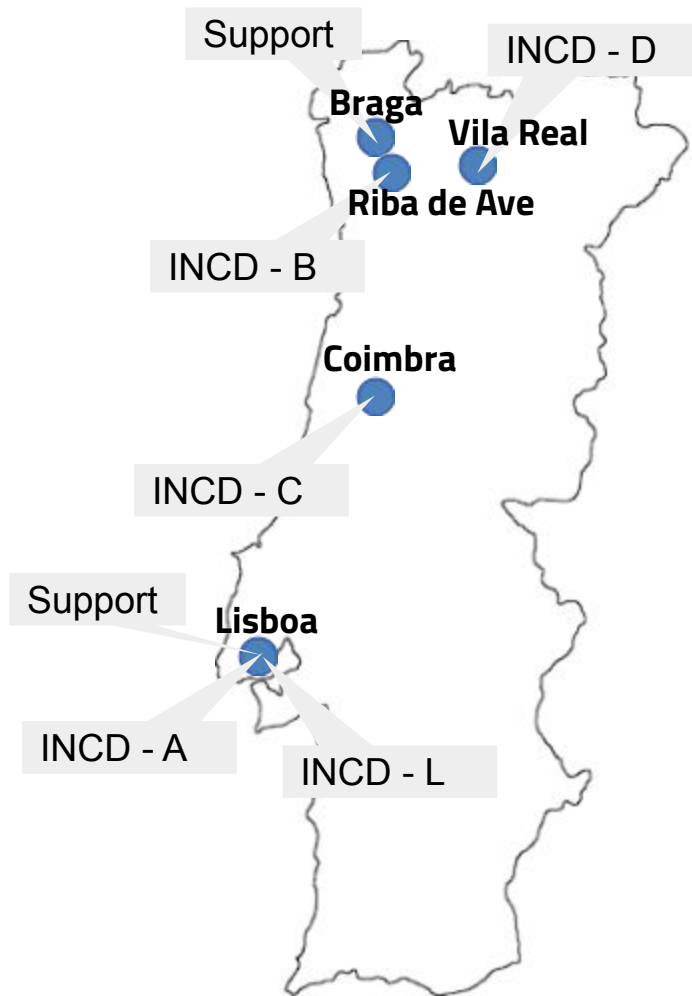
Centres

Support centres

- Lisbon at LIP and LNEC
- Minho at LIP

Operations centres

- INCD - A @ LNEC in Lisbon
- ~~INCD - B @ REN in Riba de Ave~~
- INCD - C @ UC in Coimbra
- INCD - D @ UTAD in Vila Real
- INCD - L @ LIP in Lisbon





High level view

USERS

Users's Virtual Research Environments

Added-value services (generic platforms & tools)

Federation and distributed computing

CLOUD

HPC

HTC

DATA

INCD operational centres in Lisbon, North, Center regions

Advanced network services provided by PT NREN (RCTS/FCT-FCCN)

Interoperability, Security

I&D, Collaboration, Training, Support



INCD operations centers in 2022



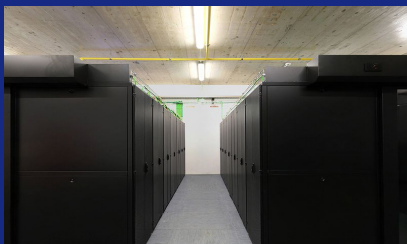
INCD-A @ LNEC in Lisbon
HPC / HTC / Cloud / Federation
6000 CPU cores
5 Petabytes online raw
100 Gbps
Includes the WLCG Tier-2



INCD-B @ REN in Riba-de-Ave
(DECOMMISSIONED in 2023)
HPC / HTC
2600 CPU cores
384 Terabytes raw
1 Gbps



INCD-L @ LIP in Lisbon
Tape storage
1 Petabyte backups
10 Gbps



INCD-D @ UTAD in Vila Real
(BEING DEPLOYED)
HPC / HTC / Cloud / Federation
5000 CPU cores + IB HDR200
4 Petabytes online raw
10 Gbps



INCD-C @ UC in Coimbra
(BEING IMPROVE)
Tape storage expansion
20 Petabytes
10 Gbps



Main services

● HPC

- Slurm batch system
- Infiniband network
- Lustre
- CVMFS
- Access to GPUs A100/V100/T4
- Containers

● HTC

- Slurm batch system
- Ethernet network
- Lustre
- CVMFS
- NFS
- Access to GPUs A100/V100/T4
- Containers

● Cloud

- Openstack
- Virtual networks
- Ceph block storage
- Ceph object storage
- Dashboard and APIs
- Access to GPUs T4



Farm

ARC-CE

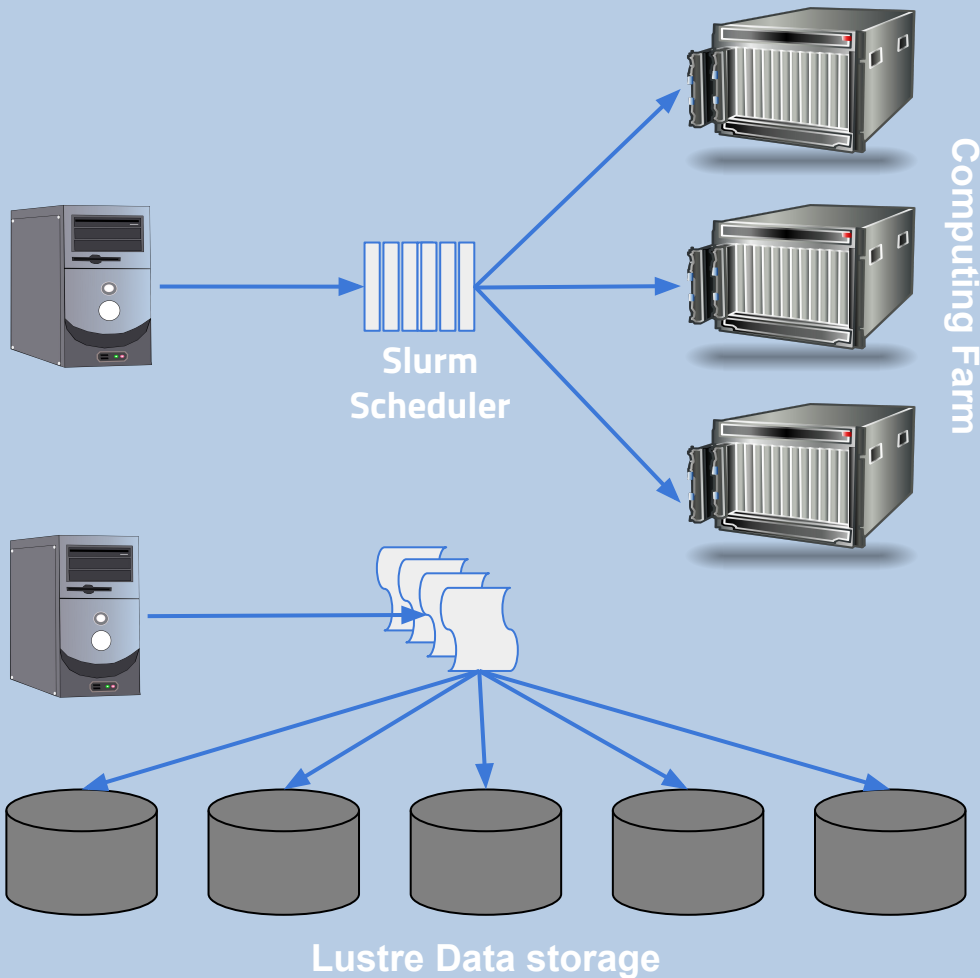
with

Slurm as
scheduler

XRootd
Webdav
StoRM SRM

with

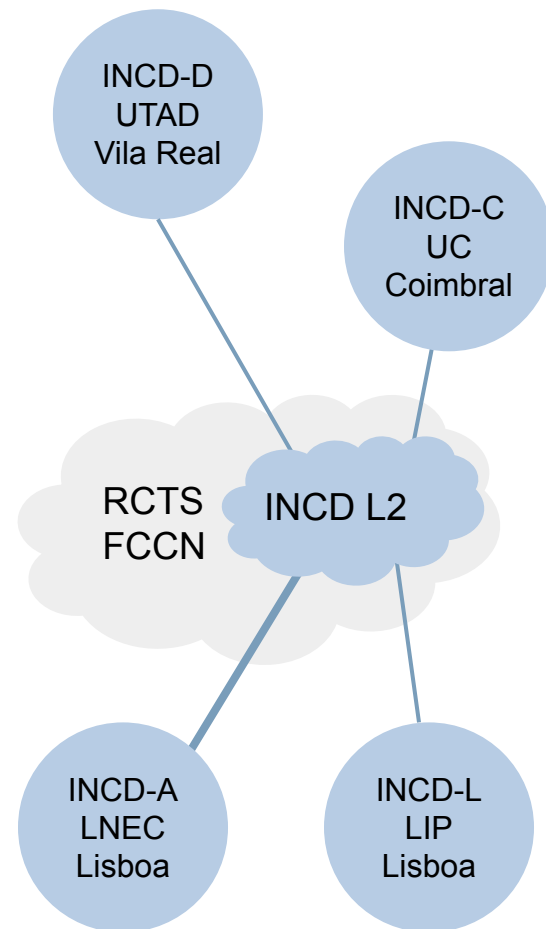
Lustre as
Underlying
Storage





Network and housing in 2022

- **INCD - A @ “Sala-Grid” LNEC in Lisbon**
 - Main data centre for INCD
 - 100 Gbps connectivity
 - Data centre managed by FCCN
 - Equipment managed by LIP team in Lisbon
- **INCD - C @ UC in Coimbra**
 - 10 Gbps connectivity
 - Physics department datacenter under agreement with LIP
 - Equipment managed by LIP team in Lisbon
- **INCD - D @ UTAD in Vila Real**
 - 10 Gbps connectivity
 - University of Trás-os-Montes e Alto Douro data centre under agreement with FCT
 - Equipment managed by LIP/INCD team in Braga/minho
- **INCD - L @ LIP in Lisbon**
 - 10 Gbps connectivity
 - LIP datacenter
 - Equipment managed by LIP team in Lisbon





Public tender 2022

- International public tender launched in February 2022
 - Execute the remaining of the equipment budget
 - Total 1,033,000.00 € plus VAT
 - Contracted a loan to be able to pay and then claim the cost
 - VAT is now recovered from tax authority (needed changes)
 - Delivery very delayed had to ask for project extension
- Divided in three batches for each operations centre
 - Lisbon (242,000.00 €)
 - Disk storage + Computing
 - Vila Real (638,000.00 €)
 - Disk storage + Computing + Networking
 - Coimbra (153,000.00 €)
 - Tape storage



-> Dell

-> Dell + Mellanox

-> Lenovo + IBM



INCD-A @ LNEC in Lisbon upgrade

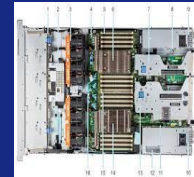
- Computing capacity
 - ~ 2000 CPU cores
 - Dell PE R6525 & R7525
 - 2x AMD Epyc 7643 2.3GHz
 - 96 CPU cores and 512 GB RAM per server
 - 480 SSD + 8TB HDD
 - Infiniband FDR + 10 GbE
 - A100 GPUs 80GB + 8TB NVME
- Storage capacity
 - ~ 2 PB raw storage for Lustre
 - Dell PE R740xd2
 - 20 CPU cores and 96 GB RAM per server
 - 2x SSD per server
 - 480 TB HDD per server
 - IB FDR + 40GbE





INCD-D @ UTAD in Vila Real upgrade

- Computing capacity
 - ~ 5000 CPU cores
 - Dell PE R6525 & R7525
 - Dual AMD Epyc 7643 2.3GHz
 - 96 CPU cores
 - 512 GB or 1024 GB RAM per server
 - 480 SSD + 8TB HDD
 - Infiniband HDR 200 + 10 GbE
- Storage capacity
 - ~ 3.7 PB raw storage for Lustre and Ceph
 - Dell PE R740xd2
 - 20 CPU cores
 - 96 GB (Lustre) or 512 GB (Ceph) RAM per server
 - 2x SSD
 - 480 TB HDD
 - IB HDR 200 + 2x25 GbE
- Support servers
 - 7x Dell PE R650xs
 - Xeon Gold 5315Y with 64 GB RAM
 - 2x NVME 960GB
 - IB HDR 200 + 2x25GbE
- Network
 - Mellanox Quantum QM8700
 - 40x HDR 200 per switch
 - DellEMC S5248F
 - 48x10/25 GbE + 4x100 GbE + 2x200 GbE





INCD-D @ UC in Coimbra upgrade

- Tape storage
 - IBM TS4300
 - 8x LTO-9 fibre channel tape drives
 - 18 TB raw capacity per cartridge
 - Up to 20 Petabytes raw storage
- Disk storage capacity
 - 640 TB raw storage
 - 2x Lenovo SR655 + D1212
 - Dual Xeon Silver 4210R
 - 128 BG RAM
 - 480 GB SSD
 - 320 TB HDD
 - 2x25 GbE
 - 2x Fibre channel HBA
- Network
 - DellEMC S5248F
 - 48x10/25 GbE + 4x100 GbE + 2x200 GbE





Computing capacity now in 2023

CPUs	Network	COREs	Centre
Intel/AMD - 8 cores	Ethernet	4056	Lisbon
haswell - 16 cores	Infiniband	4960	Riba de Ave
haswell - 16 cores	Ethernet	1120	Lisbon
haswell - 24 cores	Ethernet	1008	Lisbon
Epyc 1 - 64 cores	Infiniband	2112	Lisbon
Epyc 2 - 96 cores	Infiniband	384	Lisbon
Epyc 3 (NEW) - 96 cores	Infiniband	1920	Lisbon
Epyc 3 (NEW) - 96 cores	Infiniband	4992	UTAD
Total		11536	

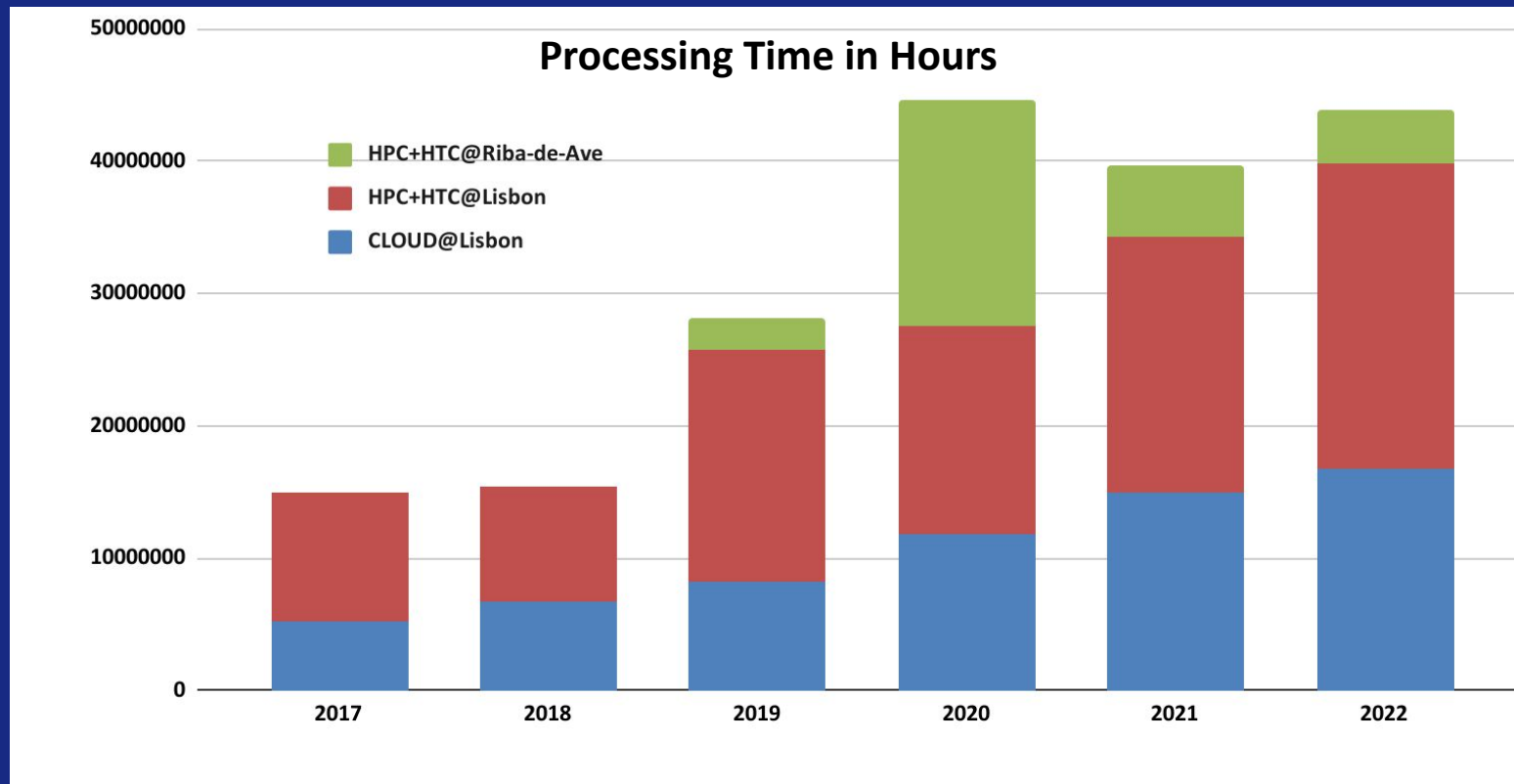


Storage capacity now in 2023

Storage type	Network	Raw capacity	Centre
Lustre	Ethernet	1728 TB	Lisbon
Lustre (OLD)	Ethernet	4032 TB	Lisbon
Lustre (NEW)	Infiniband	1920 TB	Lisbon
Ceph	Ethernet	1392 TB	Lisbon
Lustre	Ethernet	384 TB	Riba de Ave
Lustre (FCCN)	Infiniband	440 TB	Riba de Ave
Lustre (NEW)	Infiniband	960 TB	UTAD
Ceph (NEW)	Ethernet	2880 TB	UTAD
Tape	Ethernet/FC	20160 TB	Coimbra



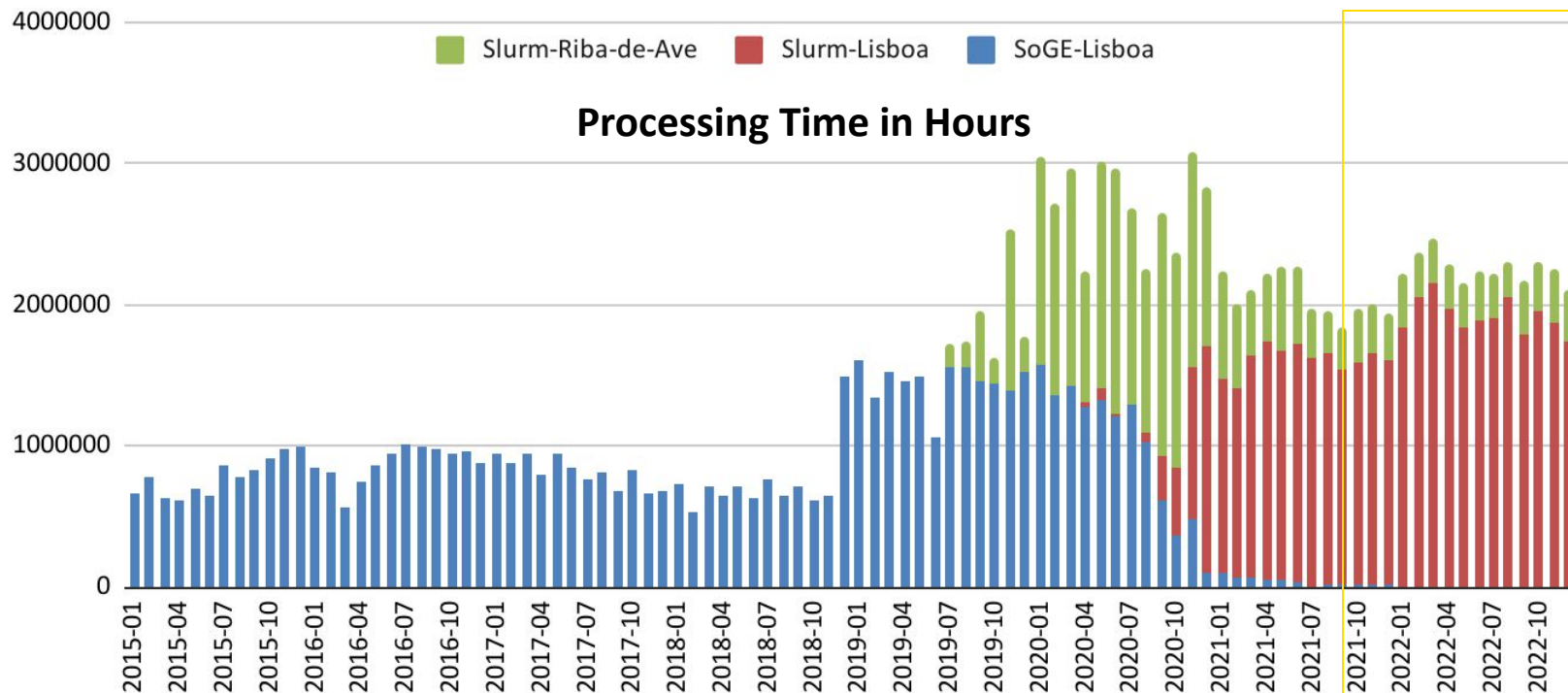
Overall usage



Total usage in 2022 over 43.854.000 hours



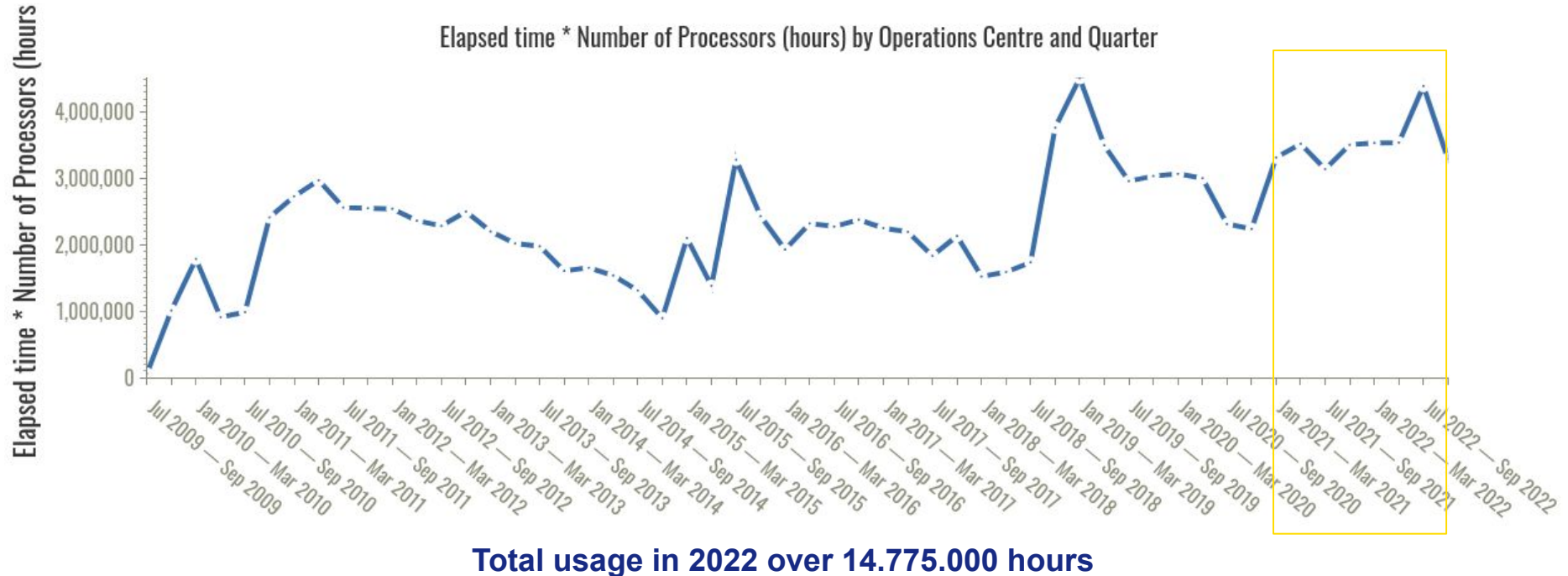
Batch clusters usage both HTC and HPC



Total usage in 2022 over 27.061.000 hours

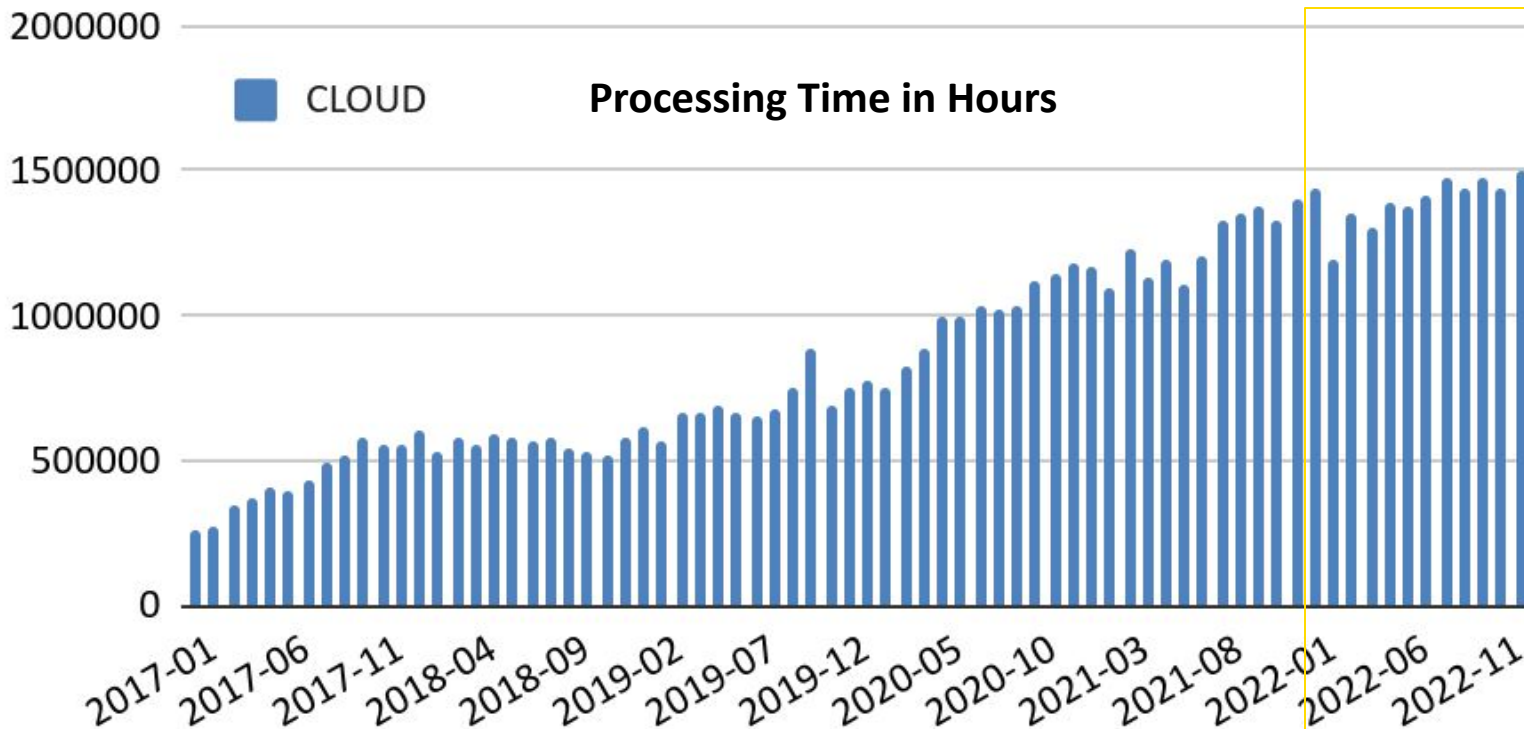


Federated computing usage (grid)





Cloud usage



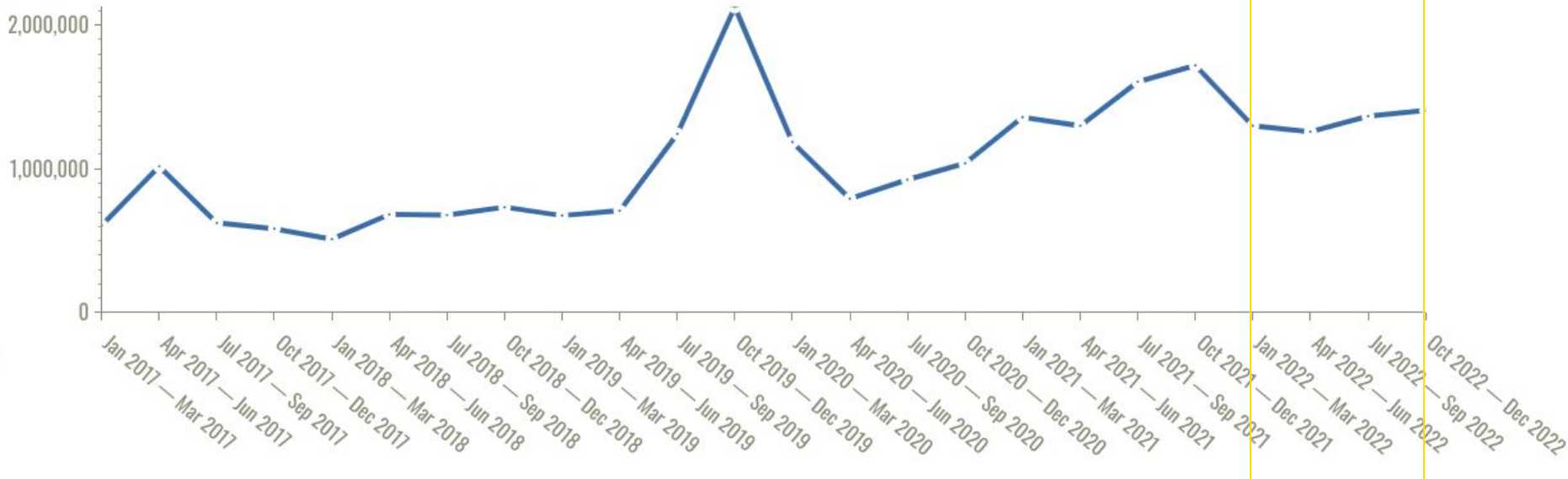
Total usage in 2022 over 16.793.000 hours



Federated cloud usage

Elapsed time * Number of Processors (hours)

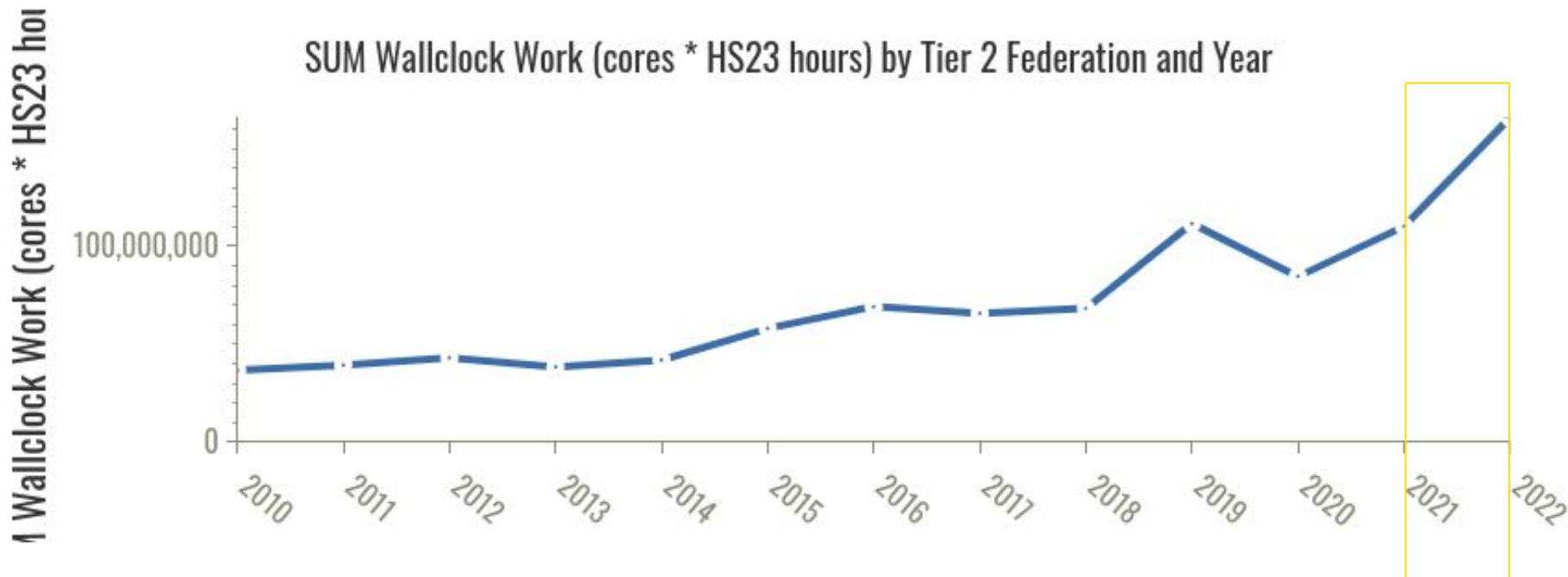
Elapsed time * Number of Processors (hours) by Resource Centre and Quarter



2022 total usage 5,328,000 hours



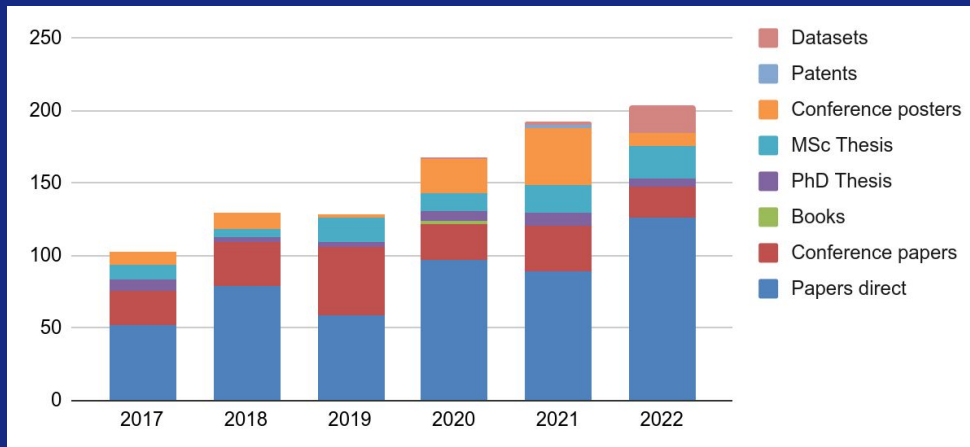
CERN / WLCG - Portuguese Tier-2



2022 total usage: 471,068 jobs, 165,631,874 HS23 wallclock hours (52.5% CMS / 47.5% ATLAS)



Results

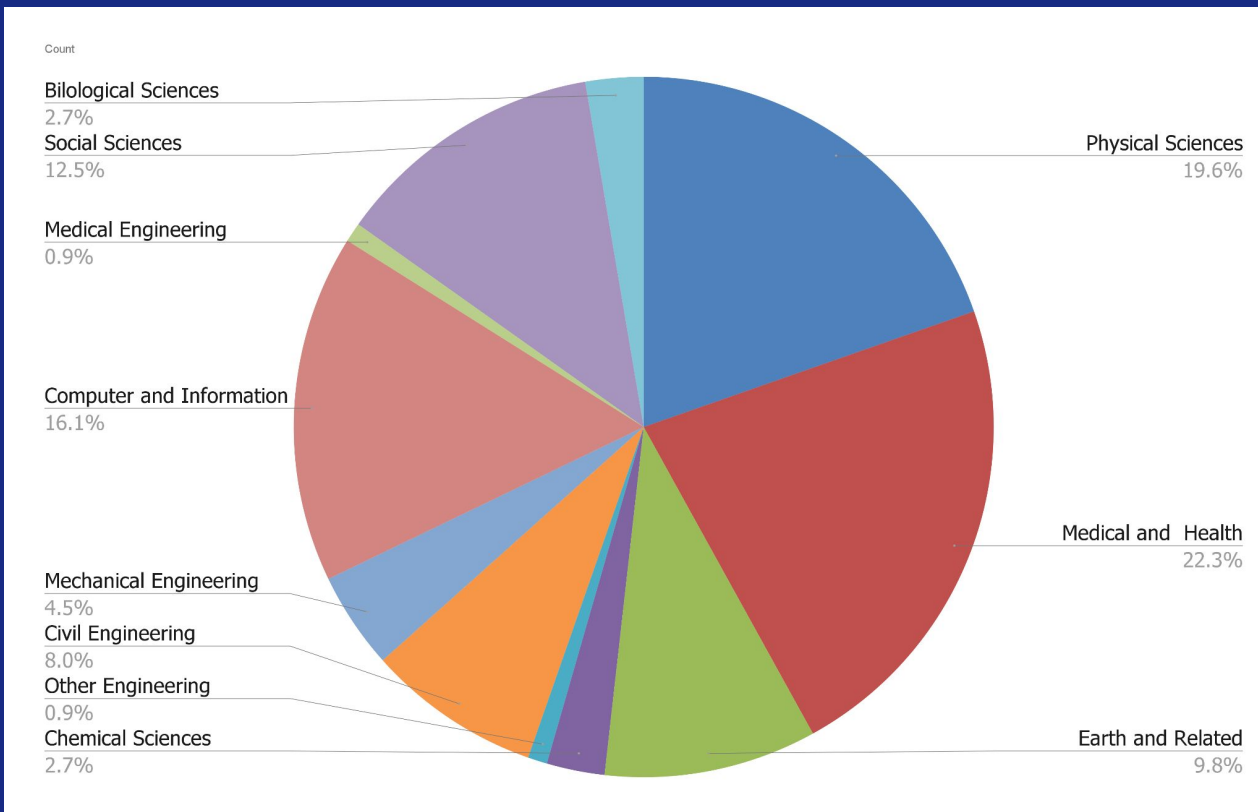


	2017	2018	2019	2020	2021	2022	Total
Papers direct	52	79	59	97	89	126	502
Conference papers	24	30	47	25	32	22	180
Books	0	0	0	2	0	0	2
PhD Thesis	8	4	3	7	9	5	36
MSc Thesis	10	5	17	12	19	23	86
Conference posters	9	12	2	24	39	8	94
Patents					2	1	3
Datasets				1	2	19	22
Total	103	130	128	168	192	204	925



Projects per area

Year	Projects
2017	61
2018	57
2019	65
2020	122
2021	123
2022	114
Total	634

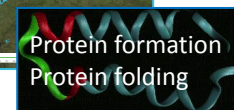
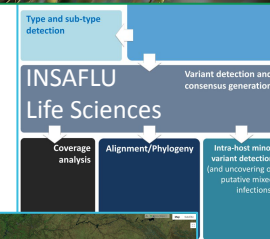
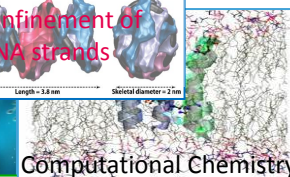
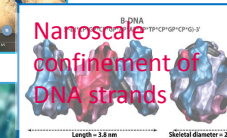
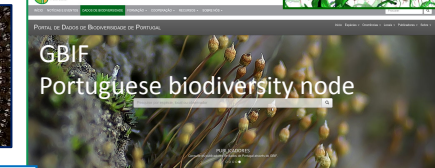
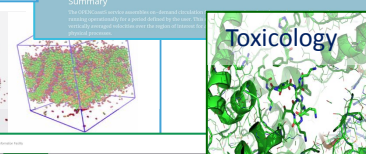
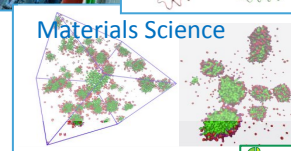
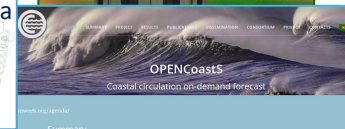
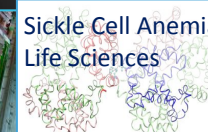
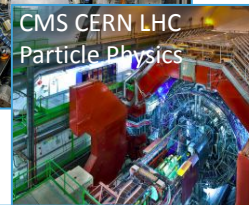
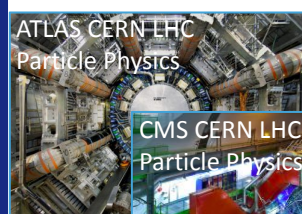


114 supported projects in 2022 split per research area



Biomolecular SIMulations Research Group (BioSIM) / UCIBIO
Business Research Unit (BRU) / ISCTE
Concepção e Desenvolvimento de Sistemas de Informação (CDSI) / ISCTE
Centro de Estudos de Doenças Crónicas (CEDOC) / UNL
Centro de Engenharia e Tecnologia Naval e Oceânica (CENTEC) / U.Lisboa
Centro de Ecologia Evolução e Alterações Ambientais (CE3c) / U.Lisboa
Centro de Ecologia Funcional (CEF) / U.C
Centro de Física do Porto (CFP)
Centro de Investigação em Biomedicina (CBMR) / UALG
Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR) / U.Porto
Fundação Champalimaud
Instituto de Biosistemas e Ciências Integrativas (BioISI) / U.Lisboa
Centro de Neurociências e Biologia Celular (CNBC) / U.Coimbra
Departamento de Informática / FCUL / U.Lisboa
Departamento de Informática / FCT-UNL
Departamento de Engenharia Civil / U.Aveiro
Departamento de Física / IST / U.Lisboa
Departamento de Física / FCUL / U.Lisboa
Departamento de Física / U.Minho
Departamento de Engenharia Informática / U.Coimbra
Departamento de Informática / U.Porto
Departamento de Química / U.Aveiro
Faculdade de Ciências Sociais e Humanas / UNL
Faculdade de Letras / U.Porto
Faculdade de Medicina / U.Lisboa
Fundação para a Ciência e a Tecnologia - Unidade FCCN (FCT-FCCN)
Nova School of Science and Technology (FCT/UNL)
Institute for Bioengineering and Biosciences (IBB) / U.Lisboa
Instituto de Biologia Experimental e Tecnológica (IBET/ITQB)
Instituto de Geografia e Ordenamento do Território (IGOT) / U.Lisboa
Instituto de Ciência e Inovação em Engenharia (INEGI)
Instituto de Engenharia de Sistemas e Computadores - Investigação e Desenvolvimento (INESC-ID)
Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA)
Instituto de Ciências Sociais da Universidade de Lisboa (ICS) / U.Lisboa
Instituto de Saúde Ambiental (ISAMB) / U.Lisboa
Instituto Tecnológico e Nuclear (ITN) / U.Lisboa
Instituto de Plasmas e Fusão Nuclear (IPFN) / U.Lisboa
Instituto Superior de Agronomia (ISA)
Instituto Superior de Engenharia de Coimbra (ISEC)
Instituto Superior de Engenharia de Lisboa (ISEL)
Instituto Universitário de Ciências Psicológicas, Sociais e da Vida (ISPA)
Júnior Empresas do Instituto Superior Técnico (JUNITEC)
Computer Science and Engineering Research Centre (LASIGE) / U.Lisboa
Laboratório de Instrumentação e Física Experimental de Partículas (LIP)
Laboratório Nacional de Engenharia Civil (LNEC)
Nova School of Business and Economics (Nova SBE) / UNL
Rede de Química e Tecnologia (REQUIMTE) / UCIBIO
Sociedade Portuguesa de Botânica (SPBOTANICA)
Universidade Aberta (U.Aberta)
Applied Molecular Biosciences Unit / UCIBIO
Portuguese node of the Global Biodiversity Network (GBIF)
Portuguese Coastal Monitoring Network (CoastNET)
Portuguese Biological Data Network (BIODATA.PT)

Users
from 53
units and
entities
in 2022





EOSC-Future call for commercial cloud distribution



Call for **Digital service aggregators** (e.g. non-profit entities, NRENs, RIs and e-Infrastructures, HPC centres)

+

OCRE cloud service providers in the same region collaborating on dynamic and creative proposals.

Proposals had to demonstrate a **concrete approach to distributing state-of-the-art digital services** (e.g. compute, storage, machine learning, analytics, AI) **via the European Open Science Cloud.**

The award:

1. **up to €500 000** in pre-procured IaaS/PaaS/SaaS from the OCRE cloud provider
2. The call was part of a €4.8M adoption funding programme supported by the EU, through the EOSC Future project (the 1st call distributed €2M)



As digital service aggregator

+



Google Cloud

+

 **SPARKLE**



Public-cloud / Private-cloud partnership ...



Google Cloud

Additional Capacity and Capabilities

Peaks of usage
Specific services
Specific hardware
Resilience



Base Capacity and Capabilities

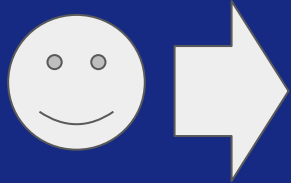
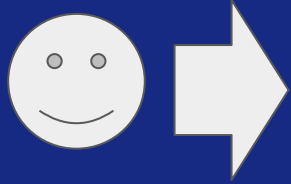
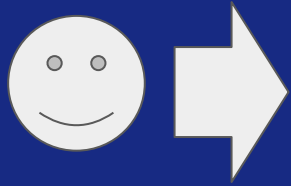
Safe harbour
Sustained usage
Low cost
User support

Research and academic community

Use INCD cloud
Burst into GCP
Avoid lock-in
Minimise costs



Shielding from vendor lock-in



INCD
Kubernetes



Platforms at INCD
SQLaaS
Thematic Services

INCD
Farm



Virtual Machines
Instantiated by INCD
IM



Google
Kubernetes
Engine



Google Cloud



Google
Compute
Engine

<https://www.incd.pt>



helpdesk@incd.pt

Thank you

Cofinanciado por:

