Lighting:

Futureproofing Yourself in a World of Changing Controls & Code

VOSS®
LIGHTING • DESIGN • SERVICES

TEMA CONFERENCE 2019

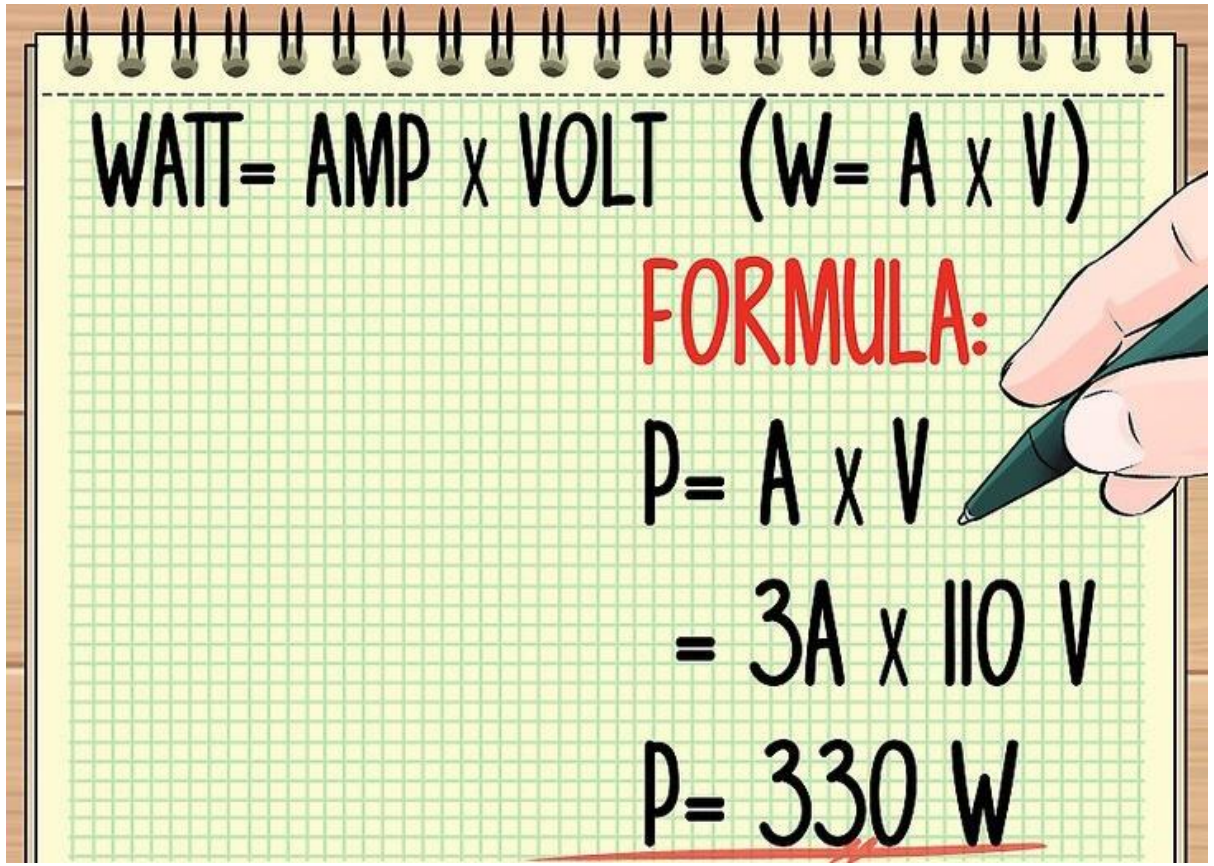
APRIL 30 – MAY 2 WACO CONVENTION CENTER

How to Pick the Right Light:

1. Color
2. Energy
3. Light
4. Life

1. Color

2. Energy



3. Light

lu·men[1]

/ˈlo͞omən/

noun PHYSICS

plural noun: **lumens**

the SI unit of luminous flux, equal to the amount of light emitted per second in a unit solid angle of one steradian from a uniform source of one candela.

4. Life

L70

TM-21

LM-80

25,000 Hours

50,000 Hours

100,000 Hours

Energy Star

Traditional vs. LED Lighting

Type	Incandescent	Halogen	Fluorescent	HID	LED
Wattage	High Wattage	High Wattage	Lower Wattage	High Wattage	Lowest Wattage
Heat	High Heat	High Heat	Low Heat	High Heat	Lowest Heat
Total Cost of Ownership	$	$$	$$	$$	$
Controllability	Easier	Easy	Harder	Harder	Easy

Cost of LED

1. Cost of bulb/fixture
2. Cost of labor/installation
3. Cost of disposal/recycling
4. Cost of energy
5. Cost of waiting

Why Should You Convert to LED?

(Insert picture of coins to show cost of ownership)

“The most expensive LED you will buy is the LED you have to buy twice.”
- Tom. H

How to Pick the Right LED:

1. Bulb, Lamp, or Fixture
2. Lumens & Footcandles
3. Wattage
4. Color Temperature
5. Warranty/Reliability & Age of Manufacturer
6. Price
7. Dimming & Controllability

Controlling LED's

1. Switching
2. Dimming
3. Occupancy/Vacancy Sensing
4. Daylight Harvesting
5. Color Tuning
6. Zone Control
7. Time Scheduling

Controlling LED's

How to choose the right control system:

1. 0-10V
2. Line Voltage
3. POE
4. DALI
5. Wireless

Questions

Getting to Zero in School Retrofits

TEMA 10th Annual Conference – May 1, 2019

Texas Energy Managers Association
10TH ANNIVERSARY
2009 - 2019

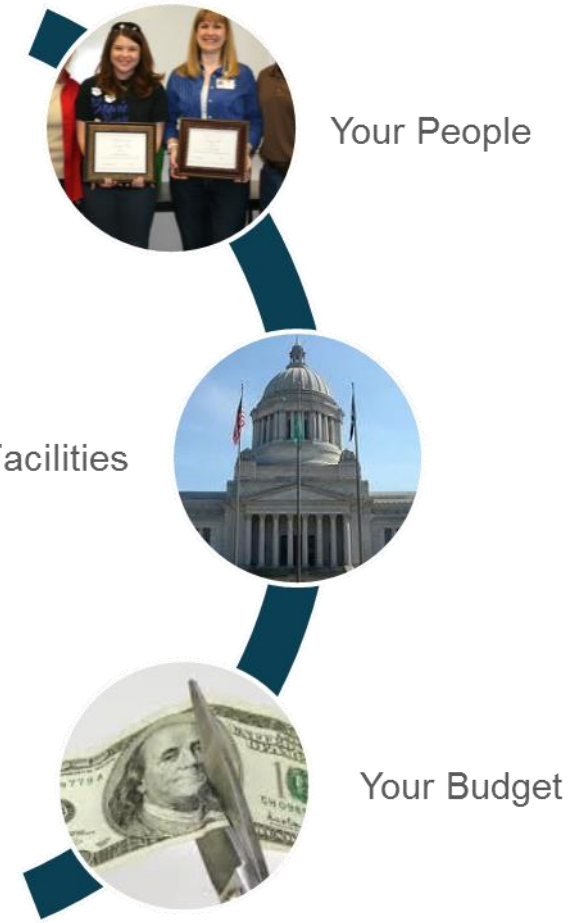
McKinstry
For The Life Of Your Building

AGENDA

- Overview
- Ways to get to Zero
- Funding mechanisms
- Case Studies
- Q&A

Overview: Educational Facilities Challenges

- **Aging buildings** and infrastructure
  - Requirement for a better educational environment
- **Increasing deferred maintenance** and capital renewal needs
  - Rising utility and operational costs
  - Heightened building security concerns
- **Increased building complexity –**
  - Rapid technology innovation and adoption, pushing campuses to adapt, adopt and keep pace.
- **Short-staffed** with added responsibilities
  - Limited capital funding available and prospects for future bond
  - Growing competition for students and staff



K-12 Schools

SPACE

- 5.8 billion ft^2
- Avg size:75,000 ft^2
- <100,000 school bldgs.
- 55,019 properties*
- Avg age = 44 yrs.**

ANNUAL COSTS

- $99B on construction and O&M
- $14B utility costs

- **ENERGY/ENVIRONMENT**
  - Average Energy Star Score = 67
  - EUI Scores = 50 to 500 kBtu/ft^2
  - EUI Median 58.2

** In Energy Star Portfolio Manager*

*** Since construction*

Higher Education

SPACE

- 5.5 billion sq. ft.
- 275,000 buildings
- 57% 50+ years old

ANNUAL COSTS

- $15B on O&M
- $11B on construction
- $4.5B on energy

ENVIRONMENT

- 6.3 metric tons of CO_2 per student

"If we expect buildings to perform significantly better, we need to change the process by which we put them together."

What is a NetZero Building?

NetZero Schools Today

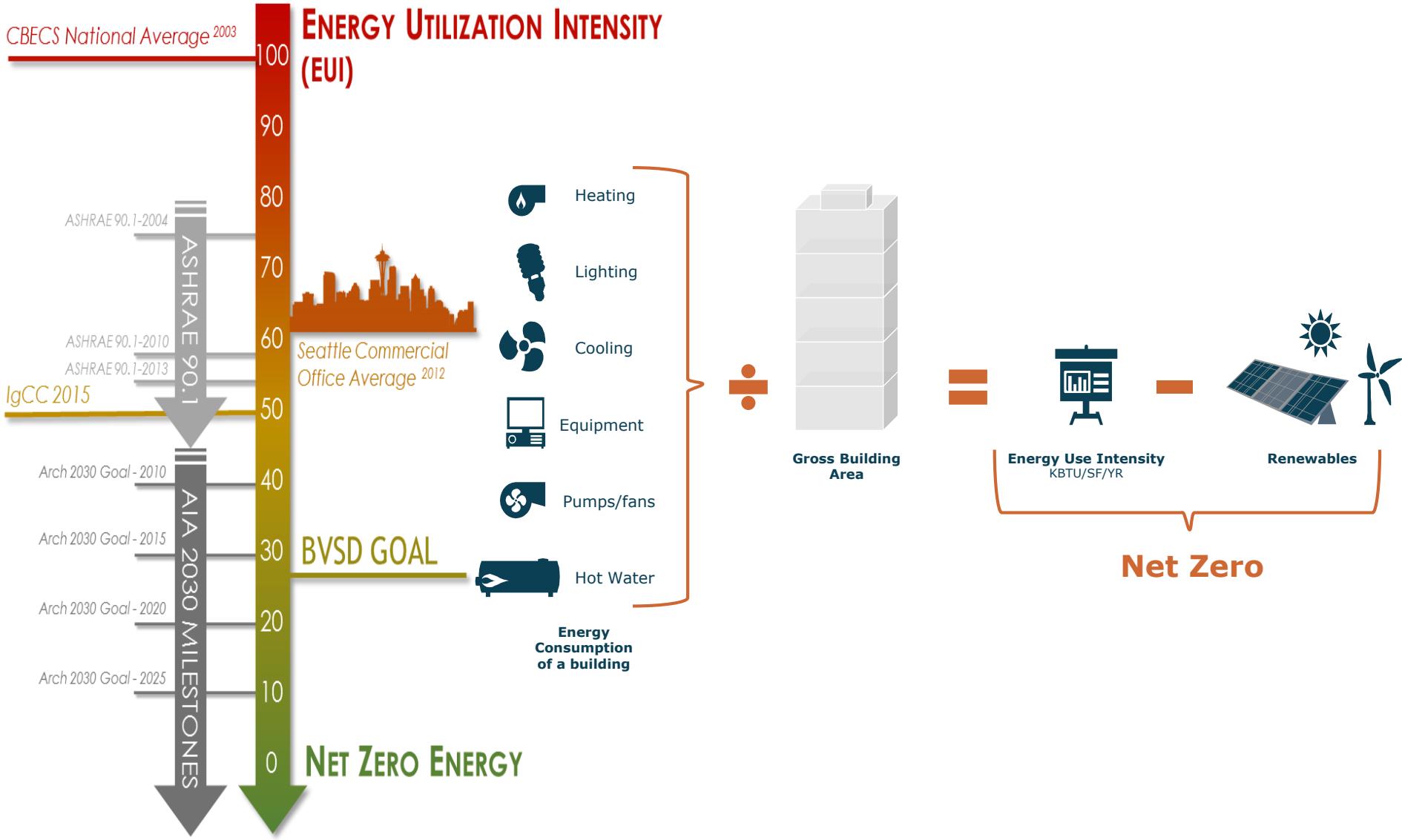
- Schools and government buildings - fledgling ‘net-zero” boom
- 500 verified and emerging zero-energy (ZE) buildings in US & Canada
- 89 verified or emerging ZE schools
- 700% growth in ZE buildings from 2010-2018

Getting to Zero

Let me count the ways…

Getting to Zero

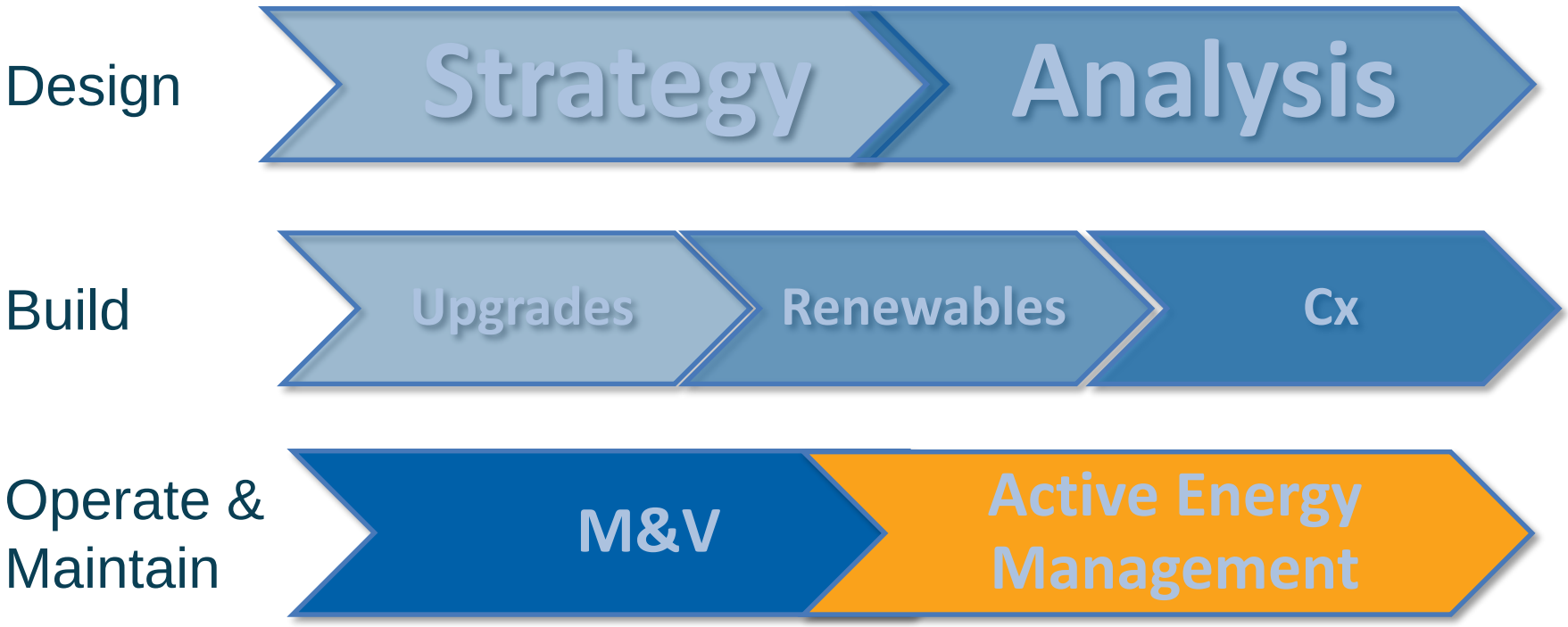
Getting to Zero


CBECS National Average 2003
ENERGY UTILIZATION INTENSITY (EUI)
100
90
80
70
60
50
40
30
20
10
0
ASHRAE 90.1-2004
ASHRAE 90.1-2010
ASHRAE 90.1-2013
IgCC 2015
ASHRAE 90.1
Arch 2030 Goal - 2010
Arch 2030 Goal - 2015
Arch 2030 Goal - 2020
Arch 2030 Goal - 2025
AIA 2030 MILESTONES
Seattle Commercial Office Average 2012
BVSD GOAL
NET ZERO ENERGY
Heating
Lighting
Cooling
Equipment
Pumps/fans
Hot Water
Energy Consumption of a building
Gross Building Area
Energy Use Intensity
KBTU/SF/YR
Renewables
Net Zero

Getting to Zero

- **New Facilities**
- **Deep Retrofits**
  - Planned Capital Improvement
  - Major Envelope Replacement
  - Major System Replacement
  - Comfort or Maintenance Issues
  - Mitigating Energy Hogs
- **Reno & RCx**
  - Replace Equipment
  - Commission New Equipment
  - Retro-commission Systems That Remain

NetZero Design, Build, Operate & Maintain (DBOM)



That’s nice.. But how do we pay for it?

Funding Your NetZero School

- Bonds
- Rebates/incentives
- Texas LoanStar Revolving Fund Program (SECO)
- Energy Savings Performance Contracts

Energy Savings Performance Contract (ESPC)

Energy Savings

$$$

Utilities

O&M

Capital Costs

Find Facility Improvement Measures (FIMs) that will generate savings *to pay* for facilities and system upgrades.

NetZero Case Studies

South Landing, Eastern Washington University, WA

McKinstry
For The Life Of Your Building

AVISTA®

Catalyst Building

- 159,00 sq. ft. / Five floors
- EWU anchor tenant
- 40,000 system iterations
- Passive house envelope
- Cross-laminated timber
- Efficient heating systems
- LED lighting
- Smart building enabled

Reducing Operating Costs – Zero Energy

Zero Energy

Produces as much energy as it consumes

Ultra Efficient

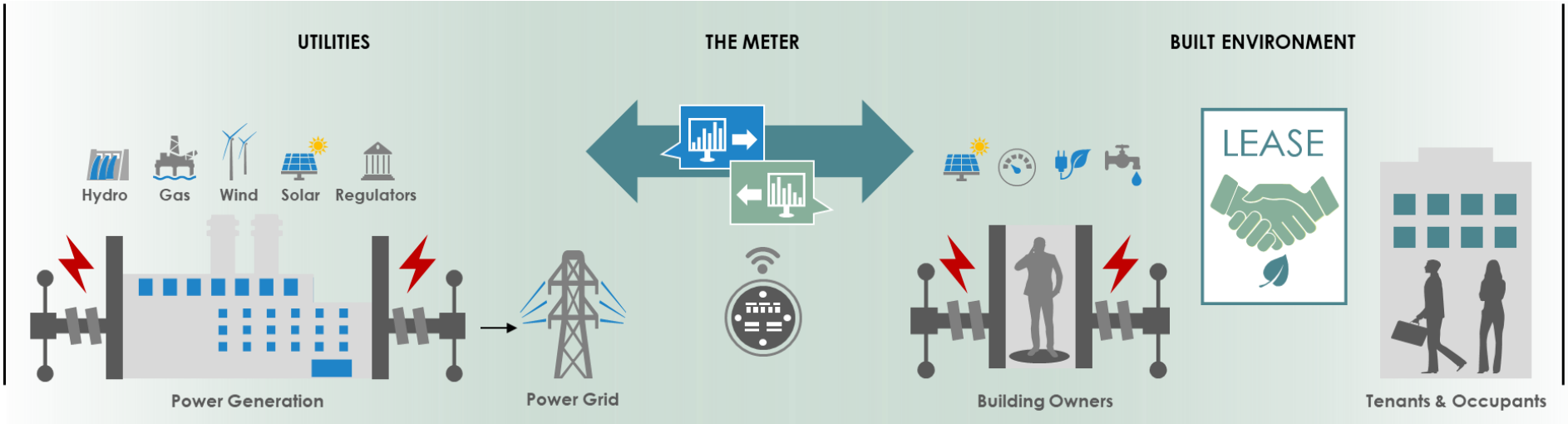
Target EUI ~20 kBtu / sq. ft./year

Zero Emissions

No fossil fuels combusted on site

Energy Value Chain

South Landing creates an eco-district that redefines the energy value chain by allowing the utility to work alongside the built environment.



McKinstry
For The Life Of Your Building

South Landing Eco District

Inventing the utility of the future

- Central energy hub
- Ground-coupled heat pump chiller
- Solar photovoltaics (PV)
- Battery storage
- Catalyst will be the first building connected to the eco-district
- Future developments will connect when built

a strategic approach to ONE

Boulder Valley School District

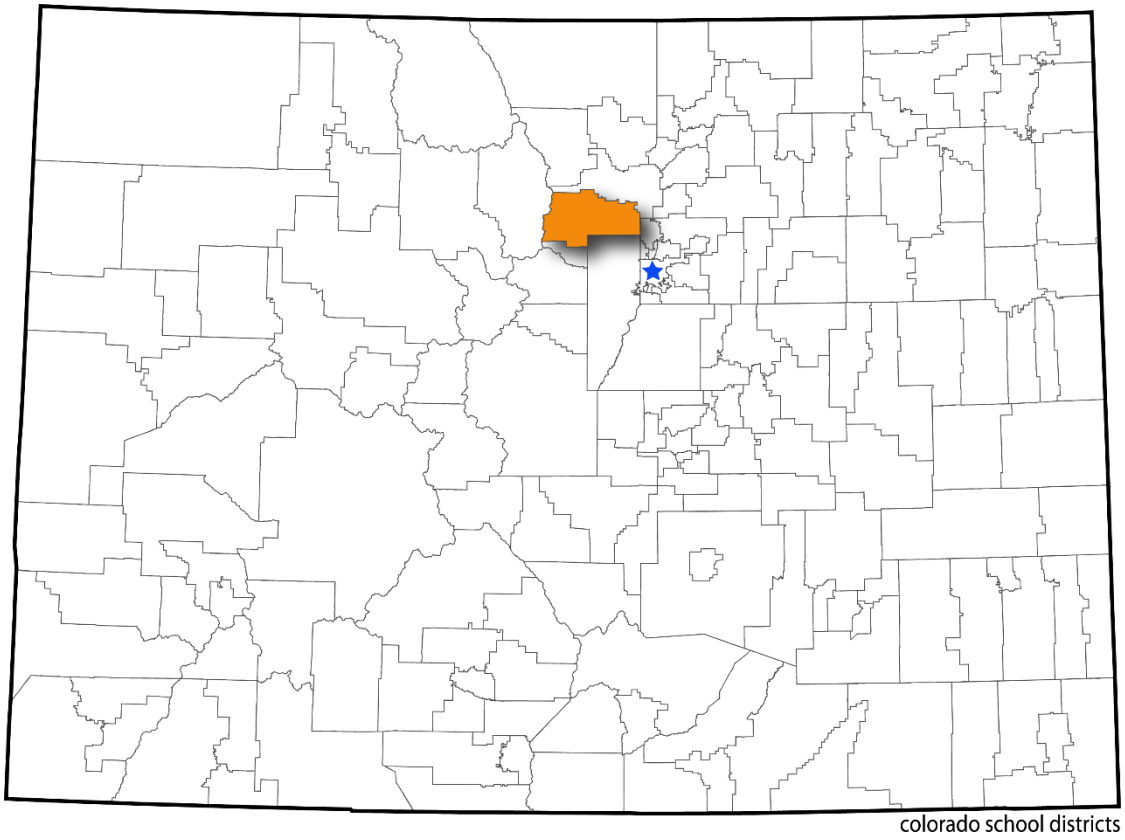
Phillip Saieg CEM, LEED AP O+M
Project Director
www.mckinstry.com
phillipsa@mckinstry.com

BVSD Goals: Energy Plan

2019: 20% REDUCTION

2050: ZNEC District

- 500 sq miles
- 56 schools
- 4 support facilities
- 4.8 million sf
- 72%: 30+ years old
- Oldest: 1882
- Newest: 2011
- 30,000 students
- 4000+ employees



BVSD Sustainability Management System

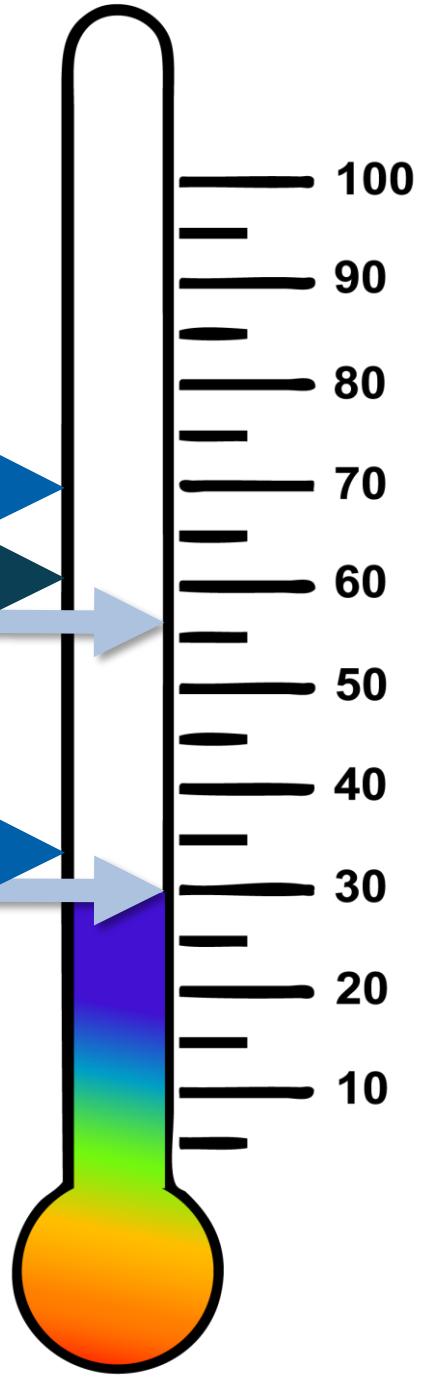
BVSD Average **68 EUI**

U.S. K-12 median: **58.2 EUI**

2019: average 55 EUI

BVSD Best Performing CASEY MS **32 EUI**

2050 ZNEC: average ≤30 EUI



BVSD Financing Plan

$800m

assessed deficiencies
majority deferred maintenance

BUILDING FOR STUDENT SUCCESS

Boulder Valley School District

$576m approved

2014 BOND

Strategies Decision Matrix

2014 Bond Mechanical Systems/Energy Review Matrix

CREEKSIDE ELEMENTARY

scale: 1=poor/undesirable, 10=excellent/desirable

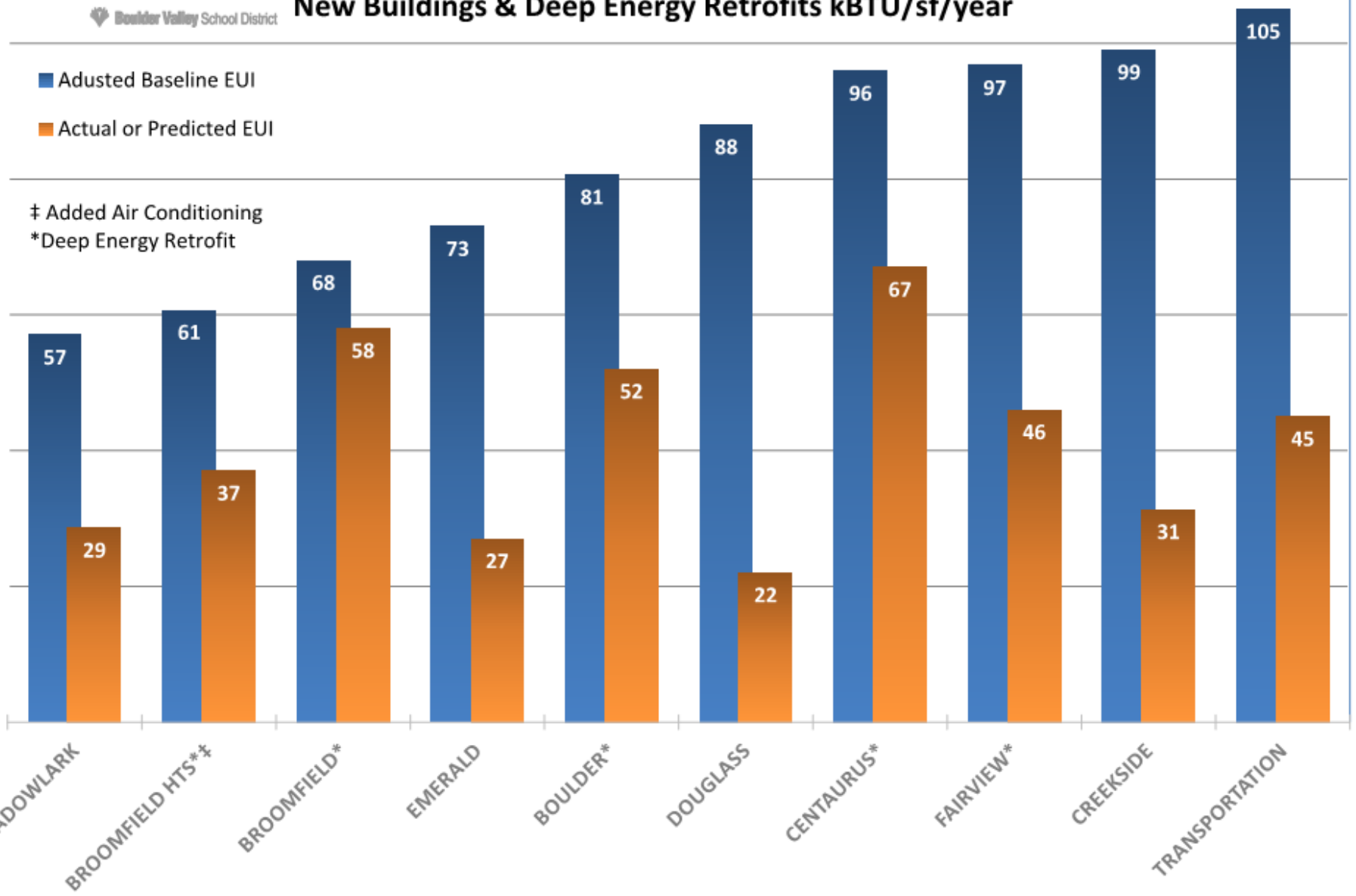
	FACTOR	OPTION 1 Geothermal Heatpump	OPTION 2A Displacement + Hydronic Heat	OPTION 2B Displacement + Geothermal	OPTION 3 4 Pipe Chilled Beam Heat Recovery Chiller	OPTION 4 VAV
1	**FIRST COST** Cost/sqft - Building Sq.Ft. 48,900	$2,666,263 $54.5	$2,257,180 $46.2	$2,944,112 $60.2	$3,138,423 $64.2	$2,081,020 $42.6
	Impact to project construction budget.	**7.19**	**9.15**	**5.85**	**4.92**	**10.00**
2	**CONSTRUCTABILITY/ARCHITECTURAL IMPACT**					
	Consider the impact on construction schedule, building aesthetics and exterior acoustics.	**7.5**	**6.5**	**6.5**	**5**	**7.5**
3	**ENERGY USE INTENSITY (EUI)**	25.9	29.0	25.3	26.1	38.2
	Consider the lowest EUI	**9.65**	**8.62**	**9.88**	**9.58**	**6.54**
4	**MAINTAINABILITY**					
	Consider parts availability, relative system complexity, and ease of repair.	**7**	**6**	**6**	**7**	**8**
5	**FUTURE-PROOFING**	$8,304,017	$8,402,109	$8,207,057	$7,636,733	$9,491,343
	Ability to hedge against future energy price volatility. Energy cost shown is predicted 50 year sum.	**9.13**	**9.00**	**9.25**	**10.00**	**7.57**
6	**OPERATING COSTS**					
	Simple payback.	**5.91**	**8.12**	**4.78**	**4.57**	**10.00**
7	**INDOOR ENVIRONMENT QUALITY**					
	Level of mechanical acoustical interference with instruction in the classroom. Indoor air quality - Amount of outside air that will be delivered to the space/occupant.	**7**	**10**	**10**	**8**	**7**
	score	**7.63**	**8.20**	**7.47**	**7.01**	**8.09**

Date: **21-Dec-15**

BUILDING FOR STUDENT SUCCESS
Boulder Valley School District

BVSD Bond Project Energy Use Intensity

New Buildings & Deep Energy Retrofits kBTU/sf/year



Lady Bird Johnson NetZero Middle School, Irving ISD

Sustainable Technologies*

- Geothermal water source heat pumps
- LED Lighting, light shelve and light harvesting
- ENERGY STAR rated kitchen
- High efficiency glazing and wall/roof insulation
- Water cistern for recycling and irrigation

Renewable Energy Sources

- 600 kW solar array with 2,988 Solar PV
- Wind turbine - 2.4 kW capacity

Financing

- Bonds, Incentives and Grants

First NetZero Public School in Texas

** From Bosch Case Study*

Thank You!

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For The Life Of Your Building

When to apply:

Existing Building Cx

Kyle Fisher, PE, BCxP, CPMP
Director of Commissioning for O'Connell Robertson

O'CONNELL ROBERTSON

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Key takeaways:

- Understanding the Existing Building Cx Process
- How to define the scope of the process in your own building
- What to expect from the process

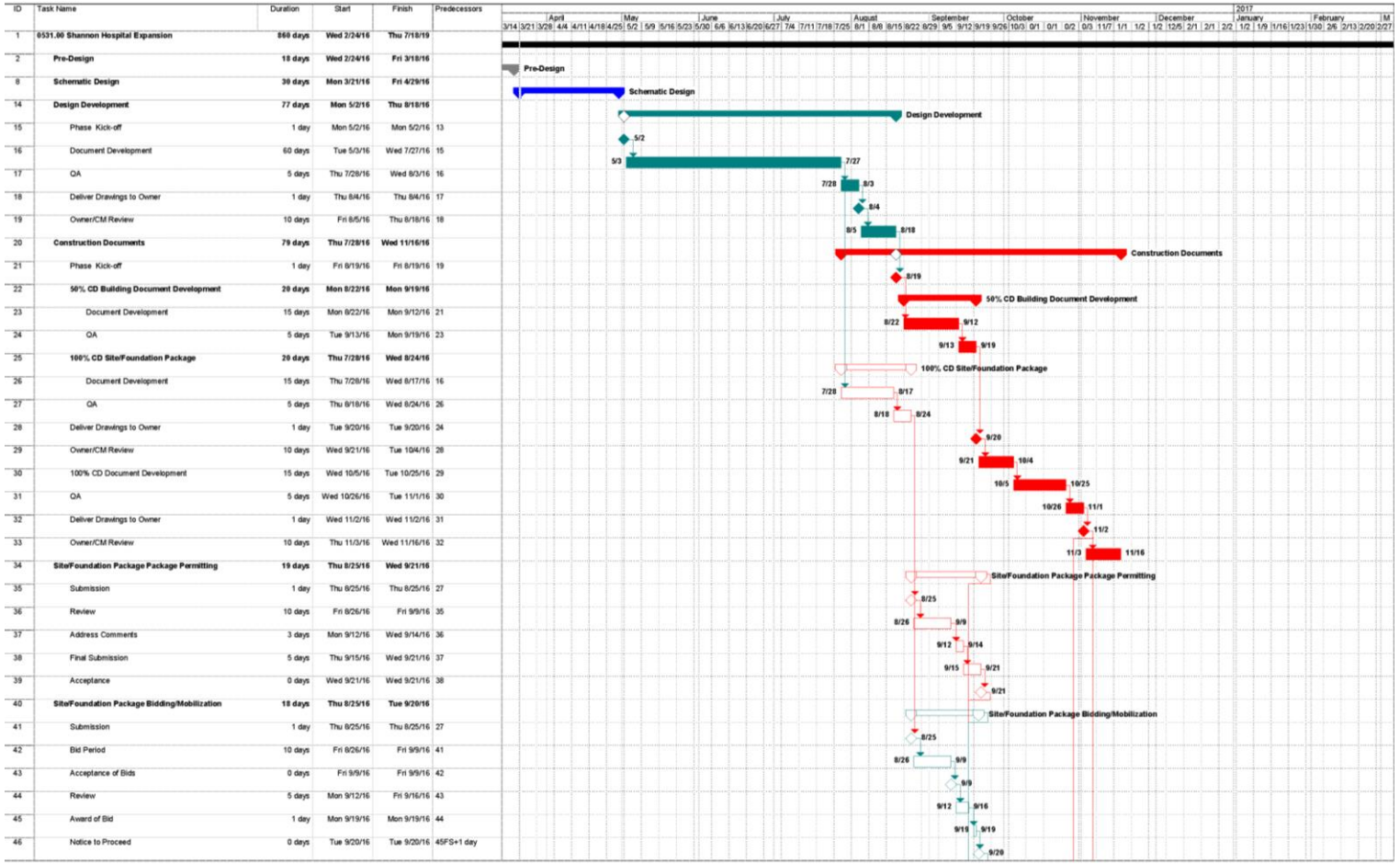
ASHRAE Guideline 0.2 -

Commissioning Process for Existing Systems and Assemblies

“An organized, quality-oriented process for planning, assessing, investigating, implementing, verifying, and documenting that improves the performance of facilities, systems, and assemblies to meet defined operational requirements and criteria for the facility over time.

Phase 1 – Planning

- Establish team, scope & set goals
- CFR – Current Facility Requirements
- Gather documents
- External team



ID	Task Name	Duration	Start	Finish	Predecessors
1	**0531.00 Shannon Hospital Expansion**	**860 days**	**Wed 2/24/16**	**Thu 7/18/19**	
2	**Pre-Design**	**18 days**	**Wed 2/24/16**	**Fri 3/18/16**	
8	**Schematic Design**	**30 days**	**Mon 3/21/16**	**Fri 4/29/16**	
14	**Design Development**	**77 days**	**Mon 5/2/16**	**Thu 8/18/16**	
15	Phase Kick-off	1 day	Mon 5/2/16	Mon 5/2/16	13
16	Document Development	60 days	Tue 5/3/16	Wed 7/27/16	15
17	QA	5 days	Thu 7/28/16	Wed 8/3/16	16
18	Deliver Drawings to Owner	1 day	Thu 8/4/16	Thu 8/4/16	17
19	Owner/CM Review	10 days	Fri 8/5/16	Thu 8/18/16	18
20	**Construction Documents**	**79 days**	**Thu 7/28/16**	**Wed 11/16/16**	
21	Phase Kick-off	1 day	Fri 8/19/16	Fri 8/19/16	19
22	**50% CD Building Document Development**	**20 days**	**Mon 8/22/16**	**Mon 9/19/16**	
23	Document Development	15 days	Mon 8/22/16	Mon 9/12/16	21
24	QA	5 days	Tue 9/13/16	Mon 9/19/16	23
25	**100% CD Site/Foundation Package**	**20 days**	**Thu 7/28/16**	**Wed 8/24/16**	
26	Document Development	15 days	Thu 7/28/16	Wed 8/17/16	16
27	QA	5 days	Thu 8/18/16	Wed 8/24/16	26
28	Deliver Drawings to Owner	1 day	Tue 9/20/16	Tue 9/20/16	24
29	Owner/CM Review	10 days	Wed 9/21/16	Tue 10/4/16	28
30	100% CD Document Development	15 days	Wed 10/5/16	Tue 10/25/16	29
31	QA	5 days	Wed 10/26/16	Tue 11/1/16	30
32	Deliver Drawings to Owner	1 day	Wed 11/2/16	Wed 11/2/16	31
33	Owner/CM Review	10 days	Thu 11/3/16	Wed 11/16/16	32
34	**Site/Foundation Package Package Permitting**	**19 days**	**Thu 8/25/16**	**Wed 9/21/16**	
35	Submission	1 day	Thu 8/25/16	Thu 8/25/16	27
36	Review	10 days	Fri 8/26/16	Fri 9/9/16	35
37	Address Comments	3 days	Mon 9/12/16	Wed 9/14/16	36
38	Final Submission	5 days	Thu 9/15/16	Wed 9/21/16	37
39	Acceptance	0 days	Wed 9/21/16	Wed 9/21/16	38
40	**Site/Foundation Package Bidding/Mobilization**	**18 days**	**Thu 8/25/16**	**Tue 9/20/16**	
41	Submission	1 day	Thu 8/25/16	Thu 8/25/16	27
42	Bid Period	10 days	Fri 8/26/16	Fri 9/9/16	41
43	Acceptance of Bids	0 days	Fri 9/9/16	Fri 9/9/16	42
44	Review	5 days	Mon 9/12/16	Fri 9/16/16	43
45	Award of Bid	1 day	Mon 9/19/16	Mon 9/19/16	44
46	Notice to Proceed	0 days	Tue 9/20/16	Tue 9/20/16	45FS+1 day

Phase 2 – Assessment

- EBCxA to gather information about site, systems, performance, etc.

Phase 3 – Testing

- Compare actual vs. expected

Phase 4 – Analysis & Recommendation

- Cost benefit analysis of proposed solutions

Phase 5 – Implementation

- Carry out accepted solutions

Phase 6 – Verification

- Re-test, M&V, Document

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

SCUCISD selected 3 Cx companies through RFQ process in 2017

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

- 135,500 SF Middle School
- 2 x 267 Ton Air-Cooled Chillers
- 2 x 1.5MBTU(output) Non-Condensing Boilers
- VAV AHUs with HW VAV box
- Single zone, constant volume 4-pipe AHUs
- Library & Admin unit with chilled water & DX
- Equipment changeout in 2007 & 2015 both were commissioned

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Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Planning Phase:

- Work to be limited to HVAC equipment
- Major issues with AHU-2
- Current sequences unknown
- Programming to be done in-house
- Owner to provide EBCxA with remote access to ALC WebCTRL

Texas Energy Managers Association
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2009 - 2019

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

- 43-programming issues resolved
  - Graphical errors, PID loop adjustments, economizer hours lost, points not linked, sequences corrected, etc.

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

- 43-programming issues resolved
  - AHU-2: After hours flow about 3000cfm for 30T DX cooling. Reprogrammed with associated VAVs to act as constant volume DX unit after-hours

Texas Energy Managers Association
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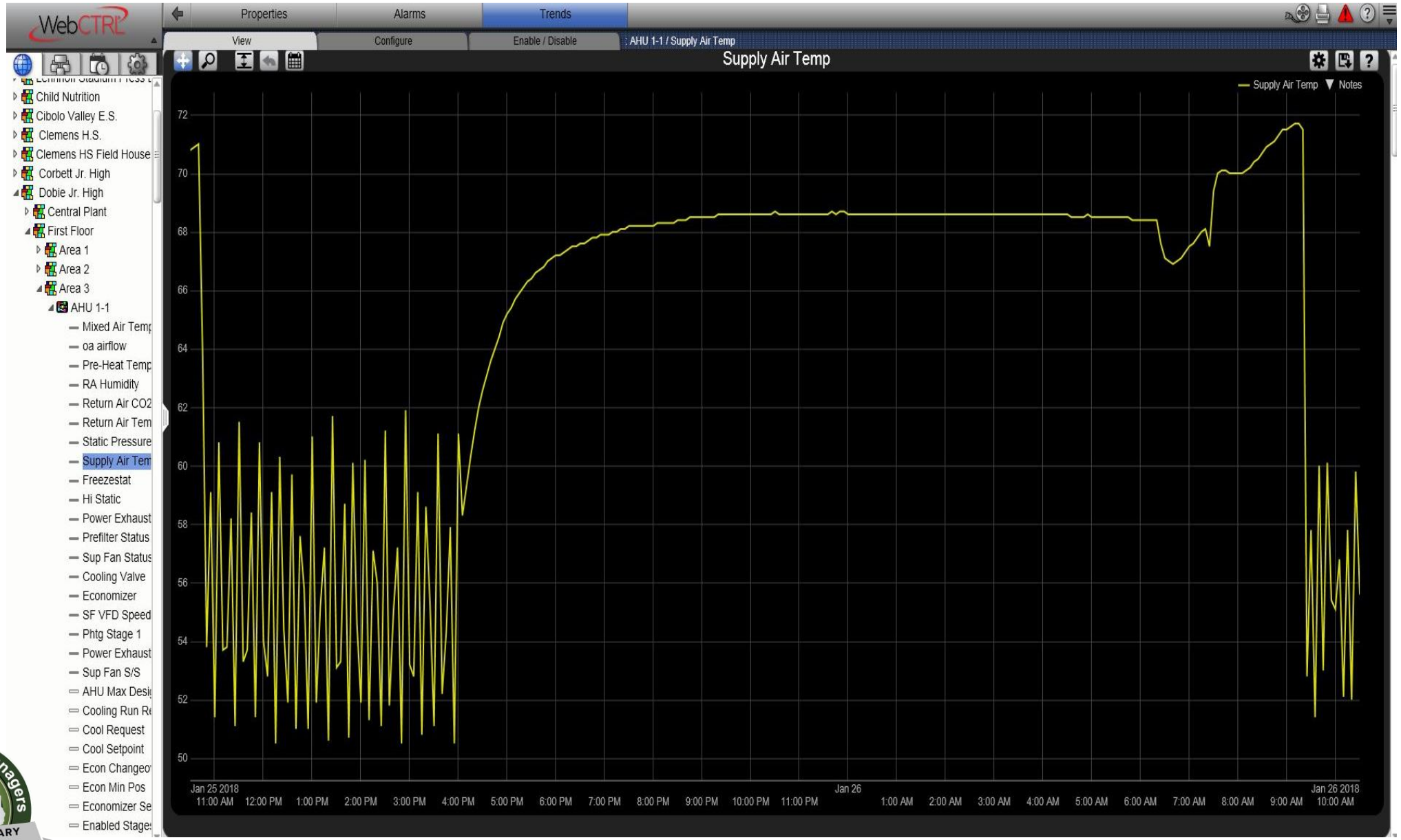
2009 - 2019

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

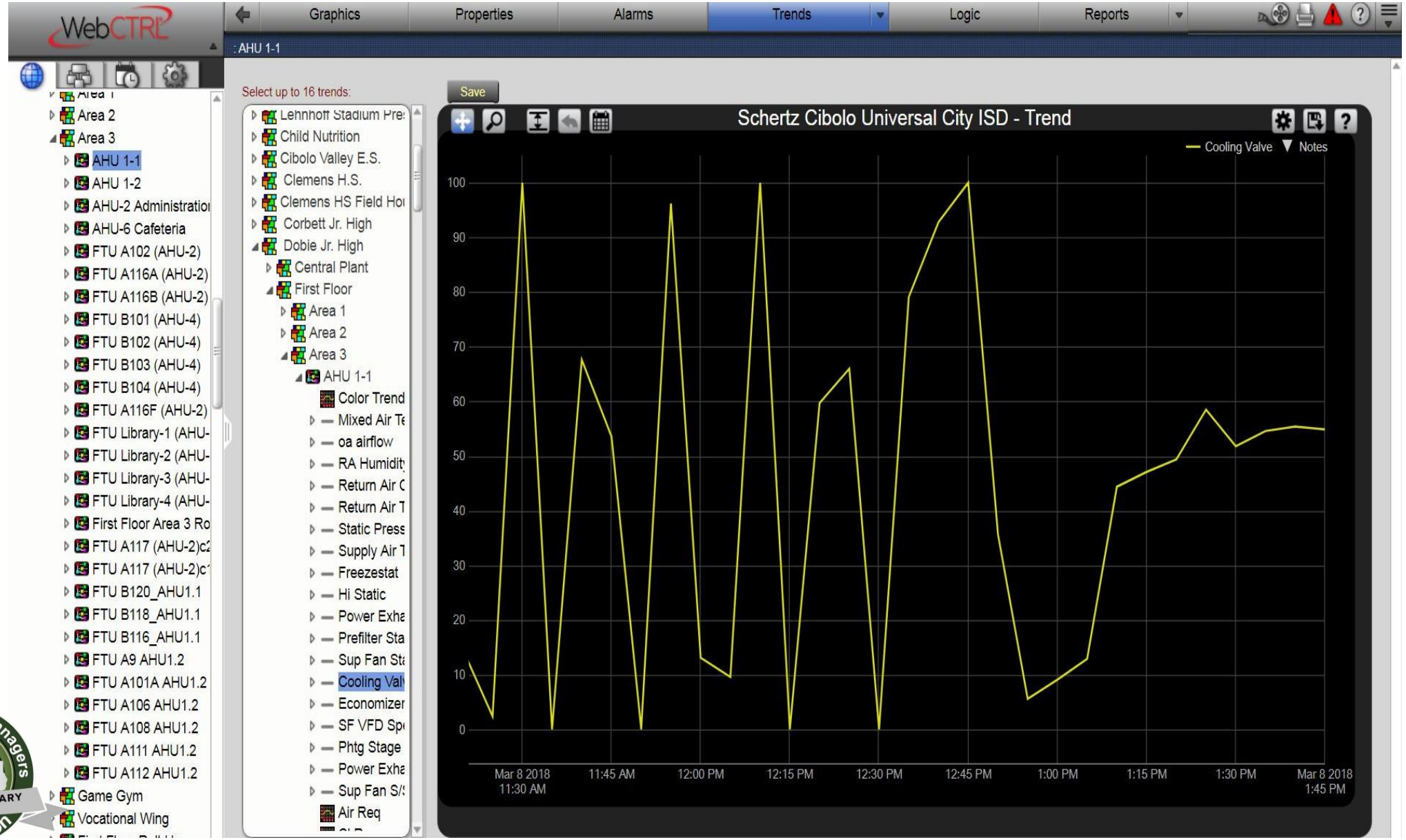
- 43-programming issues resolved
  - AHU-1.1: Part of the 2015 project which was commissioned



Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

- 43-programming issues resolved
  - AHU-1.1: Part of the 2015 project which was commissioned
  - AHU-1.1: Adjusted PID loop values



Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

- 22-hardware issues resolved
  - Removed OA obstructions, replaced faulty actuators (damper and valve), added sensors for units under warranty, corrected boiler malfunctions, etc.

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

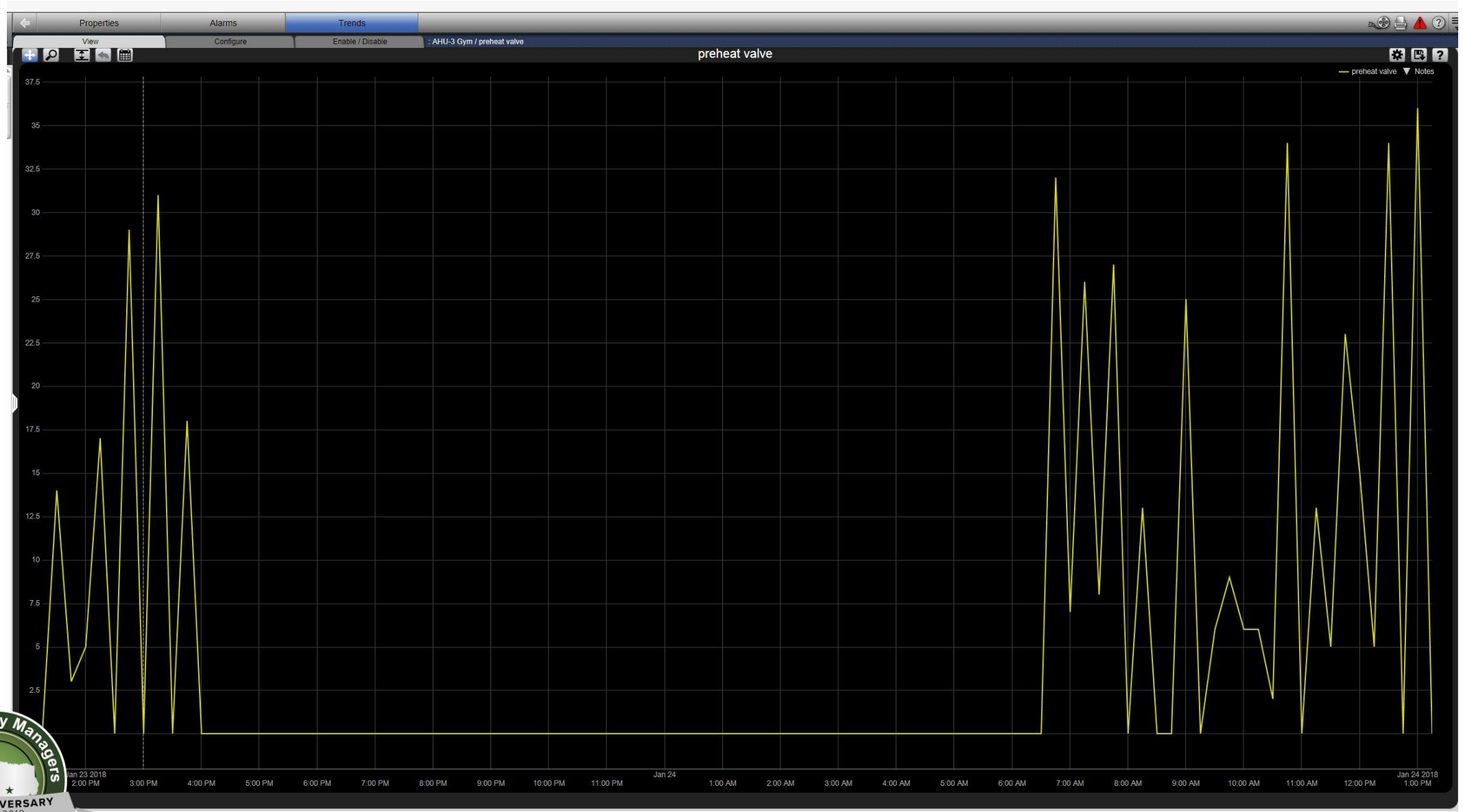
Resolved Issues (80 total with 70 resolved):

- 22-hardware issues resolved
  - Removed insect screen and AFMS straightening device restricting flow
  - Owner opted to replace AFMS with thermal dispersion type (Ebtron)

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

- 22-hardware issues resolved
  - Initially what looked like an issue with HW valves not tuned correctly



Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

- 22-hardware issues resolved
  - While watching remotely EBCxA noticed periodic alarms on the boilers
  - Upon further inspection found B-1 had 0.5M starts in about two years

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

- 22-hardware issues resolved
  - New AHUs added in 2015 renovation were missing AFMS (x2) & humidity sensors (x2)
  - Owner contacted supplier and had missing items provided under warranty

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Resolved Issues (80 total with 70 resolved):

5-design issues resolved

- Misinterpreted OA values in 2007 project led to higher than necessary OA flows
- Demand control ventilation rates scaled from min (as shown) to economizer flow
- EBCxA recalculated min flow rates consistent with mech code

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

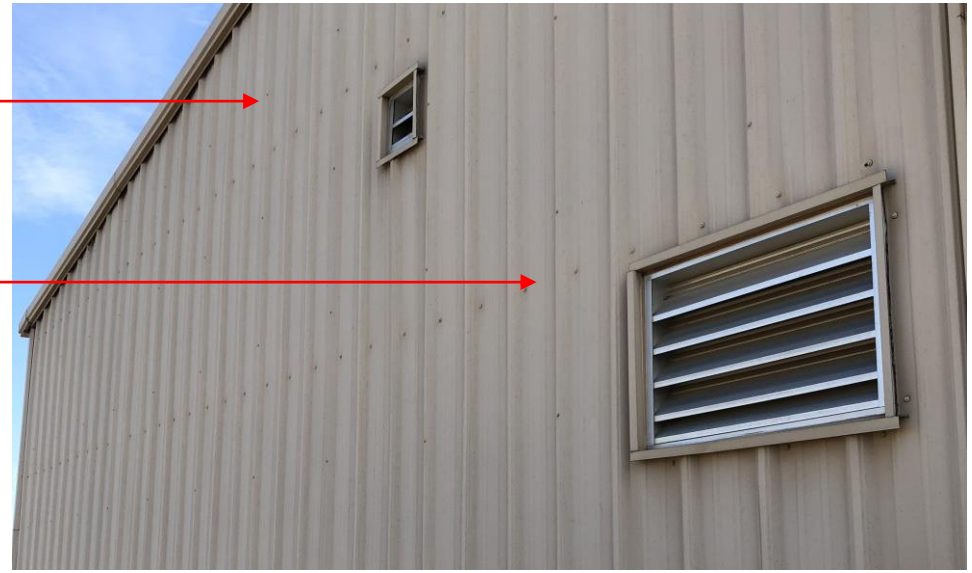
Unresolved Issues (10 total of 80 identified):

10-unresolved/pending issues

- EBCxA ranked all issues according to cost and benefit
- Items such as undersized OA louvers not to be pursued

AHU-13
3000 cfm

AHU-12
3,000-10,000 cfm



AHU–12	AHU–13
10000	3025
3000	2650–3025
GYM	LOCKER ROOMS
2	2
100 / 78	100 / 78
FC–DWDI	FC–DWDI
BELT	BELT
18	9
1001	1956
CONST	CONST
8.59	3.11
10 / 460 / 3	5 / 460 / 3
CW	CW
10,000	3,025
81.2/65.8	91.6/77.2
55/54	55/55
500	500
0.45	0.55
63.1	39.9
5.8	16.7
4/144	6
381.4	240
294.7	125


ALLISON L. STEELE
ENHANCED LEARNING CENTER
J. FRANK DOBIE
JUNIOR HIGH SCHOOL
WILDER
INTERMEDIATE SCHOOL
JORDAN

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Project Timeline:

Contract in December 2017

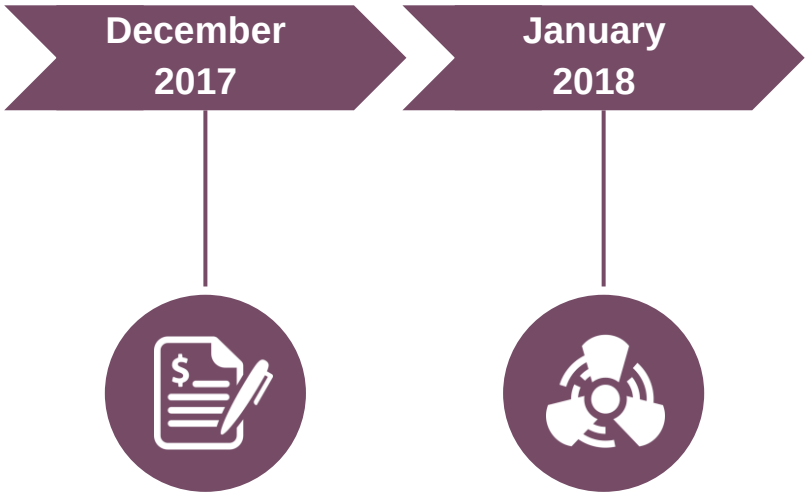
December 2017

Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Project Timeline:

Contract in December 2017

First Assessment



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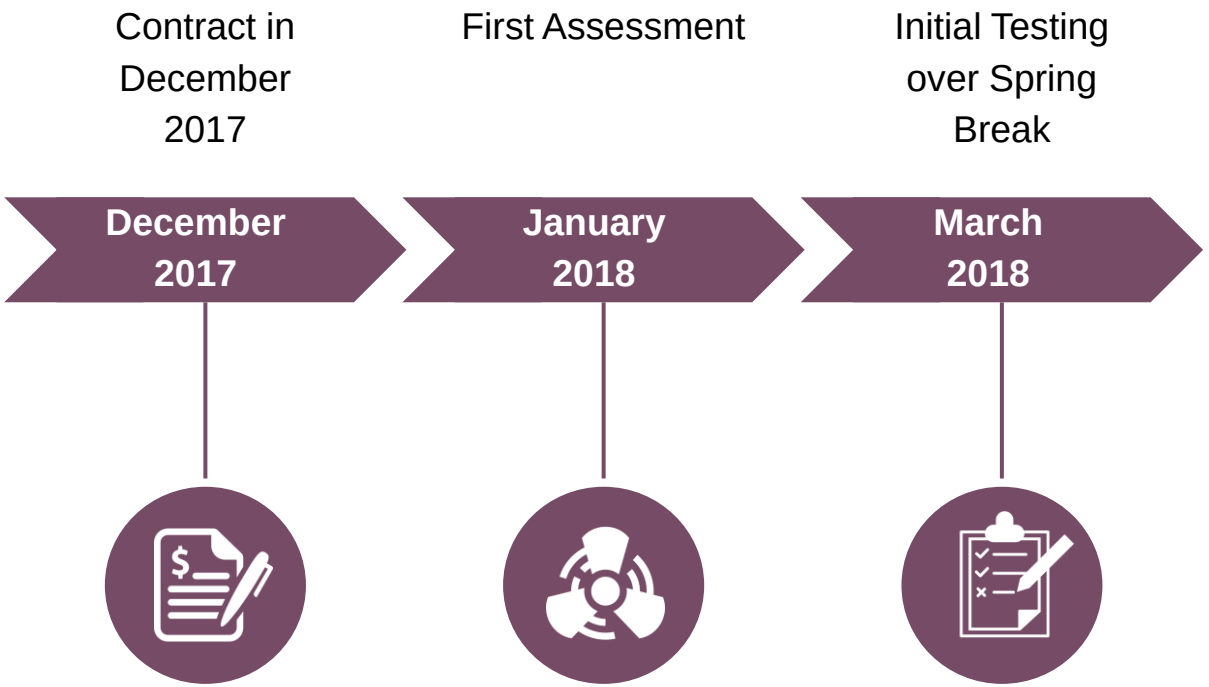

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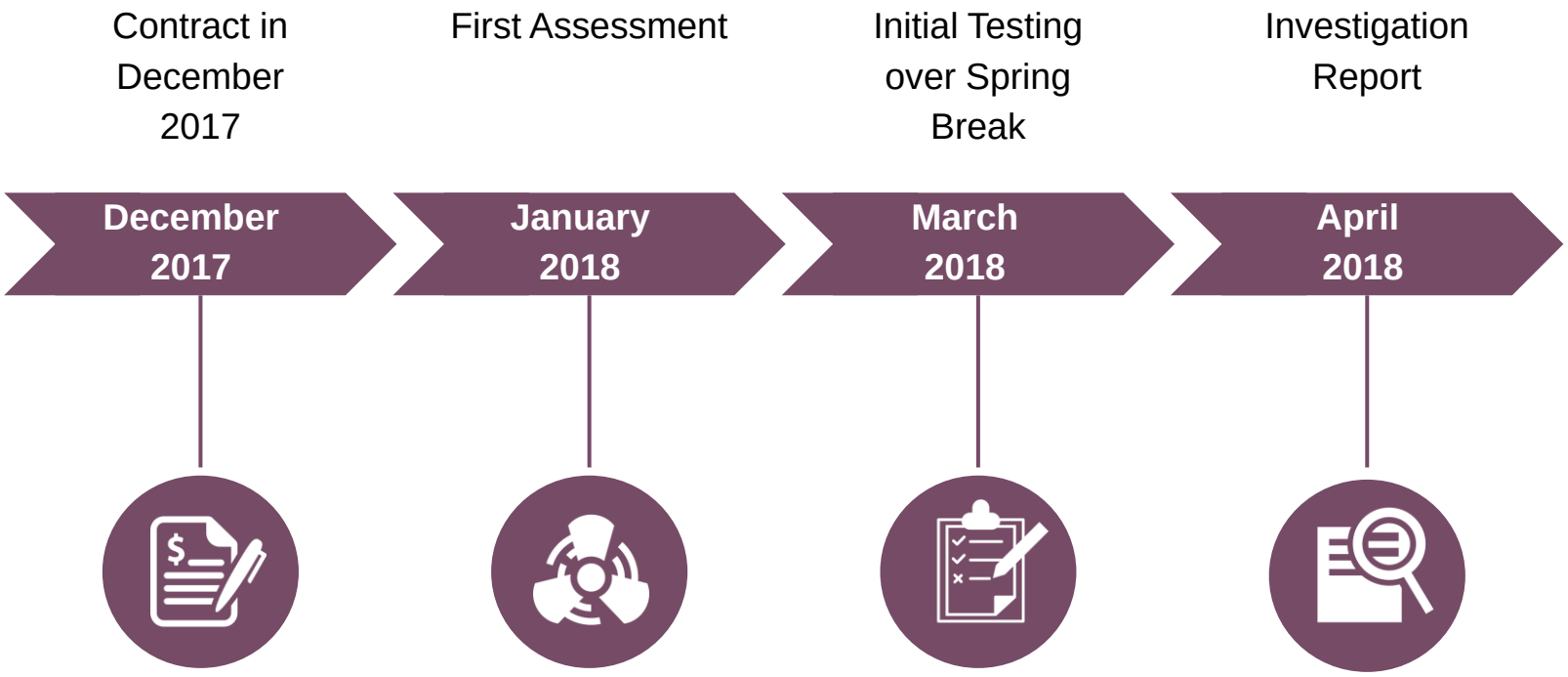
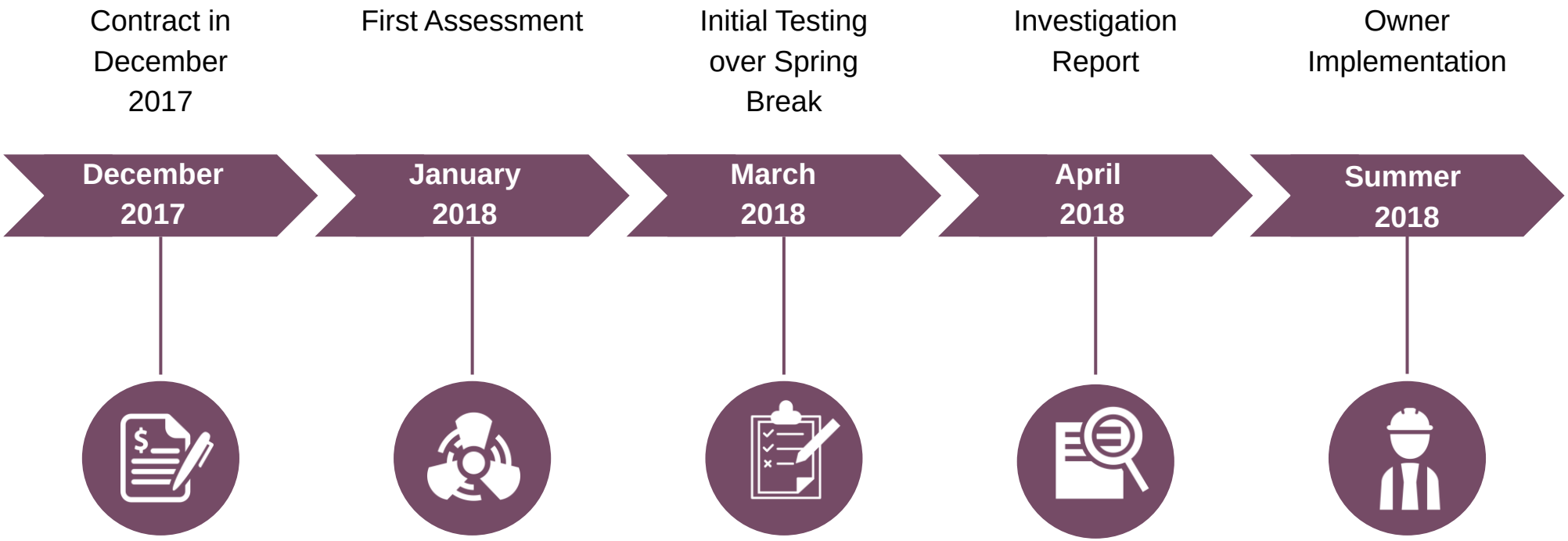


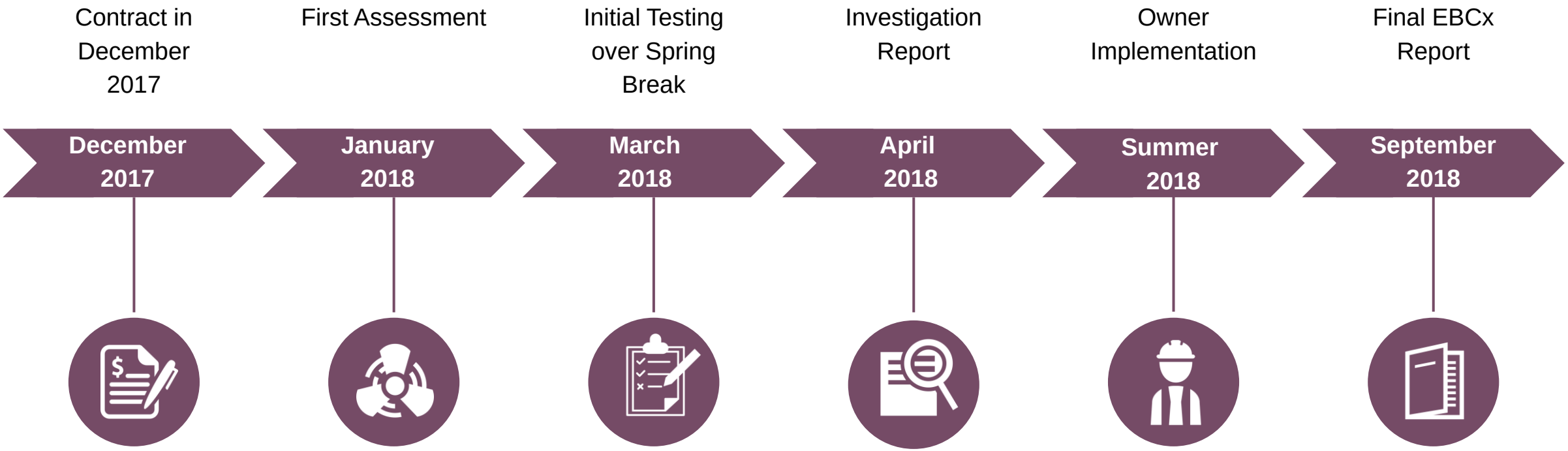
Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Project Timeline:



Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Project Timeline:



Case Study: Schertz-Cibolo Universal City ISD – Dobie JHS

Project Success:

- Corrected issue with Admin AHU
- Corrected boiler short-cycling
- Corrected numerous sequences
- Corrected misinterpreted OA flows from 2007 project
- Added static pressure reset strategies
- Added AHU supply temp reset strategies

Value Added: $2-3k energy savings / month
Projected to payback in < 2 years

Case Study: Austin Community College – Cypress Creek

Example Project: ACC Cypress Creek

- Approx. 2007 build
- Building 2000: 65,000sf lab, lecture & offices
- Owner reports that building over pressurized
- First visited in September 2018
- Final EBCx report in September 2018
- WO complete in April 2019

Example Project: ACC Cypress Creek

- Approx. 2007 build
- Building 2000: 65,000sf lab, lecture & offices
- Owner reports that building over pressurized
- First visited in September 2018
- Final EBCx report in September 2018
- WO complete in April 2019

Value Added: Owner expected to save $10,000/month on energy bills (during peak months)

When to apply:

Existing Building Cx

Kyle Fisher, PE, CPMP
Director of Commissioning for O'Connell Robertson

O'CONNELL ROBERTSON

Texas Energy Managers Association
10TH ANNIVERSARY
2009 - 2019

Questions?

TEMA CONFERENCE 2019

APRIL 30 – MAY 2 WACO CONVENTION CENTER