

## Sustainable Energy Inc. (SEI) Introduction

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### Technical Abstract

Sustainable Energy Inc. (SEI) CTO and Board Chair William Todorof is developing a non-lithium, ceramic semiconductor battery with saline-based gel-paste electrolyte. In 7 years of active development, he has hand-made and tested over 3,500 anodes and 6,000 cathodes, starting at 0.55 Volts open circuit (**0.55 Voc**). Two years ago he discovered a new semiconductor material for the cathode, with high capacity and durability; a significant percentage now test at **2.36 Voc**. His new anode model indicates **2.4+ Voc**. He plans to end 2019 with a complete cell technology that is patented, well-validated, and in low-volume prototype or alpha production.

He reduced electrical resistance from 10-20 Ohms to around 1 Ohm. Designs range from 20 to 75 Amperes, for under-100-gram cells. The average cost of the widely available materials for our latest formula is \$1.53 a pound; earlier formulas range from \$0.50 to \$1.00 a pound. They are nontoxic and fireproof (no explosions); he uses no lithium, cobalt, or rare earth materials.

His near-term target is 850 Watt-hours per kilogram (**850 Wh/kg**), over 50 charge and discharge cycles in 24 hours. His cell stretch target is 2.4 Voc x 50 amps/70 grams, or 1.7+ kilowatt-hours per kilogram (**1.7+ kWh/kg**). At the battery level we expect nominal **1.3+ kWh/kg** capacity (*or 4 to 10+ times the capacity of lithium batteries today*), with volume nearly **1.5 kWh/Liter**. We will commercialize between the near-term target (it works for aircraft!) and the stretch target. We'll use a mature, high volume, low cost, high yield, fully automated fabrication technology.

Later, William plans to incorporate graphene and solid-state electrolytes. This approach may take us over **2,700 Watts** per kilogram (**2.7kW/kg**) & **2,300 Watt-hours** per kilogram (**2.3kWh/kg**). The model points to more than 10,000 cycles, with as much as 80% capacity retention. At \$100/kWh selling price in volume, it offers customers a simple leveled cost of storage of \$0.01 per charging cycle for most of the lifespan, rising later in life to \$0.0125 per cycle.

### Commercial battery application targets

- 1) Battery-electric cars, buses, trucks & elevated-guideway transit, and ships, trains & aircraft.
- 2) Uninterruptible power supplies (UPS) for critical systems, including hospitals.
- 3) Electricity time-of-use-shifting and ancillary services (basically stabilizing electricity supply) for utilities, microgrids, wind farms, solar farms, and distributed solar (rooftop and ground-mounted solar, plus solar canopies over parking, streets, and crops that thrive in partial shade).

I'm in San Mateo, California. William's lab is in southeastern Iowa. The new anode design means the specs on our website are now a little behind, but still better than any other battery.

Please contact us to participate in or explore purchases from this ground-breaking venture.

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