

U.S. Department of Agriculture Forest Service Pacific Southwest Region (Region 5)

CASE STUDY



Challenge

From clean air and fresh water to recreational activities and wildlife habitats, everyone benefits from U.S. forests and grasslands.

The U.S. Forest Service (USFS), an agency of the U.S. Department of Agriculture, stewards 193 million acres across the country's 154 National Forests and 20 National Grasslands. However, forests and grasslands are greatly imperiled by wildfires. According to the State of California, wildfires destroyed over 4.2 million acres of land in the state, and damaged or destroyed nearly 10,500 structures in 2020.

The USFS selected five fire facilities in five National Forests in California for a solar-energy and lighting-upgrade project. Facilities were selected based on a lifecycle cost assessment conducted as part of Trane's Investment Grade Audit. Each site is remote and off-grid, and had been relying on truck-delivered propane or diesel for generators that provided electricity and directly powered on-site equipment.

Having most sites operating aging and often over-sized generators 24 hours per day, 7 days per week during seasonal operation created a host of problems, ranging from rising fuel costs and frequent re-deliveries to escalating maintenance and service expenses. Also, unexpected generator breakdowns, with no backup in some cases, jeopardized the fire stations' mission, while burning fossil fuels increased greenhouse gas (GHG) emissions.

By embracing renewable energy sources, the USFS was able to decrease its dependence on traditional energy supplies and improve operational efficiency. The USFS approach also directly advances its progress toward federal sustainability goals.

United States Forest Service
Region 5 Regional Office
Vallejo, CA 94592

PROJECT HIGHLIGHTS

CHALLENGE

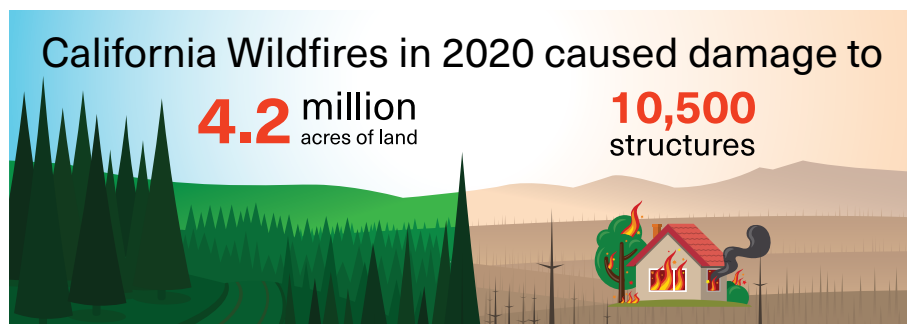
- Sustainably powered electricity and on-site equipment
- Greenhouse gas (GHG) emissions
- Federal sustainability goals
- Protection of National Forests and Grasslands

SOLUTION

- Public- and private-sector partnership
- Adaptable, self-sustaining and customized off-grid mobile solar photovoltaic (PV) systems and LED lighting
- Collaboration, knowledge-sharing and cross-team motivation

RESULTS

- Improved power-system function and independence
- Reduced health, safety and environmental risks
- Nearly \$3.8 million total guaranteed cost savings over a 22-year performance period
- GHG-emission declines to barely zero
- Progress toward federal-sustainability and similar targets



Source: State of California

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Solution

Throughout the USFS's more than 100-year history, ongoing improvements and progress have been critical to its ability to meet natural-resource management goals. Today, agile and adaptable practices – coupled with the best available science and technology – are paving the way to achieving those goals across National Forests and Grasslands.

Unleashing the Power of Solar Systems

Experience creating innovative systems that generate, store and supply solar energy, even at the most remote sites, was among the capabilities that distinguished Trane® for the Region 5 project. It also brought a new dimension to the USFS-Trane relationship. Trane previously installed a chiller and boiler, as well as controls, as part of the USFS's Seed Nursery project in Placerville, California. The facility is the only Northern California seed nursery that grows seedlings for reforestation after fires.

Off-grid mobile solar photovoltaic (PV) systems and LED lighting met the unique energy needs for the Region 5 project at the following five fire facilities:

- Cleveland National Forest – Pine Hills Fire Station
- Los Padres National Forest – Pacific Valley Ranger Station
- Mendocino National Forest – Soda Creek Fire Station
- Plumas National Forest – Frenchman Fire Station and Work Center
- Sequoia National Forest – Blackrock Fire Station and Work Center

The project, which was performed from May 2018 to November 2019, was the first USFS project to receive a Department of Energy Assisting Federal Facilities with Energy Conservation Technologies (DOE AFFECT) grant. It was also the second Energy Savings Performance Contract (ESPC) ENABLE project for Region 5, and the first General Services Administration (GSA) ENABLE project for Trane.



ESPCs allow federal agencies to make energy-saving facility improvements with no upfront capital costs. Project costs are paid by guaranteed energy cost savings. ENABLE is the streamlined process for completing ESPCs using a select group of pre-approved GSA Schedule contract holders.



Building Momentum Through Teamwork

From start to finish, the project was a model for collaboration, knowledge-sharing and motivation across the more than 50-member USFS and Trane team spanning the State of California. In fact, 31 buildings, including fire stations, living quarters, administrative offices and recreational facilities, were included, collectively occupying nearly 32,000 square feet.

The project also benefited from the Department of Energy's upfront budgeting and site-auditing support, as well as the National Renewable Energy Laboratory's evaluation of system performance and battery technologies.



Awards and Recognition

- 2020 Federal Energy Management Program's (FEMP) Federal Energy and Water Management Award
- 2019 FEMP FEDS Spotlight Award
- 2019 Forest Service Region 5 Regional Forester's Honor Award

The project was also presented before the FEMP Renewable Energy Work Group in 2020.

2020 Department of Energy FEMP Energy and Water Management Award winners are included in the link below:

<https://www.energy.gov/eere/femp/2020-federal-energy-and-water-management-award-winners>

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Moving Beyond the One-Size-Fits-All Model

The project – off-grid mobile solar PV systems, battery backup and LED lighting across multiple locations – was a first-of-its-kind undertaking for the USFS and Trane. It was also a type of project, in terms of magnitude, that had yet to be successfully completed by any other company or organization.

Trane's cross-team collaboration and blend of complementary resources resulted in systems customized to each site's specific needs and requirements. They also led to project goals being achieved without interrupting day-to-day site operations.

Remote site locations and inclement weather made system design, construction and timing for each of the five sites especially high priorities. Varying altitudes – from sea level to 9,000 feet – and weather conditions – from heatwaves and snow storms to typical wind and rain – mandated that systems be resilient and easily transportable by trailers to sites for assembly and installation. Systems also needed to be able to be quickly disassembled and removed should a fire threaten the site.

Key to the on-site assembly feature, and lower installation costs, was Trane's proactive approach that included providing as much pre-fabricated, factory-tested and assembly-ready equipment as possible before transportation to the sites.

Lighting upgrades at each site were also made. They consisted of replacing inefficient florescent fixtures and incandescent bulbs with LED lighting, resulting in lower energy use.

“We are no longer dependent on generators as primary power sources for the stations. Using generators only as a backup eliminates a significant amount of fuel-delivery trips to remote locations and reduces their higher delivery costs.”

- **Phillip Hoover**, Engine Captain, Upper Lake Ranger District, Mendocino National Forest

Key Advantages to Off-Grid Mobile Solar PV Systems



Functionality in remote locations



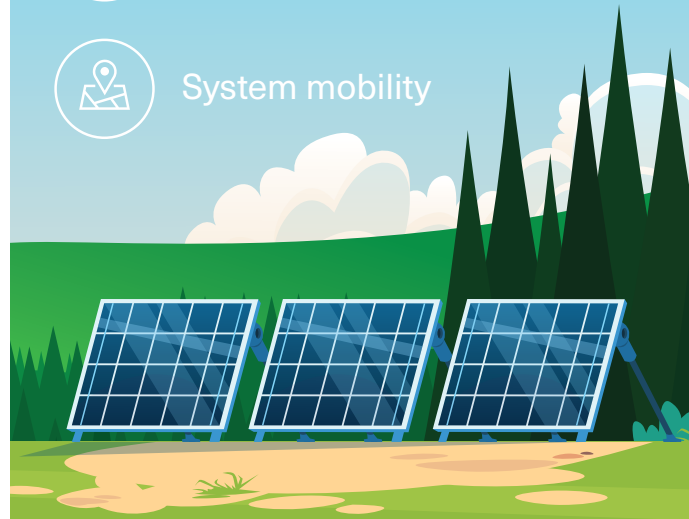
Energy and cost efficiencies



Resilience with two energy sources



System mobility



Placing a Premium on Performance

Functionality in remote locations, energy and cost efficiencies, and mobility were key advantages that made off-grid mobile solar PV systems the best solution for this subset of Region 5 facilities.

Rather than having generators operating 24 hours per day, 7 days per week, the systems rely on batteries to store electricity generated by solar panels during the day when the sun is out and electricity demand is low. Electricity is then banked in the batteries for use when the system is not generating enough power to sustain facility functions, such as at night. The self-sustaining system is also ideally suited for remote locations, where grid-tied connections are either limited, unstable or not accessible.

Research, planning and teamwork were driving forces when selecting and customizing the following core system components that made the project an all-around success (totals for all five facilities):

- PV Panels: 115,575 watts/115.6 kW (345 panels @ 335 watts each)
- Batteries: 830 kWh (590 kWh lead acid and 240 kWh lithium)
- Charge Controllers: 26
- Inverters: 11

Each site is equipped with a backup propane- or diesel-fueled generator. Since the project was completed, systems have operated successfully. Generators are expected to be used only when needed for monthly testing and to recharge batteries during prolonged periods of cloudy or hazy weather.

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Results

Partnerships between the public and private sectors, each with their own unique skills, approaches and resources, produce exceptional results – and the resilient PV/battery system and LED lighting project was no exception. From allowing the USFS to pursue its core mission more efficiently and effectively to helping preserve the environment for future generations, the USFS Region 5 project is helping to set a new standard for sustainable facilities management in the U.S.

Operational

- Enhanced system function, reliability and resilience
- Decreased health and safety risks
- Energy independence
- Lower ambient noise and higher comfort levels

Environmental

- Declines in GHG emissions to barely zero (less fossil-fuel usage and diminished carbon footprint)
- Fewer fuel-transport deliveries and lower risk of spills
- Progress toward federal-sustainability, renewable-electricity and third-party contracting targets

Financial

- Nearly \$3.8 million total guaranteed cost savings over the performance period (under 14-year performance period, with AFFECT grant applied to 22-year simple payback)
 - 3,023 MMBtu projected annual energy savings
 - Approximately 82% renewable energy use
 - Conservatively estimated 70% or greater reduction in generator fuel at each site (depending on weather conditions and other factors), and service and replacement costs
- Improved data-monitoring and analysis

Additional results include building awareness of third-party financed energy projects and sustainable facilities solutions among USFS leadership and project staff. The project also supported U.S. businesses and products through compliance with the Buy American Act – 98.6% of total contract funds were paid to U.S. businesses.

“The project makes fire stations more self-sufficient. The energy reserve allows us to keep water wells running 24/7 and without generator noise, sites are so quiet we can hear the birds now!”

- **Phillip Hoover**, Engine Captain, Upper Lake Ranger District, Mendocino National Forest



About U.S. Forest Service (USFS)

The mission of the [Forest Service](#), an agency of the Department of Agriculture, is to sustain the health, diversity and productivity of the nation's forests and grasslands to meet the needs of present and future generations.

The agency manages 193 million acres of public land, provides assistance to state and private landowners, and maintains the largest forestry research organization in the world. Public lands the Forest Service manages contribute more than \$13 billion to the U.S. economy each year through visitor spending alone. Those same lands provide 20% of the nation's clean water supply, a value estimated at \$7.2 billion per year.

The agency also has either a direct or indirect role in stewardship of approximately 80% of the 850 million forested acres within the U.S., of which 100 million acres are urban forests where most Americans live.

Contact the Trane Federal Team at [651-407-4000](tel:651-407-4000) or TraneFederalTeam@trane.com for more information.



Trane – by Trane Technologies (NYSE: TT), a global climate innovator – creates comfortable, energy efficient indoor environments through a broad portfolio of heating, ventilating and air conditioning systems and controls, services, parts and supply. For more information, please visit trane.com or tranetechnologies.com.