Planning for a Better Tomorrow: Utilizing Accurate Models to Shape the Future
We Love a Good Puzzle

PRECONSTRUCTION / SOLUTION DEVELOPMENT
BUILD
FACILITY SERVICES
BUILDING ANALYSIS + MODELING
ENERGY + ENVIRONMENT
MANUFACTURING
BUILDING AUTOMATION
Diversity, Equity & Inclusion (DEI)

MISSION + VISION

UMC’s DEI mission is to foster a culture that welcomes a diverse group of skills, perspectives, and experiences—and empowers individuals to succeed and grow.

We are committed to creating a workplace where everyone feels safe, seen, valued, and heard.

THIS INCLUDES

- Dedicating resources to ensure UMC is a safe place for all.
- Supporting diverse trade partners and vendors so they can thrive.
- Providing education opportunities around unconscious bias.
- Establishing core actions and policies to retain talent.
- Evaluating pay equity and promotion velocity data within UMC.
- Continuous monitoring of the health of our DEI culture.
BAM!

David Park, Ph.D, PE, CEM, BEMP
BUILDING ANALYSIS & MODELING MANAGER

Every. Single. Energy savings. Matters! David couples analysis with energy audits to identify energy efficiency measures (EEMs) that are cost effective for owners’ business goals. Driven to make a significant impact towards carbon reduction and sustainability, David enjoys studying and analyzing how building energy reduces utility and operational costs, making it a great investment for the future.

Hailee Hammerquist, LEED Green Associate
BUILDING ANALYSIS & MODELING ENGINEER

Hailee is detail oriented, organized, and passionate about sustainable design. She loves tackling the complexity of our projects to ensure all the pieces fit efficiently together inside high-performing exteriors. Coming from West Virginia, Hailee is excited to experience all the outdoor adventures that the Seattle area has to offer. She spends her time off the clock outside hiking in the summer and hitting the slopes in the winter.
Objectives

**KNOWLEDGE**

Why is our building so important?

**TIMELINESS**

What is a “Model”?

**FORESIGHT**

What is going on with new energy code and legislature?

**COLLABORATIVE**

How can we understand our building better?
90% of time is spent indoors.

Why are Buildings so Important?

- 40% of energy consumption...
- 14,600 million ton of CO₂ emission
- Carbon sequestered by 241,412 million tree seedlings grown for 10 years

We spend 90% of our time indoors. Over 21 of our 24 hours!

IAQ can be worse than we think.

“Concentrations of many VOCs” are consistently higher indoors (up to ten times higher) than outdoors.”

- EPA

*volatile organic compounds

And has real consequences.

U.S. indirect costs, including missed work and lost productivity:

- Asthma: $5 billion
- Allergic rhinitis (i.e. hay fever): $9.7 billion

But better IAQ improves productivity.

Removing volatile organic compounds and enhancing ventilation improved problem solving in an office setting:

- 288% higher strategy scores
- 299% better information usage
Possible Complications

Stricter Targets Energy Code

Clean Buildings Standard

Seattle Building Emissions Performance Standard

Incremental Improvement Compared to Targets

Reduction in Energy use (2006 Base)


0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Clean Buildings Standard

Compliance Date by Building SF

*Buildings 20,000 SF – 50,000 SF must now submit their EUI per Energy Star Portfolio Manager along with their Energy Management Plan, Operation & Maintenance Program, and Capital Management Plan by July 1, 2027

Seattle Building Emissions Performance Standard

Timing: Set emission targets now, so owners have time to plan and implement projects.
1ST LAW of Thermodynamics

The First Law of Thermodynamics
Energy transformation

Energy before
Energy after

ENERGY INPUT: Total Energy Consumption

Checking point
Are we minimizing energy loss?
Are we minimizing waste?

ENERGY NEED: Building

WASTE

ENERGY LOSS: Inefficiency
Do we know our buildings?

Your Account Summary

Previous Charges:
- Amount of Your Last Bill (dated 6/13/2018) $157.78
- Payment received 7/2/2018 – Thank you! $157.78
- Past Due Amount $0.00

Current Charges:
- Electric Charges $103.95
- Natural Gas Charges $1.69
- Total Current Charges $165.64

Total $165.64

Late Payments: A late payment fee of 1% per month will apply to past due charges. If any, and amounts unpaid more than 10 business days after the statement date. Amounts will be considered delinquent if payment is not received on or before the due date.

Monthly Energy Tip
Save money and stay cool this summer. Add insulation to make your home more energy efficient throughout the year.

How to reach us
Email: customer.care@pse.com
Customer Service: 1-888-225-5773
TTY: 1-800-962-9498
Hours: 7:30 a.m. – 8:30 p.m. M – F
Puget Sound Energy, P.O. Box 91269, Bellevue, WA 98009
24 Hour Emergency and Outage line: 1-888-225-5773
Technological Evolution

- Pre 1970
- 1990–2000ish
- Now
What is Building Energy Model and CFD?

BUILDING ENERGY MODELING

The practice of using computer-based simulation software to perform a detailed analysis of energy use and energy-using systems

COMPUTATIONAL FLUID DYNAMICS (CFD)

Mathematically predicting physical fluid flow by solving the governing equations using simulations
List of Capabilities with model

TYPICAL TIME (FEE) SPEND WITHIN THE PHASES OF THE DESIGN PROCESS
Business as usual vs energy modeling

- CAMPUS + DISTRICT ENERGY PLANNING
- CARBON + ENERGY PLANNING
- CODE COMPLIANCE
- CLEAN BUILDINGS STANDARD COMPLIANCE
- COMPUTATIONAL FLUID DYNAMICS (CFD)
- DEEP ENERGY + CARBON RETROFITS
- ENERGY ANALYSIS
- GREEN BUILDING RATING SYSTEM CERTIFICATION
Why You Should Consider Modeling

Energy Modeling Enables a Cycle of Benefits Throughout the Design Process

- Aggressive targets and code
- Smart and efficient decisions
- Reduced Operating and Cost
- Deeper knowledge of building design
- Sustainable Design and Solution
- Working together
Limitation and Challenges
Complex in Nature

- Site, Climate, Shading
- Building Schedule
- Occupancy type
- Loads
- Design
- AND MORE!
Spreadsheet

eQuest
Open Studio
Energyplus

Energy Models

IES-VE

Energy Management Software
Building Automation Systems
Retrofit Analysis Software

Precision

Accuracy
Overlake Medical Center

- Objective: Develop energy management plan to meet clean building standards and decarbonization goals

- Challenge
  - Finite amount of budget
  - Complicated system
High accuracy and precision

CASE STUDY
Overlake Hospital Medical Center
All systems at the campus are modeled, however, some systems are combined for simplicity purposes.
DHW USAGE CALCULATION

- Typical Hospital 150-250 gallons of water per day per bed (70% assumed to be hot water)
- 20 visitors per day on average per staff
- Overlake
  - 349 Beds (250 x 349 x 70% = 61,075 gallon of hot water)
  - 3,000 Staff (20 x 3,000 = 60,000 Visitors)

Water consumption data can be re-calibrated once total water consumption data is available.
Overlake Medical Proposed Design Summary

Energy Use Intensity Proposed model

223.4 120.6 kBtu/sf/yr

Energy Efficiency Measures (EEM) Summary
Following list summarizes only key EEMs for each category. Breakout EEM analysis will be provided in the future.

Load Reduction (1-5 EUI reduction)
• Lighting improvement (Occupancy sensors, LED installation, and etc) – currently only focused on patient room and amenity – Potentially more savings available with full lighting audit
• Mechanical load optimization (Lab/med vacuum)

HVAC Upgrades (20-35 EUI reduction)
• AHU return air installation (South Tower AHU-3,4,5, SP SF-1,2,3)
• Fan wall replacement
• Setpoint optimization (Zone temperature set point, occupancy sensor setbacks, etc.)
• Static pressure resets for AHUs (coil cleaning, reset control, removing inlet vanes, and etc.)
• Surgery Volume scanning & Minimum ACH optimization

Plant Upgrades (5-15 EUI reduction)
• General Heat recovery for the plant
• Boiler economizer
• Steam leakage/heat loss reduction (DA tank pressure reduction, pipe insulation, etc)
• Cooling Tower Relocation and optimization
• Chiller plant sequence optimization
• Pump VFD installation

DHW heat recovery (3-10 EUI reduction)
• DHW preheat / heat recovery

Major Equipment Upgrades (15-40 EUI reduction)
• High efficiency condensing boiler
• HP technology
• Heat recovery Chiller

Annual Cost Saving
$468,151 per year
FROM THIS | Just numbers

TO THIS | Informed decisions

**Project TOTAL**

**TOTAL**

**$1,089,000**

**17**

**AEH Damper Functional Testing & Adjust**

HVAC: AEH Damper Functional Testing & Adjust: AEH-24 dampers are mostly shot and not positioning correctly. AEH-12 in NET return dampers not functioning properly. AEH-04 dampers not positioning properly, VWT/HEAT ventilator AEH outside air dampers not functioning properly. AEH-08 booster damper section not open. These and other issues indicate need to functional testing of all AEH dampers with those modules given priorities.

**$1,000,000**

**20**

**AEH Supply Air Temperature Reset**

HVAC: AEH Supply Air Temperature Reset. Reset AEH supply air temperature based on zone level input from all terminal units that the unit serves. Investigate and correct any rogue zones which artificially reset the AEH. Add timers to provide system stability.

**$850,000**

**71**

**Internal Envelope Inspections and Optimization in High-Ach or Volume Rooms**

Envelope: Internal Envelope Inspections and Optimization in High-Ach or Volume Rooms. Perform a detailed inspection of room internal envelopes and appropriately seal the room. Survey Rooms, Decontamination, All Rooms, Stirling Processing, and Labs are areas including any rooms where airflow offsets are greater than room requirements to meet pressure requirements.

**$400,000**

**75**

**AEH Airflow Stations for Calculating Minimum Outside Air Damper Position**

HVAC: AEH: Airflow Stations for Calculating Minimum Outside Air Damper Position. AEH-A1/A1 without airflow stations should have these stations added for outside air and supply air, as then calculate minimum outside air position (technically flow not position).

**$130,000**

**83**

**AEU-J 2 for OMT DN Sequencing Optimization**

HVAC: AEU-J 2 for OMT DN Sequencing Optimization. The direct expansion cooling sequence of operations for the OMT AEU-Js appears to not be as energy efficient as it can be. Adding a new optimized sequence can help the unit perform better.

**$40,000**

**84**

**AEU Remote Fan Inlet Dampers, Add Current Transducers (or alternatives), and Alarm**

HVAC: AEU: Remote Fan Inlet Dampers, Add Current Transducers (or alternatives), and Alarm. Numerous AEU’s have inlet fan barometric dampers which produce significant pressure drops and friction for the system, reduces efficiency, and unnecessarily adds to energy consumption. Removal and adding vibrations to catch any fan failures can produce the same intended results as the damper.

**$100,000**

**86**

**AEU Return Air Addition to All 100% Outside Air Fans and Remove Heat Wheels & Heat Piping**

HVAC: AEU: Return Air Addition to All 100% Outside Air Fans and Remove Heat Wheels & Heat Piping. Surgery Pavilion, South Tower 2nd Floor Mechanical Rooms, and any other 100% outside air AEUs can be converted to return air units, then heat recovery devices removed, airflow sensors added to control system to monitor ventilation needs. This reduces heating and cooling loads significantly.

**$1,400,000**

**92**

**DOAS Install for OMT Pharmacy Space & Remove from Central AEH**

HVAC: DOAS Install for OMT Pharmacy Space (add 10 air handlers, 10 filters) & Remove from Central AEH. DOAS installation on the 3rd floor and 2nd floor of existing building or 3rd floor ABC mechanical room above existing unit. Associated airflow to pharmacy space from OMT 2nd floor HVAC.

**$2,500,000**

**92**

**Fan Terminal Unit Filter Upgrading to 2”**

HVAC: Fan Terminal Unit Filter Upgrading to 2”. Install sheet metal ventilation or return ducts to approximately 238 Fan Terminal Units in the building.

**$550,000**

**93**

**Fan Terminal Unit Reliability to Neutral in OMT**

HVAC: Fan Terminal Unit Reliability to Neutral in OMT. Reliability of approximately 238 FTUs. Adjustment of setpoints to balance unit to neutral. This does not include

**$235,000**

**94**

**NET Heating Water Bypass Valve for Series Operation**

HVAC: NET Heating Water Bypass Valve for Series Operation. Add a heating water bypass valve in the NET mechanical room to allow the SRO series with the nearest heat exchanger.

**$69,000**

**95**

**Optimal Start/Stop Sequence Addition for OMT**

HVAC: Optimize Start/Stop Sequence Addition for OMT. Add optimal start/stop sequence to the existing Siemens OEC system.

**$10,000**

**Recommend FY2023 (+6 EUI Benefit)**

**$200,000 be assigned to Low Capital Projects**
Method 1 | **ENERGY MODEL**

**Contract**
Client = ~$ 25,000

**Hours spent**
157 hours

**Scope**
- Develop Energy Management Plan for CBS compliance / Decarbonization
- Prioritize investment to meet EUI goals
- Built energy model for any future studies / upgrades

Method 2 | **SPREADSHEET (EST)**

**ROM hours to estimate energy savings**
24 hours

**Estimated hours for 40 measures**
960 hours

Approximately 6x more than energy modeling

**Cost underestimate**
ROM hours of 24 hours to develop spreadsheet for each measure is probably underestimated.

**Single-use**
Because projects vary, spreadsheet must adapt, and the time spent developing them can increase.

**Unreliable**
Accuracy is not guaranteed.
Achieving Success through Accuracy

Initial Load Calculation of ~500 ton cooling

PROBLEM
- The project does not have enough roof space for bigger chillers
- Traditional load calculation tool is not able to consider shading effect accurately
- Initial load is peak of peaks, not building peaks

BAM IMPLEMENTED SHADING ANALYSIS
- Peak of peak: 490 ton
- Building Peak: 450 ton
Computational Fluid Dynamics (CFD)

Simulates fluid flows and analyze the flow characteristics using numerical methods.

- Tunnel Ventilation
- Data Center Cooling
- Thermal Comfort
- Contaminant Control
Top Three 2022 BAM Jobs

SAVINGS! SAVINGS! SAVINGS!

$435,263 cost reduction

175.5 EUI reduction

Over 4 Million LB CO2 Emission (4,391,869 LB)

Equal to 32,940 tree seedlings grown for 10 years

1-2 Months payback

School Shelton SD
Hospital Overlake Medical Center
Multifamily 303 Battery
Questions? Let’s Connect

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