Developing and Testing the Sonsight 3.5kW Wind Turbine at Beech Mountain, NC

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This Beech is no Picnic

- Beech Mtn test site
  - Mountain ridge 5,100 ft up
  - Average windspeed at 30m = 7m/s
  - Beautiful – across from a ski resort
- But:
  - Turbulent site that tortures turbines
  - Not the best site for power performance testing
  - Good site for developing turbine controls
  - Good site for benchmarking in non-ideal operating conditions

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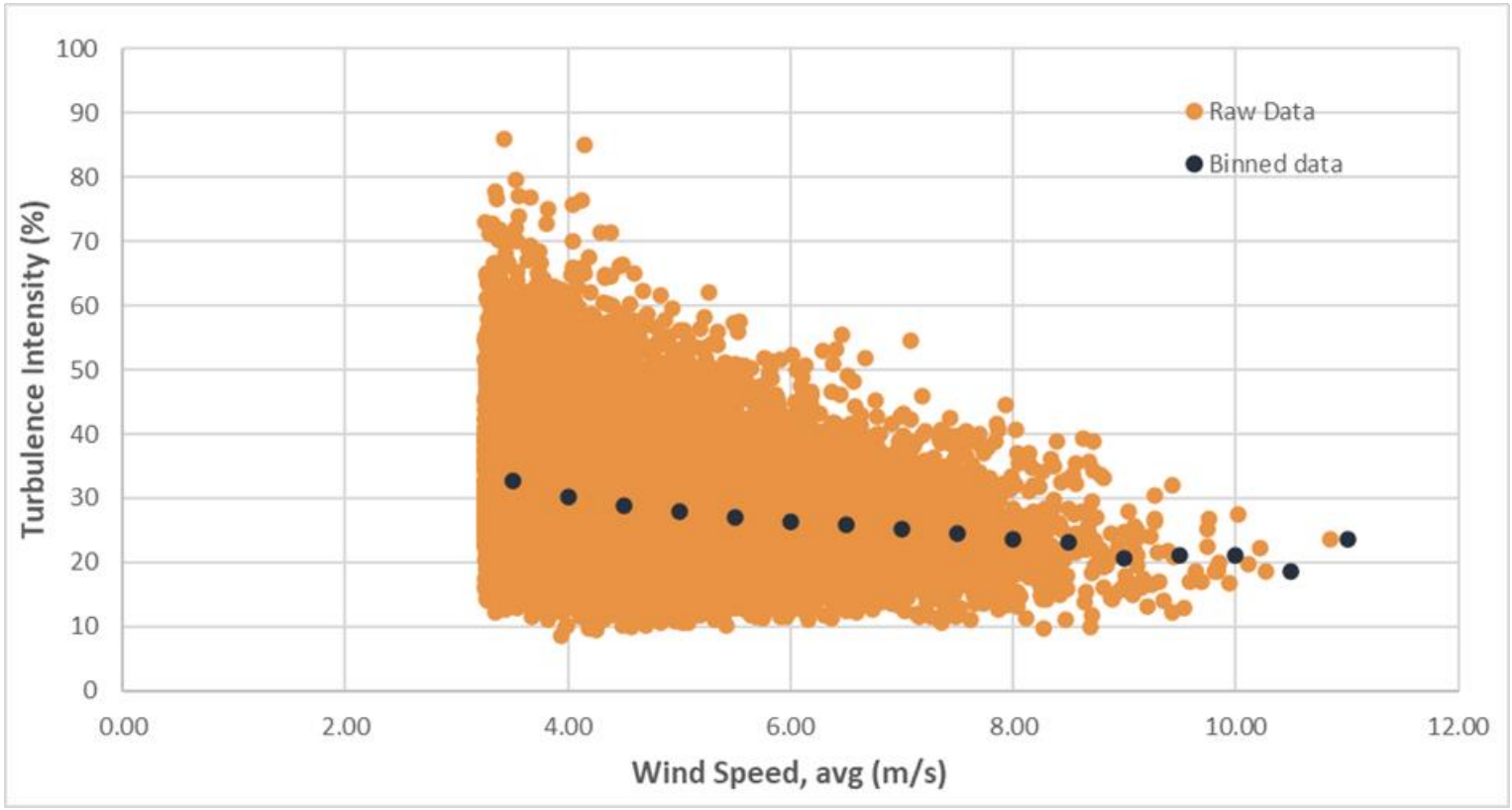
- Turbulence intensity calculation by REI during our prior 3rd party prototype performance tests



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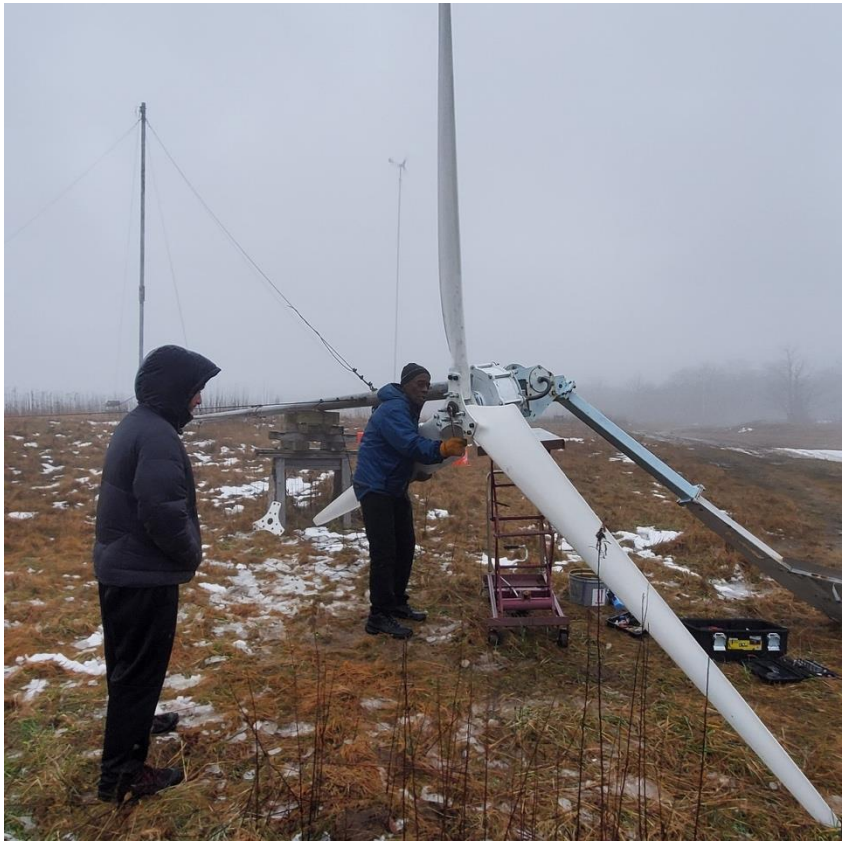

A Little Background

- Started with developing a novel generator
  - Low RPM & Low mass
  - Patented design
  - Initially planned to stop there

- But:
  - Ended up at Beech Mtn with a turbine designed around the generator
  - Furling tail behaved badly
  - Manufacturers stopped making small wind inverters
  - Solar prices kept falling

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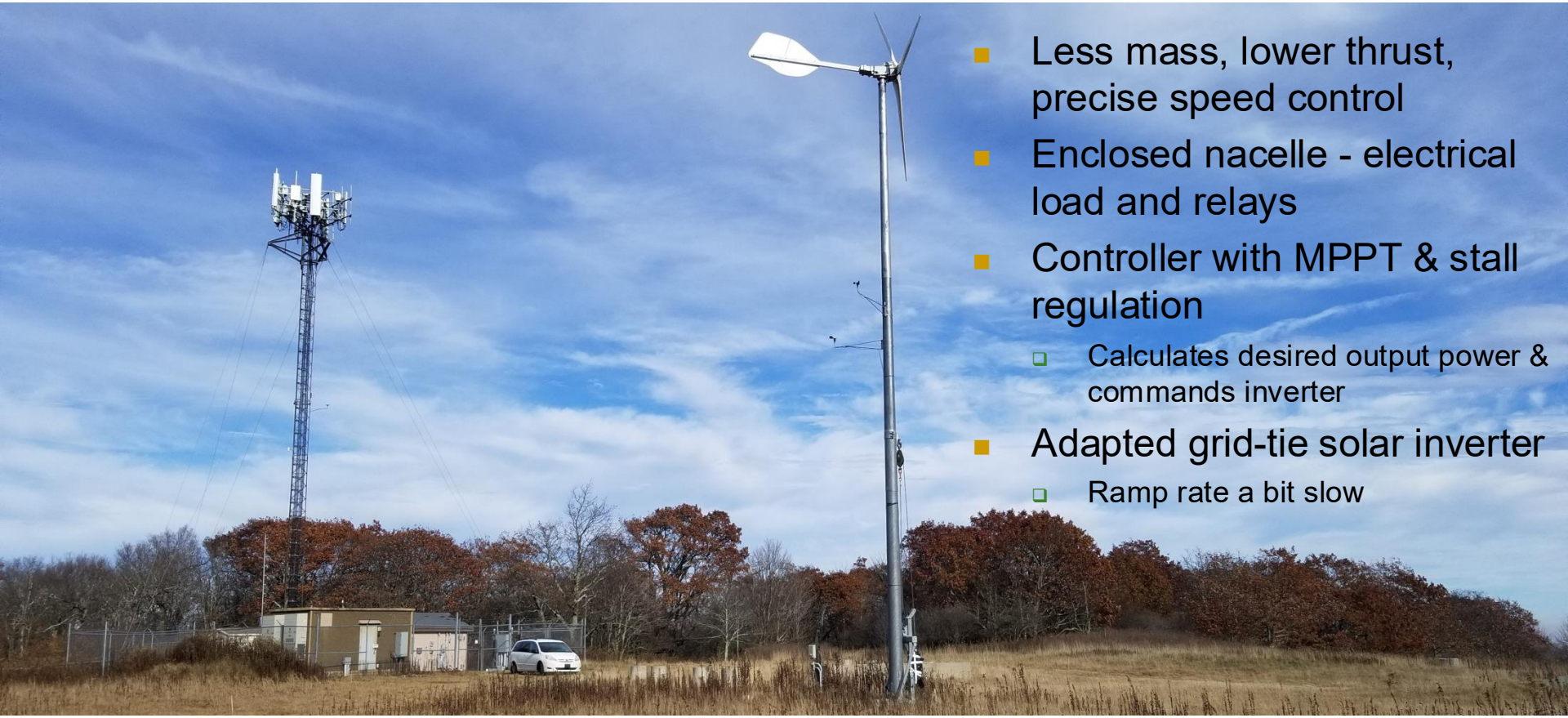
SS3-Stall Regulated (V1)



- Less mass, lower thrust, precise speed control
- Enclosed nacelle - electrical load and relays
- Controller with MPPT & stall regulation
  - Calculates desired output power & commands inverter
- Adapted grid-tie solar inverter
  - Ramp rate a bit slow

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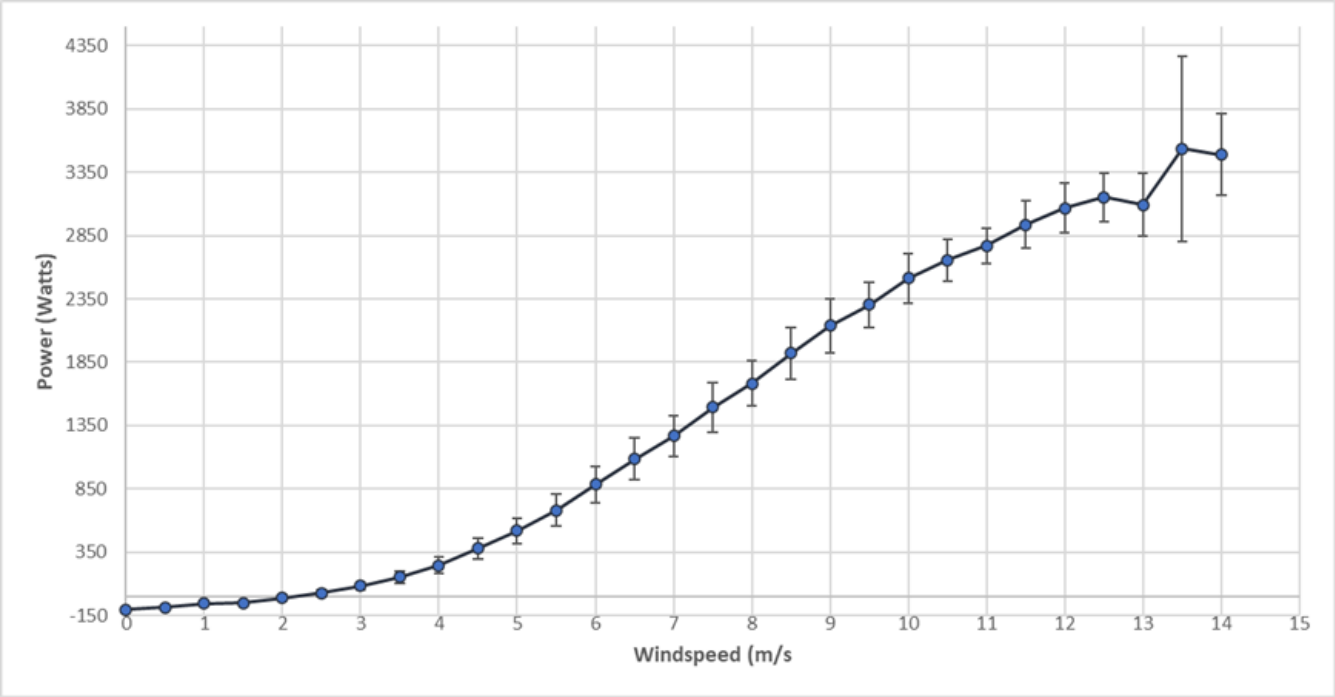
SS3-Stall Regulated (V1)

- REI 3rd party prototype performance power curve for V1 turbine
- Power performance less than target but not totally off



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SS3 (V1 vs. V2)

- Redesigned SS3 nacelle (with braking loads) to decrease mass and cost
- Redesigned controller and nacelle electronics and updated generator & the control software to improve efficiency & response time and to better handle turbulent winds
  - Transition from Teensy microcontroller + comms board + somewhat expensive inverter, to XFlow SCADA + VFD + less expensive inverter
  - ~10x faster ramp time + remote monitoring & control

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