

American-Made Solar Prize  
TECHNICAL ASSISTANCE REQUEST  
**Enhancing Cyber Security of Grid Connected Renewables  
via Digital Watermarking Technology**

Our team would highly benefit from assistance of NREL Laboratories involving several aspects of our implementation strategy as follows

- 1) Collaboration on analyzing different types of commercial PV inverters connected to the electrical grid. The tests would include the following:
  - a. Characterizing the noise sources such as Electromechanical Interference (EMI), switching frequency, low order harmonics, white noise, and others, that typically occur during normal operation. This could help us distinguish the attack noise among the normal noise sources.
  - b. Perform a yearly based inverter power output profile, this could be used to validate the mathematical model of the grid-connected inverter used to perform the attacks.
  - c. Perform a yearly based solar insolation levels, this could be used to analyze the impacts that the ambient variations may inflict on our approach.
- 2) Engage NREL engineers and researchers on the options to alter the commercial PV inverters to adapt with our Cyber Security Water marking Detector (CSWD) device.
- 3) Consult NREAL engineers and researchers about different kinds of cyber attack models that could be performed on a commercial inverter.

4) Utilize NREL facilities/laboratories to perform experiments on grid tied commercial inverters. The tests that would be performed include:

- a. Cyber attack implementations on the inverters, to analyze the negative impacts these different attacks could potentially create.
- b. Alter commercial PV inverters at NREL labs to adapt with our Cyber Security Water marking Detector (CSWD) device, to test the validity of our approach.

