

# FM4017 Project

**Title:** Solar Panel Data Collection and Heat Balance

**USN supervisors:** Kjell-Arne Solli (PEM), Hans-Petter Halvorsen (EIK)

**External partner (part time):** Proventia, Suncells Scandinavia AS / Jan Bjarne Lid, (Kragere Energi or Skagerak Energi)

## **Task background:**

Electric power from solar panels has a high potential for contribution to the global demand for power and low CO<sub>2</sub> emissions. The power generated from photovoltaic (PV) cells is influenced by temperature, irradiation intensity and sunlight spectral composition. Positioning of solar panels on a lake or ocean can potentially increase power efficiency and reduce conflicts related to use of land area.

A bachelor project was accomplished spring 2019 targeted on modelling the power from one solar panel, as well as the heat balance, based on spectral irradiation and temperature measurements. A test rig and instrumentation was built for this purpose, and some measurements performed outdoor and indoor (artificial light, spectral analysis of irradiation, temperatures, panel power). The solar panel as well as instruments were purchased by Proventia, and the project financed by Proventia with partners and Suncells Scandinavia. Suncells Scandinavia is aimed at commercializing the production of a raft with solar panels for delocalized production of electric power utilizing water areas. It is planned for building two grid-connected pilot rafts each of 36 panels (on an 11×11 m raft) in a pre-project autumn 2019. The instrumentation might also serve as a site for PV reference solar measurements. Per August 2019, the capital needed for the investments are not yet ready.

## **Task description:**

1. Continue work on solar panel heat balance description and simulation based on outdoor measurements using the test rig. Location for outdoor measurements will be provided at USN campus Porsgrunn by Statsbygg. Optionally add instrumentation for total solar irradiation and wind, eventually shading observations.
2. Automatize data collection. For spectral data, a dark spectrum base line correction is needed, and a mechanism for this should be constructed. Have data saved to a cloud-based service.
3. Develop simulation model for PV power generation including heat balance (build upon bachelor work and literature).
4. Contribute to instrumentation design of solar panel rafts as PV reference solar measurements. This would include remote operation of spectral measurements, for which an automated aperture control (point 2 above) is needed.
5. Perform data measurements and collection from solar panel rafts (if available).
6. Eventually include DC-AC inverter variables and properties into simulation model for power generation.

**Project objective:** Develop heat balance simulation of solar panels into a tool for power estimation from solar panel arrays based on local climate, as well as land versus sea placement. Develop automatized data collection for reference solar measurements, panel temperature measurements, and PV array power generation. Potentially demonstrate the data collection.

**Student categories (a mix is preferred):**

PT (Process Technology)

EET (Energy and Environmental Technology)

IIA (Industrial IT and Automation)

**Practical arrangements:**

*To be decided*, test rig placement at USN campus. Placement of the solar panel rafts are tentatively planned near Kragerø harbour, but discussions with Skagerak Energi is ongoing. For potentially some work in Kragerø, an available +car for transport would be beneficial.

**Signatures:**

Supervisor (date and signature):

Students (date and signature):