D1.1 Industry Cooperation Strategy SOLARIS

Project acronym: Sylinda

Project full title: Synchrotron Light Industry Applications

Grant agreement no.: 952148

Version: 1.3

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Due Date of Deliverable: 30/06/2021

Completion Date of Deliverable: 30/06/2021

Lead partner for deliverable: Jagiellonian University

Project funded by the European Commission within the Horizon 2020 programme		
Dissemination Level		
PU	Public	✓
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including Commission Services)	
CO	Confidential, only for members of the consortium (including Commission Services)	

Document History

Issue Date	Version	Changes Made / Reason for this Issue	Author
15/06/2021	V1.0	Initial Draft	Piotr Ciochoń
22/06/2021	V1.1	Introduction of changes, comments and suggestions of the project partners	Piotr Ciochoń, Alejandro Sanchez, Josef Hormes
28/06/2021	V1.2	Introduction of changes and suggestions of the project partners, extension of the SWOT analysis, changes in the analysis of the industrial sectors likely to cooperate with SOLARIS	Piotr Ciochoń Alejandro Sanchez, Josef Hormes, Henning Lichtenberg
30/06/2021	V1.3	Introduction of minor corrections, approval of the final version	Piotr Ciochoń Alexey Maximenko

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1 Objective of this document

This deliverable will describe the strategy, to be adopted by the National Synchrotron Radiation Centre SOLARIS, intended to build-up and maintain industry contacts. The strategy will constitute the basis of the effective industry cooperation and the successful use of the newly installed SOLABS beamline for industrial projects.

The work presented here corresponds to Task 1.1 and Task 1.2:

"T1.1 (SO): The industry liaison officer will develop a strategy for building-up and maintaining industry contacts as well as the network with cooperating industry liaison offices in cooperating synchrotron laboratories. In addition, he or she will establish structures to manage the acquired contacts and ensure sustainability. The industry liaison officer will involve the beamline scientist into the customer meetings and hand over the R&D project to the beamline scientist for implementation. The industry cooperation partner will always be guided and supported by the industry liaison officer through all the duration of the service provided by the light source. Early stage researchers will be involved in customer meetings to broaden their view on possible R&D projects and train them in science management (see WP 2). Throughout the project, the industry liaison officer will acquire industry contacts, perform initial meetings with potential customers to understand their real underlying problem and match it with the available synchrotron based techniques. For this purpose, the industry liaison officer will also build-up and maintain a network with other synchrotron laboratories to be able to involve cooperation partners with complementary techniques, depending on the specific requirements of the R&D challenge at hand.

T1.2 (AL): The industry liaison officer will be trained in the Sylinda network. Initially, the industry liaison officer will spend 3 months in the industry liaison office at ALBA, Barcelona (lead Alejandro Sanchez, Industry Liaison Office Director ALBA). During this period, he or she will cooperate with the staff of the local industry liaison office and become acquainted with the appropriate techniques in acquisition of and communication with (industry) customers. Specifically he or she will be involved in tasks organising the annual Industry Workshop planned by ALBA for 2021. In talks to beamline scientists, he or she will develop a feeling for the specific challenges of carrying out industry projects in a synchrotron laboratory. This training period at ALBA will form the basis for the industry cooperation

strategy to be developed for SOLARIS. In addition, the industry liaison officer will spend at least 3 weeks in the Research and Transfer Department of HN (lead Alexander Prange, Vice-President Research and Transfer). During this period he or she will learn from the specialists about specific challenges of applied research projects, building up networks with especially SMEs, Research Funding, Innovation Transfer and Intellectual Property. In addition to the knowledge acquired at the synchrotron laboratory ALBA, this will broaden his or her view to more different research disciplines and a different setting in a University of Applied Sciences In view of potential (applied) research projects to be acquired for the newly installed beamline, this experience will complete the training. Considering the location of SOLARIS in Krakow, insights into research structures in Germany will be helpful in cooperation with German customers. The insights gained during the training period will feed into the strategy to be developed."

Due to the ongoing COVID-19 pandemic, and in line with the decision of the Project Officer, in-person training of the Industry Liaison Officer was postponed to 2022. The development of the strategy was instead supported by the regular teleconference meetings held between the Industry Liaison Officer from SOLARIS (Piotr Ciochoń), representatives of the Industry Liaison Office of the Alba Synchrotron (Alejandro Sanchez, Marta Avila) and Prof. Josef Hormes from the University of Bonn. The concepts, ideas and plans were also discussed and validated during meetings with other project partners, including Henning Lichtenberg from Research and Transfer Management Unit II at the Hochschule Niederrhein, as well as during industrial workshops, conferences and networking events, aiming at creating the network of European industry liaison and contact officers. The strategy has been validated and endorsed by the management of the National Synchrotron Radiation Centre SOLARIS and by the Executive Board of the Sylinda project.

2 Executive summary

National Synchrotron Radiation Centre SOLARIS, established in 2015, is the only synchrotron radiation facility in Poland and in Central and Eastern Europe. It currently operates four beamlines, with the available photon energies in the UV and soft X-ray range, and the National Cryogenic Electron Microscopy Centre with two available electron microscopes. Four additional beamlines are under construction, which will provide access to hard X-ray and IR radiation. The commissioning of the beamlines is planned for 2021-2023.

Stimulating and enhancing cooperation with industry is one of the main strategic goals of SOLARIS. As a modern synchrotron radiation facility with highly qualified personnel, offering access to a wide variety of unique research techniques and with a wide network of international partners, the Centre is well positioned to become an important research and innovation hub for the industry in Poland, as well as for the whole Central and Eastern Europe region. External factors, positively affecting the outlook for the industry cooperation programme at SOLARIS include: rapid economic growth in Poland, strong increase in R&D spending, especially by private enterprises, international and governmental incentives for performing industrial research and post-COVID-19 recovery funds, being launched in the European Union. However, several political, legal, societal and environmental threats can hinder the successful introduction of the programme, most notable of which are: legal uncertainty, due to the rule of law disputes with the European Commission, and rising electricity costs, as well as unstable grid, stemming from the reliance of Poland on fossil fuels in the electricity generation.

In order to accomplish the main goal of making SOLARIS the favored synchrotron radiation facility for industrial cooperation, five main strategic objectives need to be achieved. They form a logical chain of: (1) creating an effective framework for industrial cooperation, (2) raising awareness of the possibilities of SOLARIS in Poland, (3) engaging with Polish industry, (4) increasing the number of performed industrial experiments and (5) raising awareness of the possibilities of SOLARIS in Central and Eastern Europe. These objectives are the basis for the strategic action plan, which will be translated into actionable tasks and milestones. Completing the strategic action plan in the upcoming years will allow SOLARIS to greatly enhance its societal and economic impact and to stimulate the innovativeness of the economy both in Poland and in the whole region.

3 Current status of the National Synchrotron Radiation Centre SOLARIS

3.1 Basic information and available techniques

National Synchrotron Radiation Centre SOLARIS was established in 2015 as the first synchrotron light source in Poland and in the whole Central and Eastern Europe (CEE) region. It is a third-generation light source, developed in collaboration with the Swedish national light source, MAX-Lab. The storage ring at SOLARIS consists of 12 identical double-bend achromat magnets, allowing for the maximum energy of the electron beam equal to 1.5 GeV, with a very good emittance of 6nm·rad.

Four operational beamlines are available for external users, with four additional beamlines currently under construction. The summary of the available beamlines and offered research techniques is shown in Table 1.

Table 1: Beamlines at the National Synchrotron Radiation Centre SOLARIS.

Beamline	Status	Photon energy	Primary available techniques
UARPES	operational	8-600 eV	Angle-resolved photoelectron spectroscopy (ARPES)
XAS	operational	100-2000 eV	X-ray absorption spectroscopy (XAS) X-ray magnetic linear/circular dichroism (XMLD/XMCD)
PHELIX	operational	50-1500 eV	Angle-resolved photoelectron spectroscopy (ARPES) Spin-resolved photoelectron spectroscopy (SR-ARPES) X-ray absorption spectroscopy (XAS)
DEMETER	operational	50-1500 eV	Photoelectron emission microscopy (PEEM) Scanning X-ray transmission microscopy (STXM)
SOLABS	u/c	1-15keV	X-ray absorption spectroscopy (XAS) / X-ray fluorescence (XRF)
POLYX	u/c	5-15keV	X-ray multimodal imaging (μXRF, XRF-CT, μXAFS, μXRD, μCT)

SOLAIR	u/c	12.5-500 meV	Infrared microscopy with a focal plane array detector (IR-FPA) Atomic force microscopy - infrared spectroscopy – near field optical microscopy (AFM-IR-sNOM)
SOLCRYS	u/c	5-25keV	X-ray diffraction (XRD) Small-angle X-ray scattering (SAXS)

The commissioning of the SOLABS beamline, which will be the main focus of the Sylinda project, is planned for the second half of 2021. The commissioning of the other three beamlines is planned for 2022 and 2023. In addition to the synchrotron light source, SOLARIS also operates the National Cryogenic Electron Microscopy Centre, with two cryoEM microscopes available for external users: Thermo Scientific Krios G3i and Thermo Scientific Glacios.

Several aspects of the mission, vision and strategic goals of the National Synchrotron Radiation Centre SOLARIS[1] are directly aligned with industrial cooperation and form the basis for the dedicated industry cooperation strategy, presented in this document. The vision of the Centre states that: *"SOLARIS NSRC is a national science center providing open access to research infrastructure. As a unique source of synchrotron radiation in Central Europe, it opens new perspectives in many areas of basic and applied research, offering a wide spectrum of modern research techniques. SOLARIS NSRC is a platform for the development of national and international cooperation, as well as an incubator of new technologies"*.

This is detailed in the mission statement, wherein several industrial sectors are directly outlined: *"The Center's infrastructure serves basic and applied research in such areas as catalysis, biomedical engineering, nanomaterials, pharmacology or geology. It facilitates the search for new energy sources and solutions for future electronics"*. The need to strengthen the cooperation with industry is explicitly stated: *"SOLARIS NSRC stimulates the cooperation of Polish scientists with industry in finding new technical solutions with commercial potential"*.

Cooperation with industry is directly aligned with two out of six strategic goals of the Centre:

[1] https://synchrotron.uj.edu.pl/en_GB/wizja-misja-i-cele, last accessed: 14.06.2021

"2. Strengthening of the position of SOLARIS in the European Research Area and developing international cooperation.

3. Recognising and utilising the potential of domestic industry development through technology transfer, direct cooperation and commercialisation of inventions and intellectual property."

The general strategy of the Centre puts special emphasis on the cooperation with industry and creates a solid basis for the dedicated Industry Cooperation Strategy.

3.2 Overview of the access modes for external users

SOLARIS currently offers both proprietary and non-proprietary access to the beamlines and the cryoEM facility. Non-proprietary access, which is aimed primarily at academic scientists conducting non-commercial research, is based on open calls, announced twice a year (usually in March and September). Experiment proposals are evaluated by the international commission. In 2020, additional options of rapid access, for time-sensitive experiments, and remote access were introduced. Non-proprietary access mode is offered for the users free of charge. However, it requires them to publish the results and the collected data is stored at SOLARIS.

There are two main proprietary access options available to commercial users: research infrastructure access (basic access) and commissioned project (comprehensive access). The former is based on granting access to the research equipment, with the support of a qualified, dedicated operator. Commercial users can perform experiments of their choice, after the assessment of their safety and feasibility, and receive full datasets upon completion. This mode doesn't, however, include any additional services provided by the staff of SOLARIS. The customers are billed hourly, on the basis of the fixed price, established using internal procedures of the Jagiellonian University, which is the parent unit of the Centre. This access mode doesn't require signing the contract with the customer and the relations are based on general documents describing terms and conditions of the measurements.

The second access option encompasses a comprehensive service of an industrial research project and can include additional services, provided by the staff of SOLARIS, or other university laboratories and units, alongside the commercial time on the beamlines or in the cryoEM facility. Additional services may encompass: experiment planning, literature review, advanced data analysis, additional experiments, formulating opinions and recommendations for the customer. Every request for the commissioned project access mode

is quoted individually, and for projects with the value over 10.000 PLN (around 2.500EUR), a contract has to be signed between the Centre and the customer.

3.3 SWOT analysis.

SWOT analysis is a strategic planning technique, allowing for the analysis of the internal and external factors affecting the development of a given organization. In Table 2, SWOT analysis of the SOLARIS Centre, in the context of industry cooperation, is presented.

Table 2 SWOT analysis of the industry cooperation possibilities at SOLARIS.

Strengths	**Weaknesses**
Modern synchrotron radiation facility Availability of complementary research techniques, including cryoEM Highly qualified personnel Strong support of SOLARIS management for industrial activities Strong international partnerships Participation in the international projects with industrial focus, such as Sylinda Cooperation with large research universities Relatively low measurement costs, given the value of obtained information	Limited number of available beamlines and research techniques Limited experience in industry cooperation Relatively low number of employees, given the involvement in different activities Involvement of the central university bureaucracy, leading to substantial delays
Opportunities	**Threats**
Rapid growth of Polish and CEE economies Increase in R&D spending in Poland Introduction of R&D tax credits in Poland Governmental and international incentives for industry-academia cooperation National and international funding programmes aimed at industrial research Post-COVID-19 stimulus packages favoring industrial R&D and innovation Limited competition – no other synchrotron light sources in CEE	Possible disruptions in operation due to the construction works planned for 2022 Operation of other, highly competitive synchrotron radiation facilities Possibility of economic recession, due to COVID-19 pandemic or inflation growth Possibility of limiting access to EU funding for Polish entities, due to the ongoing rule of law disputes

SWOT analysis shows, that SOLARIS is well-positioned for successfully introducing industry cooperation programmes. With the commissioning of the 4 beamlines planned for the next two years, the main weakness of the Centre (limited number of available beamlines and research techniques) will be solved. International cooperation, within the framework of the Sylinda project, will be used to overcome the second main identified weakness: lack of experience in the industry cooperation. SOLARIS can take advantage of numerous opportunities, which will allow for the rapid growth in the next few years. However, risk mitigation strategies should be adopted, to avoid identified threats, especially with regard to the economic aftermath of the COVID-19 pandemic and the ongoing rule-of-law disputes between Polish government and the European authorities.

3.4 PESTEL analysis.

PESTEL analysis is a framework used to assess the external macro-factors affecting organization's goals and strategy, grouped into six main categories: political, economic, social, technological, environmental and legal. This section will describe the influence of those factors on the adopted industry cooperation strategy.

Internal **political** situation in Poland is rather stable, with the ruling coalition having a minimal majority in the lower house of parliament, which is responsible for introducing new laws and approving governmental positions. In recent years, several new laws have been adopted, which affect higher education sector, as well as research and innovation, most notable of which are 2018 Act on Higher Education and Science and 2019 Constitution for Science Act. They focus on strengthening practical dimension of education, introducing dual education programmes with the employers, including dual PhD programmes (conducted jointly by higher education institutions and private employers, focusing on solving industrial R&D problems), and reforming the governing bodies at higher education institutions. Moreover, The Research Network Łukasiewicz has been launched in 2019, with the aim of conducting applied and industrial research. The network is the third largest research network in Europe. The government has declared its support for strengthening R&D and innovation and has introduced several instruments aimed at stimulating industry-research collaboration, including the R&D tax credits, which allow the companies conducting R&D activities to deduct up to 100% of the costs of R&D from the tax basis (up to 150% in case of specialized SMEs, which have the status of "R&D centres"). The main political risks, connected to the industry cooperation strategy, concern the ongoing dispute between the Polish government

and the European Commission, regarding the rule of law principle[2]. With the adoption of a special conditionality mechanism[3] in December 2020, aimed to protect the EU budget in case of rule of law deficiencies in member countries, the risk of delaying, or suspending the EU budget funds for Poland, including funds for R&D activities both for enterprises and research institutions, has grown significantly.

Polish **economy** has witnessed steady growth since 1991, with the latest 5-year average real growth of 4.3%[4]. Following the decline by 2.7% in 2020, due to the COVID-19 pandemic, GDP is projected to grow by 4.0% in 2021 and by 5.4% in 2022, according to the European Commission's projections[5]. Gross domestic spending on R&D activities in Poland has grown significantly over the past years and in 2020 reached 1.324% of GDP, up from 0.963% of GDP in 2016[6], which is a growth of over 35% over the past 5 years. According to the government's data, in 2019 62.8% of gross domestic expenditure on R&D came from the private enterprise sector, while 35.6% came from higher education[7]. The rapid growth of the Polish economy, combined with a strong increase in R&D spending, financed mostly by the enterprise sector, creates strong external incentives for increasing the rate of collaboration between SOLARIS and industrial partners, thus increasing the likelihood of the successful implementation of the industry cooperation programme.

There are several **societal** factors affecting this strategy. With around 7.4 researchers, per 1000 employed, Poland remains below OECD average[8], which can result in the shortages of highly qualified staff at research facilities, including SOLARIS. Because of the relatively low wages of R&D personnel at public research facilities in Poland and due to the high mobility of researchers and technical staff, this problem is likely to increase in the coming years, creating a productivity gap and under-utilisation of research infrastructure. This can be further deepened by the controversial practices of Polish regional authorities, deemed as discriminatory by many national and international bodies. The most notable example concerns the creation of the declaratory (non-legally-binding) "LGBT-free zones", which, together with other factors, make Poland one of the least LGBTI-friendly countries in Europe, ranked 43rd

[2] https://link.springer.com/article/10.1007/s40803-021-00151-9, last accessed: 14.06.2021
[3] https://www.europarl.europa.eu/news/en/press-room/20201211IPR93622/parliament-approves-the-rule-of-law-conditionality-for-access-to-eu-funds, last accessed: 14.06.2021
[4] OECD Economic Surveys: Poland 2020
[5] https://ec.europa.eu/info/business-economy-euro/economic-performance-and-forecasts/economic-performance-country/poland/economic-forecast-poland_en, last accessed: 14.06.2021
[6] https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm, last accessed: 14.06.2021
[7] https://www.gov.pl/web/development-labour-technology/research-and-development-activities-in-poland-in-2019, last accessed: 14.06.2021
[8] https://data.oecd.org/rd/researchers.htm#indicator-chart, last accessed: 14.06.2021

out of 49 studied countries[9]. This can affect both researchers, considering their place of work and residence, and companies choosing where to perform industrial experiments, many of which are enacting anti-discriminatory internal regulations. This factor is important especially in the context of the LGBTIQ Equality Strategy 2020-2025, adopted by the European Commission[10]. Poland has also fallen significantly in the corruption perceptions index and in 2020 was ranked 45 out of 179 countries, down 16 places from 2016[11]. Societal factors, mentioned above, form significant risks for the industry cooperation programme and special attention should be put on their mitigation in the following years.

SOLARIS has access to modern **technological** solutions, with regard to the design and manufacturing of accelerators, beamlines, end-stations and microscopes. International cooperation with European organizations, such as the League of European Accelerator-based Photon Sources (LEAPS) or Central European Research Infrastructure Consortium (CERIC-ERIC), partner light sources, such as MAX-Lab, and partners in various projects, including Sylinda project, enable adoption, co-creation and provision of advanced technologies to industrial users. However, a factor that can negatively affect the strategy is the low level of university-industry collaboration in R&D in Poland, which in 2017 was ranked 89 out of 137 countries according to the World Economic Forum Global Competitiveness Index[12]. This is one of the major challenges that need to be overcome, in order to enable effective collaboration of SOLARIS with industry.

Environmental factors affecting this strategy are centered around the climate crisis, related to the greenhouse effect and to the CO_2 emissions, associated with industrial production and electric energy generation in Poland. In 2019, around 73.6% of electricity in Poland was produced using coal, and renewable energy sources account to around 15.4% of the production[13]. With the adoption of EU-wide climate target of the reduction of greenhouse emissions by at least 55%, compared to 1990 levels, by 2030, and of climate neutrality by 2050[14], supported by the EU Emissions Trading System and the strong increase in the emission prices in the past years, price of electricity in Poland is growing rapidly. This can negatively influence the financial situation of both Polish enterprises, and the SOLARIS Centre itself. Moreover, due to the water shortages, especially during summer months, Polish

[9] https://www.ilga-europe.org/rainboweurope/2021, last accessed: 14.06.2021
[10] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2068, last accessed: 14.06.2021
[11] https://www.transparency.org/en/cpi/2020/index/nzl, last accessed: 14.06.2021
[12] https://tcdata360.worldbank.org/indicators/h4247b4d7?country=POL&indicator=604&indicators=944, last accessed: 14.06.2021
[13] https://forum-energii.eu/en/polska-transformacja-energetyczna, last accessed: 14.06.2021
[14] https://ec.europa.eu/clima/policies/eu-climate-action/2030_ctp_en, last accessed: 14.06.2021

electricity grid remains unstable, as evidenced by the introduction of limited power supply in 2015, due to the shortage of 4000 MW of electric power[15]. The risks stemming from environmental factors should be taken into consideration in the planning processes.

Legal situation in Poland remains complicated, due to the ongoing reforms of the judiciary, introduced by the governing coalition, and the subordination of the central prosecutor's office to the political representatives of the government. Poland's score in the World Justice Project Rule of Law Index has been declining since 2015[16], which is reflected by the number of legal challenges, brought to the Court of Justice of the European Union by the European Commission. The possibility of alienating the Polish judicial system from the judicial system in other member countries of the European Union creates a significant risk for enterprises cooperating with Polish entities, including the SOLARIS Centre. Legal risks have to be mitigated in the upcoming years, despite the limited possibilities of the Centre in solving aforementioned systemic issues.

3.5 Overview of the industry sectors, likely to cooperate with SOLARIS

Table 3 shows industry sectors, relevant to the Polish and regional economy, which are likely to be interested in performing industrial research at the SOLARIS Centre, together with the exemplary studies, possible to be performed at the available and developed beamlines, or at the cryoEM facility.

Table 3: Industrial sectors, which could be interested in performing industrial research at SOLARIS.

Industrial sector	Exemplary applications	Associated techniques
Chemical and materials (including metals, non-metals, polymers)	Chemical speciation Oxidation state determination Small molecule crystallography Catalyst optimization and regeneration Reactions involving magnetic particles Characterization and recycling of plastics Characterization of cements, pigments, adhesives and rubbers	XAS/XRF STXM XRD/SAXS cryoEM XMCD/XMLD µCT IR-FPA AFM-IR-sNOM
Food and Agriculture	Speciation of metal particles, nanoparticles and compounds present in plants Optimization of minerals uptake by plants	XAS/XRF STXM IR-FPA

[15] https://www.pse.pl/-/operator-systemu-przesylowego-osp-wprowadza-ograniczenia-w-dostarczaniu-i-poborze-energii-elektrycznej-ogloszono-19-i-20-stopien-zasilania, last accessed: 14.06.2021
[16] https://worldjusticeproject.org/rule-of-law-index/country/Poland, last accessed:14.06.2021

	Studying the effects of biosolids on plant growth and development New technologies in food packaging	AFM-IR-sNOM µCT cryoEM
Energy	New materials for renewable energy sources (e.g. photovoltaics) New materials for energy storage (batteries, supercapacitors) Optimizing structure and function of filters and catalysts, used to treat exhaust fumes	ARPES XPS XAS/XRF PEEM STXM µCT cryoEM
Wood and paper	Distribution of metal ions in woods Characterization of the microstructure of papers and its influence on printability Speciation of trace elements in woods Characterization of the structure of cellulose and its changes under stress	XAS/XRF STXM IR-FPA AFM-IR-sNOM µCT cryoEM
Oil & gas, mining	Impurities speciation in crude oil Characterization of the chemical environment of sulfur in oils *Operando* studies of chemical reactions Characterization of porous materials for gas storage Speciation of elements in mining waste Extraction of precious metals from minerals	XAS/XRF STXM XRD/SAXS µCT cryoEM
Electronics	Determination of the electronic and spin structure of materials Surface characterization of materials New materials for spintronics, optoelectronics, quantum computing	ARPES XPS PEEM XMCD/XMLD
Environmental engineering	Speciation of heavy metals in soils Design and testing of remediation strategies Characterization of fertilizers Determination of the composition of	XAS/XRF STXM cryoEM µCT

	different pollutants, including ashes and particulate matter	
Biotechnology and health	Structure determination of proteins, complexes and small molecules Functional studies of biomolecules Characterization of the interactions between active substances and cells/tissues Bioavailability of drugs and cosmetics	XRD/SAXS cryoEm STXM XAS µCT IR-FPA AFM-IR-sNOM

This list does not include all industrial sectors that could use unique techniques offered by the SOLARIS Centre, but focuses on the sectors which are strongly represented in the Polish and regional economy by both SMEs and large enterprises, with the technological needs that can be answered by the research techniques offered by SOLARIS now or in the near future. Table 4 shows the share of the sales and employment of the aforementioned sectors in Polish industry, according to the National Statistics Office[17].

Table 4: Share of sales and employment of the selected industrial sectors in the Polish economy.

Industrial sector	% of total sales	% of total employment
Chemical and materials	25,8	24,9
Food and Agriculture	16,8	14,6
Energy	7	4,3
Wood and paper	5,4	5,7
Oil & gas, mining	3,6	4,8
Electronics	2,7	2,1
Environmental engineering	1,5	2,2
Biotechnology and health	0,8	0,9
Total	63,6	59,5

[17] https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/statistical-yearbook-of-industry-poland-2020,5,14.html, last accessed: 28.06.2021

The industrial sectors, identified as most likely to use synchrotron radiation to solve their technological problems, represent 63,6% of the total sales and 59,5% of the total employment in the Polish industry. This shows, that the potential effect of adopting synchrotron radiation-based techniques in those industrial sectors is very high. Successful implementation of this strategy can lead to the very positive economic, societal and environmental impact on Poland, as well as on the whole Central and Eastern Europe region.

4 Goals of the strategy

The main goal of the Industry Cooperation Strategy described in this document is to achieve the first key objective of the Sylinda project:

"*Extend the ability of SOLARIS to become the favoured SR lab for industry cooperation partners offering to them unique services with regard to measuring low Z-elements down to Z = 11 and high resolution X-ray absorption spectroscopy (XAS).*"

In order to achieve this goal, several partial objectives need to be achieved, which also correspond to other key objectives of the Sylinda project. They are summarized in Table 4.

Table 5: Goals of the Industry Cooperation Strategy at SOLARIS.

No.	Goal	Description
1.	Establish clear access procedures and cooperation structures for industrial users.	Establishing clear legal and procedural framework is crucial for effective industry cooperation. The framework should be centered around the Industry Contact Office, which should become a single access point for industrial users. Clear rules, with regard to the beamtime available for industrial experiments, price of the experiments, division of the profits acquired by the Centre between the general and beamline budgets, as well as IP rights, should be introduced.
2.	Enhance the visibility of SOLAIRS among industrial players in Poland.	In order to enhance the level of industry cooperation and to attract industrial partners, it is necessary to raise awareness of the benefits of research-industry cooperation, advantages of using synchrotron radiation for the industrial experiments, and of the unique characteristics of

		the SOLARIS Centre and the SOLABS beamline. This encompasses both the experiments focusing on high-Z and low-Z elements.
3.	Increase the level of engagement of SOLARIS with industrial users.	Before performing commercial industrial experiments, or complete commissioned projects, it is necessary to engage directly with the entities interested in performing experiments at SOLARIS, which would facilitate the final decision about collaborating with the Centre.
4.	Increase the number of industrial experiments performed at SOLARIS.	Increasing the number of experiments conducted in partnership with industry, especially with SMEs is crucial to achieving the main objective of this strategy. Experiments should be performed at all available beamlines, as well as at the cryoEM facility. A special emphasis should be put on the SOLABS beamline, which offers unique possibility of performing XAS measurements of low-Z elements.
5.	Increase the presence of SOLARIS among industrial partners in CEE.	After establishing an industry cooperation programme in Poland, SOLARIS has the unique possibility of increasing its presence in the whole CEE, as the only available synchrotron light source in the region. The outreach efforts should focus both on the direct cooperation with industries in other countries and on the joint projects, co-financed by the external sources, or by the interested entities.

5 Strategic action plan

The strategic action plan presented in this section creates a roadmap to achieving each of the goals presented in the previous section. Because of the nature of this document, the plan is general and needs to be translated into actionable tasks and milestones.

5.1 Establishing cooperation framework

The legal and practical framework for establishing cooperation with industry, has to be based on the regulations of the Jagiellonian University, which is overseeing the SOLARIS Centre. Two access routes for commercial users, which are possible to apply, are outlined in section 3.2 of this document. Currently, infrastructure access cards, which contain a calculation of an hourly price of a given infrastructure, approved by the Jagiellonian University have been prepared for the ARPES and XAS beamlines, as well as for some of the advanced metrological equipment of the Centre. The cards are a formal pre-requisite for any commercial cooperation with external users. While the basic access procedure is handled by the administrative office of the Centre, the comprehensive access procedure (commissioned research projects) has to be approved by the central university technology transfer and innovation office.

An Industrial Liaison Officer has been appointed at SOLARIS and his responsibilities include establishing contacts with commercial users, promoting the Centre in the industrial and innovation communities, participating in national and international projects with the industry cooperation components, facilitating the contacts between industry representatives and beamline scientists, development and maintenance of the legal and practical framework for effective industry cooperation, contacts with the central university administration.

In order to achieve the first goal of this strategy, following actions should be undertaken by the Industry Liaison Officer, SOLARIS management and other SOLARIS employees:

- Development and approval of the infrastructure access cards for all experimental equipment, intended to be shared with commercial users;
- Establishing effective communication channels with central university administration, including technology transfer and innovation office;
- Establishing working contacts with beamline scientists, as well as cryoEM facility employees;
- Introduction of regulations, governing the amount of experimental time

available for commercial users, as well as the procedures for fast access and for approving industrial experiments, including the input of the User Office;

- Adoption of the rules of test/pilot industrial experiments and their pricing;
- Development of incentives for staff members actively involved in industry cooperation, promoting proactive behavior and problem-solving attitudes.

5.2 Enhancing the visibility of SOLARIS in Poland

Despite being the largest research infrastructure available to external users in Poland, SOLARIS remains relatively unknown, especially in the industrial circles. Raising awareness of the Centre and its possibilities is the first stage of a "sales funnel" of commercial research services and should focus on reaching the widest possible number of entities. Following actions will contribute to achieving this goal:

- Participation in industrial forums, conferences and other events, actively presenting the potential of using synchrotron radiation to solve industrial problems and challenges;
- Publications about SOLARIS and potential applications in the journals and magazines dedicated to the specific industrial branches (such as: Chemia i Biznes, for the chemical sector, Biotechnologia, for the biotechnology sector, or Paliwa i Energetyka, for the oil&gas sector);
- Online, targeted advertising in the professional services, including social media channels relevant to the innovation community, such as LinkedIn or Researchgate;
- Organisation of webinars, events, presentations and "demo days", targeting industrial partners and specific industry branches;
- Cooperation with the Centre for Technology Transfer CITTRU of the Jagiellonian University, in order to use its networking capabilities and experience;
- Cooperation with external entities, with large outreach possibilities (such as consulting companies) focusing on R&D activities and on obtaining external funding of R&D, through projects conducted in cooperation with research institutions;
- Utilization of the contact networks of SOLARIS employees, partner institutions and cooperating scientists;
- Cooperation with clusters and industrial organizations (such as Polish Cluster

of Composite Technologies, BioMedTech Masovia Cluster, or the Cluster for Photonics and Fiber Optics);

- Cooperation with innovation and R&D projects and consortia, especially consisting of, or targeting SMEs.

5.3 Increasing the level of engagement with industry

After raising awareness and generating contacts and early interactions with the industry representatives, it is necessary to increase the level of engagement with the entities interested in the future collaboration. This can be understood as the second stage of a "sales funnel" of the commercial research services. Activities, aiming at improving the level of engagement with industrial partners include:

- Direct communication with targeted companies, likely to be interested in particular techniques or services offered by the Centre;
- Engaging industry representatives after industrial events, webinars, or conferences, using B2B matchmaking tools and services;
- Analyzing R&D agendas, in particular of the large entities, showing the possibilities of applying synchrotron radiation-based techniques to answer their specific needs or solve specific problems;
- Answering inquiries or requests for offers, published on the procurement bulletins, or aggregator websites and services;
- Organizing pilot experiments, a discounted price, intended to show the capabilities of specific research techniques and the expertise of the employees of SOLARIS.

5.4 Increasing the number of industrial experiments

Industrial experiments, conducted jointly with external partners, represent the final, third stage of the "sales funnel". Activities aimed at increasing the number of experiments and improving the satisfaction of industrial partners should be centered around:

- Providing timely and accurate response to the requests and needs of the industrial partners;
- Facilitating contacts between scientists and industry representatives, with the Industry Liaison Officer acting as a "catalyst", enabling productive cooperation between the two sides;
- Providing rapid access to the available beamlines, or the cryoEM facility, for

the industrial users;

- Providing fast and accurate analysis of the acquired data, as a part of a comprehensive service;
- Encouraging the use of mail-in service and remote access to the infrastructure;
- Protecting the confidentiality of the experiments and results, including signing the non-disclosure agreements (NDAs), when requested.
- Participating in national and international projects, in order to share best practices, enhance the possibilities of obtaining external funding for industry access to SOLARIS and to take advantage of the expertise of European partners, including the experience gained through the Sylinda project;
- Fostering industry usage via international partnerships and networking, including active participation in the activities of the League of Advance Photon Sources (LEAPS) or the Central European Research Infrastructure Consortium (CERIC-ERIC).

5.5 Enhancing the visibility of SOLARIS in CEE

Expanding the activities of SOLARIS to the other countries in the CEE region will require adjusting the activities, related to the three stages of the "sales funnel", to the regional and national specificities. The actions will need to be upscaled, in order to accommodate the needs and requirements of the whole region, and they should focus on:

- Engaging the international partnerships, projects and organizations, which could allow for the upscaling of the outreach activities;
- Participation in the regional industrial and innovation forums, events and conferences and promotion of the possibilities of SOLARIS;
- Obtaining the support of the government in the expansion activities, based on the international partnerships of Poland, such as the Visegrad Group, or the Three Seas Initiative;
- Strengthening the cooperation with Central European infrastructure consortia, such as Central European Research Infrastructure Consortium (CERIC-ERIC);
- Engaging with the networks of Regional Development Agencies, active in the CEE region, grouped for example in the European Association of Development Agencies (EURADA).

6 Conclusions

National Synchrotron Radiation Centre SOLARIS is one of the most important research infrastructures in Poland and in Central and Eastern Europe. As the only operational synchrotron light source in the region, it offers unique research possibilities, which could be extremely valuable for numerous industry sectors. Strengthening industry cooperation could benefit not only the Centre and involved enterprises, but also the whole innovation community and the economy of the region. If the specific obstacles to the development of the industry cooperation programme are overcome, the successful implementation of this strategy will lead to achieving the ultimate goal of the Sylinda project and ensure its long-term impact. SOLARIS is well positioned to become an active R&D and innovation centre, deeply interconnected with the European scientific, innovation and industrial communities.