BESLUT

Datum för beslut:
2025-04-03

Diarienummer:
KTH-RPROJ-0276016

Beslut om ett strategiskt forskningsinitiativ, KTH Uno Lamm Electrification Center

Detta beslut har undertecknats elektroniskt.

Beslutet

KTH:s vicerektor för forskning beslutar att:

- Finansiera *KTH Uno Lamm Electrification Center* med 1 mnkr centrala medel under 2025.
- Utse Hans-Peter Nee, EECS-skolan, som ansvarig forskningsledare för satsningen.
- Återrapportering enligt utvärderingskriterier, för dialog om fortsatt bidrag ska vara Forskningsberedningen tillhanda 13 april 2026.

Ärendet

KTH:s initiativ för forskningssatsningar inrättades enligt förslag från Översyn av KTH:s särskilda forskningssatsningar (Dnr: KTH-RPROJ-0276016). Förslaget innebär att centrala medel ska kunna användas till direkt finansiering av tre- till femåriga forskningsinitiativ med det huvudsakliga målet att dra in externa forskningsanslag.

Under föregående år har Forskningsberedningen arbetat vidare med att konkretisera förslaget, och kommit fram till ett antal kriterier för ett KTH Strategiskt initiativ samt kriterier för utvärdering (Protokoll 10/2024):

Kriterier för KTH Strategiskt forskningsinitiativ:

- Strategiska forskningsinitiativ är ett sätt för KTH att kraftsamla inom områden där det krävs nya samarbeten som är viktiga utifrån KTH:s vision och mål. Det kan dels vara att förstärka ett område som redan finns eller utveckla ett nytt.
- Strategiska forskningsinitiativ ska kunna initieras av både forskare, KTH:s ledning och forskningsberedningen.
- Strategiska forskningsinitiativ är satsningar med central finansiering på 0,5 - 3 mnkr per år i max fem år.
- Målsättningen för en beviljad satsning är att generera betydande externa bidrag till KTH om totalt minst 100 mnkr. Det kan vara externa bidrag från flera olika finansiärer som

tillsammans stärker området för forskningsinitiativet. Utväxlingen blir den viktigaste indikatorn som följs upp årligen.

Kriterier för utvärdering av beviljat KTH Strategiskt forskningsinitiativ ska ske efter ett år enligt nedan:

- Projektansökan – En eller flera projektansökningar.
- Kraftsamling - Vilka PI´s är med i projektansökan/ansökningar?
- Förberedelsearbete inför utlysningar.
- Exempel på nya forskningssamarbeten.

Dessutom kommer behov av central finansiering, budgetutrymme och strategisk relevans att vägas in vid Forskningsberedningens bedömning.

Till Forskningsberedningens möte den 26 mars inkom förslaget KTH Uno Lamm Electrification Center, med professor Hans-Peter Nee, EECS-skolan, som ansvarig forskningsledare, se bilaga 1.

Baserat på Forskningsberedningens diskussion rekommenderas Vicerektor för forskning att stödja att förslaget beviljas sökt budget, 1 mnkr för år 2025. En utvärdering ska ligga till grund för diskussion om fortsatt finansiering och i vilken omfattning. (KTH-RPROJ-0276016 Protokoll 10/2024).

Detta beslut har fattats av vicerektor för forskning Annika Borgenstam efter föredragning av forskningsrådgivare Johan Schuber.

Kungl. Tekniska högskolan

Annika Borgenstam, vicerektor för forskning KTH

Johan Schuber, forskningsrådgivare, avdelningen för forskningsstöd inom Verksamhetsstödet

Bilaga 1: projektförslag

Sändlista

För åtgärd:

Hans-Peter Nee, EECS-skolan

Kopia till:

Skolchef EECS-skolan

Controllergruppen, controller@kth.se

Chefen för avdelningen för forskningsstöd Maria Gustafson

Tf Kommunikationschef Gunilla Iverfelt

Anna Aminoff

Sanna Pehrson, avdelningen för forskningsstöd

Expeditionsdatum:

2025-04-03

KTH Strategic Research Initiative

An initiative addressing the unprecedented need for research and education in the field of electrification including high-voltage direct current and all associated technologies enabling massive non-fossil electricity generation and global energy interconnection

Uno Lamm Electrification Center

PI: Hans-Peter Nee, Prof. EECS
Funding requested: 1,0 MSEK annually for 3 years

Co-PIs:
Xiongfei Wang, Prof. EECS
Hans Edin, Prof. EECS
Lina Bertling Tjernberg, Prof. EECS
Lars Nordström, Prof. EECS
Ilka Jahn, Assist. Prof. EECS
Mikael Hedenqvist, Prof. CBH
Richard Olsson, Prof. CBH
Mikael Unge, Adj. Prof. CBH

Purpose

The key mechanism of the global energy transformation is the replacement of fossil fuels with non-fossil electricity generation, where renewables are indispensable. Renewable electricity is, however, not necessarily available at locations where the needs are, or at the point in time when necessary. The two most straightforward ways to address these two problems are long-distance electric transmission and energy storage, where batteries are a key technology in the latter. The most energy and cost-effective technology for transmission of electricity over long distances is high-voltage direct current (HVDC) transmission, especially if the transmission is across seas as in the case of offshore wind farms. At this time HVDC transmission is in an unprecedented growth phase (see Fig. 1), and Swedish industry like Hitachi Energy and NKT are world leaders in this technology. Recently, Hitachi Energy received the largest order in the history of Swedish industry (147 BSEK) and NKT has orders of approx. 127 BSEK. Moreover, it is likely that this high intensity will last for decades, and that the enormous need for well-educated persons and ground-breaking research will persist for a long period of time. The Swedish transmission system owner Svenska Kraftnät is also in a phase of large investments along with distribution system owners like Vattenfall and Ellevio.

Even if HVDC transmission is the key technology for massive electrification, the surrounding eco system of technologies is essential. This ranges from fundamental sciences regarding magnetic, thermal, and electric characteristics of materials to applied sciences within digitalization, systems control, and artificial intelligence. The areas of application include technologies such as: power transformers, polymer applications of machine-learning, physics-informed artificial intelligence for condition monitoring, metal-oxide varistors, flexible alternating current transmission systems, and switchgear etc. Generally, capabilities for higher electric fields, current densities, and temperatures are sought for in both materials and components without sacrificing high requirements on reliability. This can only be addressed by a multi-disciplinary effort on the material level, component level, and system level. Circularity will play an important role, and the keywords regarding material use would be: rethink, reduce, re-use, repair, and recycle.

In view of the rapid growth in HVDC transmission, the timing is perfect for a large center formation by which KTH can coordinate its many strategic collaborations within industry including Hitachi Energy and NKT, and actors like for instance Svenska Kraftnät, Vattenfall, Ellevio, ABB, Alstom, Scania, and possibly many others, may contribute with essential competence, technology, and financial strength. The center would be active in both research and education. Research-wise the already strong research in electric transmission and polymeric insulation at KTH should be strengthened with a focus on education of PhDs that can be employed by Swedish industry. Education-wise the already strong education at KTH should be strengthened by the development of new courses in HVDC technology and related subjects, attracting excellent students from all over the world. This can be combined with internships in industry and cleverly formulated scholarship programs.

Why at KTH?

In short, KTH is already committed to the field as is clear from the input to the Swedish research proposition, stating "*KTH proposes a targeted effort for the establishment of a new research center within high-voltage direct current transmission encompassing the whole value chain for HVDC*".

Historically, the story begins with an alumnus from KTH by name Uno Lamm. After graduation from KTH in 1927 he started working with ASEA in Ludvika, and in 1929 he was

appointed project manager for the development of the mercury-arc rectifier, the key element of the first generation HVDC transmission. In 1943 he obtained his PhD degree from KTH and in 1950 ASEA got the contract for the HVDC Gotland project, which was the first HVDC transmission when it was completed in 1955. During the late 1980ies and 1990ies Prof. Åke Ekström, who was also employed at ABB in Ludvika, established a strong research and education activity at KTH. Since then, KTH has had a strong, if not world-leading, presence in HVDC research. A KTH spin-off in HVDC circuit breakers (SciBreak) made the list of Sweden's hottest 33 start-ups in 2020 and was recently acquired by Mitsubishi Electric. Additionally, KTH is leading pre-standardization activities with HVDC industry (in Sweden and world-wide), e.g. in CIGRE B4.85 on partially open-source software for interoperable HVDC systems, and taking part in the Advisory board of the HVDC-Learn project funded by the US department of Energy. Today, the relation between KTH and Hitachi Energy in research and education is manifested through the strategic partnership with Hitachi Energy, which essentially is the same entity as the one that Uno Lamm boarded when he was employed by ASEA in 1927. A similar relation exists with NKT, and in light of the proposed activities, also NKT may eventually become a strategic partner. KTH has been a stronghold for HVDC transmission for decades, and it is a natural development to form an "Uno Lamm Electrification Center" here.

The research proposition of the Swedish government states that a targeted effort on "battery technology and electrification" has been initiated and will be continued. Up to now the COMPEL initiative on *battery technology for transportation* with Uppsala University, Chalmers University of technology, and Lund University has been launched. At KTH the Battery 3PC initiative for *stationary battery energy storage* has been started, which forms a perfect complementarity to the Uno Lamm center. From a national perspective. Similarly, there is good grounds for collaboration and complementarity with the many activities within Digital Futures, in the areas of control and digitalization. From a national perspective there is a gap for "electrification", where the Uno Lamm Electrification Center can play a key role.

The main competition of the proposed center is international, by the SuperGrid Institute in Villeurbanne, France and The Energy Transmission Research Centre (ETCH) at KU Leuven, Belgium. Important activities are also ongoing in China. The natural way of dealing with this competition is to co-operate, both in everyday research and in applications for additional funding. *Nevertheless, a KTH center will have a unique strength in that it encompasses the entire value chain from materials science to system design.*

Research Team

The research team is multi-disciplinary with foci on Power Electronics, Power Systems, High-voltage Engineering, and Polymeric Insulation.

School of Electrical Engineering and Computer Science
Hans-Peter Nee: Main-circuit design of HVDC power converters
Xiongfei Wang: Passivity-based HVDC power converter control and grid forming
Hans Edin: High-voltage engineering for AC and DC power systems
Lina Bertling Tjernberg: Predictive maintenance and flexible sustainable power grids
Lars Nordström: Power System Control and related information exchange
Ilka Jahn: Interoperability in control and protection of HVDC grids

School of Engineering Sciences in Chemistry, Biotechnology, and Health
Mikael Hedenqvist: Synthetic and biobased polymeric materials

Richard Olsson: Nanocomposites materials
Mikael Unge: Impact of polymer morphology and nanoparticles on insulation

Strategy for Funding

Swedish funding

The first phase is initiated through the establishment of a core team with key persons from KTH, Hitachi Energy, and NKT. This team should investigate the possibilities to quickly establish an initial small center activity financed by Hitachi Energy and NKT. Through communication via existing networks the core team should then define a vision, a mission, and objectives suitable for a consortium with a broader electrification focus including many stakeholders from both industry and academia, including for instance STandUP for Energy, Svenska Kraftnät, Vattenfall, ABB, and Ellevio. Since the topic of the center borders those of both WISE and WASP, there will be an effort to integrate activities within those clusters as a means to explore funding opportunities. The next step is to make a promotion tour to governmental channels of funding such as the Energy Agency, Vinnova, The Swedish Foundation for Strategic Research, The Wallenberg Foundations, and The Swedish Research Council. At this stage the core team should also engage in public relations and marketing, including branding activities, online presence, and media outreach. Finally, a Conference with key players and potential future partners is organized with the purpose of finding a consensus for a large center formation. This phase is planned to take one to two years, and after that the center should gain an external funding of 5-10 MSEK annually. In order to be successful, a dedicated person at the KTH Research Support Office will be working part-time together with the core team.

European funding

In a second phase, an established center could form a hub for generating additional international funding, especially EU funding. Similarly, establishment of partnerships with key industrial actors at the global, as opposed to Swedish, level is a key enabler for increased funding. The center could be the coordinator for large European projects on electrification. Several additional Swedish industrial partners will join in this phase. Additionally, funding may be generated through direct co-operation with entities like SuperGrid institute in France, or ETCH in Belgium. This phase takes one year, and this year concludes the period with financial support from KTH and with dedicated support from KTH Research Office. After this phase, the center should gain external funding of 10-15 MSEK annually.

Funding beyond Europe

The third phase includes to approach Japanese channels of funding in co-operation with Hitachi Energy, Hitachi Japan, and Mitsubishi Electric. Finally, in a fourth phase funding through the US Department of Energy could be enabled through co-operation with the research centers of Hitachi Energy and ABB in the US. These two phases will take two additional years, but at this stage the center will not need additional support from KTH. At this time, the center should gain external funding of 15-20 MSEK annually.

First-year funding

The applied funding from KTH during the first year will be used according to: salary Hans-Peter Nee (25%) 715 kSEK, cost for the planned conference 150 kSEK, cost for branding activities 70 kSEK, and costs for establishing an online presence 65 kSEK.

KTH internt beslut med e-signatur:kth-proj-0276016_ KTH Uno Lamm Electrification Center

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