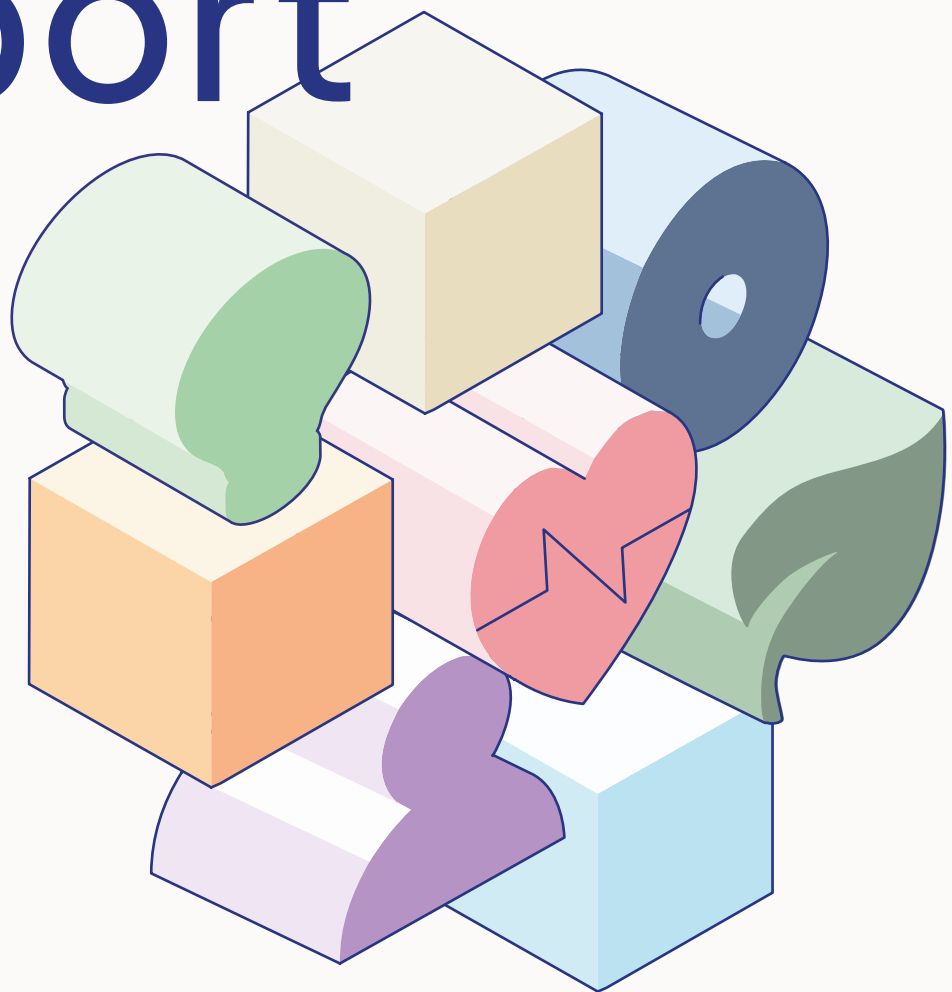


SDSC Activity Report

*Enabling Data-Driven
Science and Innovation
for Societal and
Economic Impact*



2017-2025





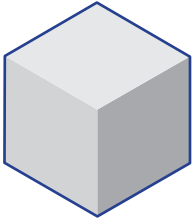


↑ Prof. Dr. Stéphanie Lacour

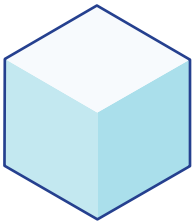
Vice President for Support to Strategic Initiatives, EPFL,
and Chair of the Partners' Assembly of the SDSC

As Switzerland continues to strengthen its position as a global leader in science, technology, and innovation, the Swiss Data Science Center (SDSC) stands as a cornerstone of this national ambition. Since its creation in 2017 under the ETH Domain's Strategic Focus Area initiative, the SDSC has demonstrated how data science and artificial intelligence can accelerate discovery, enable responsible innovation, and empower institutions across the country.

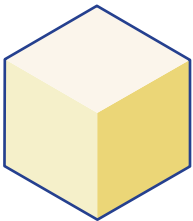
Its transition in 2025 into a National Research Infrastructure reflects both its remarkable trajectory and the critical role that trusted, accessible, and interoperable data capabilities now play in modern science. As it enters this new chapter, the SDSC stands poised to support the ETH Domain's scientific leadership and contribute to the resilience and competitiveness of our country.



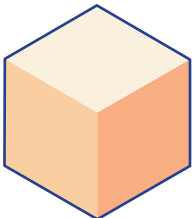
MANAGEMENT



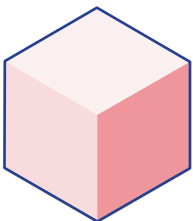
RESEARCH



ENGINEERING



INNOVATION



BIOMEDICAL

FOREWORD

By Prof. Dr. Stéphanie Lacour 1

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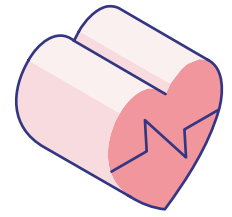
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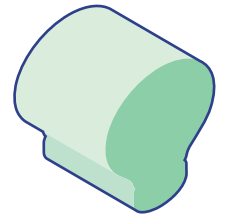
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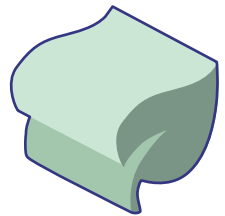




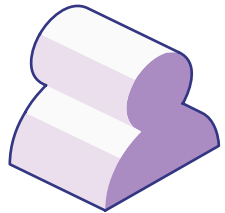
HEALTH & BIOMEDICAL



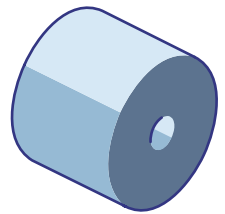
ENERGY & SUSTAINABILITY



CLIMATE & ENVIRONMENT



DIGITAL SOCIETY

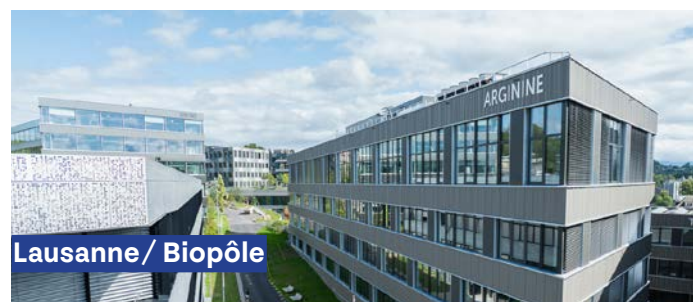


LARGE-SCALE INFRASTRUCTURES

**STRUCTURED ENGAGEMENT:
THE SDSC'S STRATEGIC DOMAINS**

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The SDSC's Leadership Team



↑Prof. Dr. Guillaume Obozinski
Deputy Executive Director
and Chief Data Scientist



↑Dr. Silvia Quarteroni
Chief Transformation Officer
and Head of Innovation



↑Prof. Dr. Olivier Verscheure
Executive Director

From Initiative to National Infrastructure

Dear SDSC Community,

In 2025, the Swiss Data Science Center (SDSC) entered a new phase of its journey: it became a National Research Infrastructure, formally recognized as a pillar of Switzerland's data and AI ecosystem.

This milestone marks the culmination of eight years of growth under the ETH Domain's Strategic Focus Area initiative, a period during which the SDSC evolved from a visionary idea into a national reference for data science, machine learning and AI.

Founded jointly by EPFL and ETH Zurich in 2017, the SDSC was created to help position Switzerland at the forefront of digital transformation and to ensure that advances in data science and artificial intelligence serve science, the economy, and society at large.

From the beginning, its mission has been to make a complex journey simple: to help researchers, companies, and public institutions navigate the full data lifecycle – from collection to insight, from proof of concept to impact.

This report highlights the evolution of the SDSC, from its inception and early projects to its expansion in scope, partnerships, and impact. Over the past eight years, the Center has become a national reference for data science and artificial intelligence applications that generate tangible societal and economic value. It has evolved into a decentralized infrastructure that federates expertise and resources across the country, providing harmonized access to curated datasets, scalable tools, data governance assets, and collaborative platforms to support research and innovation across academia, industry, the public sector, and non-governmental organizations.

Over the course of its eight-year tenure as a Strategic Focus Area (2017–2024), the SDSC has laid a solid foundation for long-term impact. It has fostered trust in data-driven methods, strengthened technical and domain expertise, and developed services, training programs, and frameworks that scale across disciplines and sectors. This maturation reflects not only the Center's growing capabilities but also the increasing national demand for scientific services in data science and artificial intelligence – a need the SDSC is now positioned to meet through its role as a National Research Infrastructure.

*Eight years of growth
have transformed the SDSC
from a vision into a national
infrastructure shaping
Switzerland's data
and AI future.*

We warmly invite you to explore, through this report, the milestones and achievements that have shaped the SDSC's contribution to data science and AI in Switzerland and to discover how we will continue advancing this mission in the years to come.

Yours sincerely,
Silvia Quarteroni, Guillaume Obozinski,
and Olivier Verscheure



1

**CREATION
OF A NATIONAL
CAPABILITY
IN DATA-DRIVEN
SCIENCE AND
INNOVATION**

Foundations of the SDSC Model

Upon its launch in 2017, the SDSC represented a new approach to collaboration in data science within the ETH Domain – one that combined scientific expertise, data-engineering capability, and applied problem-solving under a single structure. Early projects were exploratory, investigating how data science and AI methods could be applied across disciplines and institutions.

Through these first experiences, the SDSC helped connect and strengthen existing data-driven research efforts, developing the processes and collaborative practices that became the foundation of its model, while progressively raising the quality, scope, and impact of its work.

Early collaborations showcased the potential of this model and shaped its subsequent expansion.

Over time, the SDSC broadened its mission beyond academia, building multiple-year partnerships with federal offices such as the Federal Statistical Office (FSO) and the Swiss Federal Office of Energy (SFOE); with academic hospitals such as the Lausanne University Hospital (CHUV) and the University Hospital Zurich (USZ); and with leading industrial partners such as Bühler AG, Richemont, Swissgrid, and Merck.

These developments took place as part of a broader national effort to establish stronger, interoperable data infrastructures supporting science and innovation across Switzerland. Today, the SDSC's transition into a National Research Infrastructure acknowledges the relevance of its mission across Switzerland's research, public and economic landscape. It also confirms its role as a connector across disciplines and sectors, ensuring that data science expertise remains embedded, accessible, and impactful.

Additionally, the SDSC fulfills its educational and knowledge transfer mission. Its experts are committed to delivering undergraduate, graduate, and executive education programs, helping to strengthen Switzerland's data and AI capabilities across generations and professions. Additionally, by collaborating with stakeholders from the industry, public administrations, federal offices, and non-governmental organizations (NGOs), the SDSC provides bespoke coaching and training to help organizations gain maturity and impact in data-driven decision-making.

Growth and Evolution

 1-8 FTEs
 1-10 Million CHF

ENGINEERING TEAM + RENKU

Open-source platform for cross-CH research collaboration.

RESEARCH TEAM

Tackle complex challenges in domain sciences with advanced machine learning.

MANAGEMENT TEAM

INNOVATION TEAM

Knowledge & technology transfer, supporting industry, public administration, NGOs.

ENGINEERING TEAM + ORDES

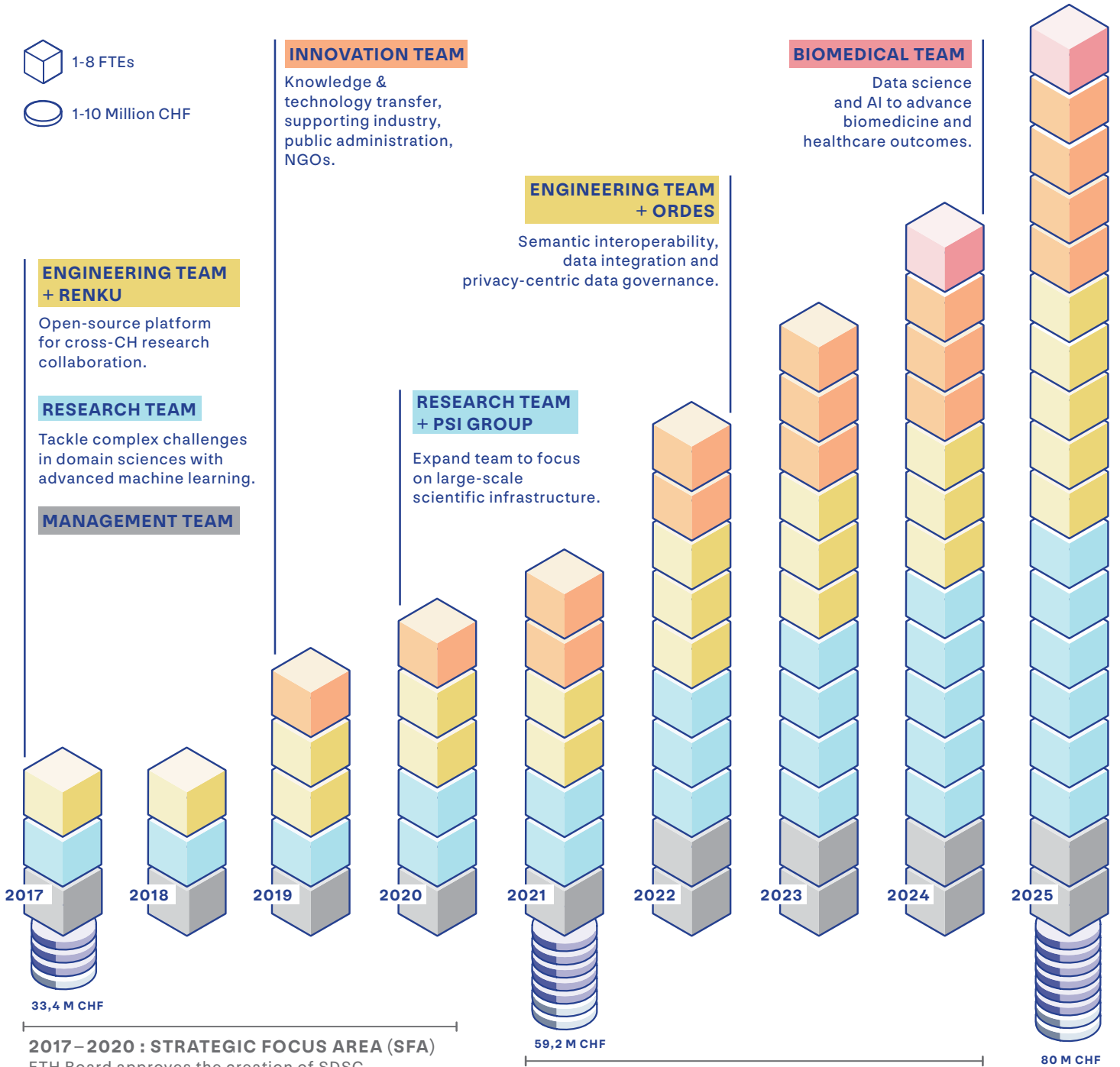
Semantic interoperability, data integration and privacy-centric data governance.

RESEARCH TEAM + PSI GROUP

Expand team to focus on large-scale scientific infrastructure.

BIOMEDICAL TEAM

Data science and AI to advance biomedicine and healthcare outcomes.



2017–2020 : STRATEGIC FOCUS AREA (SFA)

ETH Board approves the creation of SDSC serving the ETH domain.

Budget 2017–2020 :

ETH Board : 30 M CHF
 Third-party(*) : 3.4 M CHF

2021–2024 : 2ND TERM SFA

Budget 2021-2024 :

ETH Board : 45 M CHF
 Third-party(*) : 14.2 M CHF

2025–2028 : NATIONAL RESEARCH INFRASTRUCTURE

Budget 2025-2028 :

ETH Board : 60 M CHF
 Third-party(*) : 20 M CHF

*Total third-party from industry, public administration and competitive academic funding (gross before overhead)

STRUCTURING TEAMS FOR IMPACT AND COLLABORATION

The SDSC began in 2017 with an applied research team focused on leveraging advanced machine learning for scientific challenges. It soon expanded the following year with the creation of an engineering team that developed an open-source platform, named Renku, to foster cross-institutional research collaboration. In 2019, an innovation team was established to strengthen ties with industry, public administration, and civil society actors through collaboration projects, knowledge, and technology transfer.

As the SDSC matured, it broadened its reach through new partnerships, notably in 2021 with the Paul Scherrer Institute (PSI) to support large-scale scientific infrastructures. It also introduced dedicated efforts in areas such as semantic data interoperability and privacy-centric data governance with the creation of the ORDES team in 2022. In 2024, a Health & Biomedical team was added, marking the first dedicated team within the SDSC's vertical structure.

A UNIQUE INTEGRATED MODEL

Today, the SDSC is structured around three complementary and integrated teams that together address the full data lifecycle:

- **Research** – advancing the application of data science and AI to scientific challenges, through collaborative projects, national calls, and translational research.
- **Innovation** – bridging academia and society, helping companies, public administrations, and NGOs adopt data science responsibly and effectively.
- **Engineering** – building the digital foundations of data science through open-source platforms, reusable research data infrastructures, and governance frameworks.

Through this integrated structure, the SDSC serves as a driver of national capacity building: a place where data science technologies are used, tested, deployed, and then reused across sectors. Rather than a service center, the SDSC represents a platform for collaboration, where data scientists, domain experts, engineers, and innovators co-design solutions that scale and endure.

As a National Research Infrastructure with a team of over 120 experts, the SDSC continues to serve a wide community of stakeholders by offering not only integrated services but also collaboration opportunities, training programs, and access to curated data and AI capabilities.

A Collaborative Footprint Across Switzerland

With offices located in Lausanne, Zurich, and Villigen, the SDSC provides research, innovation, and engineering expertise to support partners across disciplines and sectors. It brings scientific and domain knowledge to areas of high societal relevance, such as health and biomedical sciences, energy and sustainability, climate and environment, large-scale infrastructures, and digital society, accompanying partners from problem formulation to solution deployment and tangible impact.

Collaboration Highlights

100+ Research projects

with > 200 Swiss academic labs,
100+ joint scientific publications.

50+ high-profile collaborations

with Swiss industry, administration
and NGOs.

Multiyear partnerships with
the Swiss Federal offices FSO,
FOITT, SFOE, FOEN,
MeteoSwiss and others.

Framework agreements

with CHUV, HUG, USZ,
USB and other hospitals.

Joint-venture with the Canton
of Vaud to support innovation.

Key collaborations with
Swiss AI Initiative and SNAI.





From Data to Impact

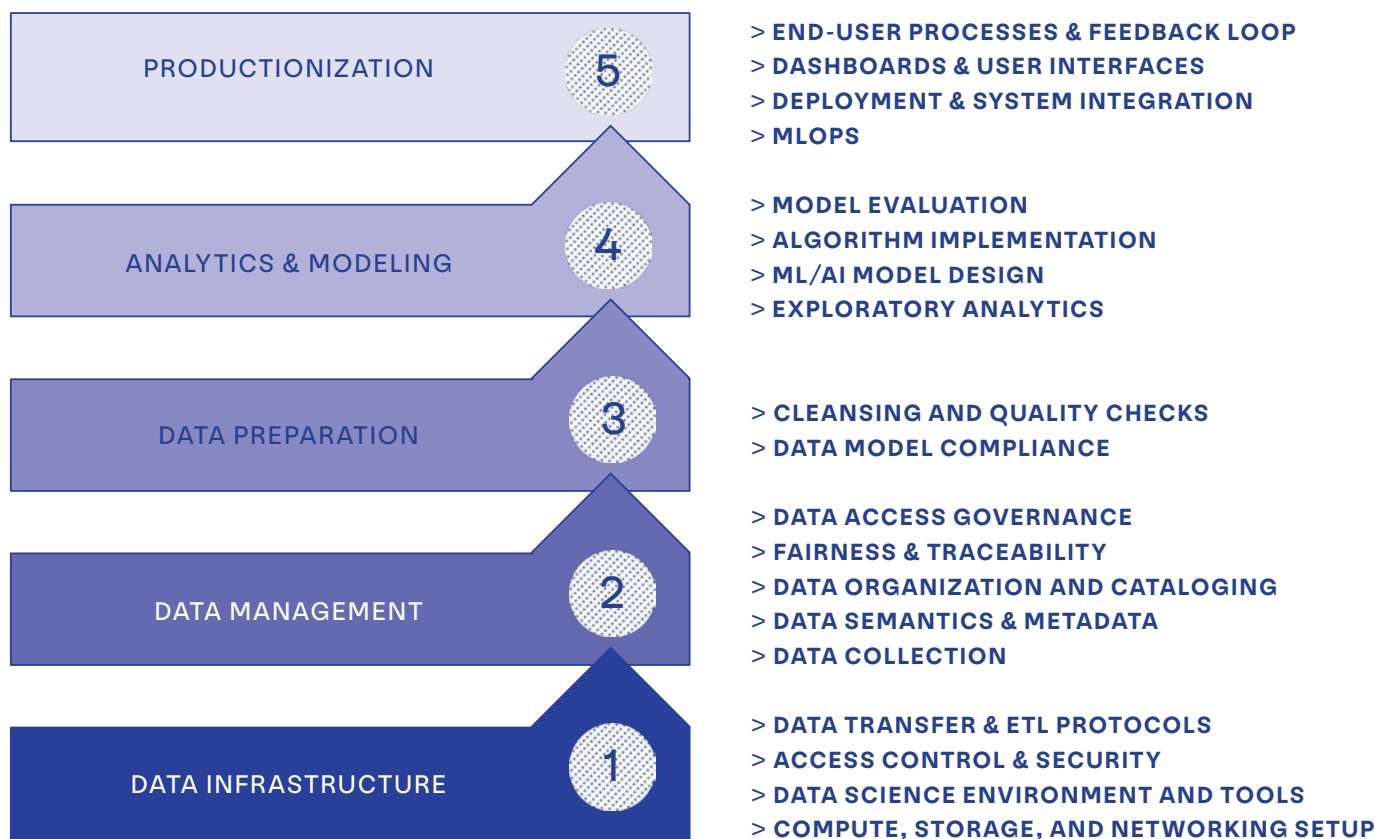
The SDSC provides end-to-end capabilities across the entire Data Value Chain, supporting organizations in managing the complexity of data-driven projects and generating practical outcomes. Activities cover the full data lifecycle, from infrastructures for data acquisition and preparation to analytics, AI/ML modeling, to the deployment of data-driven solutions into production environments.

By combining core expertise and domain knowledge within mixed teams of system engineers, software architects, data engineers, and data scientists, the SDSC helps ensure that infrastructures are

efficiently configured, secure, and compliant with relevant standards. Data management practices are guided by FAIR principles, with attention to semantic models, metadata, traceability, and access governance.

An integrated, iterative approach helps reduce fragmentation and supports data quality, accessibility, and reuse. By linking infrastructure, data workflows, model development, and production systems, the SDSC contributes to continuous learning and knowledge sharing across domains, enabling scalable solutions, operational integration, and informed decision-making in support of research and business needs.

DATA VALUE CHAIN



Collaborative Programs and National Calls



INITIAL COLLABORATIONS ACROSS THE ETH DOMAIN

Since the beginning, collaborative projects have been at the heart of the SDSC model. When the SDSC was launched in 2017 under the ETH Domain's Strategic Focus Area (SFA) program, it introduced its first Calls for Collaborative Projects. These initial calls focused on collaborations supporting projects with research laboratories and institutes within the ETH Domain – EPFL, ETH Zurich, and the four federal research institutes (EMPA, Eawag, WSL, PSI). The goal was to demonstrate how an increased use of advanced data science methods could accelerate scientific discovery through close, hands-on collaboration between SDSC experts and domain scientists, or through the support provided by the SDSC to researchers in data science, machine learning and AI, to undertake ambitious applied projects.

Over the following years, demand for SDSC support grew steadily, both in volume and diversity. Research teams sought not only for contributions in statistical data science, machine learning and AI, but also engineering assistance, reproducible workflows, and support for operationalization and governance. To meet these broader needs, subsequent collaborations began to mobilize all three SDSC teams (Research, Innovation, and Engineering) to deliver integrated support across the entire data science value chain.

EXPANDING TO NATIONAL STAKEHOLDERS

With the SDSC's transition toward a National Research Infrastructure, this approach expanded beyond the ETH Domain. Starting in 2024, the SDSC broadened its National Calls for Collaborative Projects to research groups across Switzerland, as well as to public administrations, hospitals, companies, and NGOs that seek to adopt data science responsibly and effectively. This new framework reflects the SDSC's national mandate: to serve as a bridge between scientific excellence, engineering capacity, and real-world impact.

The first National Calls received 130 pre-proposals from all major Swiss institutions and resulted in 50 selected projects across domains such as health and biomedicine, climate and environmental sciences, energy and sustainability, and digital transformation. Selected projects benefit from in-kind SDSC expertise over a one or two-year period, combining data engineering, AI modeling, and responsible AI guidance.

With calls evolving from an internal ETH Domain instrument to a national collaborative program, the SDSC has developed an effective mechanism to stimulate data-driven innovation and strengthen Switzerland's research and innovation ecosystem.

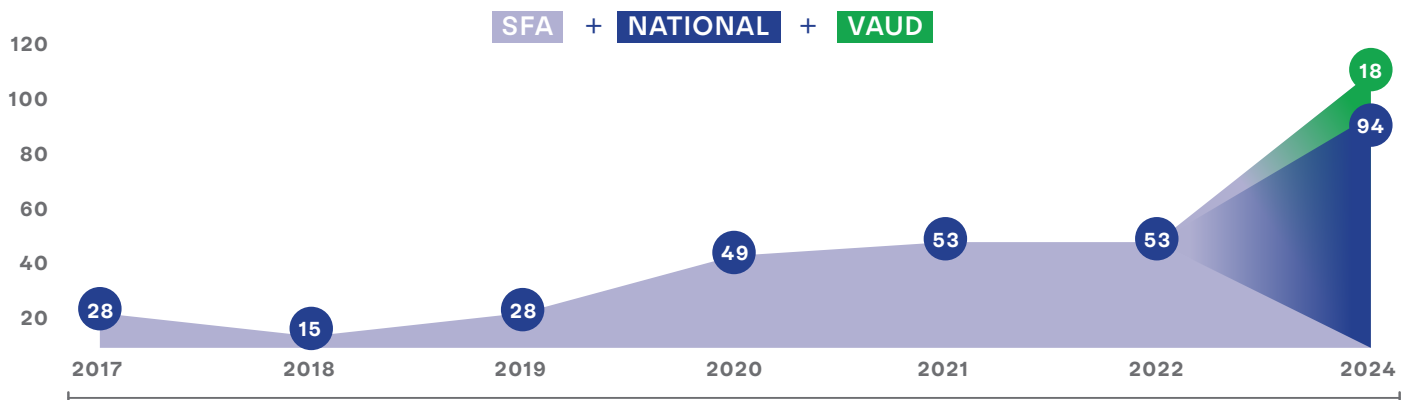
Robust Demand and Third-Party Interest

Driven by growing demand for data science and AI expertise, the SDSC received more than 220 full proposals to its 2017-2022 Calls for Collaborative Projects during its time as a Strategic Focus Area (SFA). This mechanism enables the SDSC to identify high-impact collaborations and allocate its resources in a transparent and fair manner.

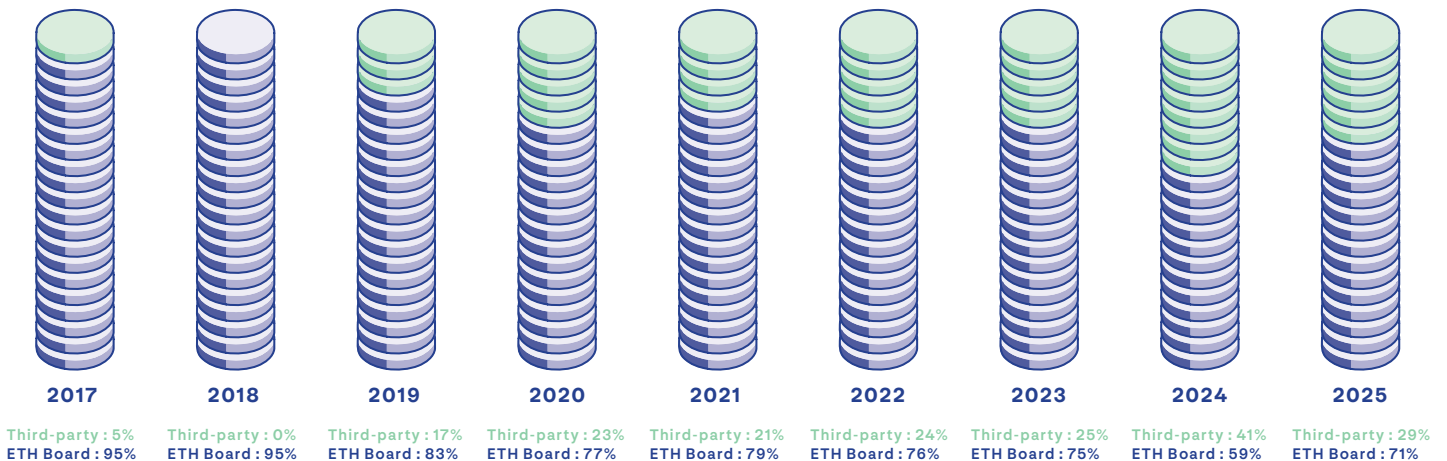
This demand increased – to a total of over 300 submissions – as SDSC began its transition into a national research infrastructure with its National Calls in 2024, when access was expanded to all Swiss organizations.

A dedicated new Call for projects with the Canton of Vaud was introduced in the same year (Figure 1). The SDSC is also benefitting from an increasing fraction of third-party funding, whether to support other calls, like the call funded by the Canton of Vaud, from grants funding for large research projects whose research data infrastructure is implemented by the SDSC, or from industry or other public partners who directly fund the services of the SDSC (Figure 2).

HIGH-QUALITY SUBMISSIONS FOR CALLS OF PROJECTS



ETH BOARD VS. THIRD-PARTY FUNDING





↑ Through professional hackathons, the SDSC enables rapid ideation and prototyping.
(Example: “ORD for the Sciences” hackathon, co-organized by the SDSC and EPFL Open Science in 2024)

Research Team : Data Science for Scientific Domains



EMBEDDING MACHINE LEARNING AND AI IN DOMAIN SCIENCE THROUGH COLLABORATION

The Research Team was the first team established at the SDSC in 2017, reflecting the Center's original mandate to support data-driven research by contributing machine learning, statistical modeling, and AI expertise in scientific collaborations.

The team's data scientists work in close collaboration with domain experts, integrating domain knowledge into models and designing customized adaptations of established state-of-the-art algorithms to address the specific constraints, objectives, and practical realities of each problem. The team brings broad, research-informed expertise across statistics, machine learning and AI, computer vision, natural language processing, and related disciplines.

A core contribution of the team is early-stage project support, including problem formulation, data characterization, and preliminary analyses. These activities help identify suitable machine learning and AI approaches, key leverage points, and potential risks or bottlenecks. The team also facilitates collaboration between methodological experts and

Its strongly collaborative model enabled the Research Team to effectively embed data science expertise in over 100 research projects across multiple domains, involving more than 200 research laboratories.



↑ Prof. Dr. Guillaume Obozinski
Deputy Executive Director and Chief Data Scientist

applied domain teams to strengthen and accelerate project impact.

Focused on enabling applied research, the research team complements academic research laboratories in AI and statistical science by supporting projects that require substantial exploratory work, complex data preparation, and customized solutions. These contributions strengthen research outcomes and provide critical support, even though they do not advance the state-of-the-art ML/AI methodologies nor results in core specialist publications.

Between 2017 and 2024, the team supported over 100 collaborative projects with scientists from ETH Zurich, EPFL, PSI, WSL SLF, Empa, Eawag and 100 collaborative projects with more than 200 research units from the ETH Domain.

Early collaborations included the DeapSnow project with SLF, applying deep learning to avalanche-level forecasting, and DLOC, a cosmological analysis project with ETH Zurich to model the large-scale structure of the universe. During the COVID-19 pandemic, the team developed models to forecast the evolution of the number of cases and deaths, combining epidemiological data and uncertainty quantification methods. Other projects addressed medical imaging, genomics, and environmental modeling and many more.

SUPPORTING LARGE-SCALE EFFORTS AT THE NATIONAL LEVEL

As a National Research Infrastructure, the SDSC will provide expertise and services for more ambitious data science efforts, including the development of research data infrastructures and data science platforms. One key objective is to undertake projects that benefit broader research communities and other stakeholders, while generating significant impact on society at large.

Drawing on extensive experience in cross-domain collaborations, the Research team is well positioned to assess domain community needs in areas such as data resources, analytical tools, models, and interoperability. This role is critical for enabling more ambitious data-driven interdisciplinary research, including the integration of heterogeneous data modalities into large-scale foundation AI models.

The SDSC – and particularly the Research Team – will increasingly support translational research and work in close collaboration with the AI Centers at EPFL and ETH Zurich on projects that leverage foundation models developed in the Swiss AI initiative.



↑ The SDSC joined forces with the Cosmology Group and the Data Analytics lab at ETH Zurich to model large scale dark matter maps in the universe. (Image: the Milky Way galaxy)

Innovation Team : Bridging Science and Society

TURNING DATA INTO IMPACT

The SDSC's Innovation Team was created in 2019 to leverage academic excellence and address Switzerland's economic and societal challenges. Its mission is to accelerate the responsible adoption of data science and artificial intelligence across the economy, public institutions, and civil society.

The Innovation Team operates under a collaborative model tailored to organizations facing concrete operational challenges and seeking high technology readiness levels. It works with companies, hospitals, NGOs, and administrations to harness data and AI for improved decision-making, processes, and services. This model relies on close, co-designed engagements, rather than consultancy or IT integration mandates, where SDSC experts work alongside partner teams to define problems, design approaches, and implement solutions that generate tangible impact and strengthen internal capabilities.

Through this work, the SDSC helps organizations build maturity in automated processing, predictive analytics and decision support systems while promoting ethical, transparent, and sustainable uses of AI.

A SUSTAINABLE BUSINESS MODEL

The Innovation Team operates under a cost-recovery model. More than 90% of its operating budget is covered through direct mandates from partners, primarily from the private sector, but also from public institutions. Only a small portion of its budget comes from state or institutional funding.

Over time, the Innovation Team has collaborated with over 50 major Swiss organizations, in sectors such as manufacturing, energy, and health. It has built strong relationships with organizations such as Bühler AG, The Adecco Group, Richemont, dsm-Firmenich, Swissgrid, Covalo, the Federal Statistical Office (FSO), and the Lausanne University Hospital (CHUV).

Partners are encouraged to integrate the methods, workflows, and governance practices developed jointly with SDSC teams into their own operations. This capacity-building aspect is central to the team's mission: helping Switzerland's organizations become not merely users but producers of data-driven innovation.

Notable examples include:

- **CHUV**, where the SDSC and hospital teams co-developed the first machine learning solution to reach production within the institution – a milestone for both partners.
- **The Federal Statistical Office**, where SDSC experts contributed to new approaches for secure data access and AI-assisted statistical analysis.
- **The International Committee of the Red Cross**, where data science was applied to understand and monitor patterns of violence, supporting humanitarian action strategies.
- **Bühler AG** and **Swissgrid**, where advanced modeling and AI techniques improved industrial efficiency and energy forecasting.
- **Richemont**, where the SDSC supported the local data team and several watchmaking and jewellery “maisons” in better understanding their products and customers to enable more informed predictions and recommendations.
- **dsm-Firmenich**, where the SDSC collaborated with the R&D lab in optimizing experiment design and identifying effective representations of ingredients and formulas in the fragrance and flavor industry.

EXPANDING THE INNOVATION ECOSYSTEM

The SDSC also plays a convening role. Through events such as SDSC Connect, workshops, and meetups, and hackathons, the Innovation Team helps demystify data science, connect communities, and share best practices across sectors.

This activity is further strengthened by two complementary ways to benefit from the SDSC’s expertise: memberships and executive training. In memberships, partners receive impartial, highly qualified support in their ongoing activities - SDSC acts as a sparring partner, making sure that internal use cases meet the requirements of state-of-the-art and production-readiness at the same time.

Through executive trainings, SDSC equips decision makers and the C-suite with the tools to understand AI technology together with concrete application examples in domains relevant to Swiss industry and public sector.

PARTNERING WITH PUBLIC ADMINISTRATION

Innovation in data science depends on adaptive collaboration models that serve both industry and society. Impact is best achieved by aligning the interests of key stakeholders: public administrations seeking regional impact, SMEs driving AI innovation while maintaining “Swiss-made” excellence, and academia wishing to integrate research in impactful business scenarios. A concrete example of this multi-stakeholder approach is SDSC’s partnership with the Canton of Vaud.

The Innovation Team helps bridge science and society by turning data into practical impact. By working closely with our partners, we translate research excellence into solutions they can own, sustain, and scale – strengthening Switzerland’s capacity for responsible, data-driven innovation.



↑ Dr. Silvia Quarteroni
Chief Transformation Officer and Head of Innovation



**Partnership with the Canton of Vaud
Delivering Societal and Economic Impact**

In 2024, the SDSC launched a strategic partnership with the Canton of Vaud to create a joint innovation program focused on supporting projects that deliver tangible benefits for the local economy and municipalities. With the Canton’s support the SDSC is establishing new headquarters at Biopôle, a leading hub for life sciences and innovation in the north of Lausanne.

This initiative brings together the academic strength of institutions like EPFL, UNIL, and HEIG-VD with the SDSC’s expertise in data science and

AI to address pressing societal and innovation challenges. A key goal is to equip companies, especially SMEs, with the skills and capabilities that are critical to succeeding in today’s data-driven world.

As part of this program, the SDSC launched in early 2025 a competitive call for collaborative projects in data science and AI and a second call in September 2025. This initiative aims to support projects with lasting societal and economic impact, led by companies or academic/industrial consortia based in Vaud. Selected projects receive funding and benefit from in-kind support from the SDSC.

Engineering Team : Foundations for a Trusted Data Ecosystem

EMPOWERING COLLABORATION THROUGH RENKU AND ORDES

Behind every successful data-driven project lies a solid digital foundation. The SDSC's Engineering Team brings together two teams, Renku and ORDES (Open Research Data Engagement and Services) that work hand in hand to make data science collaboration practical, reproducible, and trustworthy.

Their joint mission is to develop and deliver the tools, frameworks, and infrastructures that allow researchers, institutions, and companies to share, analyze, and reuse data responsibly and efficiently.

RENKU: ENABLING REPRODUCIBLE AND COLLABORATIVE RESEARCH

Renku is an open-source platform created by the SDSC to simplify the entire lifecycle of collaborative data science. It integrates code, data, and computational environments into a single workspace, ensuring that projects are transparent, traceable, and reproducible across teams, institutions, and time.

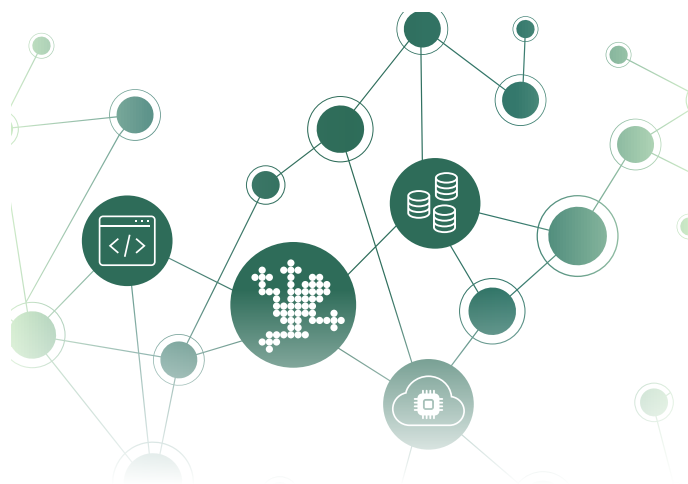
Renku allows researchers to focus on science rather than on resource infrastructure configuration: it enables automated workflows, data traceability, and seamless collaboration across laptop, cloud and high-performance compute clusters. Today, Renku supports users across Swiss universities, research consortia, federal institutions and private companies from teaching and hackathons to national research projects.

In 2024, Renku entered a new development phase, focusing on interoperability. It now acts as a connection hub, linking diverse data and compute environments and enabling integration with existing institutional infrastructures. Through its modular architecture, Renku adapts to projects of any scale, from a classroom exercise to a national data-sharing initiative.

At its core, Renku is about empowering collaborative science. By providing a unified, trusted environment that adapts to researchers' needs, we help institutions work more openly, more efficiently, and at greater scale. Renku's evolution toward interoperability reflects our commitment to supporting Switzerland's research ecosystem as it becomes increasingly connected and data-driven.



↑ Dr. Rok Rožkar
Head of Engineering - Renku Platform



ORDES : BUILDING RESEARCH DATA INFRASTRUCTURES THAT LAST

ORDES, Open Research Data Engagement and Services Team, complements Renku by designing and deploying data science infrastructures, including data models, workflow automation, data access, and governance frameworks that make data sharing and reuse secure, interoperable, and FAIR-compliant by design. This approach blends community engagement, rapid prototyping, and technical excellence to ensure that infrastructures meet real-world scientific needs while remaining sustainable over time.

Between 2021 and 2024, ORDES helped design advanced national data ecosystems:

- **Digitalizing data access governance** through the Data Access Committee (DAC) Portal and the Swiss Data Custodian for the Swiss Node of the Federated European Genome-phenome Archive (FEGA) and LUCID National Data Stream (NDS);
- **Releasing reusable blueprints** and reference architectures for clinical AI deployment now being rolled out across Swiss hospitals; and
- **Delivering core national platforms** and data models, including Imaging Plaza and the Multi-Omics Digital Object System (MODOS), to support major initiatives funded by Personalized Health and Related Technologies (PHRT).

Together, these achievements lay the foundation for national research ecosystems that are interoperable, policy-driven, and designed to evolve as scientific and regulatory needs change.

A SHARED PHILOSOPHY: BUILD ONCE, REUSE OFTEN, SHARE WIDELY

Although they operate at different levels – Renku at the platform layer, ORDES at the infrastructure component and governance layer – both teams share the same principles: openness, interoperability, and sustainability. They collaborate closely, often on the same projects, ensuring continuity between tools, workflows, and infrastructures. Together, Renku and ORDES embody the SDSC's engineering ethos: developing practical, reusable, and trustworthy digital foundations that empower researchers and innovators alike, in Switzerland and beyond.

ORDES is about creating the data foundations that modern research depends on. By uniting strong governance, smart design, and scalable architecture, we enable data to be shared and reused with confidence. Our recent work demonstrates how a coherent, interoperable ecosystem can empower national research communities and remain resilient as technologies and policies evolve.



↑ Dr. Oksana Riba Grognez

Head of ORD Engagement & Services Team



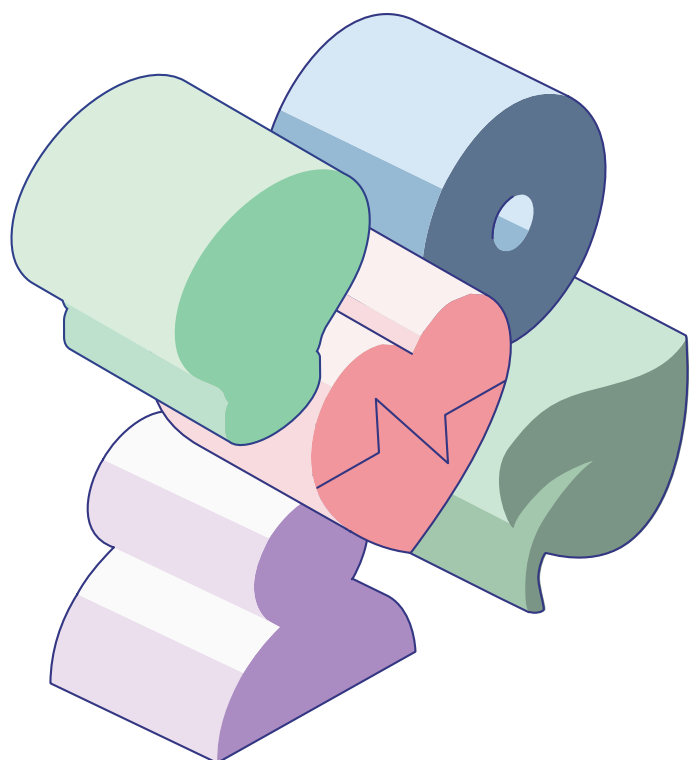
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**STRUCTURED
ENGAGEMENT:
THE SDSC'S
STRATEGIC
DOMAINS**

A Transversal Impact in Strategic Domains

Throughout its first eight years, the SDSC has demonstrated that data science is a connector, linking disciplines, sectors, and institutions to generate shared value. Its collaborative model, grounded in Research, Innovation, and Engineering, has proven that multidisciplinary, data-driven methods help tackle some of Switzerland's most pressing scientific and societal challenges.

Building on this foundation, the SDSC is now entering a new phase of engagement with structured support to five of Strategic Domains, or Verticals, within its organization. These verticals represent a new way of organizing knowledge and impact, mobilizing expertise from SDSC's three core teams while engaging national partners to advance science and innovation in areas of high national relevance.



From 2025 onwards, the SDSC is structuring its activities around five Strategic Domains, each guided by a Community Steering Group composed of experts from academia, industry, and the public sector. These groups define priorities, identify opportunities for collaboration, and ensure alignment with Switzerland's scientific, economic, and societal goals.

The five Strategic Domains

Health and Biomedical – advancing precision medicine, clinical decision support, and trusted health-data infrastructures.

Climate and Environment – supporting efforts integrating diverse data sources and AI models to better understand, monitor, and address climate change and other key environmental issues.

Energy and Sustainability – supporting the energy transition in society and in industrial processes through advanced machine learning models, data-driven optimization and forecasting methods.

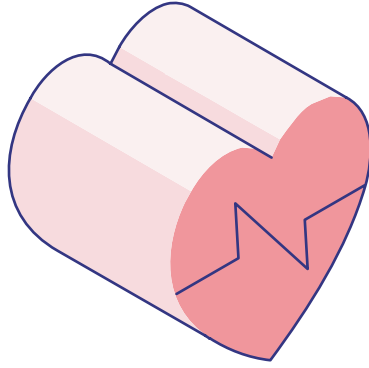
Digital Society – fostering responsible AI, data governance, and digital policy innovation for public administrations and civic organizations.

Large-Scale Scientific Infrastructures – leveraging data science and AI to improve the collection, processing, management and scientific analysis of the data generated by large-scale research infrastructures.

Health & Biomedical

SUPPORTING HEALTHCARE : FROM DATA INFRASTRUCTURE TO AI

Healthcare systems are facing increasing strain as populations age and chronic, multifactorial diseases such as cardiovascular disorders, diabetes, neurodegenerative conditions, and cancer become more prevalent. Managing these conditions demands complex, long-term care and generates vast amounts of information from diverse sources, including high-resolution medical imaging, an increasing number of omics data types, longitudinal health records, wearable sensors, etc. While this wealth of information offers unprecedented opportunities for extracting valuable insights, its scale and complexity exceed the limits of traditional analytical approaches.



Artificial intelligence, and particularly machine learning, can integrate and interpret this complex health information to detect subtle patterns, forecast disease trajectories, and tailor treatments to individual patients. This enables earlier diagnoses, more targeted therapies, and fewer side effects. It can also inform public health strategies and support outbreak preparedness, ultimately improving outcomes and quality of life while optimizing the use of costly healthcare resources.

In light of this transformative potential, the SDSC was mandated to support the health and biomedical (HBM) sector as a priority domain. Through more than 50 HBM data science projects, the SDSC collaborated with academic, public and private partners in applying advanced data science and AI across a wide range of use cases spanning oncology, genomics, medical imaging, biomarker discovery and drug development, thereby accelerating research and enabling innovation across Switzerland's health ecosystem.

Given the rapid growth and complexity of biomedical data, and the increasing demand to use this data for the development of AI algorithms that support predictive and personalized medicine, the SDSC also contributed to the design and implementation of robust data infrastructures. These infrastructures enable harmonization and interoperability while ensuring secure and controlled access to data. Together, these efforts strengthen the entire research-to-practice continuum, from data collection and analysis to clinical application.

As a National Research Infrastructure, the SDSC is committed to supporting the development of secure, national AI-ready infrastructures that make human biomedical data more accessible and reusable.



↑ Dr. Nora Toussaint
Health & Biomedical Domain Lead

NATIONAL DATA INFRASTRUCTURES FOR BIOMEDICAL RESEARCH

The SDSC has been contributing to several initiatives developing data infrastructures for Health and Biomedical Sciences. These efforts aim to ensure that research data is findable, accessible, interoperable, and reusable in a secure and controlled manner, enabling collaboration and accelerating innovation nationally and internationally. Two key examples are the SPHN/PHRT National Data Streams and the Swiss node in an international network of national human data repositories (Swiss FEGA).

SPHN/PHRT National Data Streams

The Swiss Personalized Health Network (SPHN) and the ETH Domain Strategic Focus Area Personalized Health and Related Technologies (PHRT) funded four National Data Stream (NDS) projects aiming at the development of research data infrastructures to support the generation of and secure access to interoperable and reusable datasets across hospitals, research institutions and biobanks.

The SDSC has actively been supporting three NDS: LUCID on Low Value of Care in Hospitalized Patients, SPO on Swiss Personalized Oncology, and IICU on Infection-related Outcomes in Swiss Intensive Care Units. The SDSC assumed significant responsibilities in these different NDS from data management to data workflow and infrastructure implementation, including semantic validation workflows, automated data quality checks, data access governance policies, and more.





↑ The SDSC partnered with Tigen Pharma to improve the efficiency, safety and scalability of hyper-personalized cancer treatments like CAR T-cells.

Swiss FEGA

The Federated European Genome-Phenome Archive (FEGA) network is a major global resource for sharing sensitive human omics and related data consented for secondary use, linking national repositories to drive disease research and improve health outcomes. In July 2024, the Swiss FEGA initiative was launched to provide a secure environment to archive and share genomic and other human data generated in Switzerland, compliant with national legal requirements. The SDSC contributed to this national effort with the main contribution led by the ORDES team. They digitized the data access request and approval processes. Furthermore, supporting Swiss FEGA's extension beyond genomics, the team also extended MODOS, a technology enabling patient-centric, multi-omics data representations, that was initially developed through a PHRT collaboration.

TOWARDS AI-AUGMENTED ONCOLOGY

As a National Research Infrastructure, the SDSC commits to making significant efforts in support of precision oncology.

Precision Oncology Flagship

In partnership with the Tumor Profiler Center, the SDSC aims to establish its first flagship in the health and biomedical domain by building a national data infrastructure for precision oncology research, extending and improving the research data infrastructure developed through the Tumor Profiler Study. This is an observational trial designed to evaluate the relevance of in-depth tumor profiling for clinical decision-making and to advance the biological understanding of cancer. The ambition is to make this infrastructure scalable, highly automated, AI-ready, and portable to other disease areas.

National AI Initiative for Precision Oncology

To further strengthen this work and expand its impact, the SDSC is going to collaborate with over 25 partners from academia, healthcare institutions, and industry on the National AI Initiative for Precision Oncology (NAIPO), funded under the 2024 Innosuisse Flagship Initiative. NAIPO aims to transform cancer care through an AI-powered precision oncology platform that optimizes diagnostics, personalizes treatments, and supports data-driven clinical decisions. The SDSC is responsible for building the AI-ready data and compute platform underpinning the initiative. It also contributes to advancing trustworthy AI for multi-modal clinical data, from genomics to imaging and beyond.

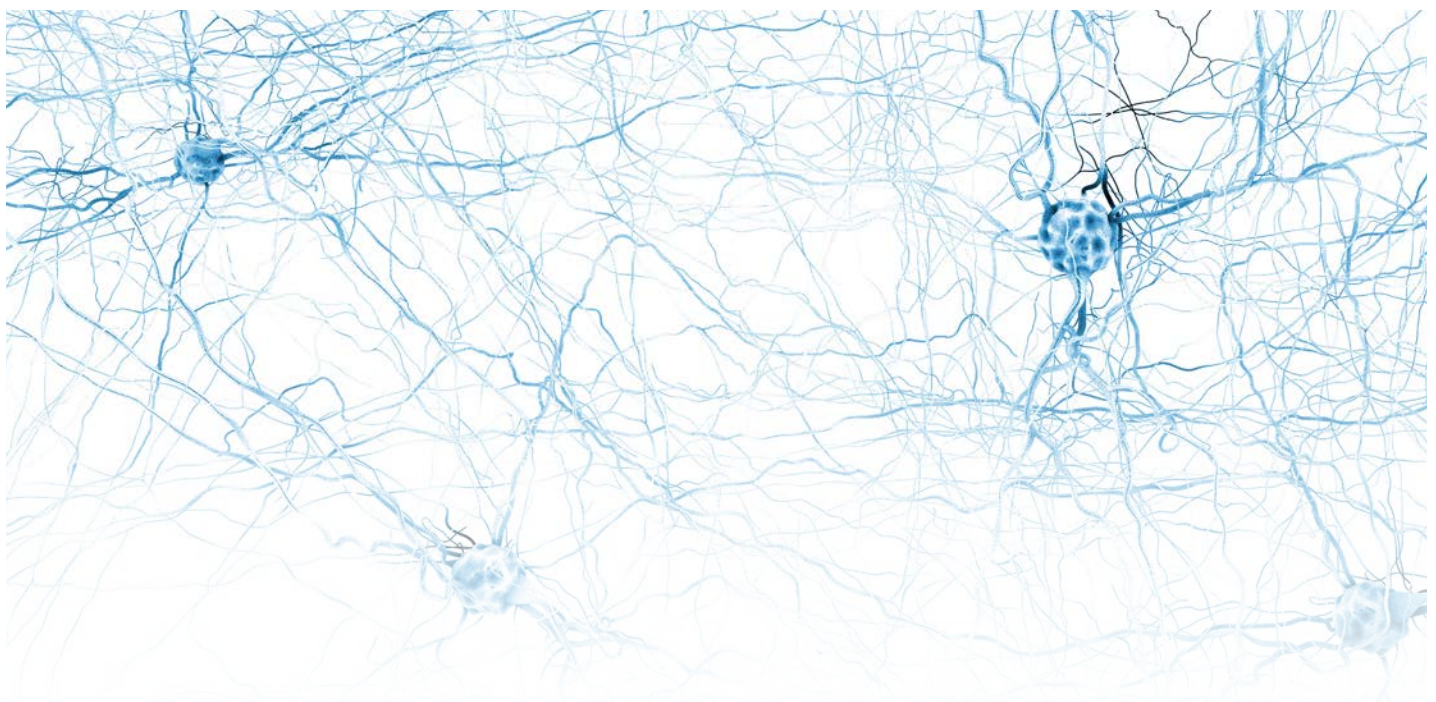
Through these initiatives, the SDSC continues to strengthen Switzerland's capacity for data-driven biomedical research and innovation. By combining technical excellence with strong national partnerships, it contributes to advancing precision medicine and improving patient outcomes across a variety of health areas.

BIOMEDICAL DISCOVERY AND TRANSLATION

The SDSC supported more than 20 research projects in health and biomedical sciences using artificial intelligence. These projects cover a broad spectrum of applications, from neuroscience to oncology. Two illustrative examples include work on the analysis of Parkinsonian neuron activity and on modeling tumor dynamics from medical imaging.

Characterizing Parkinsonian Neurons' Activity In Vitro

Populations of biological neurons grown in vitro were used to study the electrical activity of interconnected neural networks recorded through high-density microelectrode arrays. In collaboration with the Bio Engineering Laboratory and the Machine Learning and Computational Biology Lab at ETH Zurich, the SDSC research team developed and validated ML methods to analyze this complex neural activity in the context of Parkinson's disease. These methods, which can be extended to other neurodegenerative disorders, identified biomarkers distinguishing Parkinsonian from healthy neuronal populations that may serve as early indicators of the effectiveness of new treatments.



Learning Tumor Dynamics from PET/CT Imaging for Personalized Oncology

While immunotherapy has transformed cancer treatment, for example through the use of immune checkpoint inhibitors (ICIs), outcomes remain difficult to predict. In collaboration with clinicians from the Department of Radiation Oncology at University Hospital Zurich (USZ), the Service of Nuclear Medicine and Molecular Imaging of Lausanne University Hospital (CHUV), the Department of Oncology at CHUV, and the Precision Oncology Center of Geneva University Hospitals (HUG), the SDSC is joining forces with the Signal Processing Laboratory at EPFL and the Institute of Informatics at HES-SO Valais, to develop artificial intelligence models that capture the spatial and temporal evolution of individual tumor lesions from longitudinal PET/CT imaging and radiomics analyses. This approach brings the field closer to early prediction of ICI response and, ultimately, to more personalized and effective treatment strategies.

Beyond academic collaborations, the SDSC also partnered with over 10 private companies from the health and biomedical sector to advance the application of artificial intelligence in the industry.

Early Estimation of Cancer Treatment Effect Based on Circulating Tumor DNA

In a collaboration with Merck, the SDSC designed summary metrics to describe tumor burden and heterogeneity from circulating tumor DNA (ctDNA) collected via liquid biopsy. This allowed the identification of subpopulations of patients with higher probability of progression free survival under specific targeted therapies. It also showed the potential of ctDNA measurements to characterize tumor evolution and quantify tumor treatment effects earlier than other traditionally applied methods.

Cell and Gene Therapy

In collaboration with Tigen, the SDSC combined AI and mechanistic models to optimize the complex biomanufacturing process of T-cell-based cancer therapies. These models capture key biological dynamics influencing cell growth and predict optimal harvest timing. By integrating patient data, the collaboration enabled further personalization of therapy production. Overall, this partnership improved the efficiency, safety, and scalability of hyper-personalized cancer treatments like CAR T-cells.





CLINICAL WORKFLOW AND PATIENT CARE

Implementing AI algorithms in clinical environments presents many challenges. The SDSC is proud to have successfully contributed to two projects that achieved clinical implementation. In collaborations with CHUV and the University of Lausanne (UNIL) the SDSC built AI-based predictive platforms to evaluate the risk of bedsores and to recognize sepsis using routine data from electronic health records.

Bedsore Prediction

The bedsores platform enables the prediction of pressure ulcers for all hospitalized patients of participating units at CHUV, in contrast to previous approaches which focused only on a manually selected subset of patients. This is achieved without requiring additional data collection, thereby improving coverage and reducing the workload for the healthcare teams. The project, carried out jointly by the SDSC Innovation and ORDES teams, is now being extended to other hospital-acquired complications in elderly patients.

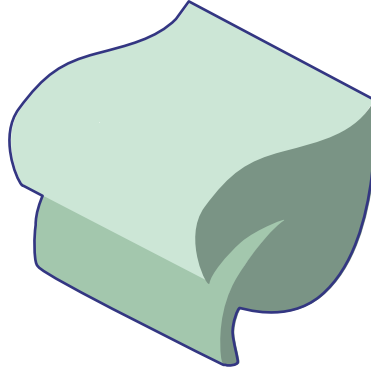
Improved Sepsis Detection and Quality of Care

This project was conducted in close collaboration with clinicians and the CHUV Biomedical Data Science Center. As part of the hospital's Sepsis Quality of Care program, the SDSC developed and deployed an AI-pipeline leveraging the hospital's electronic health records, data warehouse, and IT infrastructure. An interactive dashboard was released in the hospital wards to assist care teams and improve sepsis patient care. This interface fostered clinical team engagement, improved reporting accuracy, and provided an effective tool for evaluating and enhancing sepsis management procedures. Wards using the system saw a reduction in sepsis-related mortality.

Climate & Environment

DATA SCIENCE AND AI TO UNDERSTAND AND PROTECT THE PLANET

All around the planet, sensing and measuring technologies continuously produce vast amounts of data on the state of ecosystems, atmosphere, oceans and lands. They play a crucial role in supporting our understanding of the evolution of the different components of the Earth system. But traditional scientific modeling approaches fall short of efficiently integrating all these sources of information.



Data science and AI have thus become crucial instruments to extract and process information from these sources. These disciplines offer a wide array of techniques that can be used to perform many useful tasks, such as automatically classifying events and predicting risk levels for natural hazards, categorizing and

tracking small objects in videos like insects and birds, predicting concentrations of chemicals or forecasting precipitation and temperature extremes. But the use of AI requires a careful work of preparation and harmonization of data, to guarantee that various data sources representing different elements of the complex Earth system are clean, interoperable, standardized, and follow best practices from and for the community.

Since its early days, one of the SDSC's strong commitments has been to support the use of data science and AI in environmental sciences. We look forward to contributing further by improving access to key data sources and enabling ambitious projects that help Switzerland better understand, monitor, and address climate change and other environmental issues.



↑ Dr. Michele Volpi

Climate & Environment Domain Lead

As a National Research Infrastructure, the SDSC is committed to supporting the access to key geo-located datasets, such as weather station time series and climate datasets, and to facilitating their use in AI models. This is a critical need in environmental sciences: climate models at different resolutions in space and time are essential for anticipating and providing scenarios of climate change impacts, including trends and extreme events. Such information is essential for many environment-related issues ranging from ecosystem health and biodiversity to natural hazards such as avalanches and mass movements, while also informing resilient societal planning and policymaking. By extension, integrating and facilitating the joint exploitation of other complementary datasets will expose the stakeholders to new ways of deriving or integrating information.

The SDSC contributes to the development of AI foundation models for weather and climate as part of the Swiss AI initiative. It is also engaged in a partnership with MeteoSwiss to develop a new generation of AI-based operational tools for weather forecasting in Switzerland.

Additionally, the Center is committed to fostering synergies and broad research community efforts for the development of integrated models that capture the interdependencies between climate, hydrology, vegetation, and ecosystem health, as well as how human activities impact and are impacted by a changing environment.

NATURAL HAZARD MONITORING AND EARLY WARNING

Switzerland is well-known for its alpine landscape – a specificity that demands proactive management of natural hazards across both public and private sectors. Avalanches, landslides, debris flow, and heavy localized precipitation, are the cause of fatalities and large monetary loss. The SDSC has worked on several projects aiming at improving forecasting, detection and early warning of natural hazards.

DeapSNOW : Augmented Intelligence for Avalanche Forecasting

In a long-standing collaboration with the the Swiss Federal Institute for Snow and Avalanche Research SLF, the SDSC has been supporting expert avalanche forecasters with machine learning models. The solutions that were developed and deployed operationally are now informing avalanche forecasters at SLF daily since 2022.

DATSSFLOW and DEDGEFLOW : Seismic Measurements for Early Warning

The SDSC worked with the Torrents and Mass Movements group within the Mountain Hydrology and Mass Movements Unit at WSL on methods for processing seismic measurements from portable seismometers. SDSC data scientists and engineers provided models and implementations that were tested directly on-device, to approach real time predictions, potentially contributing to the development of early warning systems. The focus has been on debris flows, which are very destructive mass movements involving the mobilization of sediments and rocks through water.



EAGLE : Slope Instabilities in the Alps

The SDSC also worked with the Alpine Remote Sensing group at SLF, with the Engineering Geology group at ETH Zurich and with the Mass Movement team of the Federal Office for the Environment, on the detection and characterization of slope instabilities in the Alps, relying on radar remote sensing products coupled with modern deep learning AI systems, to detect anomalies, update inventories, and identify potential accelerations.

AI FOR WEATHER AND CLIMATE - UNDERSTANDING IMPACTS

The state of the environment is strongly driven, among other factors, by weather and climatology, both on local and global scales. Modeling past, present and future of the Earth system and providing informed forecasts about natural processes requires fast and accurate models of weather and climate.

Several collaborative projects at the SDSC focused on AI models to improve spatial and temporal resolution of weather forecasts.

Weather Forecast Downscaling

Many climate scenarios and weather models mostly operate at coarse spatial resolutions. The task to infer a forecast at a smaller scale from a coarse one - called downscaling - can be achieved using generative AI models, which are capable of generating realistic high-resolution data by learning patterns in existing data. The SDSC developed several models of this kind in several collaborations.

One example is the **Speed2Zero** project, a large ETH domain joint initiative, which aimed to produce temperature and precipitation forecasts for Switzerland from global forecasts.

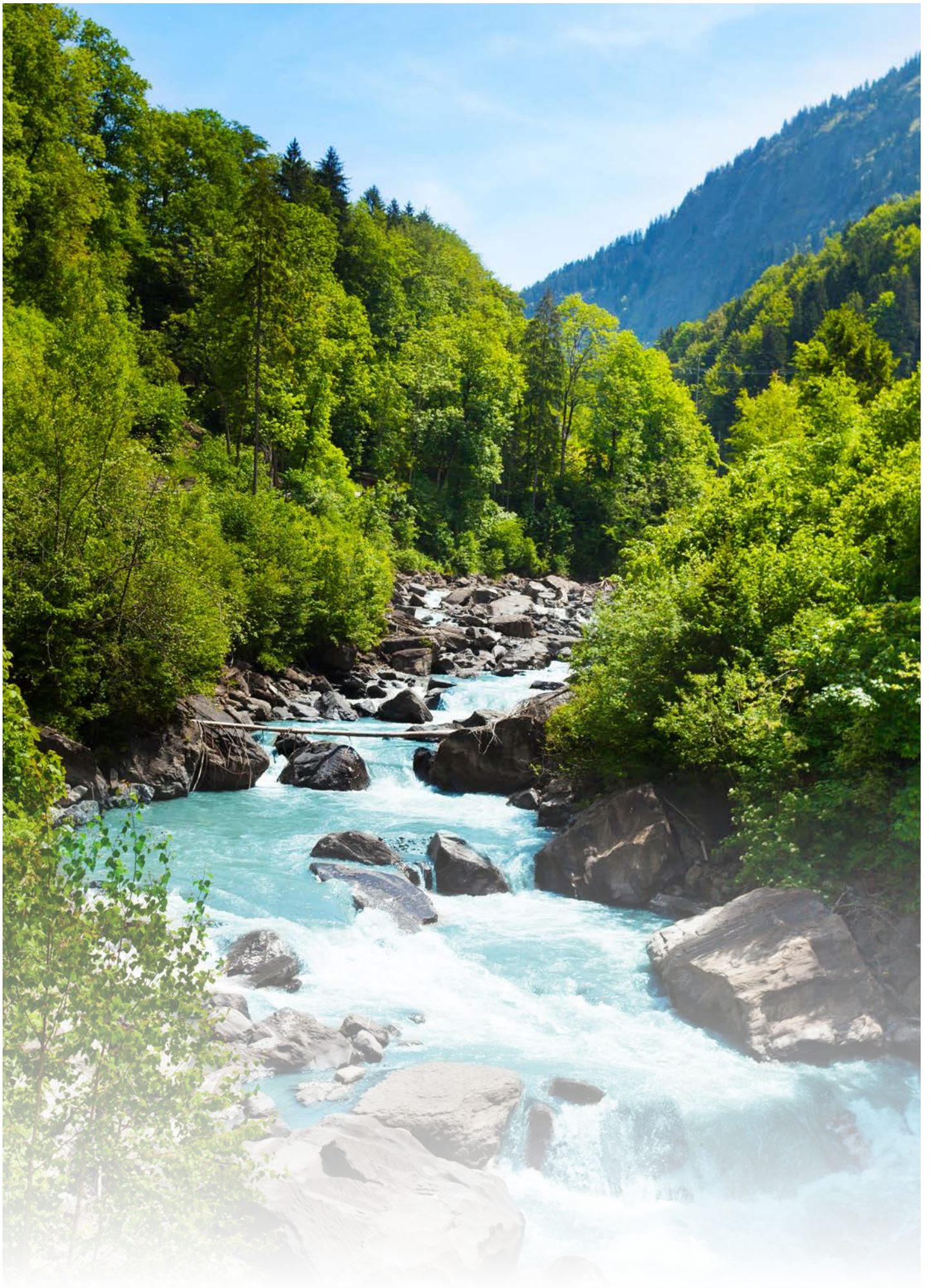
Another example is the **DeepDown** project with the Mobiliar Lab for Natural Risks and Hydrology of the University of Bern, which aimed to produce local forecast at the kilometer scale from forecast at the scale of the country.

DeepCloud : AI for Faster Radiation Flux Computation in the ICON Weather Model

Even at coarse scales, numerical weather forecasts are computationally heavy. AI can address this challenge: one of the costliest parts of weather models is the computation of the radiation flux from the sun that is reflected and diffused in the atmosphere and how it contributes to heating it.

In the DeepCloud project, the SDSC collaborated with the Atmospheric Circulation Group at ETH Zurich to implement a deep learning algorithm to replace this computation. The model produces accurate approximations of the numerical model with limited compute runtime. The SDSC then collaborated with the Center for Climate Systems Modeling (ETH Zurich) to interface the AI algorithm directly into the ICON weather model code.

Follow-up work will be carried out in collaboration with MeteoSwiss, aiming to operationalize similar developments.





↑ In a project with WSL, the SDSC aimed to relate tree growth to water stress based on factors such as temperature and precipitation.

Modeling the Impact of Climate on Forests and Biodiversity

The SDSC has worked on several projects spanning hydrology, water quality, biodiversity monitoring, and forest ecology, all of which benefit from the availability and integration of accurate, high spatial and temporal resolution weather and climate forecasts. For instance, variations in insects and river bottom-dwellers populations (**BioDetect** and **Inter-Detect** projects) must be analyzed in relation to changes in climate and weather patterns as well as human interventions, such as river management and agricultural practices.

Forest ecology studies strive to obtain high-resolution data on precipitation and temperature. In a collaboration with the Ecophysiology Group of WSL, the SDSC team aimed to relate tree growth to water stress; a relationship that depends, among other factors, on temperature and precipitation (**Fore[st]cast** project). In a collaboration with the Geocomputation and Earth Observation Unit of the University of Bern, the SDSC data scientists developed machine-learning based mechanistic models to detect early browning of trees using climatological variables and Earth observation data at the Swiss scale (**DIMPEO** project).

The SDSC will continue to participate and foster in collaborations integrating data and models for a better understanding of ecosystems and impacts of climate change.

MODELING WATERSHED RESPONSES AND RIVER FLOWS

Climate change is significantly affecting water resources. The retreat of glaciers and smaller snow caps reduces summer river flows, which, combined with high temperatures, leads to droughts. In winter, the rising temperatures cause more frequent rain-on-snow events which can suddenly melt snow caps and produce sharp increases in river flows. These changes have a significant impact on both the quantity and quality of water.

Measures or estimates of river flow are crucial in many sectors, from agriculture to energy production, and key for the prevention of droughts and floods. But despite the accuracy of gauging station measurements, sparse observation networks leave significant gaps in regional river flow maps.

MACH-Flow, a collaboration with the Institute for Atmospheric and Climate Science at ETH Zurich and the Hydrological Forecast group at WSL leverages advanced machine learning methods, including recurrent neural networks, to model gauging station time series with gridded weather and climatological data. This approach provides high-resolution predictions of river discharge across Switzerland while quantifying uncertainty for downstream uses of these estimates.

Such detailed estimates of weather conditions at the catchment level can serve as inputs for **WATRES**, a project that models how water flows through and is retained within watersheds, and can thus provide information needed to predict the water quality, since the chemical composition of water changes if it is slowly filtered by porous rocks for example. WATRES is a project in collaboration with the Hydrology group at the University of Lausanne and the Department of Environmental Systems Science at ETH Zurich.

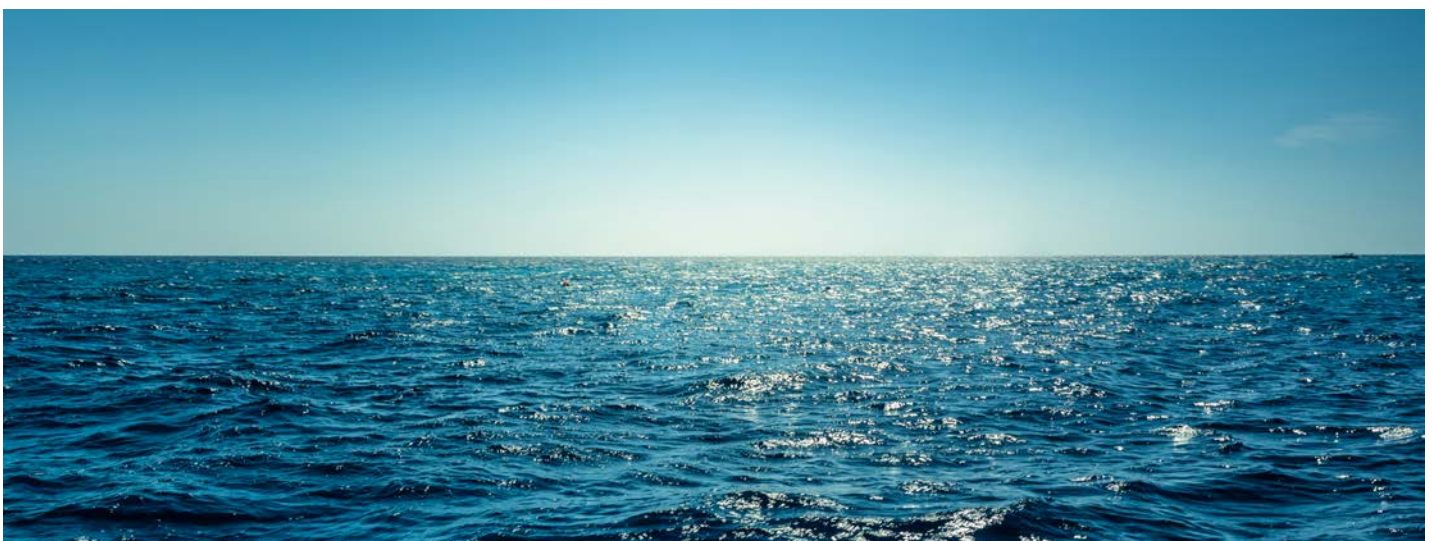
Tracking Ocean Plastic Pollution

Marine litter is a growing concern that needs to be addressed at a global scale. Floating plastics are not only directly hampering life, but degrade into microplastic entering the food chain, transport invasive species and endanger open water and coastal habitats.

While satellite ocean current and wind models are available in abundance, only limited progress has been made towards continuous monitoring and tracking of marine litter aggregated in floating patches, and even less for the prediction of trajectories and future locations.

Working closely together with the Environmental Computational Science and Earth Observation laboratory of EPFL Valais in Sion, the SDSC proposed two AI models to help track plastic pollution: one to automatically identify and segment floating marine litter from multi-source satellite imagery; and another one based on generative time series models which are not only able to forecast likely location of floating objects, but also the associated spatial uncertainty (**ADOPT** project).

Project partners included Ocean Cleanup, a non-profit organization that plans, develops and deploys technologies to collect plastic and limit their spread. Close collaboration between all partners provided novel ways to track plastics in the oceans, by relying on ocean current models jointly with Earth observation data, which Ocean Cleanup will be testing in practice.



↑ With EPFL Valais and other partners, the SDSC proposed AI models to help track plastic pollution in oceans.

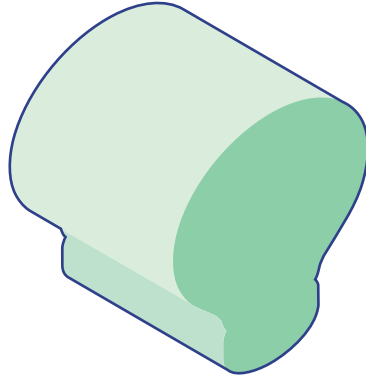
Energy & Sustainability

SUPPORTING ENERGY TRANSITION

In the face of pressing global challenges such as climate change, resource scarcity, and infrastructure resilience, data science has emerged as a powerful tool in driving sustainability solutions. It plays a crucial role in predicting and optimizing energy production and consumption, thereby enhancing the reliability of renewable energy sources like wind and solar power. It supports the green transformation of the built environment and of the mobility sector. It monitors and reduces energy consumption in industrial manufacturing, without compromising product quality. All these actions reduce environmental impact, which is a top priority for SDSC.

In the energy domain, one of the biggest challenges today is the shift from centrally managed energy systems, where electricity is generated in large power plants, to a decentralized model of electricity generation. With technologies like rooftop solar photovoltaic panels, individuals can produce energy locally, meet their own needs, and feed excess electricity back into the grid. Data science provides real value in managing this complexity and enabling a smarter, more efficient balance of supply and demand.

To improve the energy efficiency of the built environment, data from sensors are utilized for monitoring energy use in real time, and actuators can automate decisions such as adjusting heating or turning off unused systems. AI models trained on historical consumption patterns and environmental data can act on behalf of occupants to reduce energy wastage, ultimately saving energy without compromising comfort.



INDUSTRY AND PUBLIC SECTOR COLLABORATIONS

A similar logic applies in industrial settings. Traditional manufacturing lines are optimized for productivity rather than for energy efficiency. But by instrumenting production lines with sensors and using AI to model machinery behavior, it is possible to identify inefficiencies, prevent unexpected breakdowns, save energy, and optimize raw material usage. The SDSC worked closely with Swiss top-tier companies, like Bühler, to use advanced predictive control methods to reduce the power consumption of some of their industrial processes. For example, by precisely controlling the speed of the fan in the malting process, the AI-based solution reduces typical electricity consumption per batch by up to 16%, while also extending the lifespan of equipments.

By combining advanced data science with strong partnerships across industry, research and the public sector, we can create interoperable, trustworthy solutions that make Switzerland's energy system smart, resilient, and more sustainable.



↑ Dr. Roberto Castello
Energy & Sustainability Domain Lead



At the national level, the SDSC has collaborated with the Swiss Federal Office of Energy (SFOE) on data-driven initiatives such as the Energy Dashboard, which monitors Switzerland's energy supply and demand. The information contained in this dashboard enables policymakers and urban planners to make informed, data-driven decisions with significant societal impact.

Beyond technical expertise, the SDSC fosters a culture of responsible data sharing in the Swiss energy sector. By encouraging collaboration among national institutions, researchers, distributors, and federal offices, SDSC supports the development of interoperable, accessible and privacy-preserving data

and metadata hubs, for a more accurate forecasting, smarter infrastructure management, and more sustainable energy practices across Switzerland.

Nowadays, as the population grows and ecological challenges intensify, it is increasingly essential to enhance the efficiency of energy systems and decarbonize energy. Data science provides powerful tools to support this shift, contributing, for example, to optimize energy use in buildings and industrial processes, or enabling smarter integration of renewable energy sources like solar and wind. Sustainability and profitability can go hand in hand, especially when supported by data-driven approaches.



↑ The SDSC collaborates with the SFOE to accelerate digital innovation in the energy sector

SFOE : Analysis of the National Electricity Demand and its Forecast

The SDSC has been collaborating with the Swiss Federal Office of Energy (SFOE) to accelerate digital innovation in the energy sector. As the global energy crisis puts increasing pressure on the energy sector, data science provides innovative ways to monitor and optimize the use of electricity resources. In this context, the SDSC has collaborated with the SFOE on several data-driven initiatives, including contributions to the Energy Dashboard, which tracks Switzerland's national electricity demand with unprecedented resolution.

This dashboard incorporates both AI models to estimate in real time the national electricity consumption from distribution system operator data, but also to enable short-term forecasts of the energy

demand. The outcome of these models provides essential information for citizens, local authorities, and policymakers that could not be made available in real time before.

Another model developed by the SDSC also made it possible to track and to quantify electricity savings by specific consumer groups on a daily basis, following the information campaign launched by the Swiss government in late 2022. In this context, the combination of data recorded by a few energy utilities proved highly effective in extrapolating and measuring the end-user energy savings at the national scale.

The outcome is a useful tool for policymakers in the energy sector and a demonstration of an impactful data science-based solution deployed to serve public administration.

ENERBAT: Data-driven Building Renovation Strategies and Enhanced Energy Efficiency

The ENERBAT project is a collaboration between the Swiss Data Science Center and the Canton of Vaud, aiming to demonstrate how data can drive informed decisions within the framework of the cantonal energy strategy.

It comprises two main objectives. The first focuses on large-scale, data-driven renovation recommendations: by combining publicly available building characteristics such as architectural and structural features, location, and historical renovation data – the model outputs tailored, energy-efficient renovation strategies. The goal is to move from expert-only, one-off assessments to scalable, personalized guidance that can help the canton prioritize its building renovations across its real estate portfolio. The second objective is to investigate how real-time sensor data can be used to manage energy consumption without major structural changes. By collecting and analyzing hourly data, such as temperature, humidity, and energy usage, the project

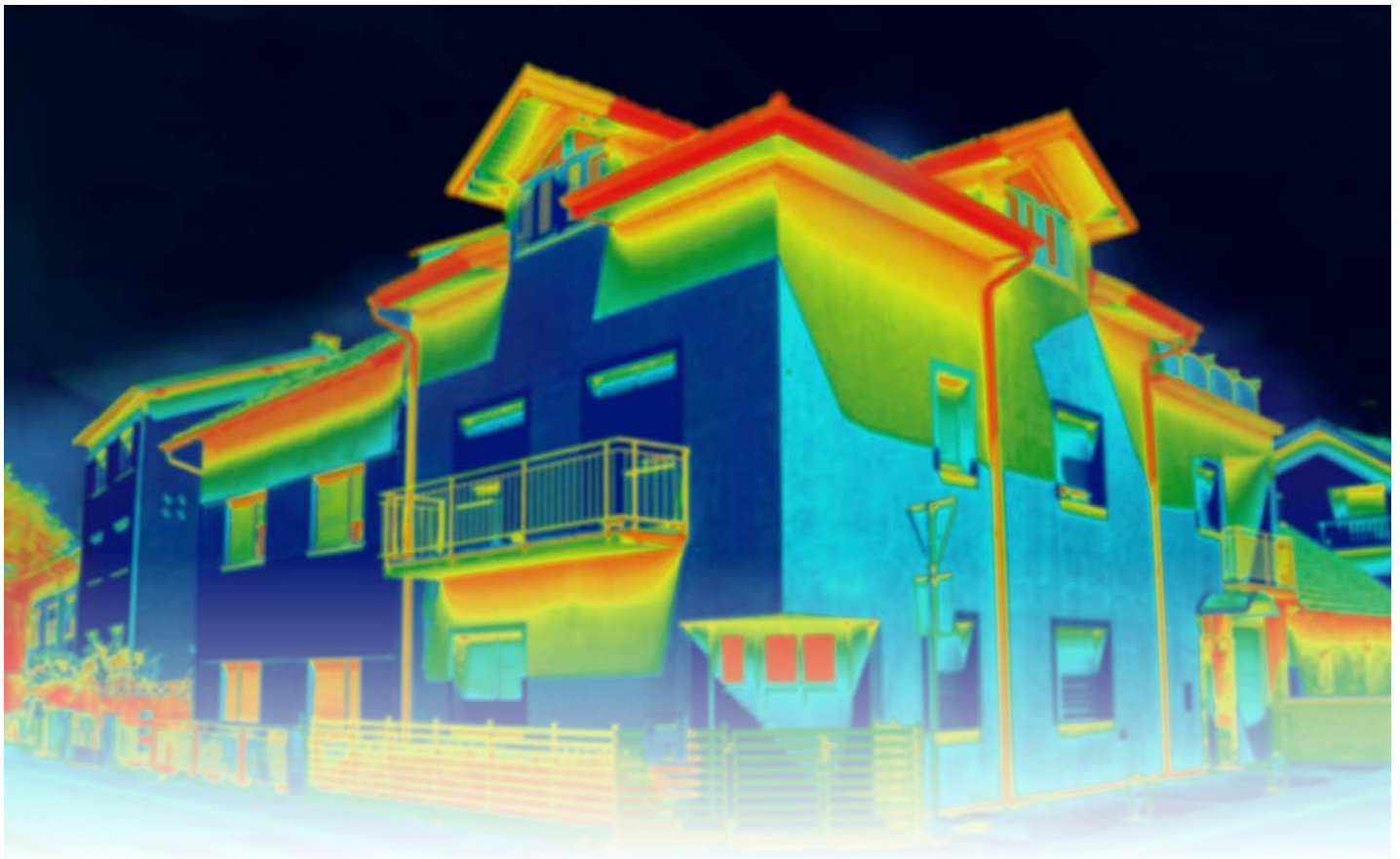
demonstrates that data collected through installed sensors can be used to reduce energy consumption in real-time and result in substantial savings.

The ENERBAT model successfully provided realistic renovation strategies and their prioritization for the real estate portfolio of the “Direction générale des immeubles et du patrimoine” (DGIP) of the Canton of Vaud. It's designed to be generalizable, with the potential to be adapted and scaled for other cantons or even nationwide, accounting for regional climatic and architectural differences.

Bühler Group: Improving Industrial Processes

Bühler Group and the SDSC have partnered to develop AI-driven solutions that improve both energy efficiency and product quality across Bühler’s operations.

The jointly developed idea, MontBlanc, is a data-driven solution to reduce CO₂ emissions in the malting process – a major contributor to food industry emissions. By optimizing kilning parameters using





↑ The SDSC worked with Bühler Group to launch innovative solutions for industrial manufacturing.

real-time data (like weather and grain conditions), **MontBlanc** improves efficiency and cuts energy use. The approach holds promise for broader industrial energy savings and emissions reduction.

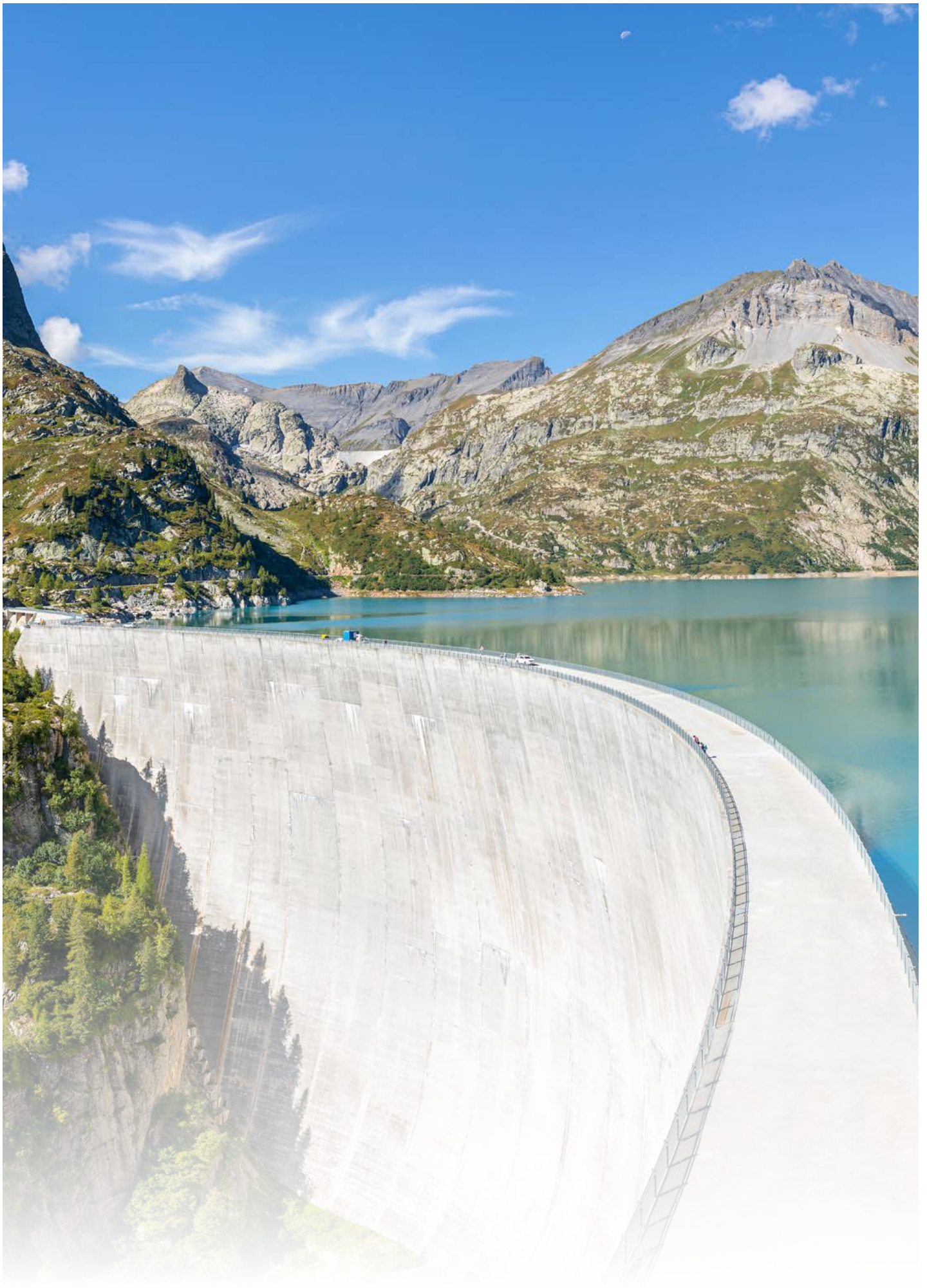
In quality management, analyzing years of multilingual, text-heavy issue reports is a challenge. Together with SDSC, Bühler developed **Qlaire**, an AI tool that uses Natural Language Processing (NLP) and Large Language Models (LLMs) to extract insights from quality control reports. Qlaire automatically processes, translates, and summarizes issue data, which helps experts resolve problems faster, identify patterns, and improve long-term quality of the Bühler products.

Mont Blanc and Qlaire demonstrate how Bühler and SDSC are utilizing AI to drive real-world improvements in industry sustainability and quality, setting a strong example for innovation in industrial manufacturing.

Ramping up Hydropower Turbines

As the share of renewable energies such as wind and solar increases in the mix, Swiss hydropower will be led to play a crucial role in compensating for the fluctuations of these highly variable energy sources. This will require ramping up and down hydropower turbines faster than before, but without wearing them out. Indeed, turbine transitions between operating states, especially during start-up, can cause significantly more mechanical stress and induce fatigue damage than steady operation.

In collaboration with the Technology Platform for Hydraulic Machines (TPHM) at EPFL, the SDSC developed deep learning algorithms predicting the levels of stress induced by different operating conditions, and, as a consequence, the fatigue damage produced by different control trajectories. This made it possible to then calculate a least-damaging start-up control trajectory to ramp up a turbine from rest to full speed and discharge. Experimental results on the TPHM turbines show that the optimized control trajectory developed by the SDSC reduces fatigue damage by more than 99.5% compared to the conventional approach (**PAIRED-HYDRO** project).



Digital Society

FOSTERING INNOVATION AND TRUST IN THE DIGITAL AGE

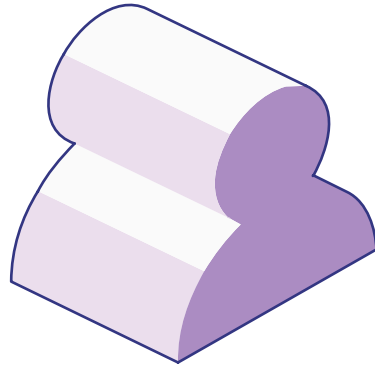
The SDSC aligns with the Swiss ETH Board's vision of a Digital Society where technology meets societal expectations for quality, inclusivity and trust. In accordance with its mandate, the SDSC helps different stakeholders use data science, machine learning and AI towards the digital transformation of society. We aim in particular at fostering data-driven innovation to support communities and individuals, enhance public services, and address key societal challenges.

The SDSC has been advancing its Digital Society mission through three complementary objectives.

In a rapidly evolving digital world, our mission is to ensure that data-driven innovation strengthens society by creating digital services that are accessible, interoperable, and participatory for communities and individuals.



↑ Dr. Alessandro Nesti
Digital Society Domain Lead



The first objective is to deliver data-driven services that help public institutions, NGOs and other actors serve society more effectively, enhancing transparency, accessibility and societal impact.

The second is to empower individuals as active contributors to digital innovation by fostering civic engagement, participatory data initiatives, citizen science, and public education.

And finally, the SDSC is preparing to develop shared infrastructures for collaboration that will enable ethical, secure and interoperable data sharing across organizations, sectors and cantons.

The efforts of the SDSC to support a more inclusive and resilient Digital Society are primarily focused on personalized digital services, public administration, social equity and data science literacy.

PERSONALIZED DIGITAL SERVICES

Digital services tailored to individuals and communities are increasingly recognized as essential for reducing inequality, democratizing access to information, and fostering collective growth. The SDSC actively supports private and public organizations in developing such socially impactful services. Collaborations include:

Human Resources Sector: Partnering with Adecco to unify and standardize job titles across diverse data sources using knowledge graphs and semantic similarity, creating a consistent taxonomy that enables recruiters to match candidates and job postings more efficiently.

Healthcare Sector: Collaborating with the online platform OneDoc to address the growing need for accessible healthcare services and developing their first prototype of AI-powered assistant that helps patients find the right specialists and schedule appointments efficiently.

Environmental Sector: Working with WSL to develop a biodiversity ML-based monitoring platform that guides citizen-scientists in collecting plant observations that best enhance its coverage.

Digital Interpreting Services: With the support of Innosuisse, collaborating with the company Bhaasha on a feasibility study to develop a bi-directional real-time speech-to-speech interpreter tailored for public services and low-resource languages. This preliminary effort led to securing funding for an 18-month Innosuisse national project that will start in March 2026.

PUBLIC ADMINISTRATION

The public administration faces challenges linked to the growing and ageing of the population as well as the digital demands of today's society. The SDSC supports these efforts with the design and implementation of efficient data-driven solutions that streamline administrative operations and enhance the quality of public services.

Analyzing Parliamentary Data: An exemplary set of achievements in this area is our collaboration with the Chair of Systems Design at ETH Zurich in the DemocraSci project to extract, structure, and connect over 125 years of Swiss parliamentary records into a rich knowledge graph, fostering a transparency of the Swiss political discourse and enabling researchers, historians, and journalists to analyze long-term political trends.



Enhancing Access to Archives: In a collaboration with the University Cantonal Library of Fribourg and the EPFL+ECAL Lab, the SDSC is applying natural language processing to enhance the metadata generation of library archives, making historical documents more accessible and engaging. Ultimately, this project aims to strengthen citizens' connection to their cultural heritage and foster a deeper sense of belonging.

Optimizing Processes: The SDSC has further supported public service providers such as the home care services of the Canton of Vaud (AVASAD), Switzerland's Parliamentary Services, and the city of Burgdorf in optimizing their processes, enabling them to deliver more efficient and effective services to their communities (Smart Waste Collection).

SOCIAL EQUITY

Vulnerable populations worldwide often face exclusion from technology-driven services due to barriers such as limited digital literacy, socioeconomic disparities, and insufficient access to resources. The SDSC is increasingly collaborating with non-governmental organizations to develop inclusive digital solutions that bridge the digital divide, empower marginalized communities and support global social progress. This is well illustrated by our collaboration with the International Committee of the Red Cross.

DATA SCIENCE LITERACY

As data science becomes increasingly influential across sectors, there is a growing need for education and demystification to promote responsible use of technology, align expectations, counter misinformation, and avoid missed opportunities. The SDSC is committed to strengthening data science literacy by offering continuing and executive education through our membership programs and in collaboration with the continuing education schools of EPFL and ETH Zurich.

Among these initiatives, Enabling Innovation with Data Science (ENID) is a 5-day course for senior managers and executives that has already held three editions in Lausanne and Zurich, reaching over 40 participants. New sessions are planned annually, and an adapted version for the humanitarian sector will be delivered for the first time in January 2026.



↑ In a project with the University Cantonal Library of Fribourg and the EPFL+ECAL Lab, the SDSC is applying natural language processing to enhance the metadata generation of library archives, making historical documents more accessible and engaging.



DemocraSci : a Knowledge Graph on the Swiss Parliament Proceedings

Vast collections of digitized materials are available in repositories like the Swiss Federal Archive, yet they are seldom formatted in ways that enable systematic analysis and data-driven research. In collaboration with the Chair of Systems Design at ETH Zurich, the SDSC developed algorithms and a scalable data processing pipeline for extracting and structuring information from the Swiss parliamentary proceedings, covering more than 125 years of political history. This process involved automated AI-based document layout analysis, as well as entity extraction, and categorization of the content into speeches, laws, and votes using natural language processing. The extracted data was then encoded in the form of a knowledge graph connecting members of parliament, parties, speeches, bills, policy domains, votes, etc.

This knowledge graph and the extracted speeches from members of parliament promote transparency and accessibility of public records, and form a unique resource for political scientists, historians, and journalists interested in exploring parliamentary activity, party dynamics, and historical trends. For example, the follow-up project EvolvingDemocraSci explored the role and influence of individual parliament members and political parties over time, revealing long-term trends in political discourse and polarization, and offering new insights into the evolution of Swiss democracy.



↑ The SDSC and the ICRC worked together to develop an open-source algorithm that automatically produced structured conflict reports.

ICRC: Monitoring Patterns of Violence

The International Committee of the Red Cross (ICRC) currently relies on observations, interviews and status reports compiled by field analysts to monitor the impact of its work aimed at influencing armed forces and groups to fight in accordance with international humanitarian law (IHL). These reporting and analysis methodologies present several limitations, such as subjectiveness or the lack of structure that may facilitate the extraction of relevant information, as well as the lack of human resources to monitor episodes of armed violence across entire countries.

To address these issues, the SDSC and the ICRC have collaborated to jointly develop an open-source algorithm that automatically produces structured conflict reports. This algorithm relies on machine learning models trained on large amounts of textual data and integrates the ICRC's expert knowledge to carry out automatic event analysis. It processes large numbers of conflict-related reports to uncover patterns of violence in the affected areas and to identify «who-did-what-to-whom». This automated tool enhances the ICRC's ability to monitor crises, evaluate the impact of its protection efforts, and strategically plan future interventions.

Burgdorf: An AI Adaptive Routing System for Smart Waste Collection

Urban waste management faces inefficiencies from fixed collection schedules, often requiring unnecessary trips to half-full containers. In collaboration with the city of Burgdorf and the Swiss Center for Electronics and Microtechnology (CSEM), and funded by Innosuisse, the SDSC developed an AI-powered routing system to help truck drivers dynamically adapt to real-time conditions, improving operational efficiency. The solution helped replace static schedules with adaptive algorithms that optimize waste collection based on container fill patterns, vehicle capacity, and other constraints. Using deep reinforcement learning (RL) further helped to minimize travel distances, container overfilling, and truck overloading. Early results showed that the dynamic routing system can achieve a 10-20% reduction in collection distances (×500 km per year) in the City of Burgdorf, hence significantly lowering fuel consumption, CO² emissions (×250 kg CO² per year), and operational costs.

AskDigi : Virtual Assistance for Parliamentarians

The Swiss Parliament's Helpdesk assists members of parliament with various enquiries, such as conducting document searches in the library, finding commission contacts, or addressing lost access cards. Traditionally, answers to these searches have been available in a comprehensive master document that contains the collective knowledge. However, navigating the document in search of answers is a time-consuming effort, often requiring them to additionally consult the Parliament's Helpdesk.

On a mandate from the Swiss Parliament to provide faster and more accessible assistance to parliamentarians, the SDSC developed a virtual assistant for new parliamentarians that leverages generative AI to instantly and accurately provide responses sourced from the internal documentation in Switzerland's three main languages: German, French, and Italian. This project highlights the transformative potential of machine learning models in streamlining parliamentary operations and improving access to information.

↓The SDSC worked with the City of Burgdorf to deploy adaptative algorithms for smarter waste collection.



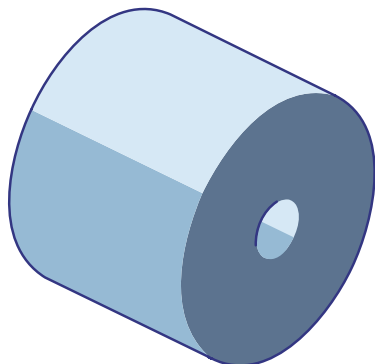
Large-Scale Infrastructures

THE ROLE AND IMPACT OF LARGE-SCALE SCIENTIFIC INFRASTRUCTURES

Large-Scale scientific infrastructures (LSI) such as those operated by the four research institutes of the ETH Domain (Eawag, the Swiss Federal Institute of Aquatic Science and Technology; Empa, the Swiss Federal Laboratories for Materials Science and Technology; PSI, the Paul Scherrer Institute; WSL/SLF, the Swiss Federal Institute for Forest, Snow and Landscape Research) constitute top-notch research facilities that play a fundamental role in advancing scientific research and technological development in various disciplines spanning the natural sciences, engineering, or medicine.

For instance, particle accelerators such as the Swiss Light Source (SLS) or the Swiss Free Electron Laser (SwissFEL) operated at PSI, allow for the study of the properties of matter at different scales in space (from microscopic to atomic) and time (fractions of a second). The NEST smart building demonstrator at Empa makes it possible to study energy consumption patterns for optimal thermal control and reduced energy consumption in residential buildings. Also, sensing and monitoring networks such as those of SLF for avalanche prediction and detection allow for rapid response and prevention measures against natural hazards.

The scientific outcomes of the research undertaken at these facilities address major questions in key sectors of society such as climate and energy, medicine and biology, and digitalization. They also bear transformative potential in the development of new technologies and applications such as quantum computing, material design and manufacturing, drug development and renewable energy. Such advances are only possible thanks to the advanced and specialized instrumentation of the large-scale scientific infrastructures.



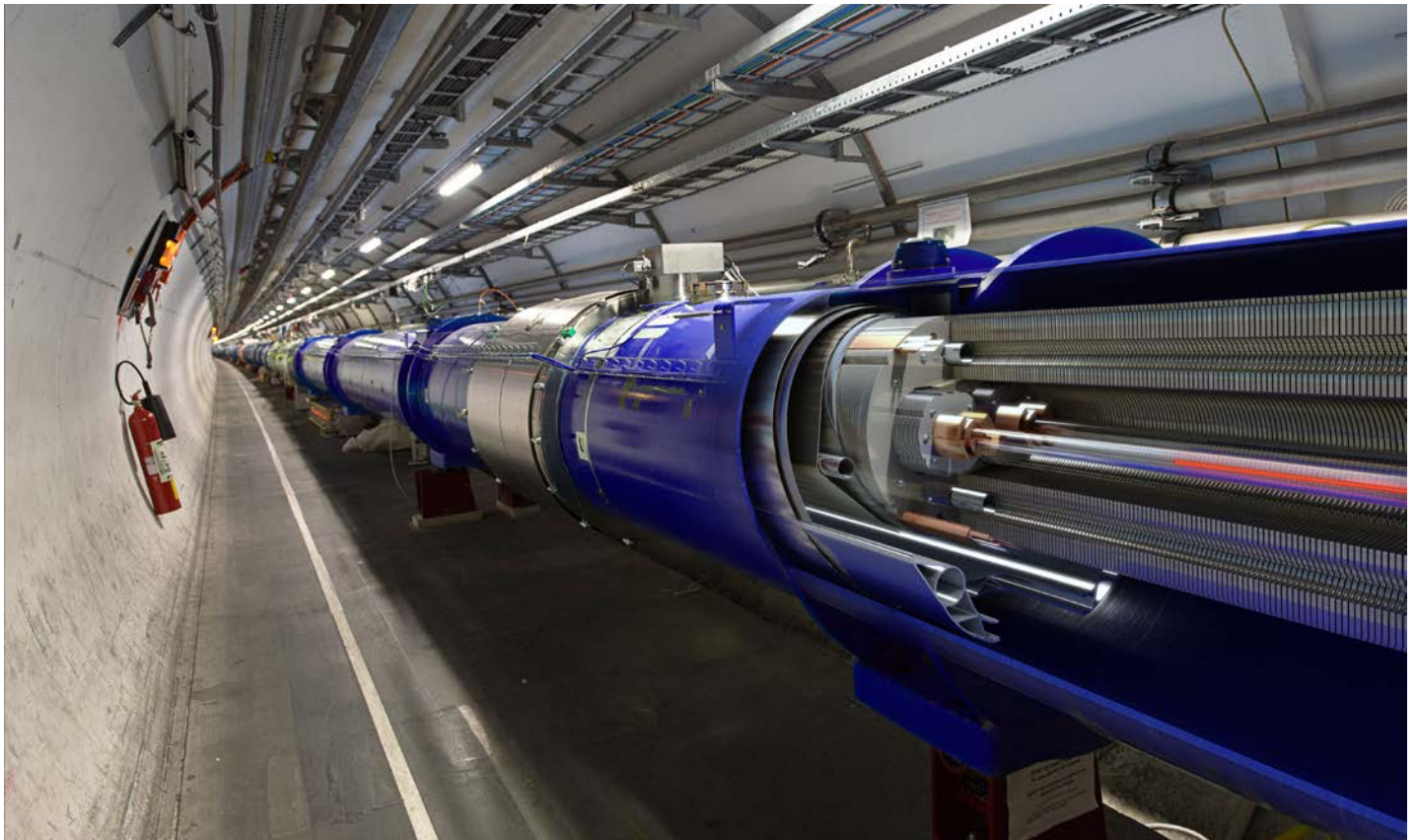
SDSC ENGAGEMENT AND DATA SCIENCE FOR LARGE-SCALE INFRASTRUCTURES

With the establishment of the third office of the SDSC at PSI in 2022, the first projects related to LSIs were launched. Since then, the SDSC has been continuously engaged in several collaborative projects both through yearly calls and external funding mechanisms, providing expertise in machine learning and enabling advanced data science solutions for applications related to the LSI.

Equipped with advanced data science capabilities, large-scale scientific infrastructures bear a unique capacity for groundbreaking research and innovation. Through its collaborative projects, the SDSC contributes to unlocking the full potential of large-scale infrastructures by bringing modern data science and AI into their routine operations, turning massive data streams into actionable knowledge that drives technological development.



↑ Dr. Benjamín Béjar Haro
Large-Scale Infrastructures Domain Lead



↑ The SDSC is collaborating with the High Energy Physics Laboratory at EPFL to improve online classification and detection methods for particle showers detected at the Large Hadron Collider (LHC) at CERN.

Key distinctive features of these projects are: the production of large data volumes and the need for efficient data intake and data processing methods; the need for optimized instrument usage and maintenance via predictive control and feedback, smart sensing and optimal experimental design capabilities; the access to indirect measurements only often grounded in physical laws.

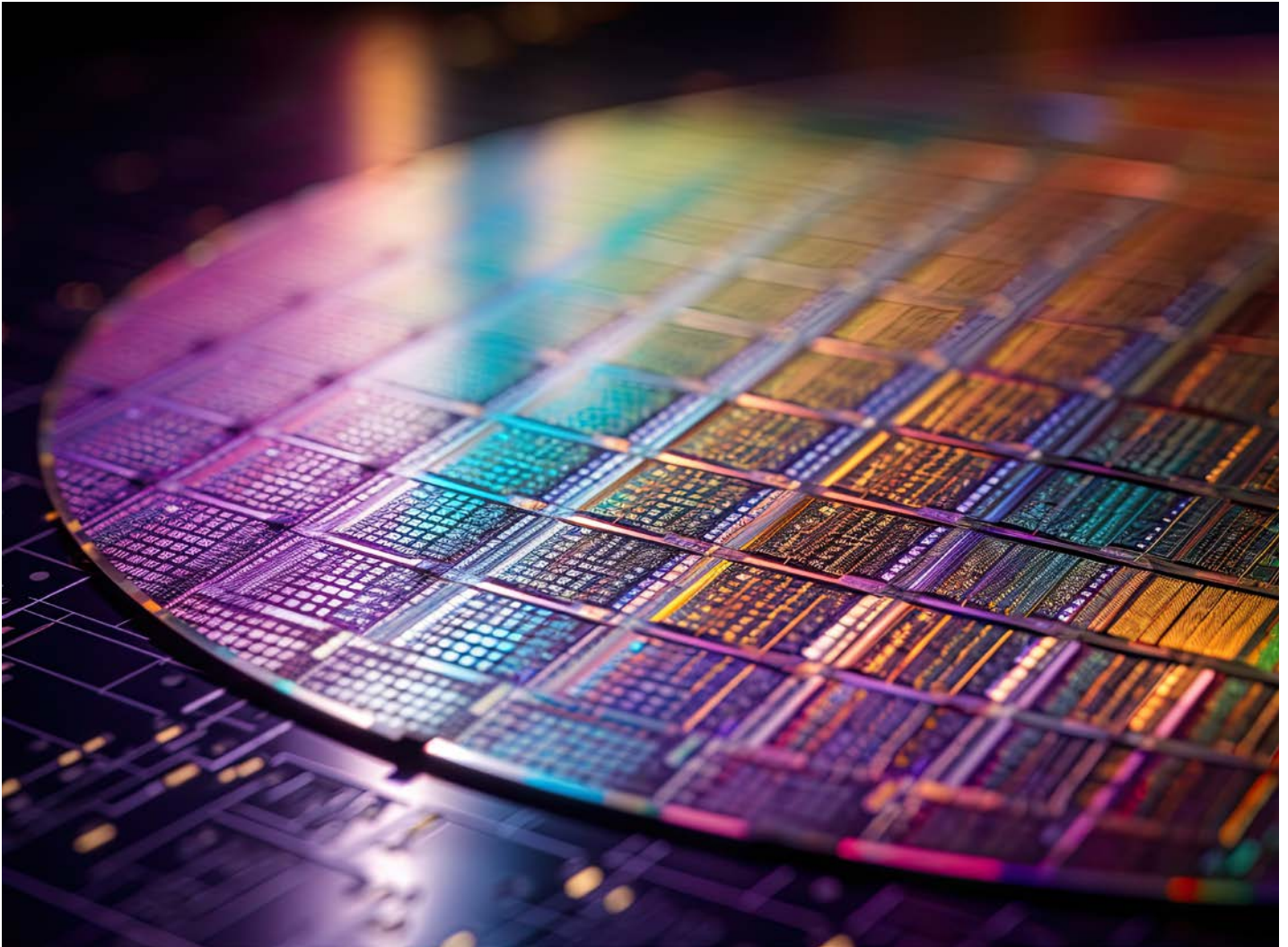
During the SDSC's 2017-2024 funding period, the Center contributed to several projects aimed at enabling an even more stringent end-to-end use of operations, data analysis and scientific results at large-scale research facilities. Several projects exemplify this effort.

AI FOR COMPUTATIONAL IMAGING

Synchrotron sources such as the Swiss Light Source (SLS) allow for, and are routinely used for imaging samples and dynamical processes at very high spatial and temporal resolutions. The SDSC has contributed to the implementation of advanced imaging methods leveraging machine learning and artificial intelligence for applications in neuroscience, biology, chip manufacturing, and materials science.

ALBUM : Reconstruction and Segmentation for Brain Ultrastructures

In collaboration with the Structural Neurobiology research group at PSI, the SDSC aims at improving the reconstruction and segmentation quality of neural tissue volumes obtained from scanning →



↑ LAMP Project : the SDSC worked on reconstruction methods using AI for photomask inspection.

transmission electron microscopy measurements, while enhancing acquisition and processing times to enable the processing of data volumes at unprecedented rates.

LAMP : Generative Reconstruction for Photomask Inspection

In a collaboration with the Advanced Lithography and Metrology Group at PSI, the SDSC has proposed reconstruction methods using generative AI models for EUV photomask inspection from ptychographic measurements. These methods accelerate the reconstruction process with improved estimation capabilities. Simultaneously, they enable the reduction of the number of required measurements.

The proposed methodology paves the way for the development of an alternative, cheaper, and more efficient technology for metrology applications in chip manufacturing.

CHIP : Data-Driven Tomographic Reconstruction

In a collaboration with the Computational X-ray Imaging Lab at PSI and EPFL, the SDSC has contributed to the development of AI-driven image reconstruction techniques from a sparse set of measurements for X-ray tomography. The proposed methods exploit data-driven priors to optimize the acquisition process and choose the most informative measurement angles given the current object estimate. This technique substantially reduces radiation damage

on the measured samples and accelerates experiments, showing great performance for chip layout reconstruction.

DATA REDUCTION

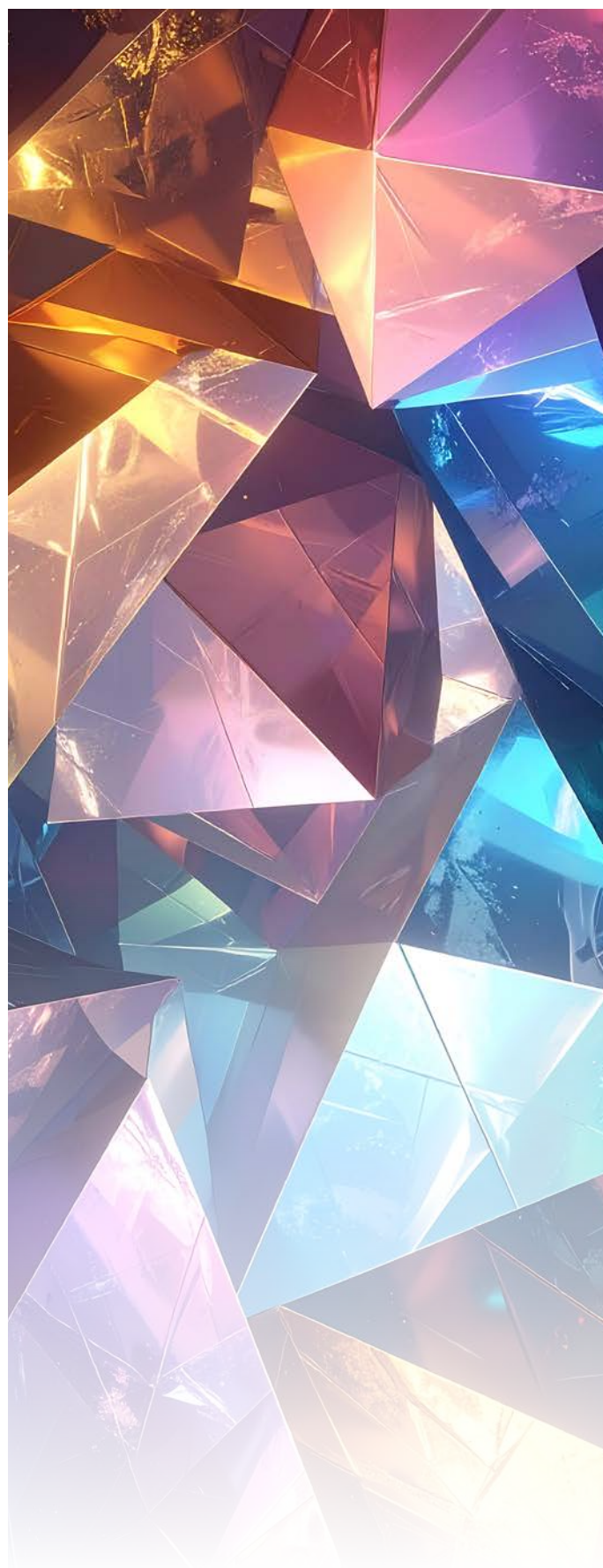
The ever-increasing volumes of data generated by experiments at large research infrastructures are straining current processing and storage capabilities. The SDSC is responding by designing innovative data-reduction and compression strategies for use across multiple experimental setups.

RED-ML : Reduction of Experimental Data in Serial Crystallography

The RED-ML project studied efficient methods for determining the molecular structure of biological samples in X-ray Serial Crystallography, in which the most time-consuming part is the so-called indexing problem. In collaboration with the Data Processing Development and Consulting Group from Science IT Infrastructure and Services at PSI, we contributed to the development of an efficient method for indexing X-ray diffraction patterns in serial crystallography that is capable of processing thousands of diffraction images per second by leveraging the parallel processing capabilities of GPUs. This achievement represents a major leap in indexing performance, as previously existing methods could only handle a handful of diffraction patterns per second. The indexing algorithm opens the door to real-time user feedback and smart experimentation being able to exploit the full capabilities envisioned by the upgrade of Swiss Light Source 2.0. Real-time indexing enables on-the-fly data reduction to overcome the ever more pressing data-storage bottlenecks. The developed method has been successfully tested at other synchrotron facilities such as the European synchrotron at DESY in Hamburg, MAX IV in Sweden, or ALBA in Spain.

SDATE : On-the-Fly Data Reduction for Time-Resolved Tomography

In the SDATE project, the SDSC is exploring data reduction and compression methods for time-resolved tomography for the TOMCAT beamline at the Swiss Light Source (SLS). In this collaboration that involves researchers from the TOMCAT group,



as well as from PSI Science IT Infrastructure and Services, several approaches are being explored: from standard image/video compression algorithms to AI-based methods to achieve on-the-fly or near real-time data reduction.

MDS-Rec : Online Classification at the LHC

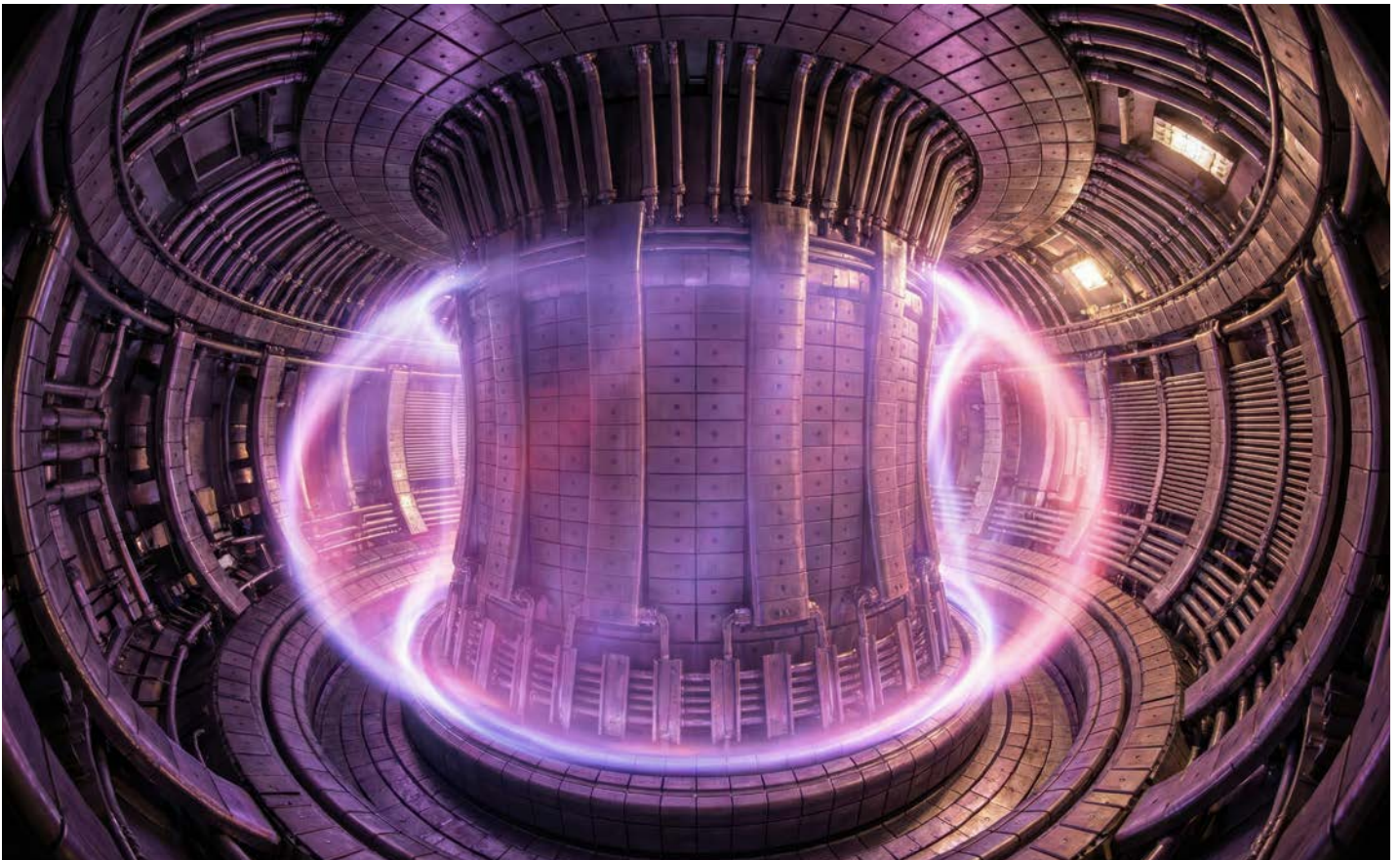
The Large Hadron Collider (LHC) at the European Council for Nuclear Research (CERN), the largest and most powerful particle accelerator in the world, generates a volume of data that exceeds current storage and processing capabilities. In the MDS-Rec project, the SDSC is collaborating with the High Energy Physics Laboratory at EPFL to improve online classification and detection methods for particle showers detected at LHCb in the search of new particles that deviate from the standard physics model.

SUPPORTING PARTICLE ACCELERATOR AND TOKAMAK OPERATIONS

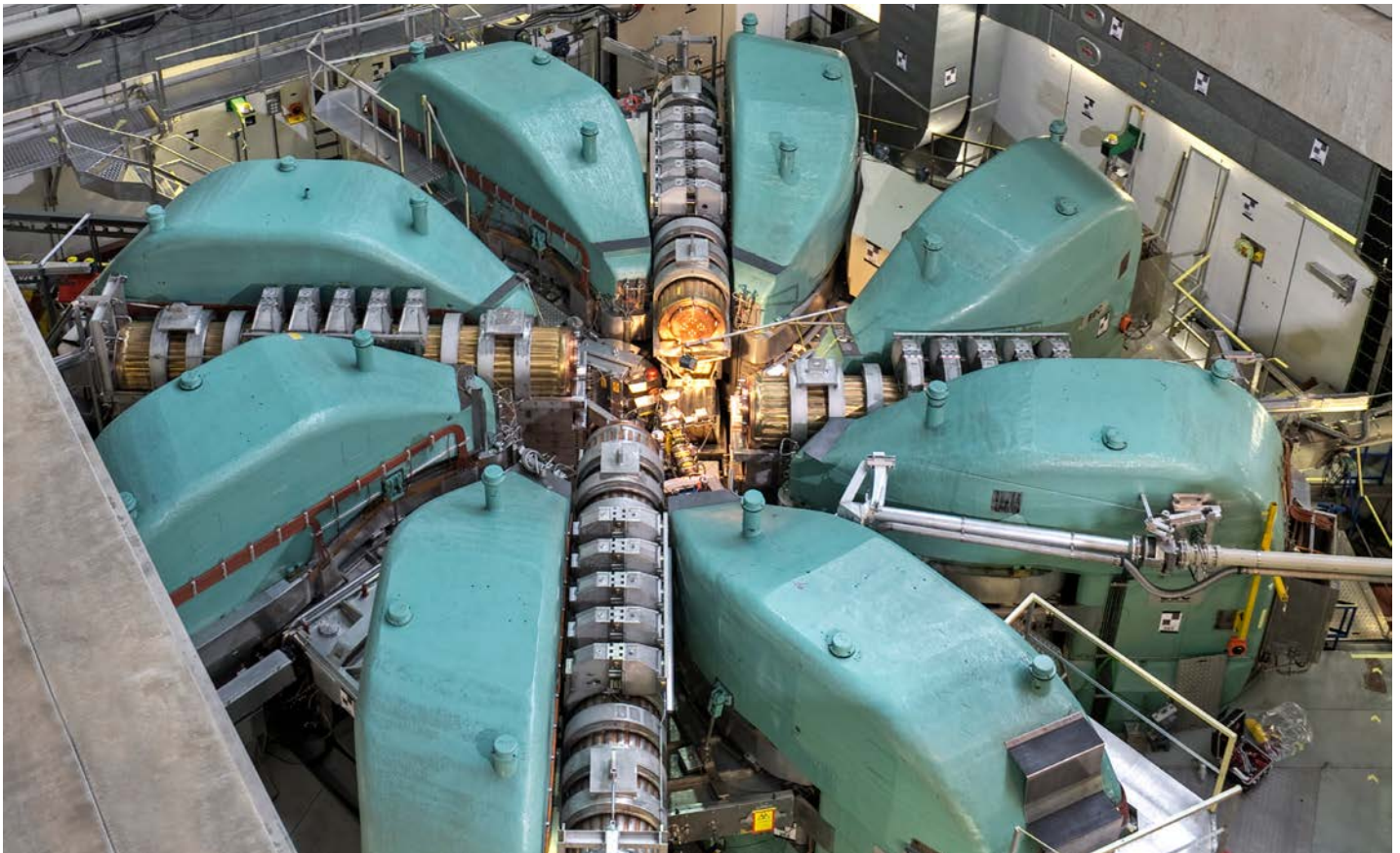
Infrastructures such as particle accelerators and tokamaks rely on complex control systems and vast streams of sensor data, creating a strong need for data-driven methods to improve understanding and optimization of machine behavior. The SDSC contributes to the development of advanced machine learning models towards these goals.

MLFusion : Disruption Prediction in Tokamaks

Tokamaks are infrastructures to confine and control hot, electrically charged gas (plasma) in order to achieve nuclear fusion, following the same energy-producing process that powers the sun. One of the major challenges in operating tokamaks is to avoid disruptions, triggered by sudden and uncontrolled loss of the plasma current and confinement. In collaboration with the Theory group at the EPFL Swiss Plasma Center (SPC), the SDSC developed predictive models for the disruption of the plasma in the TCV, the tokamak operated by the SPC.



↑ Tokamak machines are a promising technology for the ever-growing demand for clean energy.



↑ The High Intensity Proton Accelerator (HIPA) at Paul Scherrer Institute (PSI) provides the primary beams to PSI's versatile experimental facilities which in turn provide high intensity beams for research.

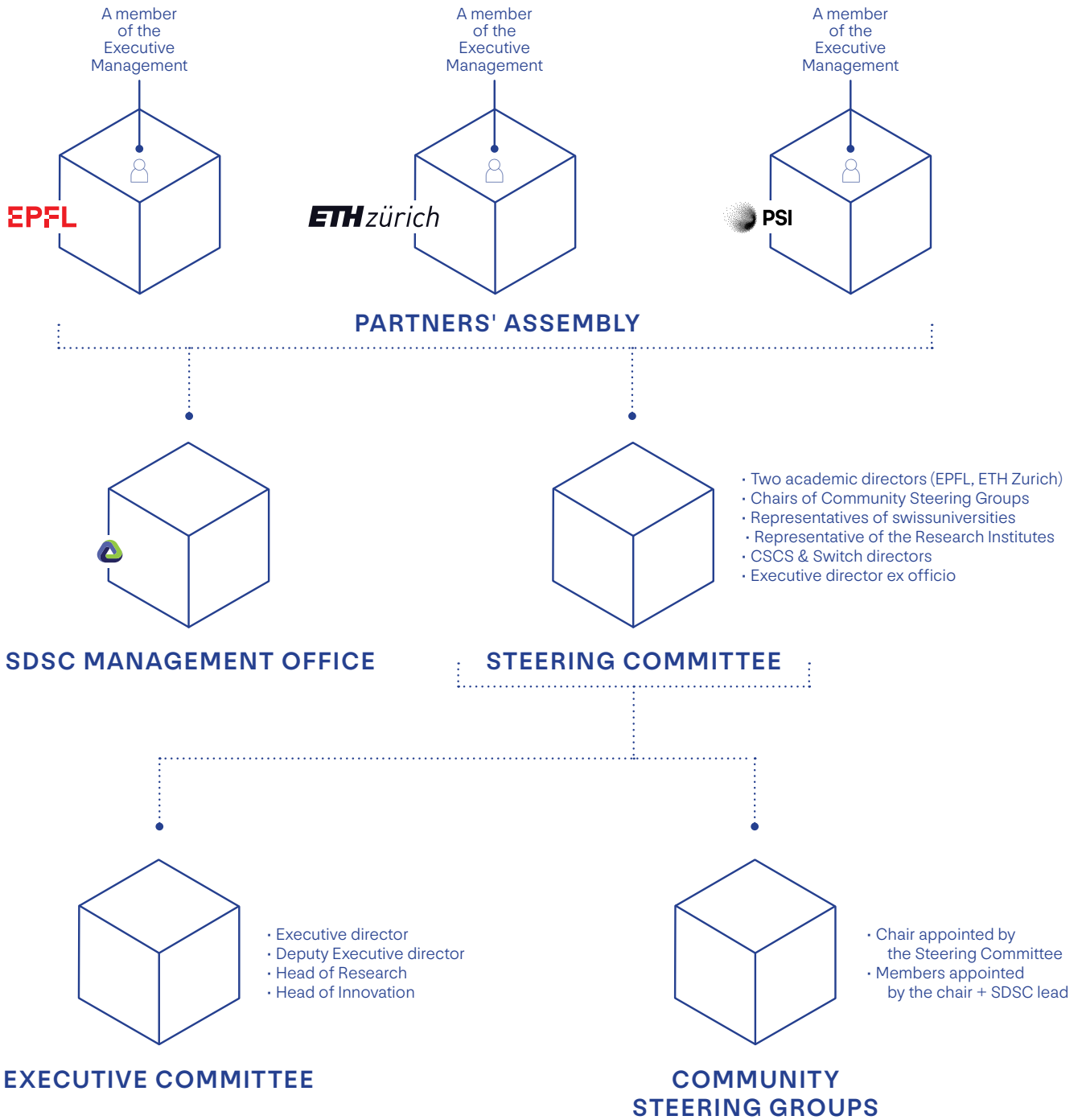
PACMAN HIPA : Preventing Interruption and Minimizing Beam Losses at HIPA

This collaboration with the Cyclotron Development and Beam Dynamics group and the Laboratory for Scientific Computing and Modelling at PSI led to the development of a model for early forecasting of potential interruptions of the beam by the machine protection system of the High Intensity Proton Accelerator (HIPA). In the context of this project, the Learning & Adaptive Systems group at ETH Zurich could also develop safe Bayesian optimization algorithms to optimize controls and reduce beam losses, while preventing that the exploration leads to machine interruptions.

PACMAN LHC : Modeling Beam Particle Losses at the LHC

Sustaining a high intensity beam for the longest time possible is one of the challenges in particle accelerators. This is what makes it possible to keep a higher collision rate for longer experiments in the Large Hadron Collider (LHC) at CERN. But the intensity gradually decreases as the beam loses particles. The SDSC collaborated with the Particle Accelerator Physics Laboratory at EPFL to build models based either on real or simulated data to monitor how the control parameters of the LHC affect the level of particle losses, with the ultimate goal of better controlling parameter configurations.

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Scientific Writing and Editing : Hector Garcia Morales,
hectorgarciamorales.wordpress.com

Project Lead & Editorial Direction : Catherine Hugon,
Executive Affairs, SDSC

Contributors:

Julien Anet

Benjamín Béjar Haro

Angelo Borges

Roberto Castello

Imen Choura

Ekaterina Krymova

Alessandro Nesti

Guillaume Obozinski

Oksana Riba Groguz

Rok Roškar

Silvia Quarteroni

Sofiane Sarni

Adrien Simard

Nora Toussaint

Uta Ünal

Olivier Verscheure

Michele Volpi

Biopôle

Bâtiment Arginine

Route de la Corniche 17

CH-1010 Lausanne

EPFL

Inn 218

Station 14

CH-1015 Lausanne

ETH Zurich

Andreasturm, 18th Floor

Andreasstrasse 5

CH-8050 Zurich

www.datascience.ch

communications@datascience.ch

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