**A Methodology for Reducing Building Energy Usage**

**Introduction**
This research outlines a methodology for reducing building energy usage and improving operational efficiency. A study of Cooper Union’s engineering building, 41 Cooper Sq, shows significant laboratory ventilation and a high base load during unoccupied hours. A comparison of academic facilities and analysis of energy profiles reveals significant potential savings if HVAC usage is aligned with thermal load and occupancy.

**Motivation**
- Building sector is 32% of global energy consumption.
- LEED certification, a rating system for green construction, does not account for actual performance after completion.
- Energy Star, a benchmark to assess energy efficiency, does not address differences between buildings within a single property type.

**Methodology**

**Summarize Energy Consumption**
Capture utilization of the entire building and compare to similar properties.

**Inspect Energy Profiles**
- A large portion of energy usage goes to the air handlers located in the subcellar and on the roof.
- Additional energy is spent on conditioning outside air.

**Investigate Individual Subsystems**
Correlate energy consumption from ventilation with building hours.

- Laboratories have higher ventilation requirements independent of occupancy.
- Weekend profile reveals constant energy usage even when building is closed.

**41 Cooper Square**
Constructed in 2009, 41 Cooper Square is a 175,000 square feet academic and laboratory building on Cooper Union’s campus. Certified LEED Platinum, a state of the art building management system (BMS) operates the various subsystems. The building is cooled electrically and heated using natural gas, supplemented with a cogeneration plant producing 250 kW of electricity and 450 kW in thermal energy.

**Energy Flow**

**Efficiency Loss**

**Operational Waste**
Energy is wasted when demand exceeds the actual load. Energy load should correlate with occupancy and weather.

**Source Energy Use Intensity (EUI)**
Annual energy usage per square foot, adjusted for raw fuel type.

- Academic Buildings 262 kBTU/ft²
- Laboratories 382 kBTU/ft²

**Heating Degree Days**
Measures thermal load due to temperature variation over a given period of time.

**Degree Occupant Days**
Simultaneously account for both thermal and occupant loads.

Better daily electricity usage correlation than degree-days.

**Building energy usage can be reduced by at least 25%**.

**Recommendations**
- Reclassify spaces that are not utilized as laboratories.
- Adjust setpoints during nights and weekends.
- Recommission building to meet design intent.