Problem Statement #1:
Harvest power from stray capacitance

The goal of this investigation is to determine how much power can be harvested from displacement currents around a medium voltage overhead conductor. The team will need to design the harvesting section and the power supply. Simulation and prototyping to validate theoretical results will be required.

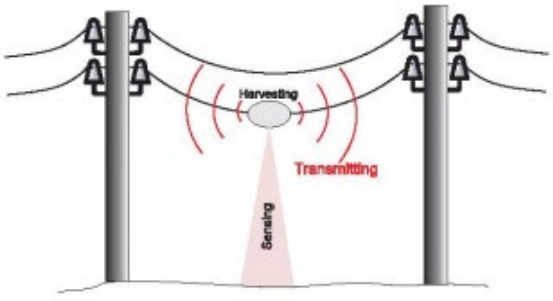

Figure 1 Power Harvesting concept using displacement currents [1]

The project scope includes:

- Design and simulate a power harvesting circuit, demonstrating the maximum power that can be harvested under these constraints/conditions:
  - Single overhead conductor located 35 ft from the ground
  - Line to ground voltage limited to 7.2 kVrms at 60 Hz
  - Evaluate the effects of contamination and their impact on the power harvested
  - Focus on the 60 Hz steady state condition; ignore protection against high voltage transients like BIL, surge currents, or switching transients
  - Focus on the electronic design; do not consider packaging or installation constraints

- After a successful simulation, build and test a prototype circuit that can be tested at a lower voltage and current levels that are commensurate with the actual application. S&C will provide guidance on the test setup.

The project will include a twice-monthly cadence to be established by the student team and S&C Electric.

The deliverables include:

1. Model and simulation results
2. Schematics
3. Test Report
4. Final Report

A Final Review will be held at the end of the project. It will be presented by the student Team to the S&C Team and the academic advisor.

Prior Art:

[1] H. Zangl, T. Bretterklieber and G. Brasseur, "Energy Harvesting for Online Condition Monitoring of High Voltage Overhead Power Lines," *2008 IEEE Instrumentation and Measurement Technology Conference*, Victoria, BC, Canada, 2008, pp. 1364-1369, doi: 10.1109/IMTC.2008.4547255.

[2] J. C. Rodríguez, D. G. Holmes, B. Mcgrath, and R. H. Wilkinson, “A self-triggered pulsedmode flyback converter for electric-field energy harvesting,” IEEE J. Emerg. Sel. Topics Power Electron., vol. 6, no. 1, pp. 377–386, 2018. doi: 10.1109/JESTPE.2017.2738157. 111.

[3] R. Moghe, A. R. Iyer, F. C. Lambert, and D. Divan, “A low-cost electric field energy harvester for an MV/HV asset-monitoring smart sensor,” IEEE Trans. Ind. Appl., vol. 51, no. 2, pp. 1828– 1836, 2015. doi: 10.1109/TIA.2014.2354741.

[4] S. Kang, S. Yang, and H. Kim, “Non-intrusive voltage measurement of ac power lines for smart grid system based on electric field energy harvesting,” Electron. Lett., vol. 53, no. 3, pp. 181–183, 2017. doi: 10.1049/el.2016 .3935.