

# Chiller Optimization Via Tube Fouling Prevention & Emerging Technologies

Presented by:  
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# Defining the Problem

- Chillers represent >15% of building's energy use during warm months
- Studies show >95% of shell & tube heat exchangers suffer fouling  
(Muller-Steinhagen, 2011; Steinhagen et al., 1992; Garrett-Price et al., 1985)
- >\$1.5 Billion wasted every year in USA due to chiller inefficiency



# What Exactly Is the Problem?



- Scale (hard H<sub>2</sub>O)
- Particulate (dust or silt)
- Biofilm



# ATCS Technology: Multiple Dimensions of Value

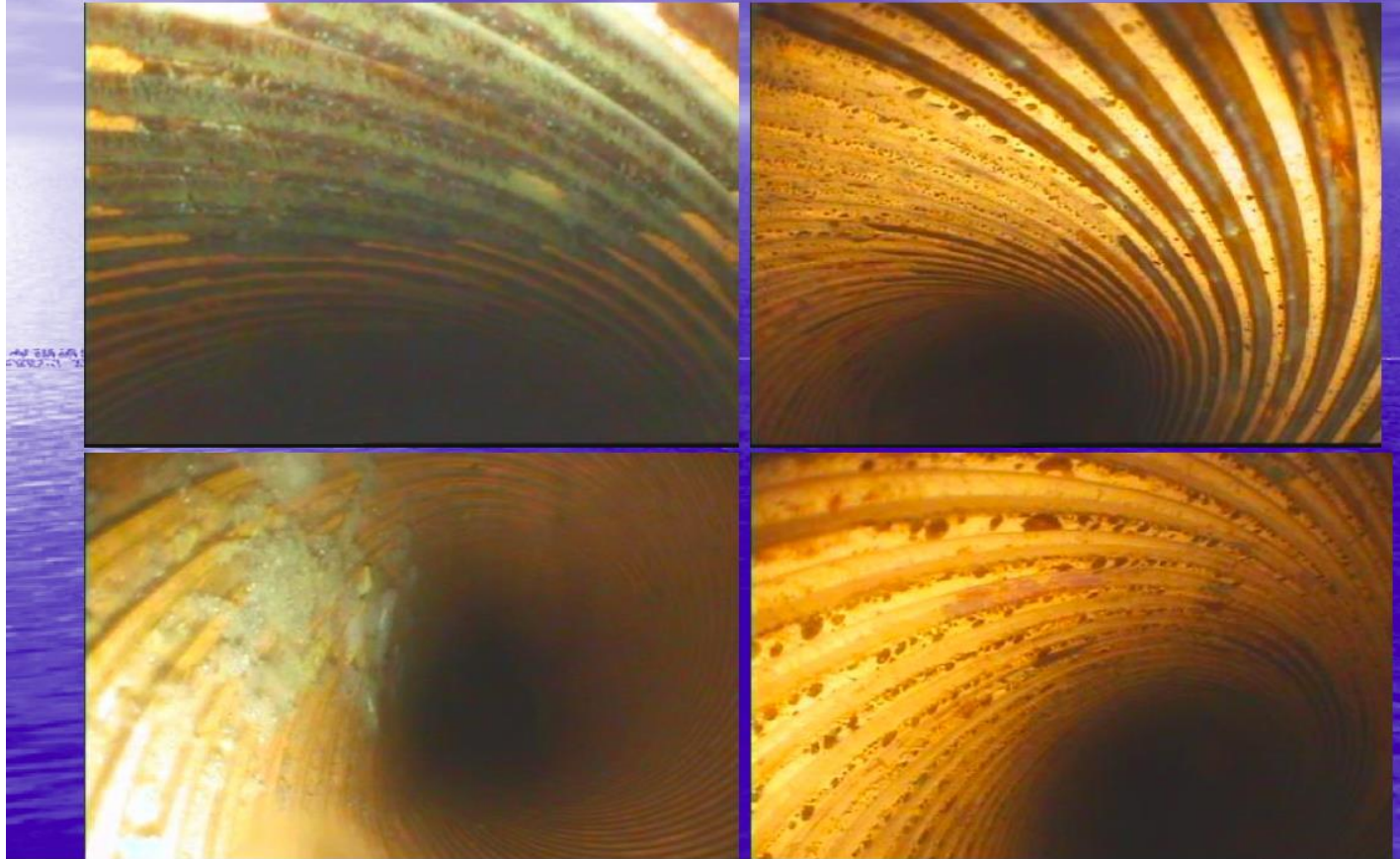


- Chiller energy efficiency improves 5-15%
- Reduce or eliminate manual tube brushing & chemical cleaning
- Improves chiller plant availability
- Reduce GHG emissions and environmental impact



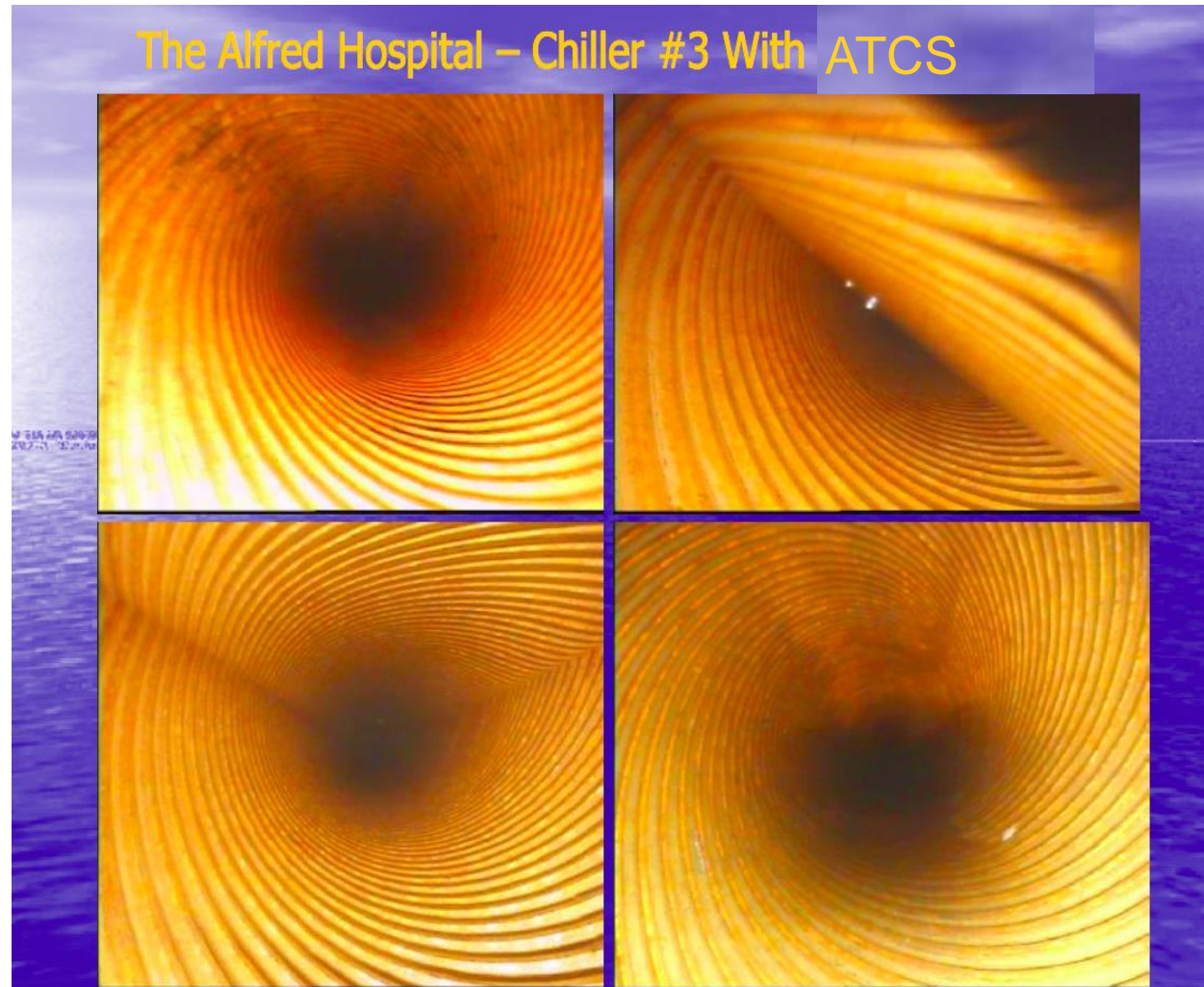
# Condenser Tubes Without ATCS

The Alfred Hospital Chiller #4  
Videoscop image of condenser tubes without ATCS



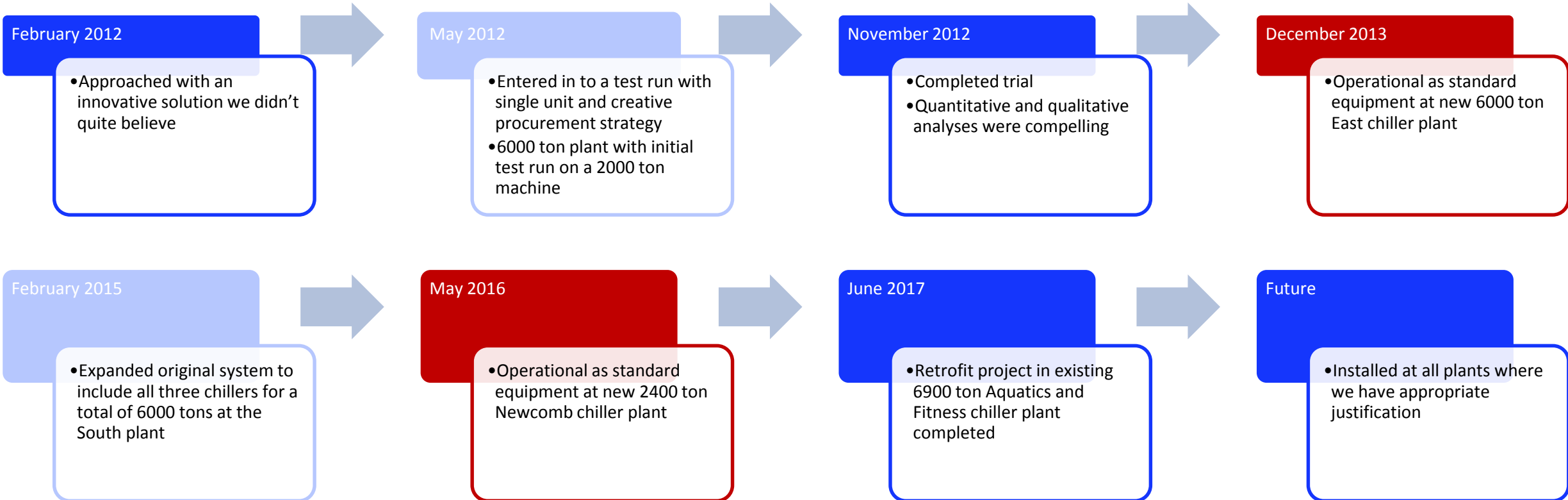
Source: D. Ross, Pangolin Associates, World Energy Engineering Congress, 2016.

# Condenser Tubes With ATCS



Source: D. Ross, Pangolin Associates, World Energy Engineering Congress, 2016.

# So Who's Using It?

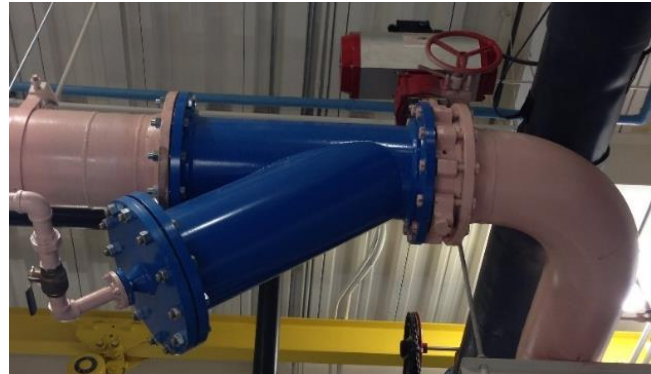
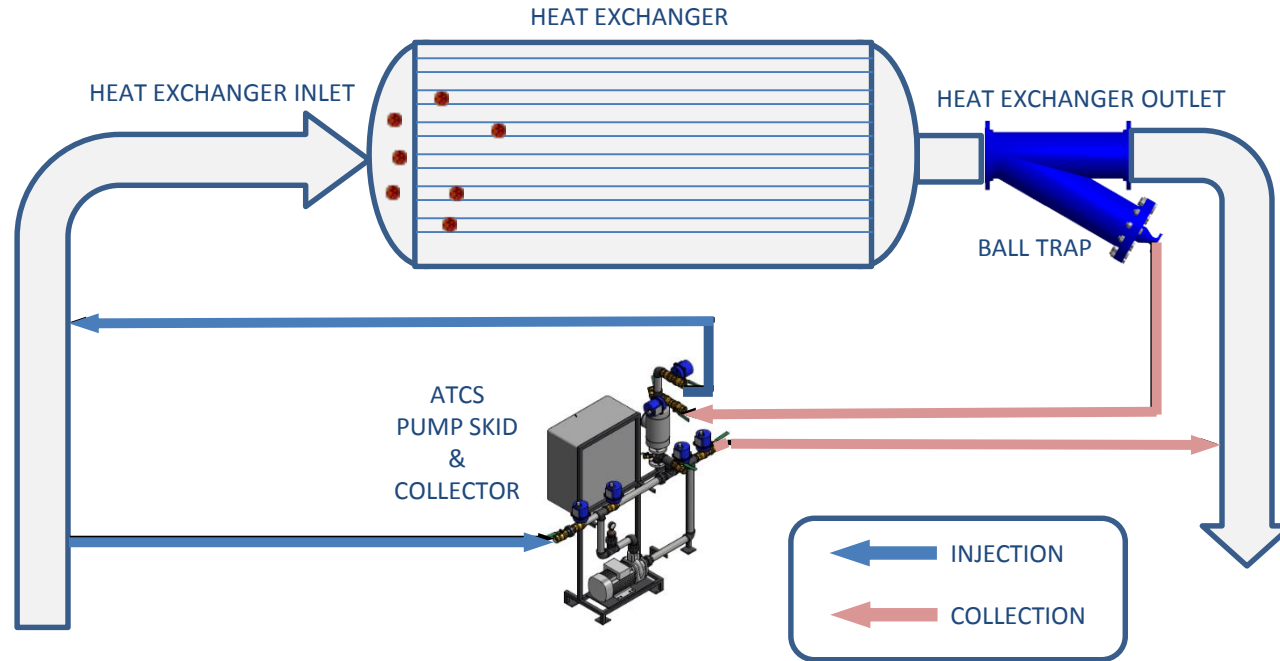


University of Virginia's Path To ATCS

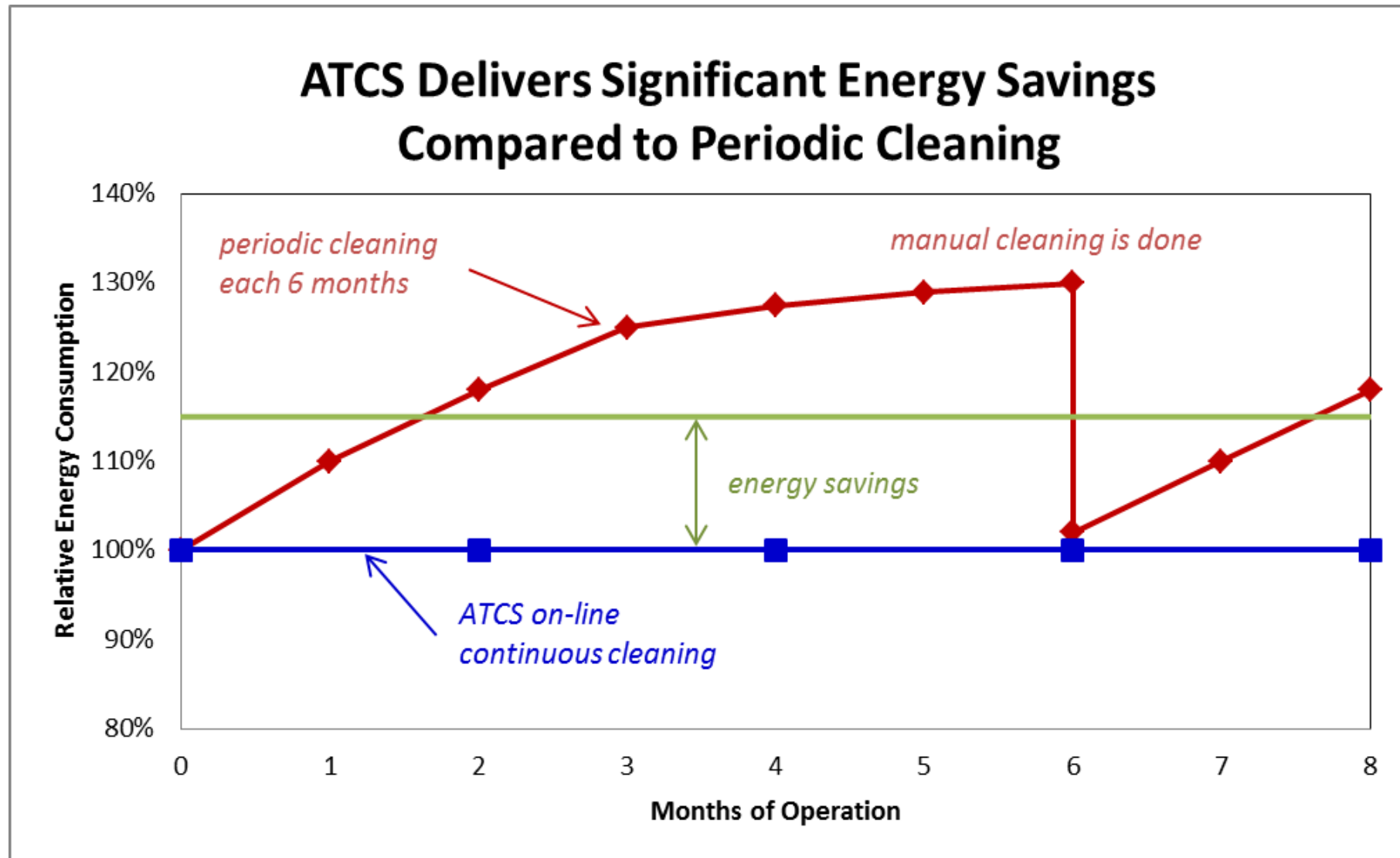
# How Auto Tube Cleaning Systems (ATCS) Work



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# Chiller Energy Consumption: ATCS vs. Annual Tube Cleaning

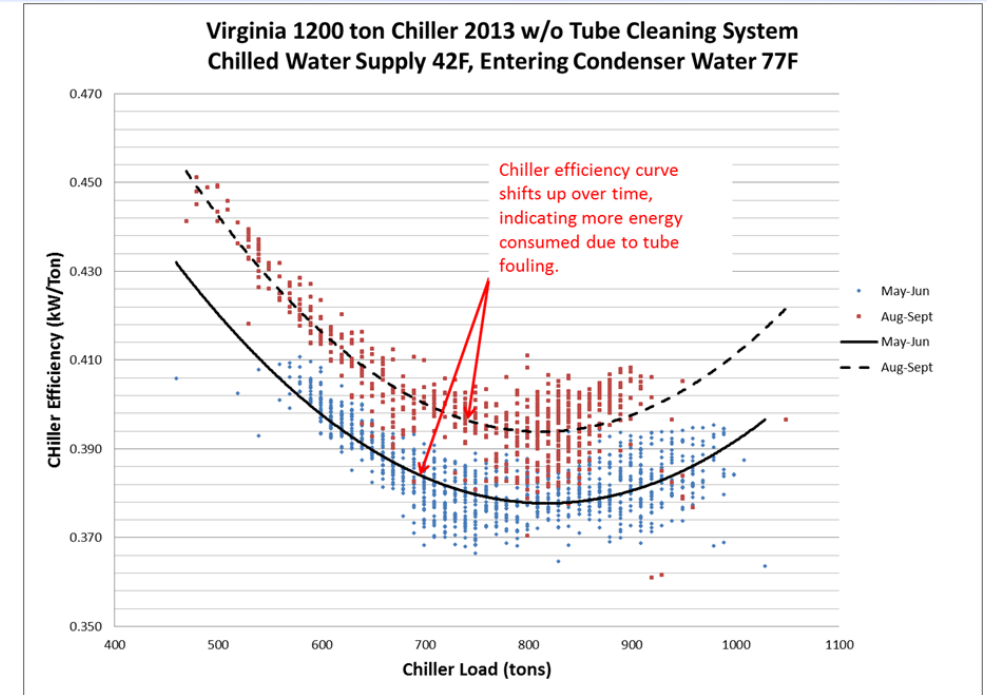
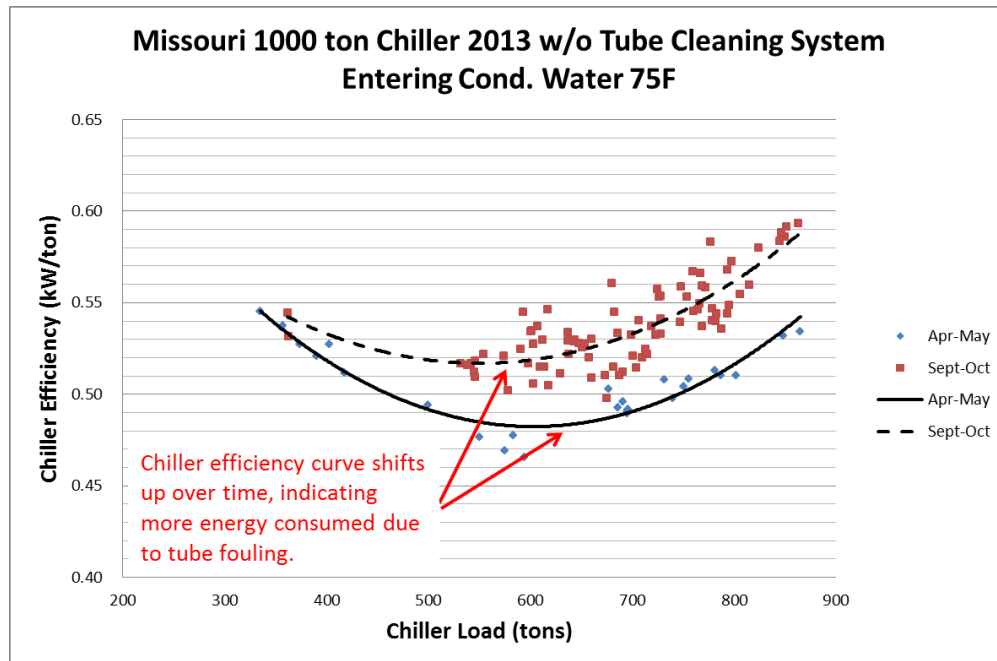


# If Our True Goal is to Optimize Chiller Efficiency...

Chemical Treatment Alone

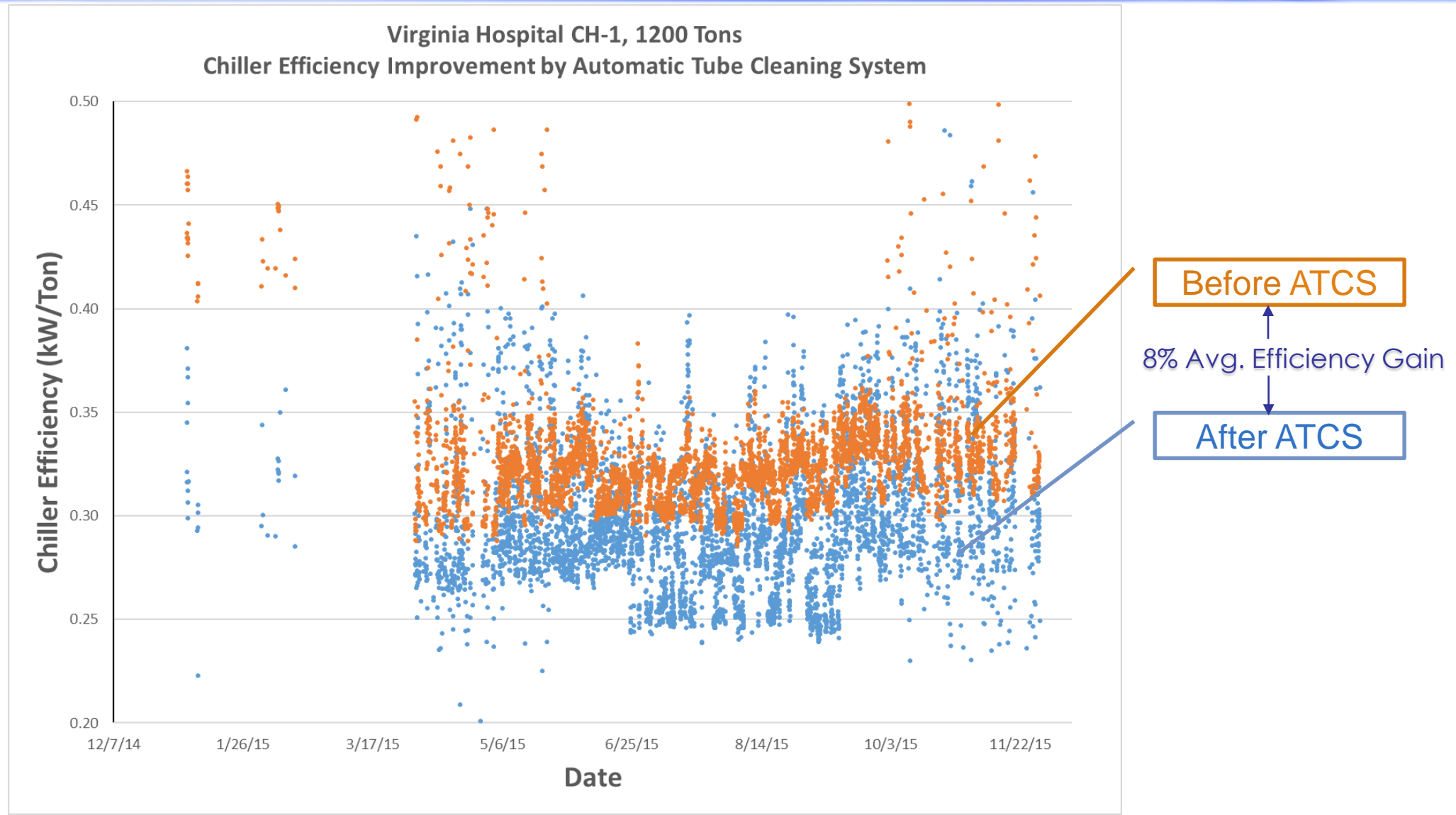
Is NOT

“Best In Class” Efficiency

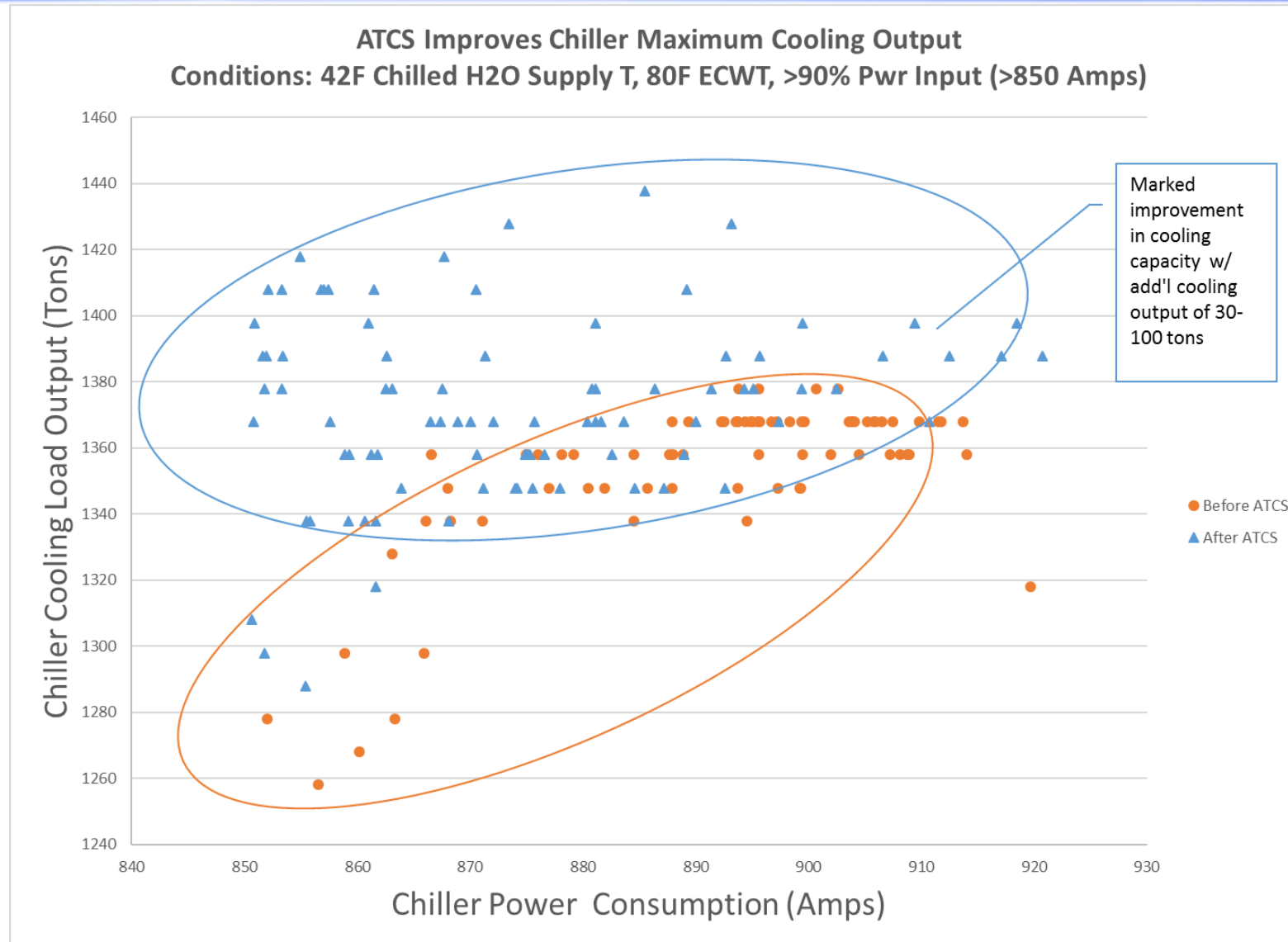


Water Treatment +  
Continuous Tube Cleaning  
= True Optimized Efficiency

# VA Hospital Case Study: Improved Chiller Energy Efficiency by 8%



# VA Hospital Case Study: Increased Chiller Capacity by 30-100 Tons



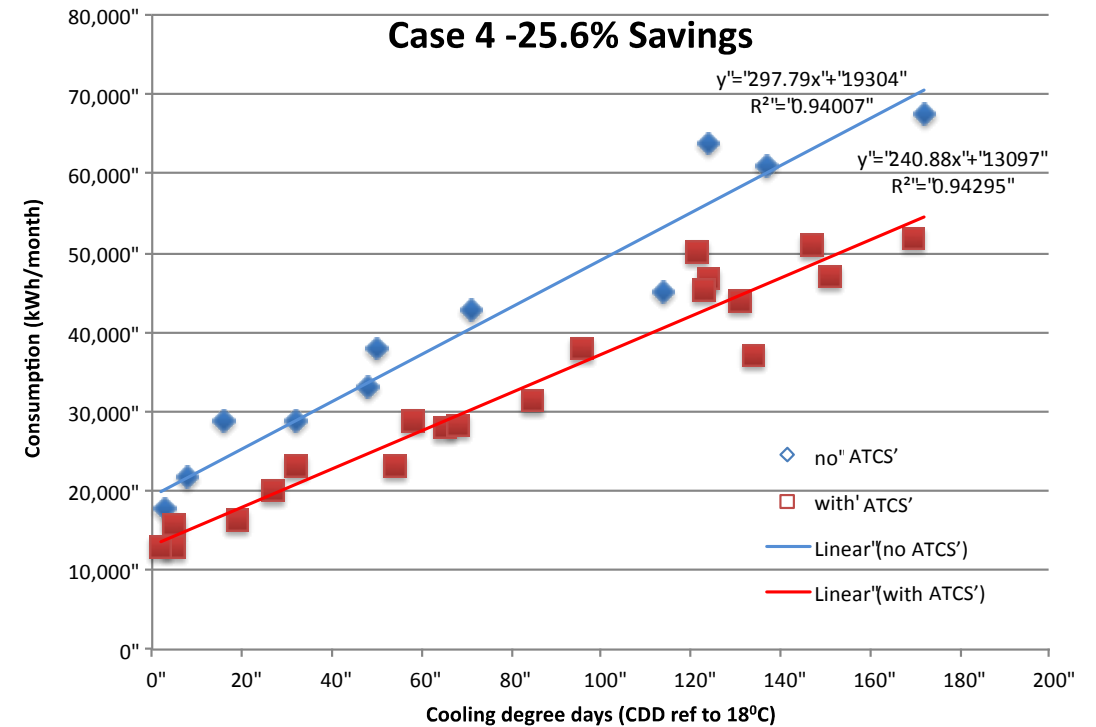
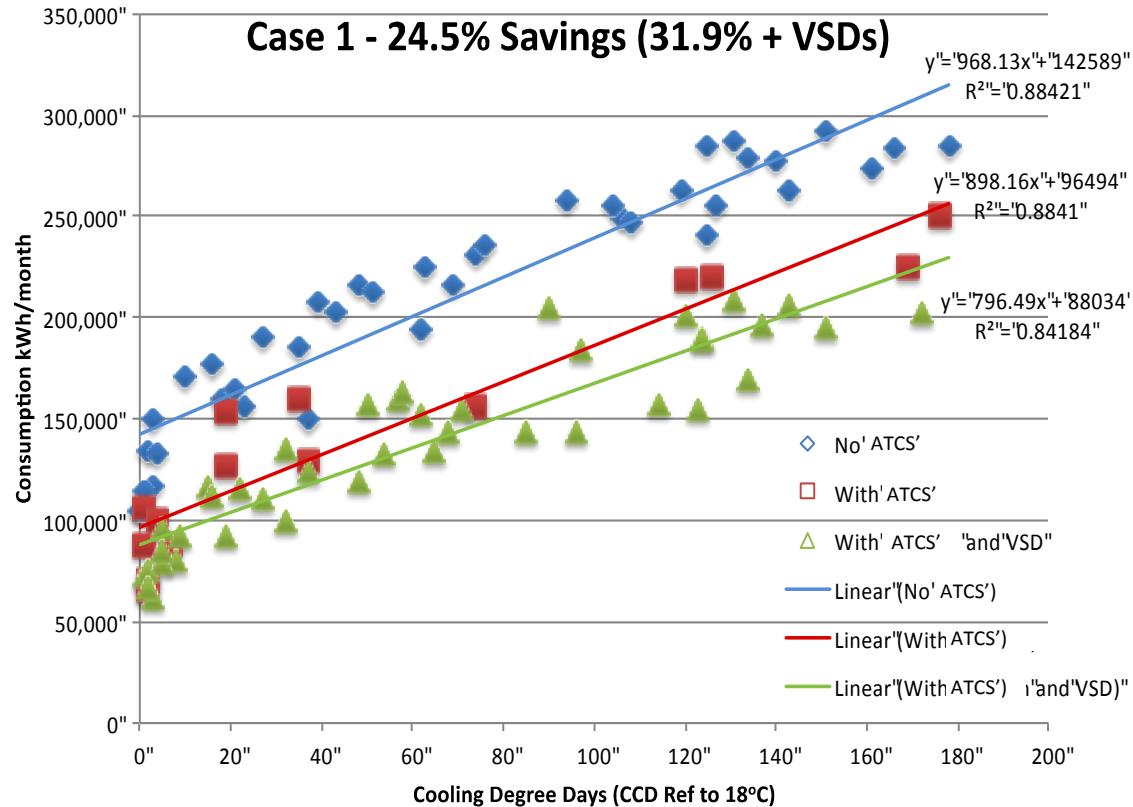
# ATCS Office Building Chillers: 4 Case Studies

	Case 1	Case 2	Case 3	Case 4
No. floors	24	32	20	25
Building type	Category A office building	Category A office building	Category A office building	Category A office building
NABERS energy rating	3.5	4.5	4.5	3.5
Net Lettable Area	-	39,398	26,271	-
No. Chillers installed with BallTech	2	2	3	2
Chiller Make/Model	Trane	Carrier/Trane	3 x Trane	2 x Powerpax
Condenser	Double pass	Double/single pass	Double pass	Double pass
Tube I.D. (mm)	15	22; 15	2x 22; 1x 15	16
BallTech unit	2 x 6"	10"/6"	2 x 10" / 1 x 6"	1x 12"
Date of installation	04/2010 & 10/2010	12/2008	06/2010	08/2013

Studies by 3<sup>rd</sup>-Party Consulting Engr. Firm Specializing in Energy Savings M&V

Source: D. Ross, Pangolin Associates, World Energy Engineering Congress, 2016.

# ATCS Office Building Chillers: 4 Case Studies



Normalized energy savings ranging between 24.5% to 26.5% for the 4 bldgs!

# Case Study: Oregon Hospital

*“...We have not cleaned the chiller tubes in four years since the tube cleaning system was installed. With ATCS approach temps run between .5 and 2 degrees throughout the year...Before ATCS with constant cleaning we had double digit approach temps. Chillers needed several acid cleanings as well as brushed.”*

*--Pat Lamb, Central Utility Plant Director*

## Project Life-Cycle Metrics (15 yrs.)

Electricity Cost Savings:	\$1,030,000
Energy Conserved:	11.5 Million kW-hrs
GHG Emission Reduction:	8,800 tons
Equiv. Cars Removed:	1,550
Equivalent Trees Planted:	195,000

## ATCS Installation on 5,000 Ton Chiller



ATCS Skid and Collector



5000 RT Chiller w/ 24" Ball Trap

## ATCS Installation on 5,000 Ton Chiller



24" Inlet Strainer



5000 RT Chiller w/ 24" Ball Trap

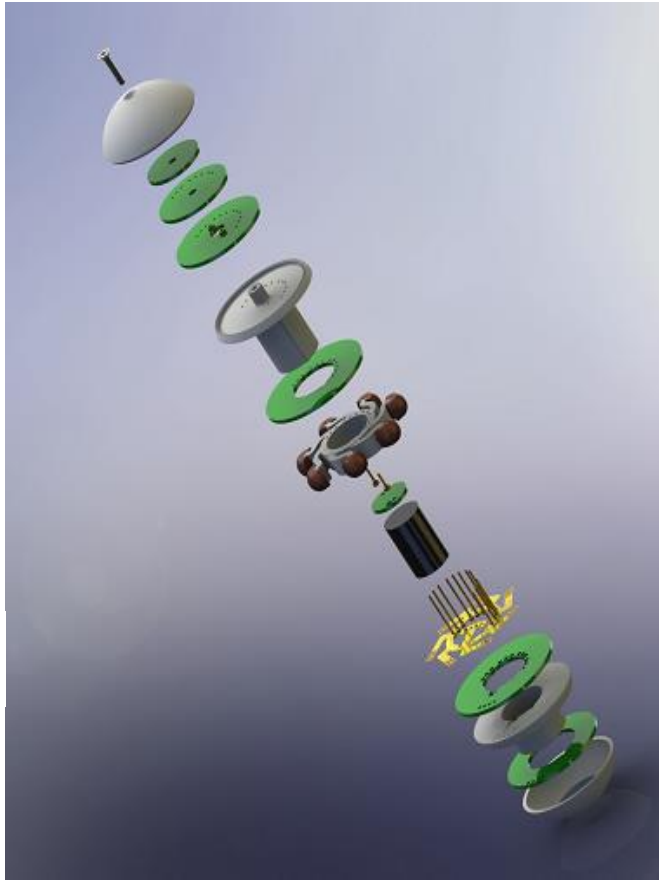
# Key ATCS Technology Application Concepts



- Supplements water treatment
- Applies to chiller condenser or evaporator
- Upper temperature limit of 280 F
- Effective coarse straining of inlet cooling water is critical



# ATCS & Emerging Technologies



- Low Cost
- Condenser speed and temperature measurement
- Predictive failure prevention through vibration analysis
- Growth to provide online tube condition analysis.
- Allows optimized condenser operation.
- Total disruptive technology

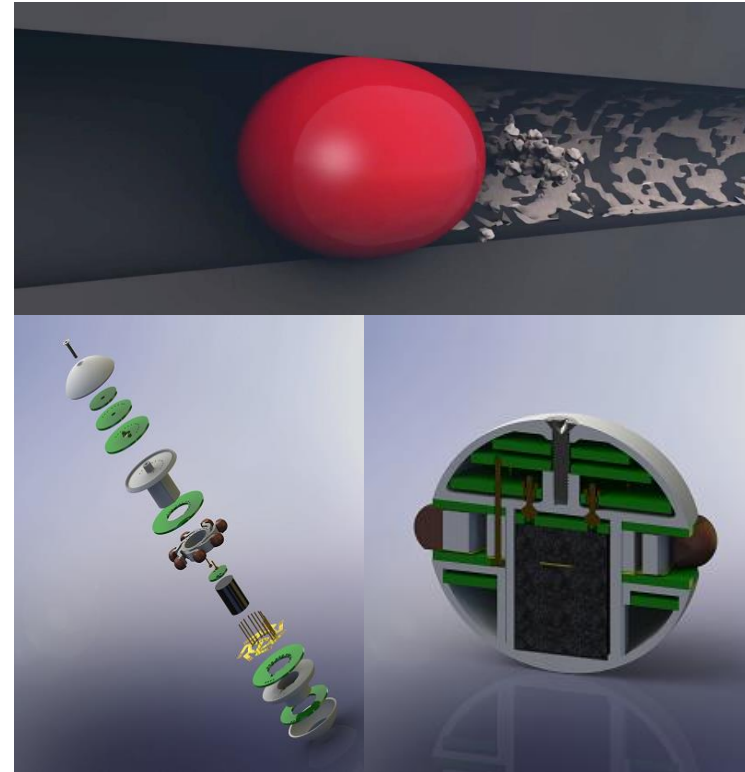
## Introducing Mobile Micro-sensor Technology to Operating Chillers

# ATCS & Emerging Technologies

## Industrial IOT: Automate A Slow and Manual Process



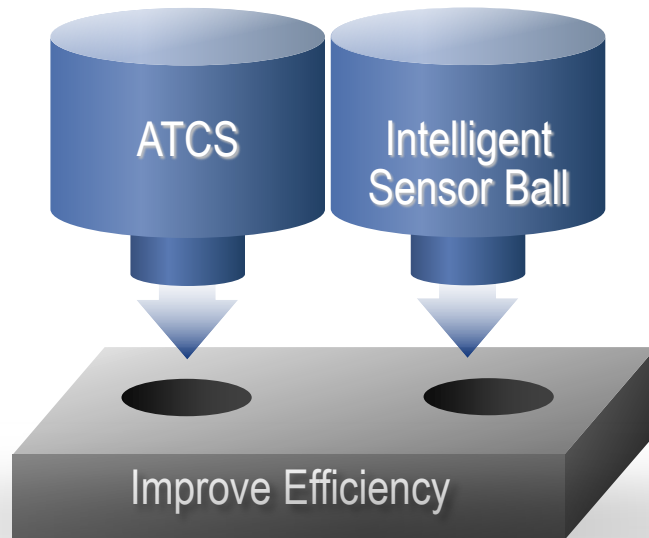
Today  
Offline, Manual, Reactive



Tomorrow  
Real Time, Automated, Predictive

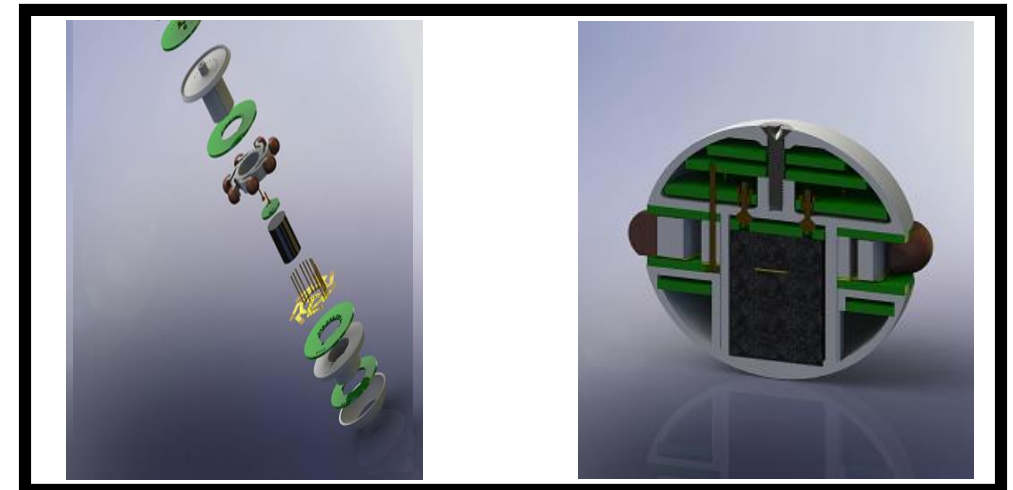
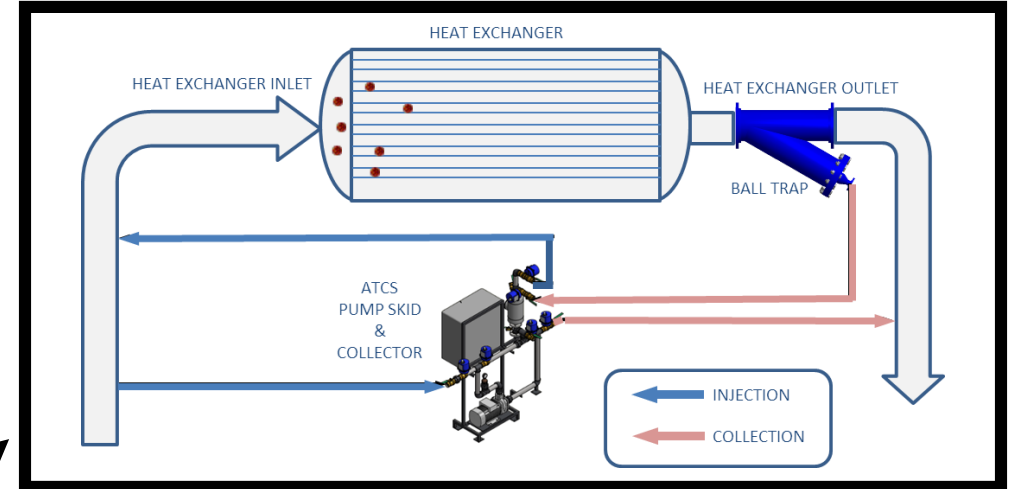
# A Two-Pronged Approach to Efficiency

## Composite Solution Overview



### A Two Pronged Approach

- 1. Ensure Clean Condenser Tubes:**  
*Automatic Tube Cleaning System*
- 2. Continuously Monitor for Maintenance Needs**  
*Preempt failure and unscheduled maintenance*





# Questions?

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