ENCYCLE

SMARTER ENERGY

*This document is a technical whitepaper, intended for engineers and auditors, describing how Encycle's Swarm Logic™ provides savings.*

**WHITE PAPER SAVINGS**

**RESULTS POWERED BY ENCYCLE'S PATENTED**

SWARM LOGIC

# DEMAND MANAGEMENT

## EXCESSIVE COINCIDENCE LEADS TO HIGHER THAN NECESSARY PEAK DEMAND

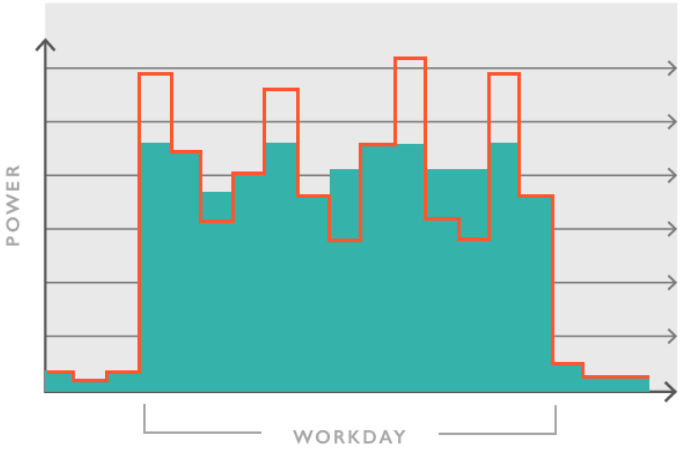
The issue at hand is a lack of system-wide coordination of HVAC loads, leading to excessive coincidence of loads that naturally occurs given the overcapacity of installed HVAC units. This coincidence occurs for brief periods of time and ultimately sets the monthly demand peaks observed by the utility meter. This peak is directly reflected as a charge on the customer's monthly energy bill. Comfort conditions could have adequately been met without all these loads operating precisely when they chose to. If the runtimes of a few HVAC units were shifted by a few minutes here and there, comfort could be maintained, the peak demand lowered, and the monthly energy bill significantly reduced.

One of the primary contributors for excessive coincidence is built-in HVAC over capacity to always ensure occupant comfort, particularly as facility operators and occupants tend to add more people and equipment than initially estimated when the building was designed. Redundancy is also built in such that if one HVAC unit fails, there is extra capacity from its neighbors to shoulder the burden.

Another key contributing factor is a lack of knowledge of the group as a whole. Conventional control systems govern cooling for each zone by only monitoring their assigned zone, and therefore have no way of avoiding inevitable situations whereby the majority of HVAC units will independently enable cooling at the same time. The implication is that while each HVAC operates independently in a reasonably efficient manner, conventional control systems do nothing to ensure that all HVAC units operate as efficiently as possible as a group to minimize demand spikes.

## ENCYCLE'S PATENTED SWARM LOGIC REDUCES PEAKS BY MANAGING LOAD VOLATILITY

The Swarm Logic approach reduces a system peak by ensuring the group works towards the goal of smoothing out its collective demand, negating the volatile swings caused by uncoordinated loads.




**DEMAND REDUCTION**

By measuring the natural duty cycle of each load under baseline conditions, the percentage of time each load needs to run during peak periods can be deduced. If each load operates at this duty cycle, and the runtime is spread out during the period (i.e. not crowded entirely to one end or another of the period), then the load will consume the same amount of power and do the same job of cooling the zone as it normally would – thereby ensuring that comfort is maintained. Swarm Logic even adapts to continuously varying circumstances, due to either rapid changes in occupancy or weather conditions.

Therefore, Swarm Logic controls the effect of the group always moving to its average. This replaces the randomness of coincidence in a system where Swarm Logic controls ensure that only the minimally required load is allowed to run at any point in time and, in turn, maximum peaks over the course of each month are reduced.

Swarm Logic has proven to optimize group behavior by reducing coincidence, and thus reduces peak demand by up to 25%.

To calculate the specific energy savings attributed to Swarm Logic, Encycle initially places a site in a baseline mode of operation, whereby load demands and cycling patterns under the building's native controls (whether that be thermostats or building automation systems) are simply observed. Baseline operation continues for a few weeks, the duration depending on the coverage of high temperatures compared to seasonal averages. After sufficient baseline data has been gathered, Encycle will calculate the maximum demand when fully running, the highest consumption during peaking periods, and the maximum optimal duty cycle.

### SWARM LOGIC LEADS TO PEAK SAVINGS

First installed with Swarm Logic controllers in 2012, retail company Living Spaces Furniture has realized notable energy savings as Swarm Logic controllers operate to smooth out the daytime demand of the HVAC units, lowering monthly peaks. An average of 20% peak load reduction has been achieved across six locations in the first half of 2015.

Movie theatres and cinemas are well suited for Swarm Logic. In 2014, Harkins Theaters in Chino Hills achieved a 27% peak reduction during the hot California summer months. This represented an average lowering of 64 kW across their 42 HVACs. In shoulder months, a reduction of 24% was realized.

## CONSUMPTION MANAGEMENT

### ERRORS IN THE OPERATING SCHEDULE LEAD TO UNNECESSARY CONSUMPTION

Facilities often inefficiently consume excess electricity outside of core occupied hours, largely in part to scheduling errors. The method of programming schedules, whether using thermostats or in a building automation system, is typically complex and tedious. Given the complexity of many control systems, accidentally setting permanent rather than one-time overrides is common, even when experienced technicians are involved.

Confirming schedules can be very time consuming if one has to walk an entire building to set each thermostat, leading to uncertainty that correct schedules have been set. It is not unusual for facility staff to forget to set some thermostats, particularly if they are interrupted during the "walk-around", or simply because there may be many thermostats to locate and some are missed.

There exists the possibility that someone at the site intentionally changed a setting that the facility operator did not intend to be altered (e.g. employees changing thermostat settings causing HVAC units to start early or remain on late), or simply because they want to change set-points for their own benefit without understanding the implications for energy costs to the facility operator.

In some cases, facility operators are not 100% certain of the location of every temperature sensor or thermostat, in which case it would be impossible to know if they have accounted for all control systems governing each HVAC unit.

It is not uncommon to find buildings where the facility operator is not sure which HVAC unit cools each zone making it very simple for an innocuous scheduling change to adversely affect a zone unintentionally.

The Swarm Logic portal provides a very simple, convenient, and fast tool for facility operators to set schedules using a calendar widget. Setting recurring vs. one-time events is simple and easy, and doing so eliminates the possibility of accidentally setting a one-time event as a recurring one.

## ENCYCLE SUB-METERING AND SCHEDULING CORRECTS INEFFICIENCIES

Encycle's sub-metering capabilities provide a direct measure of how much energy each load is consuming 24x7, ensuring that the facility operator can spot any errant activity, readily control it (by altering the simple-to-use site schedule in seconds), and easily quantify the reduction benefits. The data can be easily charted or extracted as a spreadsheet, based on date ranges, and time granularity (ranging from 5 minutes to 1 day), then drilled down to individual loads or aggregated to all loads in the building (even across a set of buildings in a portfolio). Training to view this data requires less than 5 minutes, even for novice users.

Even in the unlikely scenario that all operating schedules are perfectly set across all loads across all months; the Swarm Logic portal provides a very simple method to both implement and continuously optimize different daytime startup and overnight spin down settings. Changing settings, either by adjusting start and end times of schedules or adjusting individual load duty cycles or blower controls, typically requires less than a minute.

Overall, the ability for Encycle customers to easily visualize off-hours consumption, correct errors in existing schedules, and optimize schedule transitions between occupied and unoccupied modes allows for a persisted savings estimated at 10% of total load beyond core operating hours of the given facility.

## ENCYCLE DELIVERS CONSUMPTION SAVINGS

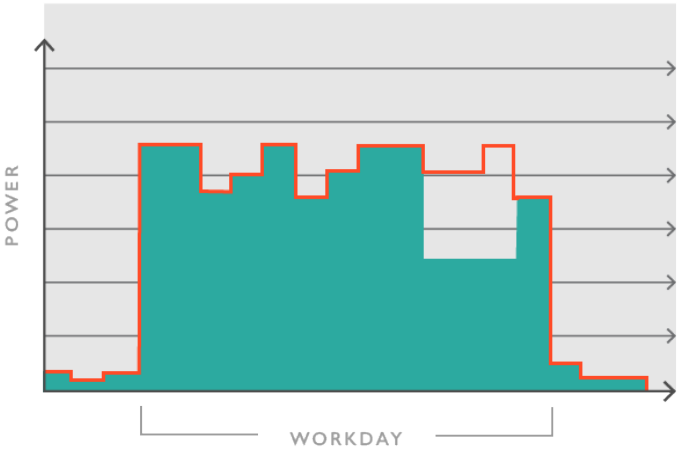
During the first half of 2015, using Encycle's Swarm Logic solution, the previously mentioned California furniture retail chain, (Living Spaces) reduced their monthly consumption by an average of 27% average across 6 stores and 127 HVAC units. Similarly, John's Incredible Pizza in Modesto has averaged 21% consumption reduction across its 240 tons of HVAC cooling in the same time period.

# INTELLIGENT DEMAND RESPONSE

Demand Response (DR) programs, managed by the utility, ask participants to shed load when the grid is overly stressed (e.g. peak hours on hot days). This plays a significant role in meeting the utility's responsibility to ensure grid stability and reliability. In return, utilities provide payments or credits each time a registered participant is able to answer the call and reduce their peak load. Funds are available to participants on a first come, first served basis until funding is depleted. These funds are new revenue stream for DR program participants.

## ENCYCLE SIMPLIFIES AUTOMATED DEMAND RESPONSE

Encycle's Intelligent Demand Response is fully automated to respond to utility DR signals. When the need for peak reduction arises, the utility will dispatch a signal to registered participants to shed load during a specific time period. Swarm Logic will automatically schedule this event and, when the time arrives, reduce the duty cycle of each controller by 10% to 20% or more depending on the building and temperature tolerances.




**DEMAND RESPONSE**

During demand response events, cooling and dehumidification is still provided even during the start of events, although on a reduced basis. Interior temperature and humidity will therefore increase, although only gradually, since loads are not fully

curtailed. This ensures minimal impact to occupant comfort and differs from traditional load limiting techniques where entire loads are shut down, which results in rapid and drastic increases in interior temperature and humidity. Furthermore, optional temperature sensors can be used and monitored to prevent exceeding customer-defined thresholds. When events complete, Swarm Logic intelligently transitions back to normal operating conditions and avoids the common post-event demand rebound effect. With traditional load limiting techniques, a rebound can occur whereby all loads re-start simultaneously to immediately bring interior temperatures back to regular set-points, and thus resulting in a higher than normal demand peak, destroying month to date peak savings. Swarm Logic avoids this problem by staggering the re-start times, such that demand does not exceed the month to date peak.

Eligibility requirements for DR programs typically span commercial, retail, industrial, and agricultural type facilities with a minimum load of 100 kW demand, and an interval meter or Smart Meter. Encycle will optionally fully manage the complex demand response program enrollment with the utility or load aggregator on the customer's behalf. This process typically includes the following tasks:

1. Technical review of the facility to determine detailed load shed potential
2. Enrollment in the DR program and application to reserve funds
3. Purchase and install eligible equipment
4. Submit DR fund request
5. Measurement and Verification (M&V) of facility curtailment capability

By participating in DR programs, customers can reduce their environmental impact through improved efficiency and automation while improving corporate social responsibility.

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