Tumalow
Energy Ingenuity

What We Do

The electricity infrastructure is changing, and energy storage devices will become a critical piece of distributed electrical infrastructure. Sandia National Laboratory has identified 17 distinct and quantifiable uses for energy storage devices, including hedging electricity price volatility, improving grid resiliency, servicing costly transmission and distribution equipment, and smoothing integration of renewable energy. A growing number of industry stakeholders from utilities (Duke Energy, Consolidated Edison) to regulators (California PUC, New York PSC) to industry consultants (Deloitte, Accenture, Navigant) have reached this consensus in an otherwise contentious industry.

Energy storage devices are only useful if they are put to work intelligently. **Tumalow** develops control software for energy storage devices. We automatically optimize the use – and monetization – of energy storage by calculating the best times to charge and discharge. Figure 1 below illustrates an example in which **Tumalow** delivers three distinct energy storage applications within a single commercial building:

- ❒ **Demand Charge Reduction** – discharges the storage device to reduce the building's maximum power demands of the grid, which ***reduces the customer's electricity bill.***
- ❒ **Frequency Regulation** – responds to short duration charge/discharge requests to help balance the grid, for which ***the grid operator pays a market price*****.**
- ❒ **Demand Response** – discharges the storage device in response to the local utility company's request to curtail electrical load, ***in exchange for a contracted payment.***

❶ *Tumalow analytics predicts that both demand response and demand charge events are likely during the day. The control software begins charging the storage system.*

❷ *The storage system stops charging before it is full. The system participates in frequency regulation - generating extra revenue during this time.*

❸ *A demand response notification is received to begin curtailing load in two hours. The control software stops frequency regulation and charges the device until full.*

❹ *The control software discharges the device to curtail load per the demand response request.*

❺ *Tumalow analytics predicts an opportunity to reduce demand charges during the evening hours. The control software begins charging the storage system.*

❻ *The device discharges to reduce demand charges.*

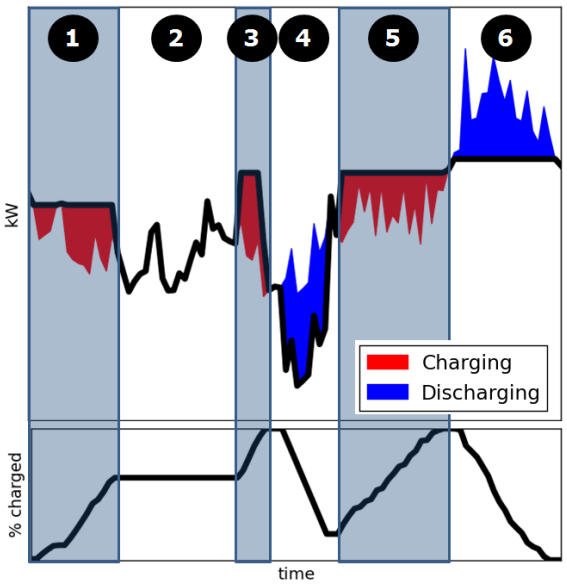
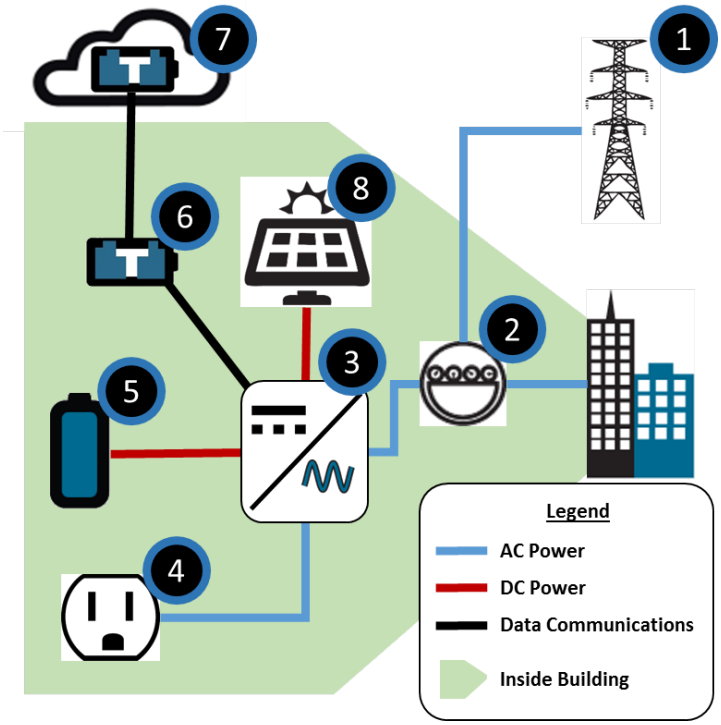


Figure 1

How We Do It

The Tumalow solution combines our cloud-based analytics and control applications and distributed control agents with industry leading battery storage systems deployed at the customer facility. Figure 2 below illustrates the logical topology and components that participate in the optimization of energy usage that **Tumalow** delivers.



❶ *Utility (grid) connection – primary source of electricity for the building, potentially also used to charge the battery system.*

❷ *Meter – existing utility meter that tracks usage for billing purposes.*

❸ *Power Conversion System (PCS) – intelligent bidirectional DC/AC inverter that mediates between the grid, the building electrical system and any local electricity source (i.e., battery or local generation).*

❹ *Electrical panel – existing breaker/fuse panel into the building's wiring infrastructure.*

❺ *Battery system – rechargeable commercial battery packs with battery management system (BMS); controlled by the TCA via the PCS.*

❻ *Tumalow Control Agent (TCA) – distributed control software that communicates with the cloud-based applications, the battery system and the Power Conversion System (PCS) to execute discharge and recharge actions.*

❼ *Tumalow analytics and control server (TACS) – cloud-based applications tracking usage, optimizing actions and supporting customer dashboard / reporting interfaces.*

❽ *Local generation source – optional on-property generating system (e.g., solar, CHP, wind, generator).*

The **Tumalow Control Agent** (TCA) collects building electrical usage based on a configurable interval, and relays that data and battery charge status to the **Tumalow Analytics and Control Server** (TACS) over a secure internet connection (e.g., 2G or higher cellular data, Ethernet, etc). The TACS maintains utility and ISO/grid operator rate and market pricing data, which it combines with the site-specific customer data to predict the optimal times and durations to discharge and recharge the battery system.

The TACS sends commands back to the TCA, which directs the PCS accordingly using standard protocols (e.g., Modbus). Depending on availability of local generating resources (e.g., solar, CHP) battery recharge may use that source or the standard grid connection.