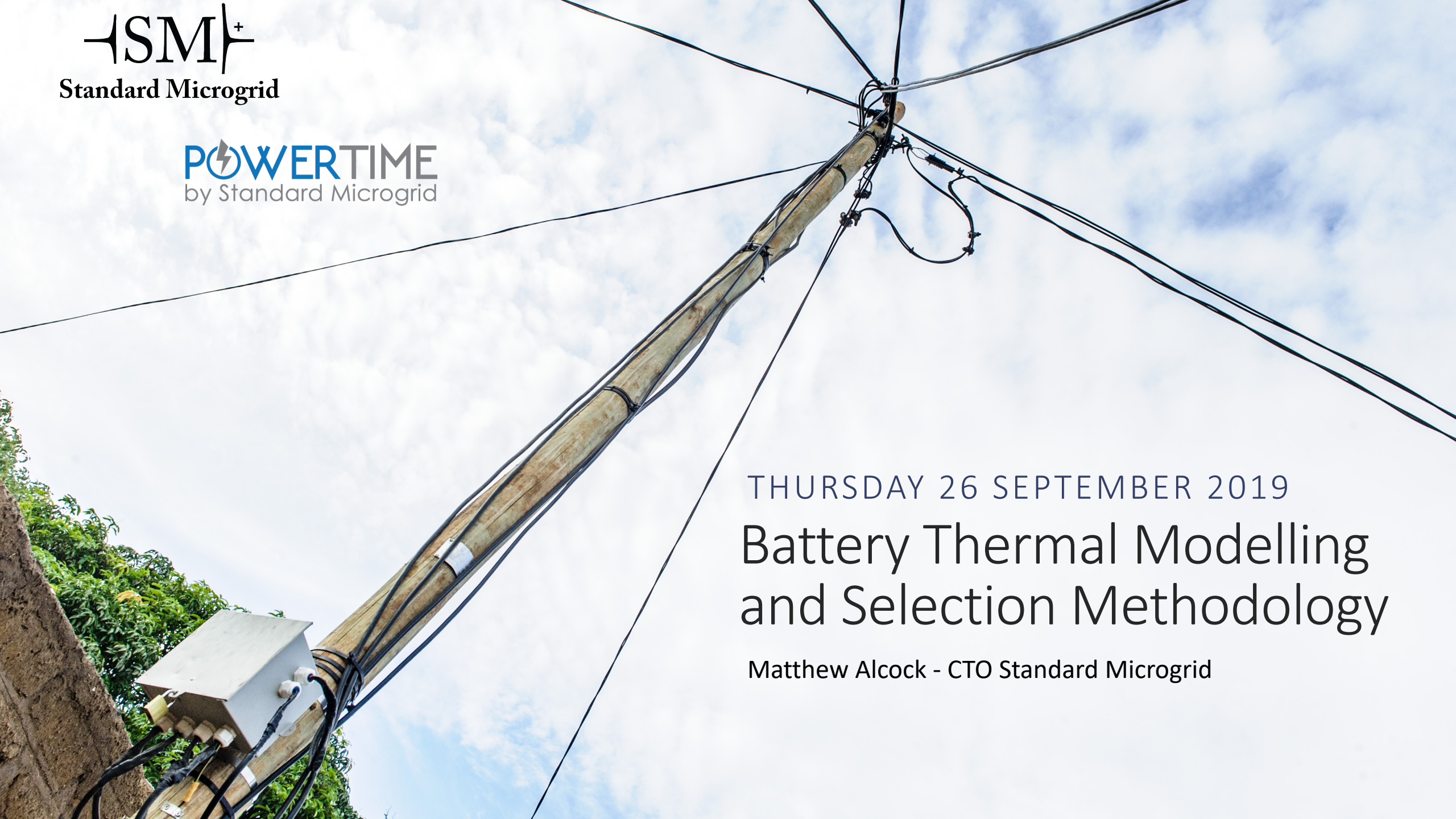
Standard Microgrid

POWERTIME
by Standard Microgrid



THURSDAY 26 SEPTEMBER 2019

Battery Thermal Modelling and Selection Methodology

Matthew Alcock - CTO Standard Microgrid

Company overview

Standardized Power Systems

- 12kWp Solar, 30kWh lithium battery backup, overhead grid to +-150 homes, schools and businesses
- 7 grids installed and operational in Zambia
- > 900 home and business connections

Precise Demand Side Control and Monitoring

- Smart meter enabling affordable energy service based billing
- Utilize 90% of potential energy production

Localized Capacity

- 11 female microgrid manager agents reselling Powertime subscriptions
- Regional technicians to be able to perform routine maintenance and unscheduled service to grids, reducing opex

SM+
Standard Microgrid

POWERTIME
by Standard Microgrid

Battery considerations

Price - When comparing usable kWh

Performance

- Efficiency
- Portability
- Data logging

Longevity

- Cycles vs Capacity
- Heat tolerance

Supplier track record

- Warranty terms
- Ability to back said warranty

Standard Microgrid

POWERTIME by Standard Microgrid

NREL Engagement

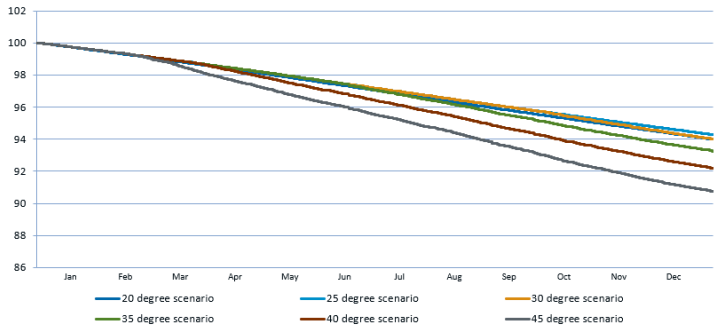
Conducted a study with NREL through 2018 as part of a wider engagement

1. Assess temperature impacts on battery degradation using NREL SAM
2. Thermal modelling to predict temperatures based on
    1. Ambient temperatures (20 – 45 degrees C)
    2. Structure
    3. Ventilation
    4. Active/passive cooling

Standard Microgrid

POWERTIME
by Standard Microgrid

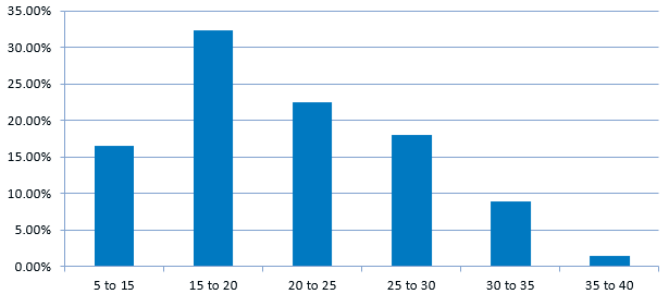
Impacts on Battery Degradation



Battery life over 12 months with static temperature

	20° C	25° C	30° C	35° C	40° C	45° C
90%	1.62	1.68	1.60	1.46	1.30	1.10
80%	3.06	3.09	2.96	2.77	2.54	2.26
70%	4.27	4.33	4.20	3.97	3.68	3.34
60%	5.45	5.48	5.35	5.09	4.76	4.37
50%	6.70	6.63	6.49	6.20	5.83	5.39

Matrix showing years to usable capacity at various temperatures

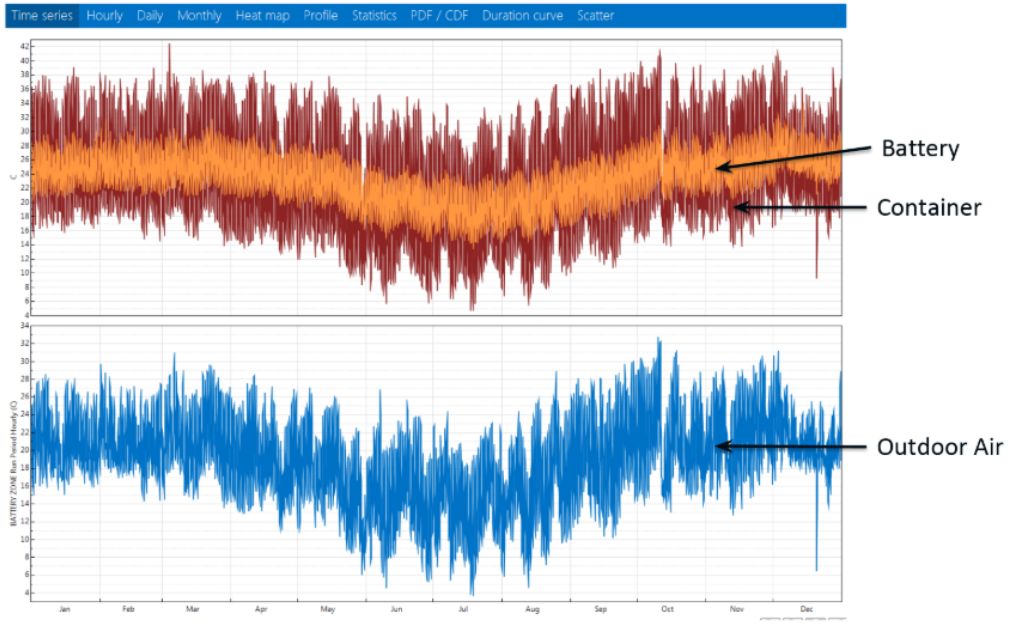


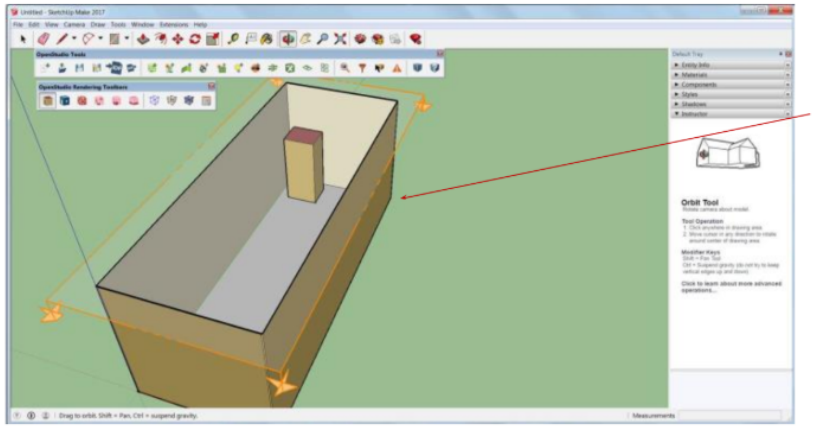
Histogram of hours at various temperatures (Lusaka)

Standard Microgrid

POWERTIME by Standard Microgrid

Thermal modelling





Two Zone Shipping Container Painted White and uninsulated

Standard Microgrid

POWERTIME by Standard Microgrid

Thermal modelling cont.

Structure and shading model provided in Sketchup

Reported on the average space temperature throughout the year for various combinations of fans/AC/passive

Interesting results to note:

- For Lusaka, none of the fan sizes were able to keep the container below 35 C during all parts of the year
- The shade device has a substantial impact on the ability of the fans to keep the container within setpoint
- 450 CFM fans would lead to 14 hours of temperatures exceeding 42 degrees, and in those cases, only with an average of 0.5 degrees in excess of 42.

Settled on 2 x 350 CFM fans, both dispatchable at customizable temperature set points

Typically one runs during daylight hours, the other when temperatures >30 degrees C

SM+
Standard Microgrid

POWERTIME
by Standard Microgrid

Standard Microgrid

Matthew Alcock
malcock@standardmicrogrid.com
www.standardmicrogrid.com