CLPU

CENTRO DE LÁSERES PULSADOS

2025 – 2028

STRATEGIC PLAN

Centro de Láseres Pulsados

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Compliance with the Strategic Plan 2021-2024

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One of the top challenges for the CLPU is having to run and maintain at the best performance a scientific and technological infrastructure including one of the most advanced laser systems in the world with its experimental capabilities but also to continuously keep up with possible upgrades and updates to remain at the forefront of research within the scientific community. In addition, the complexity of certain goals, joint with resources' constraints (both material and human) proper of a public institution, and the global political realm/framework have inevitably hindered the completion of all objectives. However, these issues have not precluded CLPU from making an outstanding effort and reaching very significant milestones.

Detailed annual plans with intended objectives were created from the Strategic Plan for 2021-2024 and monitored by the Executive Commission annually using assessment indicators. CLPU has successfully completed the evaluation process in all instances.

The implemented Strategic Plan 2021-2024 addressed the scientific strategy recommended by the Scientific and Technological Advisory Committee (STAC) including objectives and general actions, moreover advancing on the path to develop the main suggestions:

- The Center should be continued and its capabilities enlarged: On the short term, sufficient resources for personnel and equipment; on the long term, additional target areas.
- Radiation protection provisions that allow to work on several experiments in parallel should be made.
- The cooperation with the university should strongly be intensified, in particular with the University of Salamanca. Both, CLPU and the University, would strongly profit from a close interaction.

The key milestones achieved between 2021 and 2024 are briefly summarized below, organized according to the four strategic pillars that form the foundation of the CLPU strategy:

Strengthening & expanding the user facility infrastructure	Offer the scientific community competitive access to state-of-the-art scientific and technological equipment, expanding experimental functionalities within an innovative working environment that allows maximizing its use and an efficient performance of user teams. • Maintaining a distinctive & reliable laser system that users can trust • Upgrade of the VEGA laser system by 2025 • New HRR tools for user campaign operations • Permanent beam lines for improved efficiency • Bridge to Europe and beyond • Towards a distributed ICTS • Data and control

- Publication of the Third Call for Competitive Access to VEGA laser system, externally co-funded for the first time
- Beginning of AREX2 construction and tender for the related scientific equipment
- Reorganization of VEGA beamlines:
  - Installation of the first stage of the uncompressed VEGA-3 transport line to the experimental area
  - Delay line prototype to synchronize VEGA-2 and VEGA-3 in picosecond range and start femtosecond synchronization phase
  - Implementation of VEGA-1 beam transport line to the experimental area
  - CEP laser system oscillator pumping optimization and synchronization with VEGA as a probe
  - Setup of spatio-spectral characterization devices for improving VEGA peak performances
- Development of the oscillator and VEGA front-end pump lasers remote starting prototype
- Commissioning of a laser-driven neutron source, achieved through the interaction of laser-accelerated protons

with a converter, has been successfully carried out. CLPU has developed and implemented this cutting-edge technology within their specialized bunker, designed to safely accommodate the high-energy interactions involved.

- Establishment of a Radio Protection Service, as well as the Health and Safety Commission
- Commissioning of the remote shot system in the control room of the target area
- Creation of online users linked to the VEGA database to facilitate its remote evaluation and analysis by users.
- Development of a high-density high repetition-rate targets
- Design and implementation of an online temporal laser metrology in the target area.
- Reorganization of the complementary laboratories in the M5 building: SEM microscopy, ULAMP and LITeL supporting the VEGA laboratory
- Development of RStudio based tools for intelligent uploading of stored data and for trend searching and analysis.
- Design, implementation of innovative diagnostic tools to characterize heavy proton/ion beams at different angles with the purpose of performing spatial, quality measurements of the particle beams.
- Installation of a high-pressure gas compressor for near-critical interaction experiments in the target area.
- Electromagnetic pulse study and management, Faraday cage environment to prevent high-frequency interferences & damage in measurement instruments
- Extension of the vacuum systems and development and set-up of the rough pump automatic control valve.
- Experimental campaigns: Competitive Access (10); Restricted Competitive Access (2 - RADNEXT Project); Strategic External Access (2) and Strategic Internal Access (12).
- Participation in European projects to promote research and innovation through access to the infrastructure: RADNEXT, Remade@ARI, Laserlab Europe IV, Laserlab Europe V, Laser4Europe and RIANA.
- Development of devices and methods for high repetition rate operations (targets, electromagnetic pulse management, control system routines, diagnostics, laser development)
- Preparation of the Fourth Call for Competitive Access to VEGA laser system.

Research & training to reinforce the user facility

Research and training to reinforce the user facility. Foster excellent science through research, generating knowledge that increases scientific and technological capacities for the development, attraction and retention of talent.

- Strengthening of a research unit
- Towards new research applications
- Scientific & innovative talent attraction & retention
- High level training

- Renewal of the JCyL UIC 167
- Participation in the Excellence Unit LUMES of the University of Salamanca
- Throughout years 2021 to 2024, CLPU has participated in 9 research projects:
  - European (4): Pathways to energy from inertial fusion (IAEA); Integrated management and reliable operation for used-based laser scientific excellence (IMPULSE - H2020); European Plasma Research Accelerator with excellence in applications (EuPRAXIA - H2020), and Plasma Accelerator Systems for compact research infrastructure (PACRI -HE)
  - National (4): Europa Investigación (MCI); Targets in ultra-intense laser interaction, particle production and applications (TULIPÁN - MCIN); New approaches for pulsed extreme lasers (NAPLE - MCI); Advanced particle and plasma experiments (APPLE - MCI).
  - Regional (1): Transporte y manipulación de partículas en aceleradores láser: nuevos escenarios en radioterapia FLASH (TYMPAL - JCyL)
- Scientific Division staff increased by 100 per cent (2021-2024)
- Publication of 53 papers and participation with almost 90 works (posters, oral contributions, and invited talks) in different international events. The papers included in Q1 & Q2 for the strategic plan analyzed are 56,60%.
- 50% of the strategic internal experimental campaigns have been run with VEGA laser system in the framework of internal research projects.

- Organization of 7 specialized international events: ECPD2021 (300 participants); EPS Satellite Meeting 2021; I Iberian ELI-ERIC Information Day (2021); Laserlab Europe User Meeting (2021); II Iberian ELI-ERIC Information Day (2022), NEILS 2023 and 50th EPS Conference on Plasma Physics (2024 more than 700 participants).
- Organization of 3 specialized summer schools in Plasma Physics (LaPlaSS2021, LaPlaSS2022 and LaPlaSS2023) with participation of more than 300 students form Spain, Europe and abroad. Lessons imparted by International recognized professors with local CLPU researcher staff involved. Strong focus on practical sessions in the VEGA laboratory during the in-person events.
- Specialized training course in laser plasma accelerators and radiological protection in laser facilities for the CSN) personnel
- Collaboration in different master programs of the University of Salamanca: “Máster Universitario en Modelización Matemática” & “Máster Universitario en Física y Tecnología de los Láseres”.
- Tutoring of internships of students from different Universities, as well as of Final Degree Projects and Master Projects

Knowledge & technology transfer	Actively participate in innovative ecosystems both geographical and sectoral, pointing out the value of the transfer of knowledge and the experience acquired in the field of intense lasers to improve the technological innovation of the industrial sector. • Spanish laser applications ecosystem • Innovation in strategic sectors • Preparation of demonstrative laboratories • Artificial Intelligence and big data as a global emerging technology • Radiation protection

- Promotion of a strategic network in lasers (Laserlab Spain proposal)
- Inclusion of the Center in the Spanish industrial capabilities for big science facilities catalogue (by CDTI)
- Participation in clusters and associations of different fields to improve knowledge transfer: ‘Ineustar’- Asociación española de la Industria de la Ciencia, ‘Fotónica 21’, ‘Enterprise Europe Network’, ‘Sociedad española de Óptica’, ‘Real Sociedad Española de Física’, ‘Sociedad Española de Astronomía’, ‘Plataforma de Protección Radiológica and Cluster de Defensa’.
- Organization of 3 industry events: ‘Fusiona2’ (2021), CentraTec ‘Tecnología láser para la transformación digital’ (2023) and ‘Spain4 Fusion’ (2023); and participation in several editions of the ‘Research and Innovation round table’ of the Regional day: ‘White Book for the development of Salamanca’
- Participation in all the editions of the ‘Jornada CDTI. Industria de la Ciencia - ICTS’
- Strategic position on the defense sector through a National project (‘Sistema Guiado de Láser Pulsado de Alta Potencia para Ámbito Militar’ SIGILAR), RDI contracts (with the Spanish joint venture INDRA-ESCRIBANO and AIRBUS) and projects funded by the EDF funds, such as Laser Ceramics (LACE) and Optical Military Secure Communications (OPTIMAS).
- Besides the Defense and Space fields, the infrastructure has also participated in 3 National projects of transfer and innovation, within the Healthcare and Industrial (materials, detection, …) sector fields:
  - Hybrid prototype based on laser boost of a Linac to obtain an ultrahigh high dose rate in radiotherapy (Hybrilin – MCIN)
  - ‘Development and testing of new systems based on CMOS technology’ (...) (CSN)
  - ‘Development and optimization of the VEGA experimental lines’ (DOLEV - MCI)
- Expansion of the LITeL lab capabilities with acquisition of new scientific equipment
- Collaborative work with the computer science and automation department of the University of Salamanca for the development and commissioning of an intelligent beam pointing control system for uncompressed PW- line

- Proof of concept TCUE project ‘Sincrobeams’ together with TIDOP research group at USAL to develop a high frequency multiple beams stabilizing control system.

Generation of public information & outreach	Promote the dissemination of knowledge and open science, fostering the spread of research and innovation into society through new models of governance based on transparency, ethics, integrity and equality. • Enhance the visibility of CLPU • Increase the society scientific culture • Generate and apply new models of governance

- Development of 3 outreach projects in the framework of the Spanish Scientific Culture Call of FECYT: ‘Luciérnagas’(2021-2022), ‘Teia’ (2022-2023) and ‘UCC’ (2023-2024)
- Participation in the Scientific Week of Castilla y León with several activities, Ciclo de la Luz (2021), Café Con Ciencia (2022), II Ciclo de la Luz (2023) and Outreach talk ‘Radiados por ser terrícolas’ (2023).
- Obtention of the distinction ‘Unidad de Cultura Científica e Innovación (UCC+i)’ given by FECYT in 2022
- Approval of a new financing plan (2022-2028) for the operating costs of CLPU, increasing the contribution of each member of the Consortium by 30 per cent
- Implementation of the remaining funds to the Investment Plan (2022-2028)
- Implementation of the CLPU Equity Plan
- Creation of a new webspace in the CLPU website related to the Transparency Policy and Good Governance aspects
- Achievement of the ENS core category certification for information technology systems management
- Publication of Antifraud Planning and implementation of CLPU complaint online channel.
- Participation in the evaluation of the Transparency Commissioner of Castilla y León and audits from the CTBG Council
- Implementation of new electronic administration systems: employment portal, evaluation of human resources performance, management of training plan, ...
- Management of Next Generation Funds through electronic tools (CoFFEE, MINERVA)

Mission and Vision 2

Mission

CLPU is the Spanish facility at the forefront in the field of ultra-intense ultra-short pulsed lasers and their potential applications, which addresses the demand of the scientific, technological and industrial community to develop frontier research and projects, through an open policy of competitive access.

Likewise, as an execution agent of the Spanish science, technology and innovation system, CLPU acts also as a research entity that develops projects that increase the knowledge and experience of scientists and to promote the continuous improvement of infrastructure. Besides, the in-house scientific expertise guarantees a cutting-edge top-quality service, working side by side with national and international users, fostering the achievement of inner-driven scientific and technological goals.

Vision

Directing the future of the CLPU towards a resilient infrastructure able to develop key expertise, to successfully address immediate challenges such as scientific and technological excellence, digital transformation, internationalization and sustainable development. In particular CLPU vision will be directed to:

- **Serve** the national and international user community
- **Establish/consolidate** a national expertise and **advance** in the physics of intense laser matter interaction
- **Drive** technological development in Spain related to high power, ultra-short and high- repetition rate lasers
- **Connect** research centers and laboratories in Spain, in Europe and abroad.
- **Spread** the knowledge and the results of laser physics at all the Spanish society levels
- **Promote and foster** the Internationalization of CLPU by strengthening the relations and collaborations with the relevant European Infrastructures.

SWOT Analysis

The CLPU has assessed the main positive (Strengths) and negative (Weaknesses) aspects related to its internal organization, so to drive possible action lines aimed to strengthen the good points and eliminate the bad ones or minimize their effects.

Besides, the center has analyzed the external environment and identified the factors that are likely to help (Opportunities) and hinder (Threats) its growth. Though many of those elements are independent and not influenced by the actions carried out by the Center, yet they are taken into account to design the best strategies that allow to take advantage of them or to mitigate their impact.

Strengths

- Infrastructure in the top operative PW-class laser facilities with high repetition rate
- Spanish leadership in ultraintense laser science and technology
- High level of satisfaction and recognition from national and international users' community
- Highly qualified and specialized personnel for the operation of the facility
- Stable permanence in the ICTS map as a single-site facility
- Internationally relevant placement through the involvement in strategic European netwoks and projects (i.e LASERLAB-Europe, ELI, CERN-Radnext, EuPraxia…)
- Reference facility for Lasers applied to dual-use technology in the national landscape, while strengthening its international role through involvement in key projects, committees and study groups
- Spanish leadership in pulsed neutron sources generation and laser radiological protection

Weaknesses

- Lack of an outlook for medium and long-term stable investment funds
- Scientific and technological staff out of the national regulatory framework for research personnel
- Working framework not attractive for specialized professional careers
- Restrictions on staff recruitment, careers build up and difficulties in attraction & retention of talent
- Lack of a well-established internationally relevant roadmap for the center
- Central government administrative burdens over-dimensioned and inefficient for small facilities
- Risk of technological obsolescence of the infrastructure
- Lack of dedicated funding to upgrade VEGA laser system as state-of-the-art facility at world level
- Shortage of technological developments
- Lack of competitive-access experimental campaigns during the implementation of the AREX2 project (construction of the new target area and re-organization of the new lines of VEGA)

Opportunities

- High demand as transversal technology, especially in Lasers applied to defense, space and biomedical sectors
- Capability of simultaneous experimental campaigns
- Possibility for Spain to have an advanced player in a rapidly growing scenario of Laser strategic infrastructures in EU (i.e., EuPraxia, XFEL, ELI)
- Possible topical competitive access calls to open to new communities
- Cooperation and bridge towards new large international laser facilities
- Traditional and plasma accelerator technology used and combined with lasers
- Experience and capacity of coordination for the Spanish Laser community
- Reference player in higher education training on high intensity lasers and related plasma physics
- National reference point for Spanish involvement in laser fusion science and technology

Threats

- Increase of new large-scale laser facilities operating in Europe, US and Asia with ambitious plans and resources
- Insufficient external financing mechanisms for competitive access
- Excessive dependence on non-national and sometimes unique suppliers
- Better job conditions in other international facilities, national public institutions and private companies
- Legal difficulties for CLPU staff to access the professional career
- Drain of high specialized talent
- Absence of Spanish representation in European infrastructures related to laser technology and topics of interest to the Center
- Risks on information security, operational continuity and reputation due to potential cyberattacks
- Excessive and continuous legislative changes and bureaucracy
- Lack of representation in the core national institutional bodies that establish the roadmap of strategic topics for research, funding etc.

Objectives 4

The rationale behind the CLPU according to its Statutes must be taken into account as a general framework when facing with the task of setting out the goals of the Center for the next four years.

Accordingly, special attention is taken to the STAC suggestions when setting objectives and strategies, as, -through its periodic valuable reports and the priceless expertise of its members-, bolsters the Center, by addressing the main CLPU shortcomings, but also suggesting opportunities, chances and future actions to enhance the quality and scope of the services offered to the community.

Given such general framework, the CLPU will face and follow the priorities established by the national and European guidelines to enhance and strengthen the R+D+I system. More in detail, the Spanish Science, Technology and Innovation Strategy 2021-2027, the National Scientific and Technical Research and Innovation Plan 2024-2027, Horizon Europe (the research and innovation framework program running from 2021-2027) and the European Regional Development Fund 2021-2027 will be taken into account.

Besides, having the Community of Castilla y León as one of the shareholders of the Consortium, the strategic lines and execution priorities contained in the Regional Research and Innovation Strategy for an Intelligent Specialization (RIS3) come into play.

4.1 Objectives Description

Recognizing the pivotal strategic role of R&D infrastructures in fostering smart, sustainable, and inclusive growth, along with the core attributes of CLPU, the Center has identified the following key goals for the next four-year cycle:

OBJECTIVE 1 || EXPAND THE CLPU INFRASTRUCTURE

Reach the best setting for the joint asset of the laser system and technological equipment surrounding it. Expand the functionalities of the infrastructure within an innovative work environment that allows maximizing its use and the efficient performance of user teams.

OBJECTIVE 2 || FOSTER RESEARCH AND TRAINING PROGRAMS TO PROMOTE EXCELLENT SCIENCE

Advancing technology and generating knowledge to enhance scientific and technological capacities, fostering the development, attraction, and retention of talent.

OBJECTIVE 3 || FACILITATE KNOWLEDGE GENERATION & TECHNOLOGY TRANSFER TO THE INDUSTRIAL SECTOR

Actively engage in innovative ecosystems, both geographical and sectoral, emphasizing the value of knowledge transfer and expertise in intense lasers to enhance technological innovation within the connected industrial sector

OBJECTIVE 4 || ENHANCE SOCIAL RESPONSIBILITY AND KNOWLEDGE-TRANSFER TO SOCIETY

Crafting and using tools based on digital transformation and automation aimed to make society aware and informed of the use of public funds and the implementation of the principles of transparency, ethics, integrity and equality, moreover enabling the dissemination of the scientific and technological achievements of the Center

4.2 Strategies and forseen actions

The strategies linked to each objective and the actions planned for their implementation are reported here:

O1 OBJECTIVE || EXPAND THE CLPU INFRASTRUCTURE

The rapidly evolving global landscape of high-power laser infrastructures makes it essential to reinforce performances, reliability and functionality of the VEGA system with an orientation towards the uniqueness and specialization of CLPU, mainly in the context of the existing high repetition rate PW-class lasers.

In this context, the construction of a new experimental area is planned as an annex to the existing facility. Once completed, CLPU will be equipped to operate two experimental areas simultaneously, accommodating different experiments.

O1.S1. STRATEGY || Construction & equipment of a new experimental area

The successful execution of the new experimental area's construction is critical for the Laser infrastructure, having to strive to minimize downtime for the experimental activities. Likewise, the effective implementation of the new scientific equipment devoted to pave the way for simultaneous operations of the VEGA laser system will have to be designed and followed with extreme care. Furthermore, integrating, updating, and enhancing the facility's essential systems, such as electrical, vacuum, and shielding, is crucial to ensuring the system's optimal performance for the new expanded scenario.This strategy must be developed through a series of actions that guarantee compliance with the technical requirements of both construction and equipment and, most importantly, its completion within the established deadlines.

GENERAL ACTIONS	START	END
O1.S1.A1 Improve efficiency/stability performances of the building ancillary systems	2025	2028
O1.S1.A2 Preparation of ancillary systems and personnel to new operation modes	2025	2028

O1.S2. STRATEGY || Keep VEGA laer unique and reliable

Simultaneous use of VEGA beamlines requires upgrading the system to ensure stable operations in experimental areas. All these developments will benefit the overall facility's performances. Strong advancements will be opened with the implementation of the AREX2 new experimental site. In addition, high investment, long term activities will be initiated with a primary focus on establishing a clear strategic plan to operate VEGA at its HRR along with the assessment of necessary upgrades for amplifiers and pump lasers.

GENERAL ACTIONS	START	END
O1.S2.A1 Development and implementation of new laser capabilities	2025	2028
O1.S2.A2 Improvement of performances and new operation modes	2025	2028

O1.S3. STRATEGY || Establish an ultra-high-intensity station for extreme physics

The opportunity that arises with AREX2 new experimental site will be used to enhance CLPU capabilities within ultra-high Intensity laser physics activities reaching the frontier of 1021-22 W/cm2. This new limit will pave the way in the long-term scenario to advance in laser acceleration schemes as well as going towards the establishment of a dedicated line for high brightness neutron sources generated by photo-nuclear reactions or by laser driven ion spallation.

GENERAL ACTIONS	START	END
O1.S3.A1 Beamlines and experiments' design and implementation	2025	2028
O1.S3.A5 Matching with scientific community (scientific case, user meeting)	2025	2028

O1.S4. STRATEGY || X-ray betatron source & THz source.

Implement and optimize a betatron source driven by using VEGA-2 or VEGA-3 in long focal configuration, possibly with guiding structures and extended accelerating lengths for applications in advanced imaging techniques such as the Phase Contrast Imaging. The final aim is to offer a stable user station that would serve an expanding user community interested in material science, biomedical applications, plasma diagnostics. Such a betatron source will be unique in Spain. Moreover, VEGA-1 can be used to generate a set of useful probes, such as pulsed THz beams to make studies related to material science, particle acceleration and others.

GENERAL ACTIONS	START	END
O1.S4.A1 Beamlines and experiments' design and implementation	2025	2028
O1.S4.A2 Matching with scientific community (scientific case, user meeting)	2025	2028

O1.S5. STRATEGY || Consolidate secondary sources beamlines for applications

The existing experimental area has been continuously modified in the last four years in order to keep up with the diverse set of experimental proposals carried out. This class of activities will continue in the forthcoming years, though, as recognized in the former STAC report, the establishment of dedicated lines providing ions, electrons and x-rays would greatly streamline and improve the operations, optimizing the number of campaigns with respect to the dedication effort. Such permanent beamlines would be dedicated to applications in material science and biomedical studies as well as to enhance local user community connected to these activities. The upgrade of the experimental area with the new bunker would be a strong asset towards the new scenario of multiple working areas and beamlines.

GENERAL ACTIONS	START	END
O1.S5.A1 Beamlines and experiments' design and implementation	2025	2028
O1.S5.A2 Matching with scientific community (scientific case, user meeting)	2025	2028

O1.S6. STRATEGY || Establishing plasma station for High Energy Density Physics

Implementation of multi-beam stations connecting the VEGA-2 and uncompressed VEGA-3 beamlines synchronized with picosecond resolution. The new station will combine the 200 TW at 30 fs pulse duration with the uncompressed ns long laser and will be devoted to fundamental physics experiments in the field of laboratory astrophysics, high energy density physics and warm dense matter. The final goal is to offer the station to the growing European laser plasma user community. In a parallel action, a preliminary study aimed to assess the path for a possible dedicated R&D program aimed to implement a new class of laser devoted to the exploitation of such topics (HEDP etc.) and potentially scalable towards the high energy frontier. Such an action line would be implemented upon allocation of needed resources by the funding agencies.

GENERAL ACTIONS	START	END
O1.S6.A1 Beamlines and experiments' design and implementation	2025	2028
O1.S6.A2 Matching with scientific community (scientific case, user meeting)	2025	2028

O1.S7. STRATEGY || Bridge to Europe and beyond

Consolidate CLPU connections at the international level (European and extra-European) by establishing/reinforcing active collaborations with relevant European infrastructures in order to maintain the CLPU infrastructure at the most advanced level of scientific and technological expertise in the relevant fields crucial for the reference community.

GENERAL ACTIONS	START	END
O1.S7.A1 Promote collaboration with European and international facilities and scientific groups	2025	2028
O1.S7.A2 Promote connections with private enterprises to foster Public-Private-Partnership	2025	2028

O1.S8. STRATEGY || The CLPU as a connection hub for Spanish laboratories.

In agreement with a recent proposal aimed to implement a strategic network, the CLPU is coordinating the Spanish laboratories related with laser activities in order to take advantage of closer collaboration strategies and streamlining possible bureaucracy so to share resources, advance in the crossed training of specialized personnel and for the access to ESFRI-class European facilities.

GENERAL ACTIONS	START	END
O1.S8.A1 Coordinate the Spanish access to ESFRI-class facilities	2025	2028
O1.S8.A2 Promote access to CLPU infrastructure for the Spanish scientific community.	2025	2028

O1.S9. STRATEGY || Data & control

Implementation of strategies to ensure the control of scientific and technical devices and the proper acquisition of data generated during the operation of the VEGA laser system, with a special focus on high repetition mode. Access to the experimental data is extremely important for a user facility and after some embargo period, data will be made available to the scientific community, according to a Data Management Plan (i.e., DMP) to be assessed and approved.

GENERAL ACTIONS	START	END
O1.S9.A1 Build an integrated environment for experiment control and data management	2025	2028
O1.S9.A2 Implement an Open Data framework	2025	2028

O1.S10. STRATEGY || Health & Safety

Creating a robust health and safety strategy for the facility in order to ensure the well-being of everyone in collaboration with the Committee on Health and Safety at work. This strategy encompasses a variety of essential components, each meticulously designed to minimize risks and foster a healthy and safe environment. Through a systematic approach to risk assessment, health protocols, emergency readiness, user education, the integration of a safety and health culture in all layers of the organization and continuous improvement, the strategy aims to create an environment where safety and health are prioritized and integrated into the daily operations of the facility.The center aims to continuously evaluate the quality of staff training courses on Risk Prevention and Emergency Procedures by involving top experts as instructors and complementing theoretical instruction with practical, hands-on sessions.

GENERAL ACTIONS	START	END
O1.S10.A1 Implement advances in safety/risk management and training	2025	2028

O1.S11. STRATEGY || Enhancing Radiological Protection & Regulatory Framework

The goal is to maintain CLPU position as Spain's leading center in radiological protection for infrared laser laboratories, supporting the Spanish Nuclear Safety Council (CSN) in accrediting future laser accelerators. Establishing a new licensing category for CSN operators and supervisors tailored to laser radioactive facilities marks a significant advancement

in nuclear and radiological safety regulation. This strategy addresses the unique challenges of high-powered laser facilities, requiring specialized training programs to equip personnel with the necessary skills and knowledge for safe operation in these complex environments.

GENERAL ACTIONS	START	END
O1.S11.A1 Collaboration with key research institutions, regulatory bodies, to promote best practices and update inner organization	2025	2028
O1.S11.A2 Improve training and research for people in charge of radioactive operations	2025	2028

OBJECTIVE 2 || FOSTER RESEARCH AND TRAINING PROGRAMS TO PROMOTE EXCELLENCE SCIENCE

The CLPU team gained experience in the field of fast laser plasma physics and more in general in high intensity laser matter interaction. Such experience is fundamental to promote and deliver the necessary high-level training, especially in the scientific division of CLPU whose main goal is to develop science, research and technological advancements with clear implications for existing user communities or supporting the growth of new emerging user communities.

O2.S1. STRATEGY || Strengthening the Research Unit

Renew and strenghten the “Unidad de Investigación Consolidada 167 (UIC-167) de Castilla y León” to foster and promote excellence and high-level research with the high intensity lasers plasma physics and related applications for the CLPU team. The CLPU researchers, including researchers from other institutions, mainly constitute the core of this unit.

GENERAL ACTIONS	START	END
O2.S1.A1 Connection with international projects, excellence groups and training programs	2025	2028

O2.S2. STRATEGY || Laser driven Fundamental Physics

The establishment of the ultra-high-power station will pave the way for research development in fundamental physical processes such as extreme lasers in high energy particle physics, QED and advanced ion acceleration schemes. CLPU expertise started from recent experimental campaigns with VEGA-3 and will be reinforced by expanding scientific collaborations with external groups.

GENERAL ACTIONS	START	END
O2.S2.A1 Collaborations to develop portfolio of fundamental physics experiments	2025	2028

O2.S3. STRATEGY || Laser-driven Nuclear & Plasma Physics, Material Science

Reinforcement of the CLPU team experience in laser plasma physics through the implementation of experimental activities in collaboration with the CLPU user community and fostering the scientific collaboration and exchange with EU and Extra-EU scientists. The implementation of the ultra-high intensity and laser plasma stations represents a unique experimental environment for developing research in laser plasma physics with possible application in the new growing field of laser fusion. CLPU team expertise will also be reinforced in material science related applications including laser-plasma based implantation techniques and aerospace applications.

GENERAL ACTIONS	START	END
O2.S3.A1 Improve expertise through training, prepare related experimental activities offers	2025	2028

O2.S4. STRATEGY || Advance in laser metrology, targetry & diagnostics

Consolidation and expansion of the high-level expertise of the CLPU team related to high power laser experiments. This includes: 1) physics and technology of target design and implementation for high repetition rate working mode with emphasis on low density targets, gaseous and liquid targets; 2) Physics and technology of laser-plasma diagnostics with special focus on the ultra-fast physical processes; 3) ultra fast high power laser metrology is a new expanding field of investigation devoted to measure laser matter Interaction at extreme conditions.

GENERAL ACTIONS	START	END
O2.S4.A1 Improve CLPU expertise through training and collaborations, development of custom real time high repetition and reliable operations tools and devices	2025	2028

O2.S5. STRATEGY || Biomedical applications

Relevant advances in high intensity lasers and driven secondary sources have been driving an increasing interest in possible biomedical applications, with different players involved, mainly research institutions, with an increasing interest from the private sector. Radiation therapy and diagnostics (e.g., through radioisotopes) could be driven by lasers in the next future, with a promising outlook for an efficient integration in hospitals and a wide diffusion of instruments (e.g., synchrotrons) that nowadays are too massive and expensive. A strong attention of the medical community has been devoted to the effect of high-dose rates in tissues, with an urgent need of a more profound fundamental study and experimental support to the so-called FLASH effect in radiation therapy.

GENERAL ACTIONS	START	END
O2.S5.A1 Develop experimental platform through private-public partnerships	2025	2028

O2.S6. STRATEGY || Talent attraction & retention

There is a permanent need to be attractive to relevant scientists in the international framework. CLPU will complement the external measures adopted by the AGE with scientific tools that will increase the attraction of talent to Salamanca. It also plans the development of collaborative tools to exchange scientists. The absence of the professional career and collective labor agreements for the staff of the ICTS hinders the retention of talent and fosters the brain drain towards other institutions, preventing as a consequence the training process from reaching the high level of specialization required to operate on the ICTS. Therefore, specialized training programs and collaborations with other institutions will be reinforced for the exchange of scientific and technical personnel, mainly.

GENERAL ACTIONS	START	END
O2.S6.A1 Foster opportunities of training, secondments, grants, career advance	2025	2028

O2.S7. STRATEGY || High level training & education

Implication of laser science in undergraduate programs and particularly involvement in graduate and master studies. Establishment of international links for master programs. Specialized training not only in laser and plasma physics but also in all aspects related to the facility as engineering, data management, radioprotection safety and also management of large facilities. The experience of the LaPlaSS summer school was successful and must be supported in order to consolidate a periodic summer school sponsored by CLPU.

GENERAL ACTIONS	START	END
O2.S7.A1 Involvement in education/training programs for master and PhD students	2025	2028

O2.S8. STRATEGY || Prepare customized user access on specific relevant research topics

Diversifying CLPU's experimental activities by pursuing collaborations with various partners, including laboratories, research centers, and private companies. Goal-oriented user calls for access can focus on specific research topics of interest, fostering new scientific pursuits and driving technological innovation.

GENERAL ACTIONS	START	END
O2.S8.A1 Identify topics and activities to be investigated/advanced through access calls	2026	2027

OBJECTIVE 3 || FACILITATE KNOWLEDGE GENERATION & TECHNOLOGY TRANSFER TO THE INDUSTRIAL SECTOR

One of the primary objectives of CLPU is to narrow the gap between academic research and practical applications with lasers in industry, particularly within Spain and Castilla y Leon region. It is planned to strengthen this goal through strategies that would facilitate technological transfer, enabling the adoption of new technologies, improvement of industrial processes and development of innovative solutions by the industrial sector.

O3.S1. STRATEGY || Laser applications for Space & Dual Technologies

By assessing a general analysis crossing CLPU technological readiness with the EU main strategies of innovation in space, two main topics of applications have been found: ground-air-space optical communications, which will require the development of high power and high efficiency systems and laser-based space debris mitigation, for which the development of a new generation of high-power lasers in pulsed modes is needed. The objectives of CLPU in defense and civil applications of lasers keep following a path already in progress on the development of high-power lasers for drone neutralization, real-time atmospheric monitoring for laser propagation, the design of new lasers for dazzling/blinding drone optical sensors and disruptive technologies like laser-induced electromagnetic pulse (EMP).

GENERAL ACTIONS	START	END
O3.S1.A1 Developing current projects, prepare portfolio activities for industrial collaboration	2025	2028

O3.S2. STRATEGY || Spanish laser applications ecosystem

Identify the Spanish technologies that can be relevant for CLPU, directly or indirectly related to lasers. Active participation in industrial and technological ecosystems creating a stable platform for knowledge transfer. Play a leading role (due to the natural link with the Spanish Publicl Administration) in collaboration with public partners in relation to laser technology.

GENERAL ACTIONS	START	END
O3.S2.A1 Develop connected body optimized to promote technology transfer and to get advantage of specific tools and financial support devoted to industrial players	2025	2028

O3.S3 STRATEGY || Innovation in laser development

Grow sufficient expertise to contribute to innovations in laser technology, establishing a foundation for the development of a new generation of high peak and average power ultrashort lasers. Also advance on the design and development of OPCPA (Optical Parametric Chirped Pulse Amplification) architectures, short pulse Ytterbium (Yb) and Thulium (Tm) lasers. Finally, simulate new diode-pumped amplifiers, with a specific focus on creating a comprehensive model of the amplification process and develop methods for ultra-stable laser spatial and temporal synchronization.

GENERAL ACTIONS	START	END
O3.S3.A1 Design and development of novel laser architectures and components to increase peak, average power, efficiency, wavelength outputs.	2025	2028

O3.S4. STRATEGY || Implement laboratories dedicated to industrial liason

Keep resident experimental setups located in secondary laboratories for demonstration actions directed to foster collaboration with domestic companies, in order to enhance their potential portfolio. The goal is to find conclusive proofs in support of novel applications of lasers. Preparation of ad-hoc labs or setups for proofs of concept requested by possible industrial partners. One of the developed lines will be the implementation of new laser microprocessing systems for industrial applications and laser microprocessing techniques for surface modification of materials, waveguides, laser cutting and microdrilling, laser welding and advanced targets for generation of secondary sources with VEGA. Additionally, new experimental systems for materials processing with different wavelengths (UV-VIS short pulses) for medical, biological and food applications will be expanded.

GENERAL ACTIONS	START	END
O3.S4.A1 Prepare list of activities, related devices, design and implement laboratories	2025	2028

O3.S5 STRATEGY || Specialized radiation protection instruments

The development of new instruments for dose measurements tailored to the unique radiation environment generated in laser installations is crucial for enhancing radiological protection and safety. High-intensity lasers generate complex radiation fields that traditional instruments may not adequately measure. Therefore, specialized instruments with advanced detection technologies are needed to handle the specific characteristics of laser-generated radiation. These instruments must be precise, reliable and robust, capable of functioning under extreme conditions. Their development involves rigorous research, testing, and collaboration with experts in laser technology and radiation physics. Implementing these instruments will significantly improve the monitoring and control of radiation exposure, safeguarding personnel and equipment in laser facilities.

GENERAL ACTIONS	START	END
O3.S5.A1 Advance in procedures, research focused on laser generated radiation	2025	2028

OBJECTIVE 4 || ENHANCE SOCIAL RESPONSIBILITY AND KNOWLEDGE-TRANSFER TO SOCIETY

As a public administration entity funded by public agencies, the CLPU is committed to maximizing societal benefits. This commitment is reflected in the honest and transparent management of allocated funds, strict adherence to applicable regulations, and the continuous modernization of processes aligned with social values that guide the Center's management. Additionally, the CLPU holds the responsibility of disseminating the knowledge it generates and facilitating its transfer to society and industry.

O4.S1. STRATEGY || Implement virtous procedures & management

Reinforcement of the governance model focused on social responsibility in the public administration based on the internationally recognized ethical standards for the promotion of good practices, both in the internal administration of the organization (labor and environmental management) and in its link with society.

GENERAL ACTIONS	START	END
O4.S1.A1 Introduce procedures and best practices aimed to promote virtuous behaviours	2025	2028

O4.S2. STRATEGY || Boost the Scientific and innovation Culture Unit

Develop new spaces to improve the outreach activities creating new tools to reach general public and students to convey clear, understandable and true information that supports the growth of critical thinking and increase the scientific vocations.

GENERAL ACTIONS	START	END
O4.S2.A1 Update and expansion of the Scientific and Innovation Culture Unit (UCC+I) capabilities with permanent dedicated spaces and strengthening of outreach activities.	2026	2028

O4.S3. STRATEGY || Optimization & advance of the IT infrastructure

Adapt and configure the systems and communications infrastructure of the CLPU in accordance with the provisions of the National Security Framework (ENS), with a focus on training and raising awareness among employees and users, applying the principles, requirements and security measures legally required for the adequate protection of the information processed and the services provided.

GENERAL ACTIONS	START	END
O4.S3.A1 Upgrade IT infrastructure capabilities, stability, security, assets, offered services	2025	2027

O4.S4. STRATEGY || Enhance CLPU visibility towards the industry

CLPU must improve its presence in three main areas: industry, new scientific communities, and society by enhancing the visibility of its research projects, results and specialized events.

GENERAL ACTIONS	START	END
O4.S4.A1 Prepare events and synergy/collaboration paths with industry	2025	2026

O4.S5. STRATEGY || AI & Big Data as a global emerging technology

Develop applications of artificial intelligence, big data, automation, robotics, machine learning, and all those emerging technologies that assist in decision making.

GENERAL ACTIONS	START	END
O4.S5.A1 Develop AI tools to improve operation of complex systems and associated devices	2026	2028

O4.S6. STRATEGY || Digitalization & management

Promote the digitalization and modernization of services, processes and tools within the framework of the electronic administration of the public sector and management applications.

GENERAL ACTIONS	START	END
O4.S6.A1 Improve training and develop tools for management efficiency/optimization	2025	2028

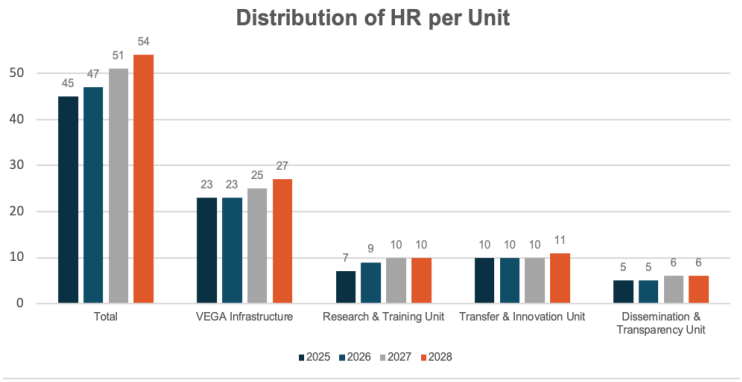
4.3 Resources

4.3.1 Human Resources

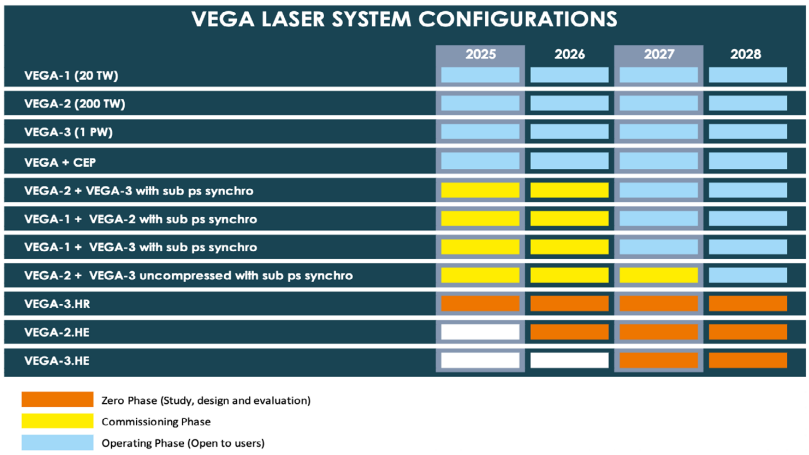
In order to facilitate the achievement of the objectives pursued, we envision an organisational structure based on four functional units working in an efficiently coordinated and transversal way:

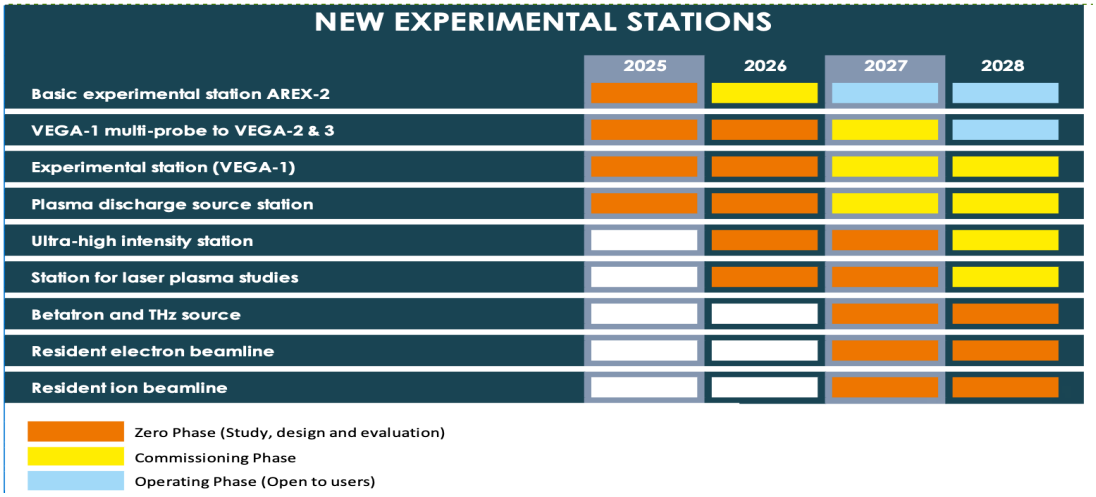
- **Unique Infrastructure VEGA**: focused on guaranteeing the existence of a state-of-the-art laser system open to users and very prominent worldwide. In this unit, a core of scientists and technologists will be able to operate the laser and perform sophisticated laser-plasma experiments.
- **Research and Training Unit**: although strongly associated to the users' facility, this unit will perform the scientific and technological research and prospective needed to keep the facility alive and constantly upgrading. This is fundamental for the scientific and technical career of a large fraction of CLPU staff, as well as for the visibility of the center with publications and presentations. Also this is the framework for specialized training of students and new staff.
- **Transfer and Innovation Unit:** created to allow the flow of knowledge generated in the two functional units previously explained to the industry. The CLPU is the national benchmark in intense pulsed lasers technology, so this unit will develop the necessary actions to inform and transfer this technology efficiently to the national productive sector.
- **Dissemination and Transparency Unit**: society should be ultimately the beneficiary of the existence of public research centers and ICTSs. Therefore, access to information and transparency in management undoubtedly justify the existence of a minimum structure to make known the most relevant results and scientific and technological breakthroughs.

The following graph represents the average of structural staff. The staff will be completed with casual personnel around research and technological projects.



4.3.2 Material Resources





4.3.3 Economic Resources

Thousand euros (k €)	2025	2026	2027	2028
INCOME	3805	3818	3966	4040
Consortium Funds	3200	3200	3200	3200
Other Incomes	605	618	766	840
EXPENSES	3425	3745	4116	4344
Personnel	2065	2245	2476	2663
Running Expenses	1360	1500	1640	1680
EXCESS	380	453	303	0

Chronogram & Monitoring

5.1 Chronogram

This Strategic Plan will be reviewed periodically by the competent bodies of CLPU, through several actions:

- Approval of the Annual Budgets. Annually the Rector Council (RC) approves the budget that will determine the resources at the disposal of the Center to programme activities and accomplish objectives.
- Approval of the Annual Plan of Actions and Projects. The RC approves the Plan of Actions and Projects to be implemented the following year.
- Follow-up of the set of actions and indicators. The Executive Platform will be in charge of gathering and assessing all the information regarding the degree of compliance with the previous year Plan.
- Implementation of the Risk Management Plan and decision on required adjustments. The Executive Platform will respond to any risk or contingency as soon as it arises, implementing the foreseen mitigation strategies or taking any other appropriate measures to minimize the impact on the smooth functioning of the Center.
- Counseling and report from the CACT. The CACT advises on activities, programs and scientific plans that the Director submits to the EC. Additionally, the CACT prepares a four-year report on the future opportunities, prospects and capabilities of CLPU. This report is directly presented to the Rector Council to assist in the strategic orientation of the Center.
- Comprehensive review of the Strategic Plan. The Executive Platform shall check the degree of compliance of the objectives set at the Plan and analyze their validity or whether, on the contrary, new measures should be taken to place CLPU as a state-of-the-art facility for the scientific and technological research and development.
- Renewal of the financial commitments of the Consortium Agreement of CLPU: The current collaboration agreement between the consortium entities establishes a financial contribution plan valid until 2028. Therefore, to guarantee the continuity of the activities, a new financial contribution plan should be available before the end of the one currently in place.

The chronogram will be as represented in the following diagram:

5.2 Indicators

The Center has established a set of general indicators that will periodically be checked out to evaluate the adequate progress of the ICTS. Each of these indicators has their associated specific indicators – generally of a numerical nature - to verify different issues related to them. However, it is important to notice that some of these indicators will only be applicable once the ICTS is in full operation again.

O.1 OBJECTIVE || EXPAND THE CLPU INFRASTRUCTURE

Indicator	Reference
Nr. of VEGA configurations offered	3 – 7
Synchronisation between VEGA 3 Uncompressed and VEGA 2	1-50 ps
% of cancelled sessions due to laser malfunction	5 – 15%
Annual number of shots in competitive experimental campaigns by VEGA	> 6000 shots
Number of experimental accesses in new experimental area stations	1 – 2
% of VEGA operative time offered in open (competitive) access	20 – 50%
Ratio of Nr. Sessions requested v. Nr. Sessions offered in competitive access	1,5 - 2,5
% of users' satisfaction regarding the functioning of the laser system	55-95%
Number of project proposals submitted in collaboration with RIs, scientific groups or private companies	2-6
Number of meetings to foster international collaboration	1-3
% of Spanish researchers taking part in access proposals	5 - 10%
Prototype of experimental campaigns integrated management tool	≤2028
Drafting of a Data Management Plan	≤ 2028
Nr. of training hours on safety & risk prevention issues	40 h - 120 h
Delivery of new safety system for the full set of experimental areas	≤2028
Request authorizations for the radioactive facility to offer new sources to users	≤2028
Percentage of electric energy produced internally	20-40%

O.2 OBJECTIVE || FOSTER, RESEARCH & TRAINING PROGRAMS TO PROMOTE EXCELLENCE SCIENCE

Indicator	Reference
Update the UIC	≤2028
Nr. of PhD working at CLPU	5 – 15
Annual campaigns in other facilities to develop strategic topics of Objective 2	1 - 3
Nr. of research projects handled on strategic topics of Objective 2	5 - 15
Nr. of proposals submitted on strategic topics of Objective 2 by CLPU researchers to competitive access per call	1 - 2
Total Nr. of publications from CLPU personnel	10 - 20
% of publications in journals positioned in the 1st and 2nd quartile in its thematic area	8-16
Number of publications with acknowledges as a result of the access to CLPU facilities	1-3
Number of applications to personnel grants	1-3
Nr. of training hours of scientific scope received by CLPU staff	100 - 300 h
People involved in staff exchange programs with relevant scientific infrastructures	1-3
CLPU staff collaborating in master programs	1-2
User meetings to match the community expectation and expand user connection	1-2
International schools organized at CLPU targeted to specialized scientists	1-2

People involved in the scientific committee of internationally relevant conferences	1-2
People Involved in national/regional excellence groups	1-2
Participate to events to get in contact with interested students and universities	2-5

O.3 OBJECTIVE || FACILITATE KNOWLEDGE GENERATION & TECHNOLOGY TRANSFER TO THE INDUSTRIAL SECTOR

Indicator	Reference
Nr. of collaborations with the industrial (space & dual technologies) sector	2-5
Nr. of technical consultancy services provided to companies in space and dual technologies sector	2-5
Nr. of technology transfer events in which CLPU takes part	3-5
Nr. of development & innovation projects in execution	2-5
Meeting with relevant players (e.g., CDTI, MICIU, AEE, ESA etc.) for inclusion in long term research programs with national/international agencies	2-5
Development and reinforcement of laboratories devoted to industrial research	<2028
Meetings with relevant players (ICECyLI,CDTI etc.) to develop possible bodies in charge of industrial liaison	1-5
Development of a plan for a linked body at CLPU dedicated to industrial liaison	<2028
Successful delivery of ongoing projects	Milestones
Meetings in dedicated working groups devoted to specific technological lines developments	1-3
Development of a possible plan to extend VEGA interest for targeted companies (e.g., Space, Fusion, etc.)	<2028
Sharing possible personnel and students with companies for common goals applying to grants	2-5

O.4 OBJECTIVE || ENHANCE SOCIAL RESPONSIBILITY AND KNOWLEDGE TRANSFER TO SOCIETY

Indicator	Reference
Nr. of training hours on ethical codes and good governance and practices received by CLPU staff	50-100
Nr. of outreach events	1-4
Opening Ceremony for the construction fo the new experimental area	<2027
Submission of outreach project proposals	1-4
Nr. of activities to publicize the capabilities of the innovation laboratory	2-5
Preparation and publication of CLPU's offered services	< 2028
Nr. of data analysis and efficiency improvement applications through AI and digital tools	2-4

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