Theme 3: Novel or emerging technologies for sustainable and continuous energy supply

1. **'Enabling continuously operating nuclear fusion power plants', DKK 59,999,564 over 6 years**

   Main applicant: Stefan Kragh Nielsen, Department of Physics, Technical University of Denmark

   Co-applicants:
   Henrik Bindslev, Faculty of Engineering, University of Southern Denmark

   Stefano Coda, Swiss Plasma Center, École Polytechnique Fédérale de Lausanne

   Mark Henderson, Tokamak Science Department, United Kingdom Atomic Energy Authority

   Brief description:
   Nuclear fusion has significant potential to address the energy and climate challenges society faces. Fusion processes have powered the stars for billions of years, and yet, it was only in 2022 that controlled experiments successfully demonstrated an energy surplus in a laboratory setting. Fusion reactors are still limited to pulsed experiments of short duration, and for fusion-based power plants to be implemented in society, the fusion processes need to be sustained continuously in the reactor. Kragh and coworkers aim at developing methodologies for driving currents in fusion power plants using electromagnetic waves; a fundamental requirement for continuous operation of tokamak fusion reactors. The team will investigate potential loss of electromagnetic waves in reactor relevant conditions and develop unique models and experiments to validate the detailed understanding. Finally, they will develop a predictive tool to enable the design of continuously operating nuclear fusion power plants. Collectively, this will allow the team to identify regimes where continuous operations of fusion power plants can be secured – a critical step toward making fusion reactors viable for societal use.

2. ‘SMARTER - Salt Melts for Advanced Reactor Technology and Energy Research’, DKK 59,996,910 over 6 years

Main applicant: Anja-Verena Mudring, Department of Biological & Chemical Engineering, Aarhus University

Co-applicants:
Gerd Meyer, Department of Biological and Chemical Engineering, Aarhus University

Thomas Albrecht-Schoenzart, Department of Chemistry, Colorado School of Mines joint with Los Alamos National Laboratory and Idaho National Laboratory

Robin D. Rogers, Department of Chemistry, University of Wyoming

Brief description:
Molten salts hold great promise for various sustainable technologies, such as thermal energy storage and molten salt reactors (MSR), with significant potential to contribute to sustainable and continuous energy supply. MSRs are a type of advanced nuclear fission reactor that offers enhanced efficiency and safety features as compared to conventional reactor technologies, while minimizing the waste burden. In an MSR, the nuclear fuel is dissolved in a high temperature liquid salt capable of retaining radioactive products developed from nuclear fission processes. While being a key component of the improved safety profile, molten salts also bring new chemistry questions to the field of nuclear energy, and this is exactly what SMARTER is targeting. Collecting expertise from world-class laboratories, SMARTER will address fundamental questions on molten salt compositions for various applications, mitigation of corrosion reactions occurring between the salts and the container material, and not least the chemistry of nuclear reaction products. By closing these knowledge gaps, SMARTER aims to aid fast and responsible deployment of green energy technologies.