

ACTION PLAN FOR SUSTAINABILITY MAX IV

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INTRODUCTION

As a world-class research infrastructure, MAX IV Laboratory, in collaboration with our users, funders, and stakeholders, aims to lead in addressing the United Nations Sustainable Development Goals (UN SDGs). The MAX IV organisation shares the same vision and goals for sustainability as our host Lund University (link: lunduniversity.lu.se/sites/www.lunduniversity.lu.se/files/2023-02/sustainability-plan-2020-2026-revised-swedish.pdf).

The overall sustainability work at MAX IV is categorised into four priority areas:

- Identify and promote sustainability research
- Reduce the carbon footprint
- Financial sustainability
- Sustainable workplace

MAX IV provides cutting-edge X-ray experimental techniques to support the needs of our academic and industrial user communities for sustainability research. The science supported at MAX IV is typically characterised by a commitment to understanding and addressing complex systems, e.g. focussing on areas such as atmospheric science, aerosols, renewable resources, energy storage, sustainable materials, food production, soil, water science, and related topics. Examples of sustainable research conducted at the facility include development of new materials based on national forest resources at ForMAX beamline, and battery research on a dedicated station at HIPPIE beamline.

The energy utilised at MAX IV comes from sustainable and renewable sources. The EU-funded project Research Infrastructure (RF 2.0) initiated in 2024 with coordination by the Karlsruhe Institute of Technology (KIT) and participation by several European facilities, including MAX IV. The project focusses on improving energy efficiency and sustainability in large accelerator-based research infrastructures.

In terms of financial sustainability, the MAX IV emphasis extends both to long-term financial planning and the incorporation of sustainability criteria throughout the procurement process. To establish the laboratory as a sustainable workplace, considerations for sustainability are applied on the individual, interpersonal, and organisational level.

As a research infrastructure, MAX IV actively targets areas resonant with the priorities of our academic and industrial user communities. Beamtime allocation follows a review process, prioritising academic users who publish significant results in open-access journals. Alternatively, proprietary access is available for industry users who do not have open-access publication requirements but pay for the service. MAX IV staff focus on developmental research related to instrumentation.

Promoting sustainability at various levels necessitates collaboration with other partners. This encompasses, for example, changes to the MAX IV building, ongoing biodiversity projects in the surrounding hills, and adherence to the environmental management system of Lund University.

Effective communication is integral to the MAX IV sustainability efforts. This is executed in alignment with the organisation's communication plan and includes internal dissemination as well as external outreach through platforms such as the website and social media channels. The primary focus is on engagement with our user communities, funders, and various stakeholders.

This plan was developed by a working group with representatives from all parts of MAX IV. It was approved by the MAX IV Director on 2024-03-08 and will be followed up and eventually updated in a two-year cycle.

PRIORITISED AREAS

1. Identify and promote sustainability research

MAX IV Laboratory plays a pivotal role in the progression of environmental science research by offering an extensive array of X-ray techniques, encompassing spectroscopy, imaging, and scattering. The facility contributes to addressing challenges in environmental science by enhancing relevant experimental capabilities and supporting our research communities.

The organisation supports research that prioritises dynamic processes over static properties, recognising the need to study real, complex systems rather than relying on simple models. Support includes investigations into heterogeneous structures and chemical compositions of real samples, addressing processes occurring over various time and length scales.

The research conducted at the facility is guided by the principles of the United Nations Sustainable Development Goals (UN SDGs), which also influence the development of both current and future beamlines. This integration of sustainable goals is closely intertwined with graduate training and research, encompassing all users, whether from the academic or industrial sectors. This commitment to sustainability is a foundational aspect of the MAX IV Strategic Plan for 2023-2032 (link: www.maxiv.lu.se/about-us/max-iv-strategy-2023-2032/)

Notably, the selection of transformative science areas prioritised by MAX IV, such as "batteries and energy materials" and "tackling environmental challenges", reflects this overarching commitment.

The organisation aims to facilitate opportunities to better understand complex systems of the natural environment and anthropogenic impacts as well as support research on sustainable solutions for the future. MAX IV develops these opportunities in collaboration with our user communities and funding agencies. Some recent examples of such developments include:

- **Renewable Energy Technologies**
A dedicated electrochemistry station at HIPPIE beamline targeting battery research.
- **Circular Economy and Materials Innovation**
ForMAX beamline—a cornerstone within the Treesearch initiative, a national platform enabling collaboration between academia and the forest industry to target new materials from Swedish forests.

The WISE beamlines

MAX IV staff have developed the conceptual design reports (CDR) for three potential new materials science beamlines together with the scientific community, in collaboration with the Wallenberg Initiative Materials Science for Sustainability (WISE), and funding by the Knut and Alice Wallenberg Foundation. MAX IV aims to further develop one or several of these proposals for the realisation of new beamlines once funding for development and operational costs is secured.

There are many examples of research done at other MAX IV beamlines in areas such as energy conversion and fuel technologies, bioenergy and carbon capture. Recent (2023) examples from MAX IV Science Highlights and news include:

- Studies on soot emissions with a newly developed aerosol sample delivery system at FinEstBeAMS beamline.
- Swedish researchers analysed the cloud-forming abilities of particle exhaust from ships using low-sulphate fuels as well as high-sulphate fuels conditioned with wet scrubbers at SoftiMAX beamline.
- Studies on the efficiency of catalysts at Balder and Species beamlines by optimising particle size can lead to a more effective conversion of toxic carbon monoxide exhaust even in challenging cold start conditions.

MAX IV enables the best possible experimental conditions for research. In collaboration with our users, the organisation will continue to deliver inspiring research stories for our funders, and report news to further promote scientific sustainability work.

To secure future needs in specialised trained staff with deep knowledge and understanding of offered methodologies, MAX IV supports and promotes education of next-generation synchrotron researchers and accelerator developers. One example is the EU-cofunded programme Prismas.

MAX IV continually informs the user communities, stakeholders, and funders about the development status of our instruments enabling sustainable research. The organisation actively engages in EU calls focussing on sustainability, e.g. ReMade@ARI and RIANA.

MAX IV participates with five other large accelerator-based research infrastructures in the EU-funded project Research Infrastructure 2.0. The three-year project began in January 2024 with a total EU funding of ca 5 MEUR. The project aims to perform a comprehensive analysis of large research infrastructure energy management challenges, from component to system level, and to develop and test possible corrective actions in realistic environments. MAX IV will contribute with the design of a permanent magnet-based alternative to the MAX IV 3 GeV ring dipole magnets. For goal, see under Reduce carbon footprint, Energy. In addition, MAX IV will be involved with life-cycle assessment of the carbon footprint for permanent magnet and high efficiency radio frequency amplifiers.

MAX IV is implementing the FAIR Data principles (Findable, Accessible, Interoperable and Reusable), e.g. in the data management project Datastamp. The organisation is also active in diverse European Open Science Cloud (EOSC) projects.

Goal: MAX IV is recognised as a world leading synchrotron laboratory targeting areas prioritised by our scientific user communities and industry, such as developing energy materials and technologies, boosting life and biomedical sciences, and solving environmental challenges.

Actions: Maintain a prioritised list of beamlines to add to the portfolio and capabilities in collaboration with the scientific community, industry, and other stakeholders. Ensure MAX IV continues to develop the accelerators. Responsibility lies with the MAX IV Management and Board.

Industry engagement

In the era of rapid transformation towards a sustainable society, companies are navigating a steep learning curve concerning new materials and manufacturing processes. Synchrotron facilities, such as MAX IV, are emerging as pivotal tools, not only for materials and process research but also as catalysts for creating interdisciplinary and cross-organisational collaborative learning platforms.

The MAX IV strategy regarding industry aims to enable industrial users to reach the UN Sustainable Development Goals through research at the facility. To achieve this, the organisation utilises sector-based initiatives targeting the ten industry sectors of strategic interest in the Nordics: paper and pulp, drug discovery, food and packaging, metals and engineering, health and life sciences, catalysis and chemical processing, mining and recycling, textiles, automotive and aerospace, and batteries and energy materials.

Goal: Engage the ten most important industry sectors in the Nordics with initiatives utilising MAX IV.

Actions: Perform a multitude of outreach activities, including launching or connecting to thematic initiatives, sector-specific workshops and training sessions, company visits and events at MAX IV, and provide educational and inspirational material such as case stories and brochures. Responsibility lies with the Industrial Relations Office.

2. Reduce the carbon footprint

The MAX IV organisation is committed to working as sustainably as possible and to keep close track of our environmental impact. To reduce the carbon footprint, it is vital to measure different areas of daily work. MAX IV is an energy intensive facility, but innovation and engineering make it far more efficient than comparable synchrotron light sources globally. There is, however, always room for improvement.

Energy

MAX IV is committed to ensuring energy efficiency. For details on how to address energy requirements in our instrumentation, please refer to Chapter 1, "*Identify and promote sustainability research*". In the following section, attention is specifically directed towards the building itself.

The laboratory electricity contracts state that all electricity used at the facility must come from sustainable and renewable sources, in accordance with EU's taxonomic definition. MAX IV energy needs are supplemented with rooftop solar cells. Heated cooling water is reused as district heating in the nearby municipality.

Goal: Reduce the MAX IV carbon footprint through improved energy efficiency.

Actions:

- Invest up to 500 000 SEK in energy efficient building infrastructure solutions with the aim to save 1 000 MWh per year. The timeframe is 2024. Responsibility lies with Facility Management.
- Develop energy efficient alternatives to accelerator components, in particular bending magnets. Total EU funding for this initiative is approximately 5 MEUR over three years. More info under Identify and promote sustainable research above. The timeframe is 2025-2027. Responsibility lies with the Accelerator Division.

Transport between MAX IV sites

MAX IV allocates tram tickets and bicycles for loan to employees going on work-related business within Lund. Some restrictions apply as to what is permitted to take on public transport or bicycles regarding samples, chemicals, and biological substances.

MAX IV provides charging stations (22 kWh) for cars driven privately to the facility. There were charging options for six cars in 2023.

Goal: Investigate the number of goods transports annually and identify possible improvements.

Actions:

Streamline transports to MAX IV by

- Participation in CoAction group aimed at reducing freight transports. The timeframe is 2024. Responsibility lies with the MAX IV Environmental Officer.
- Supporting mail-in science initiatives (research samples sent to MAX IV without accompanying researcher). The timeframe is ongoing. Responsibility lies with MAX IV Management.

Waste management

MAX IV Laboratory produces many fractions of waste, from office papers to radioactive waste. Waste is separated into two large handling fractions, hazardous waste and normal waste. Most of the hazardous waste is defined as laboratory chemicals, electrical waste and radioactive waste. These are handled with strict safety measures including regular lab walkthroughs during which safety, chemical hazards, storage and waste handling are discussed.

Normal waste is defined as paper, cardboard, organic waste, plastic, and different fractions of metal.

Goal: Increase the degree of sorting for waste generated on the MAX IV premises.

Actions:

- More and uniform containers for the experiments in the beamline areas for fractions of aluminium foil, corrugated cardboard, plastic, and residual waste. The timeframe is implementation throughout the facility before 2025. Responsibility lies with Facility Management and the MAX IV Environmental Officer.
- Invest in waste compactors and reduce the need for waste transports. The timeframe is 2025. Responsibility lies with Facility Management.

3. Financial sustainability

Financial control

MAX IV Laboratory opened in 2016 and currently operates 16 beamlines with additional beamlines in the planning stages. It is challenging in terms of financial sustainability, with regards to uncertainties in financing necessary investments and a sustainable Operations budget.

Goal: Improved financial control, transparency, and financial understanding organisation wide.

Actions: Continue work with financial governance models. Responsibility lies with the Senior Management team and Finance.

Procurement

Circular economy means the value of products, materials, and resources should be retained (cycled) in the economy for as long as possible.

Economically sustainable public procurement involves the efficient use of tax revenue, and aids to stimulate a well-functioning business community, a range of suppliers, healthy competition as well as economic growth that is not generated at the expense of people or the environment.

Existing framework agreements require circular economy and sustainability criteria. By purchasing products and services from these agreements, the organisation complies with the requirements.

Goal: Contract compliance

Actions: Quantify the number of purchases within certain categories where procured framework agreements are used. Responsibility lies with Procurement and Finance.

The Public Procurement Act in Sweden states that sustainability requirements should be used in all procurements. This implies that MAX IV has the responsibility to impose criteria on procurement processes, requiring contributions to sustainability from the entities being procured. Sustainable procurement can lead to spending decreases for MAX IV as well as society at large if a life cycle cost is implemented.

The MAX IV organisation currently has strategies for circular procurement such as requirements for warranties, spare parts, and service.

The laboratory is obligated to identify more sustainability requirements not yet established. A market analyse by the Procurement group is under way (2023-2024) to investigate potential, relevant sustainability requirements in procurement at MAX IV. Once completed, the organisation will identify and establish new sustainability requirements in future procurement.

Goal: 20 % of completed procurements will utilise an economic circular strategy.

Actions: For each procurement, determine whether economic circular strategy can be fulfilled. Responsibility lies with Procurement.

4. Sustainable workplace

The MAX IV organisation is actively working to achieve a sustainable work environment for our employees. To reach these goals, MAX IV has ongoing and planned activities within the following areas:

Organisational structure

The organisational structure needs to enable sustainable positions, efficient communication, and strong leadership with the goal of achieving the MAX IV Mission and Vision.

Goal: Science Division reorganization. Responsibility lies with the MAX IV Director.

Actions: A separate action plan for:

Culture

To foster a contemporary workplace culture, the Code of Conduct establishes the principles of equality, empowerment, and inclusive behaviour within the organization.

A bi-annual OSA (Organisatorisk och social arbetsmiljö) survey enables the investigation of equal opportunities for all grounds protected by discrimination law. The organisation also performs other investigations and data collection for gender-based analysis with statistics, e.g. sickness absence and salaries. Activities will be planned continually to increase insight of cultural awareness, equal opportunity, and communication.

Goal 1: Provide relevant training for managers

Actions: Training in the role as manager, and communication and leadership. Responsibility lies with the Senior Management team and Human Resources.

Goal 2: Finalise Code of Conduct Policy

Actions: Present a final draft to the Senior Management team and local Safety Committee. Send to all before approval. Implement the policy. Responsibility lies with Human Resources, all managers and co-workers.

Working hours

An implementation and information campaign regarding working hour agreements is ongoing to ensure all employees know which agreement applies to their position and have routines for reporting working hours correctly.

Goal: Implement working hour agreements and manage the balance between resources and demands.

Actions:

- HR information available in meetings and on the intranet.
- Employees report working hours correctly.
- Management establishes a Service Level Agreement (SLA) for users.

Responsibility lies with all managers and co-workers, and Human Resources.

Onboarding and offboarding

Many MAX IV employees are recruited internationally. Every recruitment represents an investment from both parties and the organisation acknowledges that the employee's initial experiences in the first few months significantly impact their productivity and tenure at MAX IV. The onboarding process should support managers in executing an efficient and standardised introduction. An offboarding process provides a valuable opportunity to find out how employees have experienced their time at MAX IV, why they have decided to leave, and if they have suggestions for improvements.

Goal: Develop onboarding and offboarding process for all employees.

Actions: Web-based Introduction program for all employees. Responsibility lies with the Senior Management team and Human Resources.

Leadership and Communication

The goal of MAX IV is to provide managers with the tools, support, and knowledge necessary to fulfil the three managerial roles as employer, leader, and operational manager.

Goal: Provide relevant training for managers.

Actions: Training in the role as manager, and communication and leadership. Responsibility lies with the Senior Management team and Human Resources.