

**Sustainable hydropower,  
biodiversity and collaboration  
for a green future in Sweden.**



# **Annual report 2023**



SWEDISH CENTRE FOR  
SUSTAINABLE HYDROPOWER



# Introduction

In this new phase of SVC - The Swedish Centre for Sustainable Hydropower - the technical focus on turbines, generators and hydraulic engineering is integrated with environmental and societal considerations, promising an exciting and significant expansion of the scope. The activities featured in this report showcase a diverse array of methodologies, from analytical and numerical calculations to laboratory and full-scale experiments. SVC's strength lies in its ability to blend the theoretical and scientific expertise of academia with the practical insights and research priorities of the hydropower industry. This collaboration is not only productive but also enriching and is fostering a dynamic exchange of knowledge and skills, particularly as individuals alter between academic and industrial settings within SVC.

The global shifts impacting hydropower highlights the increasing importance of engaging in research and development with an international outlook, collaborating with global partners and placing a special emphasis on partnerships within Europe. SVC has initiated a formal and intense partnership with HydroCen, Norway's counterpart to SVC, exemplified by specific activities in this report. Additionally, SVC researchers are actively participating in several EU Horizon projects, including the new Store2Hydro, alongside initiatives like H-Hope, Hydroflex and AFC4Hydro, as well as international organizations such as ICOLD, EERA JP Hydropower and ETIP Hydropower. SVC has also established a Scientific Advisory Board, which has issued its initial report. This board will serve as a bridge to leading international expertise and scientific leadership for all SVC partners, throughout the duration of the program period.

Hydropower plays a crucial role in today's energy landscape. Its significance, especially in providing various services is expected to grow in the future. Among these services energy storage is key, helping to balance the irregular production and consumption patterns in the energy market. This storage is historically performed through the potential energy of water stored in large reservoirs. With the expansion of wind and solar power, the demand for increased storage capacity will make pumped-storage hydropower an appealing supplement. While pumped-storage is well-established in continental Europe, Asia, and America, it remains relatively novel in the Nordic countries. There's a gap in knowledge regarding the optimal technology, its impact on dam safety, local ecosystems, social acceptance as well as capital and operational expenditures.

As the energy landscape shifts to integrate an increasing number of intermittent electricity sources, compounded by the pressures of climate change and updates in regulations particularly within the scope of the European framework directive, the urgency for research into flexible, safe and environmentally adapted hydropower solutions becomes paramount. The pooled knowledge and capabilities within SVC stand ready to tackle these evolving issues, venturing into uncharted territories of hydropower technology and its applications.

Staffan Lundström  
Luleå University of Technology  
Centre Director SVC



# Svenskt centrum för hållbar vattenkraft 2023



4

Svensk sammanfattning

SVC - Svenskt centrum för hållbar vattenkraft, bedriver forskning och utveckling av teknik, system och metoder för att stärka vattenkraftens roll i omställningen till ett hållbart energisystem. SVC drivs i samarbete mellan Luleå tekniska universitet (LTU) och Energiforsk. Centret finansieras av Energimyndigheten, Svenska kraftnät, svensk vattenkraft- och gruvindustri samt flera av Sveriges främsta lärosäten. SVC omsätter cirka 280 miljoner kronor under programperioden 2022–2027.

Centret verkar främst genom tre arbetspaket som alla har en egen styrgrupp med representanter från akademien, industrin och berörda myndigheter. Arbetspaketet inkluderar Miljö och Samhälle (WP 1), Vattenbyggnad (WP 2) och Turbiner och generatorer (WP 3). Styrgrupperna spelar en avgörande roll i att forma forskningsinriktning, granska projektförslag och övervaka projektens framsteg. Programrådet, ansvarigt för samordning och att övervaka centrets framsteg och strategi, utvärderar även projektansökningar och ger projekten en slutlig rekommendation för genom-

förande, som rektor på LTU sedan beslutar om.

## SVC strävar efter att främja hållbar vattenkraft och stärka Sverige i omställningen till ett fossilfritt samhälle.

Under 2023 startades det nya centrets verksamhet upp på riktigt och efter årets slut har 42 projekt godkänts och majoriteten har redan startat medan resterande inleder sin verksamhet i början av 2024. Några av höjdpunkterna från årets verksamhet - utöver den snabba uppbyggnaden av centrets projektportfölj - är bland annat det erfarenhetsutbyte och de diskussioner som kommit från Energimyndighetens Ledarskapsforum, vilket gett centrumledningen möjlighet att lära sig och dela med sig av kunskap till andra kompetenscentrum inom energiområdet. Även anslutningen av Sveriges Lantbruksuniversitet (SLU) som en ny akademisk partner i centret har varit mycket positiv, då det ytterligare ökat

SVC:s expertis inom miljöforskning kopplat till vattenkraften. Året såg även en lansering av SVC:s webbplats där det går att läsa om centrets projekt, hitta resultat samt läsa om nyheter från centret.

WP 1 – Miljö och samhälle fokuserar på att adressera miljö- och samhällsutmaningar förknippade med vattenkraftproduktion och utbyggda älvar. Genom fem nya projekt som initierats 2023, strävar arbetspaketet efter att utvärdera vattenkraftens miljöpåverkan och utveckla lösningar för ekologisk rehabilitering.

WP 2 – Vattenbyggnad arbetar främst för att bibehålla infrastrukturernas funktionalitet och säkerhet i en ständigt föränderlig driftsmiljö och klimatförändringar och har nu 17 aktiva projekt.

WP 3 – Turbiner och generatorer ägnar sig åt forskning för att optimera vattenkraftproduktionen och minska miljöpåverkan. Med 16 nya projekt som initierats utforskar WP 3 innovativa lösningar för att förbättra produktions tillförlitlighet och minimera utrustningsslitage av nya körsätt för vattenkraften.

Internationellt samarbete är ett viktigt fokus för SVC under den här etappen och en strategi har arbetats fram under året och kommer att presenteras under 2024. Det övergripande målet med den internationella strategin är att göra Sverige till en världsledande nation inom forskning och innovation inom hållbar vattenkraft. Redan under 2023 har det genomförts ett antal aktiviteter för att stärka centrets interna-

tionella samarbete. Några exempel är den gemensamma workshop med norska HydroCen som hölls i april samt en workshop för kompetensförsörjning på den internationella dammsäkerhetsorganisationen ICOLD:s årsmöte.

Centrets vetenskapliga råd, bestående av seniora forskare och internationella experter, vägleder SVC:s aktiviteter samt arbetar för att identifiera möjligheter till ökat internationellt samarbete. Rådet sammanträdde i början av året i anslutning till centrets årliga konferens "Vattenkraftens FOU-dagar" i Luleå och de internationella experterna deltog även i en paneldebatt under konferensen. Utöver medverkan i Luleå har de även skrivit en rapport där de granskat centrets projektportfölj och kommit med råd kring hur de internationella kontakterna kan ökas.

I SVC:s arbete ingår utöver att driva projekt även att främja jämställdhet och mångfald inom vattenkraftbranschen och en plan för jämställdhetsarbete i centret godkändes av Programrådet i slutet av året. Centrumledningen arbetar även ständigt för att binda samman de olika kompetenserna inom centret och en tvärvetenskaplig workshop genomfördes i början av året för att introducera de olika forskargrupperna för varandra samt för att diskutera potentiella projektidéer.

Genom samordnade insatser i form av styrgrupps- och programrådsmöten, workshoppar, konferenser, webinarier fortsätter SVC att leda forskningen inom hållbar vattenkraft och driva innovation och samarbete framåt inom området.

5

Svensk sammanfattning

# About us

SVC - Swedish Center for Sustainable Hydropower - contributes to increased knowledge about how Swedish hydropower should be developed and maintained, to continue facilitating the transition to a fossil-free energy system while adapting to meet modern environmental standards. The knowledge from the center guides the business sector, authorities and decision-makers in their work for the future of hydropower.



## SVC Vision

Sustainable, safe and optimized hydropower operates as the most important enabler in Sweden's transition to a sustainable energy system, while working to safeguard riverine biodiversity. Interdisciplinary research and innovative solutions, in close cooperation with the industry and public sector, strengthen our position among the international leaders in research in hydropower and river systems.

## Goals

Ensure that the industry has the knowledge and methods to maintain safe hydropower facilities with continued long life spans.

Contribute to a solid scientific base for the implementation of measures for ecological rehabilitation of riverine ecosystems.

Optimize the usage of water in regulated rivers, balancing the needs of different stakeholders, including supply of renewable, fossil-free electricity to the society.

# Table of contents

- Organization & key roles .....8
- Selected highlights 2023.....10
- Work packages .....12
  - WP 1 Environment and society .....12
  - WP 2 Civil and hydraulic engineering .....14
  - WP 3 Hydropower technology.....15
- Promoting Gender Equality and Diversity in the Hydropower Sector.....17
  - Yearly follow up of goals and requirements .....18
- International work and collaborations .....20
  - Highlights from the Joint Workshop between SVC and HydroCen in April .....20
  - Science Advisory Board.....22
  - Capacity building workshop at the 91st ICOLD Annual Meeting in Gothenburg....23
- Outreach and communication .....25
- Hydropower R&D-days in Luleå.....26
- Meet one of our PhDs.....27
- R&D-projects within SVC .....28
- Publications in international journals and conferences 2023 .....34
- Licentiate and doctoral theses published 2023 .....35
- Partners SVC 2022-2027 .....36
- Participants in Program council and steering groups 2023 .....37
- List of abbreviations .....40



# Organization & key roles

**Host university:** Luleå University of Technology

**Three workpackages** with a steering group each:

- Environment and Society - WP 1
- Civil and Hydraulic Engineering - WP 2
- Hydropower Technology - WP 3

Interdisciplinary collaborations are encouraged! The steering groups' role is to discuss research direction and project proposals and recommend them for implementation. The steering groups also follow the progress of the projects and in some cases, review the activities in the projects.

**Industry groups:** Representatives from the stakeholders who are involved in the projects to follow the progress, contribute to the project and ensure their relevance for the stakeholders.

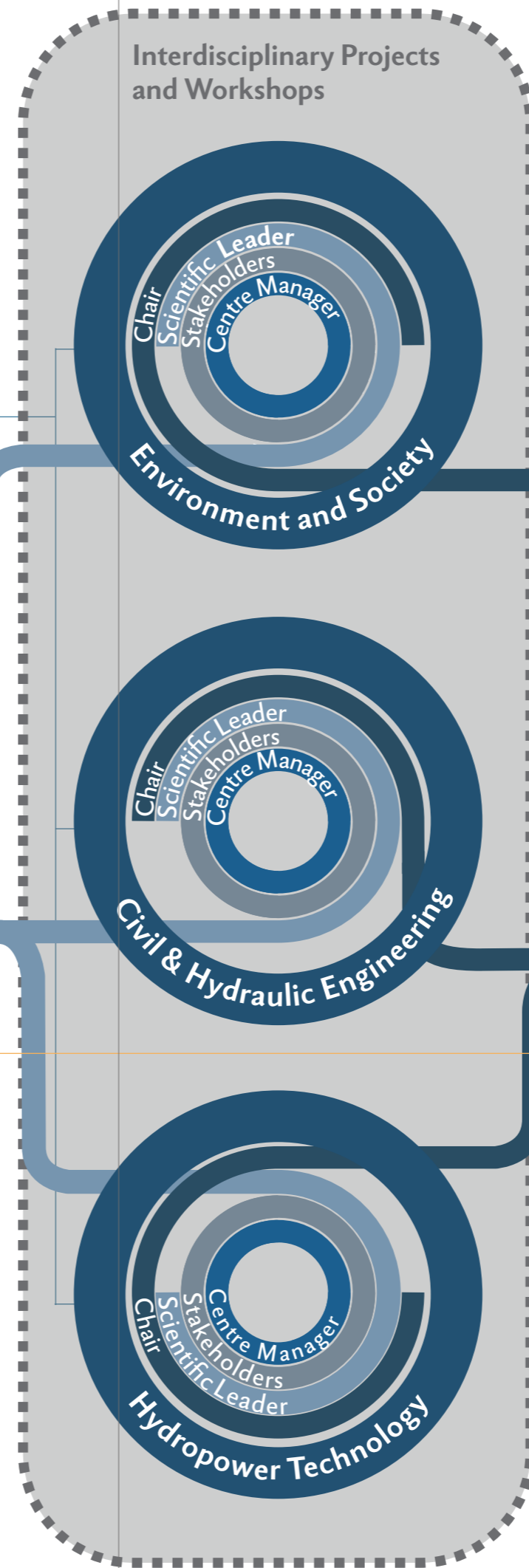
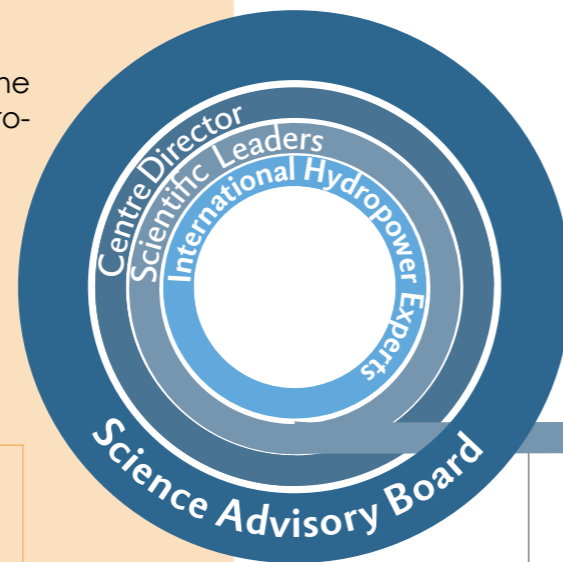
**Program Council:** Deals with issues regarding the progress and strategy for the competence center, processes project applications and submits final recommendations regarding project financing to the Vice-Chancellor (or delegated) of Luleå University of Technology.

**Science Advisory Board:** Led by the Centre director, provides input to the centre activities.

**Centre director:** Responsible for leading the centre according to its vision and ensuring that the interests of the stakeholders are recognized.

**Centre manager:** Responsible for the actual operation of the centre's activities according to the strategy put in place to reach the vision.

**Program council chair:** Acts as support to the director and manager in discussions concerning the running of the centre.



## Centre Management



**Staffan Lundström**  
Centre Director  
Staffan.lundstrom@ltu.se  
0920-492392



**Andreas Larsson**  
Assistant Centre Manager  
Andreas.larsson@energiforsk.se  
08-677 27 60



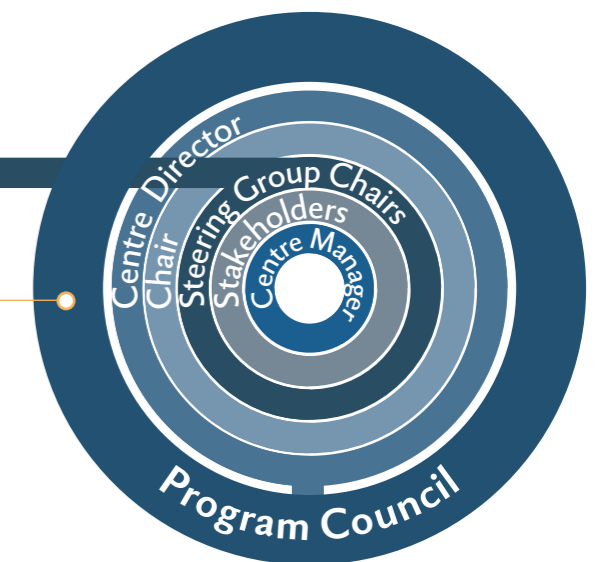
**Emma Hagner**  
Centre Manager  
emma.hagner@energiforsk.se  
08-677 27 53



**Carolina Holmberg**  
Assistant Centre Manager  
Carolina.holmberg@energiforsk.se  
08-677 27 11



**Hans Bjerhag**  
Program Council Chair  
Hans.bjerhag@fortum.com  
08-671 70 00

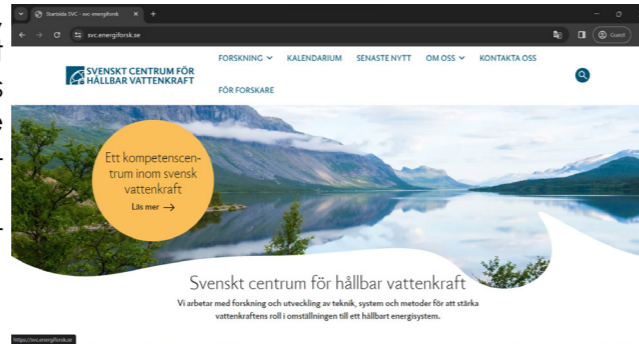


Vice Chancellor  
Luleå University of Technology



# Selected highlights 2023

**1 Filling our project portfolio:** This year, the project portfolio has made significant advancements, with a total of 39 projects receiving approval. Our research centre has nearly spent the entire budget allocation, with only resources left for WP1 where about half of the allocated funding remains.



**2 New academic partner:** In April 2023, SVC welcomed a new academic partner: The Swedish University of Agricultural Sciences (SLU). SLU joined the centre's work package for environment and society (WP1) with Johan Östergren as their representative in the steering group. Anders Alanärä was chosen to represent SLU in the Program council. Welcome SLU!



**5 New webpage:** Surf into [svc.energiforsk.se](http://svc.energiforsk.se) to read about our research projects, check out the calendar for upcoming events or read the latest news from the centre. There is also some basic information about the centre and our work packages.

**6 New work package manager - Environment & society:** The first half of 2023 saw Katja Åström (Energiforsk) as the work package manager for WP1: Environment & society but as she went on maternity leave she was replaced by Andreas Larsson, (Energiforsk). So, if you have any questions regarding WP1: Environment & society – don't hesitate to contact Andreas.



**7 Leadership Forums:** Something that has been truly valuable to the centre management are the Leadership Forums that the Swedish Energy Agency organizes and which gathers all the centre management teams for all the competence centres that were given funding in this round. Learning from other centres as well as sharing lessons learned from running SVC, has been a highlight during the year and has, undoubtedly added to the advancement of the centre and the management team.

**4 Approved communication and gender equality plans:** The program council approved both the communication plan and the gender equality plan for the centre during 2023. Despite being a competence centre constrained in directly addressing equality due to our structure - where all staff are employed by affiliated universities - the commitment to promoting gender equality remains steadfast. The communications plan stands out for its comprehensive detailing of planned activities, serving as a robust framework for our outreach efforts.



**8 Published theses:** Three licentiate theses were published as a result of SVC projects at Luleå University of Technology. They were all in the area of Civil and hydraulic engineering and the students Adrian Ulfberg, Hang Trieu and Mikael Hedberg are now continuing their efforts in active centre projects. Roberto Felicetti from Uppsala University published his doctoral thesis in electromechanics and now continues his work as a Post doc within the centre.

**9 Research school initiated:** Our research school, coordinated by Michel Cervantes, kicked off with its first sessions hosted at Luleå University of Technology. The inaugural course, "Introduction to Tribology" which ran from November 6th to 8th under the guidance of Kim Berglund, offered essential knowledge and was further enriched by Kim's specialized exper-

tise as one of the project leaders within WP3 - Hydropower Technology. Simultaneously, the course "Introduction to Hydraulic Design: Open Channel Flow," conducted from November 8th to 10th and facilitated by Gunnar Hellström, another notable project leader at our centre, attracted eight eager participants. These successful sessions marked a promising beginning for our research school.



# Work packages



## WP 1 Environment and society

There is an urgent need for knowledge and innovative solutions to meet the environmental and societal challenges posed by a demand for more hydropower production, increased environmental awareness and changes to riverine ecosystems caused by ongoing and expected climate change. This work package focuses on the following three key areas:

**The environmental impact expected from future operational patterns of hydropower** set to meet demands for short-term variation in electricity, while balancing output with other renewables and how the environmental impact of hydropower can be mitigat-

ed in cost effective ways. This includes evaluating the effects of hydropower operation on riverine biodiversity during different seasons and the effectiveness of and impact on fish migration and other riverine organisms under new operational schemes.

**New environmental requirements and their effect on hydropower production.** This includes developing environmental flow and fish passage solutions to meet new environmental and operational requirements, as well as methods for structural restoration of river channels and floodplains.

**Effects of climate change on riverine ecosystems** and the interactive environmental effects of climate change and hydropower operation. This includes methods to mitigate as

well as adapt ecosystems to climate change, for example by providing cold-water refuge and facilitating geographic range shifts of species. The consequences of allocating expected increases in average discharge to either hydropower production or environmental flows to provide benefits for ecosystems, as well as averting negative effects of droughts, need to be assessed.

### What happened in 2023?

The work package initiated five new projects during 2023. The projects range from "Using machine learning for improved eel downstream passage design" to "Morphological measures to promote biodiversity in hydropeaking reservoirs". In 2023, WP1 enriched SVC's total portfolio by adding one PhD student, three post-docs and three senior research projects. Currently, as reported, WP 1 comprises nine active projects.

The year started off with most of the funding for WP 1 still unallocated. Thus, the focus of the steering group was to initiate research projects in order to ensure completion of the goals set out for the work package by the end of the program period. Over the course of the year, the challenge shifted from securing an adequate number of research proposals to receiving more than the budget could accommodate. This shift also altered the dynamic of the steering group's approach to reviewing proposals. This has been a challenge, since the steering group is still relatively young. However, through constructive discussions and continuous collaboration, the steering group is rapidly finding its way.

The coming year will be focused on formalizing the steering group and its work process and initiating research projects. The rest of WP 1's budget will also most likely be allocated to new projects by the end of the year.



**Over the course of the year, the challenge shifted from securing an adequate number of research proposals to receiving more than the budget could accommodate.”**



## WP 2 Civil and Hydraulic engineering

The focus of this work package is to provide the needed knowledge and methods to maintain a high functionality of the facility and dam safety, taking into consideration ageing structures, changed operational patterns and climate change. The challenges in this area are also encountered by the mining industry, which is why they are actively involved in this work package. The three key areas are:

**Sustainable and cost-effective methods to maintain, repair and improve safety of existing constructions.** Specifically, this means measures for maintenance, repairs and strengthening of existing concrete and embankment dams, development of innovative construction materials and materials for remedial grouting, how tunnels and other waterways in rock can be strengthened etcetera.

**Improved knowledge and methods to assess current state of hydraulic structures and their safety** which is paramount to identify and prioritize repair and maintenance projects. The area includes: Investigations, surveillance and models for the understanding of static and dynamic loads and their effects on the construction. The impact of new operational patterns on waterways and how hydraulic functions can be optimized to minimize wear and erosion. Enhancing the understanding of the relationship between hydraulic and structural engineering is of utmost importance.

**Development and investigation of hydraulic and civil designs for new environmental measures** to ensure positive environmental effects, minimize nega-

tive effects on operation and always maintaining a high dam safety.



Study visit at Vattenfall R&D October 2023

### What happened in 2023?

The work package Civil & Hydraulic Engineering initiated 17 new projects during 2023. The projects range from studying quality and assurance in CFD for Air-Water flow predictions, to studying the effects on embankment dams due to cyclic loading in a future scenario of hydropower usage. The project portfolio contributes nine PhD:s, three post-docs and three senior researcher projects.

The steering group has had three meetings during 2023 whereof one was held during two days in Älvkarleby and included a study visit at Vattenfall Research and Development Laboratory. Almost all the funding for the work package has been allocated to projects during 2023. The steering group has also been discussing routines for ensuring industrial participation in the projects and how to facilitate implementation of results.

## WP 3 Hydropower Technology

The ongoing transformation of hydropower's role in the energy system, which is requiring a more flexible production, affects the turbines and generators in ways not entirely known today. Focus areas for the work package are:

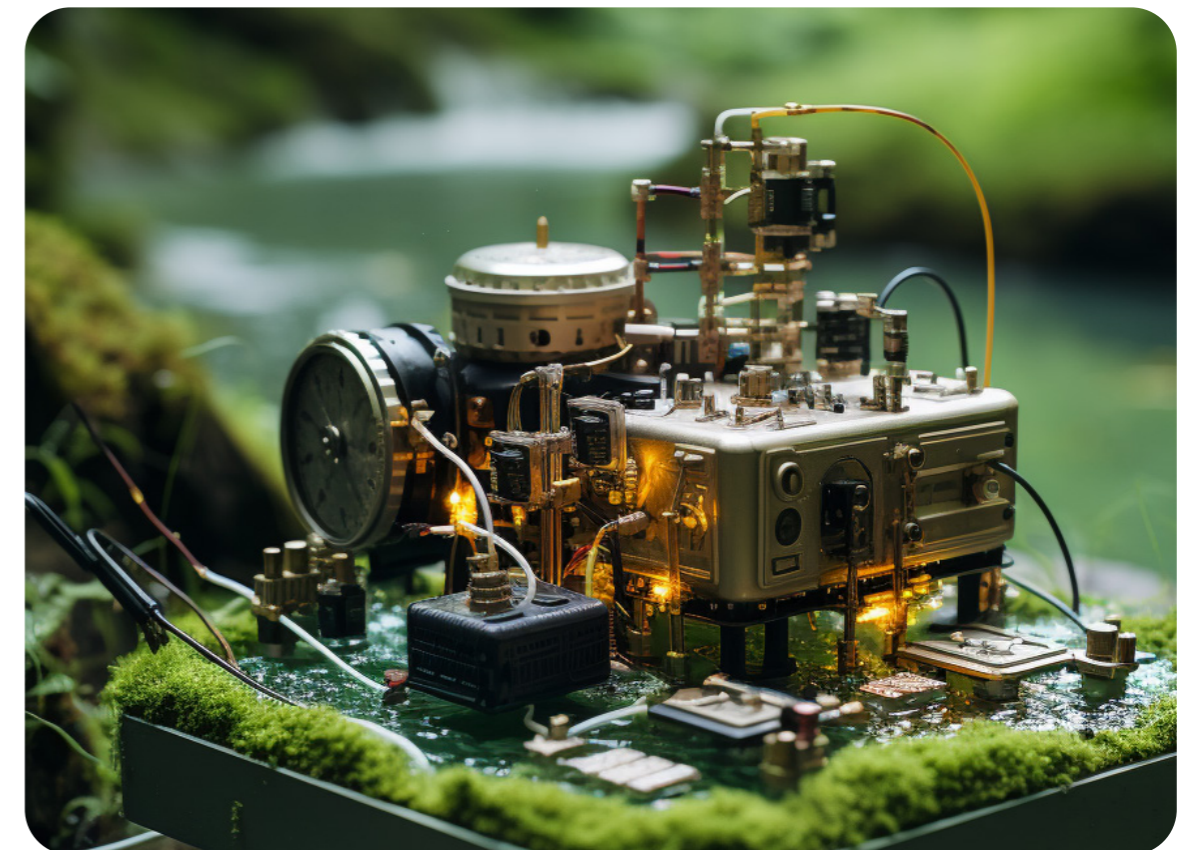
**Sustainable and cost-effective methods to maintain and improve reliability of production units** regardless of tougher working conditions.

**Improved knowledge and methods to assess current state of turbines and generators** to minimize downtime and support decision making concerning prediction of remaining lifetime and need of repairs and upgrades, that is predictive maintenance.

**Develop methods to assess loads, wear and fatigue on equipment and constructions from changing operational patterns** and investigation of innovative ways to mitigate these negative effects while maintaining a safe and effective production, i.e. using battery storages in combination with HPP facilities or other new technologies.

**Environmental aspects of bearings** with environmentally friendly lubricants.

**New and higher demands on working conditions** (primary and secondary frequency response, such as FCR-N) based on new requirements should be investigated from a perspective of mechanical degradation as this could limit development of the network grid performance.





What happened in 2023?

The workpackage for Hydropower technology initiated 16 new projects during 2023. The projects range from studying environmentally acceptable lubricants, rotor dynamics, optimization of joint operation of fast and slow storage reservoirs, to reduce wear and tear for grid benefits. The project portfolio comprises 13 PhD and three post-doc projects. There is also a senior researcher project which includes all the senior researchers in the work package in a synthesis of research to enable lifetime assessment of hydropower units.

Almost all the funding for the work package has been allocated to projects during 2023 and the steering group had its work cut out for reviewing and commenting on applications in the initial stages of the centre during the autumn of 2022 and beginning of 2023. The steering group has also had the opportunity to discuss its new role, now that almost all projects have started and the reviewing process is over.

The steering group will follow the progress in the projects, discuss dissemination of results as well as interesting issues for future research. As an example, a recurring item on the agenda is to hear from different representatives from the industry about the challenges they meet in their day-to-day work and to discuss if and how these could be tackled by future research in the centre.

Three meetings have been held during the year: one in Stockholm, another in Uppsala and one online. At the end of 2023 the steering group put forward a wish that we should try to keep the meetings in person due to the many benefits of being in the same room together during the meeting but also to the informal conversations that can be held outside the meeting.



**The steering group has also had the opportunity to discuss their new role now that almost all projects have started, and the reviewing process is over. The group will follow the progress in the projects, discuss dissemination of results as well as interesting issues for future research. ”**



## Promoting Gender Equality and Diversity in the Hydropower Sector

**A**t SVC, we're committed to foster gender equality within the hydropower sector. Here's how we're actively working towards this goal:

**Promoting Diversity and Equality:** We believe that diversity enhances the quality of our work. By promoting gender equality and diversity, we aim to improve the outcomes of our activities and contribute to greater gender equality within the broader energy industry.

**Active Engagement:** All organizations within our centre must have their own gender equality plans, actively pursued to address issues and foster a more inclusive environment.

**Balanced Representation:** When forming project and reference groups, we strive for a balanced gender distribution to ensure diverse perspectives and experiences. Our program council is required to have a maximum of 60 % of each gender.

**Transparency and Accountability:** We believe in transparency. That's why we include gender distribution statistics for both applicants and appointed doctoral positions in our annual report, keeping ourselves accountable for progress.

**Continuous Evaluation and Improvement:** We will conduct annual surveys to identify any risks of discrimination or obstacles to equality in the centre. Based on these findings, we will implement actions to address concerns and capitalize on positive aspects. As part of our overall evaluation process, we also assess our work on gender equality and diversity, ensuring that we're continuously striving for improvement.

**Highlighting Positive Role Models:** We recognize the importance of positive role models. That's why we actively identify and showcase inspiring individuals, inviting them to share their experiences at our events.

Through these concerted efforts, we're dedicated to creating an inclusive environment where everyone has an equal opportunity to contribute and succeed. The efforts are described more in detail in the centre's gender equality plan.



# Yearly follow up of the gender equality plan

## Requirements in the plan

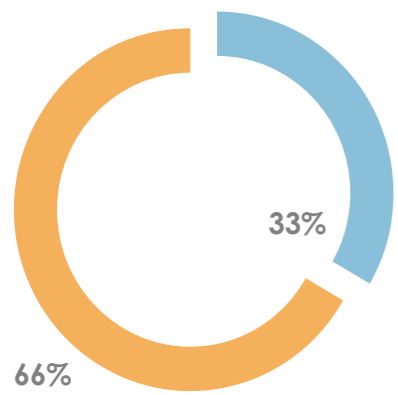
- The program council may consist of a maximum of 60 % of each gender. ✓
- All organizations in charge of projects in SVC must have their own gender equality plan that they actively work with. ✓
- A balanced gender distribution should be aimed for when forming project and reference groups. The project leader has to comment on this in the application. ✓
- Statistics on the gender distribution of both applicants and appointed doctoral positions should be reported in SVC's annual report. ✓

## Goals:

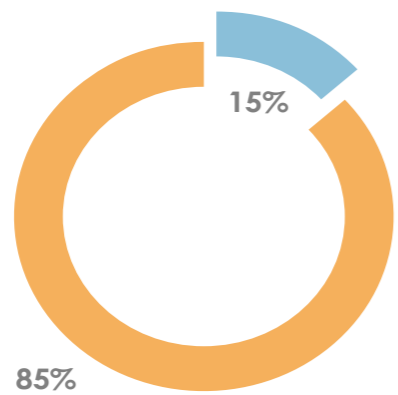
- Steering groups for each work package within SVC should consist of a maximum of 60 % of each gender. *Got a long way to go here as can be seen in the diagrams below. Stakeholders are recommended to suggest two candidates to the steering group when someone is to be replaced as a way of reaching our goals.* ✗
- Gender-balanced representation should be pursued among presenters, panel participants, etcetera at the Hydropower R&D days, workshops and other events organized by SVC. *On our way! Invited speakers from outside the centre on our R&D-days was balanced 50/50 but when including all the centre representatives on stage: 75/25.* ✗

## Steering groups

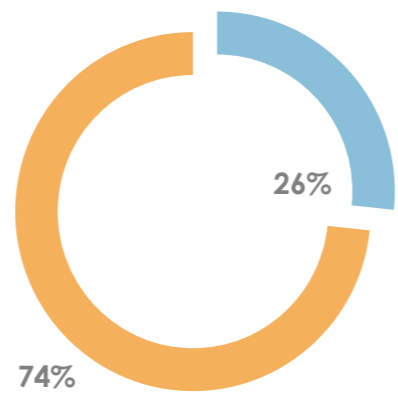
### WP1 Environment and society



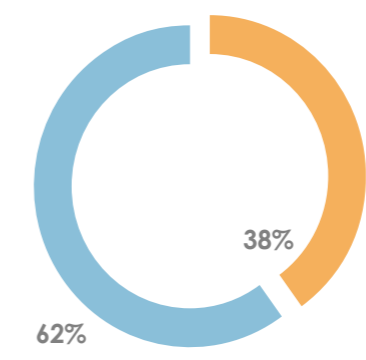
### WP2: Civil and hydraulic engineering



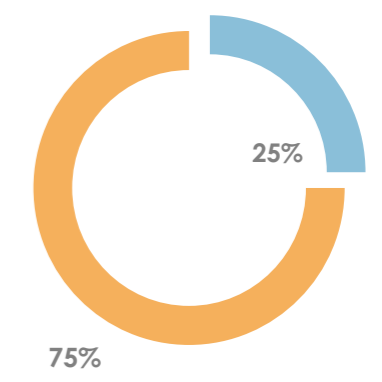
### WP3: Hydropower technology



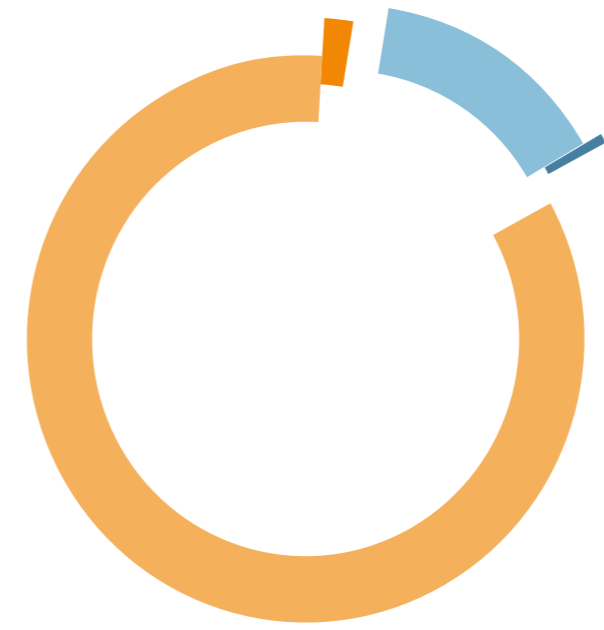
### Program council



### Speakers R&D-days



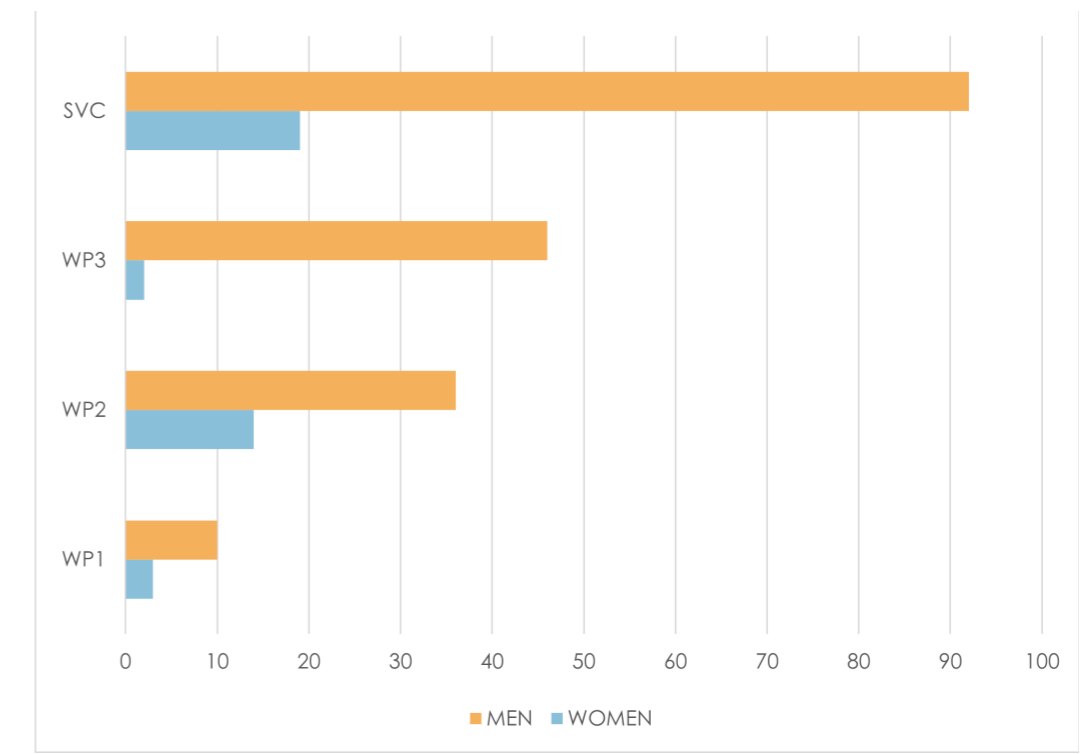
### Recruitment statistics



♀ Applicants: 88  
Hired: 4

♂ Applicants: 531  
Hired: 9

### Participants in research projects





# International work and collaborations

International collaboration plays a crucial role in achieving the goals of our hydropower centre. From the outset, our researchers and industrial partners have been actively engaged in international networks, organizations and projects within their respective fields. As we endeavor to expand our global footprint, it is imperative to foster stronger international contacts and ensure that the impactful work conducted within SVC is recognized worldwide. This chapter highlights our efforts to enhance international cooperation and shows exemplary activities undertaken over the past year.

## Facilitating Collaboration: Highlights from the Joint Workshop between SVC and HydroCen in April

**The now yearly recurring joint workshop between SVC and HydroCen serves a pivotal purpose in fostering international cooperation and enhancing ties with organizations dedicated to hydropower research. By bringing together active scientists from both centres, the aim is to cultivate a robust foundation for future collaboration in hydropower research.**



The workshop in April was designed to achieve several objectives: facilitating introductions among participants, fostering awareness of research activities across borders, showcasing lab facilities and initiating discussions to identify common interests and potential project ideas.

The first day focused on acquainting par-

### HydroCen - Norwegian Research Centre for Hydropower Technology

Their main objective is to enable the Norwegian hydropower sector to meet complex challenges and exploit new opportunities through innovative technological solutions.

Their research areas include:

- Hydropower structures
- Turbines and generators
- Market and services
- Environmental design

The Norwegian University of Science and Technology (NTNU) is the host institution and is the main research partner together with SINTEF Energy Research and the Norwegian Institute for Nature Research (NINA). HydroCen has about 50 national and international partners from industry, R&D institutes and universities. The annual budget is 48 million NOK, total 384 million NOK in the centre period of eight years.

Participants with each other and their respective research centres. Presentations from both HydroCen and SVC outlined organizational structures and ongoing activities. Additionally, a tour of lab facilities at Vattenfall R&D in Älvkarleby provided insight into available resources.

The second day was geared towards identifying common interests through a workshop method called "Open spaces." Participants engaged in group discussions on topics of their choosing,



A Memorandum of Understanding was signed between HydroCen and SVC this summer with the purpose to increase the collaboration between our two hydropower centres.

generating valuable insights and potential areas for collaboration. This interactive approach allowed for in-depth exploration and sharing of ideas, culminating in the identification of promising research avenues.

Looking ahead, the next steps involve further discussions to solidify collaboration ideas. Both HydroCen and SVC are committed to facilitating these discussions and future workshops to enhance cooperation. Identified topics for joint research activities will be followed up by respective country participants, with the aim of aligning initiatives and furthering ongoing collaboration. Regular digital meetings between center administrations also ensure progress tracking and future planning.

The success of the joint workshop in April has sparked enthusiasm for making it an annual event. Suggestions for future workshops include field trips, pre-defined discussion topics, joint summer schools and mobility programs for PhD researchers. These initiatives reflect a commitment to strengthening and deepening collaboration and innovation in hydropower research between SVC and HydroCen. The next workshop will be held in Trondheim 9-10 April.



# SVC's Science Advisory Board



The Science Advisory Board (SAB) of SVC consists of senior researchers from within the centre as well as three international and highly recognized researchers, each representing one of the centre's three work packages. The international experts are expected to provide an international perspective on the centre's activities and help identify possibilities for future collaboration in international networks. The senior researchers participating in SAB are Prof. Fredrik Johansson KTH, Prof. Urban Lundin, UU and Prof. Eva Bergman KaU. The board is led by Prof. Staffan Lundström LTU, Centre director.

**SVC needs to be proactive and strategic in exploring the results of its projects and other activities. Individual papers reporting specific results are important outputs, but additional value will come from grouping results into larger products, synthesizing results across multiple projects and creating interactive events to share and discuss results."**

Prof. Michael McClain, Exohydrology, IHE Institute of Water Education, Delft

## The international members of the SAB



Prof. Michael McClain from IHE Delft in the Netherlands, representing Work Package 1 on Environment and Society.



Prof. Anton Schleiss from the Swiss Federal Institute of Technology in Lausanne, representing Work Package 2 on Civil and Hydraulic Engineering.



Prof. Giovanna Cavazzini from the University of Padova in Italy representing, Work Package 3 on Hydropower Technology.

The first SAB meeting was held on 22nd March 2023 in Luleå, and the international experts also participated in the SVC Hydropower R&D Days in the following days. The international experts produced a report by the end of the year with a brief assessment of the initiated projects, as well as the content of the original proposal to establish SVC. They also drew from their professional expertise and experiences gained during the March events to give suggestions how the different work packages could expand their research and find additional research funding. Recommendations on how to explore the results that are produced in the centre were also given. For further details, the report can be found on SVC's webpage [svc.energiforsk.se](http://svc.energiforsk.se).

# Capacity building workshop at the 91st ICOLD Annual Meeting in Gothenburg

The workshop on the theme Capacity building, spearheaded by SVC Centre manager Emma Hagner, Chair of WP2 and Annika Bjelkevik Tailings Consultants Scandinavia, stemmed from a directive aimed at exploring the intersection between capacity building and SVC. Stakeholders from across the hydropower and tailings sectors got the chance to delve into strategies for enhancing capacity building initiatives within the International Commission on Large Dams (ICOLD) during a long but energetic summer afternoon in Gothenburg.

Establishment of research centres to innovative recruitment methods, these activities highlighted the diverse approaches that can be employed to strengthen capacity building efforts.

One of the highlights of the workshop was the presentation by cultural anthropologist Katarina Graffman, whose insights underscored the importance of understanding human behaviour in shaping effective capacity building strategies. Her address resonated



The objectives of the workshop were clearly defined:

- To share experiences.
- Gain new perspectives.
- Discuss strategies for advancing capacity building efforts.

Throughout the workshop, various capacity building initiatives that have been successful were presented, providing valuable inspiration and insights for future endeavors. From the estab-

The International Commission on Large Dams – ICOLD – serves as a forum for promoting the exchange of knowledge and experience in the planning, design, construction, operation and maintenance of large dams.

ICOLD was founded in 1928 and has approximately 100 member countries and about 6000 individual members. The main activities include:

- Technical committees publishing between 2 and 10 bulletins per year.
- Every three years, a congress is held where four subjects are addressed (between 200 and 300 papers).
- Symposia.
- Lectures.

For more information, please visit the ICOLD website: [icold-cigb.org](http://icold-cigb.org)



strongly with attendees, emphasizing the need for modern and adaptable approaches in the ever-evolving landscape of capacity building.

Output from the workshop included a wealth of suggested activities for ICOLD to consider, encompassing training opportunities, awareness-raising initiatives, organizational enhancements and information dissemination strategies. The workshop concluded with a resounding call to action, as participants expressed eagerness to translate ideas into tangible initiatives.

With the guidance of Emma Hagner and Stina Åstrand, the workshop served as a catalyst for meaningful dialogue and collaboration within the hydropower and tailings sectors. As the momentum from the event continues to build, there is optimism for the future of capacity building initiatives in ICOLD as well as within our center and beyond. Centre manager Emma Hagner was also chosen as the Swedish representative in the ICOLD Committee Z – Capacity Building and has also started a new initiative at Energiforsk to support capacity building and work with students outreach. The Hydropower Future Program, as the initiative is called, gathers the hydropower industry and Svenska kraftnät and provides a shared arena to discuss strategies as well as coordinate and carry out activities to highlight hydropower as a future employer to post millennials.

There is a wide array of career opportunities in hydropower, offering both professional development and personal fulfillment, as it is a rewarding industry where individuals contribute to combating climate change while surrounded by supportive colleagues. We all know this, but we just have to be better at communicating it to the younger generations!

Sweden has been a member in ICOLD since 1931 and conducts its operations through the Swedish National Committee on High Dams, known as SwedCOLD (Swedish Committee on Large Dams). SwedCOLD is tasked with, among other things:

- Promoting research and development within dam engineering.
- Representing Sweden at ICOLD's annual meetings.
- Providing information about ICOLD and relevant dam-related issues.
- Encouraging Swedish participation in articles for ICOLD congresses.
- Additionally, activities such as theme days and lectures are conducted.

## Outreach and communication



The goal of communication and dissemination of results from SVC is to: convey new knowledge to the Swedish hydropower and mining industries, as well as government agencies and to address the challenges posed by a sustainable energy system on hydropower. SVC also contributes to capacity building of hydropower in Sweden.

A communications plan was approved by the Program council in November, but many of the activities described in the plan had already been initiated during the year. Throughout the year, our SVC has diligently adhered to our communications plan, strategically implementing various activities to enhance visibility and engagement.

We've hosted our annual Hydropower R&D days in Luleå, providing a platform for collaboration and knowledge

sharing. We have initiated our biannual Research School courses, widening learning and networking opportunities for our doctoral students as well as industrial partners.

Monthly webinars have served as a cornerstone for disseminating project updates and insights. They have been very popular with around 100 participants each time. There are also groups of PhD students who gather at the universities to look at these together, which gives them a chance to discuss and meet over other issues related to hydropower, than their own projects.

The centre also has a new webpage that is updated with project info, articles and other news. Newsletters are sent out once a month to ensure that our stakeholders are well-informed and LinkedIn is also used to disseminate info.



# Hydropower R&D-days

What is “Sustainable Hydropower” and what role does hydropower play in the energy transition towards a fossil free society? This was the theme for The Hydropower R&D-days, hosted by SVC in March 2023. The conference marked the new start for SVC.

We enjoyed presentations from the centre's senior researchers giving introductions to their research areas with reviews of research that has been carried out historically and insights on future challenges. There was also a poster session where the PhD and post-doc students presented their projects. Luleå University of Technology hosted the event and arranged a study visit to the Laboratory facilities, which attracted media. The centre activities were also put in an international context when the Science Advisory Board was welcomed into the organization and participated in a panel discussion on the topic “Sustainable Hydropower – what is it?”

The conclusion from the conference was that Sustainable Hydropower is a big topic with challenges and many different perspectives that must be taken into consideration. The width of disciplines within SVC however gives us a great opportunity to meet those challenges towards the vision of the centre.



Kim Berglund LTU

Foto: Marie Kolod Hansen

# Meet one of our PhDs

Danilo Laban is an industrial doctoral student investigating how hydropower can be linked with energy storage systems such as batteries, flywheels and capacitors. Danilo Laban sees hydropower as a silent hero in the energy transition.

“

**My project is about combining hydropower with energy storage. We need greater insights in how to manage the upcoming fully sustainable energy system. We have a good understanding of our power system and how to produce sustainable energy, but there is less understanding of how to maintain and control this renewable system. My goal with the project is to propose common regulatory strategies and develop guidelines for the dimensioning of energy storages.”**

Danilo Laban

## Industrial Doctorate Student

Danilo works half-time at Fortum and half-time as a researcher at Uppsala University. What is it like being an industrial doctoral student?  
“It's very interesting and suits me well

because I gain experience from the industry and can combine it with the more theoretical aspects of my research. Sometimes you see doctoral projects that are a bit too far from reality; they are often too advanced or theoretical for the industry to benefit from directly. It's important for me that what I come up with is useful and implemented in our hydropower plants. I feel like I have a good sense of the challenges hydropower faces, and now I'm working to see how research can help solve these challenges. As an industrial doctoral student, I also have easy access to data from various production facilities, which is very important for advancing research and applying it in practice.”

## What are you passionate about in hydropower?

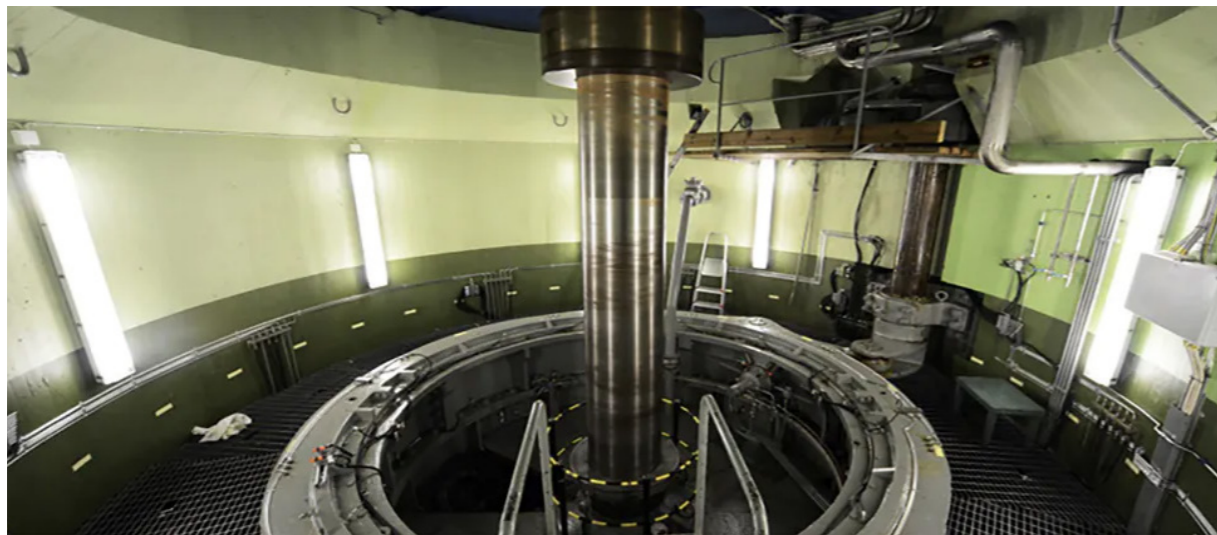
“Frequency regulation! I see hydropower as a 'silent hero', especially when we talk about frequency regulation and system balancing. More than 90 percent of frequency support services come from hydropower. Frequency support service is a technically interesting problem to solve. We are getting more and more electricity from wind and solar power that needs to be added to the system, and it's hydropower that contributes and makes it possible

for us to have so much sustainable production. Many people think that the technical issues surrounding hydropower have already been solved because we've had it for so long, but that's not the case. We have major changes in our energy system, and that raises new questions to address."

### Continuing Work

Danilo Laban has now received funding from SVC for the period 2023-2025 and continues to work on his project.

"Right now, I'm focused on working on guidelines for how to build up these



### How can we make young people realize how important and interesting it is to work with hydropower?

"We need to be able to show how important hydropower is within the energy system. We need to provide tips about interesting projects. There is a lot to develop and a lot going on in the industry. We need to demonstrate how we work and what great opportunities there are to explore and develop. A major challenge is that each hydropower plant has its own characteristics and specific challenges. There is a lot to deal with, for example, how technical solutions can be applied and adapted to different plants."

energy storage systems in terms of control schemes and dimensioning," concludes Danilo Laban.

**Published articles in the project:**  
[Storage System Design for Improved Primary Frequency Control From Hydropower Units, Danilo Laban, IEEE](#)

## R&D-projects in SVC

### WP 1 - Environment and society

| Project name  | Project leader         | Academic partners | Industry partners  | Project period    | Status  |
|---|------------------------|-------------------|--------------------|-------------------|---------|
| Floods for riparian biodiversity  | Roland Jansson         | UmU               |                    | 2022.09 - 2025.06 | Ongoing |
| Digital twins of regulated river stretches coupling hydraulic modelling with individual based models  | Anders Andersson       | LTU, KaU          | Vattenfall         | 2022.07 - 2026.12 | Ongoing |
| Ecohydraulic flows in shallow waterways with large bed roughness  | Anders Andersson       | LTU               | Vattenfall         | 2023.01 - 2027.06 | Ongoing |
| Ecological status of aquatic and riparian habitat in relation to hydropeaking in winter   | Lutz Eckstein          | KaU, UmU          |                    | 2023.01 - 2027.06 | Ongoing |
| Using machine learning for improved eel downstream passage design   | Olle Calles            | KaU               | Vattenfall         | 2024.01 - 2026.12 | Granted |
| Verification of individual-based models for population-level analysis and development of demogenetics models in hydropower-regulated rivers | John Piccolo           | KaU               | Vattenfall, Fortum | 2023.10 - 2025.12 | Ongoing |
| Experimental methods to predict riparian vegetation responses to environmental flows in regulated rivers                                    | Roland Jansson         | UmU               |                    | 2024.01 - 2027.06 | Granted |
| Morphological measures to promote biodiversity in hydropeaking reservoirs   | Birgitta Malm Renöfält | UmU               | Vattenfall         | 2024.01 - 2026.12 | Granted |
| Hydraulic analysis of technical solutions for improved connectivity at hydropower dams  | Anders Andersson       | LTU               |                    | 2024.01 - 2024.12 | Granted |



## WP 2 - Civil- and Hydraulic Engineering

| Project name   | Project leader    | Academic partners | Industry partners  | Project period    | Status  |
|--|-------------------|-------------------|--------------------|-------------------|---------|
| Spillway Discharge Safety – Quality and Assurance in CFD for Air-Water Flow Predictions  | James Yang        | KTH               | Vattenfall         | 2023.01 - 2027.06 | Ongoing |
| Analysis of stilling basin damages for cost-effective refurbishment  | James Yang        | KTH               | Vattenfall         | 2023.07 - 2027.06 | Ongoing |
| Assessment of rock scour in spillway channels through experiments and numerical simulations  | Gunnar Hellström  | LTU, KTH          | Vattenfall, Fortum | 2023.01 - 2024.12 | Ongoing |
| Degradation of grout injection in hydropower dams – coupled hydrogeological-geochemical modeling to predict dam condition and remaining lifetime | Liangchao Zou     | KTH, LTU          | Vattenfall         | 2023.04 - 2027.06 | Ongoing |
| Dynamic load and response interaction for hydropower civil structures.   | Erik Nordström    | KTH               | Vattenfall         | 2023.01 - 2027.06 | Ongoing |
| Realistic failure modelling of concrete dams   | Erik Nordström    | KTH               | Vattenfall         | 2023.03 - 2025.08 | Ongoing |
| Practical design under large uncertainties according to Eurocode 7   | Fredrik Johansson | KTH               | Uniper             | 2023.03 - 2025.09 | Ongoing |
| Description of pore pressure and alarm thresholds for probabilistic assessment of sliding stability for concrete dams                            | Fredrik Johansson | KTH, LTU          |                    | 2023.10 - 2027.06 | Ongoing |
| Safe dams – A holistic approach for improved safety of concrete dams   | Gabriel Sas       | LTU, KTH          |                    | 2023.01 - 2024.12 | Ongoing |

30

R&amp;D projects

| Project namn   | Project leader   | Academic partners | Industry partners  | Project period    | Status    |
|--|------------------|-------------------|--------------------|-------------------|-----------|
| Adaptation of monitoring with DCIP tomography for management of embankment dams  | Torleif Dahlin   | LTH/LU            |                    | 2023.01 - 2023.12 | Ongoing   |
| Integrating electrical resistivity results interpretation with numerical flow modelling for detection of internal defects in embankment dams | Torleif Dahlin   | LTH/LU            |                    | 2023.01 - 2023.12 | Ongoing   |
| Innovative design and experimental numerical studies of Piano Key Spillway for significantly enhanced discharge and hydraulic performance    | James Yang       | KTH               | Vattenfall         | 2023.04 - 2023.12 | Completed |
| Cyclic loading - future use and storage  | Jan Laue         | LTU               | Vattenfall         | 2023.06 - 2026.06 | Ongoing   |
| Towards migration of fines inside embankment dam cores   | Jan Laue         | LTU               | Vattenfall         | 2023.7-2027.06    | Ongoing   |
| Photogrammetry for flow measurements at hydropower plants with no operational  | Gunnar Hellström | LTU               | Vattenfall         | 2023.01 - 2024.12 | Ongoing   |
| Trust in CFD for hydraulic design of open water ways and spillways   | Gunnar Hellström | LTU               | Vattenfall         | 2023.01-2024.12   | Ongoing   |
| Forecasting of ice-loads on concrete dams  | Erik Nordström   | KTH               | Vattenfall, Uniper | 2023.07-2027.06   | Ongoing   |

31

R&amp;D projects

## WP 3 - Hydropower Technology

| Project name  | Project leader    | Academic partners | Industry partners            | Project period    | Status    |
|---|-------------------|-------------------|------------------------------|-------------------|-----------|
| Electrical dump-loads increasing spill capacity   | Urban Lundin      | UU                |                              | 2023.01 - 2027.06 | Ongoing   |
| Wanted and unwanted Forces in generators, modelling and control   | Urban Lundin      | UU                |                              | 2023.01 - 2025.12 | Ongoing   |
| Optimization of joint operation of fast and slow storage reservoirs reducing Hydropower wear and tear for Grid benefits | Urban Lundin      | UU                | Vattenfall, Fortum           | 2023.01 - 2025.12 | Ongoing   |
| Environmentally acceptable lubricants for hydropower applications   | Kim Berglund      | LTU               | Vattenfall                   | 2023.01 - 2027.06 | Ongoing   |
| Condition monitoring for the identification of behavioral changes – continuation stage                                  | Kim Berglund      | LTU               | Vattenfall, Skellefteå kraft | 2023.01 - 2023.12 | Completed |
| Three-dimensional FE modelling of vertical rotors   | Jan-Olov Aidanpää | LTU               | Vattenfall                   | 2023.01 - 2027.06 | Ongoing   |
| Synthesis of research to enable lifetime assessment of hydropower units   | Jan-Olov Aidanpää | LTU, UU, CTH      | Vattenfall                   | 2023.01 - 2024.12 | Ongoing   |
| Development of components for increased damping in hydropower units   | Jan-Olov Aidanpää | LTU               | Vattenfall                   | 2023.01 - 2024.06 | Ongoing   |
| Models for mechanical analysis generators with floating rotor rim   | Jan-Olov Aidanpää | LTU               | Vattenfall                   | 2023.01 - 2024.06 | Ongoing   |
| Artificial intelligence for enhanced hydraulic turbine lifetime   | Håkan Nilsson     | CTH               | Vattenfall                   | 2023.01 - 2027.06 | Ongoing   |

32

R&amp;D projects

| Project namn  | Project leader   | Academic partners | Industry partners            | Project period    | Status  |
|---|------------------|-------------------|------------------------------|-------------------|---------|
| Hydropower operation and lifetime analysis                                    | Håkan Nilsson    | CTH               | Vattenfall, Skellefteå kraft | 2023.01 - 2027.06 | Ongoing |
| Determination of added parameters in hydraulic turbines                       | Michel Cervantes | LTU               | Vattenfall, Skellefteå kraft | 2023.01 - 2025.12 | Ongoing |
| Instabilities at deep-part-load/speed-no-load in a Kaplan turbine             | Michel Cervantes | LTU               | Vattenfall, Skellefteå kraft | 2023.01 - 2025.01 | Ongoing |
| PIV measurements on a model turbine during detrimental operational conditions | Michel Cervantes | LTU               | Vattenfall, Skellefteå kraft | 2023.01 - 2024.06 | Ongoing |
| Development of the pressure-time method for low-head machines                 | Michel Cervantes | LTU               | Vattenfall, Skellefteå kraft | 2023.01 - 2024.06 | Ongoing |

33

R&amp;D projects



# Publications in international journals and conferences 2023

## Journals (Publication, Author, Date, Journal, DOI, Project)

|  |
|--|
| Modelling erosion of a single rock block using a coupled CFD-DEM approach, Penghua Teng, Fredrik Johansson, J. Gunnar I. Hellström, Journal of Rock Mechanics and Geotechnical Engineering, <a href="https://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-99600">https://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-99600</a> , 45527, Assessment of rock scour in spillway channels through experiments and numerical simulations |
| Geometric Modification of Piano Key Weirs to Enhance Hydraulic Performance and Discharge Capacity, , Water, <a href="https://doi.org/10.3390/w15234148">https://doi.org/10.3390/w15234148</a> , 45619, Innovative design and experimental□numerical studies of Piano Key Spillway for significantly enhanced discharge and hydraulic performance   |
| Simulation of Rapid Voltage Edge Related Voltage Surges in Highly Inductive Windings with Frequency Dependent Parameters, Roberto Felicetti, JPIER, <a href="https://www.jpier.org/PIERB/pier.php?paper=22122705">https://www.jpier.org/PIERB/pier.php?paper=22122705</a> , 45374, Wanted and unwanted Forces in generators  |
| A Synchronous Machine Transient Model Based upon an Algebraic Loop Accounting for Nonlinearity and Cross-Magnetization, Roberto Felicetti, Hindawi, <a href="https://doi.org/10.1155/2023/4547086">https://doi.org/10.1155/2023/4547086</a> , 45345, Wanted and unwanted Forces in generators  |
| Storage System Design for Improved Primary Frequency Control From Hydropower Units, Danilo Laban, IEEE, <a href="https://ieeexplore.ieee.org/document/10107425">https://ieeexplore.ieee.org/document/10107425</a> , 45405, Optimization of joint operation   |

## Conferences (Publication, Author, Date, Conference, DOI, Project)

|  |
|--|
| Analysis of dam structures by scale model tests: A review, Adrian Ulfberg, 91st Annual ICOLD Meeting – Gothenburg 13-14 June 2023, <a href="https://icold-cigb2023.se/documentation/icold-2023-proceedings/">https://icold-cigb2023.se/documentation/icold-2023-proceedings/</a> , 45466, Safe dams – A holistic approach for improved safety of concrete dams   |
| Modelling of erosion in rock spillway channels, Penghua Teng, J. Gunnar I. Hellström, Fredrik Johansson & Carl-Oskar Nilsson, CDA Conference 2023, Winnipeg, , 45588, Assessment of rock scour in spillway channels through experiments and numerical simulations  |
| Experimental and computational evaluation of fish passageway with porous media boundary, Mikael Hedberg, J. Gunnar I. Hellström & Nils Solheim Smith, IAHR World Congress 2023 in Vienna, <a href="https://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-98511">https://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-98511</a> , 45527, Trust in CFD for hydraulic design of open water ways and spillways    |
| Modified guide walls for incremental increase of spillway capacity, Nils Solheim Smith, Mikael Hedberg, Hanne N. Lunde, Elena Pummer & Leif Lia, IAHR World Congress 2023 in Vienna, <a href="https://doi.org/10.3850/978-90-833476-1-5_iahr40wc-p0375-cd">https://doi.org/10.3850/978-90-833476-1-5_iahr40wc-p0375-cd</a> , 45527, Trust in CFD for hydraulic design of open water ways and spillways |

Geoelectrical monitoring of embankment dams for detection of internal erosion - work in progress in Sweden, Reyhaneh Norooz, Torleif Dahlin, Per-Ivar Olsson, Aristeidis Nivorlis, Léa Lévy, Thomas Günther and Christian Bernstone, 91st Annual ICOLD Meeting – Gothenburg 13-14 June 2023, , 45466, Integrating electrical resistivity results interpretation with numerical flow modelling for detection of internal defects in embankment dams

Increasing spill capacity with an electrical dumpload, Adam Strömme-Mattson, 91st Annual ICOLD Meeting – Gothenburg 13-14 June 2023, , 45466, Electrical dump-loads increasing spill capacity

# Licentiate and doctoral theses published 2023

A concrete dam assessment approach using probabilistic non-linear finite element analysis and scale model testing, Adrian Ulfberg, Luleå tekniska universitet, <https://www.diva-portal.org/smash/get/diva2:1751257/FULLTEXT01.pdf>, 45405, Safe dams – A holistic approach for improved safety of concrete dams

Performance of image-based velocimetry in river flow – Large Scale PIV and PTV, Hang Trieu, LTU, <https://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-94130>, 45345, Photogrammetry for flow measurements at hydropower plants with no operational restrictions or limitations

Experimental and computational evaluations of parallel spillway outlets, Mikael Hedberg, LTU, <https://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-98513>, 45588, Trust in CFD for hydraulic design of open water ways and spillways

Run-up transient analysis for salient pole wound field synchronous motors - Implications for power electronics and field winding, Roberto Felicetti, Uppsala University, <https://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-510995>, 45588, Wanted and unwanted Forces in generators

# Partners SVC 2022–2027

## Governmental bodies

Swedish Energy Agency  
Svenska kraftnät

## Universities

Chalmers University of Technology  
Karlstad University  
KTH Royal Institute of Technology  
Luleå University of Technology  
Lund Institute of Technology/Lund University  
Swedish University of Agricultural Sciences  
Umeå University  
Uppsala University

## Hydropower industry

Fortum Sverige AB  
Holmen Energi AB  
Jämtkraft AB  
Jönköping Energi AB  
Karlstads Energi AB  
Mälarenergi AB  
Skellefteå Kraft AB  
Statkraft Sverige AB  
Sydkraft Hydropower AB  
Tekniska verken i Linköping AB  
Vattenfall Vattenkraft AB (inkl. VIAB)

## Other industry

### WP 1 Environment and Society

AFRY AB  
Norconsult AB  
Sweco Sverige AB

### WP 2 Civil- and Hydraulic Engineering

AFRY AB  
Boliden Mineral AB  
LKAB  
Norconsult AB  
Sweco Sverige AB  
WSP Sverige AB  
Zinkgruvan Mining AB

### WP 3 Hydropower Technology

Aker Solutions AB (originally Rainpower)  
Andritz Hydro Sverige Filial  
Norconsult AB  
Sweco Sverige AB  
Voith Hydro AB

# Participants in Program council and steering groups 2023

## Program council

Anders Alanärä, Swedish University of Agricultural Sciences  
Anders Hellman, Chalmers University of Technology  
Anna-Karin Sundqvist, Vattenfall Vattenkraft  
Anna-Lena Ljung, Luleå University of Technology  
Birgitta Malm Renöfält, Umeå University  
Cecilia Boström, Uppsala University  
Emma Wikner, Statkraft Sverige  
Gerhard Barmen, Lund Institute of Technology  
Göran Ericsson, Svenska kraftnät  
Hans Bjerhag, Fortum (Chair of Program Council)  
Larry Greenberg, Karlstad University  
Maria Bartsch, Svenska kraftnät  
Maria Johansson, Sydkraft Hydropower  
Marie Westberg Wilde, KTH Royal Institute of Technology  
**Co-opted members**  
Andreas Larsson, Energiforsk  
Carolina Holmberg, Energiforsk  
Emma Hagner, Energiforsk  
Emma Nordin, Vattenfall vattenkraft (Chair of WP 3)  
Fredrik Brändström, Energy Agency  
Frida Villemoes, Energy Agency  
Johan Tielman, Uniper (Chair of WP 1)  
Magnus Lövgren, Vattenfall vattenkraft

Staffan Lundström, Luleå University of Technology

Stina Åstrand, Fortum Sverige (Chair of WP 2)

## Steering groups

### WP 1 Environment and Society

Anders Andersson, Luleå University of Technology  
Angela Odelberg, Statkraft Sverige  
Axel Emanuelsson, Norconsult  
Erik Sparrevik, Vattenfall vattenkraft  
Eva Bergman, Karlstad University

Jakob Bergengren, Tekniska verken i Linköping

Joakim Thanke Wiberg, Vattenkraftens miljöfond

Johan Östergren, Swedish University of Agricultural Sciences

Johan Tielman, Sydkraft Hydropower (Chair of WP 1)

Marco Blixt, Fortum Sverige

Maria Sundesten, Sweco Sverige

Mats Andersson, AFRY

Roland Jansson, Umeå University

Sandra Åström, Skellefteå Kraft

Susann Handler, Jämtkraft

### Co-opted members

Andreas Larsson, Energiforsk

Anna Hedström Ringvall, Vattenregleringsföretagen



# Participants in Program council and steering groups 2023, cont.

Bertil Wahlund, Energiforsk

Birgitta Malm-Renöfält, Umeå University

David Aldvén, Karlstad University/Vattenfall R&D

Elin Spegel, Water Authorities

Emma Hagner, Energiforsk

Gunnar Hellström, Luleå University of Technology

Jesper Stage, Luleå University of Technology

Johan Kling, Swedish Agency for Marine and Water Management

Larry Greenberg, Karlstad University

Mats Billstein, Vattenfall R&D

Patrik Andreasson, Swedish University of Agricultural Sciences /Vattenfall R&D

## WP 2 Civil and Hydraulic Engineering:

Ann-Mari Darj, Statkraft Sverige

Carl-Oscar Nilsson, Sydkraft Hydropower

Erik Ronne, Boliden

Faez Sahayi, LKAB

Fredrik Johansson, KTH Royal Institute of Technology

Jan Laue, Luleå University of Technology

Jonas Persson, Norconsult

Mårten Janz, AFRY

Peter Viklander, Vattenfall vattenkraft

Petter Stenström, Sweco Sverige

Rikard Hellgren, Svenska kraftnät

Rikard Holmberg, WSP Sverige

Staffan Fahlgren, Zinkgruvan Mining

Stina Åstrand, Fortum Sverige (Chair of WP 2)

Torleif Dahlin, Lund Institute of Technology

## Co-opted members

Andreas Sjölander, KTH Royal Institute of Technology

Carolina Holmberg, Energiforsk

Emma Hagner, Energiforsk

Erik Nordström, KTH Royal Institute of Technology

Gunnar Hellström, Luleå University of Technology

James Yang, KTH Royal Institute of Technology

Magnus Svensson, Fortum Sverige

Mats Billstein, Vattenfall R&D

## WP 3 Hydropower Technology:

Anders Bard, Sweco Sverige

Anders Bertilsson, Statkraft Sverige

Bo Hernnäs, Voith Hydro

Daniel Brakke, Andritz Hydro

Emma Nordin, Vattenfall vattenkraft (Chair of WP 3)

Håkan Nilsson, Chalmers University of Technology

Jan-Olov Aidanpää, Luleå University of Technology

Jenny Jungstedt, Skellefteå Kraft

Johan Olofsson, Norconsult

Lars Svensson, Sydkraft Hydropower

Linn Saarinen, Svenska kraftnät

Mats Wahlén, AFRY

Peter Altzar, Fortum Sverige

Rebecka Nilsson, Aker Solutions

Urban Lundin, Uppsala University

## Co-opted members

Carl-Maikel Högström, Vattenfall R&D

Emma Hagner, Energiforsk

Kim Berglund, Luleå University of Technology

Mats Billstein, Vattenfall R&D

Michel Cervantes, Luleå University of Technology

Rolf Gustavsson, Luleå University of Technology/Vattenfall R&D

## List of abbreviations

CTH – Chalmers University of Technology

KaU – Karlstad University

KTH – KTH Royal Institute of Technology

LTH – Lund Institute of Technology

LTU – Luleå University of Technology

SVC – The Swedish Centre for Sustainable Hydropower

UmU – Umeå University

UU – Uppsala University

WP – Work package



SWEDISH CENTRE FOR  
SUSTAINABLE HYDROPOWER

SVC - Swedish Centre for Sustainable Hydropower, conducts research and development of technology, systems and methods to strengthen the role of hydropower in the transition to a sustainable energy system. SVC is operated by Energiforsk in collaboration with Luleå University of Technology. The centre is funded by the Swedish Energy Agency, Svenska kraftnät, the Swedish hydropower industry, and several of Sweden's leading academic institutions. SVC has a budget of approximately 280 million Swedish kronas during the program period 2022–2027.

LULEÅ  
TEKNISKA  
UNIVERSITET

 Energiforsk