

## **Technical Assistance Request:**

Capacitech Energy, Inc. (Capacitech) is requesting technical assistance in two areas:

1. Launching pilot programs and demonstrations to quantify the value of Capacitech's flexible, wire-shape supercapacitor, called the Cable-Based Capacitor (CBC), in a residential solar power system.
2. Designing, prototyping, and testing a supercapacitor management system that will protect the CBC's inputs so it can be readily used to complement a wide variety of battery systems (varying in number of batteries used, power ratings, etc...).

## **Pilot Programs & Demonstrations:**

Capacitech is seeking partnerships with solar researchers and residential solar installers to further quantify how much more peak power an average home needs. This will guide Capacitech regarding the specifications required by any CBC product. A demonstration would evaluate and compare solar homes with no energy storage systems, batteries, CBCs (supercapacitors), and CBC complemented batteries. |

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Demonstrations would involve:

- Selecting components such as a load, inverter, and battery choices, as well as any alternates.
- Measuring nominal and peak loads in standard solar power systems to determine required specifications of a commercial product.
- Comparing performance, efficiency, and capability of solar power systems that feature supercapacitors with those that do not.
- Demonstrating the value of added power density of supercapacitors by turning on loads that require more peak power than the panels or batteries can provide.

## **Supercapacitor Management System:**

To protect and ensure the proper operation of CBCs in a solar power system, especially if other energy storage devices are being used in the same system, a power electronic management system must be developed.

Batteries and supercapacitors are both energy storage technologies, but serve opposite function as they store energy in opposite mechanisms. Batteries have a high energy density, meaning they are designed to deliver energy over long periods of time. They are not designed to deliver that energy quickly, to provide a burst of power. Supercapacitors have a high power density, meaning they are designed to deliver energy very quickly, a burst of power. They are

not designed to deliver energy over long periods of time. An ideal solar power energy storage system should feature both high power density and high energy density storage technologies.

Capacitech's CBC is designed to complement batteries. The CBC will be used when a burst of power is required, which is when appliances (refrigerator, air conditioning/heater, washing/drying machines, microwaves, etc.) are first turned on. This is because the amount of power (wattage) to start an appliance typically exceeds the capability of a battery. A battery has a "long life" charge and is able to continually output energy, however, these sharp, immediate surges or deep discharges can cause unnecessary strain on the battery causing damage. This is because batteries have low power density. The use of the CBC allows for a battery to bypass the need to supply the power to these appliances for start-up. The CBC has a much greater power density than batteries and is able to charge and discharge rapidly.

To properly pair opposite energy storage technologies together like batteries and supercapacitors, a management system is required. While there are several approaches that can be used including the use of circuit breakers and DC/DC converters, a custom solution is required. If one home has one battery and another home has four connected in parallel, but they both need the same peak power assistance, the same CBC product should be able to be installed. This is only possible with a management system. If an individual chooses to add more batteries in parallel, the CBC may be subject to excessive current from the battery bank that can damage the CBCs. Our goal is to make a management system that can cover a broad range of battery configurations used in the industry so that the CBC can be readily used to complement those batteries. Initially, the management system should be designed to charge the CBC at 12V and <200A to offer over 1.5kW of peak power assistance to batteries.

**Summary:**

The goals with which Capacitech is requesting technical assistance are as follows:

1. Proving the added value of the Cable-Based Capacitor (CBC) in a solar power system.
2. Developing a supercapacitor management system to pair batteries and supercapacitors.