

# Bringing Observability to the Built Environment at City Scale

Andrew Rodgers

**intro: me**

**my career started with  
Industrial IT**

**600 employee plant, Fortune  
100 company**

**isolated process control  
network, NT 4.0 Domain**

**vendor driven, vertically  
integrated architecture**

**vendor driven, vertically  
“integrated” architecture**

**actually 67 separate vertically  
integrated architectures**



**silos...**

**that's one way to do it...**

**67 panes of glass?**

**So why am I here?**

**intro: DGS**

**District of Columbia**  
**Department of General Services**

**DGS**

~28M ft<sup>2</sup> (2.6M m<sup>2</sup>) building portfolio,  
valued at ~\$40B USD

~\$450M USD annual operating budget,  
~\$100M spent on energy

established an energy, sustainability and  
environment division in 2012

progressive city government pushing  
zero carbon goals

responsibility as an equitable provider of  
civic services

**intro: NCE**



**supporting the DC Department  
of General Services**

**energy, sustainability and  
environment**

BUILDSMART DC:  
More data.  
**Less Carbon.**  
Zero Excuses.

1

Design  
Excellence

2

Energy  
Monitoring

3

Retro-  
Commissioning

BUILDSMART DC:  
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**buildsmartdc.com launched in  
Summer 2013**

**provides a unified portal for  
energy consumption data  
about the ~400 buildings in the  
DGS portfolio**

**first time a city had achieved  
near-real-time aggregation of  
utility data and made it  
available to public**

**intro: VOLTTRON™**



**U.S. Department of Energy  
sponsored OSS platform for  
“transactional energy”**

**framework for distributed  
sensing and control with sane  
trust and security defaults**

**by researchers for researchers,  
but with lofty goals of  
commercial adoption**

**what we're building  
now**

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# what is retro-commissioning?

**process to restore and optimize  
operating building systems to  
their design intent**

**intent  $\neq$  state**

**buildings are complicated.**

**conditioning spaces in  
commercial buildings more  
closely resembles a complex  
industrial process than your  
home AC**



**an industrial process with a  
different product in every room,  
and the product changes  
multiple times each day**

**focus on energy efficiency at  
the design level encourages  
adoption of complex systems to  
achieve efficiency goals**

**if you don't see the  
parallels yet...**

**system designers rarely  
connect with system operators**

**facilities staff are operating  
systems without understanding  
the design intentions**

**rather than embracing and  
tackling the complexity head  
on, market has looked to  
vendors to hide it**

# Our goals

define the metrics that drive sustained operational excellence

reduce energy consumption and carbon impact of the built environment

raise the standard for comfort and reliability

develop the workforce that can operate and maintain the building of the future

deliver an aggressive ROI that allows investment in future innovations

**the approach**

**disaggregate energy and  
operational data, collect critical  
operational state from every  
system**



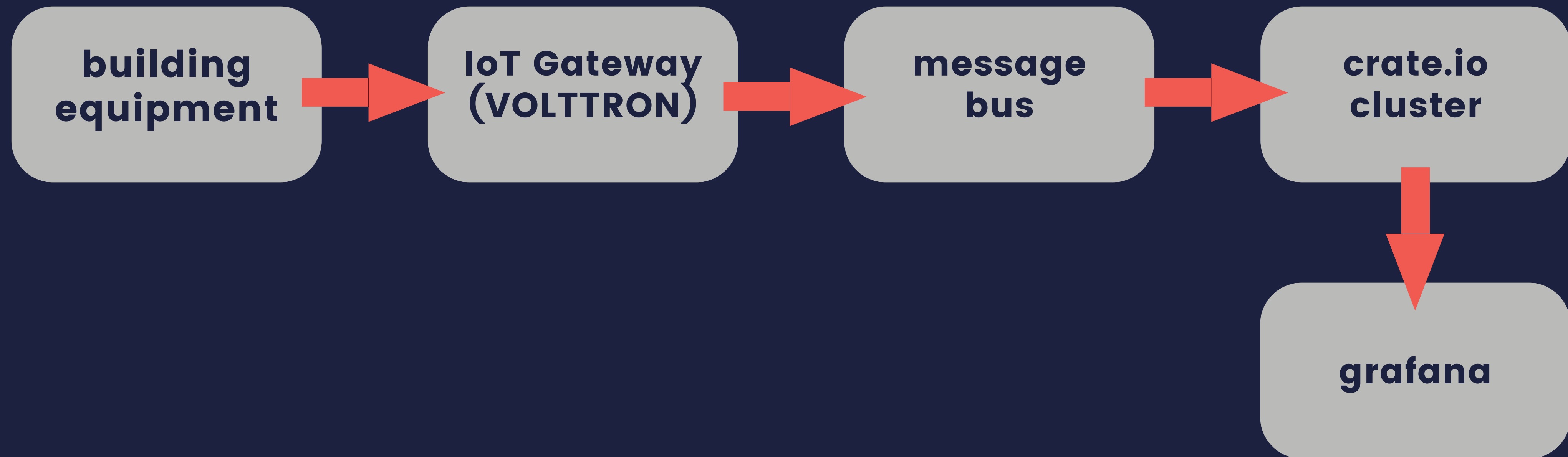
**invest time at the front end in  
data quality assurance to  
enable actionable insights at  
all organizational levels**

**support simple operational  
insights for existing staff while  
building out infrastructure for  
advanced analytics**

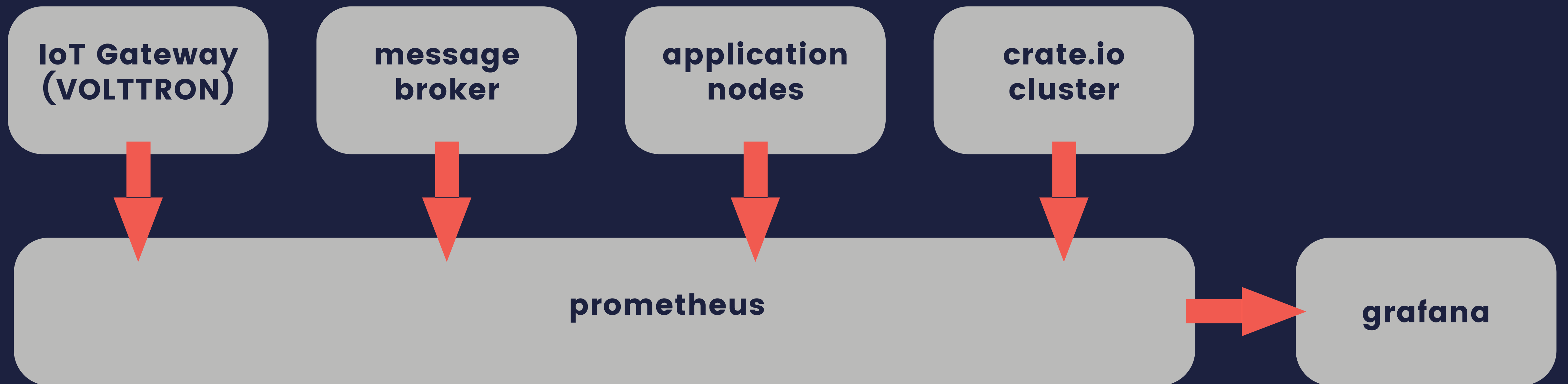
**deliver data and insights to  
public to ensure accountability  
and operational excellence is  
sustained**

**where we are**

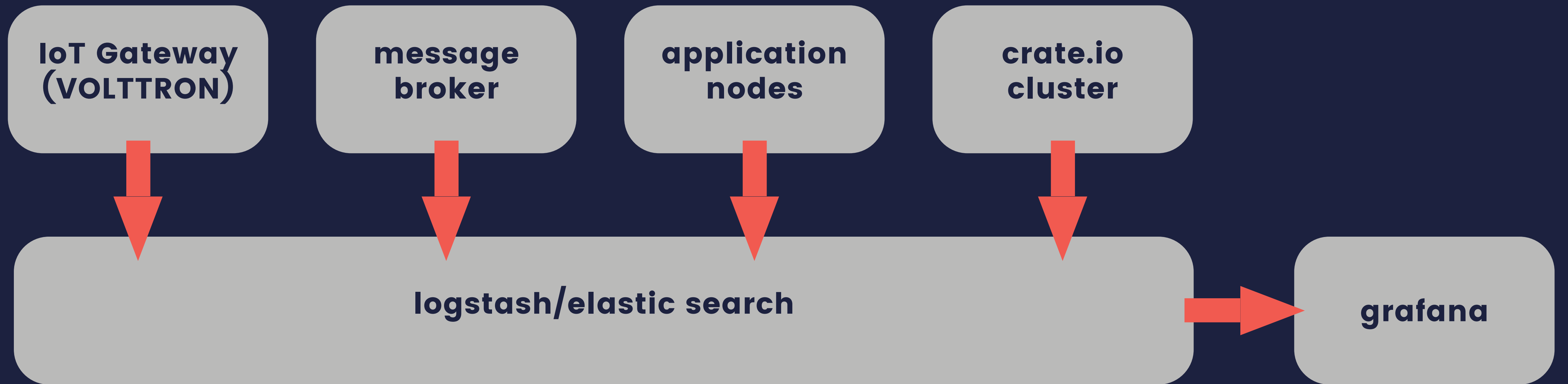
# application dataflow



# metric dataflow



# log dataflow



**46**

**sites**



**> 29,700**

**topics**

**> 2,700,000**

**samples per 24h**

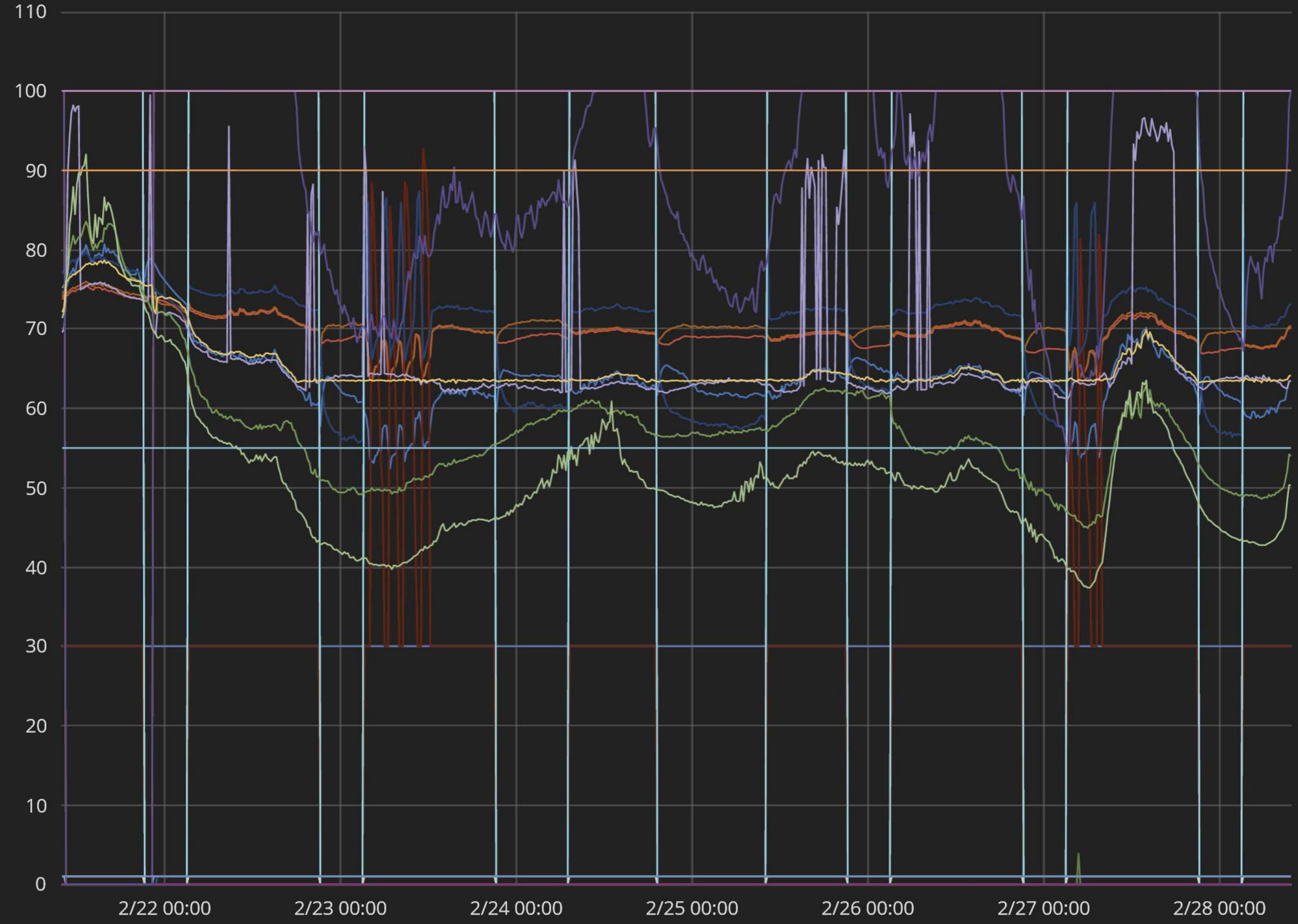
**> 972.2M**

**total sensor records**

# **data-discovery for troubleshooting**



### Ad-Hoc Dashboard

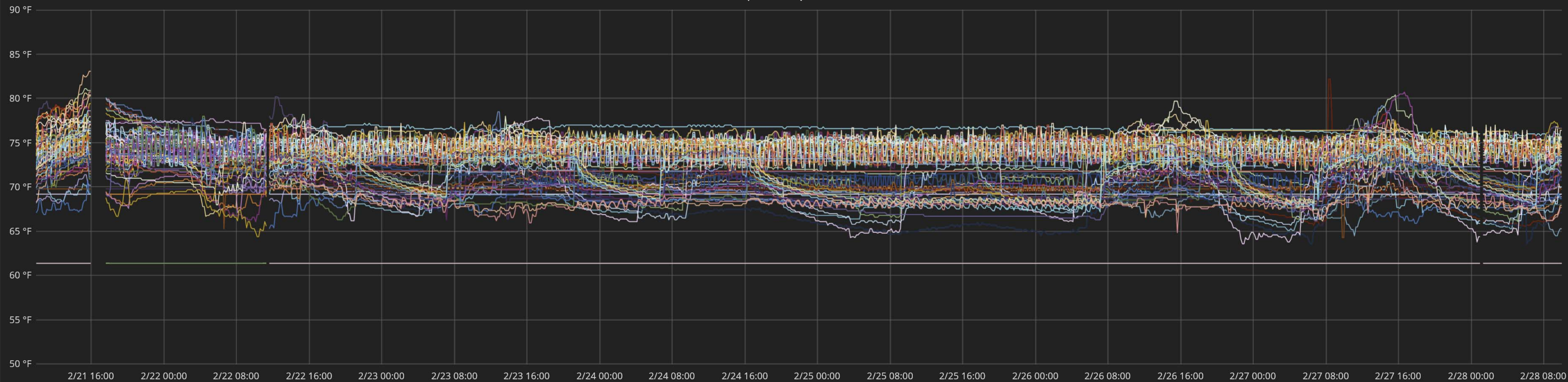


	current
dc/janney_es/ahu_1/rtu_3>east_building>compressor_1>start/stop: value	0
dc/janney_es/ahu_1/rtu_3>east_building>compressor_2>start/stop: value	0
dc/janney_es/ahu_1/rtu_3>east_building>compressor_3>start/stop: value	0
dc/janney_es/ahu_1/rtu_3>east_building>compressor_4>start/stop: value	0
dc/janney_es/ahu_1/rtu_3>east_building>cooling_coil_leaving_air_temp.: value	70
dc/janney_es/ahu_1/rtu_3>east_building>exhaust_air_temperature: value	63
dc/janney_es/ahu_1/rtu_3>east_building>exhaust_fan>start/stop: value	1
dc/janney_es/ahu_1/rtu_3>east_building>exhaust_fan>status: value	1
dc/janney_es/ahu_1/rtu_3>east_building>gas_burner>heating_output: value	0
dc/janney_es/ahu_1/rtu_3>east_building>heat_recovery_wheel>start/stop: value	1
dc/janney_es/ahu_1/rtu_3>east_building>minimum_outdoor_air_damper_position: value	30
dc/janney_es/ahu_1/rtu_3>east_building>mixed_air_temperature: value	70
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dc/janney_es/ahu_1/rtu_3>east_building>supply_fan>variable_frequency_drive: value	100
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dc/janney_es/ahu_1/rtu_4>east_building>compressor_2>start/stop: value	0
dc/janney_es/ahu_1/rtu_4>east_building>compressor_3>start/stop: value	0
dc/janney_es/ahu_1/rtu_4>east_building>compressor_4>start/stop: value	0
dc/janney_es/ahu_1/rtu_4>east_building>cooling_coil_leaving_air_temp.: value	63
dc/janney_es/ahu_1/rtu_4>east_building>exhaust_air_temperature: value	54
dc/janney_es/ahu_1/rtu_4>east_building>exhaust_fan>start/stop: value	1

**ongoing operational status**

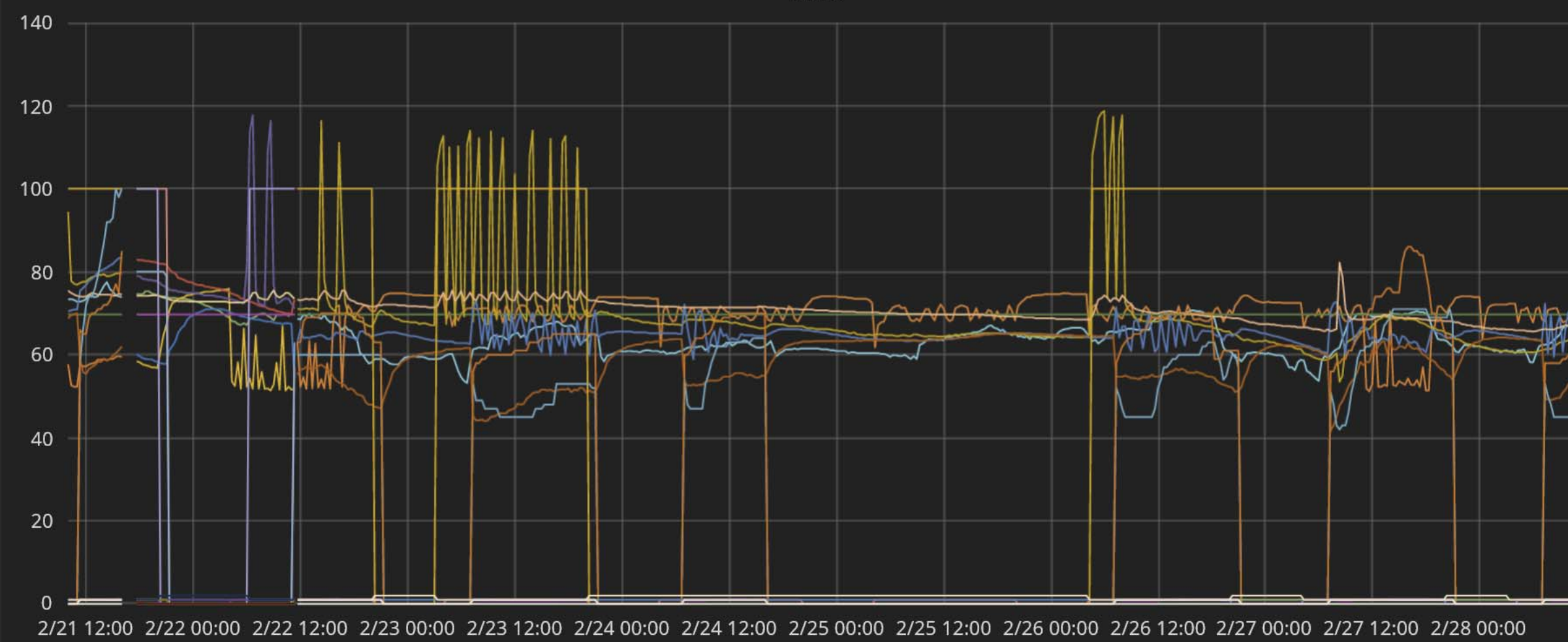
Space Temperature

Space Temperatures

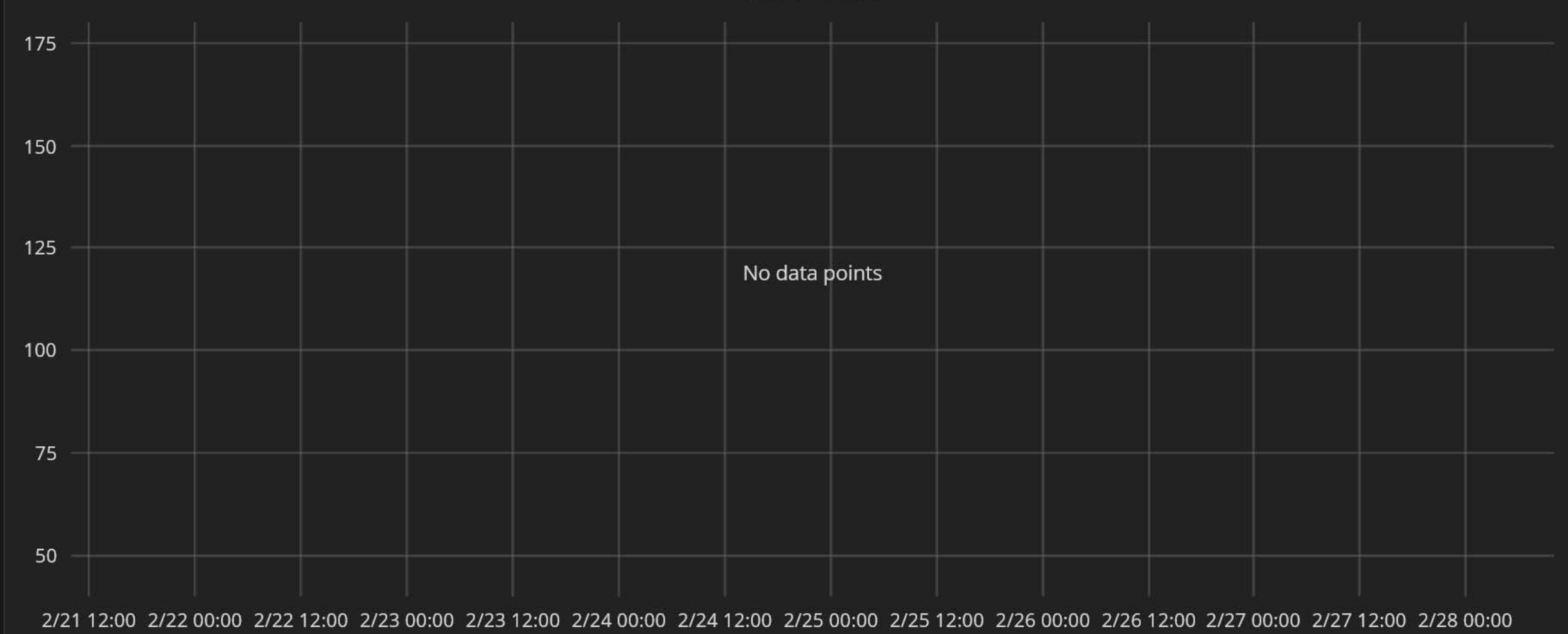


AHU & Central Plant

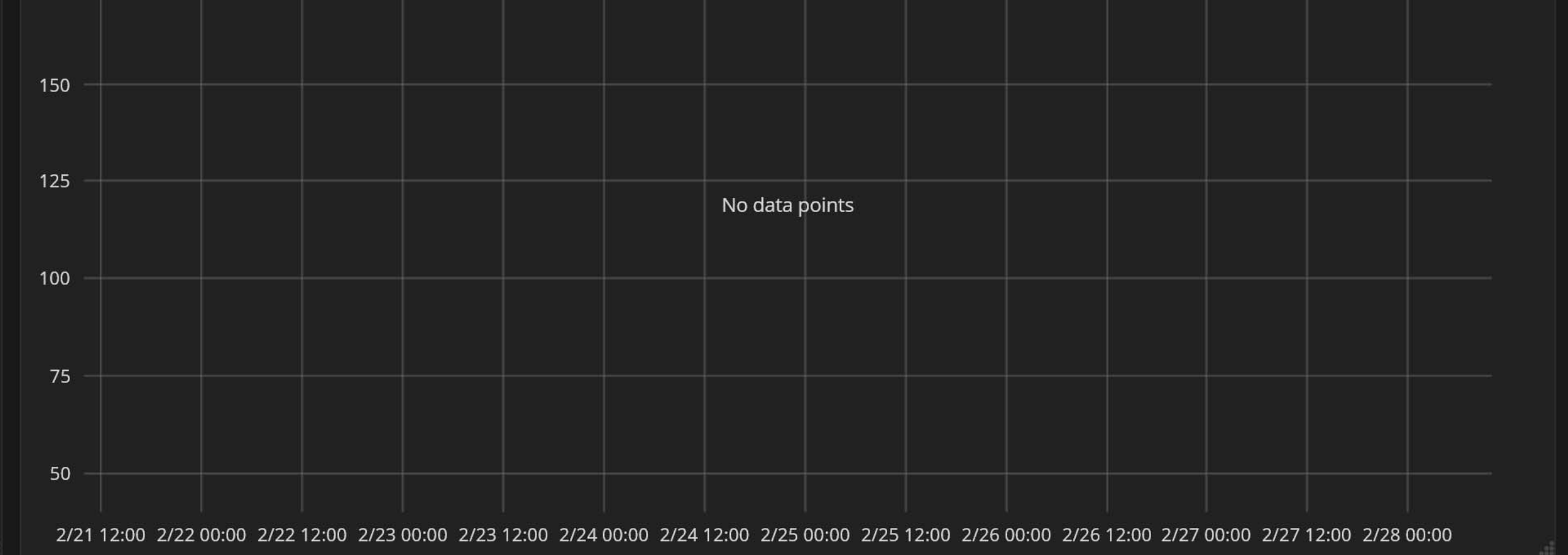
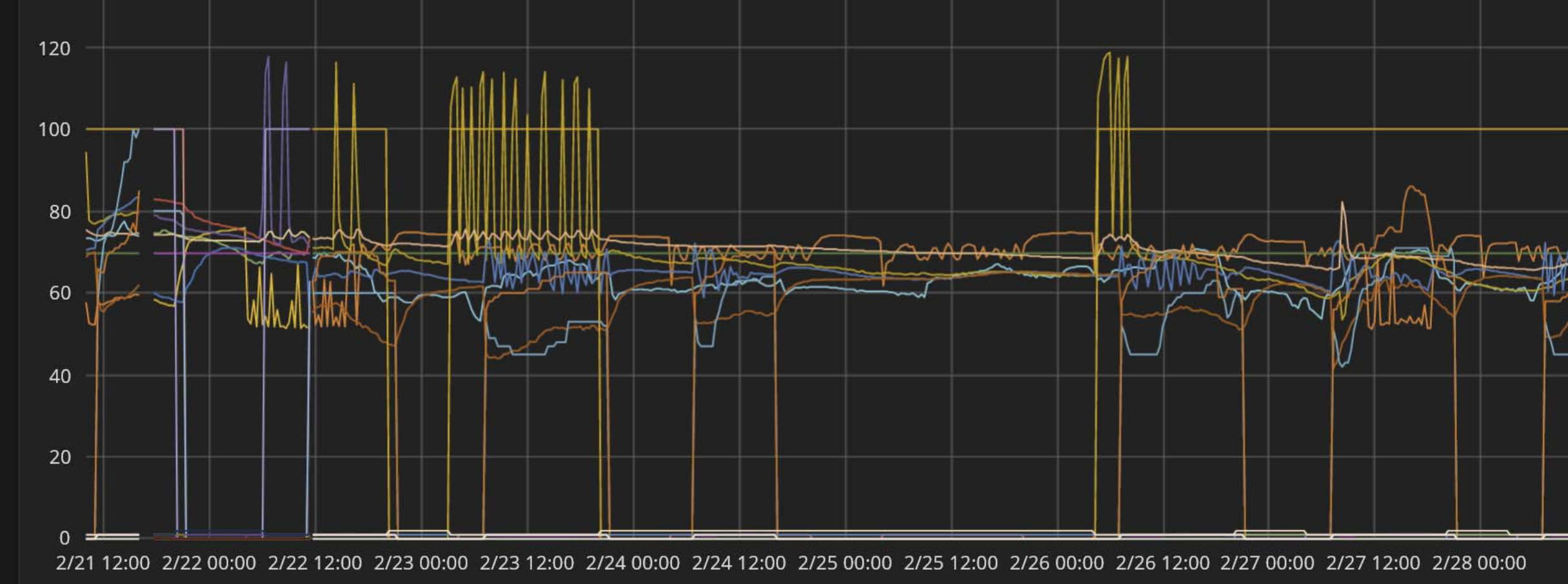
AHU



Central Plant



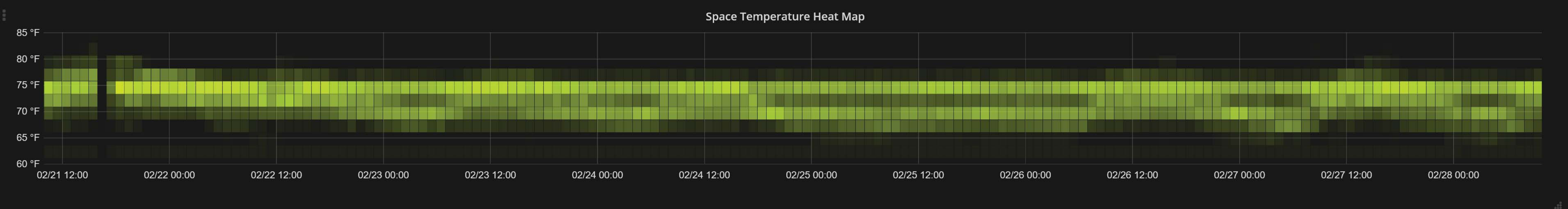
Running



Running



Space Temperature Heatmap



+ ADD ROW

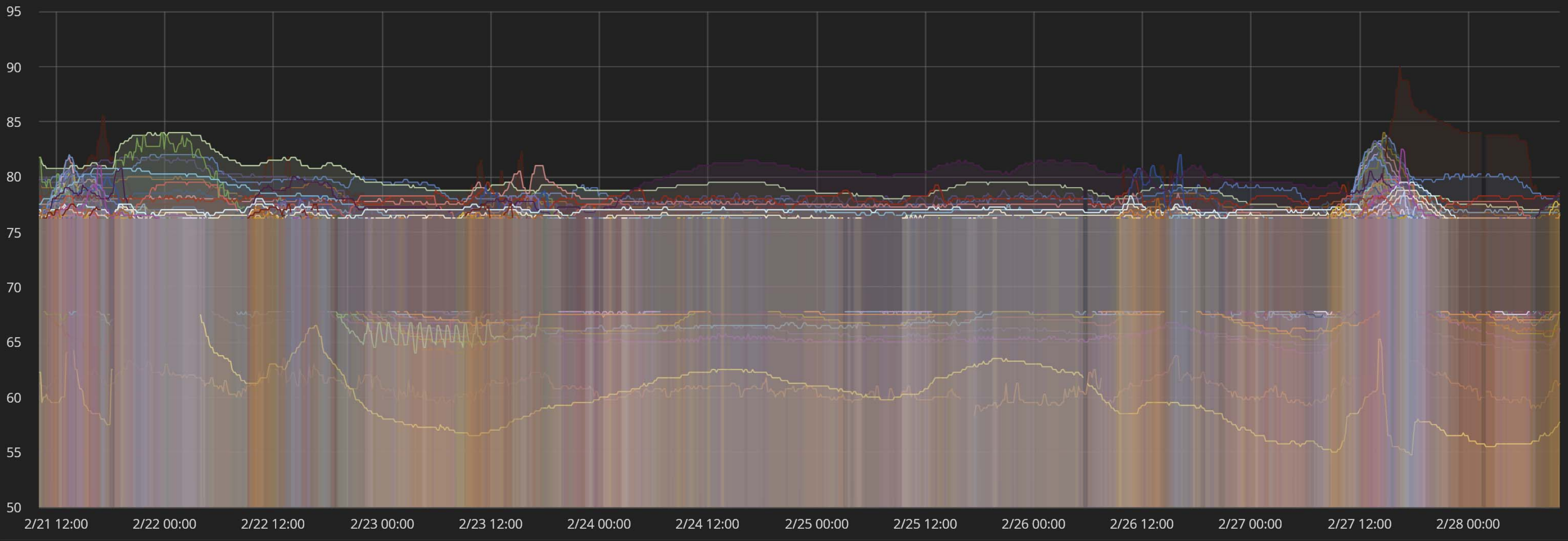


# **fault detection and alerting**



### Space Temperatures Outside of Comfort Zone

### Outside Comfort Count



25

### Sensor Summary 🕒 Last 1 minute

<u>name</u>	address	building
dc_wilson_bldg_wilson_bldg_03	10.57.78.24:8080	wilson_t
dc_wilson_bldg_wilson_bldg_01	10.57.78.24:8080	wilson_t
dc_wilson_bldg_wilson_bldg_04	10.57.78.24:8080	wilson_t
dc_wilson_bldg_wilson_bldg_02	10.57.78.24:8080	wilson_t
dc_wilson_bldg_wilson_bldg_04	10.57.78.24:8080	wilson_t
dc_wilson_bldg_wilson_bldg_01	10.57.78.24:8080	wilson_t
dc_wilson_bldg_wilson_bldg_04	10.57.78.24:8080	wilson_t

+ ADD ROW

Empty Space

**what have we  
accomplished?**

**24**

**sites with active programs**

**\$4M USD**

**total savings to date**

**\$1M USD**

**current recurring annual  
savings**

**20%**

**reduction in energy costs at  
priority sites**

**\$500K USD**

**additional recurring annual  
savings this fiscal year**



**what's next?**

## next steps

continue to develop business processes around the available data

implement advanced DERMS applications using our technology infrastructure

move toward a constant commissioning reality with continuous improvement

identify new ways to empower our users with data to achieve a sustainable city

integrate other energy resources to deliver virtual power plant solutions

# **what is constant commissioning?**

**maintain optimal performance  
through dynamic occupancy,  
equipment availability, weather,  
and energy markets**

# what is DERMS?

**Distributed Energy Resource  
Management Systems  
(energy buzzword warning)**

# what is VPP?

**Virtual Power Plant;  
mitigating the need for physical  
infrastructure through  
intelligent management of  
existing energy resources**

**deliver observability to the built  
environment**

**build the platform that enables  
sustainable, responsive  
management of real estate  
portfolios**

Thank You



andrew  
rodgers

andrew@aceics.com

@acedrew

@acedrewcha

[aceics.com](http://aceics.com)