AMCA International

Optimizing an Existing Air System for Performance and Energy Efficiency

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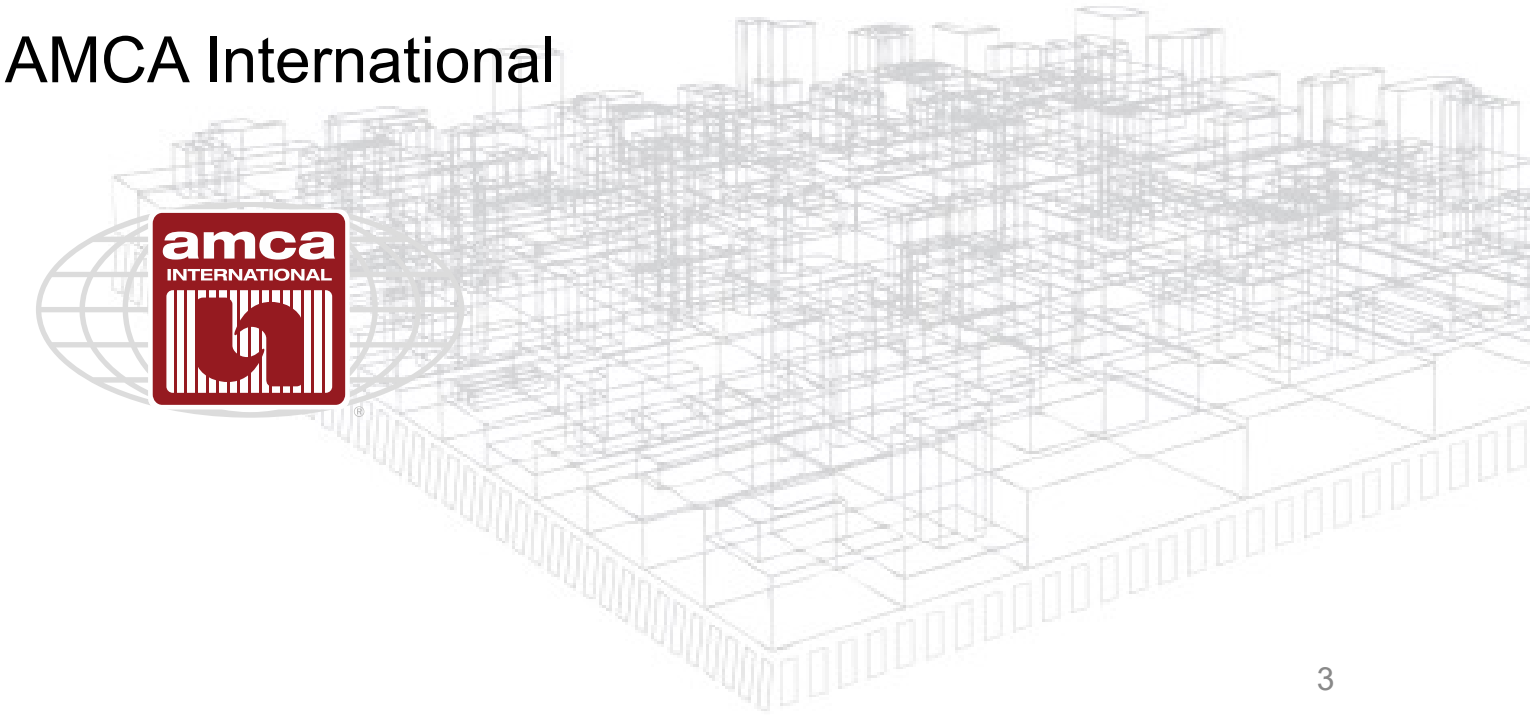
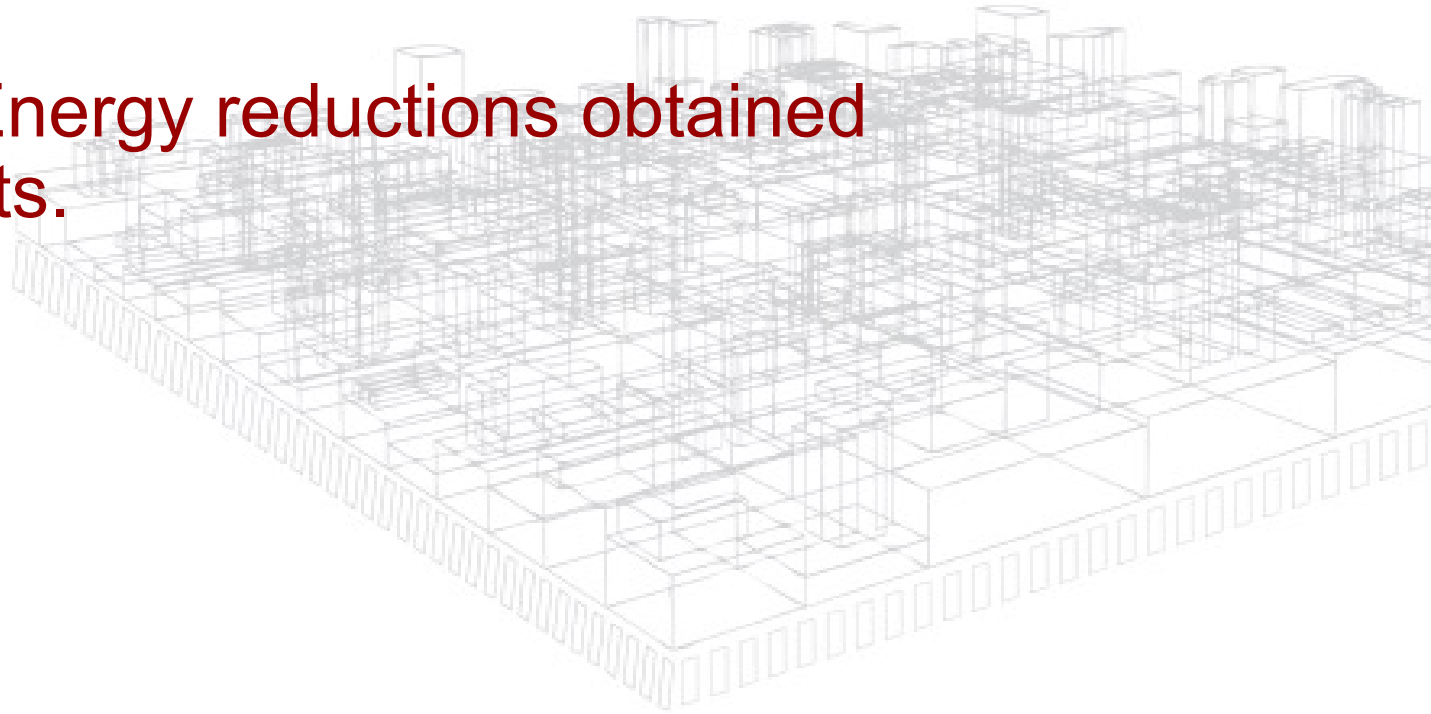


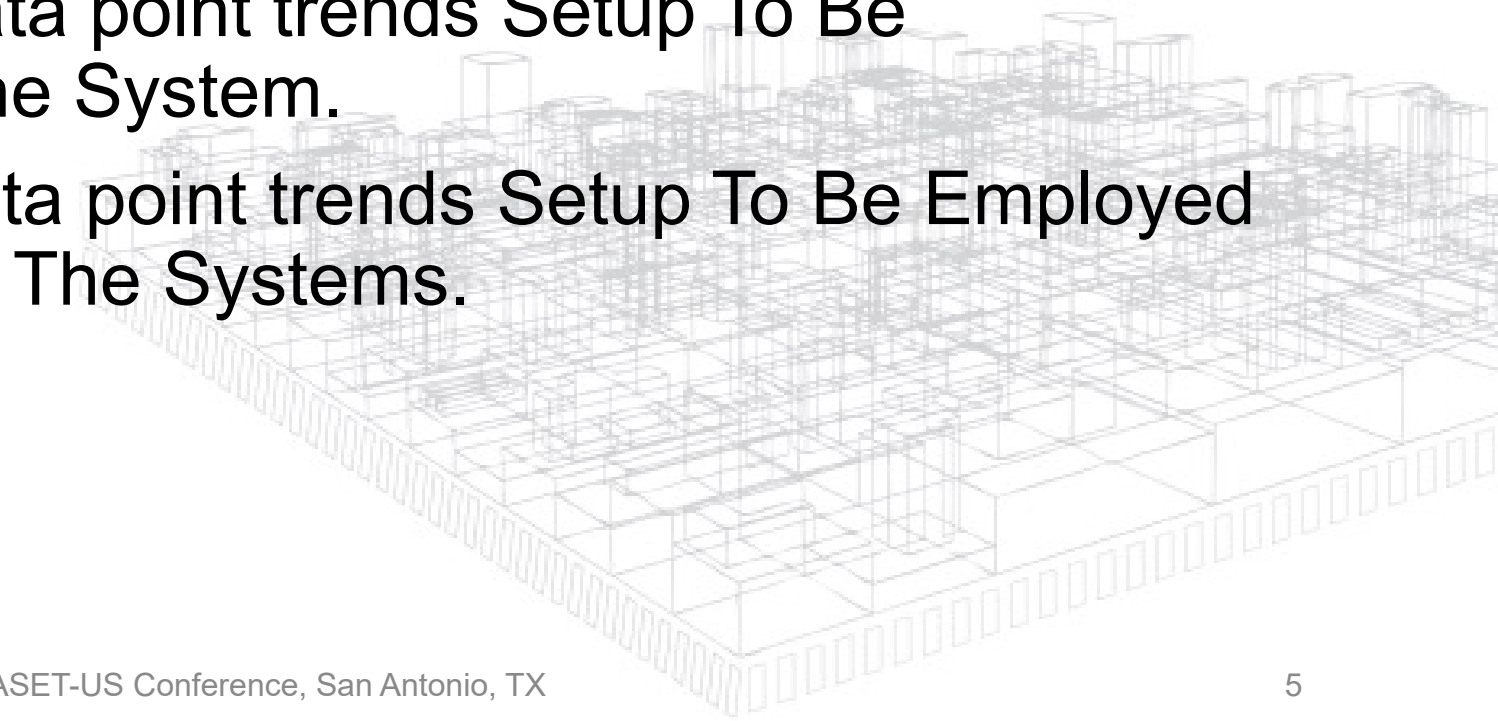
Learning Objectives

- What is Air Handling Unit Optimization?
- How to Optimize AHU systems and verify proper operation.
- How to document Energy reductions obtained during these projects.



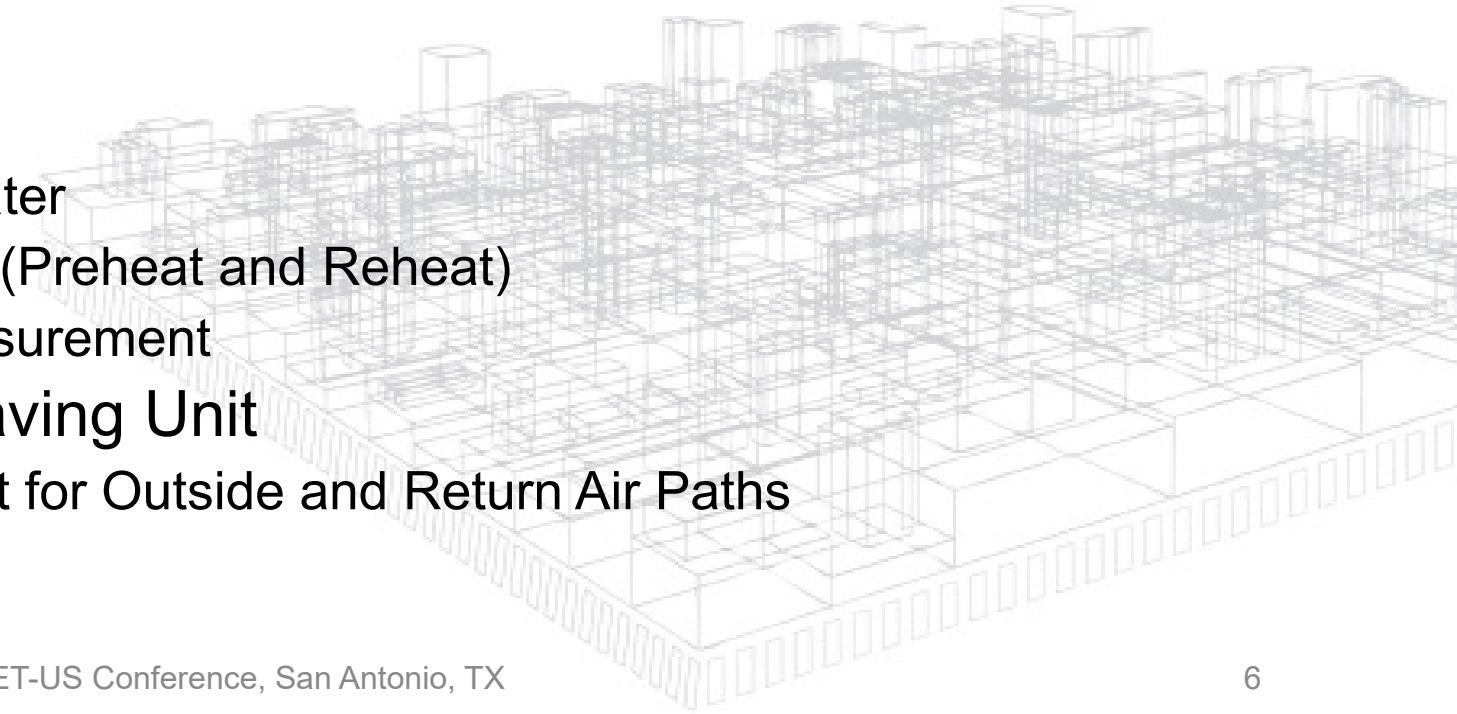
Definitions

- **Optimization** - Adjust And Control Each System To Consume The Least Energy Possible To Meet The Owner's Project Requirements (OPR) or Current Facility Requirements (CFR).
- **Long Term Trends** – Data point trends Setup To Be Permanently Active In The System.
- **Short Term Trends** - Data point trends Setup To Be Employed During The Validation Of The Systems.



Establishing System Level Baselines

- Performance Elements
  - Electrical Energy Consumed
    - If Submetering Exists
    - BAS/Drive Info if incorporated
    - Independent Datalogging
  - Coil Energy
    - Entering/Leaving Chilled Water
    - Entering/Leaving Hot Water (Preheat and Reheat)
    - If Electric Heat Current Measurement
  - All Airstreams Entering/Leaving Unit
    - Sensible Temps Only Except for Outside and Return Air Paths

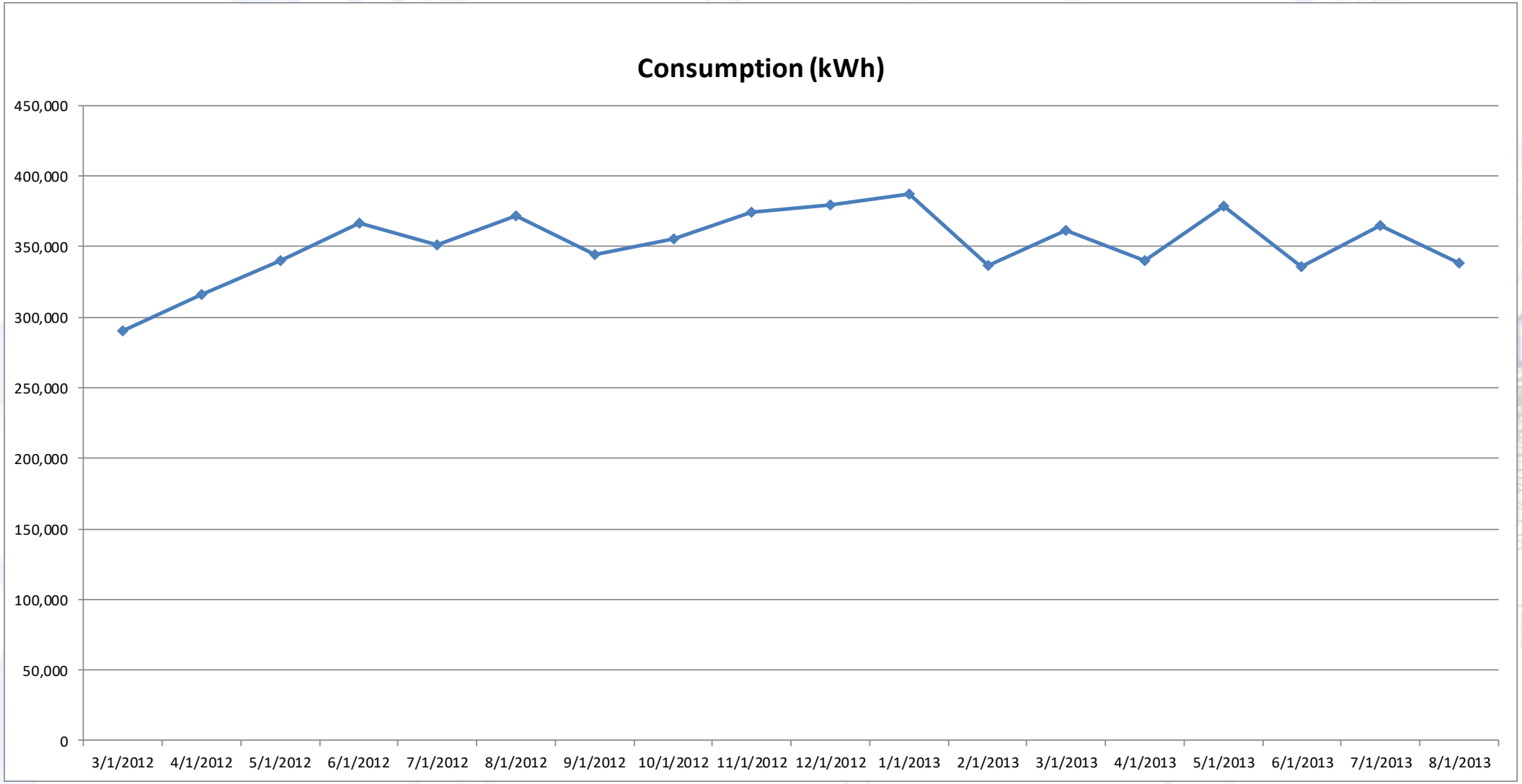


Establishing System Level Baselines

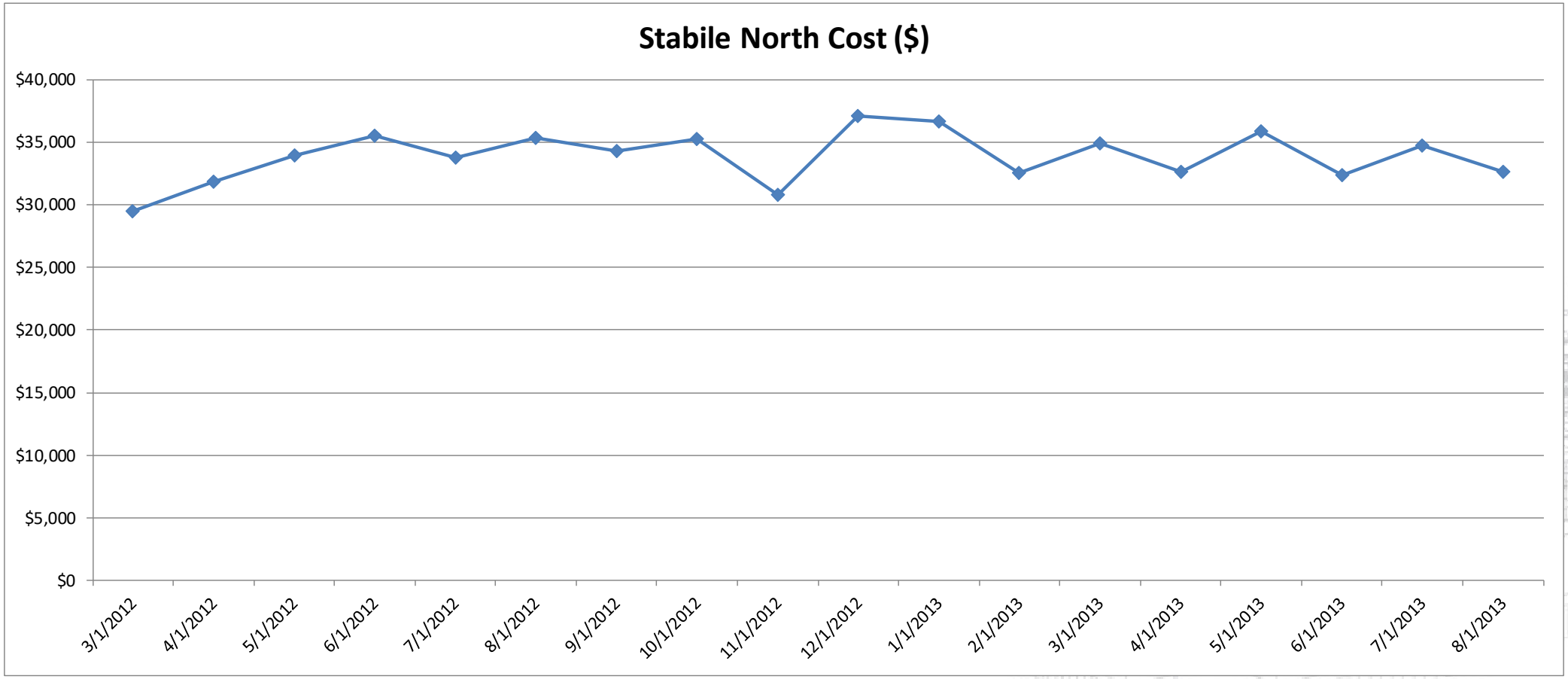
Establishing System Level Baselines

- Develop Current Facilities Requirements Document
  - Kickoff Meeting and Interviews With Key Stakeholders
  - Identify Today's the Facility Systems
  - Identify Areas Of Concern
  - Develop Logging Plan (Energy Consumption and Environmental Conditions)
  - Launch Loggers "Let'em Cook!!"
  - Obtain Historical Energy Data

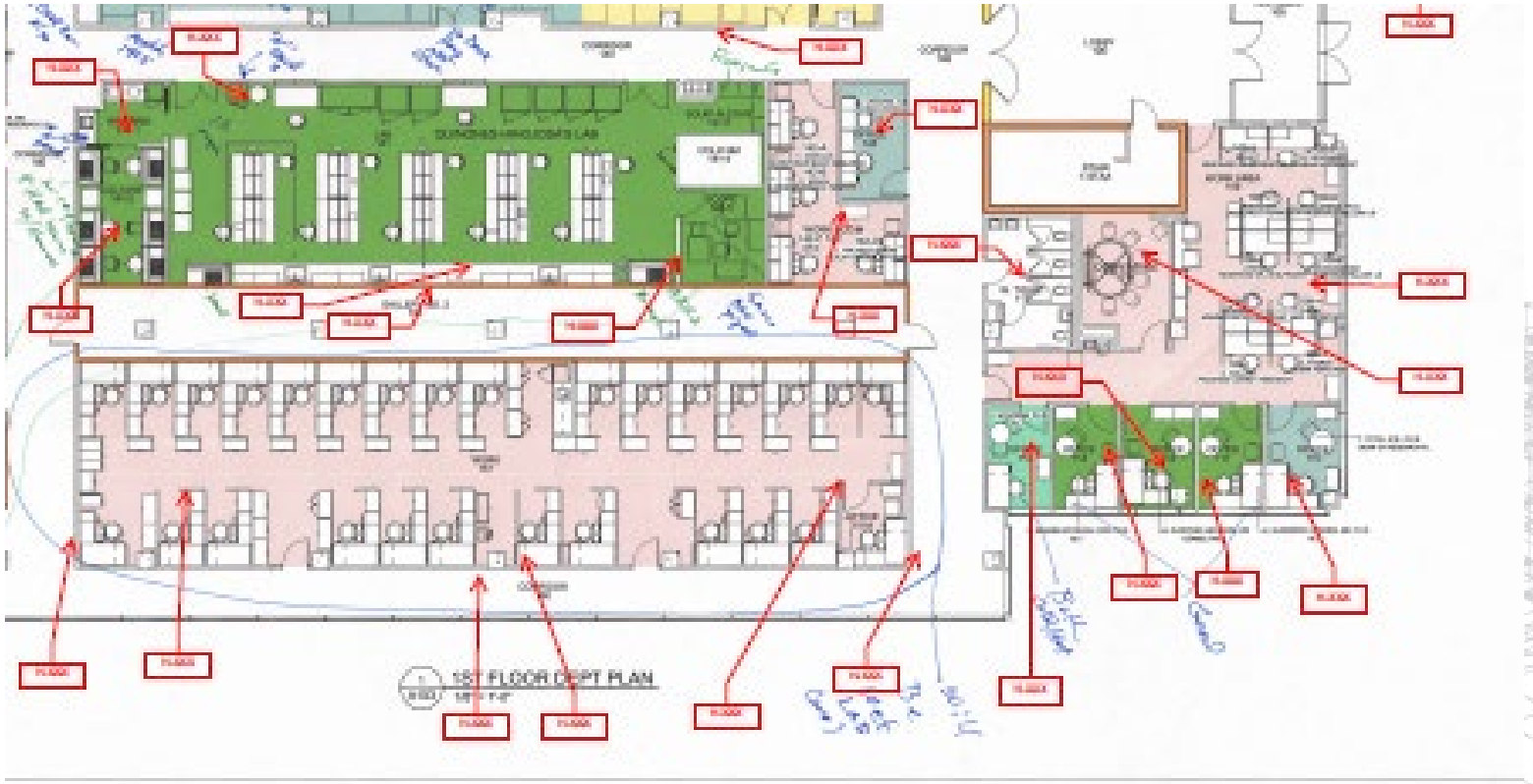
Establishing System Level Baselines



Establishing System Level Baselines



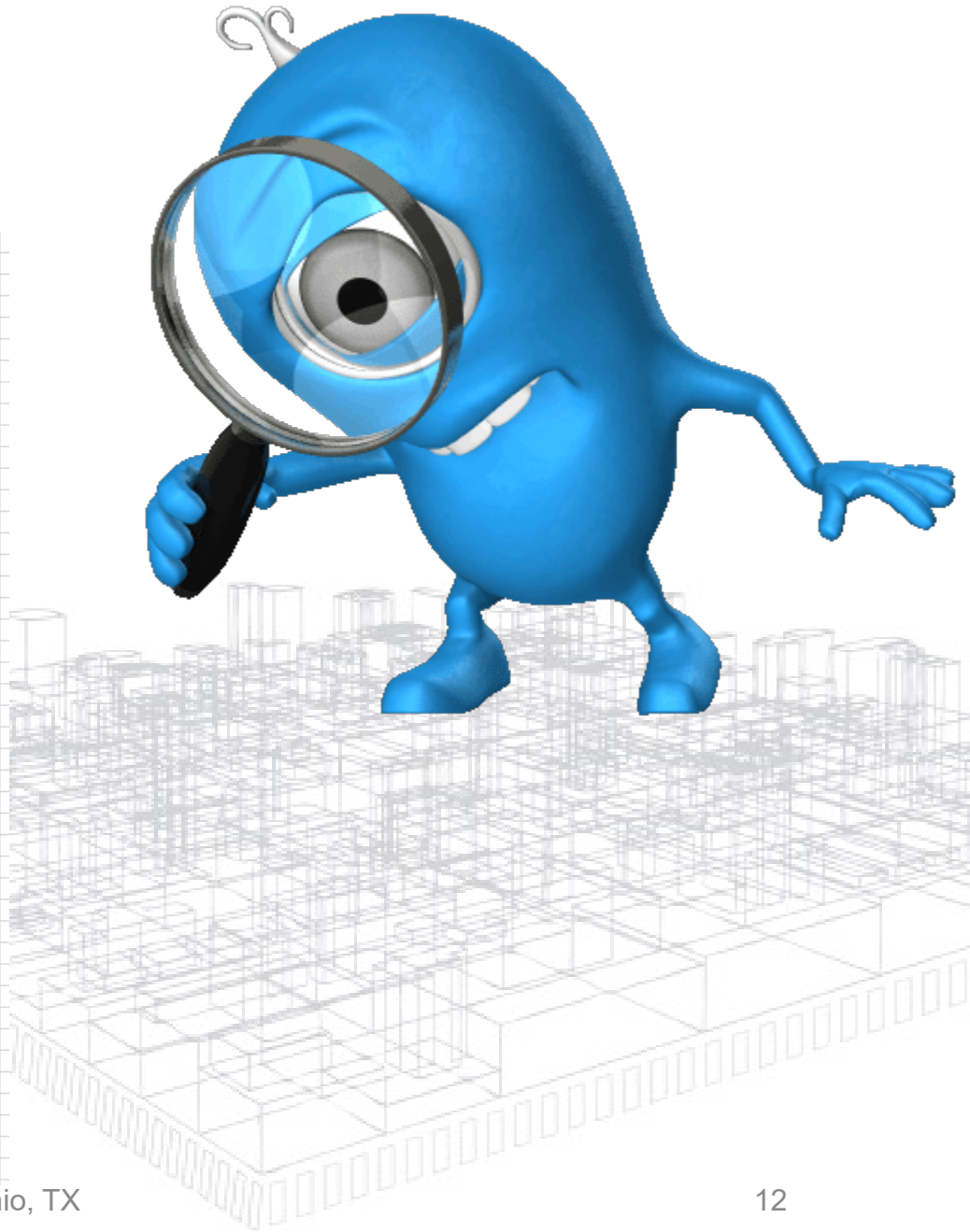
Establishing System Level Baselines



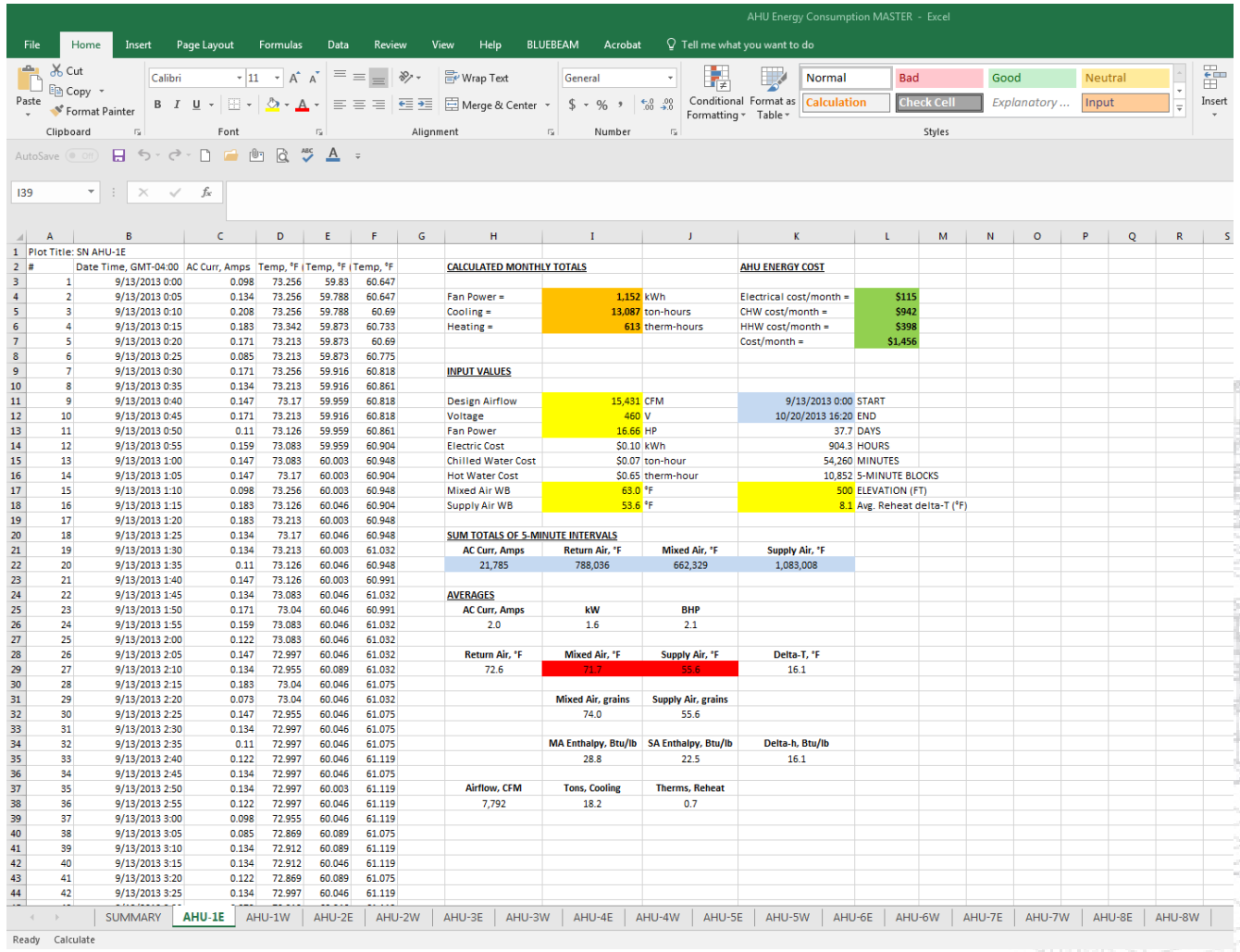
System As Founds

Plot Title: AHU-1-5

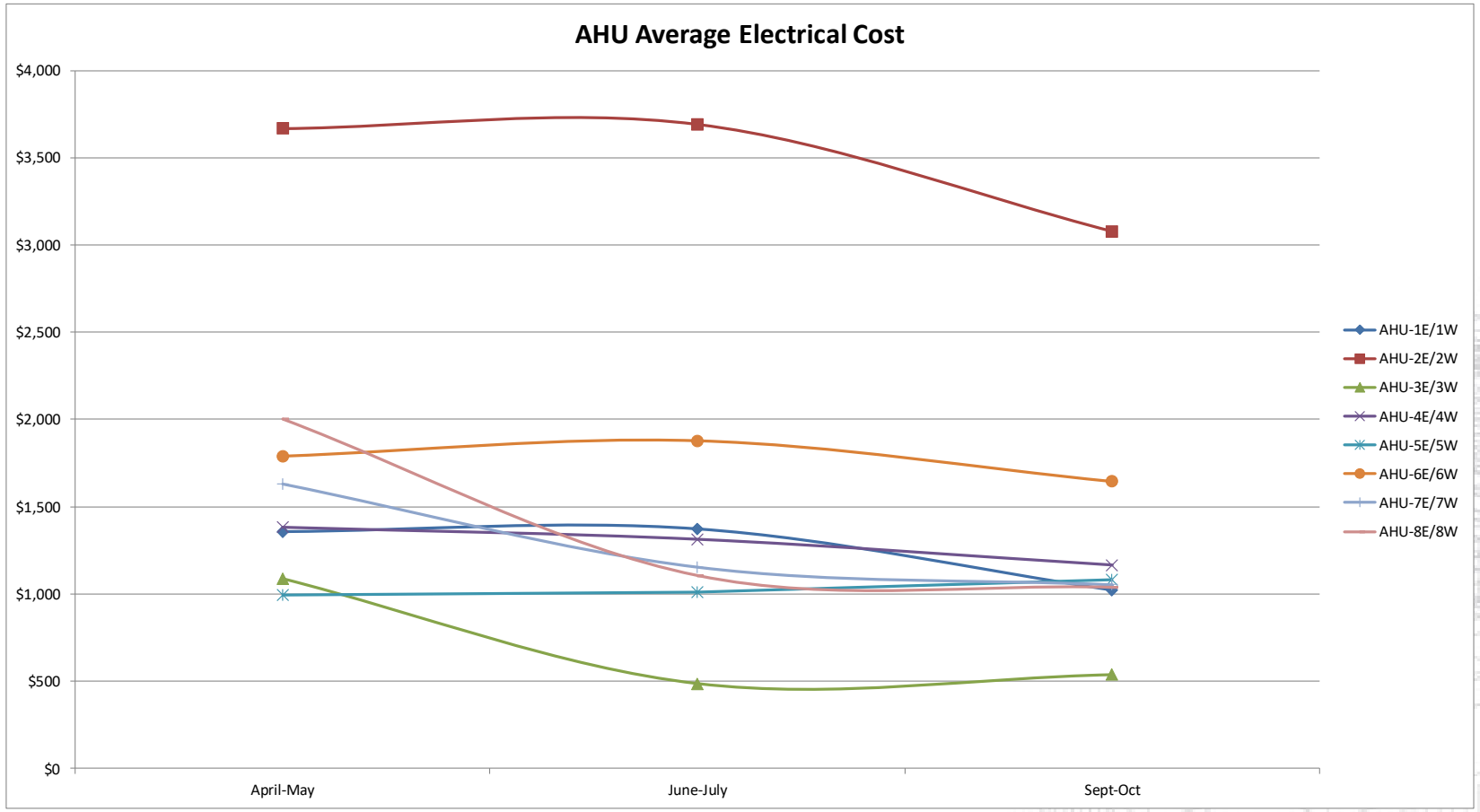
#	Date	Time	Curr (Amps)	CHWS	CHWR	SA Temp	MA Temp	RA Temp
1	9/25/2012	11:00:00	22.857	46.391	61.761	50.709	72.523	70.072
2	9/25/2012	11:05:00	24.322	46.301	61.677	50.664	72.523	70.115
3	9/25/2012	11:10:00	23.297	46.301	61.72	50.664	72.437	70.072
4	9/25/2012	11:15:00	21.538	46.301	61.977	50.621	72.567	70.158
5	9/25/2012	11:20:00	26.081	46.301	61.977	50.621	72.567	70.243
6	9/25/2012	11:25:00	24.615	46.301	62.019	50.621	72.48	70.201
7	9/25/2012	11:30:00	24.322	46.301	61.977	50.621	72.48	70.158
8	9/25/2012	11:35:00	23.883	46.301	61.848	50.621	72.394	70.115
9	9/25/2012	11:40:00	24.615	46.301	61.633	50.621	72.48	70.158
10	9/25/2012	11:45:00	24.762	46.301	61.72	50.621	72.437	70.115
11	9/25/2012	11:50:00	23.443	46.301	61.677	50.621	72.394	70.029
12	9/25/2012	11:55:00	24.615	46.256	61.677	50.576	72.394	70.029
13	9/25/2012	12:00:00	24.176	46.211	61.891	50.576	72.351	69.901
14	9/25/2012	12:05:00	24.615	46.211	61.934	50.576	72.437	69.901
15	9/25/2012	12:10:00	25.055	46.256	62.148	50.621	72.394	69.901
16	9/25/2012	12:15:00	24.176	46.256	62.019	50.621	72.351	69.901
17	9/25/2012	12:20:00	24.469	46.301	62.019	50.621	72.48	69.901
18	9/25/2012	12:25:00	24.322	46.301	61.934	50.621	72.264	69.858
19	9/25/2012	12:30:00	24.322	46.211	61.891	50.533	72.264	69.814
20	9/25/2012	12:35:00	23.443	46.211	61.59	50.533	72.221	69.771
21	9/25/2012	12:40:00	24.322	46.211	61.761	50.533	72.264	69.858
22	9/25/2012	12:45:00	24.322	46.211	61.804	50.533	72.264	69.942
23	9/25/2012	12:50:00	24.615	46.166	61.848	50.488	72.221	69.942
24	9/25/2012	12:55:00	25.348	46.166	61.848	50.488	72.307	69.985
25	9/25/2012	13:00:00	24.762	46.166	61.804	50.488	72.221	70.029
26	9/25/2012	13:05:00	24.176	46.211	62.105	50.533	72.221	70.029
27	9/25/2012	13:10:00	24.322	46.166	61.633	50.533	72.136	69.985
28	9/25/2012	13:15:00	23.443	46.211	61.891	50.533	72.093	69.901
29	9/25/2012	13:20:00	24.469	46.166	61.891	50.533	72.136	69.985
30	9/25/2012	13:25:00	24.908	46.166	61.72	50.488	72.136	70.072
31	9/25/2012	13:30:00	23.736	46.166	61.633	50.488	72.178	70.115
32	9/25/2012	13:35:00	26.52	46.121	61.891	50.445	72.093	70.072
33	9/25/2012	13:40:00	24.322	46.076	61.891	50.445	71.964	69.901
34	9/25/2012	13:45:00	24.176	46.121	61.848	50.445	71.92	69.901
35	9/25/2012	13:50:00	24.469	46.121	61.891	50.488	71.964	69.942
36	9/25/2012	13:55:00	24.322	46.121	61.934	50.488	71.92	69.942
37	9/25/2012	14:00:00	23.883	46.166	61.934	50.488	71.964	69.901
38	9/25/2012	14:05:00	26.081	46.121	61.934	50.488	71.791	69.771
39	9/25/2012	14:10:00	25.348	46.076	61.72	50.4	71.791	69.771
40	9/25/2012	14:15:00	24.762	46.121	61.506	50.4	71.748	69.771
41	9/25/2012	14:20:00	25.055	46.076	61.934	50.4	71.791	69.814
42	9/25/2012	14:25:00	25.055	46.076	61.848	50.4	71.92	70.029



Data Analyzation



Verifying Results



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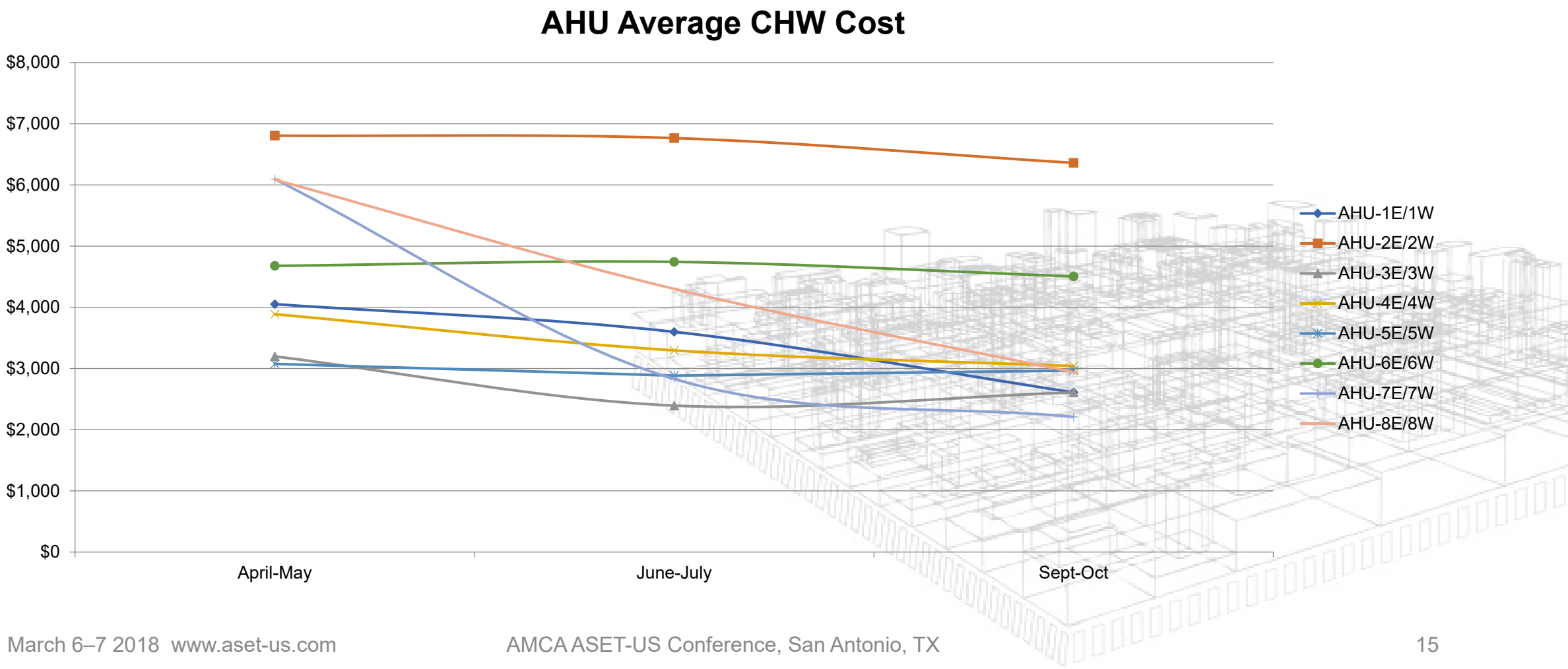
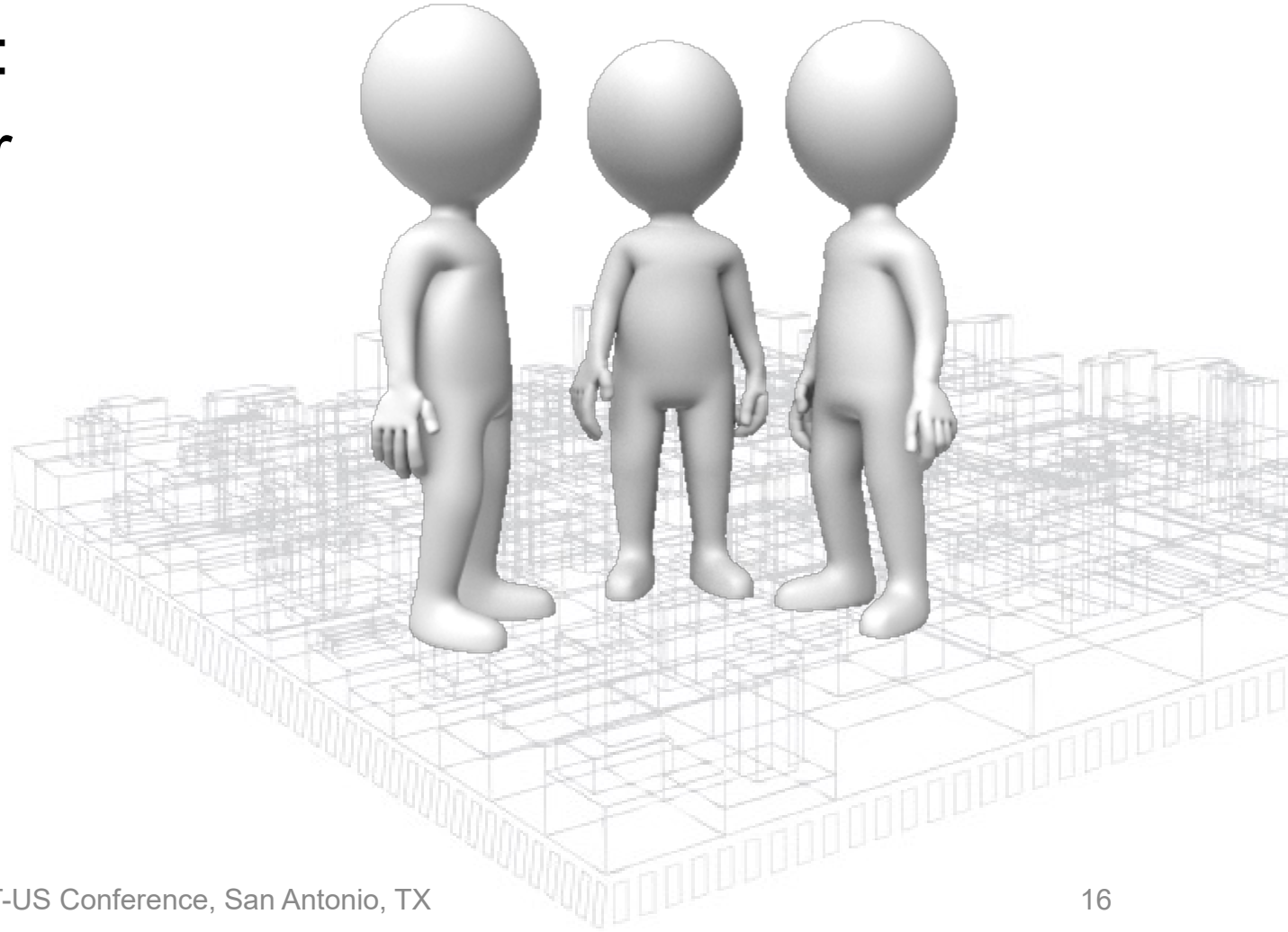


Verifying Results

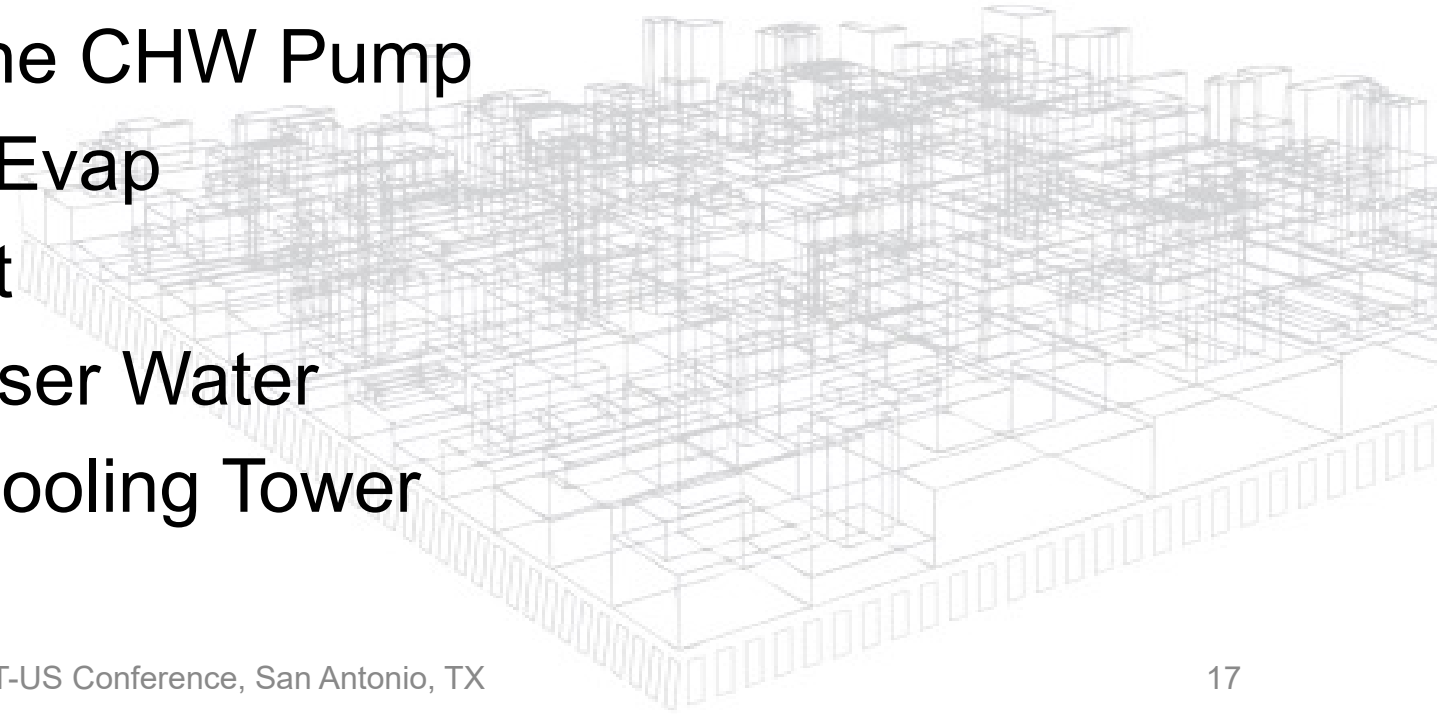
- Estimated Energy Savings:
  - ~ $11,750 Per Month, or
  - ~ $141,000 Per Year



Heat Transfer

"From The Beginning To The End"

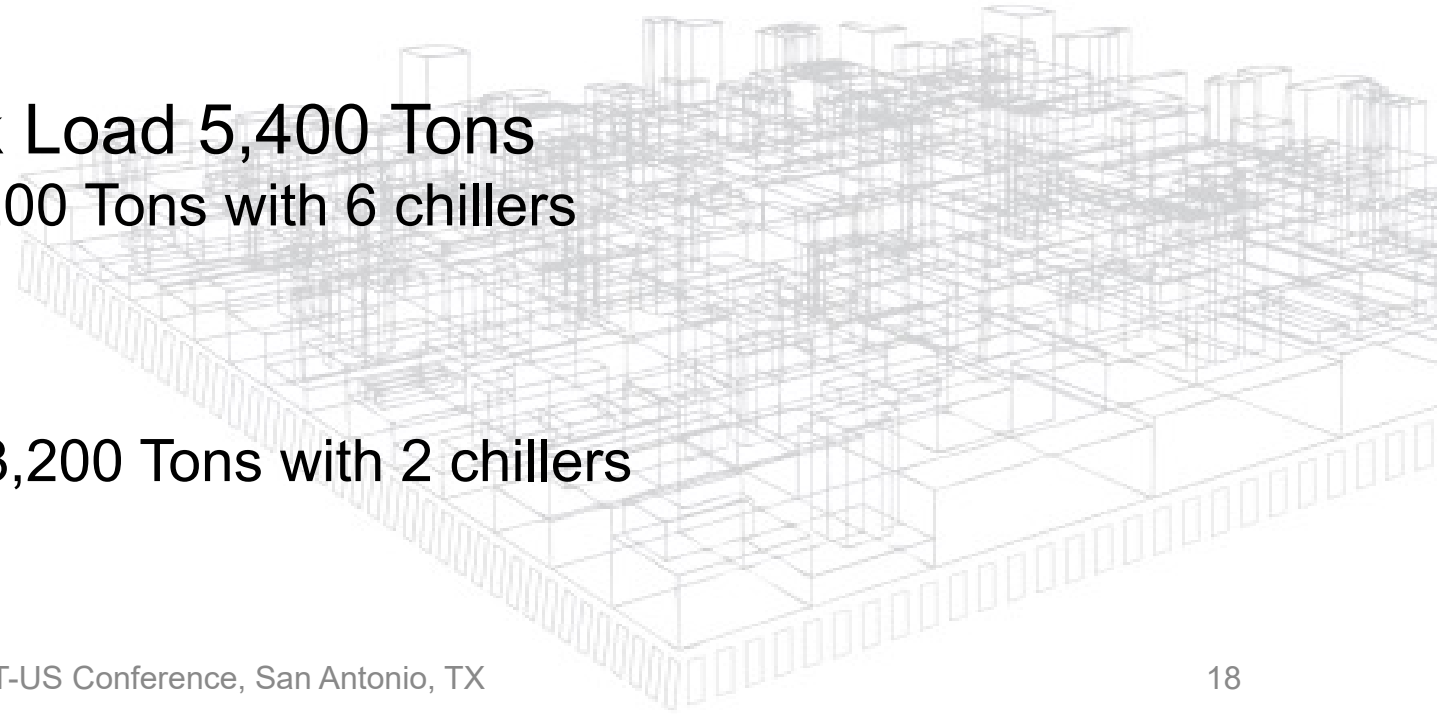
- VAV Terminal Unit To The AHU AHU To The Central Plant
- Room Air To Cooling Cool
- Cooling Coil To Chilled Water Return
- Chilled Water Return To The CHW Pump
- CHW Pump To the Chiller Evap
- Chiller Evap To Refrigerant
- Refrigerant To the Condenser Water
- Condenser Water To the Cooling Tower



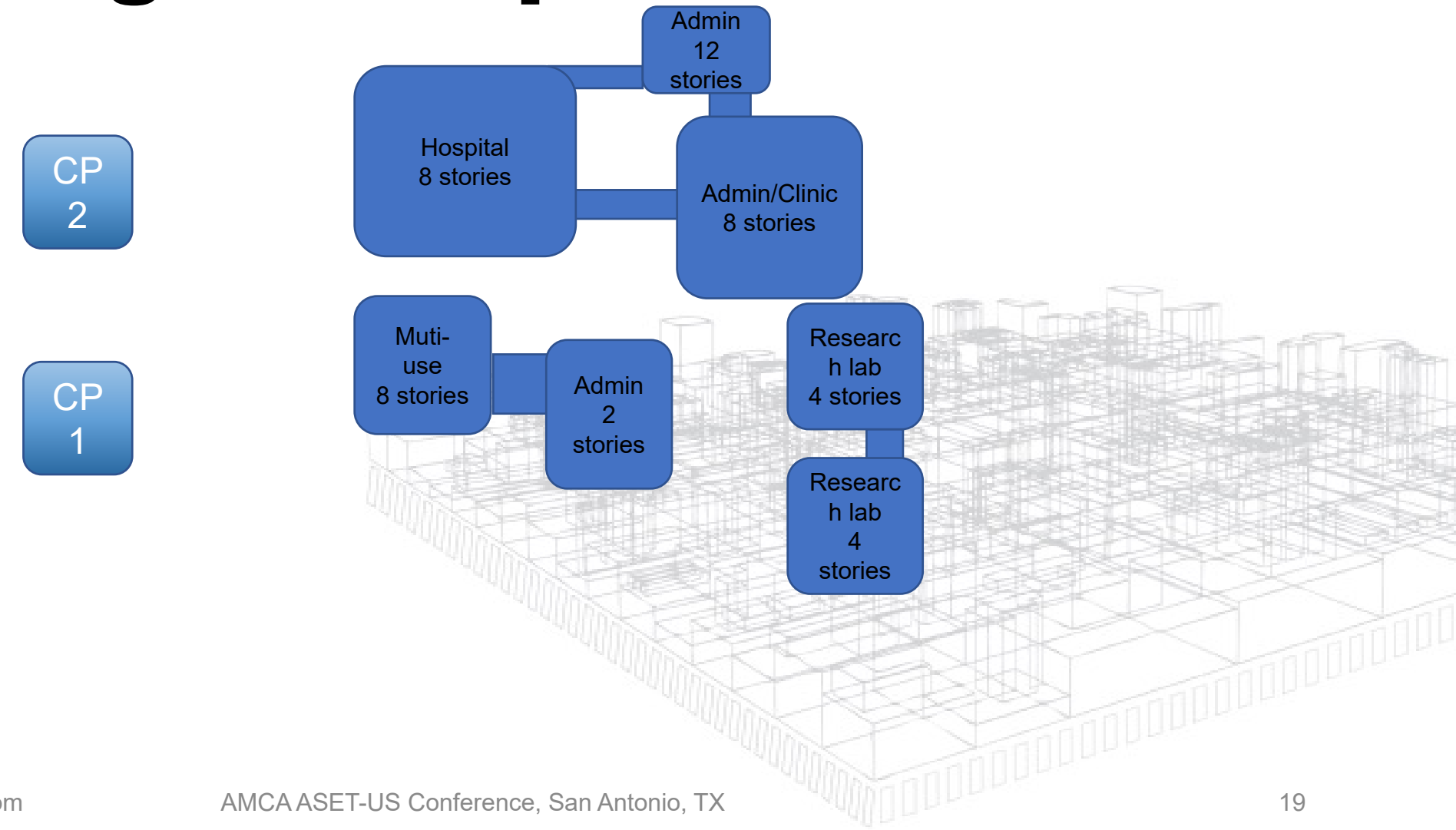
Optimizing A Campus

Chiller Staging Example

- Large Hospital Campus
  - Main Hospital
  - Admin Buildings
  - Research Buildings
- 2 chilled water plants – Peak Load 5,400 Tons
  - CP1 - (primary/secondary) 6,200 Tons with 6 chillers
    - 4 x 1,100 tons
    - 1 x 1,000 tons
    - 1 x 800 tons
  - CP2 - (variable flow primary) 3,200 Tons with 2 chillers
    - 2 x 1,600 tons



Optimizing A Campus



Optimizing A Campus

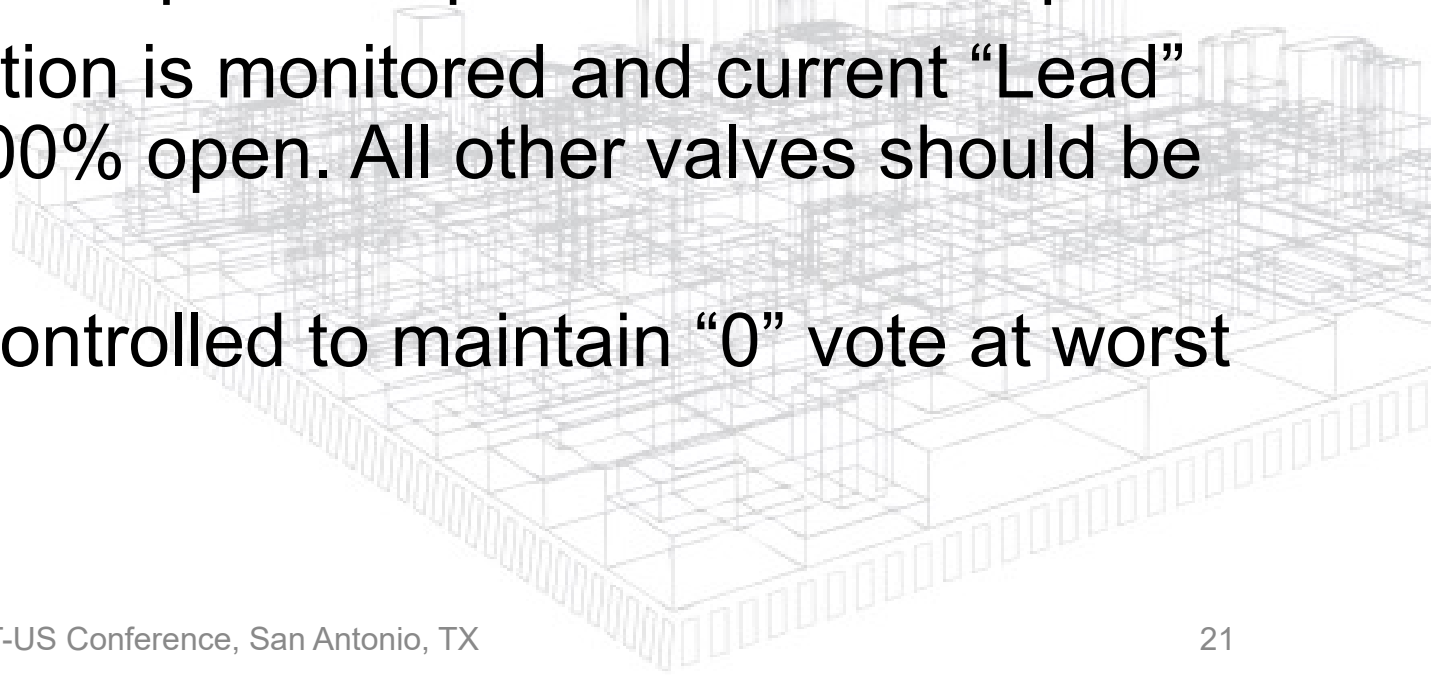
Chiller Staging Example

- Sequence of operation
  - Load Primary/Secondary System Trim With Variable Flow Primary
  - CP-1

- Optimization
  - To Truly Optimize A Central Plant System The Served Facilities Should be Optimized First.
    - Optimize Air Side First, Then Optimize Water Side
  - CP-1 When in “Flow” mode, Pumps fixed CHW flows to each chiller, These flows will be adjusted during Cx to ensure chillers are fully loaded
  - CP-2 Chiller CHW flow Is varied per facility load demand when in “Pressure” Mode.

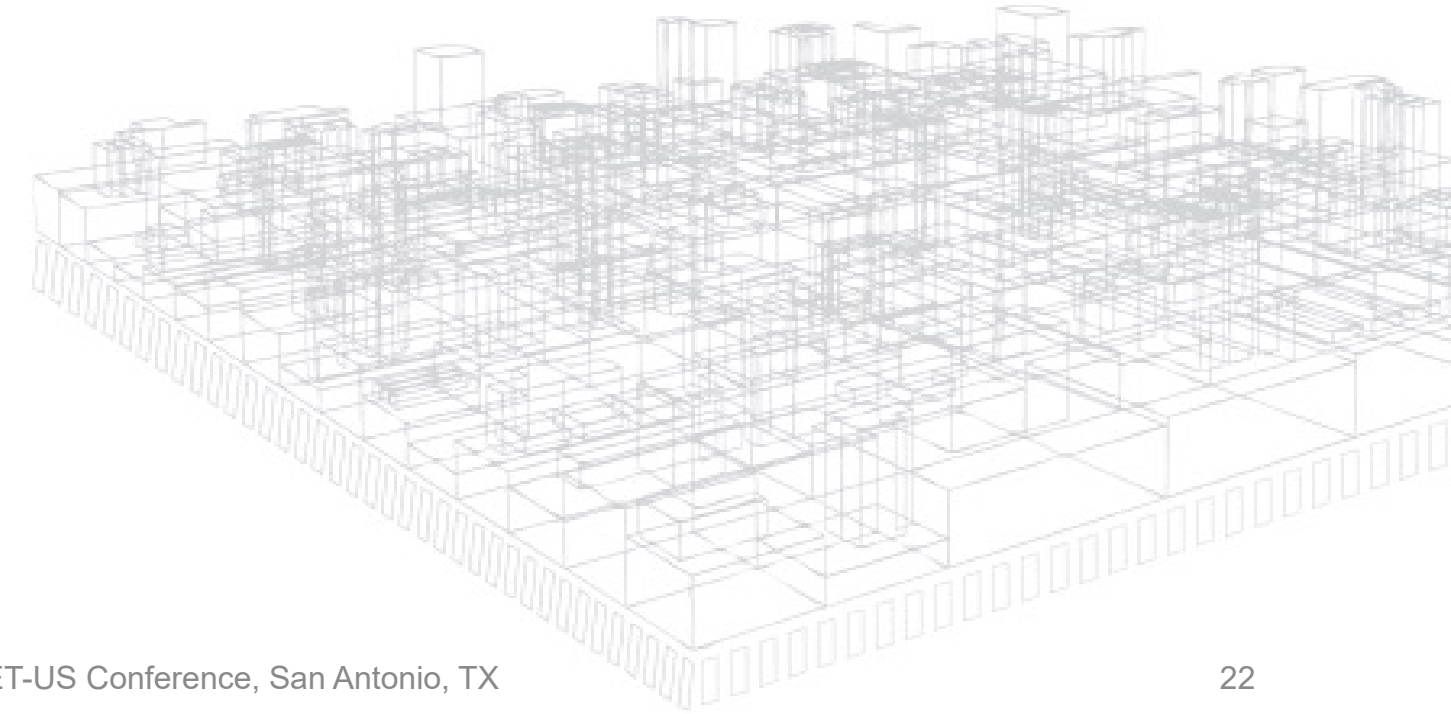
Optimizing A Campus

- Each Building has “MM” Riser Setup To Flow ONLY the water that is needed for that facility.
- With Properly Operating AHUs Monitor Valve Positions and Control Central Pumping to keep most open valve 90-95 open.
- Each “MM” riser valve position is monitored and current “Lead” building valve should be 100% open. All other valves should be partially closed.
- Central Utility Pumps are controlled to maintain “0” vote at worst facility.



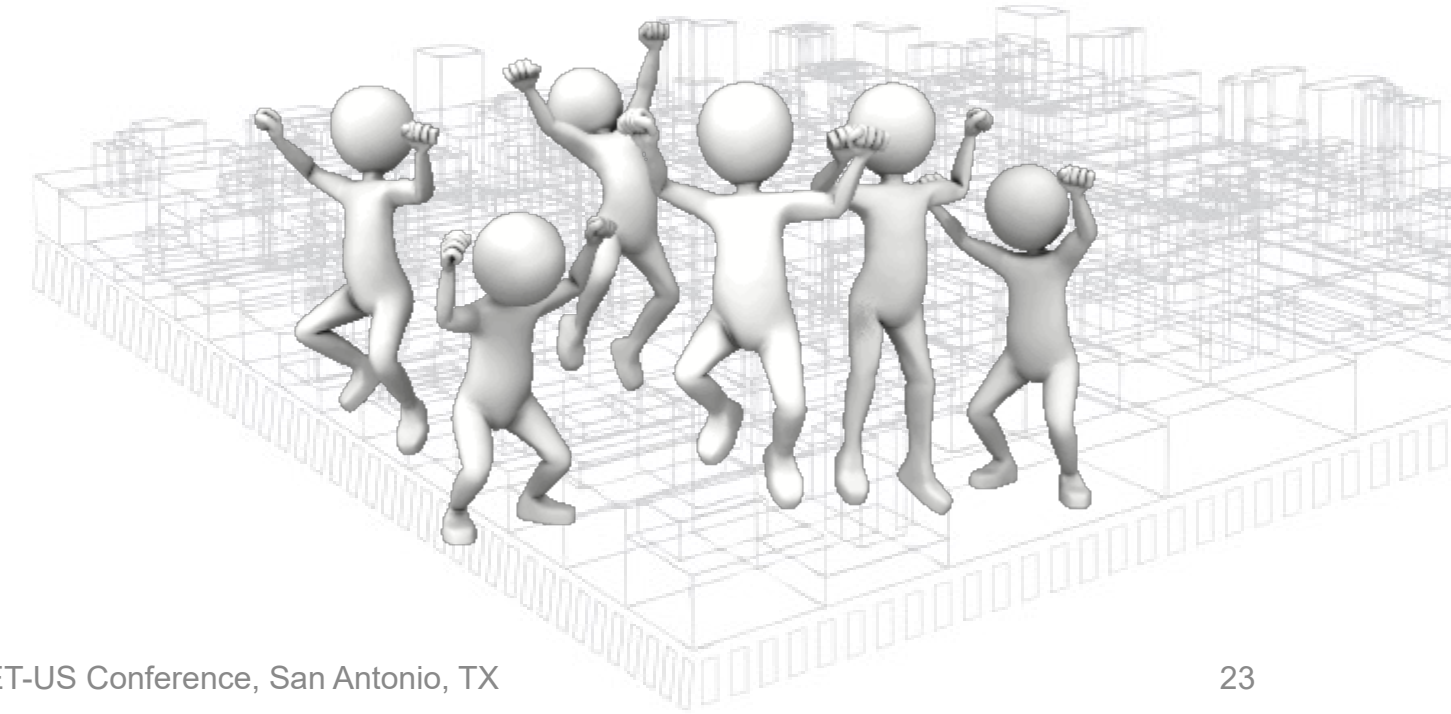
Optimization

- Condenser water temperature reset
- Chilled Water differential pressure reset
- Increase water side economizer operation
- Make-up water
  - Non-potable water
  - Stuck fill valve



Verifying results

- Campus Utility Costs were at $8,000,00 annually
- With addition of four floors of buildings annual cost have dropped $1,500,000



Questions?

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