CERIC

Central European
Research Infrastructure
Consortium

Report 2019

ERIC established by the European
Commision Implementing Decision
392/2014/EU

Open for Science

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Providing Open Access to Excellent Researchers

CERIC-ERIC is an integrated multidisciplinary research infrastructure for basic and applied research in all fields of materials, biomaterials and nanotechnology. Located in 8 countries in Europe (Austria, Croatia, Czech Republic, Hungary, Italy, Poland, Romania and Slovenia), it is open to researchers from all over the world. It offers a single access point to state-of-the-art facilities and techniques based on the use of electrons, ions, neutrons and photons. Each Member Country contributes to CERIC a high-quality PF, which is available to researchers on the basis of a positive review from the International Scientific and Technical Advisory Committee (ISTAC) of CERIC.

Jana Kolar
CERIC Executive Director

Dear Reader,

The Annual Report before you, the sixth since our establishment, showcases the variety of activities over the past year.
It demonstrates how we enable excellent science through the provision of open access to our instrumental facilities, distributed across 8 countries. We observed a great increase in publications and 13% of them were among the top 10% cited articles, which demonstrates the quality of the supported research. The discoveries cover various fields, including health, environment and climate change, and energy. Read in the report about the science potentially leading to development of future electrical components that will be faster, less energy-consuming and will heat less. New insights into the complexity of the HIV-1 genome may provide the necessary information for a possible innovative antiviral drug design, while a novel approach using mesoporous titania films for bone implants has been shown to promote tissue recovery and reduce infections.
These are only a few achievements of our users, which were complemented by the research undertaken within five internal research projects, co-funded by CERIC's various Partner Facilities and CERIC's central budget, leading to excellent scientific and technological developments, as well as to pooling complementary capacities and resources across Europe.
While science is our main business, this report also highlights our continuous efforts to improve on our delivery and relevance, which are essential elements of our long-term sustainability. Read in the report about the opinion of our funders on CERIC's performance and added value and on how to improve on it. We have also developed an impact strategy, which will allow us to deliver on the variety of objectives that the funders place in front of us. One of the recently added ones is to produce new science to tackle societal challenges and contribute to the Sustainable Development Goals. To address this objective, CERIC has launched a pilot action on batteries, to be complemented with one on fuel cells, in which renowned experts from the field of battery research have reviewed the suitability of our existing instrumental offer, identified the bottlenecks and proposed the addition of new techniques in order for CERIC to improve our services to the battery research community.
The functioning of CERIC is made possible by considerable support from the Italian government and the in-kind contributions by our Member Countries, pooling resources in order to support CERIC's operations. To minimize the risks to our operations, the General Assembly has started a discussion about introduction of annual cash contributions. On a project basis, our activities have been supported by several of the Member Countries, the European Commission, European Structural and Investment Funds and Regional Funds of Friuli Venezia Giulia, demonstrating how such funds can be used in synergy in the activities performed by CERIC.
The progress of CERIC during the past year would not have been possible without the dedication, commitment, support and expertise of the people involved, and I would like to express my sincere thanks to the scientists from our Partner Facilities and their Directors, members of the Scientific and Technical Advisory Committee, members of the General Assembly and my colleagues in the administration for their contributions.

I hope you enjoy reading the Annual Report.

Executive Summary

CERIC* had a successful year in 2019, as evidenced by the headline indicators presented in Table 1. A significant increase in value can be observed for all indicators.

Headline Indicators	2016	2017	2018	2019	% Change 2019-2018
Proposals received	119	195	234	279	19,2
Number of papers	21	37	55	85	46,6
Projects' funding (CERIC)	21,323.00	382,159.75	509,041.99	694316,91	36,4
Invited participations in policy-related activities	10	18	14	17	21,4
Share of papers among 10% top cited				13%	

Table 1 Headline indicators for 2016-2019 and changes in the last reported year.

Excellent Science

In 2019, CERIC continued to provide access to its research infrastructure and contribute to the advancement of science. Its calls for open access attracted 279 proposals, requesting the use of 44 instruments, a 7% increase over 2018. Proposals came from 39 countries and 5 continents.

The scientific output has also increased since 2018, which is reflected in the 46.6% increase in the number of scientific publications. In addition to the number of publications, their impact is also very relevant. It is most often expressed as a percentage of publications that are among the 10% top cited publications. Since CERIC was only established in mid-2014, this year was the first one for which we could collect this information according to the adopted ESFRI methodology[2]. Thirteen percent of CERIC publications published in 2016-18 are among 10% the top cited publications[1].

A distinct feature of CERIC is also the top-up funding provided to winning internal research projects that bring together at least two CERIC facilities. The activity aims to increase the integration of national multidisciplinary facilities into a unique EU-level distributed Research Infrastructure, and to pool resources across EU countries. The current four projects have been in their third year of implementation, through joint co-funding of the involved parties (in-kind, € 5,659,474), while the top-up is provided from funds for strengthening CERIC allocated by the Italian Ministry of Education, Universities and Research (MIUR, €1,750,530). The other CERIC internal research project, "Nanoanalytics for pharmaceutics", with possible applications in the pharmaceutical sector, has also registered positive results, contributing in particular to CERIC's collaboration with industry.

CERIC was established to exploit the full scientific potential in synchrotron light and other microscopic probes for analytical and modification techniques, notably in Life Sciences, Nanoscience and Nanotechnology, Cultural Heritage, Environment and Materials Sciences. In addition to its services supporting characterisation and modification of a large range of materials, the Outline of CERIC's science strategy and research roadmap upgrade, approved by the General Assembly of CERIC, foresees a stronger focus on the fields of Energy Materials and Life Sciences. To increase its capabilities in these fields, a pilot action aimed at improving services in the field of battery research, followed by fuel cells, was adopted. To this end, CERIC has contracted an external scientific advisory group of renowned experts in battery research to assist it in the improvement of its services. In addition, the project INTEGRA, which aims to reinforce, enlarge and better integrate the offer of the CERIC's Partner Facilities in the field of Life Sciences, has been endorsed for funding.

Monitoring of the quality of CERIC's instrumental and scientific support has continued also in 2019, with the periodic evaluation of the Croatian and Hungarian Partner Facilities (PFs), and with the expansion of the Polish PF, which has added a new instrument for Cryo electron microscopy to CERIC's offer.

*For an overview of CERIC and its main goals and activities, see chapter 5 "CERIC Overview"

[1]Percentage of publications based on research performed using facilities/resources of the RI that, compared with the publications in the same field and in the same year, belong to the top 10% most frequently cited.

[2]https://www.esfri.eu/sites/default/files/ESFRI_WG_Monitoring_Report.pdf

Training, Industrial Liaison, Communication, Projects

Training and up-skilling at all levels is strongly prioritised by CERIC. With the PaGES4 project, 146 school pupils from the Italian Region Friuli Venezia Giulia were enrolled in a wide programme of lectures in the schools and hands-on training in labs at the CERIC synchrotron facility in Trieste (Italy), and were empowered to make conscious choices for their future career.

Moreover, CERIC and its opportunities for research were presented to research communities from various institutes in Bulgaria, Hungary and Ukraine, and 80 industrial PhD students learnt more about building networks between industry and research.

CERIC's activity enhancing the capacity building of its staff also continued in 2019, mainly in the fields of management, administration and technology transfer.

In the industrial liaison domain, CERIC defined the Intellectual Property (IP) Framework, to regulate rights on the background and any foreground arising from collaboration within the Consortium. Direct marketing actions targeting industry were also carried out, together with those aimed at enlarging the industrial network.

To increase CERIC's visibility in the industrial community, a set of banners for online use, and a brochure for distribution at events targeting different industrial sectors have been developed. CERIC's communications supported all the activities, resulting in enhanced visibility of CERIC in European-wide networks, such as those of the ERF-AISBL, ERIC Forum and the RI-VIS project and among the general public.

In addition to ordinary funding, CERIC also received funding for European and regional (PaGES4) projects, in a total amount of nearly 0,7 mio EUR, which is a 36,4% increase over 2018. The Horizon 2020 ERIC Forum started, aiming to identify and develop collective responses to common challenges of the ERICs, and to further develop the ERIC Regulation and ESFRI framework. Among the projects whose implementation continued from previous years, are the H2020 ACCELERATE, ERIHS and PaNOSC projects.

CERIC Institutional Advances and Contribution to Policies

A paper co-authored by the Executive Director of CERIC was published in 2019, which contributed to the development of a monitoring system tailored to particular Research Infrastructures (RIs) and which contributed to the ESFRI's Working Group of Monitoring of Research Infrastructures[3].

To evaluate the societal impact of RIs, a protocol was developed and published by KNAW-RI, with the contribution of CERIC. The protocol adopts an approach that allows RIs to prepare for very different evaluation situations by following the so-called "impact pathways" model. Following this guidance document, CERIC prepared its societal return report. The activity was accompanied by a collection of feedback from all participating Member States on the performance of CERIC, and on possible improvements. This activity is considered of particular relevance, since it enables CERIC to deliver on the evolving objectives of the funders and thus contributes to the sustainability of CERIC.

The contribution of Research Infrastructures to the landscape of the wider EU priorities, set by the next European research and innovation programme, Horizon Europe is one of new objectives, to which CERIC has responded with a focus on two fields for priority action within CERIC: Life Science and Energy. Some of the current contributions of CERIC to these fields are highlighted in this report.

CERIC's sustainability so far relies exclusively on the cash contribution of the host country Italy and in-kind contributions of its members. To minimise the risk to its sustainability, in 2019 the General Assembly started discussing the introduction of participation fees.

CERIC's first data policy implementation was also explored and discussed by the members of the Board of Directors and the General Assembly of CERIC, supporting the EU-wide efforts to make research data accessible. Finally, CERIC actively contributed to the development of RIs operations in the field of in-kind contributions, and VAT and excise exemptions for ERICs.

Operations and Finance

In 2019, the General Assembly of CERIC adopted the new CERIC monitoring framework, based on the draft ESFRI proposal, introduced a new Disciplinary Code for CERIC employees, approved the template agreement for industrial cooperation and the CERIC Intellectual Property (IP) policy. The final section of this report presents the financial and economic situation of the Consortium, outlined through statements presented under the accrual basis of accounting according to the International Public Sector Accounting Standard.

[3]https://www.esfri.eu/sites/default/files/ESFRI_WG_Monitoring_Report.pdf

1

Excellent Science

Main Achievements

1. **Implementation of 2 calls for free open access** to which 279 proposals, requesting the use of 419 instruments, were submitted. This is a 19% increase in proposals received over the previous year.
2. **Proposals came from 39 countries and 5 continents**
3. **A 46.6% increase in the number of scientific publications**
4. **Positive evaluation of two CERIC Partner Facilities** by the international team of experts led by CERIC's International Scientific and Technical Advisory Committee (ISTAC)
5. **Positive evaluation of the progress of three CERIC internal research projects**

Open Access

CERIC's main aim is to enable excellent science, both as an in-house activity and as a service to international users. This is achieved mainly by providing merit-based open access to its research facilities and internal research.

In 2019, CERIC launched two open access calls for proposals to use the Consortium's research infrastructure; 279 proposals were received (Figure 1). Due to their multi-technique character, this corresponded to 419 single instrument proposals, which is a 14% increase over 2018. There were 200 experiments approved. The number of allocated instruments increased by 6% in comparison to the previous year (Figure 2). This number corresponds to a total of nearly 17,500 hours of measurements.

Among submitted proposals, 38% requested access to multiple facilities, which is still a distinguishing characteristic of CERIC.

Figure 1
Number of proposals and requested methods

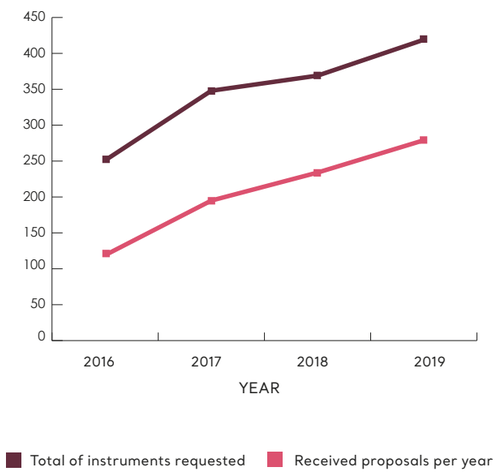
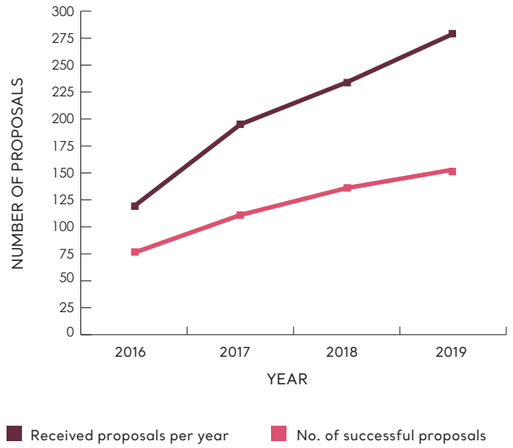
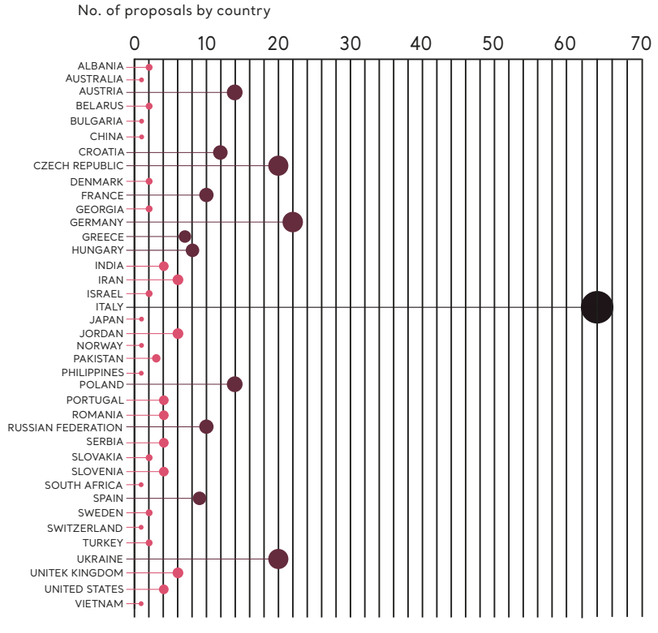


Figure 2
Number of received and successful proposals per year



CERIC remains a highly internationalised research infrastructure, with principal investigators from 39 countries and five continents in 2019 (Figure 3). Most proposals received came from European member states, while 29% of proposals came from non-EU countries.

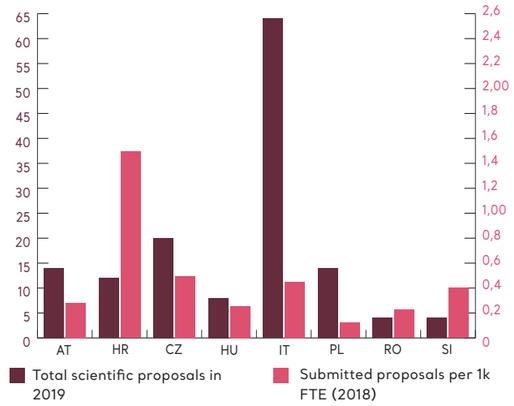
Figure 3
No. of proposals by country



- **2 calls for proposals**
- **279 proposals received**
- **Research groups from 39 countries**
- **200 allocated requests**

The majority (52%) of submitted proposals also came from CERIC Member Countries in 2019, with a slight decrease over the previous year. CERIC is still new in the European research infrastructure landscape and is still not widely known beyond its Member Countries. The most active users, in terms of fulltime employees in Research & Development in a country, are from Croatia, followed by the Czech Republic and Italy.

Figure 4
Proposals per 10K full time employees in R&D in Member Countries



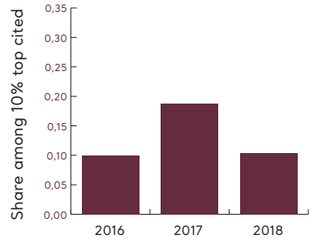
In 2019, 42% of the principal investigators and of the researchers who performed the measurements at the facilities were women (Figure 5).

Figure 5
Gender distribution of CERIC users

Quality of the Output

In 2019, the number of publications stemming from measurements taken at the CERIC facilities increased by 46.6%, while the average Impact Factor (6.0) had a very slight decrease (-0.2) in comparison to the previous year. In 2019, CERIC collected data on publications based on research performed using the facilities and/or resources of the RI, and that - compared with those released in the same field and in the same year - are among the top 10% most frequently cited ones (see figure 6).

Figure 6
Share of CERIC publications among 10% top most cited publications in 2016, 2017 and 2018



International Scientific and Technical Advisory Committee - ISTAC

The purpose of the International Scientific and Technical Advisory Committee (ISTAC) of CERIC-ERIC is to provide the CERIC General Assembly (GA) with recommendations on scientific and technical issues that bear on the full and effective utilization of CERIC-ERIC as a state-of-the-art research infrastructure, and on developments required to maintain its scientific productivity at the highest possible level and ensure its relevance to the international scientific community. In particular, the ISTAC evaluates proposals for new partner facilities, and the operation of existing ones, advising the General Assembly on acceptance and continuation.
The second periodic evaluation of the Hungarian and Croatian partner facilities (PFs) took place in May and October 2019, respectively (read more on page 27).
In the same year, ISTAC welcomed three new members: Professor Andrew Harrison, CEO of Diamond Light Source Ltd; Paolo Olivero, Associate Professor in Applied Physics and Experimental Matter Physics at the University of Turin; and Prof. Christoph Quitman, Director / Head of Division Project LightHouse, RI Research Instruments GmbH.

Scientific Publications

Eighty-five articles were published in 2019, with a cumulative impact factor of 476.8 (versus 351,8 in 2018) and an average impact factor of 6.0 (versus 6.2 in 2018):

(1) *3D microstructure of magnesium potassium phosphate ceramics from X-ray tomography: new insights into the reaction mechanisms*
Viani A., Sotiriadis K., Lanzafame G., Mancini L., Journal of Material Science, 2019, 54 (5), 3748-3760

(2) *Magnetization Reversal and Domain Nucleation in Ultra-Thin Co/Re(0001) Capped by Graphitic C*
Genuzio F., Mentes T.O., Locatelli A., IEEE Transactions on Magnetics, 55 (2), 2019, 1-4

(3) *Narrow photoluminescence and Raman peaks of epitaxial MoS2 on graphene/Ir(111)*, Ehlen N., Hall J., Senkovskiy B.V., Hell M., Li J., Herman A., Smirnov D., Fedorov A., Voroshnin V., Di Santo G., Petaccia L., Michely T., Gruneis A., 2D Materials, 2019, 6 (1)

(4) *Properties of Nitrogen/Silicon Doped Vertically Oriented Graphene Produced by ICP CVD Roll-to-Roll Technology*, Rozel P., Radziuk D., Mikhnavets L., Khokhlov E., Shiripov V., Matolínová I., Matolín V., Badaev A., Kargin N., Labunov V., Coatings, 2019, 9 (1)

(5) *Mechanistic Study of the Nucleation and Conformational Changes of Polyamines in Presence of Phosphate Ions*, Andreozzi P., Ricci C., Martinez Porcel J.E., Moretti P., De Silvio D., Amenitsch H., Ortore M.G., Moya S., Journal of Colloid and Interface Science, 2019, 543, 335-342

(6) *Comparison of plasma-enhanced atomic layer deposition AlN films prepared with different plasma sources*, Kot M., Henkel K., Naumann F., Gargouri H., Lupina L., Wilker V., Kus P., Pozarowska E., Garain S., Rouissi Z., Schmeißer D., Journal of Vacuum Science & Technology A, 2019, 37 (2)

(7) *Vibrational Spectroscopic Methods for Nanosponges*, Rossi B., D'Amico F., Masciovecchio C., Nanosponges, 2019, 8, 227-258

(8) *Antibacterial Mesoporous Titania Films with Embedded Gentamicin and Surface Modified with Bone Morphogenetic Protein 2 to Promote Osseointegration in Bone Implants*, Escobar A., Muzzio N., Coy E., Liu H., Bindini E., Andreozzi P., Wang G., Angelo P., Delcea M., Grzelczak M., Moya S.E., Advanced Materials Interfaces, 2019

(9) *In-situ aerosol nanoparticle characterization by small angle X-ray scattering at ultra-low volume fraction*, Bauer P.S., Amenitsch H., Baumgartner B., Köberl G., Rentenberger C., Winkler P.M., Nature Communications, 2019, 10 (1), 1122

(10) *Lipid-polymorphism of plant thylakoid membranes. Enhanced non-bilayer lipid phases associated with increased membrane permeability*, Ughy B., Karlicky V., Dlouhy O., Javornik U., Materovà Z., Zsiros O., Sket P., Plavec J., Spunda V., Garab G., Physiologia Plantarum, 2019

(11) *Two-quartet kit* G-quadruplex is formed via double-stranded pre-folded structure*, Kotar A., Rigo R., Sissi C., Plavec J., Nucleic Acids Research, 2019, 47 (5)

(12) *Unravelling the growth mechanism of the co-precipitation of iron oxide nanoparticles with the aid of synchrotron X-Ray diffraction in solution*, LaGrow A.P., Besenhard M.O., Hodzic A., Sergides A., Bogart L.K., Gavrilidis A., Thanh N. T.K., Nanoscale, 2019

(13) *Comprehensive characterization of nanostructured lipid carriers using laboratory and synchrotron X-ray scattering and diffraction* , Tetyczka C., Hodzic A., Kriechbaum M., Juraić K., Spirk C., Hartl S., Pritz E., Leitinger E., Roblegg E., European Journal of Pharmaceutics and Biopharmaceutics, 2019

(14) *Reversible structural changes of in situ prepared As40Se60 nanolayers studied by XPS spectroscopy*, Kondrat O.B., Holomb R.M., Csik A., Takas V., Veres M., Feher A., Duchon T., Veltruska K., Vondracek M., Tsud N., Matolin V., Prince K.C., Mitsa V.M., Applied Nanoscience, 2019

(15) *Redox behavior of Pt/Co3O4(111) model electrocatalyst studied by X-ray photoelectron spectroscopy coupled with an electrochemical cell*, Brummel O., Lykhach Y., Vorokhta M., Smid B., Stumm C., Faisal F., Skala T., Tsud N., Neitzel A., Berenova K., Prince K.C., Matolin V., Libuda J., Journal of Physical Chemistry C, 2019

(16) *Eumelanin Graphene-Like Integration: The Impact on Physical Properties and Electrical Conductivity*, Di Capua R., Gargiulo V., Alfè M., De Luca G. M., Skála T., Mali G., Pezzella A., Frontiers in Chemistry, 7, 121, 2019

(17) *Influence of Structure on Electronic Charge Transport in 3D Ge Nanowire Networks in an Alumina Matrix*, Ray N., Gupta N., Adhikary M., Nekić N., Basioli L., Dražić G., Bernstorff S., Mičetić M., Scientific Reports, 9 (1), 5432, 1-9, 2019

(18) *Spatially Resolved XPS Characterization of Electrochemical Surfaces*, Bozzini B., Kuscer D., Amati M., Gregoratti L., Zeller P., Dobrovolska T., Krastev I., Surfaces, 2 (2), 2019

(19) *Pulse picking in synchrotron-based XPEEM*, Aballe L., Foerster M., Cabrejo M., Prat J., Pittana P., Sergo R., Lucian M., Barnaba M., Menteş T.O., Locatelli A., Ultramicroscopy, 202, 10-17, 2019

(20) *Biofunctionalization of TiO2 Surfaces with Self-Assembling Layers of Oligopeptides Covalently Grafted to Chitosan*, Secchi V., Franchi S., Ciccarelli D., Dettin M., Zamuner A., Serio A., Lucci G., Battocchio C., ACS Biomaterials Science & Engineering, 5 (5), 2190-2199, 2019

(21) *Identification of Two-dimensional FeO 2 Termination of Bulk Hematite a-Fe 2 O 3 (0001) Surface*, Redondo J., Lazar P., Procházka P., Prusa S., Lachnitt J., Mallada Faes B., Cahlík A., Berger J., Šmíd B., Kormoš L., Jelinek P., Čechal J., Švec M., The Journal of Physical Chemistry C, 2019

(22) *Newly developed electrochemical synthesis of Co-based layered double hydroxides: toward noble metal-free electro-catalysis*, Musella E., Gualandi I., Scavetta E., Rivalta A., Venuti E., Christian M., Morandi V., Mullaliu A., Giorgetti M., Tonelli D., Journal of Materials Chemistry A, 7 (18), 2019

(23) *Ferrocene self assembled monolayer as a redox mediator for triggering ion transfer across nanometer-sized membranes*, Cuartero M., Chai L., Zhang B., De Marco R., Crespo G.A., Electrochimica Acta, 315, 2019

(24) *Tailoring of highly porous SnO2 and SnO2-Pd thin films*, Chundak M., Khalakhan I., Kus P., Duchon T., Potin V., Cacucci A., Tsud N., Matolin V., Veltruska K., Materials Chemistry and Physics, 232, 2019

(25) *Electrochemical activity of the polycrystalline cerium oxide films for hydrogen peroxide detection*, Kosto Y., Zanut A., Franchi S., Yakovlev Y., Khalkhan I., Matolin V., Prince K.C., Valenti G., Paolucci F., Tsud N., Applied Surface Science, 488, 2019

(26) *Ultimate dispersion of metallic and ionic platinum on ceria*, Tovt A., Bagolini L., Dvorak F., Tran N-D, Vorokhta M., Berenova K., Johanna V., Farnesi Camellone M., Skala T., Matolinova I., Myslivecek J., Fabris S., Matolin V., Journal of Material Chemistry A, 7, 2019

(27) *Chemical Stability of Mesoporous Oxide Thin Film Electrodes under Electrochemical Cycling: From Dissolution to Stabilization*, Alberti S., Steinberg P.Y., Giménez G., Amenitsch H., Ybarra G., Azzaroni O., Angelomé P.C., Soler-Illia G.J.A.A., Langmuir, 35 (19), 6279-6287, 2019

(28) *Strontium Titanate (SrTiO3) Mesoporous Coatings for Enhanced Strontium Delivery and Osseointegration on Bone Implant*, Escobar A., Muzzio N., Angelomé P.C., Bordoni A.V., Martìnez A., Bindini E., Coy E., Andreozzi P., Grzelczak M., Moya S.E., Advanced Engineering Materials, 2019

(29) *Role of carbon dissolution and recondensation in graphene epitaxial alignment on cobalt*, Jugovac M., Genuzio F., Lazo Gonzales E., Stojic N., Zamborlini G., Feyer V., Mentes T.O., Locatelli A., Schneider C.M., Carbon, 2019

(30) *Preparation of non-oxidized Ge quantum dot lattices in amorphous Al2O3, Si3N4 and SiC matrices*, Nekić N., Šarić I., Salamon K., Basioli L., Sancho-Parramon J., Grenzer J., Hübner R., Bernstorff S., Petravić M., Mičetić M., Nanotechnology, 30 (30), 335601, 2019

(31) *Ion irradiation driven changes of magnetic anisotropy in ultrathin Co films sandwiched between Au or Pt covers*, Mazalski P., Kurant Z., Sveklo I., Dobrogowski W., Fassbender J., Wawro A., Maziewski A., Journal of Magnetism and Magnetic Materials, 479, 332-336, 2019

(32) *How a ferromagnet drives an antiferromagnet in exchange biased CoO/Fe(110) bilayers*, Ślęzak M., Ślęzak T., Dróżdż P., Matlak B., Matlak K., Kozioł-Rachwał A., Zajac M., Korecki J., Scientific Reports, 9, 889, 2019

(33) *Encapsulation, Visualization and Expression of Genes with Biomimetically Mineralized Zeolitic Imidazolate Framework-8 (ZIF-8)*, Poddar A., Conesa J.J., Liang K., Dhakal S., Reineck P., Bryant G., Pereiro E., Ricco R., Amenitsch H., Doonan C., Mulet X., Doherty C.M., Falcaro P., Shukla R., Small, In press, 2019

(34) *The Assessment of Bone Deterioration with Nuclear Magnetic Resonance Spectroscopy in a Multidisciplinary Context: The Case of the UNESCO World Heritage Site of Sedlec, Czechia*, Viani A., Mácová P., Machová D., Čendak T., Archeometry, 2019

(35) *Degradation of ZIF-8 in phosphate buffered saline media*, Velàsquez.Hernàndez M.D.J., Ricco R., Carraro F., Limpoco F.T., Linares-Noreau M., Letner E., Wiltsche H., Rattenberger J., Schröttner H., Frühwirt P., Stadler E.M., Geschifft G., Amenitsch H., Doonan C.J., Falcaro P., CrystEngComm, 21 (31), 4538-4544, 2019

(36) *Adsorption of 5-Fluorouracil on Au(111) and Cu(111) surfaces*, Cassidy A., Tsud N., Bercha S., Feyer V., Prince K.C., Plekan O., AIP Advances, 9 (8), 85318, 2019

(37) *Electronic structure modifications induced by increased molecular complexity: from triphenylamine to m-MTDATA*, Zhang T., Brumboiu E. I., Lanzilotto V., Grazioli C., Guarnaccio A., Johansson F.O.L., Coreno M., de Sione M., Santagata A., Brena B., Puglia C., Physical Chemistry Chemical Physics, 21 (32), 17959-17970, 2019

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Scientific Highlights

Newly discovered isolating, conducting and magnetic material will make a fundamental contribution to future electronics and informatics[1]

Luca Petaccia

Daily life experience suggests that a material either can or cannot conduct electricity, which makes us speak of a conductor in the first case, and an insulator in the second. However, some materials have both characteristics at the same time. They are called topological insulators. If a paper sheet were a topological insulator, the central area would behave as an insulator, while the borders would conduct electricity. In addition, conduction would happen in a much better way than with classical conductors, which suffer from the Joule Effect caused by the chaotic movement of electrons during conduction. This is why devices, such as smartphone or computers, produce heat. In topological insulators, this effect is much lower, since their electrons move easily and in an ordered manner.

The first antiferromagnetic topological insulator was realized for the first time within the frame of an international collaboration of more than forty scientists from eight countries. The ground-breaking result of the study was published in Nature in December 2019.

All surfaces in topological insulators are conducting, while in topological magnetic insulators, some surfaces are conducting and some others are insulating, bringing increased flexibility in technological applications.

The importance of such a discovery is that, up to now, magnetic topological insulators have been produced by adding magnetic impurities to non-magnetic materials, thus limiting their final properties. In contrast, in this study, a material made of manganese, bismuth and tellurium was first theorized and then produced. The result is a **topological insulator with some peculiar intrinsic magnetic properties in the crystalline structure**. Such material was grown at the Polytechnic of Dresden (Germany) and at the Azerbaijan State Oil and Industry University in Baku (Azerbaijan). Its structure and properties have been confirmed with experiments in different labs, including those at the CERIC synchrotron facility Elettra in Trieste, Italy.

Luca Petaccia, co-author of this work and scientist in charge of the Band Dispersion and Electron-Phonon Coupling - BaDElPh synchrotron beamline at Elettra, stated:"This achievement is the result of international collaboration in which everyone gave their best with a strong commitment, allowing us to achieve this relevant result".

The applications of this new material may have an impact on electronics and informatics in the near future, and especially on spintronics. Spintronics is the future application of electronics not based on the movement and electrical charge of electrons, but on their rotation (spin), which can only assume two values, thus being compatible with current informatics binary systems. Future electrical components will thus be faster, less energy-consuming and will heat less.

"This achievement is the result of an international collaboration in which everyone gave their best with a strong commitment. This discovery could have a significant impact on future applications in electronics and informatics".

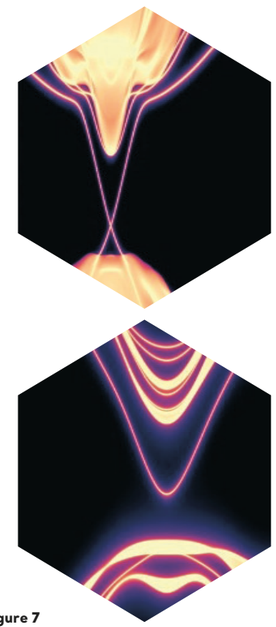


Figure 7
Graphic elaboration of the calculated surface electronic band structure

[1] *Prediction and observation of an antiferromagnetic topological insulator,* Otrokov M.M., Klimovskikh I.I., Bentmann H., Estyunin D., Zeugner A., Aliev Z.S., Gaß S., Wolter A.U.B., Koroleva A.V., Shikin A.M., Blanco-Rey M., Hoffmann M., Rusinov I.P., Vyazovskaya A.Y., Eremeev S.V., Koroteev Y.M., Kuznetsov V.M., Freyse F., Sánchez-Barriga J., Amiraslanov I.R., Babanly M.B., Mamedov N.T., Abdullayev N.A., Zverev V.N., Alfonsov A., Kataev V., Büchner B., Schwier E.F., Kumar S., Kimura A., Petaccia L., Di Santo G., Vidal R.C., Schatz S., Kißner K., Ünzelmann M., Min C.H., Moser S., Peixoto T.R.F., Reinert F., Ernst A., Echenique P.M., Isaeva A., Chulkov E.V., *Nature,* 576 (7787), 416-422, 2019, DOI: 10.1038/s41586-019-1840-9

Non-canonical DNA structures found in the control centre for the activation of HIV-1 genes[2]

After long and intense competition, the structure of DNA was described for the first time in 1953 by James Watson, Francis Crick, Rosalind Franklin and Maurice Wilkins. However, the secrets of DNA are still unfolding in front of our eyes. Other than the iconic double helix, DNA can also adopt alternative structures depending on conditions such as hydration, temperature, pH, and its primary sequence. In 2018, i-motifs were discovered in cellular DNA; they are a four-strand DNA structure that can be found in regulatory regions where there is an abundance of cytosines, one of the four letters of the DNA alphabet. These structures were found to be involved in the regulation and functioning of genes.

Sara Richter

Since then, several groups around the world have focused on the presence and role of i-motifs in human cells. In 2019, a research team led by **Sara Richter**, Professor at University of Padova and **Janez Plavec**, director of the Slovenian CERIC Partner Facility at the National Institute of Chemistry, highlighted the presence of this non-canonical DNA structure in viral DNA. The work was performed with a major contribution of **Dr. Emanuela Ruggiero**.

For the first time, i-motifs were found in the genome of HIV-1 virus, again in a regulatory region. Several instruments and techniques were employed to analyse and confirm the presence of i-motifs, including the 600 MHz Nuclear Magnetic Resonance at the SloNMR centre in Ljubljana.

Janez Plavec

"The results of this research not only provide valuable insights into the complexity of the HIV-1 genome, but also lay the necessary information for a possible innovative antiviral drug design".

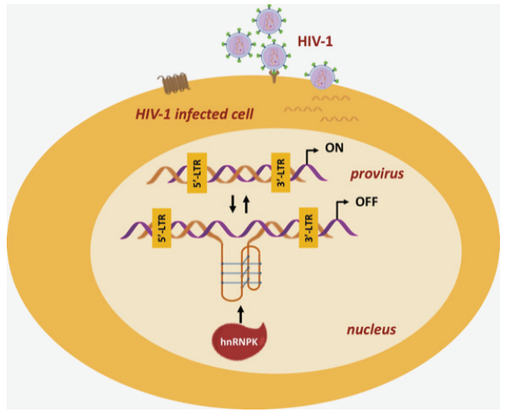


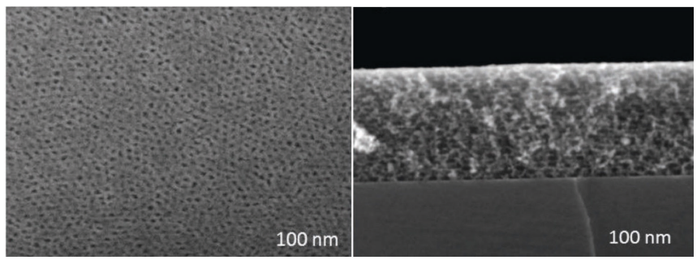
Figure 8
Scheme of an HIV-1 infected cell, showing the cell nucleus with the HIV-1 genome integrated into the host cell chromosome (provirus). The i-Motif structure identified in this work can form in the virus promoter region, be regulated by cellular proteins (i.e. hnRNPK), and, in turn, regulate the efficiency of virus transcription and replication (on-off signals). The peculiar i-Motif structure may serve as an unprecedented target for antiviral drugs.

The region in which the i-motif was found is a the control centre for the activation of HIV genes. The authors propose that these i-motifs are triggered during the infection to modulate viral processes. Moreover, the scientists demonstrated that a specific i-motif interacts with human ribonucleoprotein (hnRNP) K, a multifunctional protein involved in the regulation of various fundamental processes of human cells. The results of this research, which links the presence of i-motifs in the HIV-1 genome and their interaction with cellular proteins, not only provide valuable insights into the complexity of the HIV-1 genome, but also lay the necessary information for a possible innovative antiviral drug design.

[2] *A dynamic i-motif with a duplex stem-loop in the long terminal repeat promoter of the HIV-1 proviral genome modulates viral transcription*
Ruggiero E., Lago S., Šket P., Nadai M., Frasson I., Plavec J., Richter S.N., Nucleic Acids Research, 47 (21), 11057-11068, 2019, DOI: 10.1093/nar/gkz937

New approaches for bone implants[3]

A research study showed a novel approach directed towards the osseointegration of bone implants. To promote tissue recovery and reduce bacterial infections, the scientists used a mesoporous titania film (MTF) modified with a bone growth factor and embedded with an antibiotic.



Bone grafting is a surgical procedure that replaces a missing bone or part of it. This procedure might be necessary for recovery from a complex fracture or from the partial amputation of a bone following a bone tumour. The procedure poses a significant health risk because of possible infections or failed healing of the bone, which has a natural capacity to recover only if some conditions are met. Of these conditions, one of the most important is the absence of significant gaps between the extremities of the bone. To tackle this aspect, implants, usually made of titanium and its alloys, are widely utilized. Another relevant condition for healing is the presence of a rough surface, since it promotes cell adhesion and implant interlocking with the native bone.

Mesoporous materials are characterized by an ordered array of pores of a diameter between 2 and 50 nanometers, more or less 1/100 of the width of a human hair. Titania can be synthesized as a mesoporous material without compromising its mechanical properties, and the pores can be exploited to carry useful molecules for recovery, such as antibiotics, which inhibit bacterial infections, a major cause of implant failure.

A research study led by CERIC user **Prof. Sergio E. Moya** from the Center of Cooperative Research in Biomaterials, showed a novel approach in which a mesoporous titania film (MTF) was loaded with the antibiotic gentamicin and functionalized with a growth factor called human recombinant bone morphogenic protein 2 (hrBMP-2).

The tests showed an initial fast release of gentamicin within the first 6 hours, followed by a slower and prolonged release that lasted for 35 days. This profile meets clinical requirements, since an initial burst helps when the risk connected to the surgical procedure is higher, and a slow release helps during recovery. Gentamicin prevented the formation of colonies of Staphylococcus aureus, a bacteria that lives on the human skin and may cause infections during surgery.

For the use of growth factors, mesoporous titania film was tested with a precursor of the osteoblasts, one of the cellular components of bone. The presence of growth factors improved the adhesion of the osteoblasts to the scaffold and their proliferation, overcoming detrimental effects of the gentamicin on the osteoblasts.

The structure of the MTF was obtained at the Austrian SAXS synchrotron beamline in Trieste, Italy.

Figure 9
Two sections of the mesoporous titania film (MTF).

"We experimented with a novel approach using mesoporous titania films for bone implants, which promote tissue recovery and reduce infections".

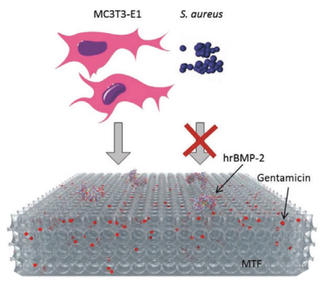


Figure 10
MTF loaded with gentamicin and growth factors prevented the attachment of S. aureus and promoted the attachment and differentiation of the osteoblasts precursors

[3] *Antibacterial Mesoporous Titania Films with Embedded Gentamicin and Surface Modified with Bone Morphogenetic Protein 2 to Promote Osseointegration in Bone Implants*
Escobar A., Muzzio N., Coy E., Liu H., Bindini E., Andreozzi P., Wang G., Angelo P., Delcea M., Grzelczak M., Moya S.E., *Advanced Materials Interfaces*, 2019
DOI: 10.1002/admi.201801648

Towards a better understanding of nano-porosity in cellulose nano-sponges[4]

In recent decades, water remediation has become a key environmental issue. Due to anthropic activities, its pollution level has increased and, unfortunately, with toxic and non-biodegradable contaminants. We now face a huge challenge to purify it. Several techniques have been studied and tested but the most effective and efficient remains adsorption, i.e., the adhesion of particles (atoms, ions, molecules) to a surface. New adsorbent materials have been developed in recent years to answer technical and societal criteria: high adsorption efficiency, easiness to manipulate and recover, low financial cost and environmental impact. Cellulose nano-sponges developed in recent years at Politecnico di Milano are a promising solution.

Cellulose is a natural compound, a long linear chain of D-glucose, found in green plants and algae. In order to obtain nano-sponges, it is necessary to modify this polymer. The first step is to "break" the long linear chain to get cellulose nano-fibres (CNF). The second step is to confer linkable properties to these CNFs, so they can be re-structured to provide highly porous materials. To do so, the fibres are first oxidized in the presence of TEMPO [1] radical, and then ultra-sonicated, leading to the formation of nano-fibres. These are then cross-linked in the presence of a polyamine polymer (bPEI), following thermal treatment, providing cellulose nano-sponges (CNS).

CNS have been successfully tested to rid water of heavy metals, as well as in drug delivery applications. Their properties have been studied from many angles. However, one was still a hypothesis: their nano-porosity.

A joint project between two research groups from Politecnico di Milano and the University of Messina, led by young researchers **Andrea Fiorati** and **Giuseppe Paladini**, respectively, focused on this property with a structural study using the Small Angle Neutron Scattering (SANS) technique at the Budapest Neutron Centre, the Hungarian CERIC Partner Facility. They examined several CNS compositions, differing in the ratio between TOUS (TEMPO oxidized and ultra-sonicated)-CNFs and bPEI, and in the presence or not of an additional compound – citric acid – which confers stability to CNS. The first observation showed a random repartition of CNFs within the nano-sponge. This was expected because of the thermal method used to produce the nano-sponges. Hydration does not affect the randomness of the CNFs repartition; however, it modifies the structure of the sponge at two different length scales. Moreover, for a CNS containing more bPEI, hydration leads to an inhomogeneous density of the nano-fibres. The researchers also analysed their experimental results with a correlation length model (CLM), a mathematical model based on the experiments that enables more precise characterisation of what happens at the nano-scale. This CLM analysis provided confirmation of the nano-porosity in the TOUS-CNFs network and the importance of the TOUS-CNFs/bPEI ratio in the behaviour of a sponge when hydrated. It also confirmed the role of citric acid as a stabilizer, since it confers rigidity to the CNS. Further investigations are still necessary to have a better understanding of CNS behaviour, but the work of Paladini, Fiorati and co-workers paves the way to adapt CNS composition and functionality, depending on the required application.

"We had a useful insight on nano-porosity of the cellulose nano-sponges that we have been developing, which represent a promising environmentally-friendly solution for water remediation, or drug delivery applications".

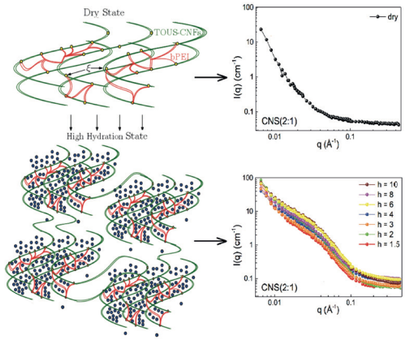


Figure 11
Images on the left show that hydration leads to inhomogeneous conformation for higher b-PEI concentrations. Graphs on the right show that hydration modifies the nanosponges' structures at two different length-scales

Note [1] TEMPO: 2,2,6,6-tetramethyl-1-piperidinyloxy

[4] *Cross-linked cellulose nano-sponges: a small angle neutron scattering (SANS) study*
Paladini G., Venuti V., Almásy L., Melone L., Crupi V., Majolino D., Pastori N., Fiorati A., Punta C., *Cellulose.*, 2019
DOI: 10.1007/s10570-019-02732-2

Manganese-doped nanowires with tuneable magnetic properties pave the way towards more efficient electronic devices[5]

In December 1959, the physicist Richard Feynman gave an inspiring lecture entitled “There’s plenty of room at the bottom” where the Nobel Prize winner considered the possibility of manipulating materials at the atomic and nanoscale level, thus predicting the advent of nanotechnology. Spintronics, also known as spin electronics is a field of research that largely relies on nanotechnology.

While conventional electronics relies on the electrical charge of the electrons moving in a semiconductor, spintronic exploits another fundamental property, the “spin”. An electron’s spin can have two orientations, “up” or “down” and it can be influenced, and thus changed, by a magnetic field. Spintronic research therefore has a strong focus on materials with specific and tuneable magnetic properties. The long-term dream is the construction of a new generation of spintronic devices, which would be smaller, faster and less energy-consuming.

Dr. Katarzyna Hnida-Gut and her colleagues, led by **Prof. Marek Przybylski**, from the AGH University of Science and Technology, conducted a study which reports the successful synthesis of manganese-doped nanowires made of indium antimonide. A pulse electrodeposition technique allowed the preparation of nanowires in which the magnetic response could be easily tuned by varying the concentration of the dopant. X-ray absorption spectroscopy allowed the determination of the chemical state and the local structure of the material. This technique was executed at the PEEM/XAS beamline at the Polish CERIC Partner Facility at the National Synchrotron Radiation Centre SOLARIS in Krakow.


Katarzyna Hnida-Gut

“The results we obtained not only affect the development of the semiconductor nanotechnology, but above all represent a milestone in the design of materials for modern, efficient electronic devices used in everyday life”.

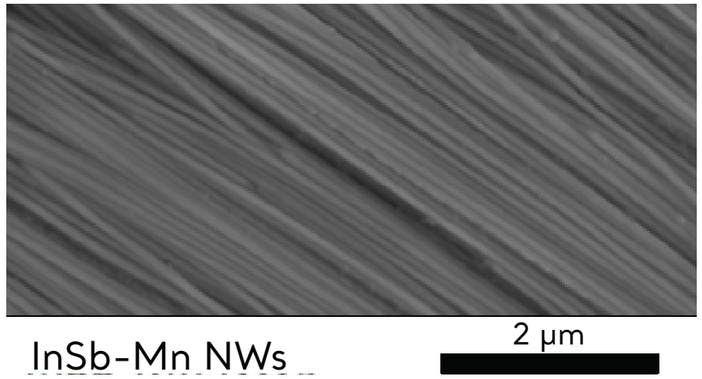


Figure 12
EM (Scanning electron microscope) photo of electrodeposited Mn-doped InSb nanowires

The study showed that the electrodeposition technique is a straightforward way of producing large amounts of high-quality nanowires with tuneable magnetic properties, which exhibit a ferromagnetic response at room temperature and above. Ferromagnets, once influenced by a magnetic field, can hold the “information” without further inputs, thus allowing the storage of that information without keeping electrons moving, as in current electronic devices, such as RAMs. Moreover, the possibility of providing these features at room temperature and above brings future spintronic devices closer to real-life applications.

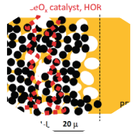
[5] *Room-Temperature Ferromagnetism in InSb-Mn Nanowires*, Hnida K.E., Żywczak A., Sikora M., Marciszko M., Przybylski M., Nano Letters 2019 19 (10), 7144-7148
DOI: 10.1021/acs.nanolett.9b02690

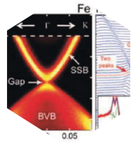
Internal Research Projects

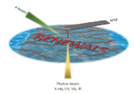
Four projects selected within the frame of the 2016 Call for Research Grants were funded between 2017 and 2019, to an amount up to 150,000 EUR/12 months, for a 3-year period. Funding is allocated by CERIC each fiscal year, subject to a positive outcome of the yearly progress evaluation made by ISTAC. The overall contribution of MIUR for the abovementioned projects amounts to € 1,750,530. The partners have contributed in-kind a total amount of € 5,659,474.

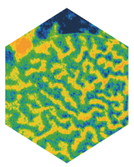
The goal of the funding is to foster the integration of national multidisciplinary facilities into a unique EU-level distributed research infrastructure for the analysis and synthesis of materials and for sample preparation. It also aims to contribute to the scientific excellence of the staff.

The projects funded are the following:
CEROP (Deciphering single-atom catalysis in Pt/ceria systems via advancing the CERIC operando methods) aims at developing in-operando experimental methods to study the process of heterogeneous catalysis under realistic conditions. This will enable a deeper insight into catalysis and will help in designing more efficient catalysts.
Dyna Chiro (Spectroscopy and Dynamics of Chiral Systems) focuses on the development and construction of special synchrotron-suitable instrumentation to investigate the chiral and dynamic properties of matter. The results of this investigation have a wide range of applications, from synthesis of new polymers to drug design.
RENEWALS (Graphene for Water in Life Sciences) addresses the growing issue of possible toxic and physiological effects of nanoparticles. The basis of the project is the development of a graphene-based liquid cells for multi-technique analysis of hydrated cellular samples and their interactions with nanoparticles.
MAG-ALCHEMI (Magnetic Anisotropy Grafting by Means of Atomic Level Chemical Engineering at Film Interfaces) focuses on magnetic materials and aims at developing tools to control thin magnetism via interfacial engineering. The main goal is to devise novel means of tuning the magnetic state of matter by appropriately modifying the interface chemistry, towards further developments in the architecture and performance of various devices.









The progress of all projects was positively evaluated by the International Scientific and Technical Advisory Committee of CERIC in 2019.

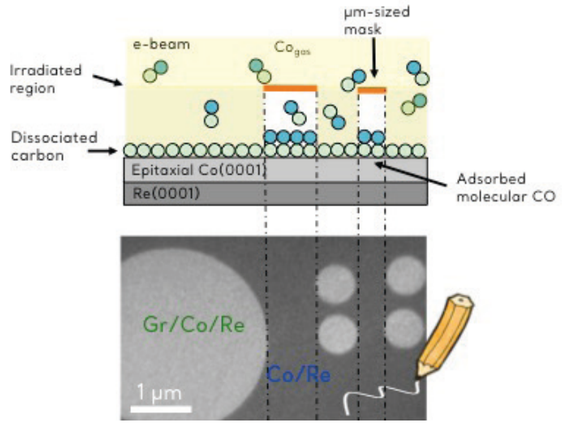
Another CERIC internal research project is "**Nanoanalytics for Pharmaceutics**", with Dr. **Aden Hodzic** as principal investigator. In the project, various nano-analytical techniques are used to develop drug formulations and release them in solid, liquid-crystal and liquid states, enclosed in active pharmaceutical ingredients (APIs). The work is based on a methodology based on nano-analytics, which predicts the dissolution and structural properties of tested drugs in a time range of minutes. Once applied, the research will impact the therapeutic performance of nano-systems.

Surface graphitization by microfocused soft X-rays and electron beams[6]

Since the beginning of the 20th century, our data storage has been based on magnetic devices, from magnetic tapes to hard disks. In these devices, the information is saved as a magnetized sector of the tape, or disk, and technological advances have allowed their miniaturization. As an example, the areal density increased by five hundred million times from 1956 to 2014, having an impact also on the cost per gigabyte, which decreased from nine million dollars to two cents from 1957 to 2018, thus allowing the construction of small but powerful devices, such as smartphones and tablets. To achieve further advances, it is fundamental to be able to manipulate magnetic regions with new techniques.

The CERIC project **MAG-ALCHEMI** aims at developing tools to control thin-film magnetism via interfacial engineering. The capacity to control the magnetic state locally is pursued through lithographic methods. In fact, lithography allows structures with arbitrary shapes to be sculpted by removing or adding atomic species on surfaces with remarkable accuracy.

Research by **Francesca Genunzio, Andrea Locatelli**, scientists at the CERIC synchrotron facility in Trieste (Italy), and colleagues,highlighted the possibility of using photons and electrons to manipulate a magnetic substrate at the nanometric scale. The researchers were able to deposit a layer of carbon atoms over a thin cobalt film. This result was achieved by adsorption of carbon monoxide (CO) followed by microfocused soft X-rays or electron beams. This procedure stimulates CO dissociation and the release of oxygen, thus leaving a layer of carbon atoms. The process was monitored in real-time by Fast-XPS and XPEEM.



The results show that, in the case of soft X-rays, the dissociation probability increases with the energy of the photons. At the same time, low energy electrons in the range of 50-200 eV dissociated CO more efficiently than did X-rays. After stimulated CO dissociation, the thin layer was heated, causing the desorption of the carbon monoxide molecules in non-irradiated regions. The remaining graphitic overlayer modified the magnetic anisotropy of the cobalt film and protected it from oxidation in ambient conditions, therefore enabling the sample transfer without protection. A remarkable feature for ultra-thin magnetic films.

Andrea Locatelli
Francesca Genuzio
Tevfik Onur Mentes

"Our work establishes a novel method of fabricating graphene, which we combine with thin ferromagnetic layers to modify their local magnetic properties, and thus engineer new layered nanostructures at the nanoscale".

Figure 13
Top: scheme of the lithographic method on which the growth of arbitrary graphene patterns on a CO thin film is based. A focused electron beam irradiates the sample surface through a mask, in the presence of CO molecules in the gas phase. Due to the interaction with the electrons, the CO molecules dissociate only in the irradiated regions not covered by the mask, leaving carbon atoms on the surface. A final annealing step removes the undissociated molecules from the surface and allows the reordering of C atoms into graphene.
Bottom: image acquired with a low energy electron microscope (LEEM) showing the results of the litographic procedure. Bright regions were irradiated by the electron beam and are covered by graphene.

[6] *Stimulated CO Dissociation and Surface Graphitization by Microfocused X-ray and Electron Beams*
Genuzio F., Genoni P., Onur Mentes T., Santos B., Sala A., Lenardi C., Locatelli A., Journal of Physical Chemistry C, 2019, DOI: 10.1021/acs.jpcc.8b09043

Oxidation atmosphere extends catalyst lifetimes[7]

The cover of a leading chemical journal, *The Journal of Materials Chemistry A* highlighted a study by scientists from the Faculty of Mathematics and Physics in Charles University, Prague, identifying, at the atomic level, the mechanisms contributing to the long-term stability and high activity of industrially relevant catalysts.
The structure of the catalysts employed in chemical production, environmental applications or in the conversion of energy from renewable sources often comprises precious metal nanoparticles supported on oxide substrates. Catalyst operation at high temperatures is accompanied with a non-desired effect of coarsening. To minimize their surface energy, precious metal nanoparticles merge into larger particles, like water droplets on a fogged window. With increasing particle size, however, their catalytic activity decreases, and the coarsening can ultimately result in catalyst deactivation.

Josef Mysliveček
Charles University
Czech Republic

"With this study, we got a better understanding of the mechanisms contributing to the long-term stability and high activity of catalysts with industrial applications in the chemical and environmental sectors".

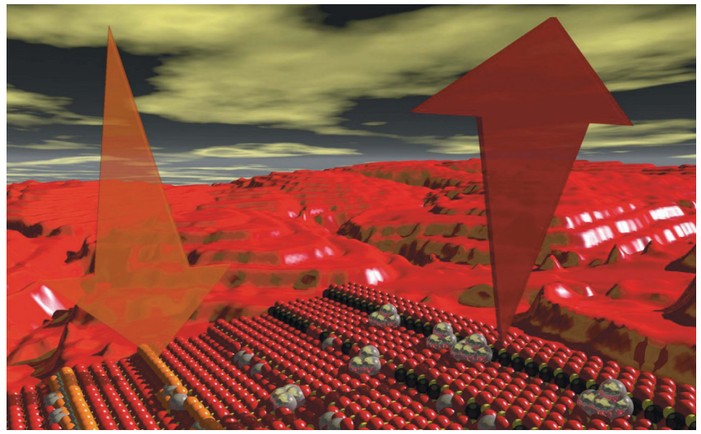


Figure 14
Smallest Pt objects on oxidized (left) and reduced (right) surface of CeO_2.

Cover image reproduced by permission of Josef Mysliveček and The Royal Society of Chemistry from J. Mater. Chem. A, 2019, 7, 13019-13028, https://doi.org/10.1039/C9TA00823C."

Experimentalists from the Charles University in Prague (Czech Republic), together with theoreticians from the Institute of Materials of the Italian National Research Council (CNR-IOM) and from CERIC, have been investigating possible strategies for avoiding the deactivation using a reverse process, so-called redispersion. On suitable substrates and under suitable chemical conditions, a new energetic state of the catalyst can be achieved, in which small nanoparticles become energetically more favourable.

The study, which was conducted in the frame of the CERIC internal research project **CEROP**, explains the mechanism of redispersion at the atomic level in the industrially relevant catalyst Pt on CeO2 (ceria). It appears that energetically the most favourable configuration of Pt in an oxidizing atmosphere are the smallest achievable objects – isolated atoms of Pt bonded at surface defects of CeO_2 and to excess oxygen atoms.
Application of an oxidizing atmosphere thus triggers dissolution of Pt nanoparticles and an extended lifetime of the catalysts. It is interesting to note that the isolated surface bonded Pt atoms are inactive for a range of chemical reactions. In these cases, the application of an oxidizing atmosphere may represent a technological step towards setting up the optimal size of Pt nanoparticles and for maximizing catalyst activity.

Source: Faculty of Mathematics and Physics of the representing entity of the Czech Republic in CERIC, Charles University in Prague

[7] *Ultimate dispersion of metallic and ionic platinum on ceria*, Tovt, A., Bagolini L., Dvorak F., Tran N-D, Vorokhta M., Beranova K., Johanek V., Farnesi Camellone M., Skala T., Matolinova I., Myslivecek J., Fabris S., Matolin V., Journal of Materials Chemistry A, 7, 2019, 13019, DOI: 10.1039/C9TA00823C

Unravelling the growth mechanism of co-precipitation of iron oxide nanoparticles with the aid of synchrotron X-Ray diffraction in solution[8]


Aden Hodzic

Applications involving iron oxide nanoparticles (IONPs), and nanomaterials in general, are expected to provide solutions to many problems in the fields of healthcare, energy and the environment. Magnetic nanoparticles (such as IONPs) have been in the exploratory stage for cancer diagnostics (e.g., in the form of magnetic resonance imaging contrast agents) for more than three decades. However, success stories are rare, partly due to the limited performance of commercially available nanoparticles, related to particle quality attributes such as size and shape, polydispersity, crystallinity and surface chemistry. Moreover, there seems to be a gap to the application of these materials in order fully to exploit their enhanced capabilities. This is also due to obstacles such as low yield, and the robustness and reproducibility of the synthesis method. Detailed studies on nanoparticle formation mechanisms are thus essential to guarantee that successful syntheses can be performed and reproduced at various research institutions at small to large scales.

The work conducted in the frame of the CERIC internal research project **Nanoanalytics for pharmaceutics** reresents such a detailed study, unravelling the growth mechanism of the co-precipitation of IONPs in solution with the aid of synchrotron X-Ray diffraction (XRD).

Since co-precipitation (the most commonly used synthesis for IONPs) features rapid particle formation after mixing the precursor solution containing iron salts with an alkaline solution, the analysis of initially formed particles and identification of possible intermediate phases before the transition to the desired magnetic forms magnetite and/or maghemite, is challenging. To guarantee fast and reproducible mixing conditions, a flow reactor was utilized for the mixing step. Collected particles were then analysed via Transmission Electron Microscopy, Mössbauer spectroscopy and XRD, in combination with a flow cell allowing the study of the crystalline phases occurring during the synthesis in solution. The signal strength of the synchrotron radiation facilitated the collection of XRD spectra at a frequency that was enough to resolve the dynamics changes of the precipitated particles.

The results revealed that two initial phases were formed during direct mixing of the iron chloride precursor solution with a solution of sodium carbonate. The phases were a poorly crystalline ferrihydrite phase formed primarily of $Fe^{3+}$and crystalline iron hydroxide carbonate plates made primarily of Fe^{2+}. The iron hydroxide carbonate concentration decreased over time, and disappeared after 3-4 min of reaction. The ferrihydrite phase grew with time from 2 nm particles, until it transitioned to magnetite/maghemite when the particles reached ~4 nm in size, which happened after 3–4 min of reaction. The ferrihydrite phase acted as seeds that grew into the eventual magnetite/maghemite particles, while the iron carbonate plates acted as a feedstock to supply the iron ions for the particles to grow and the phase change to occur. Without the presence of Fe^{2+} in solution, the formation and growth of magnetite/maghemite NPs did not occur.

Understanding this mechanism is essential not only for robust synthesis, but also to tune particle properties for targeted applications. In particular, the growth mechanism shows a separation of the nucleation and growth stages in the reaction which will allow chemists greater control over the size of the nanoparticles that can be readily synthesised via co-precipitation.

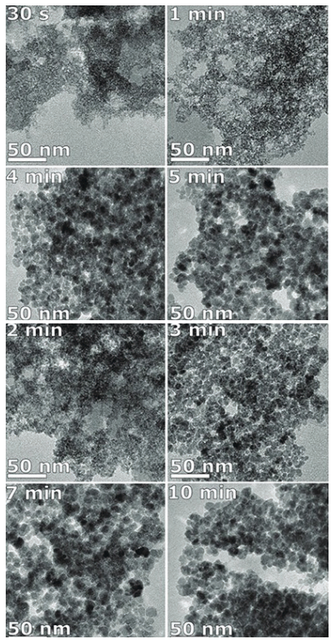


Figure 15
Transmission Electron Microscopy - TEM images of the nanoparticles formed after 30 s, 1, 2, 3, 4, 5, 7 and 10 min of reaction

[8] *Unravelling the growth mechanism of the co-precipitation of iron oxide nanoparticles with the aid of synchrotron X-Ray diffraction in solution,* LaGrow A.P., Besenhard M.O., Hodzic A., Sergides A., Bogart L.K., Gavrilidis A., Thanh N. T.K., *Nanoscale,* 2019, 11, 6620-6628, DOI: 10.1039/C9NR00531E

Infrastructure's Evaluation and Upgrade

ISTAC evaluation of CERIC's Croatian and Hungarian PFs and expanstion of the Polish PF

With the support of ISTAC, CERIC conducts a periodical evaluation of its PFs. The scope is to assess their performance in terms of the quality of their scientific activities and their contribution to the common strategic objectives, purposes and access capabilities of CERIC. Another goal is to appraise the added value for the facilities, of their inclusion in CERIC. The periodic evaluation of the Croatian and Hungarian Partner Facilities (PFs) took place in May and October 2019, respectively. After site visits to Zagreb and Budapest, the evaluators positively assessed both facilities.

The **Croatian PF** at the Ruđer Bošković Institute in Zagreb was evaluated by ISTAC members **Karsten Horn**, **Salvador Ferrer** and **Giorgio Paolucci**, and external experts **Jan Meijer** and **Federico Picollo[9]**. The Committee of Evaluators (CoE) found the research performed by the Croatian Partner Facility to be scientifically excellent and of international relevance. The PF was also considered a very relevant part of CERIC's offer, as also testified by the 100% of users very satisfied with the support and with the performance of the instruments. The infrastructure investments proposed by the PF were considered well balanced and they address the needs of CERIC users. The CoE recommended enhancing the relationship with the university and further exploiting the potential for life sciences. Finally, considering that data analysis is highly demanding in terms of competences and time, the CoE suggested that the PF should increase the number of specialised personnel devoted to user support.

The **Hungarian PF** at the Budapest Neutron Centre was evaluated by ISTAC members **Michel van der Rest** and **Andrew Harrison**, and external experts **Jaime Segura Ruiz** and **Vladimir Hutanu[10]**. The CoE concluded that the PF is relevant to the international community and well-integrated in the EU, playing an increasingly important role in the education and training of qualified users, especially in view of the reduction of neutron instruments available to Europe's scientists in the future. The staff appeared highly motivated and prepared to welcome users. However, the fraction of CERIC users in the total access of BNC is limited. The CoE therefore recommended establishing measures to increase the number of CERIC users and their publications.

In May 2019, ISTAC also positively assessed the proposal by the **Polish PF** at SOLARIS, to extend the Partner Facility with a new instrument, a state-of-the-art Transmission Electron Microscope - Krios™ G3i Cryo-TEM. In June 2019, the CERIC General Assembly approved the proposal and the Cryo-EM was already made available to the user community in the following call for proposals.

Towards CERIC's science strategy and research roadmap

In June 2019, the General Assembly of CERIC approved the outline of CERIC's science strategy and research roadmap upgrade. Based on this deliberation, CERIC has been invited to focus increasingly on and elaborate further the fields of energy materials and life sciences. The activities proposed by ISTAC in this regard were approved in November 2019. In the field of batteries, a CERIC roadmap will be produced by an external scientific advisory group of appointed renowned experts, which will be tasked to propose priority infrastructures that could be added to CERIC's list of techniques. In parallel, the specific community in the field of batteries will be addressed, and part of the access will be specifically dedicated to the field of batteries. In the life sciences' domain, it was proposed to strengthen cooperation with other RIs with a focus in this field, while the BoD will support CERIC in identifying the priority list of high-end midscale instruments or laboratories for research in this field.

[9] Karsten Horn (staff scientist at the Fritz Haber Institute of the Max Planck Society in Berlin and adjunct Professor of Physics at the Freie Universität Berlin), Salvador Ferrer (associate director of Alba Synchrotron Light Source in Barcelona), Giorgio Paolucci (at the time of the evaluation, scientific director of SESAME Synchrotron, and currently chief scientific officer at Elettra Sincrotrone Trieste), Jan Meijer (professor at Universität Leipzig) and Federico Picollo (researcher at University of Turin).
[10] Michel van der Rest (former director of synchrotron SOLEIL), Andrew Harrison (CEO at Diamond Light Source), Jaime Segura Ruiz (beamline scientist at the European Synchrotron Radiation Facility – ESRF) and Vladimir Hutanu (scientist at the research Neutron Source FRM II).

2

Training, Industrial Liaison, Communication, Projects

Main Achievements

1. **Educational projects**
Successful implementation of the 4th edition of the training programme for seven scientific high schools (PaGES 4), co-funded by the Italian Region Friuli Venezia Giulia.

2. **Training**
of PhD and post-doc students.

3. **Definition of the Intellectual Property (IP) Framework**

4. **Organization of events**
to increase awareness of CERIC's offer and services among both scientific and industrial communities.

5. **Transnational cooperation**
in four EU-funded projects.

Training Activities

Education and skills development is a core value for CERIC. The promotion of training activities was also supported in 2019, through the organization, and attendance by schools, of lectures, workshops, staff exchanges and master programmes. Some of the actions implemented are presented below.

Training high-school pupils. The PaGES 4 project

The PaGES 4 project is an educational project co-funded by the Italian region Friuli Venezia Giulia, targeting pupils from seven scientific high schools. By carrying out all the steps of a scientific experiment, participants acquired the basic tools for planning, management, execution and evaluation of a research project, and for the dissemination of its results.
A wide programme of lectures in the schools and hands-on training in the labs at the CERIC synchrotron facility in Trieste (Italy) empowered pupils to make more conscious choices for their future career. Lectures focused on project management and business planning, technology transfer and science communication, chemistry and physics, data collection and data analysis. One hundred and forty-six pupils took part in the project, as well as fifteen schoolteachers, six experts in the topic of non-scientific training, and a total of thirteen expert scientists, PhD students and post-doc researchers. At the end of the project, pupils presented the results of the experiments in public events organized in each school, for schoolmates, teachers, local authorities, representatives from industry and the general public. Outreach activities in the frame of PaGES4 involved nearly one thousand people.

Training PhD students and young researchers

To be sustainable in the long-term, CERIC strives to train young researchers and attract new users to its facilities. To this end, the scientific opportunities available in CERIC, as well as scientific use cases and research studies performed by CERIC users in fields spanning energy, health, cultural heritage, the environment and more, were presented to research communities from various institutes in Bulgaria and Ukraine. Moreover, the Central European Training School on Neutron Techniques (CETS2019) organized by the CERIC Hungarian Partner Facility in Budapest, provided insights on neutron scattering techniques and their application for studies on the structure and dynamics of condensed matter, to PhD and master students, post-doc scientists and newcomers to neutron research.
CERIC was also invited to present its experience on building a network between industry and research entities to around 80 industrial PhD students at a course on transversal competences promoted by the Consortium of University Service of Catalonia.

Human capital development at CERIC and beyond

CERIC has been making continuous efforts towards training and capacity building its staff and managers, adopting a lifelong learning approach.
In the frame of the H2020 Accelerate project, CERIC continued the capacity building activity for industrial liaison and technology transfer (IL/TT) staff of its PFs, through open periodical online webinars carried out by international experts throughout the whole of 2019, with a focus on a wide set of topics connected to IL and TT. Other institutions were also invited, to strengthen the innovation ecosystem among European research entities. In 2019, seven webinars were provided to more than 100 people from PFs and other institutions.
In the domain of administration, the Chief Administrative officer of CERIC, Andrea Santelli, completed an Executive Master's Degree in Management of Research Infrastructures in March 2019, awarded by the University of Milano Bicocca. The Master's Degree was part of the H2020 RItrain project, the Research Infrastructure Training Programme, aimed at improving and professionalizing the training of managerial and leadership staff in research infrastructures (RIs). The master thesis "Managing, reporting and accounting in-kind contributions (IKC) within a distributed RI" covered topics spanning the definition and relevance of IKCs within the ERICs' context, the definition of critical aspects, evaluation criteria, processes and operative rules to be adopted, a description of the applicable financial accounting standards, and VAT and excise issues related to IKCs' management.

Industrial Liaison Activities

During 2019, CERIC succeeded in defining the latest operative procedures regarding collaboration with industry and innovation management. After defining and putting in place its operational and marketing strategy in the previous year, CERIC defined the Intellectual Property (IP) Framework in order to regulate rights on the background and any foreground arising from collaboration within the CERIC-ERIC framework.

In relation to the marketing strategy deployment, direct marketing actions targeting industry were carried out during 2019. CERIC has reached agreements for analytical services and contract research with companies from Italy and Austria in the Pharmaceutical and Engineering sectors. The consortium acted either as coordinator of the services offered, or as liaison for the PF that actually signed the contract. The total value of those contracts with industry is 107,350.00 EUR.

CERIC also worked intensively on enlarging the industrial network by creating additional opportunities to work with industry: in 2019, the Industrial Liaison Office (ILO) supported the organization of and/or participated in four Research to Business (R2B) events, in Belgium, Germany, Sweden and the United Kingdom, at which CERIC opportunities and solutions for industry were presented. In addition, some of the partner facilities were present and/or presented to showcase their industrial solutions and their innovations. In the workshop organized in Lund (Sweden) in the frame of the H2020 Accelerate Project, innovations from various European research institutes and universities were showcased to a panel of experts in order for the best one to receive further support for transferring it into the market. CERIC invited its PFs to be among the contestants, supporting the costs of participation. An innovation coming from CERIC's Austrian Partner Facility was finally selected by the innovation committee as the best idea to receive dedicated support to be promoted to industry.

CERIC's strategic goal is also to strengthen the whole innovation ecosystem among European stakeholders, both public and private. In order to accomplish it, it was agreed that CERIC can also take a central role in supporting the Representing Entities (REs) of the Consortium, to boost their relationship with industrial stakeholders: an agreement was approved by the GA and presented to the REs, aimed at fostering industry's involvement, as well as investment opportunities for CERIC's Representing Entities and the owners/hosts of CERIC partner facilities.

CERIC staff and members attended a number of international events, including:

Industry Satellite Session during at DESY and the European XFEL User Meeting
Schenefeld - Germany
24 January 2019

Accelerate Your Idea: Technology transfer – industry networking combined workshop event
Lund - Sweden
7-8 March 2019

EUROFINISH + Materials 2019
Leuven - Belgium
15-16 May 2019

Communication and Dissemination

Strengthened communications networks across RIs in Europe

In 2019, CERIC took the lead in communications and dissemination work packages in the frame of two European projects, ERIC Forum and PaNOSC, strongly contributing to coordinating and strengthening interactions with communication experts throughout Europe, in the fields of ERICs' regulation, and EOSC and Open Data policies and practices, respectively. With reference to the latter, CERIC took part in a first action aimed at coordinating and harmonizing activities across EOSC cluster projects. In the frame of the ERIC Forum, a useful interactive map was created and published in the project's website, making it possible to search for ERICs by cluster, by country and by year of implementation.
CERIC's communications officers have actively taken part in the Research Infrastructure Communication and Engagement of RIs Working Group set up by the European Research Facilities Association, towards the organization of joint actions in the frame of the Science in the City Festival at ESOF 2020 in Trieste. In the frame of the H2020 RI-VIS project, aimed at increasing the visibility of RIs, CERIC's staff actively contributed to the definition of the content for the Communications Toolkit for Research Infrastructures, having as targets professionals from RIs working in this domain.

Release of a brochure for CERIC's promotion to industry

To present CERIC's offer to industry, a set of banners for online use and a brochure for distribution at events targeting different industrial sectors have been developed. The brochure consists of a general section highlighting the different services available for industry, and a modular section including cards describing the possible applications and solutions that CERIC may provide in eleven different industrial sectors. The content is based on the CERIC's Handbook for Commercial Access released in the frame of the Accelerate project.

Outreach Events

To increase awareness among the scientific community worldwide about the research opportunities that it offers, CERIC was presented at a number of events, including:

NESY Winterschool 2019
Altaussee - Austria, 4 March 2019

ECAART 13
Split - Croatia, 5-10 May 2019

School Conference of Young Scientists - Modern Material Science: Physics, Chemistry, Technology
Uzhhorod - Ukraine, 27-31 May 2019

Central European Training School on Neutron Techniques - CETS 2019
Budapest - Hungary, 5-10 May 2019

Materials for Today's Energy Challenges Workshop
Padova - Italy, 3 June 2019

EuroNanoForum 2019
Bucharest - Romania, 12-14 June 2019

Flow Synthesis of Multi-Scale Materials - FLOWMAT 19
Paris - France, 26-27 June 2019

Outreach event at the Bulgarian Academy of Sciences
Sofia - Bulgaria, 12 December 2019

Transnational Cooperation

Transnational cooperation is also implemented through CERIC's transnational projects. Four projects were running in 2019:

Horizon 2020 ACCELERATE project

CERIC coordinates the ACCELERATE project, which aims to support the long-term sustainability of largescale research infrastructures (RIs) through the development of policies and legal and administrative tools for more effective management and operation of RIs, with a particular focus on ERICs and CERIC.

In 2019, the following deliverables were finalised:

- **D1.3 General protocol for RIs societal impact assessment:** The protocol - developed by KNAW-RI, with the collaboration of project partners CERIC, ESS, ELI-DC, HZG, FRM II, describes an approach to societal impacts of research infrastructures (RI) and ERICs. The use of such a protocol serves to improve the possibility of anticipating, managing, monitoring and evaluating societal impacts, and enables the evaluation of societal impacts.
- **D1.4 Report on the application of the general societal impact protocol:** The document contains the reports on societal impacts of CERIC, ELI-DC, ESS, FRM II & HZG, which were written with the assistance and advice of KNAW-RI, on the basis of the draft protocol published in D1.3. In addition to the reports, the deliverable includes an introduction and reflection by KNAW-RI on the lessons learnt and on the implications for the final protocol, and a procedural description of the process.
- **D1.5 Societal impact of research infrastructures final protocol:** The deliverable is the second and final version of the protocol initially developed by KNAW-RI in D1.3 for the evaluation of societal impact, with the contribution of and for the project partners, CERIC, ELI-DC, ESS, FRM II and HZG. The approach is built on expertise, evaluation studies and academic concepts and relates to RIs' and ERICs' policy developments. In this latest version, some aspects are more articulated, and more attention is paid to the development of impact pathways. A concise introduction to the RI and its societal impact has also been added.

Horizon 2020 E-RIHS PP project

The European Research Infrastructure for Heritage Science Preparatory Phase project started in January 2017, coordinated by the Italian National Research Council.
In 2019, CERIC contributed to the achievement of an important goal linked to the IKCs of the future ERIC, with the submission of deliverable D3.4. The document aims at identifying the main foreseeable types of in-kind contributions, as well as defining a methodology for the accounting of in-kind resources, taking into account the specific needs of E-RIHS. The methodology was proposed in December 2019 and accepted by the partners on the occasion of the annual project meeting held in Evora (Portugal) in January 2020.
The document is in line with the governance structure of E-RIHS, its business model, Statute, internal rules and procedures, as well as with the list of services that will be provided by the new ERIC.

Horizon 2020 PaNOSC Photon and Neutron Open Science Cloud

The Photon and Neutron Open Science Cloud (PaNOSC) project is a EU funded project aiming to provide common policies, strategies and solutions for enabling Open Science through the adoption of FAIR principles.
In 2019, to make scientific data produced at Europe's major PaN sources fully compatible with the FAIR principles, PaNOSC partners have drafted a new Data Policy framework addressing FAIR principles, which will be finalised in 2020 and proposed for adoption by the partners.
For the proper implementation of FAIR data, PaNOSC partners have started to establish a useful set of metadata, and to design an extensible query API (Application Programmers Interface) that enables a search on these terms. Partners are committed to implement this API through their data catalogues to allow a federated search across the catalogues of all facilities involved. Such a federated data catalogue will be a major entry point to further services and software for data analysis and simulation, which will also be developed in the frame of the project.
The final aim is to provide a common portal offering access to the remote data analysis services at each facility, allowing users to analyse experimental data through both remote desktops and Jupyter notebooks.
The PaN Authentication and Authorization Infrastructure (AAI) service UmbrellaID is being integrated with the eduTEAMS service operated by GEANT, to provide full compatibility of our community AAI with EOSC and the other community services.
Training courses and workshops for staff and users are also foreseen in the frame of PaNOSC, both face-to-face and through the e-learning platform at www.pan-learning.org.

Horizon 2020 ERIC Forum project

The ERIC Forum was set up in May 2017 with the goal of further intensifying collaboration among ERICs. In particular, its objectives are to identify and develop collective responses to common challenges, contribute to the further development of the ERIC Regulation and ESFRI framework, as well as to the European and international research context, and to foster the visibility, impact and sustainability of ERICs. The ERIC Forum project has built on this previous experience and officially started in January 2019, to boost the Forum's activities, providing a frame and funding to support its actions to achieve its goals.
In 2019, all ERICs contributed to building a new governance of the Forum and drafted the Rules of Procedure (RoP), which include clear definitions and descriptions of the various bodies, the possibility of setting up Working Groups, support by external projects, costs related to the participation in the Forum, a Confidentiality Agreement, and Amendments.
Two position papers were also published in 2019: 1) the ERIC Forum Position Paper on the Development of KPIs for Research Infrastructures (RIs). The main conclusion of this paper is that, considering the diversity of RIs in terms of structures, missions, scientific areas, fields of operation and more, KPIs need to be customized according to the unique character of each RI; 2) ERIC Forum members' written contribution to the ERAC ad-hoc working group on the Future of the ERA; 3) ERIC Forum's response to the ERAC working group on ERA priorities and goals.

3

CERIC's Institutional Advances and Contribution to Policies

Main Achievements

1. **Development of a monitoring system tailored to particular RIs**
2. **Collection of the opinion of the Members on CERIC's performance**
3. **Development of a model for assessing societal impact with impact pathways**
4. **CERIC's science case identified for the 2020 pilot Research Infrastructure Roadmap in the field of batteries**
5. **Fruitful discussions towards a new CERIC' s business model**
6. **Exploration of CERIC's first data policy implementation**
7. **Launch of the Italian ERIC Forum**
8. **Further clarifications on IKCs, VAT and Excise Exemptions for ERICs**

Performance Monitoring and KPIs

CERIC dedicates significant effort to setting up a high-quality monitoring and impact assessment framework. In doing so, it builds strongly on the current knowledge and approaches of different RIs. To this end, it has authored/co-authored two reports in the past[1]. When the ESFRI (European Strategic Forum for Research Infrastructures) working group on monitoring was set up in 2018, the Executive Director of CERIC, Dr. Jana Kolar, was invited to contribute as an external expert. The working group proposed 21 Key Performance Indicators (KPIs) to monitor the progress of RIs towards their objectives. The RIs were then asked to assess the relevance of such KPIs for their institution. The results of the assessment ended up in a paper published in 2019[2], which contributed to the development of a monitoring system tailored to particular RIs. Among the authors was Dr. Jana Kolar.
To obtain a typology of RIs, cluster analysis was performed taking into account their properties, which revealed clusters of RIs with similar characteristics, based on the domain of operation, such as food, environment or engineering. Discriminant analysis was then used to study how the relevance of the KPIs differs among the clusters (ESFRI domains: Environment; Health and Food; National RIs for Physical Sciences and Engineering; pan-EU RIs for Physical Sciences and Engineering; Social and Cultural Innovation and e-infrastructures). This analysis revealed that the percentage of RIs correctly classified into five clusters, using the KPIs, is 80%. Such a high percentage indicates that there are significant differences in the relevance of certain indicators, depending on the ESFRI domain of the RI. The indicators, therefore, should not only be linked to the objectives of their institutions, but also clearly need to be adapted to the type of infrastructure. As a consequence, it was proposed that the Strategic Working Groups of ESFRI addressing specific domains should be involved in the tailored development of the monitoring of pan-European RIs.
On behalf of the ESFRI working group, Dr. Kolar also presented the outcomes of the ESFRI working group at the Scientific side event of the ESFRI meeting in Helsinki (Finland) in September 2019, and at the ESFRI Workshop on the Future of Research Infrastructures in the European Research Area held in La Palma (Spain), in November 2019.

Opinion of the Members on CERIC's performance

In 2019, as a part of preparation of the societal return report, CERIC sent a questionnaire about its performance to the representatives of Ministries in CERIC's General Assembly. The replies of all 8 of the Ministries' representatives are briefly presented below, followed by a brief review of the activities undertaken on the basis of the proposals and recommendations received.

To the first **question, on whether CERIC has met the expectations of its Members**, 8 out of 8 replied positively. CERIC's scientific and management performance was assessed as nearly excellent, with rates of 4.4 and 4.6 out of 5, respectively. A Likert scale was applied, where 5 equals "excellent" and 1 "not satisfactory".

[1]Kolar J., Harrison A., Gliksohn F., Key Performance Indicators of Research Infrastructures / 1, August 2018, https://www.ceric-eric.eu/2018/08/30/key-performance-indicators-of-research-infrastructures/ and Key performance indicators of Research Infrastructures / 2, November 2018, https://www.ceric-eric.eu/2018/11/05/key-performance-indicators-of-research-infrastructures-2/
[2]Kolar J., Cugmas M., Ferligoj A., Towards Key Performance Indicators of Research Infrastructures, in Cornell University arXiv, 2019, : https://arxiv.org/pdf/1910.00304.pdf

With reference to the first question, the Slovenian representative, Tomaž Boh (hereinafter "SI"), stressed that CERIC fully meets expectations. The Polish representative, Michal Rybinski (hereinafter "PL"), stated that the first five years of CERIC are generally a success story and that CERIC, "a much needed research infrastructure", strengthens the scientific potential of Central European countries and beyond. PL noted that, to make CERIC even more productive, and considering the increasing need for European research infrastructures (and especially ERICs) to be successful and sustainable in the long-term, a strategy-oriented process has been set up, led by one of the delegates to the General Assembly (GA), and he considers this to be a very good first step towards discussing and reflecting on the future scope, role and tasks of CERIC.

The Italian representative, Salvatore La Rosa (hereinafter "IT"), stated that CERIC met expectations, although only partially. The reason lies in the level of integration of the Partner Facilities (PFs), as required by the Statute, being still marginal, and the willingness of the PFs (as well as support towards this end by the Representing Entities) to be integrated and to work seriously towards this direction, is not yet clear. The Croatian representative, Tome Antičić (hereinafter "HR"), had a somewhat similar position, stressing that CERIC is now at the transition from the 'initial' phase of its existence, when the whole concept had to materialise, to the 'mature' phase, when CERIC must have clear position towards R&D in the EU. It has been suggested that in the coming period, CERIC bodies (ISTAC, GA and BoD) in future work jointly extend CERIC's role beyond that of only a provider of instrumentation to external researchers.

With reference to Members' opinions on **CERIC's scientific performance**, all members evaluated it positively. IT considered it very good. SI considered that CERIC fully meets its expectations in this respect, since it provides researchers with open access to top research infrastructures. It also emphasized the benefits of the external evaluations of the national research infrastructures and suggested some upgrades. The open science principles are also considered of crucial importance.

In response to the request to rate **CERIC's management performance**, the Hungarian representative, Gábor Csirikusz (hereinafter "HU"), considered CERIC to be an effectively operating scientific research consortium.
IT scored this aspect excellent. The work of the Executive Director and her team is considered excellent, since they have been able to give a positive trend to the quality of the outcomes (as shown in the quality of the content of the last yearly reports).

Another question aimed to collect feedback on **CERIC's added value to the Member Countries**, in relation to the following:

Increased international cooperation – Countries see the main benefits of CERIC in the enhanced access, and in the opportunity offered for cooperation and internationalisation (AT [Austria, represented by Reinhard Klang], CZ [Czech Republic, represented by Helena Rimska], HU, IT, RO [Romania, represented by Beatrice Paduroiu], SI). In this respect, SI emphasized the good synergies between national and pan-European investments, as well as the VAT exemption possibilities.

Improved management and administration – Another positive element identified is the possibility of stimulating an improvement in the administrative capacities of the involved facilities due to their increased interaction (IT, PL, SI), and to the management of funding coming from different sources (IT, SI). The positive effect of training is emphasized in this respect (RO, PL), in particular in the field of technology transfer (HU). Furthermore, SI stressed that CERIC has developed an important new business model for the integrated operation of its facilities, and also recognized the importance of transparent management and periodic evaluations of performance (scientific and managerial). In this respect, mid- and long-term expectations on how and in which directions national partners will develop, are very clear.

Increased visibility and internationalisation of the National Research infrastructure facility – Increased visibility and internationalisation of the National Research Infrastructure facility – The Slovenian representative stated that CERIC makes a valuable contribution to the creation of the European Research Area, by positioning national facilities into the broader configuration of European infrastructures, and it also contributes to cross-disciplinary research. PL emphasized the positive effect of the support provided for the development of research techniques based on synchrotron radiation, as well as for increasing the internationalisation and visibility of the National Synchrotron Radiation Centre SOLARIS. HR recognised that, while Croatia has very limited capacity to serve as a 'provider' of experimental facilities, CERIC is one of only a few such schemes currently available.
Given that Italy is also the host country of CERIC, the country is a special case in this category, since it also provides resources for CERIC's administrative activity. IT emphasized that CERIC is capable of generating a structuring effect, thanks to the single-entry point offered through the Partner Facility and, due to this, an active role of the Italian Partner Facility is of paramount importance. Nevertheless, at the moment it is lacking. Furthermore, IT expects a social economic impact, not only around Trieste, where the legal seat is located, but elsewhere, too, due to the interaction with other facilities and research institutions and universities involved through the users, or to specific agreements for the technical and scientific activities of CERIC. The same applies to the business sector. Greater effort should be made to realize this potential, to increase the opportunities offered by CERIC in Italy, and to involve Italian research institutions and universities more widely. Dissemination and communication are essential elements in this aim.
Finally, IT stressed that, according to Article 5.4.d of CERIC's Statutes, a common strategy and policy for intellectual property and know-how protection should be developed, together with, among other things, an exploitation plan to attract industrial users. This should now be fully developed and presented to the GA as soon as convenient.

The last question investigated the opinion of Members on CERIC's contribution to the development of the ERA.
Effective operations – HU considered CERIC to be an effective operating scientific research consortium that can be considered a good example in the ERA (AT).
Fostering international cooperation - CERIC fosters and promotes international cooperation among research institutions, as well as among the EU Member States (PL, SI, CZ), particularly in engaging the CEE region jointly to strengthen activities in the ERA (HU).
Decreasing the Research gap in the ERA – Spreading the research facilities to different countries of the European Union, in particular by supporting those in lower performing states, will certainly contribute to the further development of the ERA (HR). While this is an ambitious goal, CERIC is one of the very few research infrastructures in newer Member States, and it is therefore an important element for the development of their excellence (SI), also bearing in mind that it enables the professional development of scientists from less R&D developed regions (PL). This is further promoted by the promotional open access pilot, which contributes to bridging the research and innovation divide (RO). Collaboration with other ERICs' stakeholders can also contribute to speeding up East-West alignment in the ERA (RO). CERIC contributes to the development of the ERA, too, by supporting the circulation and mobility of researchers through open access schemes (SI, HU, PL). IT commented that CERIC has great potential to help fill the gap, in particular in the central-east part of Europe. Attention should be continuous in maintaining the excellent quality of the facilities, to be able to attract the best European research teams and proposals. In this "initial" phase, the stimulation of industrial development has been still quite modest and should be built-up.

Proposals for the improvement of CERIC

1. The functioning of some bodies, BoD and GA, in particular, is not optimal. It is proposed that the commitment of Members might increase through annual Membership Fees. Following this indication, the GA had its first discussion regarding the introduction of fees at its November meeting.

2. IT considered the weakest point to be the present overlaps between the Board of Directors and the General Assembly and proposed that a country delegate should not also be a member of the Board of Directors and suggested that actions in this respect should be defined as soon as possible. CZ considered that the BoD and scientists in general are playing only a minor role in the CERIC decision-making process, and that it is necessary to define clear competencies for the BoD. The issue was opened for discussion at the November meeting of the GA; to be continued.
3. The common strategy and policy for intellectual property and know-how protection of CERIC, developed within the past 5 years, was presented at the November GA.
4. CERIC should be more widely promoted within the communities of its Members. A review of current activities and proposals for further improvements was presented at the November GA.

Assessing the societal impact with impact pathways

The societal impact of RIs has become increasingly important for RIs' managers, funders, members, users, local authorities and other stakeholders. As ESFRI (2017) notes, there is "increasing political and social pressure at all levels for RIs to demonstrate the positive contribution they make to society in general, including the impact on regional and national economies, and the benefits they offer to our citizens through the science they deliver"[3].
To evaluate the societal impact of RIs, taking into account their own properties and their various share- and stakeholders, a protocol[4] was developed and published by KNAW-RI, with the contribution of CERIC, in the frame of the H2020 Accelerate project. The protocol adopts an approach that allows RIs to prepare for very different evaluation situations by following an "impact pathways" model.
Taking a step backward, impact is the result of the strategy of the RI, and it has to be seen as a (often long and iterative) process to which the RI contributes, as well as being affected by a variety of feedbacks, actors and influences. It occurs on multiple levels and timeframes.
The range of contributions an RI makes to the variety of impacts, the time lag and the complex process, require a rich and diverse set of data or evidence. All such information cannot be provided by a set of quantitative indicators alone, and rather also includes a narrative of what the aims of the RI area and how it intends to achieve them. It includes evidence of the contribution the RI makes: activities, results and use. For a conclusion, societal impact evaluation requires a mix of quantitative indicators, case studies and narratives.

"Impact pathways" can be defined as the pathways followed by an entity such as an RI to make an (economic, social, educational) impact. They relate to the strategic objectives of the RI, and include what effectively contributes to their various impacts, what resources the RI could make available (inputs), what the staff of the RI do (activities), the results of these activities (outputs) and the further use of the results (outcomes). Impact pathways allow the links between outcomes and impacts to be shown, and provide information regarding causality. They give a narrated vision and can be based on the Theory of Change, allowing a presentation of the strategy of the RI, as well as indicating to what extent an RI is accountable.
Following the guidance document, CERIC prepared its societal return report, consisting of impact pathways, with the following objectives:

1. The development of a Societal Impact Strategy of CERIC. The pathways address the main objectives of CERIC and accompany them with the context and activities – both present and future ones, support these with data, or indicate relevant information to collect in the future. The Strategy identifies the goals, provides the rationale and the context, as well as the activities designed to achieve desired impacts. With periodic updates, the Strategy thus allows a systematic approach to achieving impact, from the design of activities, to monitoring the effectiveness and impact of the activities put in place. It therefore increases the likelihood of CERIC delivering the desired impacts, meeting the expectations of its funders.
2. The Strategy allows CERIC to be well prepared for future impact assessments by providing the impact strategy and evidence in a coherent way.
3. The staff of CERIC were involved in the preparation of the pathways, which contributes to institutional awareness of the objectives, as well as to the better design of future activities. It is also a motivational factor, since the contribution of the members of the team to the impacts of CERIC is recognized.

In the introduction, CERIC's report elaborates the objectives of the societal impact report, positions CERIC clearly in the European RI landscape and the ERA, and contextualizes the presented impact pathways. The introduction thus also serves as an overarching narrative for CERIC as a whole. It then presents six pathways, elaborating the impact of CERIC as a science enabler and as an industrial service provider, its impact on human resources, on the research gap and on the public image of science, and finally, the impact of the integration of facilities.
With an invitation to read the full report, one pathway, "Impact on the research gap", is presented in this report as an example.

Impact on the research gap

Impact of: CERIC as a research organization / as coordinator
Impact on: ERA, in particular specific priorities of knowledge sharing

Goal

Reducing disparities in research and innovation performance by sharing knowledge and expertise across the EU is an important objective of the European Union and research infrastructures can make an important contribution to decreasing the research and innovation gap, support the circulation of researchers, rather than brain drain, and enable the professional development of scientists from less R&D developed regions. To this end, CERIC has defined a specific objective of increasing the share of users from less R&D developed countries (the target countries are Serbia, Albania, Turkey, Belarus, Ukraine, Georgia, Moldova and the Russian Federation).
As a corner stone of the European Research Area, the objective of decreasing the research and innovation gap is also addressed by the Horizon Europe proposal, which states that it 'will help countries and regions that are lagging behind in terms of research and innovation performance, including the EU outermost regions, to attain a competitive position in the global value chains"[5]. This also applies to many countries associated with the framework programme, which are the focus of this pathway. Furthermore, these countries are also addressed through the European Neighbourhood Policy. Research is one of the priorities, in which cooperation is expected to help the EU and European Neighbourhood Policy partner countries to tackle common societal challenges, such as energy security, health issues, a deteriorating environment and climate change[6].
Research infrastructures can contribute towards these Community objectives by enabling access to excellent facilities and support, usually not available in these countries, thus enabling high quality research.

[3]ESFRI Roadmap 2018, part. 1: http://roadmap2018.esfri.eu/strategy-report/the-evolving-role-of-research-infrastructures/
[4]Societal impact of Research Infrastructures final protocol, December 2019– Leonie van Drooge & Isabelle van Elzakker - Rathenau Instituut, Den Haag, the Netherlands, Deliverable 1.5 for task 1.2, H2020 Accelerate project, Reference No. 731112

[5]https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1540387739796&uri=CELEX%3A52018PC0436
[6]https://eeas.europa.eu/diplomatic-network/european-neighbourhood-policy-enp/330/european-neighbourhood-policy-enp_en

Narrative

The following activities were designed in 2016 in order to address the objective:

- **Targeted promotion of CERIC to researchers in specific countries**. CERIC was established in 2014 and is not well known to user communities in the target countries. Several presentations have been organized since 2017 in the target countries. In addition, a workshop was organized at Elettra Synchrotron in 2017. Through interactive sessions held by internationally known scientists, including both theoretical lectures and practical tutorials on synchrotron beamlines, the researchers from the target countries were acquainted with the scientific opportunities offered by CERIC[7].
- **Promotional open access**. Knowledge about the opportunities offered through CERIC has led to an increased number of applicants to the CERIC calls, but their success rate remains low, since they are not familiar with the facilities nor with the application process. To address this, CERIC put in place a promotional open access, offering personalised support for the preparation of a proposal and measurements, as well as for data analysis and publication of the results. The support is offered free of charge to researchers from the target countries.
- **Outpost in Ukraine**. As a case study for enhanced outreach to the community, CERIC decided to set up an outpost in Uzhhorod University (UZHNU), Ukraine. It is intended to contribute to the objective by providing support along two lines: 1) Firstly, by supporting the training of UZHNU research staff for effectively mediating CERIC outreach to the eastern macro-region and gradually for capacity building of the UZHNU team, to be capable of collaboration in the future on most of or all other key activities – providing access to instrumentation and industrial liaison and technology transfer. 2) Secondly, UZHNU will use ACCELERATE support for the organization of outreach events, primarily targeting research communities in the eastern region of the EU, in Ukraine and other post-Soviet countries.

Results

The activities commenced in 2017. Results demonstrate an increase in the share of applicants from the target countries (Figures 16 - 17).

Figure 16
Number of proposals submitted vs. granted from Accelerate target countries, in the years 2017, 2018 and 2019.

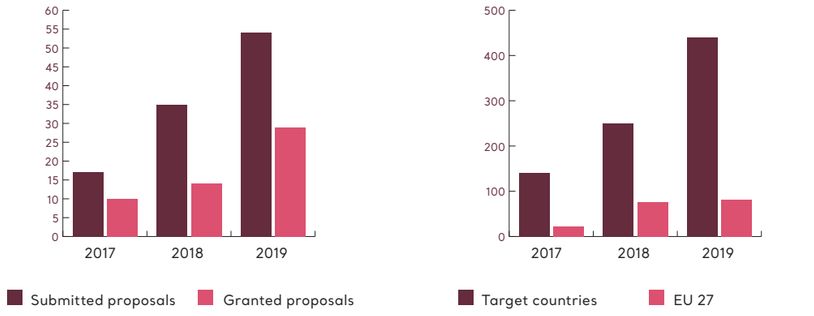


Figure 17
Growth in submitted proposals in the period 2017-2019, in %

[7]http://www.accelerate2020.eu/training-and-networking-activities-at-the-ceric-cei-contact-workshop-brought-together-researchers-from-14-countries-in-central-and-eastern-europe/

Missions and CERIC's Science Case

At the onset of the next European research and innovation programme, Horizon Europe, due to start on 2021, it is clearer than before that the programme will focus on the contribution of research and innovation societal goals, primarily by addressing the UN's Sustainable Development Goals. These will also be the focus of the Missions, a novelty in the Horizon Europe programme. They will differ from societal challenges in that they will focus on delivering against a specific target within a specific time frame, such as taking a man to the moon and back before the 1970s. In 2019, one mission of particular importance to CERIC has been elaborated, with a target of reaching 100 Climate Neutral Cities by 2030. In addition, in December 2019, the European Commission released the official Communication on the European Green Deal[8], which resets the Commission's commitment to tackling climate and environmental-related challenges that are an existential threat to Europe and the world. The "European Green Deal" is a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy in which there are no net emissions of greenhouse gases in 2050 and in which economic growth is decoupled from resource use"[9].

As stated in January 2020 in the published opinion by CERIC's director, Jana Kolar, on Research Infrastructures (RIs), Horizon Europe Missions and wider policy goals[10], RIs have the opportunity to prepare themselves contribute significantly to the wider EU priorities.

CERIC's GA responded to the growing need of RIs to contribute also to societal goals and selected two fields for priority action within CERIC: life science and energy materials. Energy materials in particular are relevant for the development of green energy and energy storage, which contribute to the European Green Deal, and the Horizon Europe mission "100 Climate Neutral Cities by 2030 by and for citizens". Following this decision, CERIC in 2020 will implement the pilot Research Infrastructure Roadmap in the field of batteries (read more on page 27), which aims at suggesting necessary upgrades of the current instruments and services, as well as identifying any possible gap in the offer of CERIC, in order to provide a more incisive contribution to the field. CERIC has also been working on a document on how CERIC's researchers in the field of green energy and energy storage can better use the capacities currently available at CERIC. Below, some of the current contributions of CERIC to these fields are highlighted through the results of CERIC's users in the fields of photosynthesis, fuel cells or batteries.

In a study published in *Nature Chemistry* in 2018[11], an international team of scientists proposed a new **artificial photosystem** by integrating a synthetic antenna to capture solar radiation and a totally inorganic catalyst that can split water using visible light. The group then conducted a complex structural analysis using a combination of light scattering techniques available at the CERIC facilities. The results highlighted increased performance of the photosystem, which very much depended on its structure. The knowledge on how the structure of an artificial photosystem correlates with photosynthetic functionality is an important step towards the development of photosystems that imitate natural examples and could lead to environmentally friendly hydrogen production in the future.

Another example is that of a study[12] on **new energy storage technologies**, such as magnesium-sulphur batteries, which employ elements that are cheap, safe, abundant and readily available all around the globe. CERIC users proposed a new electrolyte for magnesium-sulphur batteries. Experiments involved nuclear magnetic resonance and synchrotron light at the Slovenian and Italian CERIC partner facilities, respectively. Although further advances still need to be made, the results – which were published in

[8]Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal, com/2019/640 final
[9]Ibidem
[10]Kolar, J., *Opinion - Research infrastructures (RIs), Horizon Europe Missions and wider policy goals*, 31 January 2020, https://www.ceric-eric.eu/2020/01/30/opinion-research-infrastructures-horizon-europe-missions-and-wider-policy-goals/
[11]*Hierarchical organization of perylene bisimides and polyoxometalates for photo-assisted water oxidation*, Bonchio M., Syrgiannis Z., Burian M., Marino N., Pizzolato E., Dirian K., Rigodanza F., Volpato G.A., La Ganga G., Demitri N., Berardi S., Amenitsch H., Guldi D.M., Caramori S., Bignozzi C.A., Sartorel A., Prato M., Nature Chemistry, 2018, DOI: 10.1038/s41557-018-0172-y
[12]*Mechanistic study of Magnesium-Sulfur batteries*, Robba A., Vizintin A., Bitenc J., Mali G., Arčon I., Kavčič M., Žitnik M., Bučar K., Aquilanti G., Martibeau-Corcos C., Randon-Vitanova A., Dominiko R. Chemistry of Materials, 2017, 29, DOI: 10.1021/acs.chemmater.7b03956

2017 in Chemistry of Materials – gave useful insights into the path to be followed towards the delivery of a fundamental technology for a world that is increasingly reliant on batteries.
In another study performed in the field of **fuel cells**[13], CERIC users described a new strategy by which it is possible to study a complex catalyst for fuel cells in a working liquid environment, without exposing its surface to air. In fact, the transfer from ultra-high vacuum to a liquid environment is a significant challenge for the preservation of a clean and defined structure of a catalyst. The results of the work, which were published in 2018 in Nature Materials, involved different techniques available at the CERIC Austrian PF in Trieste and in Prague.
This novel strategy might pave the way towards the development of more effective, stable and cost-efficient catalysts to be applied, among others, in systems producing clean energy.
These and more studies conducted by CERIC's users in the fields of green energy and energy storage demonstrate the current strength of CERIC in these fields and provide rational for further focusing its infrastructures in order to contribute to the EU climate objective.

Towards a new business model – potential introduction of fees

In June 2019, the General Assembly, on a proposal by the Italian Delegation, initiated discussion on how to modify its business model. The present model is based solely on in-kind contributions by the Members (in the form of the operation of the Partner Facilities), which are complemented by the sole financial contribution by the Member hosting the Statutory Seat. A more sustainable model would be based on monetary contributions by all Members, to be mainly directed towards the growth of the integrated operation of their Partner Facilities. The Statute provides, on consensus of the General Assembly (art. 6), for financial contributions by Members, to be approved by qualified majority subject to limits and conditions indicated by each Member (art. 12, 3 (b)). This model would recognize the achievement of a positive impact of CERIC in each Member Country (as stated by all Members) and add in a synergic way to the activities already supported by the Members. Based on the initial discussion, the GA mandated the Executive Director of CERIC to propose a possible principle and a method for defining and calculating the annual contributions of its Members. To this end, the CERIC ED, with the support of the staff, reviewed the existing models and amounts of contributions, as available from the Statutes of the presently operating ERICs, and summarized the various options based on what is implemented in other ERICs.
Taking into account the existing examples, a set of parameters was then proposed as input data for a calculation of annual contributions in the case of CERIC. The proposal entails maintaining the current host premium of the country hosting the Seat, to be used to strengthen CERIC's integrated operations, including training, technology transfer and communication. The overall additional monetary contribution would be roughly 10% of the annual operational costs of CERIC, including the Partner Facilities. The model proposes a fixed contribution, equal for all Members, and a variable part, based on the Member's percentage of total GDP of all EU Member States. It was further proposed that the annual contribution should be used only within 10% for the central activities and the remaining funds to be used mainly in the Partner Facilities of the same Member for its strengthening and integration activities, until decided otherwise. Finally, it was proposed that the criteria and amounts, once agreed, should be reviewed every 5 years. The following discussion by the members was generally supportive of the proposal, noting that this was the first exchange on the topic and the decision is likely to be taken in 2021 or 2022.

[13] *Electrifying model catalysts for understanding electrocatalytic reactions in liquid electrolytes*, Faisal F., Stumm C., Bertram M., Waidhas F., Lykhach Y., Cherevko S., Xiang F., Ammon M., Vorokhta M., Smid B., Skàla T., Tsud N., Neitzel A., Beranova K., Prince K.C., Geiger S., Kasian O., Wahler T., Schuster R., Schneider M.A., Matolin V., Mayrhofer K.J.J., Brummel O., Libuda J., Nature Materials, 2018, 17, 592-598, DOI: 10.1038/s41563-018-0088-3

Data policy

In November 23rd, 2018, the Austrian Presidency and the European Commission launched the EOSC (European Open Science Cloud), marking its symbolic start.
CERIC, which committed to actively supporting this joint effort in the frame of the EU Funded project PaNOSC (www.panosc.eu), explored its first data policy implementation. The policy establishes the rights and obligations of both RIs and researchers, in terms of acquisition, storage, preservation and sharing of data generated at the facility and its associated metadata. It established for the first time a recommendation for a common format of the data of the consortium, making it compatible with that adopted by most of the RIs in the cluster of photons and neutrons and ensuring a higher compatibility and reusability of data, as well as of all the analysis tools developed by any of these RIs. The data policy also establishes an embargo period (i.e., the maximum period during which the data generated by experiments performed at CERIC facilities will remain private) before making them publicly accessible. This period was set to three years, a time considered long enough to protect the exclusivity of the researchers performing the measurements, but short enough to make data available to the scientific community. Feedback has been collected from the Directors of the Partner Facilities, and all the necessary steps to allow the enforcement of the data policy to be carried out in the coming years, with the aim of making CERIC data compliant with FAIR principles (findable, accessible, interoperable and reusable) and available to the community through the EOSC.

Italian ERIC Forum

In June 2019, an initiative under the name Italian ERIC Forum was started by CERIC -ERIC. The Italian ERIC Forum aims at strengthening the relationship between current and future ERICs that have their statutory seat or part of their operation in Italy.
More specifically, the Italian ERIC Forum identifies common challenges for the effective operation of ERICs related to:

- Structure of the ERIC, its status and relation with Representing Entities;
- ERIC's internal rules and best practice procedures (Administrative and Procurement Rules, Tax Exemption and In-Kind Contribution, Accounting, Financial Policies, Economic and Non-economic Activities);
- HR issues and perspectives: contracts, mobility and management;
- ERIC Regulations' implementation and membership;
- Management of the access provision: approaches and instruments.

The Italian ERIC forum enables an exchange of best practices and the sharing of existing solutions to common problems, which helps in reducing and possibly distributing the usually very high consultancy costs for this kind of very specific issue.

Moreover, the Italian ERIC Forum initiative is an opportunity to strengthen and structure communication between the ERICs and future ERICs in Italy with their responsible ministries, through the already existing so-called "Tavolo Tecnico " (Technical Table), which was set up in 2016.
Currently, 7 ERICs and future ERICs are participating: CERIC, CTAO, EMSO ERIC, EPOS ERIC, E-RIHS, EUIB ERIC, and INSTRUCT ERIC. Meetings of the initiative are held regularly, with the idea of coordinating the activities of these ERICs, as well as influencing and discussing the ERIC environment on the European level. The meetings are supported by the European Commission through the H2020 project ACCELERATE.

IKCs, VAT and Excise Exemptions

Full implementation of the ERICs mainly depends on the proper use of fiscal exemptions granted to international organizations.

The relevance of this topic at European level is described in a report from the Commission to the European Parliament and the Council on the Application of Council Regulation (EC) No 723/2009 dated 14.07.2014, within a chapter dedicated to “pending issues and next steps”. In this document, it was clearly stated that “There are also questions to clarify as concerns in-kind contributions to an ERIC by its members, in particular as to whether these contributions could benefit from the VAT and excise duty exemption and, if so, under what conditions”.

The potential benefits arising from full implementation of the VAT and excise exemption can be linked to the integration level between ERICs and the involved representing entities, as well as to their scientific and technical planning capacity.

During 2019, the use of VAT and excise exemptions was discussed in both the national and the European contexts, taking into consideration the ERICs’ structures, as well as their different area of operation. With reference to the first aspect, the different roles played by IKCs within distributed research infrastructures or single site ones have been outlined through the mechanism of the transfer of availability rather than the mechanism of the transfer of ownership. These differences have also been analysed in terms of financial representation in order to highlight the conditions for benefitting from VAT and excise exemptions

Moving to the definition of the different area of operation, the analysis of the “inner core” perimeter is intended as an area of action in which an ERIC is in full legal control and has full responsibility, in which the benefits of the ERIC as an International Organization can be applied, as well as the “integrated operations perimeter” intended as the set of different legal entities acting together as a unique facility It gives a clear reading key of the conditions to apply for VAT and excise exemptions in different contexts.

In this respect, it was very important to clarify the limits and the subjective/objective conditions for the Members to benefit from VAT/duty exemptions through their Representing Entities, outlining the current position of the Commission Tax Services with reference to these operations.

Why is it important to report these values? Who are the main stakeholders of ERICs? How can a structured process to manage IKCs support the right to benefit from VAT and excise exemptions? These questions have been answered through a fruitful exchange of experiences in different ERICs aimed at building a possible way forward.

4

Operations and Finance

Main Achievements

1. **Adoption of the new CERIC monitoring framework**
2. **Introduction of a new Disciplinary Code for CERIC employees**
3. **Discussions on the CERIC Scientific Data Policy** developed for CERIC's Partner Facilities (PFs) in harmony with the National Data Policy of each country
4. **Approval of a template agreement for industrial cooperation**
5. **Approval of CERIC's Intellectual Property (IP) policy**
6. **INTEGRA project funded for CERIC's research infrastructure development**
7. **Financial and in-kind annual account** for 2019 and estimation of the auditable values to be included in the Annual CERIC Account.

New CERIC monitoring framework

In June 2019, following draft proposals by the ESFRI Working Group on Monitoring, for a new set of indicators through which all pan-EU research infrastructures should report, the General Assembly of CERIC approved a modification of CERIC's Monitoring Framework elaborated on the basis of the one proposed by the ESFRI Working Group.

- Inputs: Financial revenues, experimental time available.
- To offer free open access to users, ensuring an efficient service and optimum conditions for users: User interest, use of the RI by researchers, international outreach, scientific output, quality of scientific output, quality of support.
- To further the integration of the PFs into a unique, EU-level Distributed Research Infrastructure: Volume of funded H2020 and ERDF/ESF project for joint research and development, added value to the PFs through collaboration within CERIC.
- To make optimum use of resources and know-how, by coordinating R&D, by joint training and by collaborating with neighbouring communities. To foster support to industrial development and users: international and inter-sectoral collaboration, staff training, number of PhD/MSc students, user training, use of the RI by industry, co-development with industry, data.
- To increase international visibility and support training for the upcoming generations of users: Participation of RI in policy-related activities, reach of CERIC activity through external media, expansion of the user base, engagement with CERIC's social media accounts, reach of CERIC activity through external media, engagement with CERIC's website and social media.

In addition, the Indicator "scientific output" was modified, to acquire better and more useful information for the decision-making process. The indicator is no longer limited to ISI publications. Instead of average impact factor, the percentage of publications based on research performed using facilities/resources of the RI, in the top 10% in the comparable field will be reported.

Human Resources – Introduction of a Disciplinary Code for CERIC's employees

In June 2019, the General Assembly (GA) of CERIC approved an update of Internal Regulation no. 10 – Rules for CERIC-ERIC employees, to which Annex A, Rules of Conduct and Disciplinary Code, has been added.
The rules of conduct are necessary for the efficient management of the Consortium's activities, for the safety and fair treatment of all employees and to guarantee correct worker/management relations. The purpose of the disciplinary code is thus to indicate guidelines for the correct application of disciplinary measures and to provide a reference for those responsible for the application of the procedure itself.
Both the "Rules of Conduct" and the "Disciplinary Code" apply to all employees of the Consortium with a fixed term or permanent employment relationship. As far as compatible, it also applies to the personnel of other entities who are detached, seconded or in any way temporarily assigned to the Consortium, as well as to personnel holding supply contracts and collaborators holding self-employment contracts.

Discussions on the CERIC's Scientific Data Policy

Throughout 2019, the Board of Directors and the General Assembly of CERIC discussed the first draft of the common Scientific Data Policy developed for the CERIC Partner Facilities (PFs) in harmony with the National Data Policy of each country, whenever present.
The purpose of the Policy is to regulate and describe a common framework for data stewardship in the frame of CERIC and its PFs, by defining the curation of data and metadata, from the generation of raw data from each experiment, to analysis of the data.

Discussions led to agreement on the following:

- The custodian of data (raw data and associated metadata) will be the PFs
- A commitment for long-term storage is avoided at the moment, until the costs involved, and the entity of the funding received for this purpose, is clearer.
- The policy will not be fully enforced until the infrastructure is developed. Aspects such as long-term storage will have to be addressed in the DMP.
- Elettra, TUGraz, SOLARIS, NMR, BNC committed to develop the necessary infrastructure to enforce the policy by the end of 2022.
- The format adopted for the raw data will be HDF5

The data policy will be modified as necessary in the future, to be adopted for all CERIC users.

Having an open access data policy with data in well-defined formats has many benefits:

- Raw data becomes open to scrutiny by other researchers, helping to uncover cases of scientific fraud. Open access policies thus foster scientific integrity.
- It makes previously measured data available for further analysis without the need to measure the same sample again.
- It promotes interdisciplinary research.
- Scientists can mine data in previously unknown ways or apply new methods to existing data.

The full strength of the approach will be achieved once all datasets, from detector data to final publication, are included, giving full advantage to the experimenting team and the scientific community. The policy framework takes into account the PaN data guideline for a common Scientific Data Policy[1] (which will be further improved and updated in 2020 in the frame of the PaNOSC project), as well as the data policy of the Elettra synchrotron.

Approval of the template agreement for industrial cooperation

During 2019, the General Assembly approved a strategy to strengthen collaboration between CERIC, its Representing Entities (REs) and the owners/hosts of CERIC's Partner Facilities, by exploiting the Consortium's potential beyond the opportunities already offered to the PFs. Within this framework, a collaboration agreement has been developed, offering support – through both CERIC and its network – to boost the relationship with the industrial environment. The agreement aims to foster industry's involvement and investment opportunities for new technologies and spin-outs/ spin-offs arising from CERIC's REs and owners/hosts of CERIC Partner Facilities.

[1]http://pan-data.eu/sites/pan-data.eu/files/PaN-data-D2-1.p

Intellectual Property (IP) policy

In November 2019, the General Assembly of CERIC approved the new Intellectual Property (IP) Policy developed to regulate rights on the background[2] and any foreground[3] arising from collaboration within the framework of CERIC. The policy applies to the three kinds of collaborations developed in CERIC:

Intellectual property policy under CERIC Projects

The policy regulates IP ownership between CERIC and the Partner Facilities regarding the outputs of CERIC projects (i.e., any project wholly or partly funded, or sponsored, by CERIC, or in which CERIC administers the funding/ sponsorship). The IP shall belong jointly to the Parties that have conceived or made it, in proportion to their contributions assessed according to reasonable and fair conditions. The policy also defines the rights of CERIC employees who are recognized as authors of their inventions. Inventors, or other Parties can, on their own initiative, financially contribute to the costs of protection and/or exploitation, having been assigned a percentage of the ownership of the intellectual property rights according to their contribution.

Intellectual property policy under CERIC Open Access

The policy regulates the ownership of IP developed by Third Party (users) during the Open Access (i.e., access to CERIC and its Partner Facilities under CERIC's Open Access regulation). As a general rule, the IP property will vest with the Third Party that was granted the Open Access.

Intellectual property policy under CERIC Commercial Access

The policy regulates the IP ownership between CERIC, the Partner Facilities and Third Parties that have access to CERIC's services under market-based costs. In relation to the foreground developed from any service provision, the IPR generated during the Commercial Access will be regulated according to agreements signed case by case. In any event, basic framework rules have been established according to the different types of service offered, to have common ground indications according to CERIC´s mission.

INTEGRA project funded for CERIC's RI development

In 2017, CERIC launched an internal invitation to its partners to develop the research infrastructure further. After a request for some modifications to solve certain critical aspects, the International Scientific and Technical Advisory Committee (ISTAC) of CERIC in 2019 endorsed for funding the project INTEGRA, coordinated by Heinz Amenitsch.
In June of the same year, the General Assembly of CERIC approved the decision of ISTAC and awarded a grant to the project, in the amount of two million EUR, for the period June 2019-June 2021.
The aims of the INTEGRA project are to reinforce, enlarge and better integrate the offer of the CERIC Partner Facilities in the field of Life Sciences, through a multidisciplinary, distributed and interconnected platform covering a wide range of biological targets, from molecules to tissues and organisms. INTEGRA will also encourage and support the translation of this knowledge into medicine and bio-nanotechnology.
INTEGRA will therefore both respond to the needs and requests of existing CERIC users, and enhance the expansion of the user community to medical researchers, cell biologists, pharmacologists, structural biologists, synthetic biologists, biotechnologists, nanotechnologists and other life scientists. The project will also complement the existing efforts of CERIC to support the set-up of an integrated Cryo-electron microscopy (Cryo-EM) platform in the region, which will include entry/medium level instruments in Ljubljana, as well as a top-of- the-range microscope at SOLARIS (Krakow).

[2]Background: any data, deliverables, documents, software, inventions, products, methods, know-how or information, whatever their form or nature as well as any IPR, that pre-exist to the Access.
[3]Foreground: All results generated during any kind of Access to CERIC and its Partner Facilities, including: CERIC Open Access, CERIC Commercial Access Services, CERIC's Projects or generated by CERIC's employees during the duration of an employment contract with CERIC.

Financial Statements 2019

Balance Sheet - Assets and Liabilities	2019	2018
ASSETS	**5,643,665.73**	**5,355,957.63**
Non-current Assets	**476,127.80**	**256,987.28**
Plant, property and equipment	436,383.87	230,908.58
Intangile assets	39,743.93	26,078.70
Investments in associates	-	-
Current Assets	**5,167,537.93**	**5,098,970.35**
Inventories	-	-
Long-term credits	-	-
Short-term credits	62,259.01	40,748.56
Other current credits and receivables	-	-
Cash and cash equivalents	5,097,254.56	5,051,300.27
Prepayments and accrued income	8,024.36	6,921.52
EQUITY AND LIABILITIES	**5,643,665.73**	**5,355,957.63**
Equity	**-**	**-**
Equity	-	-
Capital and other permanent contributions from Members	-	-
Reserves	-	-
Accumulated profits	-	-
Non-current Liabilities	**1,064,965.49**	**1,611,783.64**
Long-term financial debts and loans	-	-
Other long-term debts and liabilities	-	-
Advance payments for externally funded projects	943,360.77	1,535,053.83
Pensions funds and other benefits for compensation employment	121,604.72	76,729.81
Long-term provisions	-	-
Current Liabilities	**4,578,700.24**	**3,744,173.99**
Short-term financial debts	-	-
Other short-term debts and liabilities	276,557.95	322,560.81
Advance payments for externally funded projects	-	14,275.43
Other current payables	212,674.92	294,058.20
Contingent liabilities	40,783.62	-
Deferred income and accrued expenses	4,048,683.75	3,113,279.55

Profit and loss account		2019	2018
Revenues		**2,356,538.06**	**1,924,520.94**
	National and international grants and contributions	2,088,421.30	1,801,048.04
	Contributions in-kind	236,454.00	122,743.57
Other revenues	Other revenues	4,662.76	729.33
Operating costs		**2,259,490.55**	**1,856,891.14**
	Costs for raw materials, supplies and goods	45,792.33	51,527.74
	Costs for services	542,765.90	474,229.73
	Resources committed in-kind to CERIC from contributors	263,454.00	122,743.57
	Staff costs	1,403,650.71	1,204,052.96
	Costs of rents, concessions and royalties for trademarks	-	-
Other operating costs	Costs for institutional activities	3,827.61	4,337.14
Ebitda (Earnings before Interest, Taxes, Depreciations and Amortizations)		**97,047.51**	**67,629.80**
Depreciation		68,125.90	38,589.93
Write-downs for impairment of tangible and intangible assets		-	-
Ebit (Earnings before interest and taxes)		**28,921.61**	**29,039.87**
Financial income and expenses		**-655,61**	**-397.87**
	Financial income	401,50	288.92
	Financial charges	-1,057.11	-686.79
Income from investments		-	-
Value adjustments to financial assets		-	-
Result before tax		**28,266.00**	**28,642.00**
Taxes		28,266.00	28,642.00
Result for the year		**-**	**-**

Notes to the Financial Statements as at December 31, 2019

Accounting Criteria

These annual Financial Statements have been compiled in conformity with the IPSAS (International Public Sector Accounting Standards) international accounting standards issued by the International Public Sector Accounting Standard Board (IPSASB), and in process of being adopted by the European Commission within the meaning of Council Directive No 2011/85/EU of 8 November 2011, on requirements for budgetary frameworks of the Member States.
The decision voluntarily to adopt an accounting system that can be connected to international principles is consistent with the process of harmonization started some time ago by the EU Commission, but not yet completed. For this purpose, it is relevant to recall the “Report from the Commission to the Council and the European Parliament towards implementing harmonised public sector accounting standards in Member States. The suitability of IPSAS for the Member States”, published in March 2013.
The IPSAS can in general function as a basis for a harmonised accrual-basis accounting standard passing through its transformation into EPSAS (European Public Sector Accounting Standards). The aforementioned EU Directive states that “by 14 December 2018 the Commission shall make public a review of the sustainability of the Directive (see art.16).
CERIC-ERIC is set up as an international organization with scopes of general interest typical of an entity referable to the public sector. CERIC-ERIC should therefore be able to relate to its Members in different countries in a common language. This should be adopted in all matters and at all levels, and thus also in the model of presentation of economic-financial topics that support annual accounts and budgets.
The use of international accounting standards referable to the public sector, taking into account the specific character and scopes of CERIC-ERIC, adequately conforming to the legal characteristics of the entity and to its functions and scope, allows the development of well-defined best practices, the impact of which on the financial aspects is measurable and effective. The use of international accounting standards, in fact, allows information on the financial statements to be presented in a common way for users/stakeholders of different nationalities.

It is possible in this way to ensure that:

- The information is relevant, reliable, comparable and understandable;
- The terminology used is common, appropriate and explanatory among Members and for similar international organisations outside Europe;
- The financial statements are auditable by the International Standard of Audit by auditors from different nations;
- A host country change - and thus any site change - is not relevant for the comparability of information and models, books and records of the accounting system;
- The accounting system is able to present the in-kind contribution model, and to provide analytical accounting for projects and separate accounting for economic activities.

The aim of the annual financial statements is to provide information on the assets and liabilities, the profit or loss and changes in the financial structure of the Consortium, useful to a wide range of users.
The financial statements are prepared within a general-purpose framework.
The financial statements have been compiled in accordance with the principles of clarity and transparency and provide a correct and exhaustive framework of information on property relations, as well as economic and financial relations implemented by the Consortium in carrying out its activities.

It has been compiled taking into account international accounting standards for the public sector (IPSAS), where applicable, and integrated in order to be consistent with the legal and effective structure of CERIC.
Of the various options allowed by IPSAS 1, the Consortium has chosen to present the layout of the balance sheet distinguishing between current and non-current items, and the layout of the profit and loss account classifying the expenses by nature.

In its drawing-up, the following principles have been observed:

- The items have been evaluated prudently, taking into account the perspective of the continuity of the activities, as well as the economic function of an asset or liability;
- Only incomes and expenditures related to the financial year have been accounted, independently of the day of encashment or payment;
- The risks and losses related to the financial year have been accounted for, even if known after the end of the financial year.

These Notes have been compiled with the aim of clarifying, completing and analysing the information contained in the balance sheet and in the profit and loss account, in addition to providing information on the applied evaluation criteria, on movements that have taken place, and changes in various assets and liabilities.
The explanatory notes are an integral part of the following documents, to present these financial statements and provide descriptive and schematic information, with particular reference to property aspects, as well as economic and financial aspects of the overall management.

The financial statements comprise the following parts:

- Balance sheet
- Profit and loss account
- Explanatory notes
- Management report
- Comparison between final budget and Annual Accounts
- Statement of cash flow
- Trend of the net financial position (NFP)

Evaluation Criteria

The financial statements have been compiled in accordance with the principles of clarity and transparency and provide a correct and exhaustive framework of information on property relations, as well as economic and financial relations implemented by the Consortium in carrying out its activities. They have been compiled taking into account international accounting standards for the public sector (IPSAS), where applicable.

Balance Sheet

Items in the balance sheet are classified into/distinguished as current/non-current.

Assets

Assets have been classified as current assets when:

- They have been realized during the normal operating cycle of the institution;
- They are cash or equivalent complement not restricted in its use.

Assets realizable within the operating cycle have been classified as current, regardless of whether they have actually been realized within 12 months from the balance sheet date.

Non-current assets include tangible assets, intangible assets (licenses and in general all assets not related to the operating cycle and realizable after 12 months from the balance sheet date).

Liabilities

Liabilities have been considered current liabilities when:

a) They are extinct in the course of the normal operating cycle of the institution;

b) Extinction is due within 12 months from the balance sheet date.

Other liabilities, i.e., those not related to the operating cycle and all other institutional liabilities, are classified as current if their extinction is due within 12 months from the balance sheet date. Otherwise, they are recognized as non-current liabilities.

Deferred Incomes and Accrual Expenses

This item includes the amount of funds received for 2019 and not yet fully used by 31.12.2019 for the purposes for which they were intended. They will therefore continue to provide utility in coming years, for the same purposes. This item represents the carry-over for balances of the subsequent year to that under review. In this regard, the Consortium is obliged to operate in future years in fulfilment of the mandate required by the Italian Ministry of Education, University and Scientific Research, who assigned the financial funds (FOE) under which CERIC activities were carried out in 2019.

In-kind Contributions

Contributions in-kind will be included in the financial statements on the basis of the details contained in the document entitled "Methodology for Defining the Values Involved in CERIC-ERIC Activities, and to Detail In-kind Contributions", under the conditions specified therein and only as a result of auditing carried out by local auditors, which will be comparable with that of CERIC auditors.

Profit and Loss Account

The drawing-up of the profit and loss account is regulated by the IPSAS, integrated and conformed to be consistent with the characteristics and scopes of CERIC-ERIC.

Incomes

Incomes are increases of benefits connected to the administrative year.

Costs/Expenses

Costs/expenses are decreases of economic benefits of the administrative year. The analysis of costs has been explained in the overview of profit and loss account using a classification based on their nature.

In-kind Contributions

In-kind non-monetary contributions will be distinguished (when realized) between:

1) Those strictly related to the cost of the production factors (exhausting their utilities during the ordinary cycle).

2) Those strictly related to covering investments (in intangible and tangible assets).

Assets

Non-current Assets

Tangible Assets

Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
230,908.58	436,383.87	205,475.29

83% of the represented increase refers to purchases linked to the running internal research projects; 14% of the total amount is linked to projects externally funded; 3% refers to supplies for the central seat.

The following flow chart shows the change in individual items summarized in the present note.

Description	Property	Technical furniture	Electronic office machines	Office furniture	Mobile phone	Equipment in progress	Total
Balance as at 31/12/2018	**-**	**127,185.66**	**16,538.72**	**19,559.90**	**951.93**	**66,672.37**	**230,908.58**
Acquisitions during the year	-	128,694.37	20,397.76	3,338.80	1,537.84	107,734.24	261,703.01
Increases during the year	-	-	-	-	-	-	-
Decreases during the year	-	-	-	-	-	-	-
Depreciation for the year	-	44,500.01	7,121.27	3,995.92	610.52	-	56,227.72
Balance as at 31/12/2019	**-**	**211,380.02**	**29,815.21**	**18,902.78**	**1,879.25**	**174,406.61**	**436,383.87**

91.2% of the increments refer to purchases of tangible assets linked to the realization of scientific activities planned within the internal research grants of CERIC.

Intangible Assets

Balance as at 31/12/2018	Balance as at 31/12/2019	Difference
26,078.70	39,743.93	13,665.23

Historical costs at 31/12/2019 are as follows:

Description	Balance as at 31/12/2018	Operating increments	Operating decreases	Depreciation for the year	Value on 31/12/2019
Concessions, licenses, trademarks	26,078.70	25,563.41	-	-11,898.18	39,743.93
Intangible assets in progress	-	-	-	-	-
Total	**26,078.70**	**25,563.41**	**-**	**-11,898.18**	**39,743.93**

98.7% of the increments refer to intangible assets linked to websites' realization in line with the tasks foreseen within the project PANOSC and ERIC FORUM, both funded by the EU Commission.

Current Assets

Short-term Credits

The balance is divided according to the deadlines of the credits:

Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
40,748.56	62,259.01	21,510.45

The composition of the amount as at 31/12/2019 is as follows:

Description	Within 12 months	Over 12 months	Over 5 years	Total
Advances to suppliers	1,304.53	-	-	1,304.53
Other receivables	1,423.77	-	-	1,423.77
Tax advances	28,642.00	-	-	28,642.00
Credit notes to be received	929.79	-	-	929.79
Receivables from EU projects	16,433.92	-	-	16,433.92
Receivables from customers	11,050.00	-	-	11,050.00
VAT credit	2,475.00	-	-	2,475.00
Total	**62,259.01**	**-**	**-**	**62,259.01**

- The balance sheet item "Advances to suppliers" represents the part of the expenses paid to suppliers for activities that will be implemented at the beginning of 2020.
- The balance sheet item “Other receivables” mainly refers to reimbursement to be received in relation to travels bookings cancelled.
- The balance sheet item “Tax advances” refers to advance payments made in June and November 2019. These advance payments have been calculated on the basis of the fiscal charge for the previous year.
- The balance sheet item “Receivables from EU projects” is referred in particular to a surplus between the costs claimed within the project E-RIHS and advance payments received by the European Commission.
- The balance sheet item “Receivables from customers” refers to limited commercial activities started in the last quarter of 2019.
- The balance sheet item “VAT credit” refers to fiscal credit accrued as at 31.12.2019 for purchases from Italian suppliers in order to carry out limited commercial activities.

Cash and Cash Equivalents

The balance represents cash at the bank at the end of the financial year. It represents liquid assets and cash equivalents at the end of the year.

Cash deposited at the bank Unicredit Banca Spa:

Description	Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
Bank deposits	5,051,300.27	5,097,254.56	45,954.29

In this context, the Consortium is in a credit position towards the Institute Unicredit, Agency of

Trieste, where it has opened a current account for financial management. In December 2019, a sum of € 2,404,535.00 was delivered to this account by the Ministry of Education, University and Scientific Research through AREA di Ricerca of Trieste, to support the Consortium’s activities for the year reviewed, according to the Collaboration Framework Agreement signed with Elettra-Sincrotrone Trieste S.c.p.A.

In February 2019, CERIC-ERIC received from the EU an amount of € 6.400,00, as interim payment for the E-RIHS project; In May 2019 CERIC ERIC received from the EU an amount of € 88.812,50 as first advance payment for the ERIC FORUM project. In both cases CERIC ERIC is acting as project partner.

Prepayments and Accrued Income

Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
6,921.52	8,024.36	1,102.84

This item measures income and expenses whose competence is delayed or advanced with respect to cash or documentary; they disregard the date of payment or collection of related income and expenses common to two or more years and distributable on time. This amount represents prepaid expenses related to costs for annual insurances, to be referred, on an accrual basis, to 2020.

Equity and Liabilities

Equity

Capital and other Permanent Contributions from Members

No values are entered for these items

Reserves

No values are entered for these items

Accumulated Profits

No values are entered for these items

Non-current Liabilities

Other Long-term Debts and Liabilities

Advance Payments received for externally funded projects

The item "Advance payments for externally funded projects" includes the amounts listed in the table referring to the following running projects:

Description	E-RIHS Project	ACCELERATE Project	PaNOSC Project	ERIC Forum	Total
Balance as at 31/12/2018	5,133.03	616,613.05	913,307.75	-	1,535,053.83
Advance payment received from the EU during the year	6,400.00	-	-	88,812.50	95,212.50
Transfer of funds to project partners	-	-	-	-	-
Accrual progress report for the period Jan-Dec 2019	-27,966.95	-318,034.18	-299,025.36	-35,014.99	-680,041.48
Amount exceeding the advance payment received	16,433.92	-	-	-	16,433.92
Depreciation costs to be claimed in the following reporting periods	-	-	-14,838.00	-8,460.00	-23,298.00
Balance as at 31/12/2019	**0,00**	**298,578.87**	**599,444.39**	**45,337.51**	**943,360.77**

The item "Advance payments for externally funded projects" includes:

- The first advance payments related to the ERIC-FORUM Project (€ 88,812.50) funded by the EU. The project has a duration of 48 months and will finish in December 2023. CERIC is acting as project partner.
- The interim payment referred to the project E-RIHS (€ 6,400.00) funded by the EU.

The advance payments received relate to the implementation of the activities described in the project, and it must be returned only if CERIC does not carry out the project, or if it does not comply with the contractual obligations towards the EU.
The final amount at 31/12/2019 has been calculated on the basis of the progress reports of the projects ACCELERATE, E-RIHS PaNOSC and ERIC FORUM, with reference to the incurred costs for the period January - December 2019 (€ 680.041,48).

In view of the fact that an adequate evaluation cannot be made of the advances referred to the activities that will be carried out in the next 12 months, there is no possibility of splitting the total amount between non-current and current parts.

Description	Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
Advances	1,535,053.83	943,360.77	-591,693.06

Pensions Fund and Other Benefits for Compensation Employment

Severance indemnities for employees.

Description	Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
Severance indemnities for employees	76,729.81	121,604.72	44,874.91

The item is made up as follows:

Description	Initial value 31/12/2018	Plan balance 2019	Substitutive tax	Contribution to national funds for employees (FPLD)	Severances paid during the year	End value 31/12/2019
Severance indemnities for employees	76,729.81	51,171.57	-228.02	-3,517.66	-3,550.98	121,604.72

The severance set aside figure represents the actual debt of the Consortium at 31/12/2019, to employees in force at that date.
The contribution to FPLD refers to the sum withheld from the severance indemnities of employees in favour of national social security institutions as a contribution to general social security purposes.
The amount of the severance indemnities paid refers to the expiration of two fixed-term contracts during 2019.
As at 31/12/2019, advances have not been required by employees.

Current Liabilities

Other Short-term Debts and Liabilities

Debts

The composition of the aforementioned amounts is as follows:

Description	31/12/2018	31/12/2019	Variation
Debts to providers	199,539.14	130,083.13	-69,456.01
Tax liabilities	79,244.32	94,944.77	15,700.45
Payables to social security institutions	43,777.35	51,530.05	7,752.70
Total	**322,560.81**	**276,557.95**	**-46,002.86**

“Debts to providers” are stated net of possible trade discounts.

Balance at 31/12/2018	Balance at 31/12/2019	Variation
322,560.72	276,557.95	-46,002.86

Debts are valued at their nominal value.

The item “Debts to providers” (€ 130,083.13) includes debts to third parties, mainly related to services purchased on credit. This item appears on the entity's balance sheet as a current liability, since the expectation is that the liability will be met in less than a year.

The item "Tax payables" includes liabilities for specific taxes, and is composed of withheld taxes for employees, associates and collaborators amounting to € 52,994.09, together with 13,684.68 of VAT to be paid in 2020, and taxes due by the Consortium (€ 28,266.00). With reference to this last item, an advance payment was made in 2019 to a total amount of € 28,642.00.

“Payables due to social security institutions" includes the amount of social security contributions relating to employees, accrued but not paid as at 31 December 2019, amounting to € 51,530.05.

"Other payables" includes remaining debts, which by nature cannot be described above, including amounts due by CERIC to staff for all liabilities accrued to them, in accordance with current legislation and Personnel Regulations, including the value of accrued vacation paid at the time of reporting. This account at 31/12/2019 was as follows:

Description	31/12/2019
Payables to employees (holidays and leave not taken)	60,026.46
Other payables to employees	2,805.15
Payables to bodies	12,500.00
Other debts of a different nature	137,343.31
Total	**212,674.92**

The item “Payables to bodies” relates to the fee due by the Consortium to an internal auditor.

Debts are evaluated at their nominal value.

Description	31/12/2018	31/12/2019	Variation
Other payables	294,058.20	212,674.92	-81,383.28

The final value as at 31.12.2019 refers mainly to the additional administrative and general services activities provided by Elettra for the statutory seat (Euro 111.274,54). In particular, these additional activities refer to:

- The development of specific software packages needed to implement the annual programme of CERIC-ERIC and to increase the efficiency of the administration of users, as well as other administrative processes of CERIC (Implementation of the Virtual Unified Office – VUO)
- The involvement of Elettra's operational structure and personnel for other CERIC institutional activities (General Assembly secretariat, legal advice, preparation of collaboration agreements, logistic services, spaces and related utilities, travel costs for scientific users).

Contingent liabilities

Description	Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
Contingent liabilities	-	40,783.62	40,783.62

The final value as at 31.12.2019 is referes to the potential credit claimed by a fiscal consultancy firm. At the end of the financial year, the definition of the actual debt is not yet completed.

Deferred Income and Accrued Expenses

For accounting the contribution provided by Italy, the indirect method has been chosen and the stated amount is representative of the portion attributable to future financial years.

Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
3,113,279.55	4,048,683.75	935,404.20

The item breaks down as follows:

Description	Amount
Deferred income	4,048,683.75
Accrued expenses	0,00

The balance sheet item "Deferred income" measures the portion of the contribution funded by the Italian MIUR for the activities of the CERIC statutory seat, deferred to 2020.

The amount of € 4,048,683.75 is derived as follows:

Category	Carry over for 2018	Adjustments on carry over 2018 (depreciation plan)	Italian Contribution for 2019	Consortium expenses for 2019 covered by FOE 2018-2019	Carry over for 2019 from FOE	Depreciation quotes to be covered by external projects	Deferred incomes as at 31.12.2019
Deferred income	3,113,279.55	0,13	2,293,260.46	1,381,154.39	4,025,385.75	23,298.00	4,048,683.75

The Italian contribution for 2019 (€ 2,404,535.00) initially defined in the collaboration framework agreement signed by CERIC and its Italian Representing Entity for the period 2017-2019, was recalculated taking into account the additional activities performed by Elettra Sincrotrone Trieste S.c.p.A. (€ 111,274.54).

The amount of the carry-over for 2019 is composed as follows:

Description	Amount
Resources committed to cover the depreciation quotes covered by FOE starting from 2020	278,423.19
Orders issued as at 31.12.2018 but not closed at the end of the year	73,200.00
Order issued as at 31.12.2019 but not closed at the end of the year	55,207.90
Resources committed to the call for investment "CERIC infrastructure development"	2,000,000.00
Resources committed to cover investments not completed as at 31.12.2019	174,406.61
Carry over 2019 committed to ordinary activities (FOE)	1,152,980.63
Free carry over for 2018 (FOE)	291,167.42
Depreciation quotes covered by projects externally funded in the next financial years	23,298.00
Total deferred income as at 31.12.2019	**4,048,683.75**

During 2019, the free carry-over resulting from 2018 (euro 603,935.74) was used for the following activities:

- Purchases of durable equipment mainly referred to internal research grants (euro 149,826.18)
- Purchases order issued as at 31.12.2019 but not finalized within the end of the year. (euro 55,207.90)
- Purchases of components aimed at the realization of a scientific instrument, in relation to the project MAG-ALCHEMI (euro 107,734.24)

Income Statement

Financial Revenues

Revenue items primarily identify the portion of the contribution for the financial year allocated by Italy through the public company Area di Ricerca for the Consortium's activities to cover the expenses of management, as well as the revenues related to projects externally funded.

The Italian contribution for 2019 (€ 2,404,535.00), recalculated considering the additional activities performed by the Elettra Sincrotrone Trieste S.c.p.A. (€ 111,274.54), corresponds to euro 2,293,260.46. The portion of the FOE 2019 spent in the current financial year corresponds to € 1,140,279.83. The remaining part has been covered by FOE funds 2018 for € 240,874.56.

Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
1,801,777.37	2,093,084.06	291,306.69

The composition of the amount at 31.12.2019 is as shown in the following tables:

Category	31/12/2018	31/12/2019	Variation
MIUR ordinary contribution	1,292,006.05	2,293,260.46	1,001,254.41
FOE funds 2018 spent	-	240,874.56	240,874.56
FOE funds 2019 to be spent in the following years	-	-1,152,980.63	-1,152,980.63
Total	**1,292,006.05**	**1,381,154.39**	**89,148.34**

Category	31/12/2018	31/12/2019	Variation
FVG Region - Project PaGES	15,179.65	14,275.43	-904.22
H2020 ACCELERATE Project	454,017.38	318,034.18	-135,983.20
H2020 ERIC Forum Project	-	35,014.99	35,014.99
H2020 E-RIHS Project	37,275.31	27,966.95	-9,308.36
H2020 PaNOSC Project	2,569.65	299,025.36	296,455.71
Commercial services	-	12,950.00	12,950.00
Other incomes	729.33	4,662.76	3,933.43
Total other incomes	**509,771.32**	**711,929.67**	**202,158.35**

Contributions for Operating Expenses

The amount of the Italian contribution for the activities of the statutory seat of the Consortium is € 1,381,154.39.

This amount covered the costs for personnel, bodies, consultancies, and other costs of the seat not covered by specific externally funded projects.

Contributions In-Kind

Representing Entity	31/12/2018	31/12/2019	Variation
National Institute of Chemistry (Slovenia)	122,743.57	263,454.00	140,710.43
Total	**122,743.57**	**263,454.00**	**140,710.43**

The amount indicated refers to the Polish PF IKCs calculated with reference to the Access costs. The consortium received a detailed statement of the costs incurred by SOLARIS in relation to the activities carried out in accordance with the scientific goals of the common interest between CERIC and SOLARIS. The IKCs' calculation was implemented in accordance with the methodology adopted by CERIC.

Costs

Operating Costs

Costs for Raw materials, Supplies, Consumables and Goods

This category includes costs incurred for the supply of consumables. The increase in the year is a direct result of the increased activities of the Consortium, in particular with reference to internal research grants.

Category	Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
Costs for raw materials, supplies, consumables and goods	51,527.74	45,792.33	-5,735.41

79% of the total value for 2019 refers to costs incurred to support internal research grants; 18 % relate to ordinary activities; the remaining part (3%) is linked to projects externally funded.

Services Costs

It has been decided to divide the item service costs, to facilitate the clarity of the budget, into the following categories of expenses:

Category	31/12/2018	31/12/2019	Variation
External services related to the commercial activity	-	11,250.00	11,250.00
Legal, fiscal and administrative consultancy	91,878.84	42,025.55	-49,853.29
Technical consultancies	993.00	2,052.89	1,059.89
Administrative collaborators	20,870.00	13,988.10	-6,881.90
Scientific and technical collaborators	58,972.43	74,336.90	15,364.47
Social security contributions of collaborators	30,553.02	31,159.35	606.33
Health contribution for collaborators	397.17	321.80	-75.37
ISTAC remunerations	12,714.31	14,053.60	1,339.29
Travel costs for employees, collaborators, and bodies	128,226.37	164,163.01	35,936.64
Travel costs for users	-	63,052.38	63,052.38
Expenses for corporate meetings	2,122.60	2,527.32	404.72
Insurances	10,978.40	12,324.19	1,345.79
Representation costs	2,062.32	2,711.67	649.35
Consulting and salaries processing	30,692.75	16,323.31	-14,369.44
Mobile phones	9,265.92	10,199.96	934.04
Annual software licenses	35.38	461.95	426.57
Workshops, seminars and publications	21,379.67	11,961.95	-9,417.72
Canteen expenses	14,643.00	17,370.00	2,727.00
Bank charges	1,665.11	2,761.02	1,095.91
Postal charges	2,380.85	3,152.59	771.74
Fellowships	6,042.41	-	-6,042.41
Maintenances	-	19,720.07	19,720.07
Training costs	13,109.00	7,376.43	-5,732.57
Transportation services	5,794.79	3,981.13	-1,813.66
Other costs	15,494.80	15,490.73	-4.07
Total	**480,272.14**	**542,765.90**	**68,536.17**

The item “Other costs” includes mainly costs related to transportation services, proofreading services, and other minor costs.

Resources committed in-kind to CERIC by contributors

Partner Facility	31/12/2018	31/12/2019	Variation
National Institute of Chemistry (Slovenia)	122,743.57	263,454.00	*140,710.43
Total	**122,743.57**	**263,454.00**	***140,710.43**

IKCs contributions have been accounted on the basis of the International Public Sector Accounting Standard No. 23.

This accounting standard is focused on contributions from non-exchange transactions, which have the following three characteristics:

1. Are non reciprocal transfers;
2. Are transfers to, or from entities acting other than as owners
3. Are made or received on a voluntary basis.

Personnel Costs

Personnel expenses: breakdown

Category	31/12/2018	31/12/2019	Variation
Wages and salaries	615,960.11	721,835.50	105,875.39
Social security charges	178,474.46	210,313.74	31,839.28
Seconded personnel (IKCs against payment)	-	6,353.31	6,353.31
Severance indemnities	43,334.48	52,171.57	8,837.09
Allowances to be paid	56,783.54	60,026.46	3,242.92
Fellowships	-	10,999.98	4,957.57
Director	130,312.78	168,549.31	38,236.53
Social security charges of bodies	23,145.18	23,400.84	255.66
Auditors and IAEC	150,000.00	150,000.00	0.00
Total	**1,204,052.96**	**1,403,650.71**	**199,597.75**

17% of the total personnel expenses refers to salaries corresponded within internal research projects; 48% of the total amount refers to personnel costs covered by ordinary funds (FOE) while the remaining part (35%) refers to the incurred costs for projects externally funded.

Use of Third Party Materials or Property

No values are entered for these items

Other Operating costs

Other operating costs: breakdown

Category	31/12/2018	31/12/2019	Variation
Membership fees	2,096.00	2,000.00	-96.00
Rounding	195.99	284.61	88.62
Other taxes	833.07	204.39	-628.68
Other expenditures	212.08	338.61	125.53
Donations	1,000.00	1,000.00	0
Total	**4,337.14**	**3.827,61**	**-509.53**

Depreciation of Tangible and Intangible Assets

Depreciation is calculated on the basis of the useful life of the asset and its use in production. For the first year of use, the percentages applied have been reduced by half.

Intangible Assets

Description	Depreciation Rate	Amount
Concessions and licences	20%	11,898.18
Total amortisation of intangible assets		**11,898.18**

Tangible Assets

Description	Depreciation Rate	Amount
Office machinery	20%	7,121.27
Equipment	15%	44,500.01
Telephony and mobile telephony	20%	610.52
Office furniture	15%	3,995.92
Total amortisation of fixed assets		**56,227.72**
Total amount (intangible and tangible)		**68,125.90**

Taxation

Current tax	Balance as at 31/12/2018	Balance as at 31/12/2019	Variation
IRAP	28,642.00	28,266.00	-376.00
Total	**28,642.00**	**28,266.00**	**-376.00**

The annual tax related to institutional activity (IRAP) is calculated on the amount of salaries paid to employees, the amount of fees paid to collaborators and the costs of contracts for temporary employment, with the exception of remunerations paid for researchers.

The fiscal charge related to the commercial activity is equal to zero.

The Consortium, in the context of purchases realized, and within the limits following from the Statute, may use VAT exemptions granted on the basis of Article 143(1)(g) and Article 151(1)(b) of Council Directive 2006/112/EC, and in accordance with Articles 50 and 51 of Implementing Regulation (EU) No. 282/2011 of the Council, and on the basis of Article 12 of Directive 2008/118 /EC.

Financial Costs and Revenues

Under “Financial management”, accrued interest income on the bank account of the Consortium is stated as of 31.12.2019.

Interest on Current Account, Rounding and Exchange Rate Costs

The item represents remuneration on deposits of the Consortium on current account N. 000103334723 opened at Unicredit Banca.

Category	31/12/2018	31/12/2019	Variation
Interest on current account	288.92	401.50	112.58
Exchange rate costs	-686.79	-1057.11	-370.32
Total	**-397.87**	**-655.61**	**-254.74**

Report of the commercial activities

The limited commercial activities of the Consortium have been managed through a separate account. In 2019 two commercial contracts have been concluded.

Revenues	
Commercial services	12,950.00
Costs	
External services related to the commercial activity	11,250.00
General costs*	4,326.43
Final balance	-2,626.43

*General costs have been calculated according to the Italian fiscal rules for commercial activities performed by no commercial entities.

In particular, the calculation refers to the incidence of the commercial activities (€ 12,950.00) compared to the total amount of the revenues accounted for 2019 (€ 2,093,084.06). The ratio corresponds to 0,6187%

The resulting percentage has been applied to the amount of € 699,273.24 corresponding to the following general cost categories, common to both institutional and commercial activities.

General costs	Amount
Executive Director	150,829.46
Auditors	87,500.00
ISTAC	14,053.60
Fiscal, legal and labour consultancies	53,772.35
Insurances	12,324.19
Utilities	10,071.49
Administrative staff	370,722.15
Total	**699,273.24**

Events after the reporting date

Following IPSAS 14, this paragraph reports about events that occurred between the reporting date (31.12.2019) and the date when these Financial Statements have been approved by the General Assembly.
The only relevant event occurred has to be referred to the worldwide emergency caused by the COVID-19 pandemics. It is relevant to state that this event can be classified among the "non-adjusting events after the reporting date" and that it does not influence the assessing of the appropriate assumption of the ongoing concern of CERIC-ERIC.
The temporary consequence connected to the aforementioned event could be identified in some potential slight delays in performing the activities related to the project externally funded, for which appropriate requests of extensions could be submitted to the funding agencies.
The COVID-19 emergency might delay the organization of planned meetings and cooperation initiatives, thus affecting the use of the budget allocated to support these activities creating the necessity to postpone some expenditures. There are no valid reasons to believe that the aforementioned event could influence the Italian cash contribution from FOE, or the inkind contributions by the Italian Representing Entity and by the other International Organizations involved in CERIC–ERIC activities.

Management Report

Comparison between Final Budget and Annual Accounts

Starting from the budget for 2019 approved by the GA in November 2018, some changes were necessary as the result of the following:

COSTS and INVESTMENTS:

1. The redistribution of funds provided by the Italian Ministry of Education, University and Research initially stated in the Collaboration Framework Agreement signed with Elettra-Sincrotrone Trieste S.c.p.A.
2. The recalculation of the personnel resources involved in the projects externally funded during 2019.

REVENUES

1. The calculation of the actual carry-over for 2019. The 2019 budget was approved in November 2018 by the GA taking in to account an estimate of the carry-over for the year at closing.
2. Additional resources acquired in relation to two commercial contracts, the refund of some expenses by third parties and interest from the bank.

Costs and Investments

EXPENSES FOR 2019					
Description	**Initial budget**	**Implemented changes**	**Final budget**	**Total expenses**	**Expenditure rate**
CEROP	139,404.46	-	139,404.46	119,954.55	86,05
Dyna Chiro	214,834.00	-	214,834.00	72,941.06	33,95
RENEWALS	250,939.54	-	250,939.54	118,797.39	47,34
MAG-ALCHEMI	162,032.00	-	162,032.00	128,149.39	79,09
Training Projects	52,000.00	-	52,000.00	45,555.28	87,61
RI Investment	2,000,000.00	-	2,000,000.00	-	-
Collaboration Agreement IT PF and CERIC	3,125,465.00	111,274.54	2,236,739.54	3,236,739.54	100
Bodies - Remuneration	360,000.00	-	360,000.00	329,035.03	91,40
Remuneration for Employees	365,100.00	6,000.00	371,100.00	370,722.15	99,90
Communication	40,000.00	-	40,000.00	14,705.05	36,76
Travel Expenses	130,000.00	-	130,000.00	102,783.84	79,06
External Services, Consultants, Consumables	364,560.00	-42,774.54	321,785.46	158,244.26	49,18
IL&TT	31,000.00	-	31,000.00	11,970.84	38,62
Fixed Assets	20,000.00	-	20,000.00	17,199.25	86,00
Taxes	65,000.00	-	65,000.00	28,453.83	43,78
Support of the Italian RE to the Statutory Seat	75,000.00	-75,000.00	-	-	-
Carry Over (Estimated vs. Actual)	-	89,744.55	89,744.55	-	-
Activities Contributing to Strengthening CERIC	1,349,325.00	-	1,349,325.00	62,555.58	4,64
ACCELERATE (EU)	298,250.00	-	298,250.00	264,672.22	88,74
E-RIHS (EU)	32,250.00	-	32,250.00	22,373.56	69,38
PaGES 4	15,000.00	-	15,000.00	8,383.66	55,89
ERIC Forum (EU)	39,000.00	500.00	39,500.00	39,291.99	99,47
PaNOSC (EU)	395,000.00	-	395,000.00	272,899.52	69,09
General Expenses for Projects	-191,125.00	-	-191,125.00	-	-
TOTAL	**9,333,035.00**	**89,744.55**	**9,422,779.55**	**5,425,427.99**	**57,58**

Revenues

REVENUES FOR 2019						
	Description	**Initial Budget**	**Implemented Changes**		**Final Budget**	**Accrued Revenues**
(+)	FOE 2019 (CERIC)	2,303,535.00	(111,274.54)	-	2,293,260.46	2,293,260.46
(-)	Carry-over (for 2020)	-	-	-	(1,152,980.63)	(1,152,980.63)
(=)	FOE used in 2019	-	-	-	1,140,279.83	1,140,279.83
(+)	Carry-over from 2018	1,023,535.00	89,744.95	-872,405.39	240,874.56	240,874.56
(=)	Total resources used in 2019	-	-	-	1,381,154.39	1,381,154.39
(+)	Carry-over committed to INTEGRA	2,000,000.00	-	-	-	-
(+)	FOE 2019 (Elettra)	3,125,465.00	111,274.54	-	3,236,739.54	3,236,739.54
(+)	Commercial activities	-	12,950.00	-	12,950.00	12,950.00
(+)	PaNOSC project	395,000.00	-	-	395,000.00	299,025.36
(+)	PaGES4 project	15,000.00	-	-	15,000.00	14,275.43
(+)	E-RIHS project	32,250.00	-	-	32,250.00	27,966.95
(+)	ACCELERATE project	298,250.00	-	-	298,250.00	318,034.18
(+)	ERIC Forum project	39,000.00	-	-	39,000.00	35,014.99
(+)	Bank interests	-	412.50	-	412.50	412.50
(+)	Reimbursed costs	-	4,662.76	-	4,662.76	4,662.76
	Total	**9,333,035.00**	**107,770.21**	**(872,405.39)**	**5,415,419.19**	**5,330,236.10**

The following table includes an explanation of the difference between the actual carry-over resulting from the Financial Statements 2019 and the balance resulting from the final budget 2019.

Reconciliation between final budget and annual accounts	
Description	**Amount**
(+) Total Revenues	5,330,236.10
(-) Total Expenses	5,425,427.99
(=) Balance	-95,191.89
(+) Investments made in 2019	287,266.42
(-) Depreciation costs for 2019	-68,125.90
(+) Purchase orders not finalized as at 31.12.2019	55,207.90
(-) Purchase orders issued in 2018 and closed in 2019	-179,156.53
(=) Final balance resulting from the profit and loss account	0.00

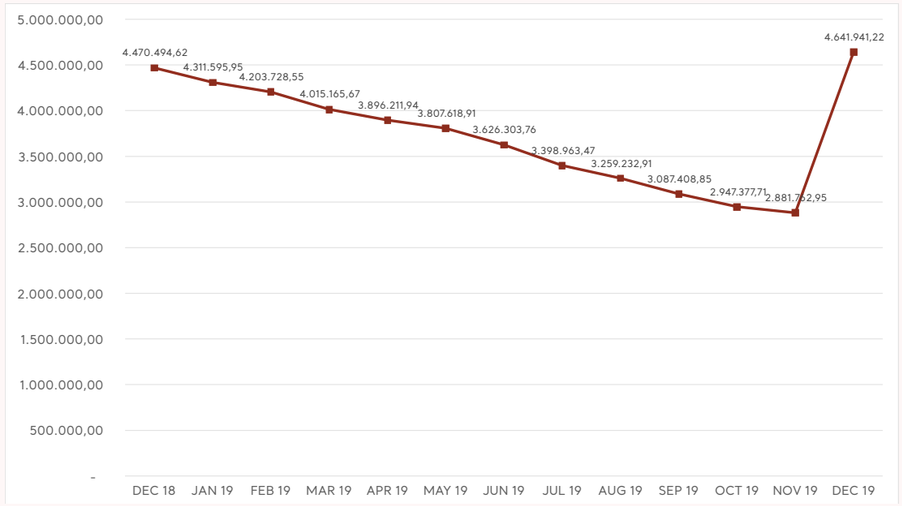
The amount of 55,207.90 Euro refers to eight supply contracts signed in the last part of 2019 for the implementation of investments planned within CERIC internal research projects.

Statement of Cash Flow

The cash flow statement identifies the sources of cash inflows, the items on which cash was expended during the year and the cash balance as at the end of the year.
Inflows and outflows are classified on the basis of their (operating or investment) nature.
In the following table is included information about the historical changes in cash (and cash equivalent) referring to operating, investing and financing activities.

Statement of cash flows for the years	2019	2018
Cash flows from operating activities		
Receipts		
CERIC externally funded projects	95,212.50	1,889,816.92
Commercial activities	1,900.00	-
Contribution from the host country	2,404,535.00	2,404,535.00
Interest received	297.11	128.34
Other receipts	23,716.67	7,545.69
Payments		
Payments to staff	1,423,977.26	1,282,667.02
Suppliers	771,933.36	426,368.33
Payments to project partners	-	396,788.61
Net Cash from Operating Activities	**329,750.66**	**2,196,201.99**
Cash flows from investment activities		
Purchase of plant and equipment	283,796.37	159,462.00
Sale of plant and equipment	-	-
Other	-	-
Net Cash Flow from Investment Activities	**283,796.37**	**159,462.00**
Cash flows from financing activities		
Proceeds from borrowings	-	-
Repayment of borrowings	-	-
Other	-	-
Net Cash Flow from Financing Activities	-	-
NET INCREASE/(DECREASE) IN CASH	**45,954.29**	**2,036,739.99**
CASH, BEGINNING OF THE YEAR	**5,051,300.27**	**3,014,560.28**
CASH, END OF THE YEAR	**5,097,254.56**	**5,051,300.27**

Net Financial Position - Trend for the period Jan-Dec 2019



The Net Financial Position represents the net debt position of the Consortium during the year, through the comparison of the following balance items:

- + cash and cash equivalent
- + short-term credits
- - short-term debts

Additional disclosures on in-kind resources (with reference to Directive 2013/34/EU)

In relation to in-kind contributions, which statutorily constitute a particularly significant element in terms of the resources and organization that can be used by the Consortium, it should be noted that it was not possible to acquire all the accounting values for 2018 according to the principles of consistency and auditability on the basis of the revised "Methodology for Defining the Values Involved in the CERIC-ERIC Activities, and to Detail In-kind Contributions" approved by the General Assembly in June 2018.

However, it needs to be highlighted that, even before the set-up of the Consortium, some of the concerned PFs manifested themselves through this particular mode of contribution, which then allowed the immediate and consistent start of activities.

These values were quantified, albeit with the limitations set forth above, by the various PFs and are shown in the tables below in order to provide supplementary information, which enables a better understanding of the relevance of the total resources used by CERIC in the whole financial year 2019.

Value of the PFs and in-kind contribution. Consolidated data (2019)

Total costs of the ordinary scientific/technical activities of the partner facilities in 2019 - COMMITTED IN-KIND									
	Recurrent costs								
PF	Personnel costs	Travel & accomo-dation and similar	Consumables	Services	Utilities	Overheads	Technical devaluation & maintenance, lease/rent costs of equipment & spaces	Cost of access committed to CERIC	Total
AT	344,543.47	-	82,511.00	7,244.00	-	108,574.62	-	-	**542,873.09**
HR	-	-	-	-	-	-	-	49,810.53	**49,810.53**
CZ	-	-	-	-			-	201,759.48	**201,759.48**
HU	-	-	-	-	-	-	11,038.00	107,006.27	**118,044.27**
IT	173,370.46	-	56.00	-	-	-	-	3,360,525.12	**3,533,951.58**
PL*	-	-	-	-	-	-	-	263,454.00	**263,454.00**
RO	-	-	-	-	-		-	41,833.43	**41,833.43**
SRB	-	-	-	-	-	-	-	-	**-**
SI	-	-	-	-	-	-	-	148,397.33	**148,397.33**
Tot.	**517,913.93**	**-**	**82,567.00**	**7,244.00**	**-**	**108,574.62**	**11,038.00**	**4,172,786.16**	**4,900,123.71**

*Amount included in the financial statements

5

CERIC Overview

The mission and main purpose of CERIC, in line with the ERIC Regulation (EC No 723/2009), is to establish and operate a multidisciplinary distributed research infrastructure on a non-economic basis.

Mission

CERIC is a research infrastructure integrating and providing open access to some of the best facilities in Europe, to help science and industry advance in all fields of materials, biomaterials and nanotechnology. It enables the delivery of innovative solutions to societal challenges in the fields of energy, health, food, cultural heritage and more.

Vision

CERIC co-creates the European Research Area by enabling the best global researchers to realize their ideas in a multicultural research environment with a worldwide reach. By expanding insight into materials on the nano-scale, CERIC contributes to solving contemporary societal challenges.

CERIC is an integrated multidisciplinary research infrastructure for basic and applied research in the fields of materials, biomaterials and nanotechnology. It integrates leading national research institutes into a unique international infrastructure, having its statutory seat in Trieste – Italy, and its nodes distributed in Austria, Croatia, Czech Republic, Hungary, Poland, Romania and Slovenia (Serbia is currently pending full membership). In each country, a Partner Facility (PF) ensures access and outreach to all national scientific communities and to users from all over the world, who compete for free access to 50 techniques available through a single entry point and based on the use of electrons, ions, neutrons and photons for the analysis and synthesis of materials. This service is also open to commercial users on market-based conditions.

The governing structure involves ministerial representatives of the Member Countries, as well as the directors of the Partner Facilities. CERIC management and research activities are distributed in the participating countries and cover administration, communication, technology transfer and project management. A common support system allows the distributed staff to operate in an integrated way for transnational and cooperative projects and joint ventures.

Each Member Country contributes to CERIC by making available and supporting a high-quality PF, which is continuously improved by being exposed to international users competing for access through peer-review evaluation and selection of their proposals, based on excellence. The PFs are strongly complementary to each other and act as a whole as an international agency providing support to the best researchers and research projects, contributing access to advanced analytical and synthesis facilities.

CERIC's international, pan-European approach, in line with ERIC Regulation EC No 723/2009, avoids duplication and fragmentation in the research system, and increases the integration and competitiveness of the European Research Area (ERA), speeding up East-West alignment in the ERA.

CERIC Partner Facilities, Instruments and Techniques

AUSTRIA

Graz University of Technology

is dedicated to the structural characterisation of nanosystems with scattering techniques covering topics such as advanced materials, (bio-)polymers, proteins in solids, surfaces, liquids and in the gas phase. The facility provides access to its light and X-ray scattering laboratories, as well as to the Austrian SAXS beamline and Deep X-ray Lithography beamline, both at Elettra.

CROATIA

Ruđer Bošković Institute

develops and allows access to ion beam techniques for materials' modification and characterization, such as PIXE and RBS, as well as a heavy ion microprobe, dual beam irradiation chamber with RBS/channeling, and TOF ERDA spectrometer.

CZECH REPUBLIC

Charles University Prague

has expertise in surface analysis, thin film growth and studies of the reaction mechanism on catalyst surfaces. It offers Photoelectron Spectroscopy (XPS, XPD, ARUPS) with Low Energy Ion Scattering Spectroscopy and LEED, Field Emission Gun Scanning Electron Microscope, Near Ambient Pressure XPS and access to the Materials Science Beamline at synchrotron Elettra dedicated to soft X-ray photoelectron spectroscopy and NEXAFS.

HUNGARY

Budapest Neutron Centre

performs and offers R&D in nuclear science and technology, studying the interaction of radiation with matter and doing isotope and nuclear chemistry, radiography and radiation chemistry, surface chemistry and catalysis (PGAA, NAA, RAD). Neutron scattering instruments allow investigation of the microscopic properties of solids, liquids, soft materials, biological objects and condensed matter (PSD, SANS, TOF, GINA, MTEST, BIO, TAST).

ITALY

Elettra Sincrotrone Trieste

covers a wide range of experimental techniques and scientific fields, including photoemission, spectromicroscopy, crystallography, dichroic absorption spectroscopy, x-ray imaging, etc.

POLAND

Polish Ministry of Science and Higher Education

offers techniques based on synchrotron radiation: the PEEM/XAS beamline (200-2000 eV photon energy range) is equipped with PEEM - Photoemission Electron Microscopy - and XAS, devoted to spectroscopy studies by absorption of soft X-rays. The UARPES undulator beamline (8-100 eV photon energy range) is equipped with an ARPES end-station, allowing precise studies on the structure of energy bands of solids and their surfaces. The new cryo transmission electron microscope FEI Titan Krios 3Gi enables researchers to look at the macromolecules almost in their natural environment.

ROMANIA

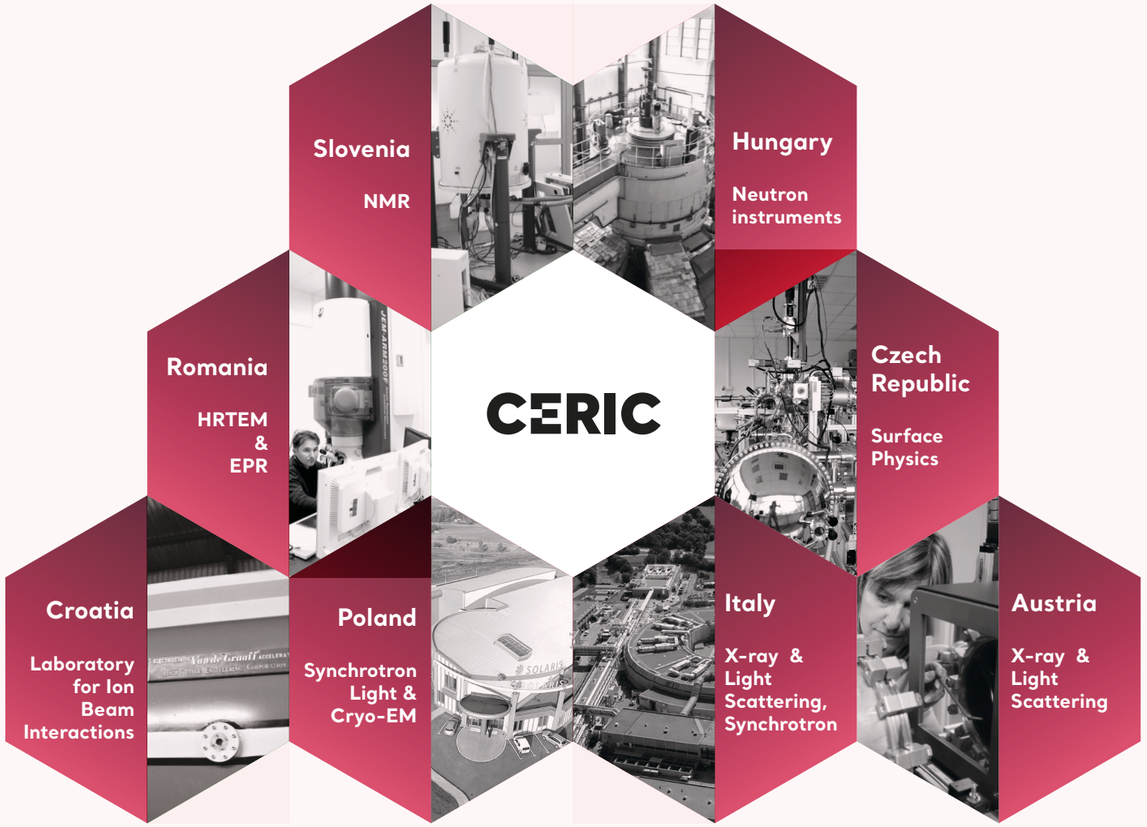
National Institute of Materials Physics

offers access to HRTEM and EPR laboratories for research in solid state physics and materials science, including the synthesis and characterisation of advanced materials for applications in microelectronics, catalysis, energy industry and ICT.

SLOVENIA

National Institute of Chemistry

offers NMR spectroscopy for chemical analysis and identification, for determining 3D structures and studying the dynamics of small and larger bio-macro-molecules, for tracking chemical reactions in analytical and bioanalytical procedures, for studying polycrystallinity and identifying metabolites and various amorphous forms.



Abbreviations

BoD	Board of Directors
CERIC	Central European Research Infrastructure Consortium
ED	Executive Director
ERA	European Research Area
EOSC	European Open Science Cloud
ERIC	European Research Infrastructure Consortium, a legal framework created by the European Commission to allow the operation of Research Infrastructures of pan-European interest.
FOE	Fondo Ordinario per il finanziamento degli Enti e istituzioni di ricerca (Ordinary Fund for the Financing of Research Entities and Institutions)
GA	General Assembly
IF	Impact Factor
IL&TT	Industrial Liaison and Technology Transfer
IR	Internal Regulations
ISTAC	International Scientific and Technical Evaluation Committee
MIUR	Italian Ministry of Education, University and Research
PI	Principal Investigator
PF	Partner Facility
RE	Representing Entity
RI	Research Infrastructure
R&D	Research & Development
S&T	Science & Technology

X-ray and Light scattering at the TU Graz and Elettra
Graz and Trieste
www.tugraz.at

Ion beams at the Ruđer Bošković Institute
Zagreb
www.irb.hr

Surface science at the Charles University
Prague and Trieste
http://spl-msb.mff.cuni.cz/

Neutrons at the Budapest Neutron Centre
Budapest
www.bnc.hu

Synchrotron and laser light at Elettra
Trieste
www.elettra.eu

Synchrotron light and Cryo electron microscopy at Solaris
Krakow
www.synchrotron.uj.edu.pl

Electron microscopy and EPR at the National Institute of Materials Physics
Magurele
http://lab50.infim.ro

NMR at the National Institute of Chemistry
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