

How data from CCE power monitoring helps ensure vaccine potency



Invention saving lives

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METAFRIDGE TECHNOLOGY



THERMOSYPHON

- 5 day holdover at 43C
- User independent freeze-free

METAFRIDGE TECHNOLOGY



THERMOSYPHON

REMOTE MONITORING

- **Integrated 30 Day temperature record**
- **Telemetry with advanced diagnostics capabilities**

METAFRIDGE TECHNOLOGY



THERMOSYPHON

REMOTE MONITORING

POWER PROTECTION

- Protects against power surges and brown-outs
- Integrated voltage stabilizer (82-290V input range)
- Monitors power availability

FIELD TEST OVERVIEW



- In collaboration with Kano State Primary Healthcare Management Board (KSPHCMB)

• 14 UNITS

• 3 month period



- In collaboration with Kenya National Vaccines and Immunization Program (NVIP)

15 UNITS

• 3 month period



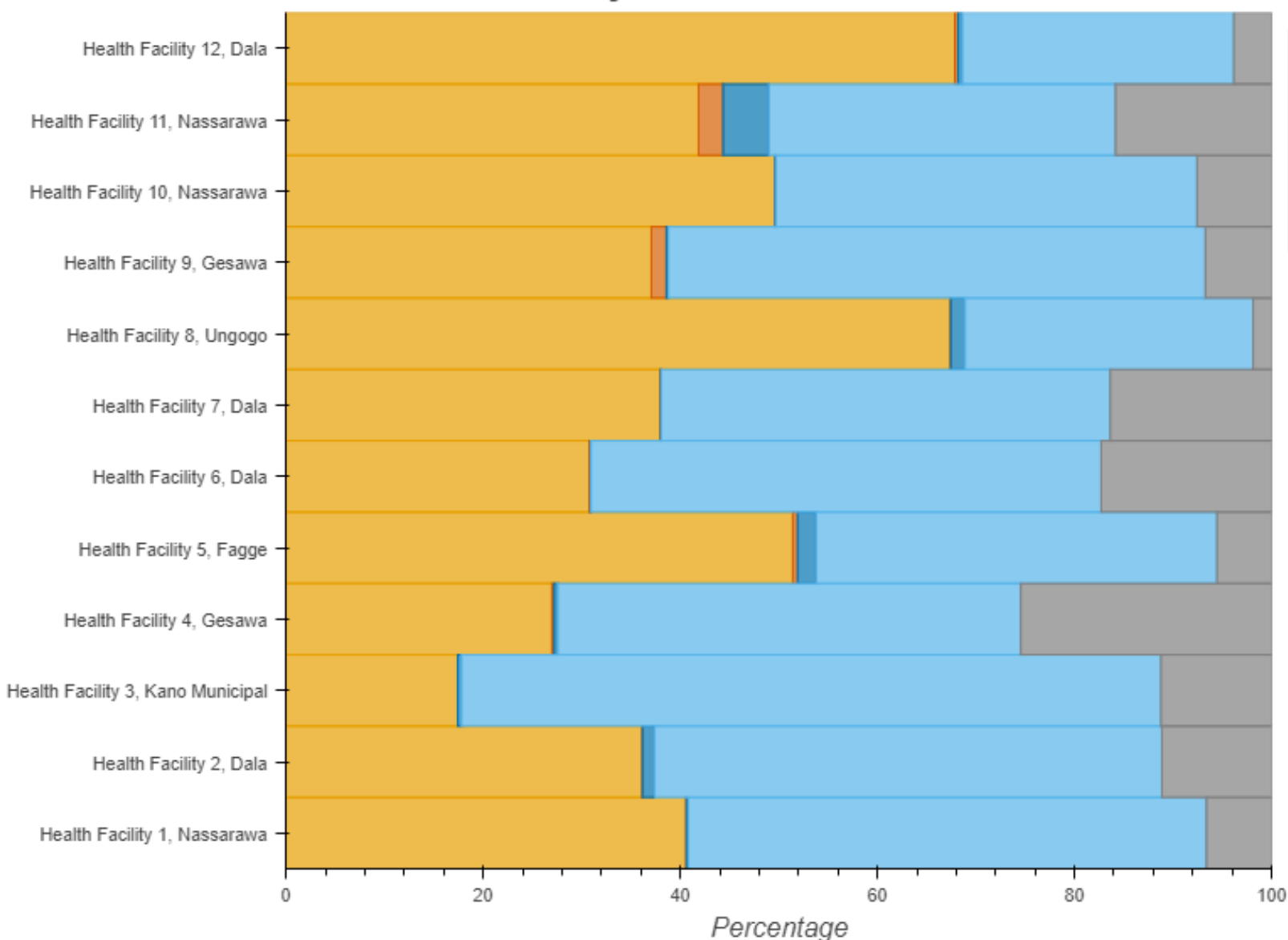
- In collaboration with Addis Ababa Private Clinic Owners Association

• 5 UNITS

• 10 month period

Kano, Nigeria power availability summary

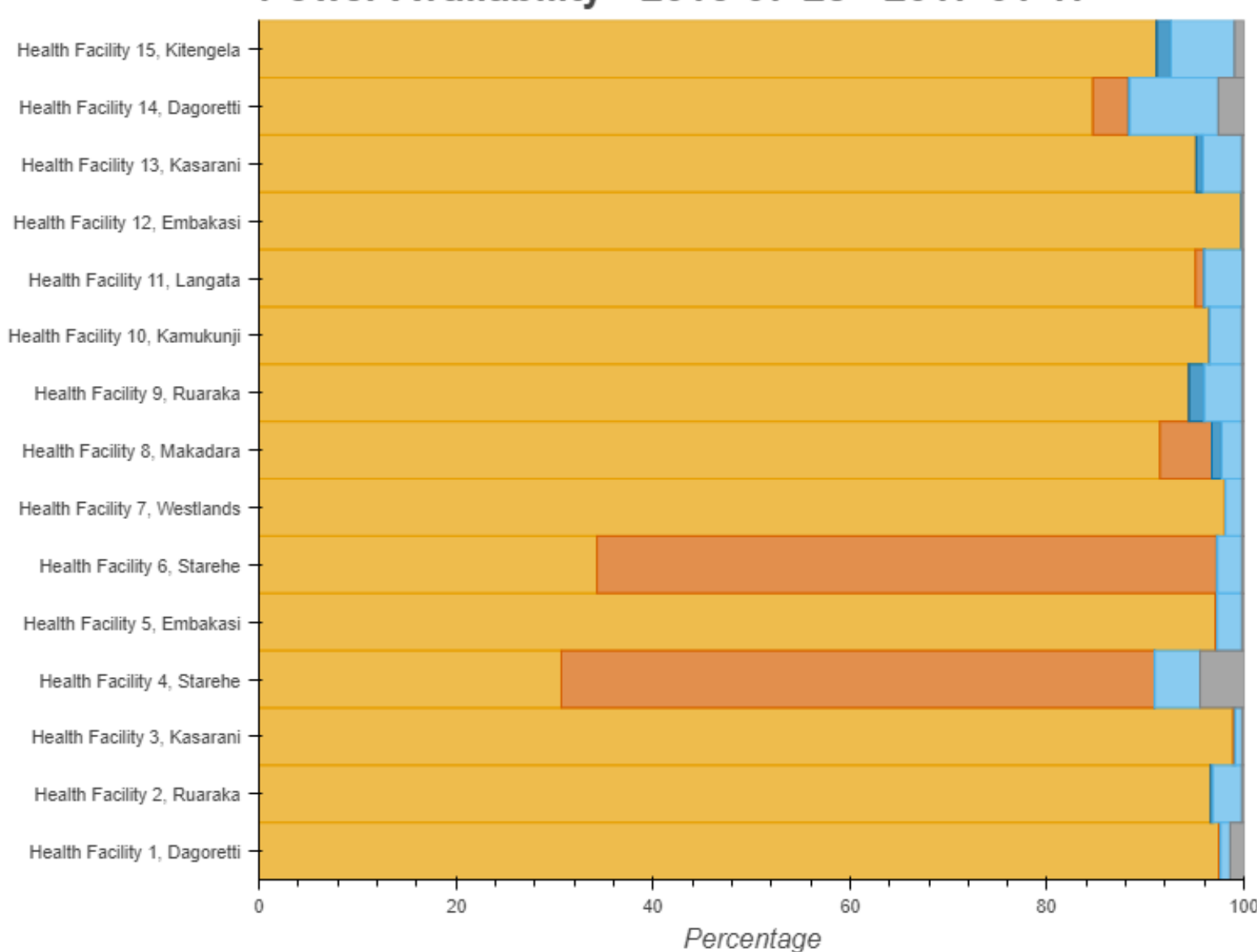
Power Availability - 2016-07-21 - 2017-01-12



- Severe long duration over-voltages (~400V) were detected in some locations
 - MetaFridge components protected by integrated voltage protection

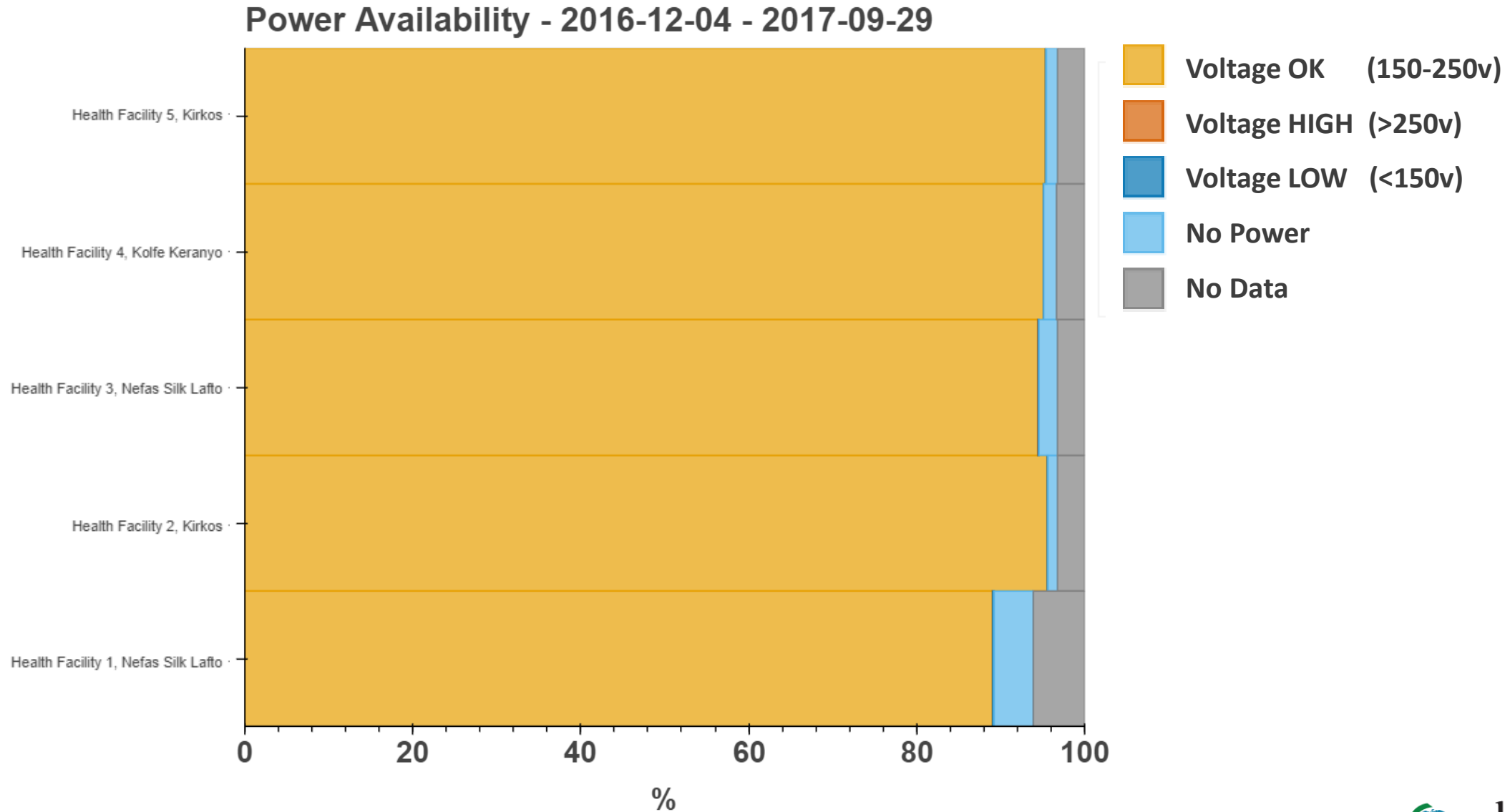
Nairobi, Kenya power availability summary

Power Availability - 2016-07-28 - 2017-01-17



- Occasional multi-day outages indicated that CCE with extended holdover is valuable even in locations with nominally 'good' power
- Consistent over-voltages seen at two sites
 - Input range of voltage stabilizer changed to 82-290V (previously 150-250V)

Addis Ababa, Ethiopia power availability summary

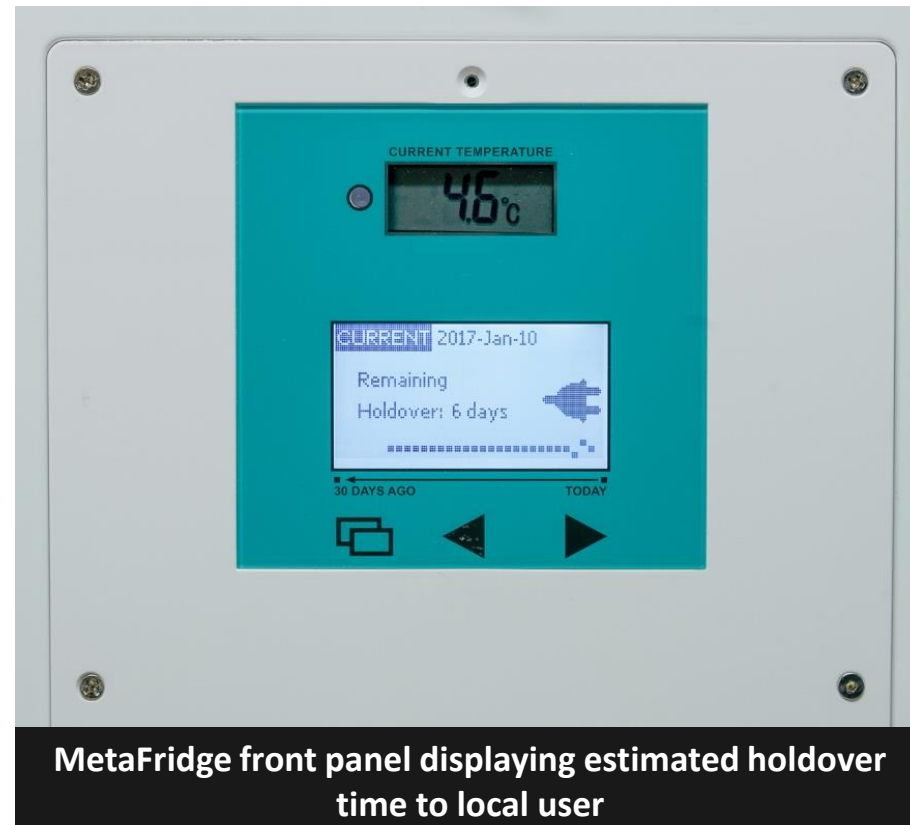


Integrated power monitoring enables proactive action

- Alarms/alerts are generated in the event of extended power outage or under/overvoltage
- Example:
 - ALARM: LOW POWER AVAILABILITY
 - ACTION: CHECK ELECTRICITY CONNECTION OR TRANSFER VACCINES TO SAFE HARBOR

Integrated power monitoring enables proactive action

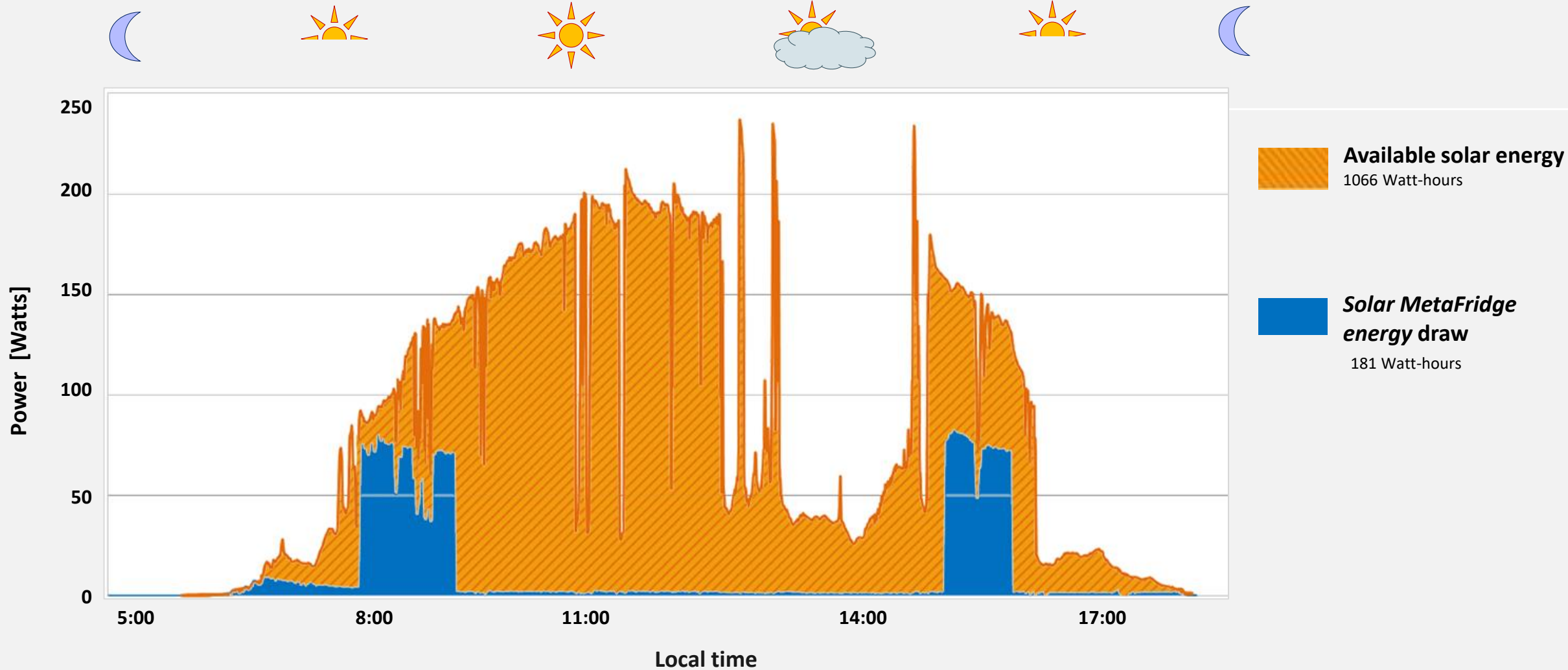
- Holdover projection during power outage enables proactive steps to protect vaccines



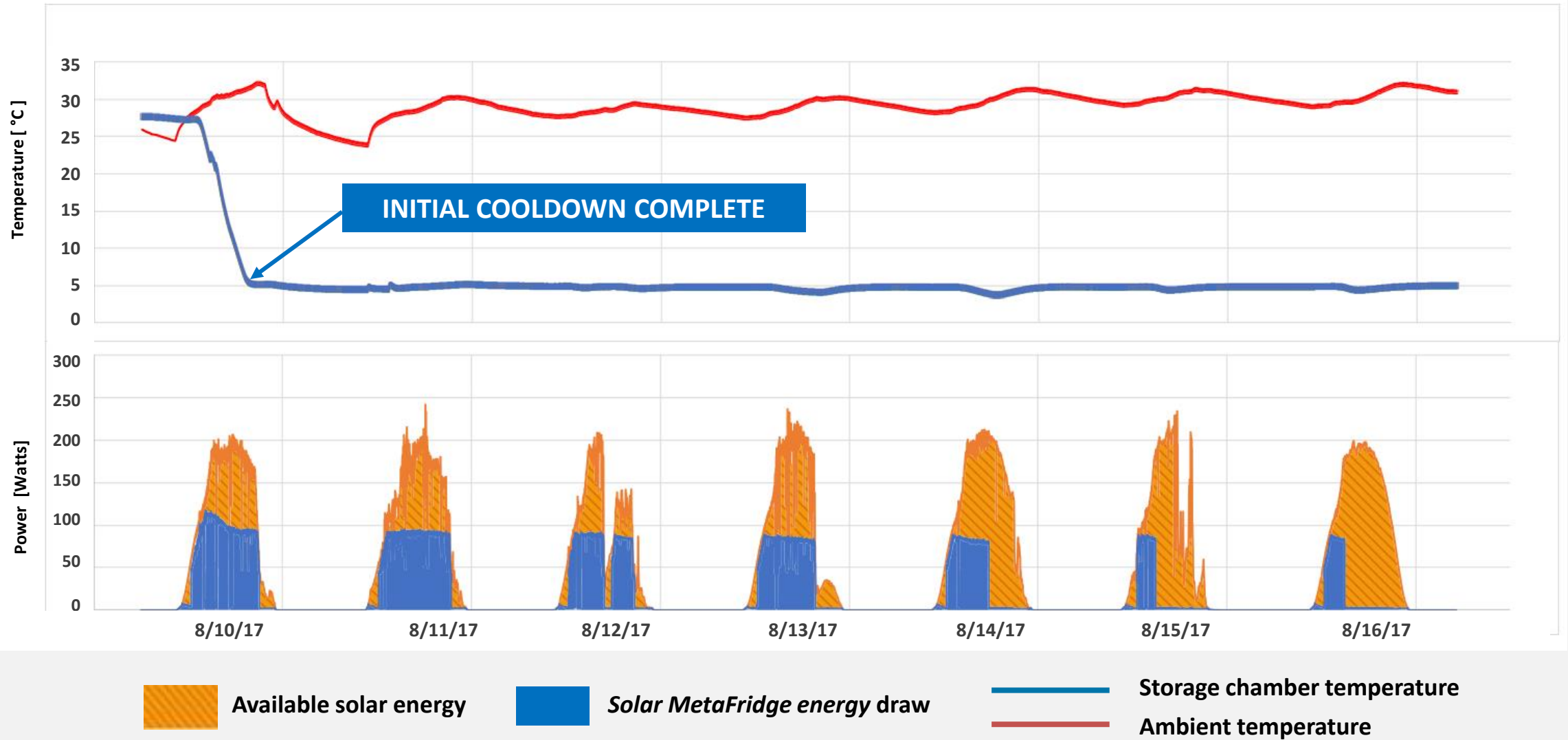
Solar CCE challenges

- A few existing challenges with Solar CCE:
 - Installation verification can requires extra trip(s)
 - Dusty or damaged or panels can go unnoticed
 - Verifying proper shading analysis / array positioning
- Global Good has developed technologies for continuous remote monitoring of available solar power

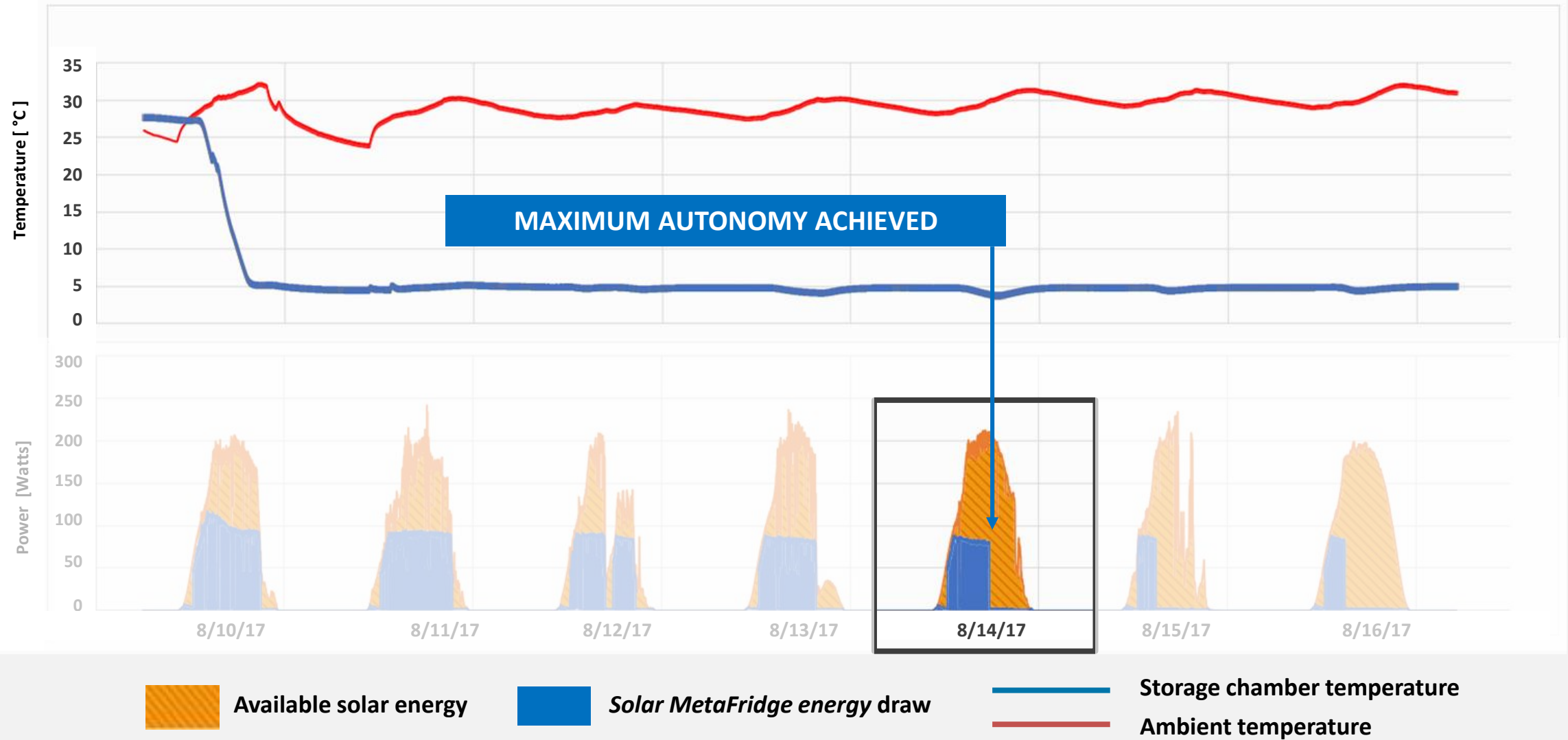
SOLAR POWER PROFILE – NAIROBI, KENYA



SOLAR INSTALLATION VERIFICATION – Port-au-Prince, Haiti

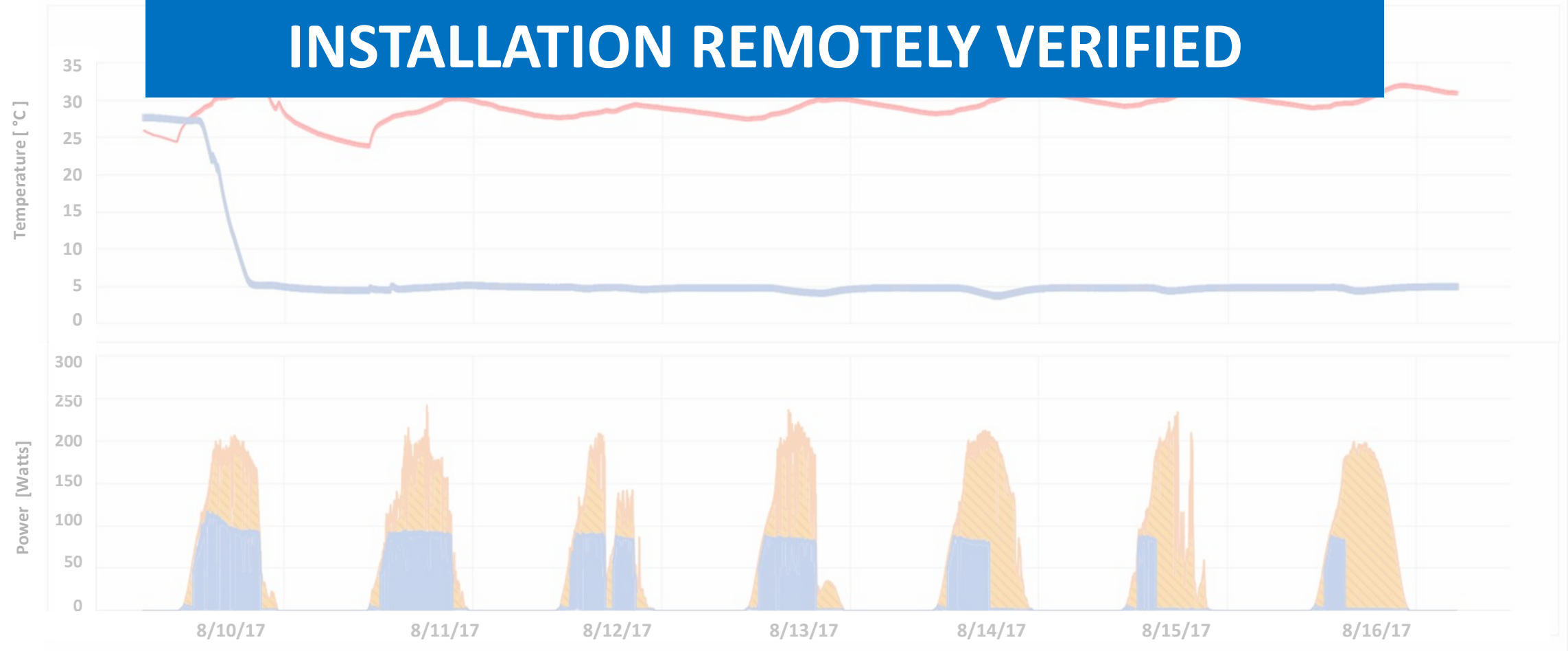


SOLAR INSTALLATION VERIFICATION – Port-au-Prince, Haiti



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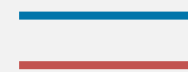
INSTALLATION REMOTELY VERIFIED



Available solar energy



Solar MetaFridge energy draw

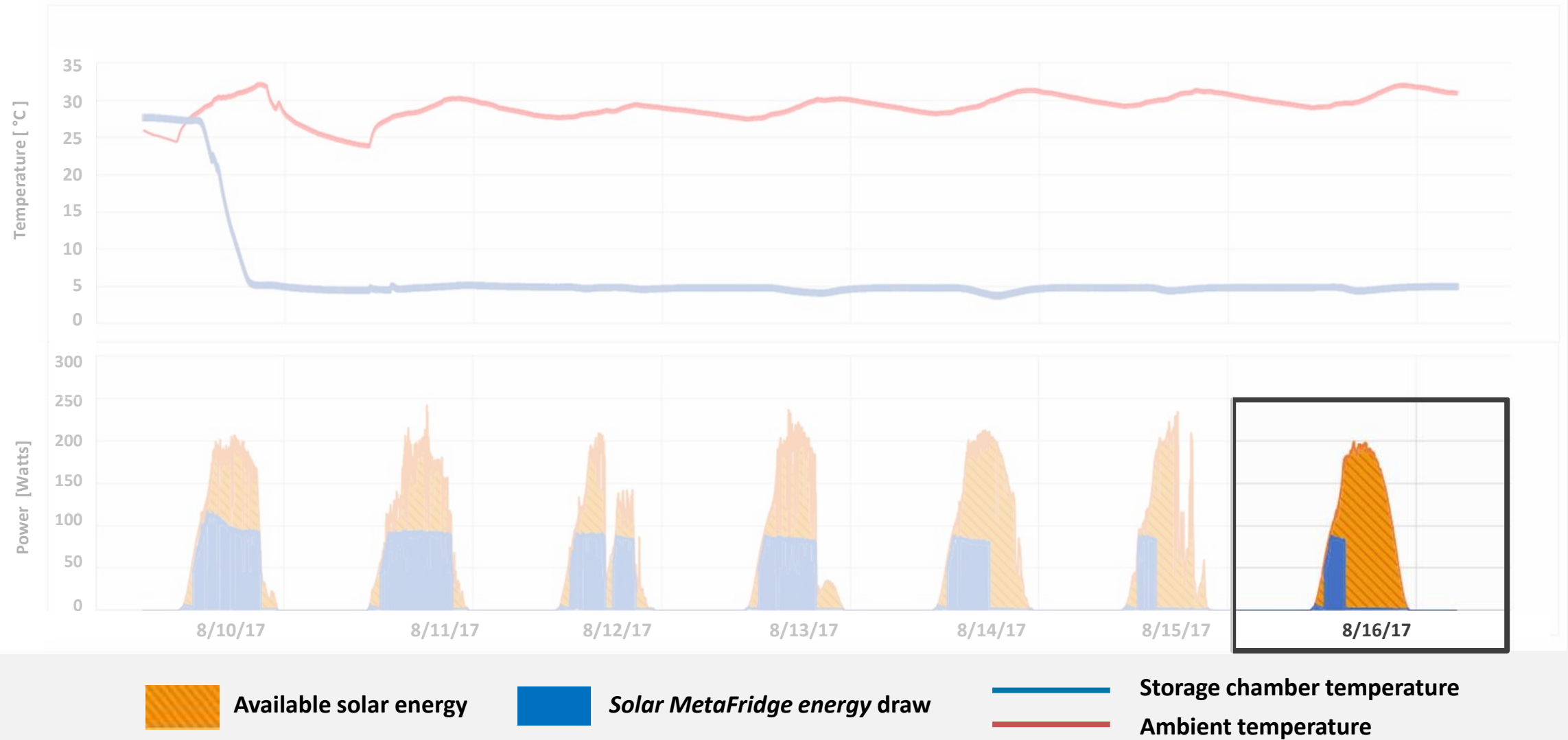


Storage chamber temperature

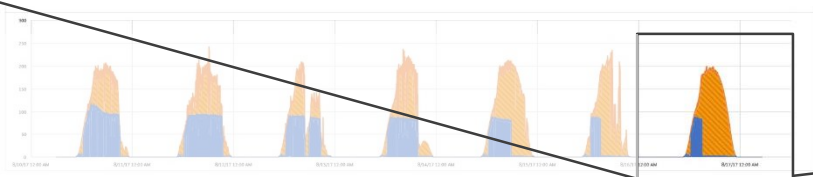
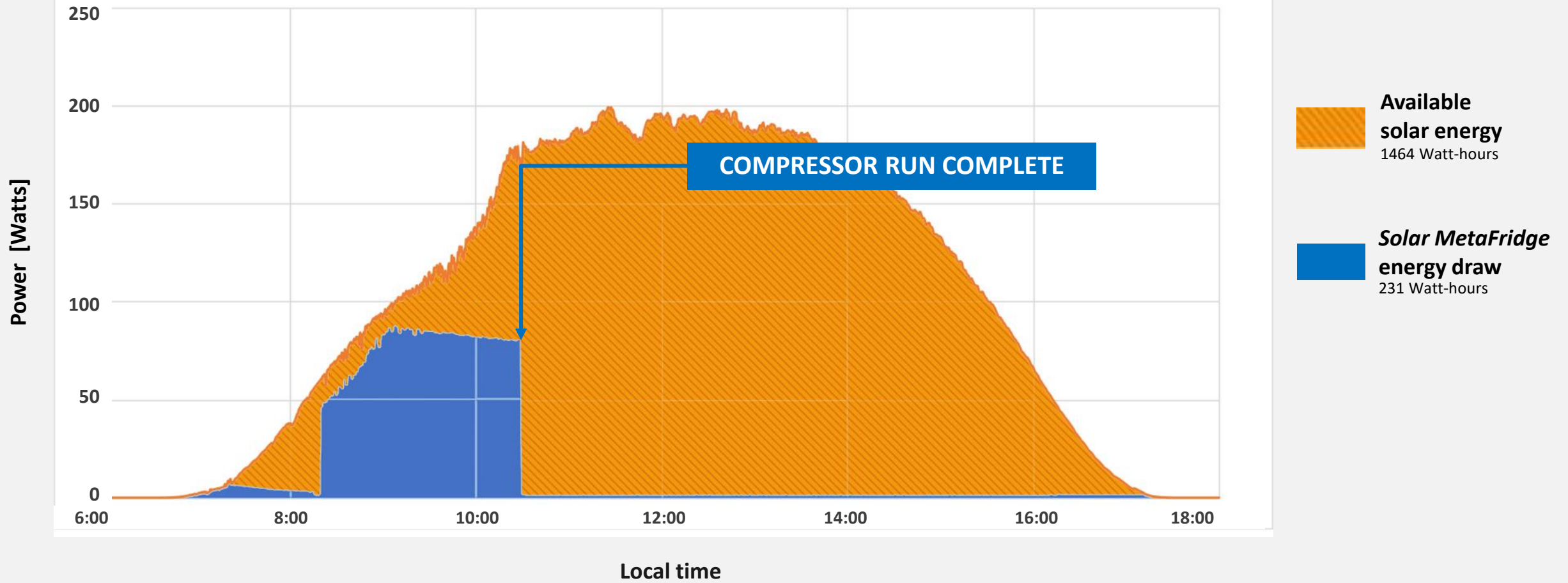


Ambient temperature

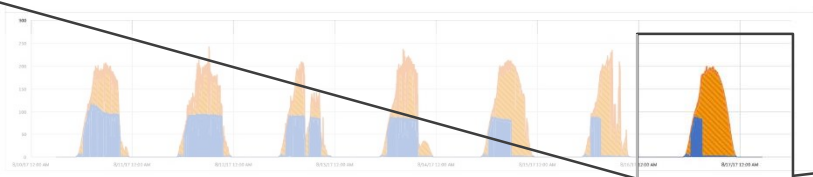
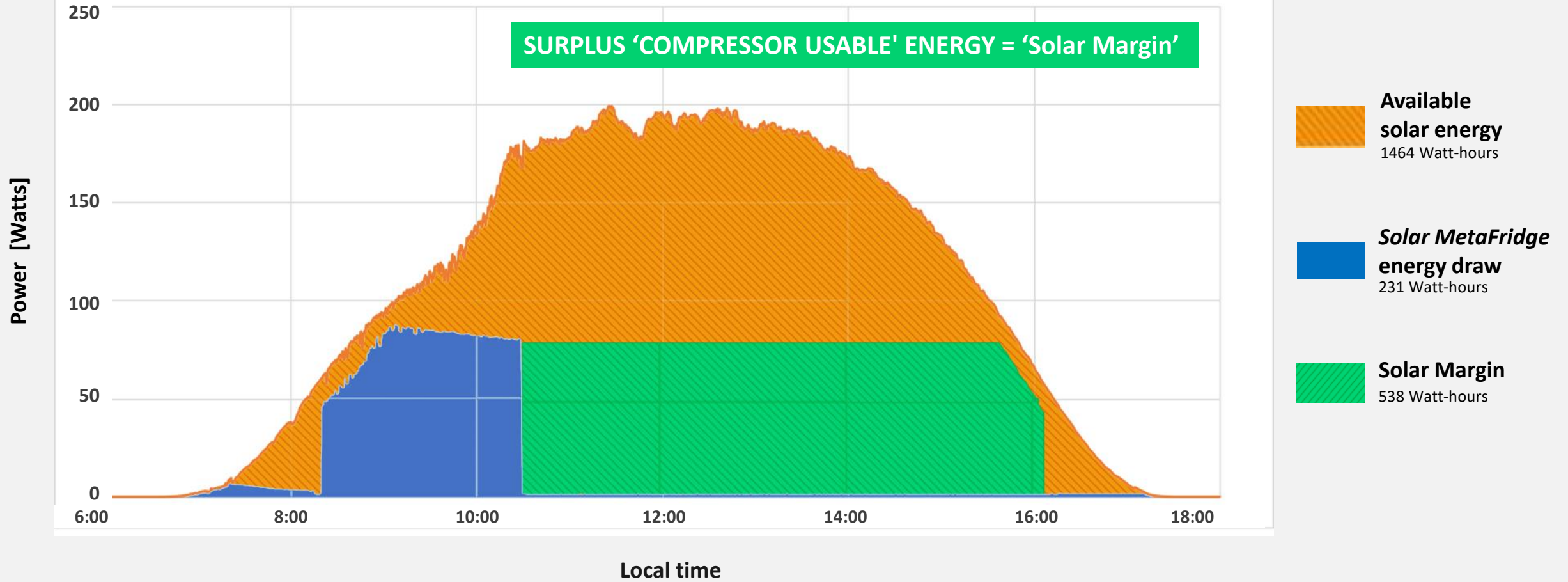
SOLAR INSTALLATION VERIFICATION – Port-au-Prince, Haiti



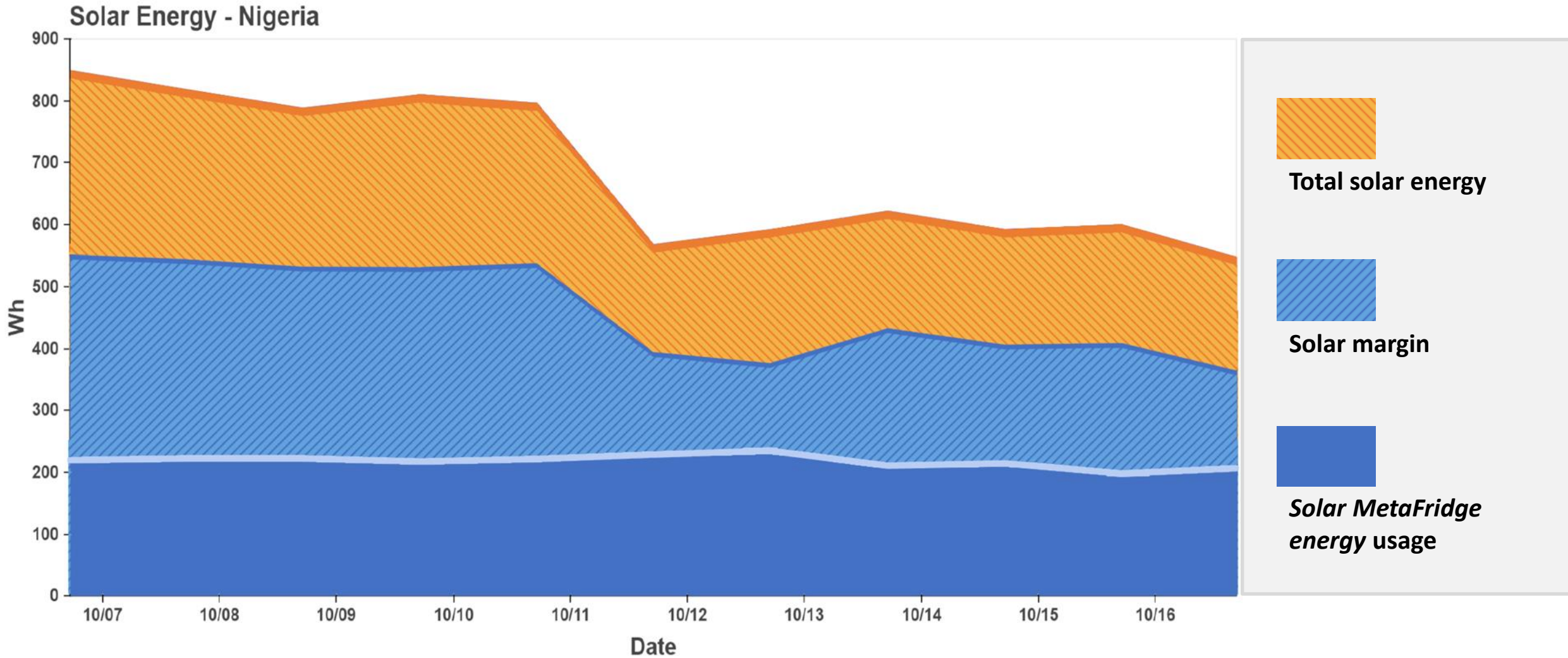
SOLAR INSTALLATION DAY 7 – Port-au-Prince, Haiti



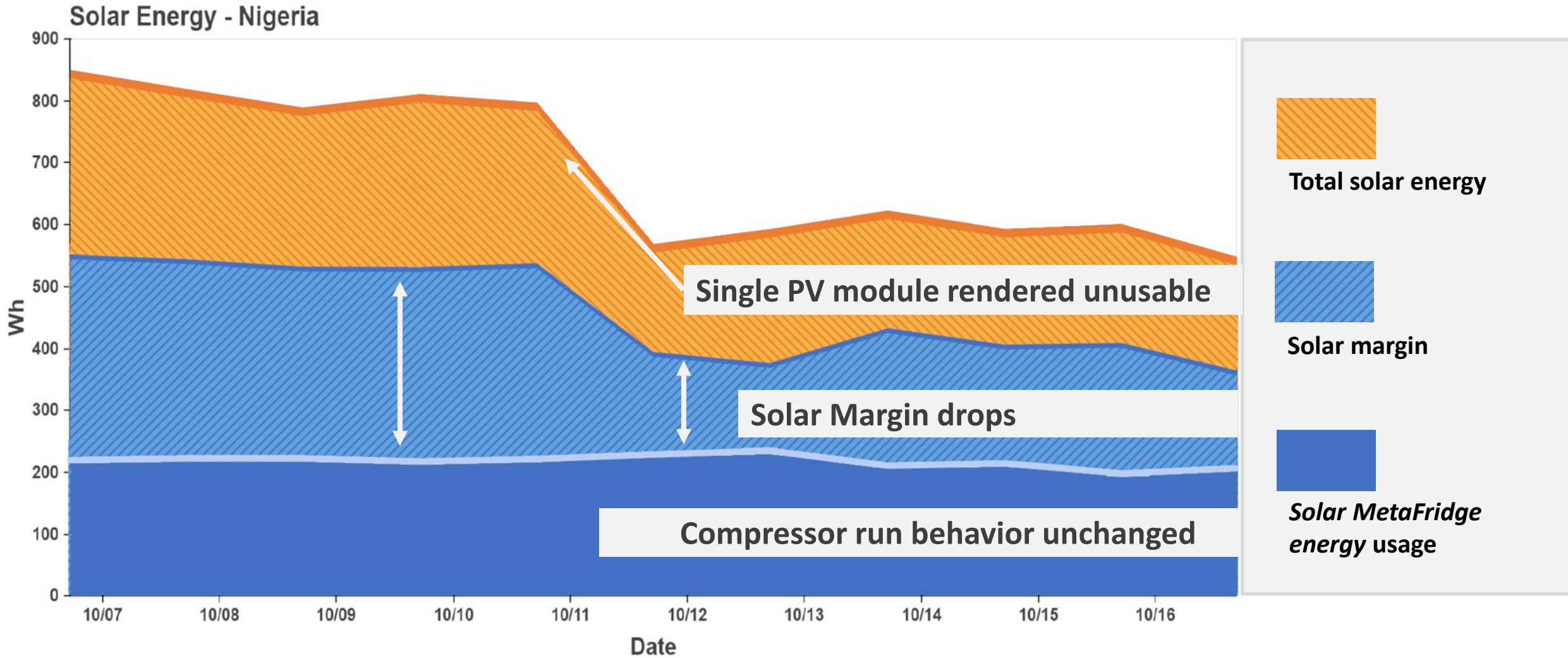
SOLAR INSTALLATION DAY 7 – Port-au-Prince, Haiti



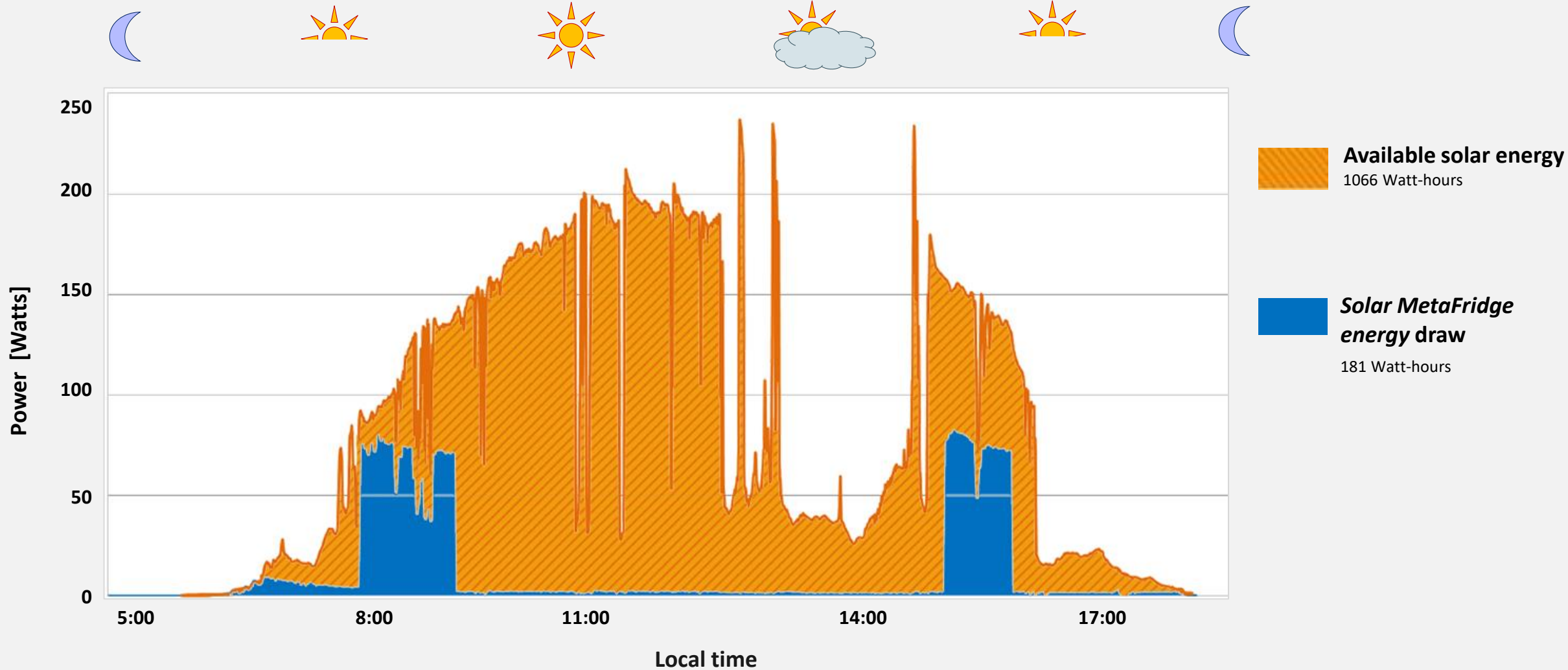
Measured Available Solar Energy – 12 Day Period



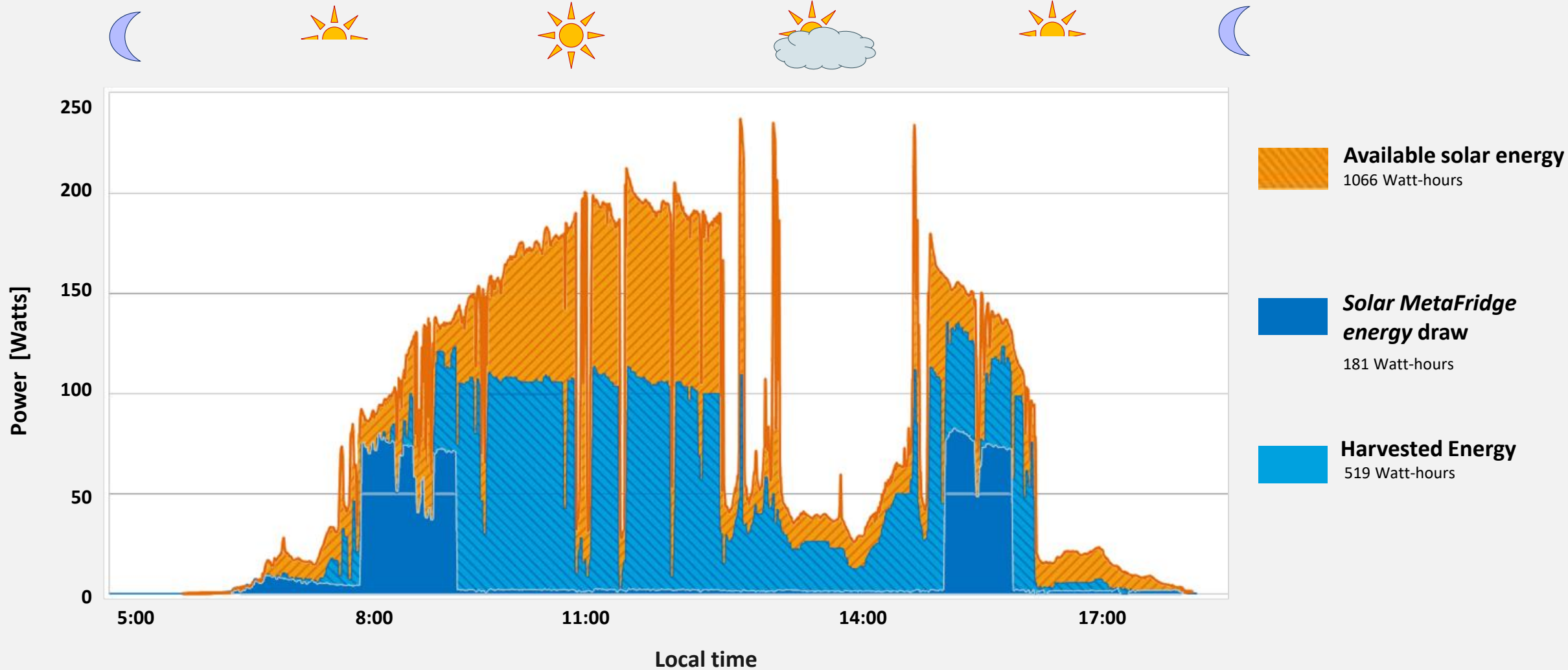
Identifying PV module issue without any change in CCE performance



SOLAR POWER PROFILE – NAIROBI, KENYA



SOLAR POWER PROFILE – NAIROBI, KENYA



SUMMARY

- **Pilot test of mains devices with integrated power monitoring identified:**
 - Variable voltage profiles measured in three countries
 - Power data can be used to help enable proactive action to protect vaccines before a temperature excursion occurs
- **Integrated solar power monitoring enables:**
 - Remote installation verification, potentially eliminating need for return visit
 - Energy harvesting control that always prioritizes fridge energy needs