Facility Integrated Resiliency Model (FIRM)

How operational efficiency, security and reliability form the three pillars of resiliency.

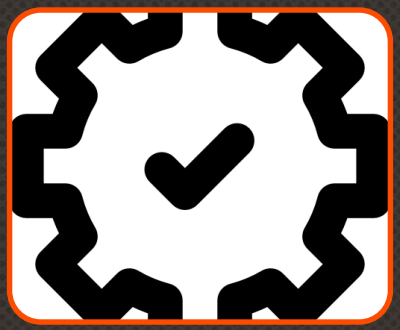
September 27, 2018

Topics

- Who we are
- Resilience Definition
- What's driving the concern over resiliency?
- Trends and Convergence
- Three Pillars of Resilience
- Resilience Sequencing
- Case studies

Who we are

Southland Industries



Energy Efficiency

- Energy Master Planning
- Audits
- System Optimization
- Sustainability Planning
- Energy Simulations & Modeling

Energy Security

- Backup Generation
- Thermal Storage Systems
- Co-generation
- Redundancy Designs
- Cybersecurity (RMF)

Energy Reliability

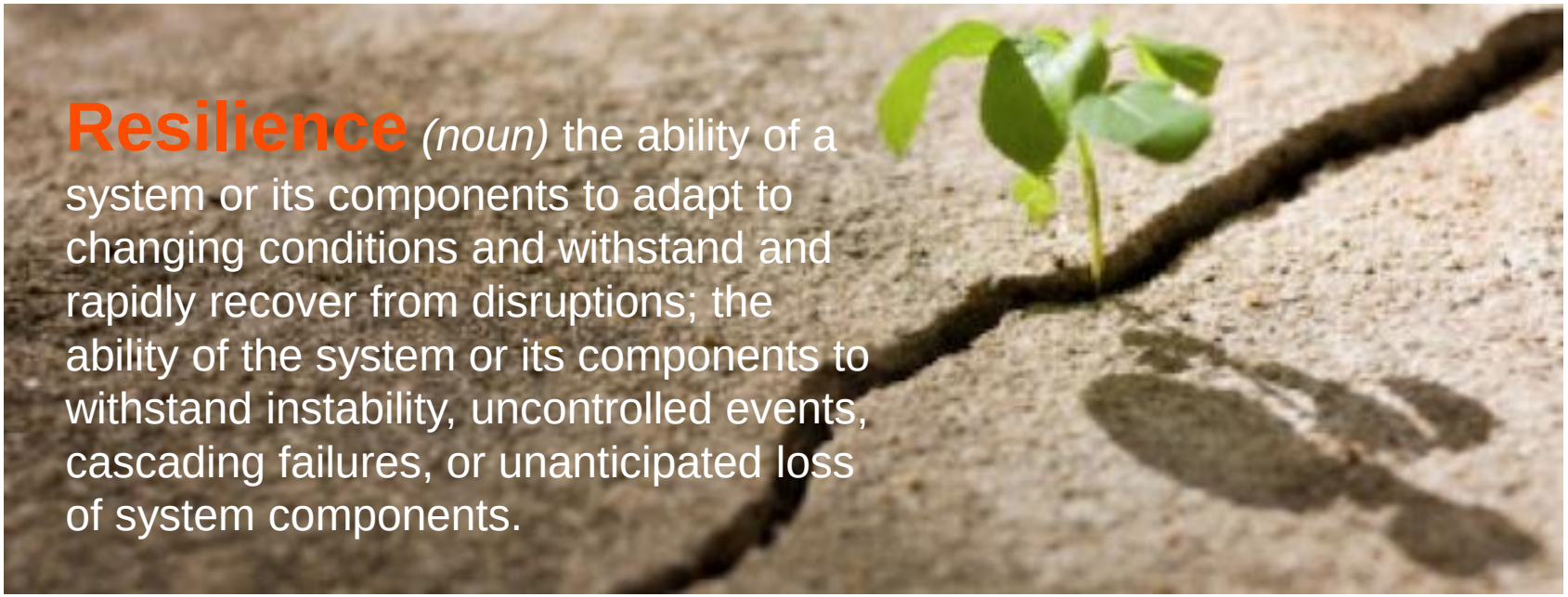
- Power Quality Analysis
- Building Metering
- Utility Analysis
- Measurement & Verification
- Performance Analysis
- Building Analytics

Operations & Maintenance

- Mechanical Service
- Building Automation Service
- Continuous Commissioning
- Repair & Replacement (R&R)

Resilience Definition

Efficiency, Reliability & Security



Resilience *(noun)* the ability of a system or its components to adapt to changing conditions and withstand and rapidly recover from disruptions; the ability of the system or its components to withstand instability, uncontrolled events, cascading failures, or unanticipated loss of system components.

What's driving the concern over resiliency?

The buzzword that everyone is talking about

Military's realization that their operational capabilities hinge on their facilities

- Force readiness isn't just about manpower and combat equipment anymore

Recent hurricanes in TX, FL, Puerto Rico rendered many organizations non-functional for extended periods

- Schools, cities, state agencies all shut down for days or even weeks
- Commercial companies shut down or severely impaired
- Concern that severe weather events will become more common in the future
- Hospital/Healthcare

Stuff is just plain getting old

- Peak load days increasingly drive demand strain on the Texas electrical grid
- Client infrastructure isn't always upgraded at the pace needed
- Equipment failures are becoming more frequent, and are never convenient!

What's driving the concern over resiliency?

Cybersecurity in facility systems

Cyber attacks on utility and industrial control systems are common

- Very advanced "hacker toolsets" developed specifically to attack industrial PLC systems
- Stuxnet is the best-known example, but there are many others

Fortunately, facility automation is seldom a target; their security standards are often appalling

- The systems themselves are vulnerable
- Lax standards for security policy and protocols for things like password protection
- IT departments are seldom familiar with facility automation; not their area of expertise

Military considers cybersecurity of facility automation to be mission critical

- DOD now requiring Risk Management Framework (RMF) certification on all automation systems

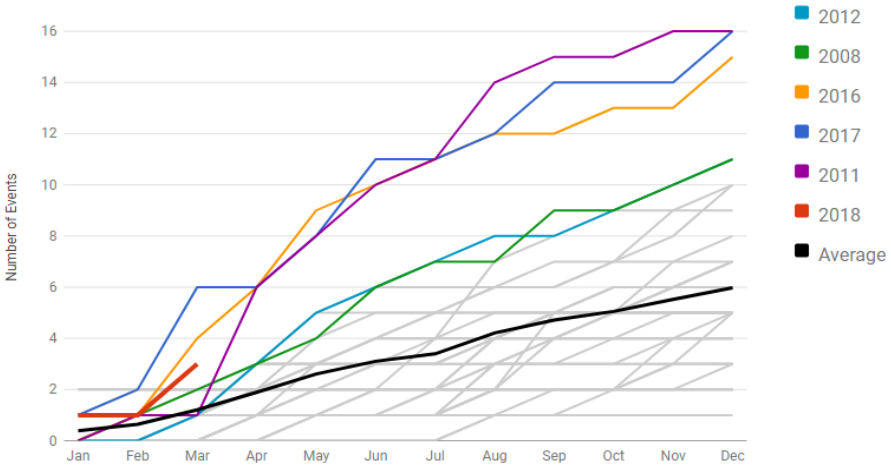
Trends and Convergence

GLOBAL TRENDS

Progress, threats and opportunities

- Digitalization is driving demand for more reliable power, in expanding locations Cybersecurity is becoming a facility issue
- Extreme weather events are becoming more common – “Billion-Dollar” disaster events rising (Fig. 1 – Right)
- Connected systems expose customers to external cyber threats
- International and domestic terrorism are on the rise
- Advancements in technology are enabling consumers to cost-effectively pursue energy resiliency
- **24 T**rillion project**ed to be spent on resiliency by 2040**

RESULT – Consumers are pursuing energy resiliency as their demand for reliable power grows



Statistics valid as of April 6, 2018.

Figure 1- US Billion-Dollar Disaster Event Frequency over 10-Years (CPI-Adjusted)
https://www.ncdc.noaa.gov/billions/

Trends and Convergence

Commercial & Industrial Trends

Resiliency / reliability of operations is increasingly important

- Increased demand for more reliable power
- Increased customer capability and sophistication
- Increased communication / interaction with utility providers

RESULT – The market is maturing from simple energy efficiency to energy resiliency as cost-effective generation opportunities present themselves

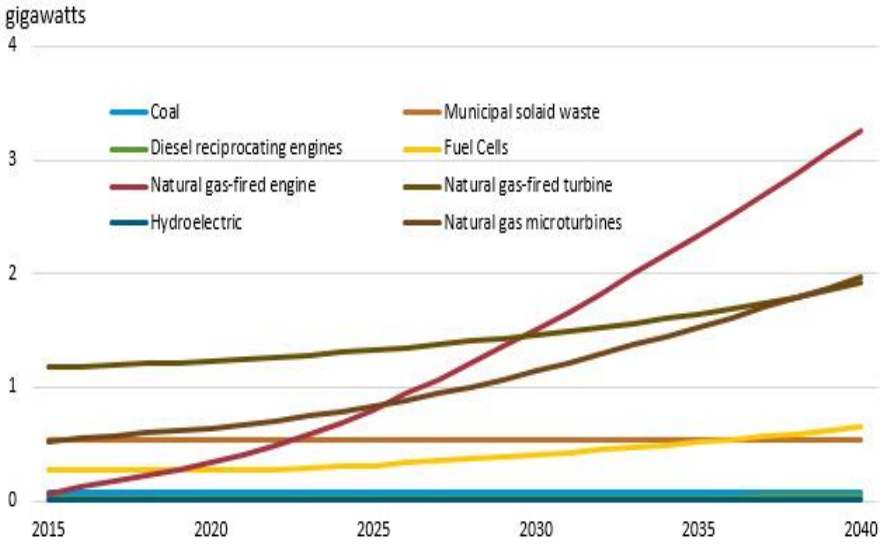


Figure 2 - Installed buildings sector non-renewable DG capacity forecast https://www.eia.gov/outlooks/aeo/nems/2017/buildings/

Trends and Convergence

All roads lead to efficiency and resiliency

Energy efficiency remains a high-priority policy for many clients

- Reduces cost; often self-financing
- Meets client policy goals for reduced energy use and emissions
- Lack of maintenance and upgrade funding is a chronic problem, reducing equipment life and reliability

Resiliency / reliability of operations is increasingly important

- Natural disasters (hurricanes, floods, etc) have impaired or destroyed the ability of many organizations to perform core functions for extended periods
- Texas grid stability is a concern in some areas due to increasing peak demand
- Cybersecurity is becoming a facility issue
- Acute awareness of resiliency issue within the military, school districts, municipalities

Trends and Convergence

As technology continues to advance…

We live in a more and more connected world

Analytics are becoming more powerful

- Demand anticipation
- Equipment failure prediction
- Energy comparative benchmarking
- Real time pricing and client response

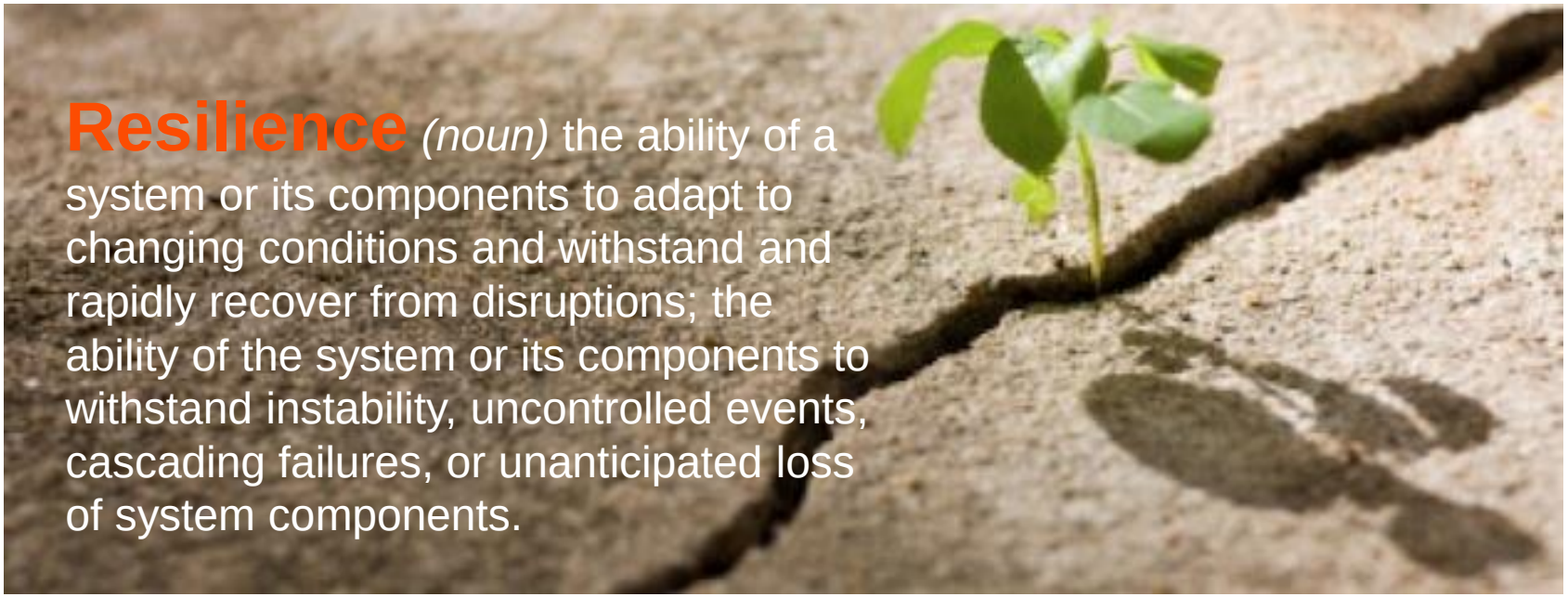
Growing complexity in facility-level networking

- Advanced automation systems / Open systems / Integration
- Multiple assets (generation, demand response, battery storage, TES) within a facility can now act in a coordinated fashion
- Programming platforms and network protocols manage and monitor mechanical and electrical reality on the ground

These trends overlap and interact in complex ways

Resilience Definition

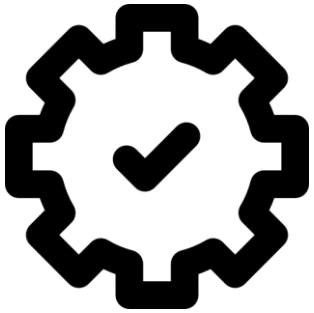
Efficiency, Reliability & Security



Resilience *(noun)* the ability of a system or its components to adapt to changing conditions and withstand and rapidly recover from disruptions; the ability of the system or its components to withstand instability, uncontrolled events, cascading failures, or unanticipated loss of system components.

Three Pillars of Resilience

Efficiency, Reliability & Security



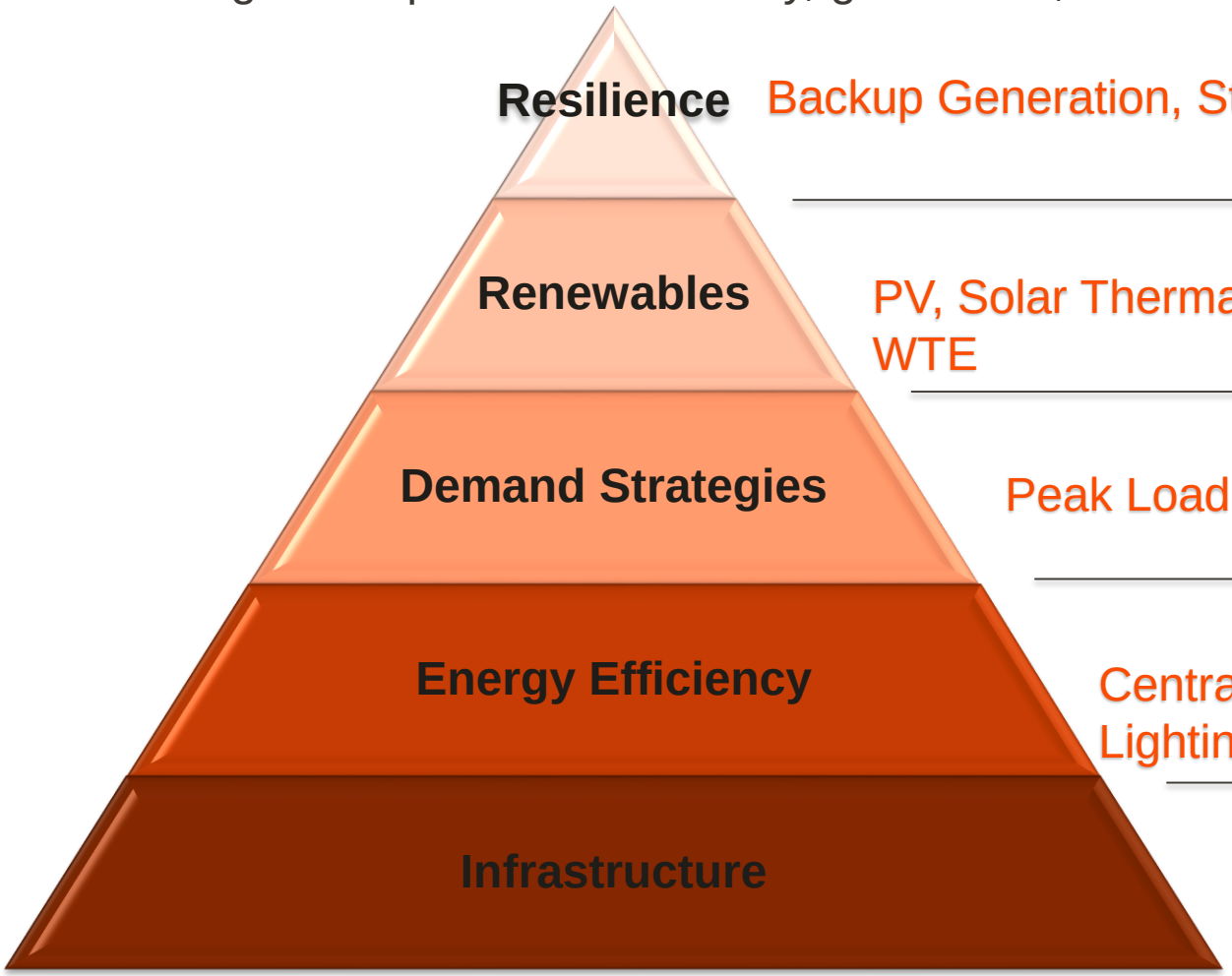
Efficiency is the state or quality of being efficient, or able to accomplish something with the least waste of time and effort; competency in performance.

Security the uninterrupted availability of energy sources at an affordable price. The ability of a system or its components to withstand attacks (including physical and cyber incidents) on its integrity and operations.

Reliability is the ability of an apparatus, machine, or system to consistently perform its intended or required function or mission, on demand and without degradation or failure.

Resilience Sequencing

The logical sequence of efficiency, generation, demand response & resiliency



Backup Generation, Storage and Microgrid

PV, Solar Thermal, Green Power, Biogas, WTE

Peak Load Control, DR & ADR

Central Plants / HVAC / Lighting / Envelope

IT / BMS / Electrical / Mechanical

Resilience Sequencing

The logical sequence of efficiency, generation, demand response & resiliency

1. Determine baseline needs and patterns

- Determine if infrastructure is adequate
- Gather all utility consumption records
- Survey all energy consuming equipment
- Identify critical loads
- Identify operational energy needs
- Determine the level of reliability needed

2. Implement efficiency measures

- Use energy as efficiently as possible; smallest load
- Reducing load lowers the cost of serving that load
- Reducing load improves the ability of installed equipment to serve it reliably

3. Determine on-site generation needs

- Cogeneration
- Solar / battery storage
- “Exotics” (waste-to-energy)
- Target appropriate level of redundancy (N+1) for major equipment, generation assets, electrical feeders / transformers and other mission-critical items
- Ensure assets are physically secure

Resilience Sequencing

The logical sequence of efficiency, generation, demand response & resiliency

4. Integrate installed and existing assets

- Network-wide integration of facility automation, generation controllers, storage, switchgear
- This is the definition of “microgrid”
- Ensure systems are electronically secure

5. Operate, Maintain, Repair and Replace

- Maintaining your primary mission remains Job 1
- Use demand mitigation strategies to improve efficiency and reliability
- Integrate predictive analytics into maintenance strategies
- Staff training is crucial; alternatively, outsource operations and / or maintenance

Case Studies

Riverside County Regional Medical Center

Riverside County Regional Medical Center installed two new 750KW co-generation units that produce 1.5MW of electricity. The 10,000 ton-hour thermal storage system adjacent to the new co-generation equipment yard. The thermal storage system is charged during off-peak periods when energy costs are low and cools the hospital during peak hours when energy costs are highest.

Project Highlights

- Two 750kw co-generation units providing 1,500 KW.
- 10,000-ton/hour thermal storage system.
- Installed an automatic revolving door system at the north east exterior entrance location located between the emergency wing and the main hospital provides improved occupant comfort and energy savings.

Chabot Las-Positas Community College District – Hayword, CA

Chabot Las-Positas installed two new energy efficient thermal ice storage central plants with chilled and hot water underground loop piping for two campuses. The Chabot included three Ajax natural gas fired high-efficiency hot water boilers, two 650-ton high-efficiency Trane chillers, 36 CalMac ice storage tanks with 6,840 ton-hours of cooling, and two Evapco cooling towers with VFDs located in a new central plant.

Las Positas included a new 3,600sqft CUP with two 300-ton high-efficiency Trane chillers, 21 CalMac ice storage tanks with 3,040 ton-hours of cooling, and two Ajax natural gas fired high-efficiency boilers with future capacity.

Project Highlights

- 1,661,189 kWh/yr and 122, 304 therm/yr in central plant savings, $653,884 energy rebate from utility.
- Upgraded DDC provides real-time monitoring and control saving 287,141 kWh/yr and 24,400 therm/yr, $78,226 energy rebate from utility.

Los Angeles Pierce College – Woodland Hills, CA

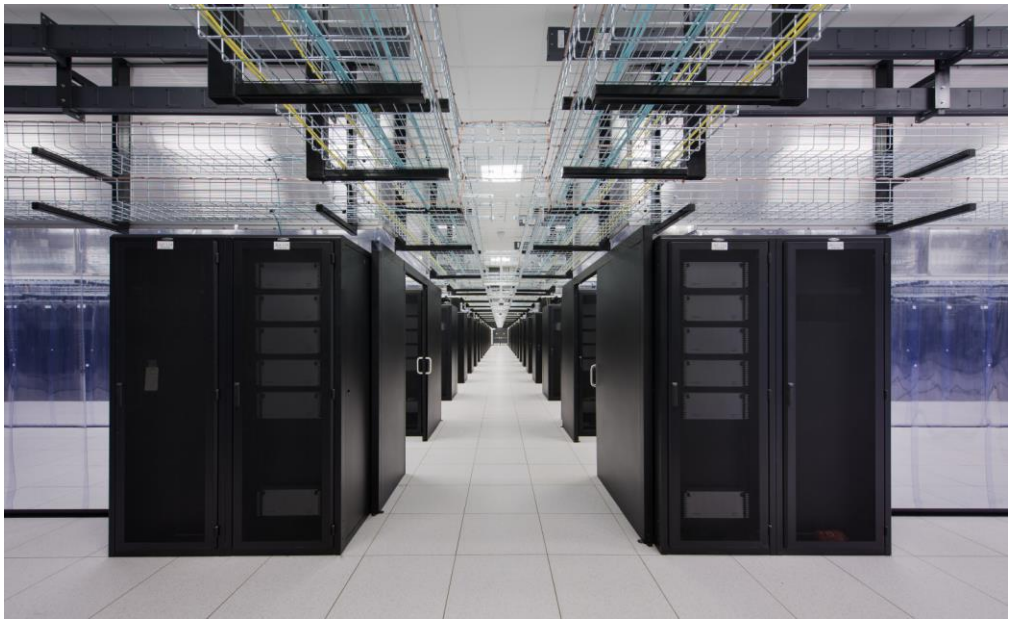
The Near Net-Zero design uses solar thermal power to generate heating and cooling for the new O&M building and horticultural buildings, which house the a gardening area, offices, administrative space, and electrical, plumbing, and carpentry shops. The infrastructure design provides for future solar thermal evacuated tube collectors and expansion provisions.

Project Highlights

- Energy efficiency: lighting and lighting controls, water conservation, HVAC, demand response, building controls, central plant, waste, and building envelope.
- Reliability: Two 2,000 MBH boilers as backup for the solar thermal system when hot water is not being generated with a 42,000 gallon underground solar hot water storage tank.
- Renewable: 189 kW of solar photovoltaic.

SSA National Support Center – Urbana MD

SSA National Support Center constructed a 285,000 square foot data center facility that contains 55,000 square feet of white space, an office building, and an access control center. The Tier III data center supports approximately 10 MW of IT load and replaces the administration's previous data center in Woodlawn, Maryland.



Project Highlights

- Uptime Tier III certified central utility plant equipment, computer room air handlers (CRAH), and chilled water distribution with N+2 redundancy requirements.
- Active chilled water thermal energy storage system to provide at least 15 minutes of chilled water capacity when switching from utility to generator power.
- Cooling tower basin design provides 72 hours of makeup water storage for cooling tower operation in the event of a water main failure.
- Largest installed single zone system in the United States.

Dallas VA Medical Center

Project Highlights

- Combined Heat and Power (CHP) plant with tie-in to the existing central steam plant for the Veterans Affairs Medical Center (VAMC) in Dallas, Texas.
- High pressure, natural gas turbine style generator that produces 4.5 MW of electricity.
- Heat is recovered through a 35,000 PPH heat recovery steam generator (HRSG) with a tri-fuel (bio-diesel, natural gas or fuel oil) duct burner to produce high pressure steam.
- Interconnection of high pressure steam (125-psig) into an existing building heating, cooling and domestic water systems without impacting ongoing facility operations

- To enhance energy security, the design-build solution incorporated the capability for the gas turbine to operate in an “island mode” configuration. This included a new 500 kW black-start diesel engine generator to provide start-up power to the CHP in a case of a loss of utility power.

Carl R. Darnell Army Medical Center – Fort Hood, TX

Project Highlights

- Received “Lonestar and US Army Corps of Engineers” awards for outstanding safety.
- 100% dedicated outside air HVAC system in all patient care areas to achieve superior indoor air quality and exceptional energy efficiency.
- Remote 5,220-ton CUP with high efficiency heating and cooling including heat recovery chillers, high efficiency centrifugal chillers, and boiler stack economizers.
- Exceeds the 30% minimum energy reduction over ASHRAE Standard 90.1.
- An Energy Independence Security Act (EISA) compliant building that achieves a 55% reduction in energy use over the existing hospital.
- Water efficient design that achieves a 30% reduction in domestic water use.
- Biosafety Laboratory level 2 and 3 spaces integrated into the facility.
- 30,000 square foot radiant cooling/heating system embedded into the atrium floor.

Innovation

- Ability to minimize water usage by 30% and maximize energy conservation proved to be a critical element due to the severe droughts Fort Hood is susceptible to from the dry and hot climates.

Questions?