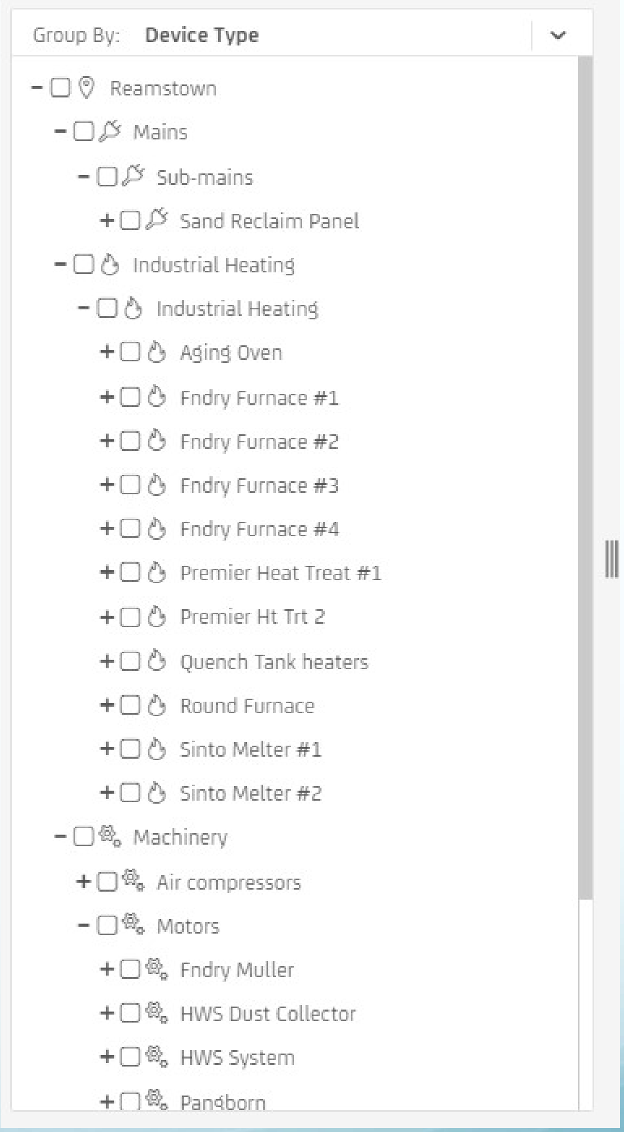
Foundry Review

What is SiteWatch monitoring?

- 11 industrial heating machines (furnaces, melters, quench heaters, aging oven)
- Sand reclamation system (at the panel level)
- 3 air compressors
- 8 individual motors (mullers, dust collectors, bag house motors)
- 1 hydraulic pump



Industrial Heating

Foundry furnaces cycle between production and standby, requiring energy to maintain a heel in each furnace (molten metal to help preheat next melt)

Furnaces usually <u>do not </u>shut off when no melting, with some exceptions (shown at left)

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Industrial Heating

What is impact of standby operation (maintaining heel) vs. turning furnace off?

- When average kW across a short period (4+ hours) exceeds some threshold (varies by furnace, usually between 20-40 kW) the furnace is melting or considered in "production"
- Lower power draw seen on weekends during non-production periods, or "standby"
- Compare "production" to "standby" hours
- Compare "production" to "standby" kW
- Annual cost for standby energy vs. letting furnaces cycle fully OFF
- Focus on furnaces with less "production" time as the impact to operators would be less significant…

Industrial Heating

What is impact of standby operation (maintaining heel) vs. turning furnace off?

How many cycles do we see per furnace?

Define cycle per furnace based on amp/kW draw

- Furnace 2 used as the example
- Analysis assumed when amps exceed 40, furnace is melting
- Lower amp draw seen Saturday morning through Sunday

Weekend standby draw to maintain heel (30 amps, or 26 kW)

Production melt cycles showing increased usage

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Industrial Heating

Red indicates production cycles, length of cycle varies from 1-4 days

Blue indicates standby periods, with time between varying from 1 to 4 days (or even weeks for other furnaces)

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Industrial Heating

- Uptime % and Downtime % - Percent of time equipment is ON or OFF
- Cycling Threshold kW - Used to establish when the machine is in "production" mode. If the average kW over a 4-hour span exceeds this value, machine is considered in "production" (this accounts for variation in furnace energy use during a cycle)
- Annual Production/Standby Time - Hours per year when each machine is in production (useful work being completed) or in standby (period between useful work when heel is maintained)
- Production/Standby kW - Energy used per period, when the furnace is producing or in standby mode

Equipment	Uptime % (ON)	Downtime % (OFF)	Cycling Threshold kW	Annual Production Time	Annual Standby Time	Production kW	Standby kW
Fndry Furnace #1	99%	1%	31	4,399	4,298	37.7	28.3
Fndry Furnace #2	92%	8%	33	2,512	5,633	39.4	23.5
Fndry Furnace #3	95%	5%	28	738	7,728	35.7	20.2
Fndry Furnace #4	95%	5%	40	1,249	7,140	47.4	28.3
Sinto Melter #1	97%	3%	22	3,570	5,017	29.1	19.7
Sinto Melter #2	91%	9%	22	2,530	5,747	29.4	17.8

Industrial Heating

Can standby hours be reduced? Focus on furnaces with less cycles and more standby time

- Furnace 3 and 4 have fewer cycles and more standby time

What's the impact of leaving Furnace 3 and 4 in standby more often versus turning them off?

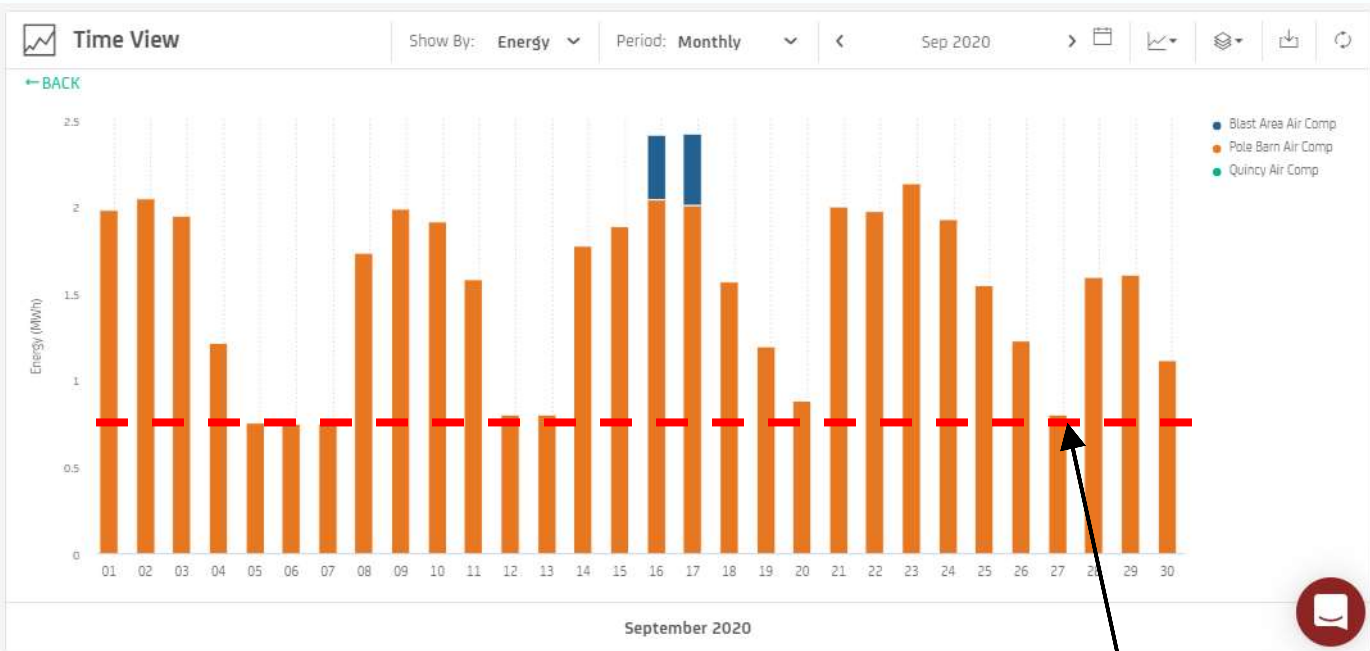
- Assume 50% of standby time can be OFF time (conservative estimate, can likely be more)
- Standby kW x Standby Time (hrs) x 50% x $ per kWh = Potential Savings
- **Furnace 3 - 20.2 kW x 7,728 hrs x 50% x $0.073 per kWh = $5,697 saved annually**
- **Furnace 4 - 28.3 kW x 7,140 hrs x 50% x $0.073 per kWh = $7,375 saved annually**

Equipment	Cycles per Year	Annual Production Time	Avg Cycle Time (production time / cycles)	Annual Standby Time	Production kW	Standby kW
Fndry Furnace #1	259	4,399	17 hrs	4,298	37.7	28.3
Fndry Furnace #2	135	2,512	19 hrs	5,633	39.4	23.5
Fndry Furnace #3	**94**	**738**	**8 hrs**	**7,728**	**35.7**	**20.2**
Fndry Furnace #4	**202**	**1,249**	**6 hrs**	**7,140**	**47.4**	**28.3**
Sinto Melter #1	281	3,570	13 hrs	5,017	29.1	19.7
Sinto Melter #2	286	2,530	9 hrs	5,747	29.4	17.8

Air Compressors

Three air compressors monitored -> Blast Area Comp, Pole Barn Comp, and Quincy Comp

Mostly Pole Barn Compressor, some Blast Area Comp, and no Quincy



Weekend load is mostly air leaks (no production equipment using compressed air is operating, only one minor load was identified)

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Air Compressors

What is the cost of operating the Pole Barn Comp on weekends?

- Annual Savings = Weekend hours (non-production periods) x average weekend kW x $ per kWh
- No WE compressor = 2,496 hrs (48 hrs per weekend for 52 weeks) x 30 kW x $0.073
- <u>Savings from turning off Pole Barn Comp on weekends = $5,466 annually</u>
- A single door requiring compressed air to operate leads to a weekend compressor needed… **What is the cost for a new "local" compressor to run that door?**
    - **Payback on compressor could be <u>weeks</u> based on size**

Assuming weekend "load" serves only air leaks… What are the prospective savings from completing an air audit and fixing those leaks?

Potential savings can be defined as 50% of weekend load (assuming 50% of leaks are repaired), applied to the number of weekday hours per year:

- Annual Savings = Weekday hours x average weekend kW x 50% x $ per kWh
- Leaks Fixed = 6,240 hrs (24 x 5 weekdays x 52 weeks) x 30 kW x 50% x $0.073
- <u>Savings from fixing leaks = $6,833 annually</u>

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Summary: SiteWatch and ROI

Considering the findings in this review, which ONLY covered furnace and air compressor device groups (accounting for <50% of site energy use) the ROI for SiteWatch is between 2.8 and 4.3x the ongoing cost

Boose Savings Opportunities	Min Annual Savings	Max Annual Savings
Furnace 3 OFF (vs. Standby)	$ 5,697	$ 8,546
Furnace 4 OFF (vs. Standby)	$ 7,375	$ 11,063
Air-Compressor Weekend Ops	$ 5,466	$ 5,466
Fix Compressed Air Leaks	$ 6,833	$ 10,250
Total Annual Savings	**$ 25,371**	**$ 35,324**
Return on Investment Calculation		
5-Year Savings	**$ 126,855**	**$ 176,618**
5-Year SiteWatch Cost	**$ 33,120**	**$ 33,120**
Return on Investment	**283%**	**433%**

This review does not quantify the main applications for energy monitoring on the site, including **monitoring equipment health**, **tracking operation of critical equipment**, and **validating production cycles**

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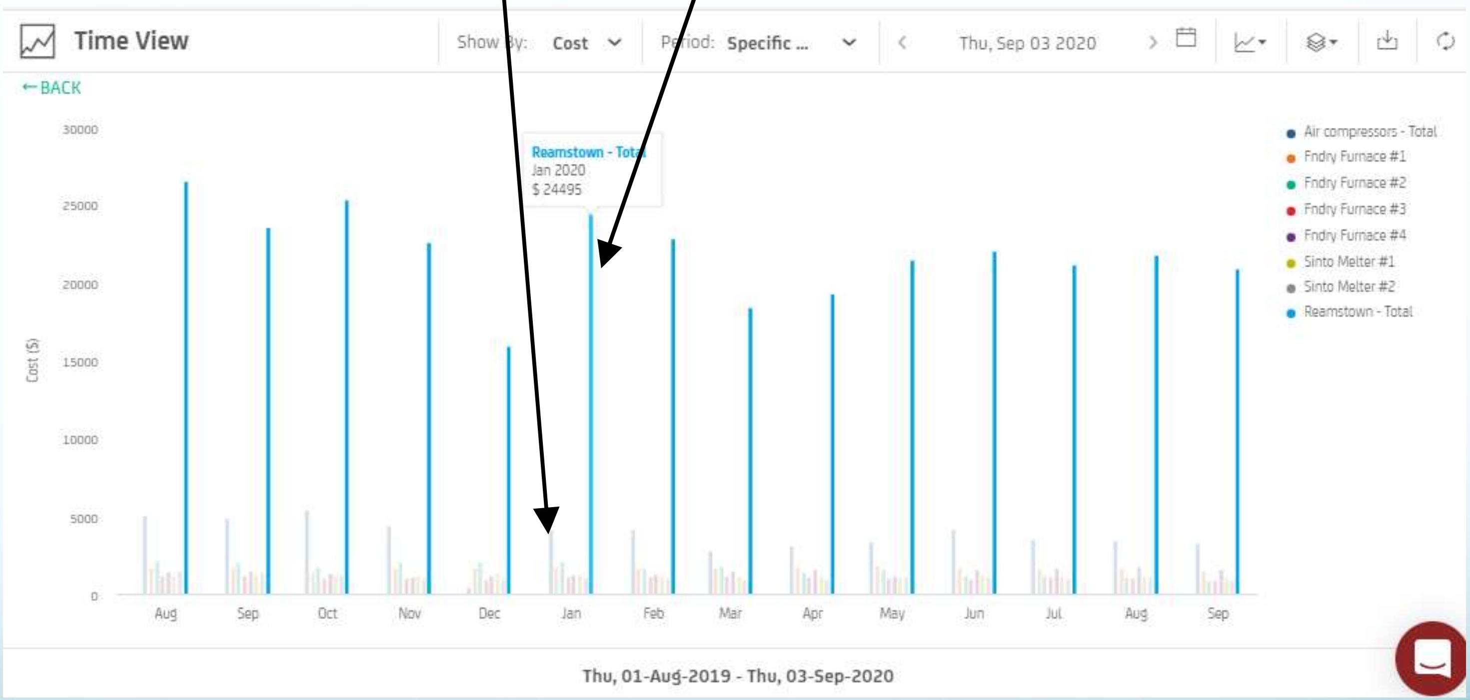
Summary: SiteWatch and ROI

Comparing equipment considered in this review versus the total site energy use, many more opportunities exist for energy savings from low/no cost changes:

Air compressor and furnace equipment monthly energy use

Total site monitored monthly energy use



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A Scalable Solution

How do we start, and how far can we go?

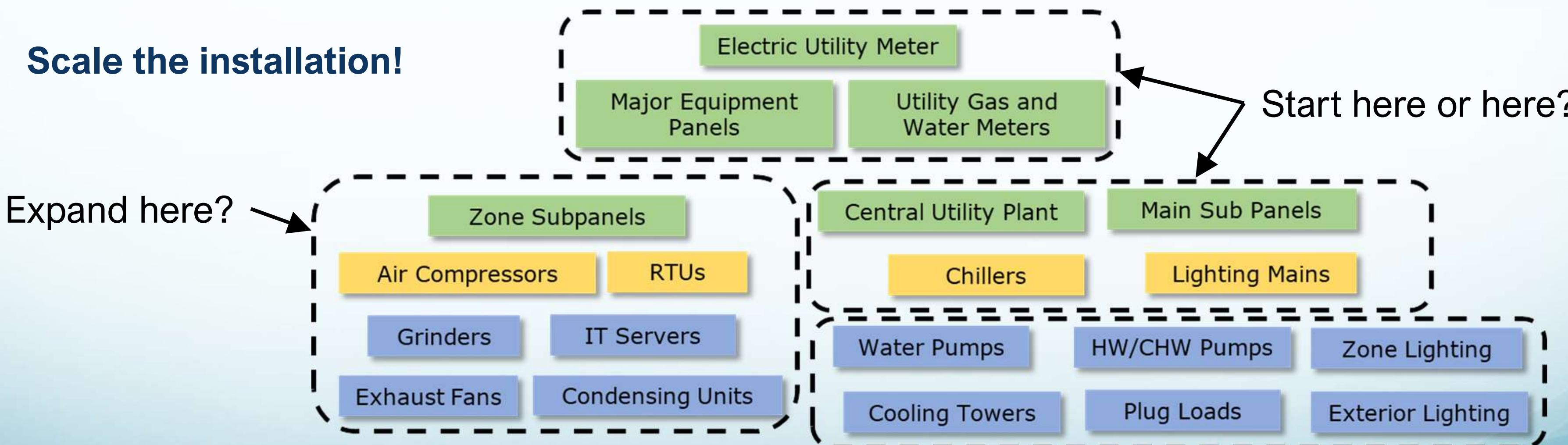
What are the objectives? Benchmarking for energy projects, identifying no or low-cost changes to save energy, and transparency into energy use by machine

What are the significant energy users (SEUs)?

Where are the issues? Troublesome equipment, maintenance or energy costs?

Are there available resources? Start focused, expand when possible!

Scale the installation!



How Does it Work?

SENSOR
Wireless, self-powered CTs clamp to machine or panel wires

BRIDGE
Receives signal from sensors, links to cloud server through Wi-Fi, ethernet, or cellular connection

Dashboard/Mobile
Collect and organize data, download in .csv format

Up to 65 amps

Up to 225 amps

Up to 3,000 amps

Revenue-grade kW meter

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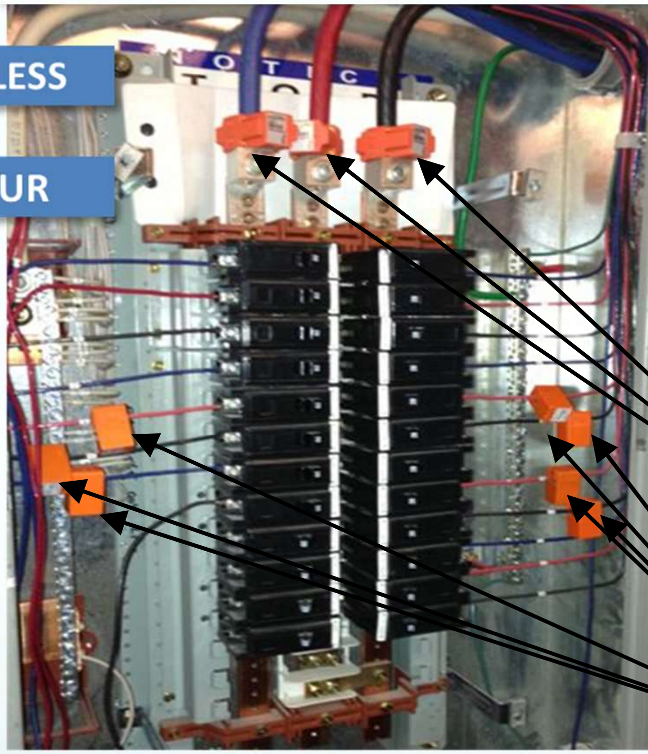
Quick and Simple Installation

WIRELESS

1 HOUR



TINY

SELF-POWERED

INEXPENSIVE

(3) Pan-12's (up to 225 amps)

(7) Pan-10's (up to 65 amps)

This panel was installed in less than 5 minutes!

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Contact Us!

To talk about your needs

Jeff Lyon
President
jlyon@sitewatchiot.com
(610) 291-0621 (cell)

To talk about hardware

Ed Brignole, PE
Director of Engineering
ebrignole@sitewatchiot.com
(484) 225-5247 (cell)

To talk about the value of data

Carter Membrino, PE, CEM
Director of Monitoring
cmembrino@sitewatchiot.com
(610) 864-5462 (cell)

To talk big picture

Kit Gutteridge
Founder/CEO
kgutteridge@sitewatchiot.com
(484) 802-2422

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