



The trusted partner in energy transformation

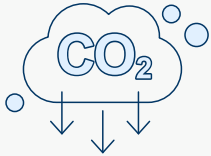
Energy as a Service Microgrids with Energy Storage for Reliability

DOE Energy Storage Safety & Reliability
Forum 2022

Steve Pullins, SVP CTO, AlphaStruxure



The challenge: climate targets, climate realities, business realities



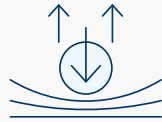
GHG emission reductions

6.21% increase in 2021 U.S. greenhouse gas emissions putting the U.S. further off track from achieving climate targets

Rhodium Group

32 business reporting quarters remaining to cut carbon emissions in half to keep global warming below pre-industrial levels

UN IPCC



Resilience

\$148 Billion the five-year average cost of billion-dollar-plus natural disasters

NOAA

6,681 extreme weather events over the past two decades (2000-2019)

UN Office for Disaster Risk Reduction



Reliability

1.33 billion outage hours across the U.S. in 2020

PowerOutage.US

\$330,000/hour average cost of Commercial & Industrial customer downtime

S&C State of Commercial & Industrial Power Reliability Report



Cost-stability

65% increase in U.S. electricity prices in the last 20 years

EIA

79% increase in U.S. natural gas prices in the last 20 years

Bureau of Labor Statistics

Microgrids: powering the transition to a net-zero economy

Microgrid

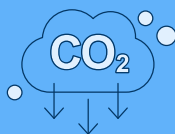
A local energy system with sources of generation, storage and advanced automation and control, often connected to the utility grid but able to function independently.



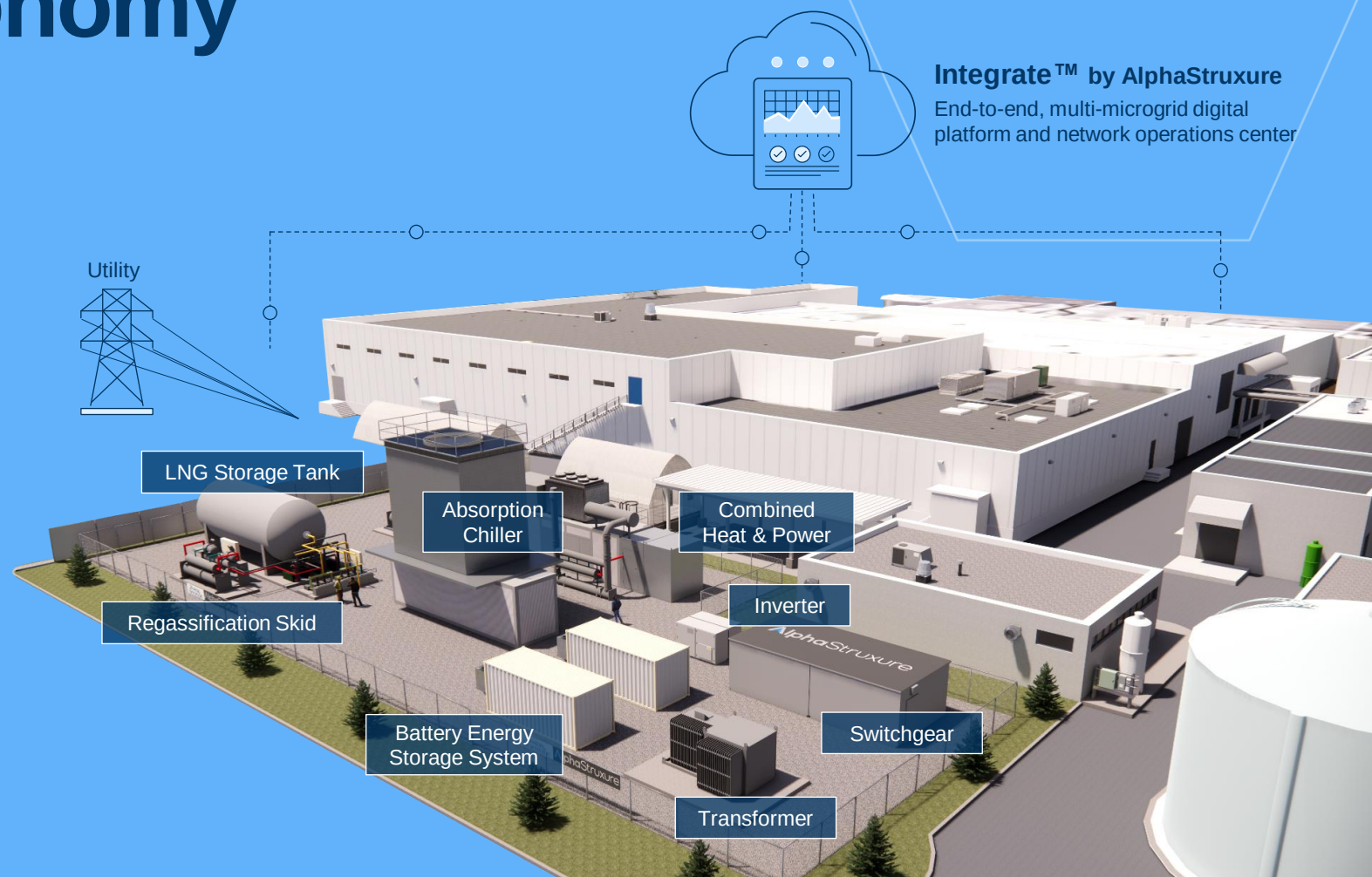
Energy cost certainty & optimization



Enhanced resilience & reliability



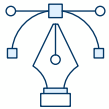
Accelerated emissions reductions



AlphaStruxure

AlphaStruxure enables organizations to achieve ambitious, tailored energy transformations — without the CapEx or complexity.

Design



We design and engineer tailored energy infrastructure to achieve your goals for greenhouse gas reduction, resilience, reliability, and cost stability.

Finance



Direct access to strategic capital from Carlyle removes funding roadblocks and reduces financial risk to accelerate your energy transformation.

Build



Partnering with industry experts, we manage the construction of your energy infrastructure to ensure an efficient, safe, and streamlined build process.

Own



We are accountable for the energy infrastructure across its lifecycle, and therefore hold a long-term interest in your success

Operate



Operation of assets through the **Integrate** digital platform and Microgrid Network Operating Center (NOC) to deliver long-term outcomes.

Maintain



As experts in the evolving technology landscape, we deliver zero CapEx asset optimization and upgrades.

Unique joint-venture combines Carlyle's capital backing with Schneider Electric's 185+ year legacy and its track record as the #1 microgrid technology provider, with over 300 successful projects across North America.

CARLYLE

One of the largest and most diversified global investment firms with \$301 billion in assets under management spanning 3 business segments and 456 investment vehicles:



Global leader in the digital transformation of energy management and automation

- #1 Most Sustainable Company in the World
- #1 Energy as a Service (EaaS) solutions provider
- #1 Energy Service Company (ESCO)



AlphaStruxure

Microgrid Energy Storage for Reliability

Battery Energy Storage System (BESS) Use Cases

Behind the meter Microgrids employ more BESS Use Cases than Utility-scale energy storage

Used in ASX Microgrids

1. PV smoothing
2. Load smoothing
3. Voltage support
4. PV shifting
5. Island mode transition & reconnection
6. VAr management & power factor correction
7. Load shifting (e.g., EV fleet)
8. Frequency regulation in island mode
9. Arbitrage
10. Constant charge
11. Constant discharge
12. Demand response (grid program participation)

Supporting Reliability & Resilience

- Reliability (grid connected)
 - Use cases #1, 2, 3, 4, 6, 7, 12
- Reliability (island mode)
 - Use cases #1, 2, 3, 5, 6, 8
- Resilience
 - Use cases #1, 2, 3, 4, 5, 6, 7, 8
- Bi-directional, four-quadrant operation
 - Coincident uses cases are very important
 - Example: reactive power and power factor management at all times charging or discharging

Microgrid BESS Examples

Common themes

Brookville Smart Bus Depot

- Always on (contractual requirement)
- Same mission if grid lost
- BESS sized recognizing the load profile
 - Island transition for short-term and long-term grid outages
 - Heavy night-time and mid-day charging
 - 95% of site load is eBus charging
 - Minimum use of grid – prevent distribution system upgrade
- Optimizes use of maximum solar PV

JFK New Terminal One

- Always on (contractual requirement)
- Same mission if grid lost
- BESS sized recognizing the load profile
 - Island transition for short-term and long-term grid outages
 - 24/7 fairly level load
 - eGSE charging is a small portion of energy need
 - Heating and cooling also drive reliability requirements
- Optimizes use of maximum solar PV

Brookville smart energy bus depot

Montgomery County, MD



Challenge:

- Transition 70 buses from diesel to electric
- Contribute to the County's goal to reach net-zero emissions by 2035
- Maximize onsite renewable energy
- Ensure uninterrupted transit bus services under any power circumstances
- Avoid utility tariffs and demand charges

Results:



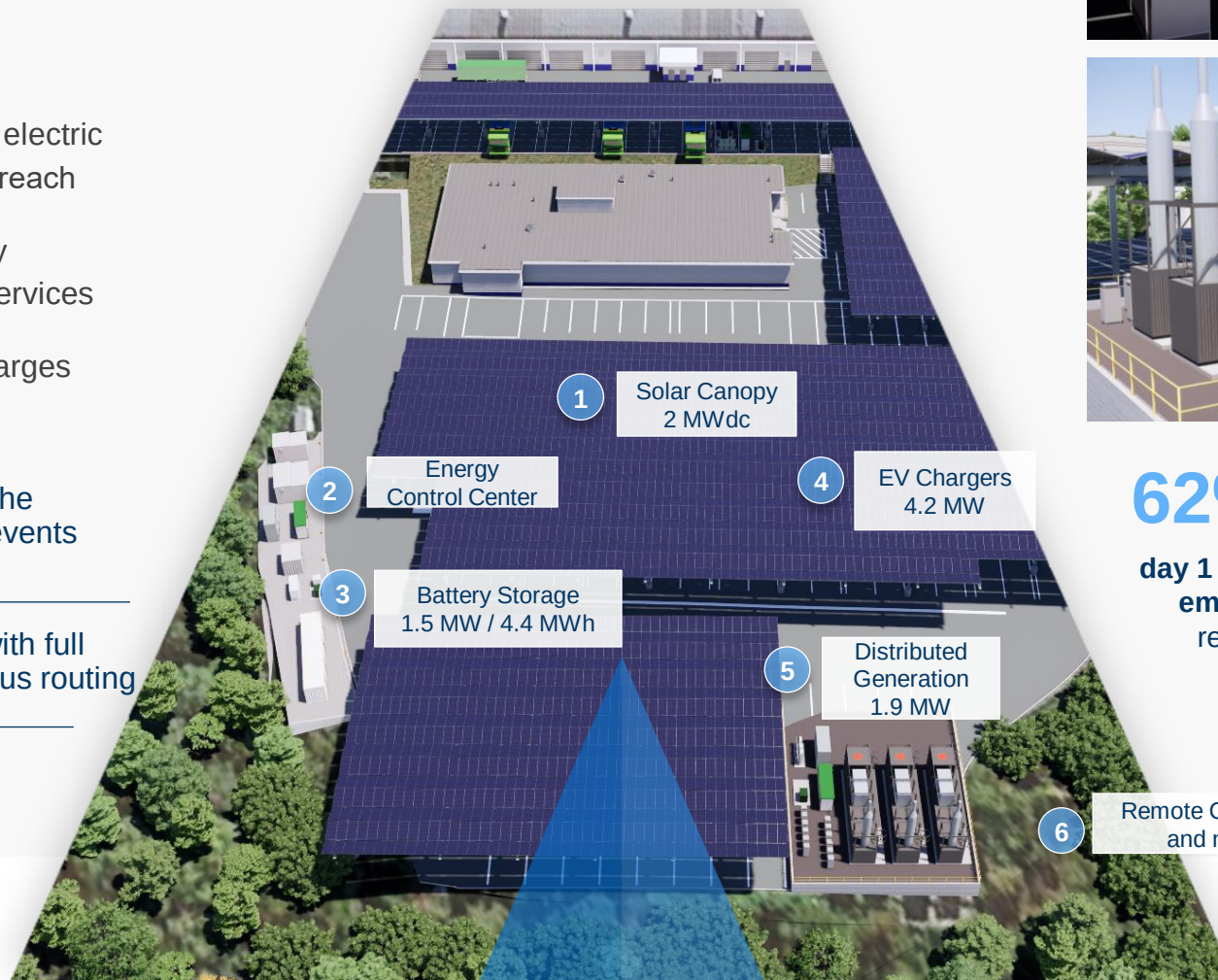
Uninterrupted service in the event of extreme weather events or power outages



Operational flexibility with full control over dispatch and bus routing



Avoid utility tariffs and demand charges



1 Solar Canopy
2 MWdc

2 Energy
Control Center

3 Battery Storage
1.5 MW / 4.4 MWh

4 EV Chargers
4.2 MW

5 Distributed
Generation
1.9 MW

6 Remote Control: ASX Integrate digital platform
and network operations center (NOC)



62%↓

day 1 carbon
emissions
reduction

155K+ tons

of lifetime greenhouse
gas benefits

CASE STUDY

JFK New Terminal One Microgrid

NYC, NY

Challenge:

- Deep decarbonization by 2030; NYC Local Law 97
- Maximize onsite renewable energy
- Ensure uninterrupted terminal services under any power circumstances – no uncovered hours
- Avoid utility tariffs and demand charges

Results:



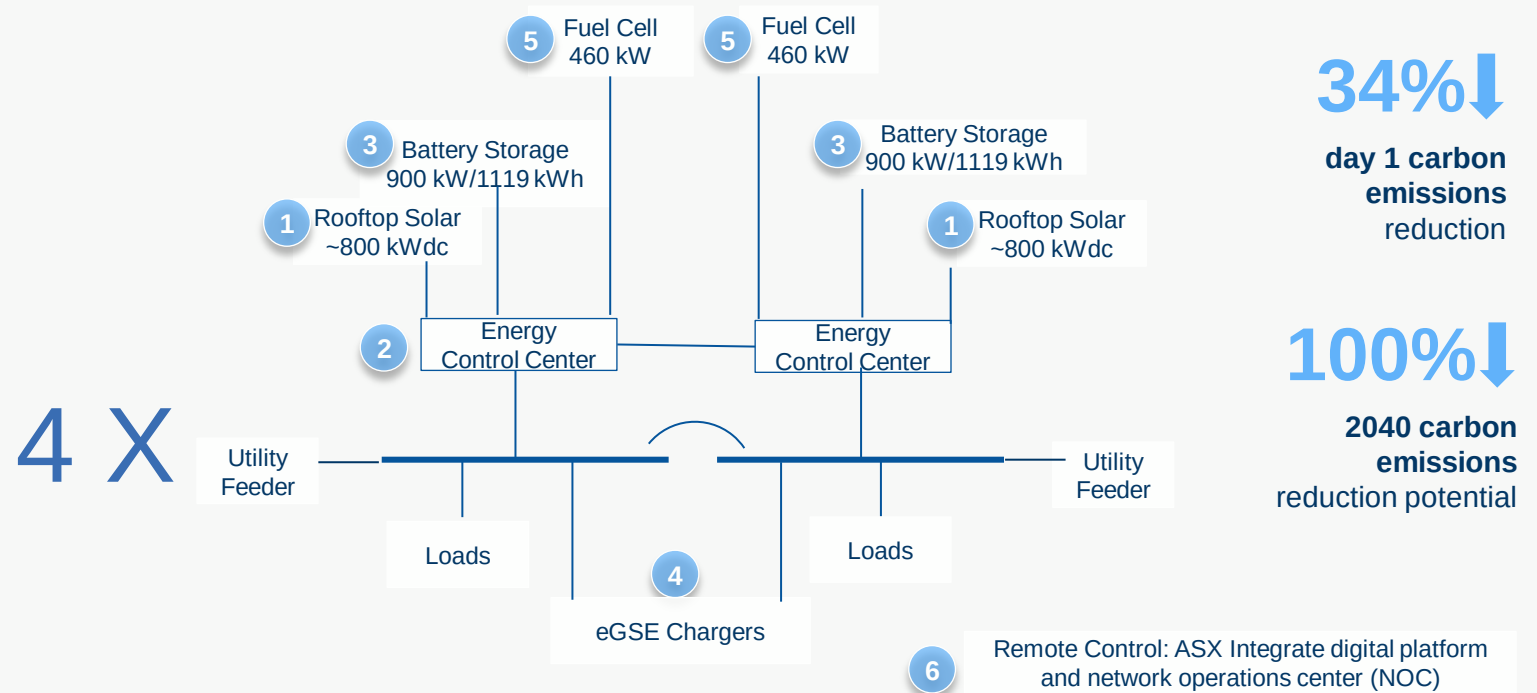
Uninterrupted service in the event of extreme weather events or power outages



Operational flexibility with full control over energy dispatch



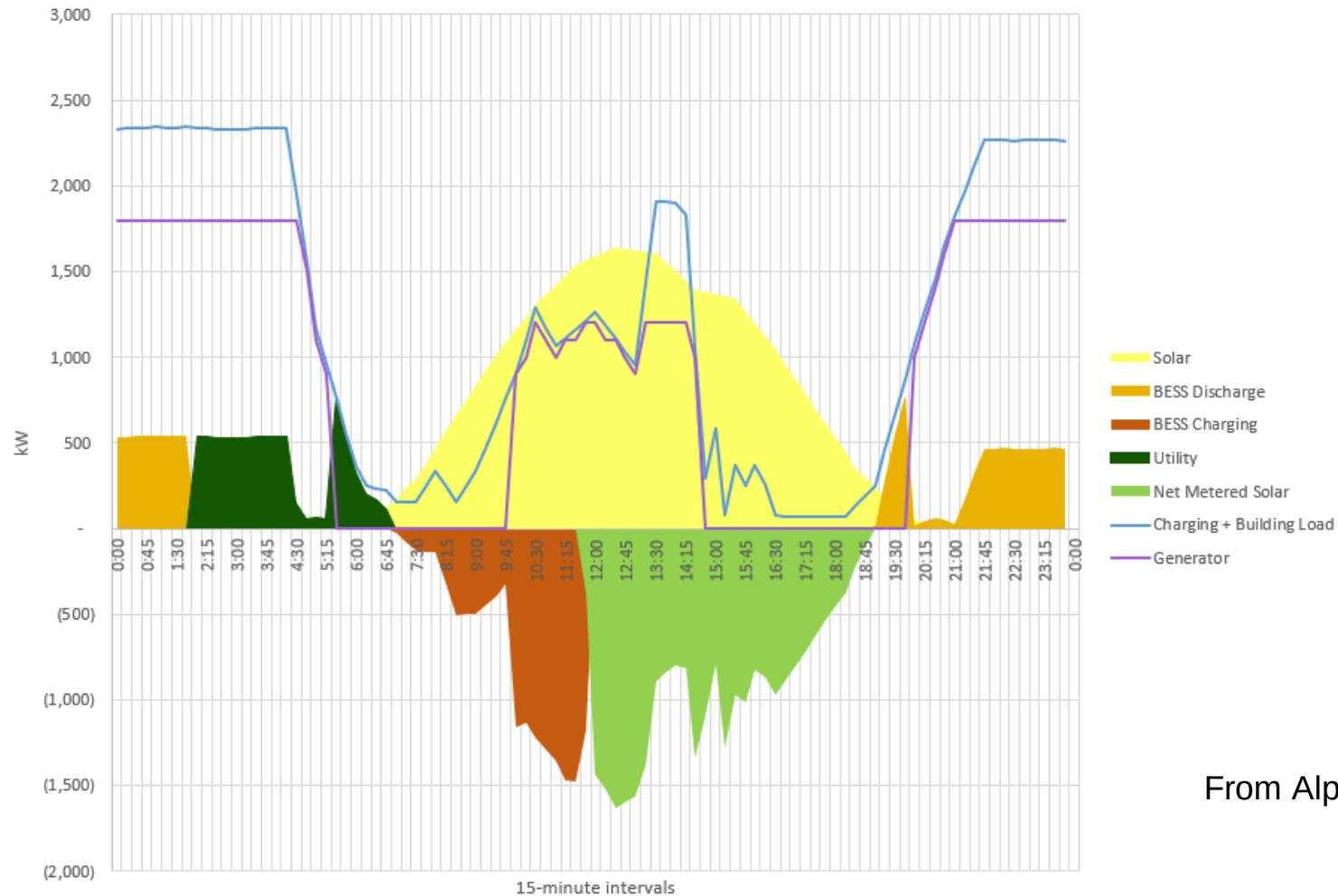
Avoid utility tariffs and demand charges



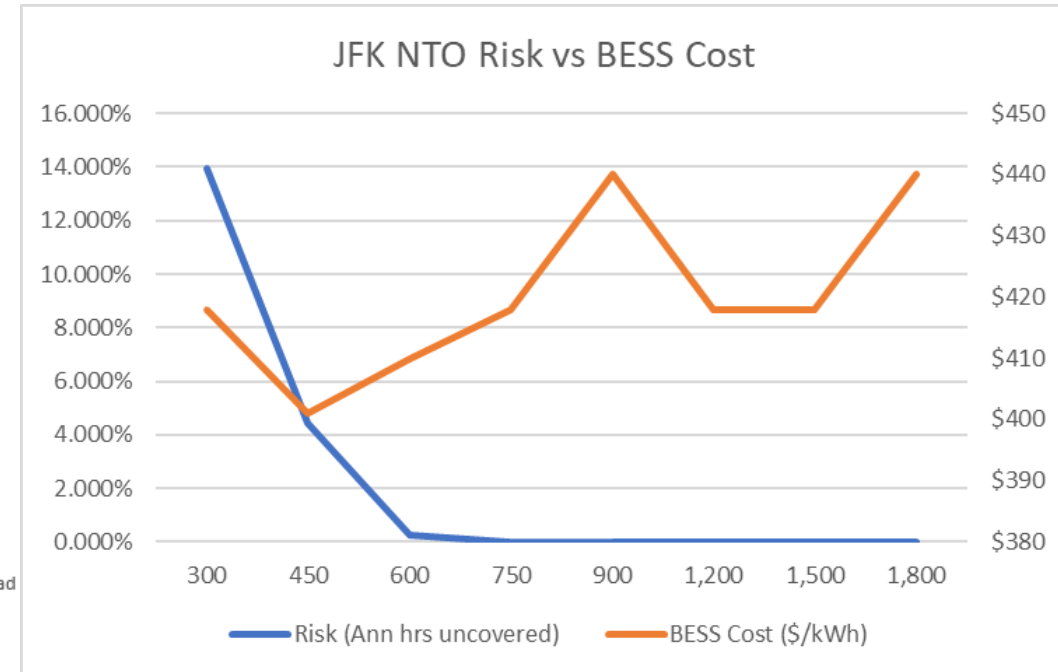
Energy Modeling

Key to sizing BESS for Reliability

Brookville 70 Buses Energy Model



JFK NTO Risk vs BESS Cost



From AlphaStruxure Interval Data Analysis Tool (IDAT) and Use Cases

AlphaStruxure

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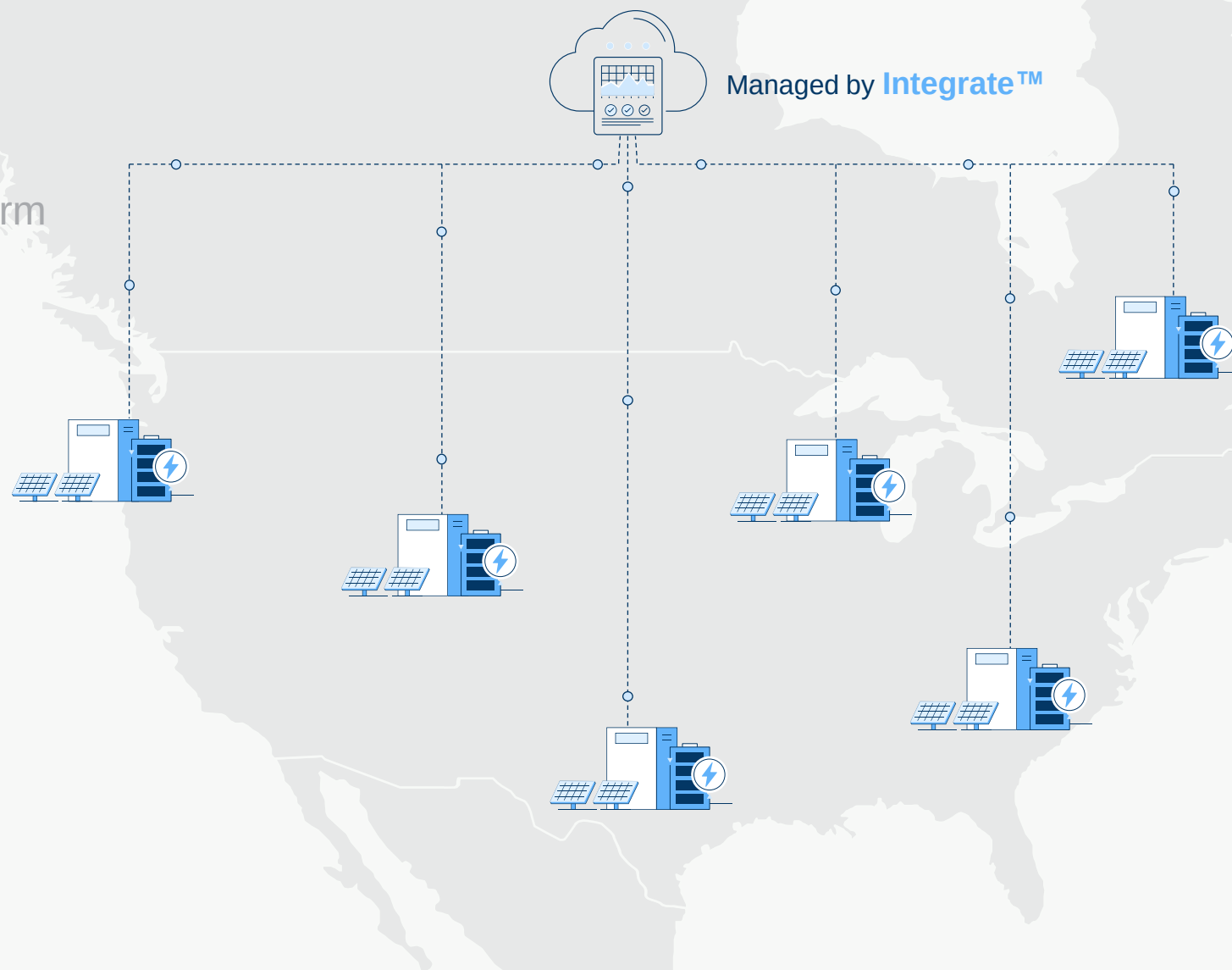
Integrate™ by AlphaStruxure

End-to-end, multi-microgrid digital platform

Integrate™ is our end-to-end, multi-microgrid digital platform that monitors, operates and optimizes tailored energy infrastructure. The platform leverages, best in class technology to deliver long-term outcomes on resilience, reliability, greenhouse gas reduction, and cost predictability. **Integrate** drives enhanced performance of on-site energy infrastructure through data science, predictive analytics, and repeatable processes.

Purpose-built features:

- Visibility into key performance metrics for clients, investors, and partners
- Digitally manages the design, build, operate and maintain phases of the microgrid lifecycle
- Secure 24/7 operations through the **Integrate** network operation center (NOC)
- Cyber secure for data protection and threat detection



Integrate™ customer experience

Real-time visibility into key performance metrics for on-site energy infrastructure

Cybersecurity

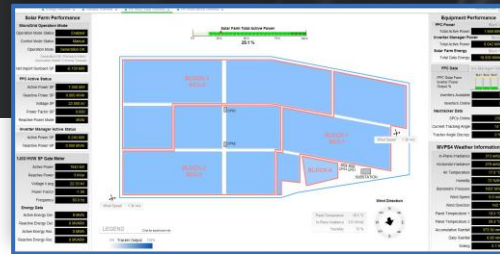
Operational Security

Key Performance Metrics

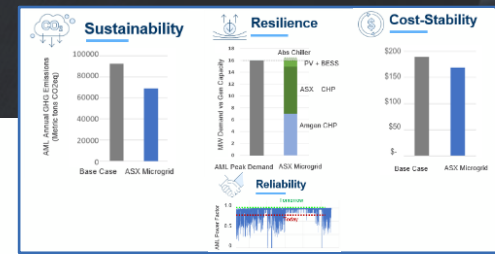
Project Lifecycle Management



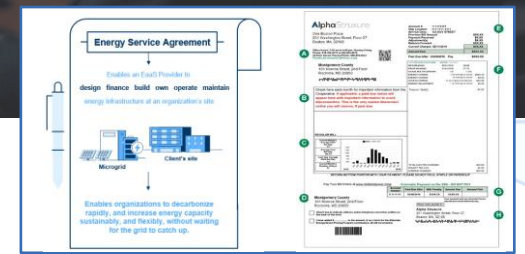
1. Fleet and Site View



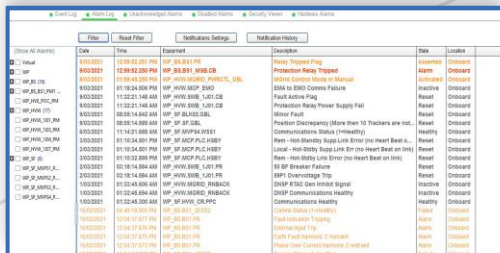
2. Live and Key Performance Insights



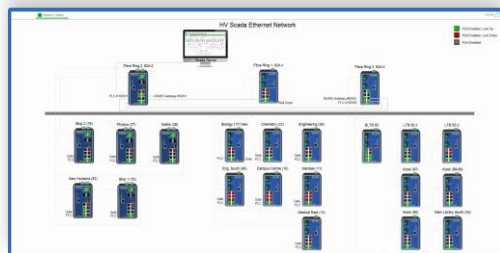
3. Sustainability, Resilience, Reliability and Cost-Stability Impact



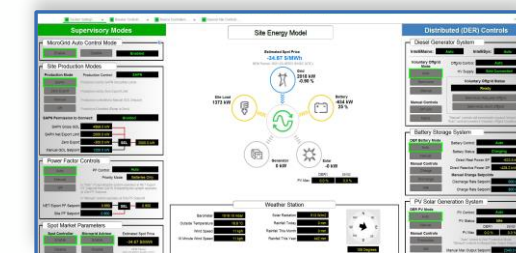
4. Contract, Metering, Billing Management



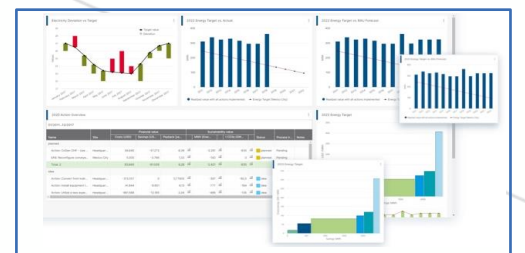
5. Customer Support Alerts and Events



6. Assets and OEM Management
Maintenance scheduling



7. Energy and Power Management



7. Compliance Management and Reporting