

# Four ideas from the Swedish Agricultural University (SLU)

## **Project Idea 1: Solar-Thermal Evaporation of Human Urine for Nutrient Recovery**

Are you interested in renewable energy and sustainable sanitation? We have recently developed a prototype solar-thermal system that uses passive solar and wind energy to evaporate human urine. The system could help produce carbon-neutral, biobased fertilisers from safely recycled urine. We are looking for a student to evaluate this system, focusing on diurnal and seasonal changes in urine evaporation rate, and to test ways that enhance heat retention and evaporation efficiency (e.g., preheating air and using phase change materials). This hands-on project will be conducted at SLU's campus in Uppsala and involve work on solar energy technologies, sanitation system design, and experimental testing.

## **Project Idea 2: Eutectic Freeze Crystallisation of Human Urine for Nutrient Recovery**

Are you interested in sustainable sanitation and cold-climate technologies? We are developing a prototype system that uses Sweden's naturally cold winters to concentrate human urine through eutectic freeze crystallisation. This project focuses on leveraging low temperatures to separate water, salts, and nutrients in human urine. We are seeking a student to investigate the process parameters, such as temperature and seeding agents, that influence crystallisation efficiency. This hands-on project involves testing various system designs and assessing the energy efficiency of freeze crystallisation. You'll gain experience with passive treatment systems, sanitation technology, and experimental testing at the Kretsloppsteknik lab in Uppsala.

## **Project Idea 3: Life Cycle Analysis of New Sanitation Systems**

This project focuses on assessing the environmental impacts of source-separating sanitation systems by analysing them at different scales: from individual toilets to multi-storey buildings, neighbourhoods, and entire cities. Using a life cycle analysis (LCA) approach, you'll explore how the concentration factor (CF) of urine—defined as the weight of urine before it is concentrated to remove water divided by the weight after it is concentrated—affects the overall efficiency and sustainability of these systems. By examining various combinations of system scale and urine concentration factor, you'll help determine the optimal level of on-site urine concentration before transportation for use as fertilizer or further processing into solid products. The project will involve assessing trade-offs between transportation energy and the energy required for concentrating urine at different scales. Your goal will be to develop a framework that can guide the design of carbon-neutral or even carbon-negative fertilizers from safely recycled urine.

## **Project Idea 4: Freeze concentration of human urine – lab scale testing**

This project focuses on the possibility to use the Swedish winter for concentrating human urine into a substrate to be used in fertiliser production. Current systems developed at SLU use heat to evaporate water from stabilised urine. This is an energy consuming process as the transformation of liquid water to gas thermodynamically needs 600Mh per liter. When freezing a liquid we can have the same separation as the water becomes solid separated from the salts, while using considerably less amount of energy. In this laboratory based study we will look into the setup for a freeze concentration reactor and evaluate the

parameters related to freeze concentration of human urine as part of the process train for urine based fertiliser production.

**Contact:** Prithvi Simha, [prithvi.simha@slu.se](mailto:prithvi.simha@slu.se)