DistrictCooling2018
Efficient Energy for Smarter Cities
DECEMBER 9-11, 2018 – ATLANTIS, THE PALM – DUBAI, UAE

Improving Chiller Efficiency & Sustainability Via Tube Fouling Prevention

Presented by:
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December 2018

INNOVAS TECHNOLOGIES

Defining the Problem

- Chillers represent >15% of building's energy use during warm months

- Studies show >95% of shell & tube heat exchangers suffer tube fouling
(Muller-Steinhagen, 2011; Steinhagen et al., 1992; Garrett-Price et al., 1985)

Scale Particulate Biofilm




- >$1.5 Billion wasted every year in USA due to chiller inefficiency

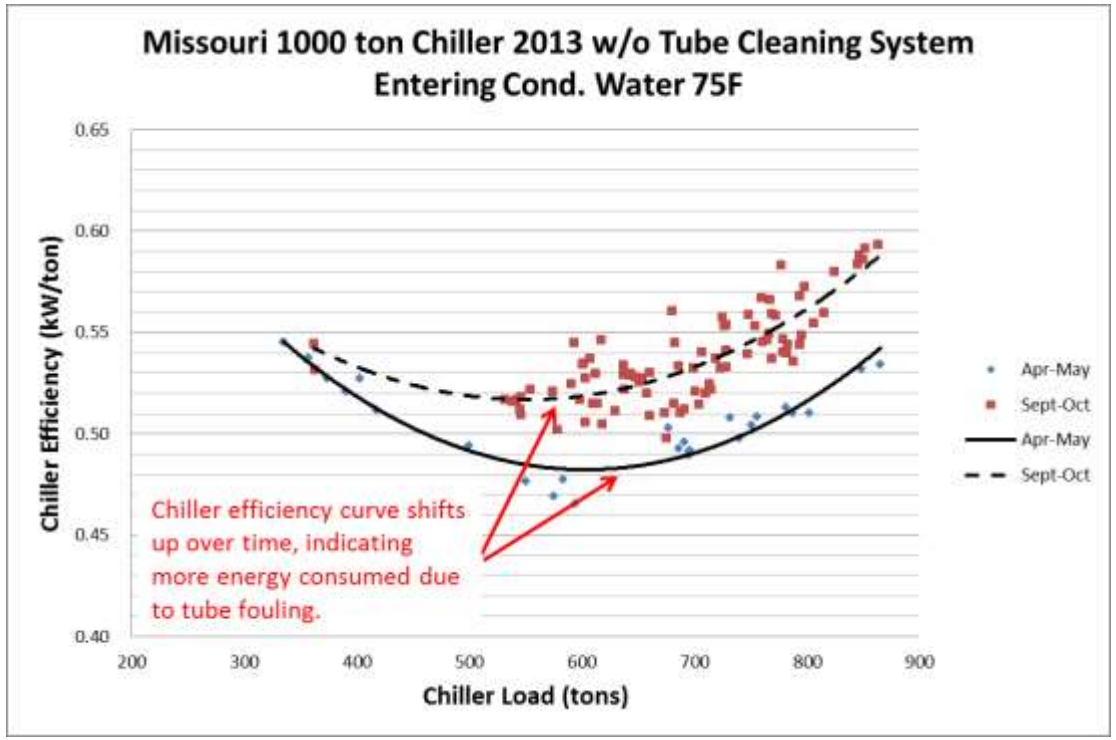


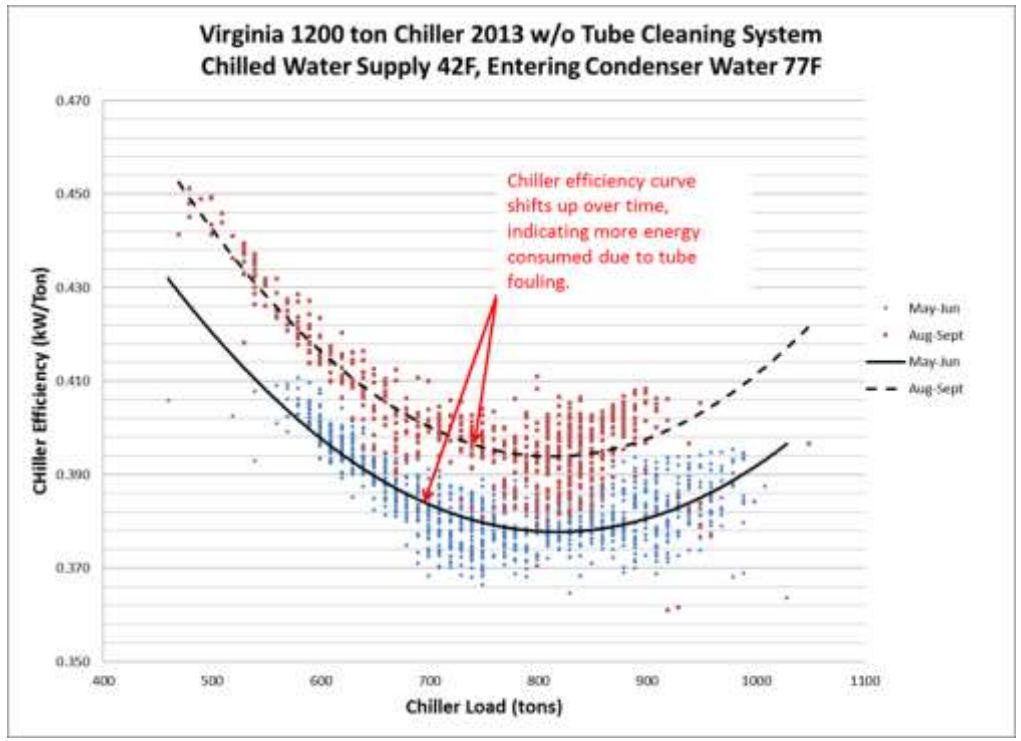
If Our True Goal is to Optimize Chiller Efficiency…

Chemical Treatment Alone

Is NOT

"Best In Class" Efficiency





Water Treatment +

Continuous Tube Cleaning =

True Optimized Efficiency

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Automatic Tube Cleaning Systems (ATCS): Multiple Value Dimensions

- Avg. chiller efficiency improves 5-15%
- Increase chiller cooling output up to 10%
- Reduce or eliminate manual tube brushing & chemical cleaning
- Improves chiller plant availability
- Reduce GHG emissions and environmental impact

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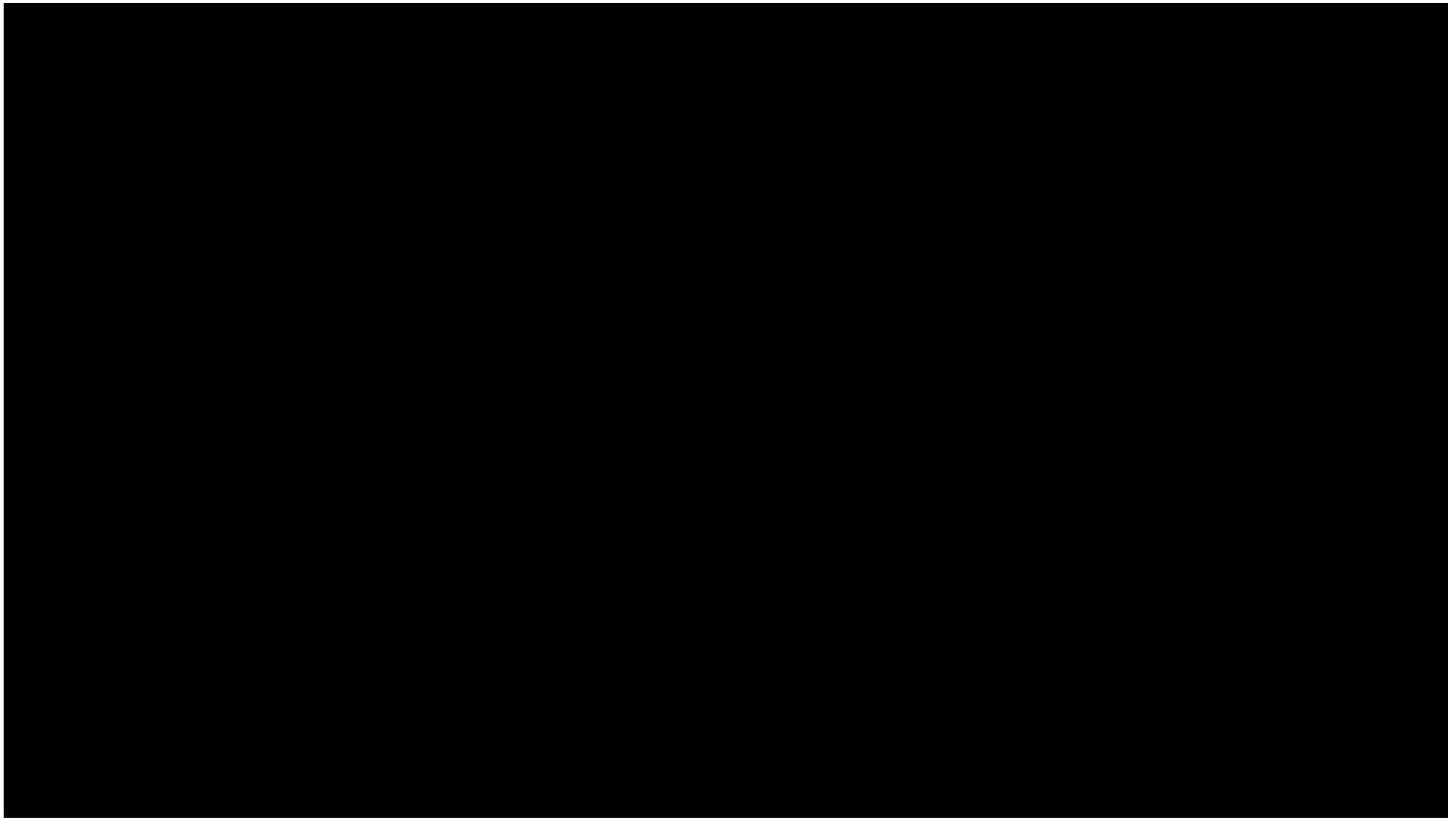
How Auto Tube Cleaning Systems (ATCS) Work



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University of Virginia Path to ATCS

February 2012
- Approached with an innovative solution we didn't quite believe

May 2012
- Entered in to a test run with single unit and creative procurement strategy
- 6000 ton plant with initial test run on a 2000 ton machine

November 2012
- Completed trial
- Quantitative and qualitative analyses were compelling

December 2013
- Operational as standard equipment at new 6000 ton East chiller plant

February 2015
- Expanded original system to include all three chillers for a total of 6000 tons at the South plant

May 2016
- Operational as standard equipment at new 2400 ton Newcomb chiller plant

January 2017
- Installed in existing 6900 ton Aquatics and Fitness chiller plant

December 2018
- Installed at 2800 ton Massie Rd chiller plant & all plants with appropriate justification

Since 2012, ATCS Installed on 18 Chillers (26,000 Tons) & Counting!

University of Wisconsin Case Study

BACKGROUND INFORMATION:

- CENTRAL PLANT - CHILLERS 1 & 2
- TWIN 4,000 TON STEAM CHILLERS
- SHARED CHILLED & CONDENSER H2O HEADERS
- ATCS INSTALLED ON CHILLER 2 CONDENSER & EVAPORATOR

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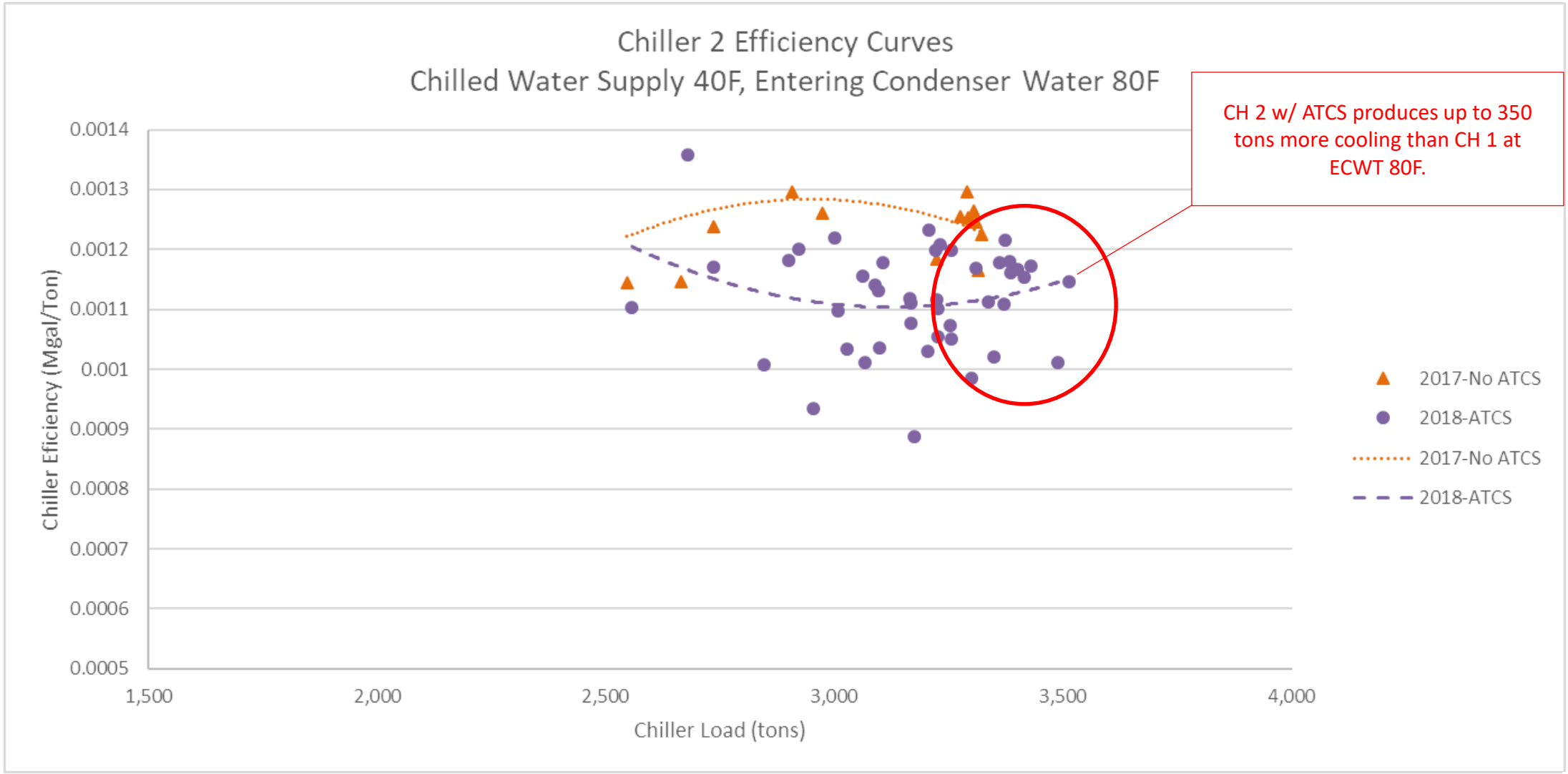
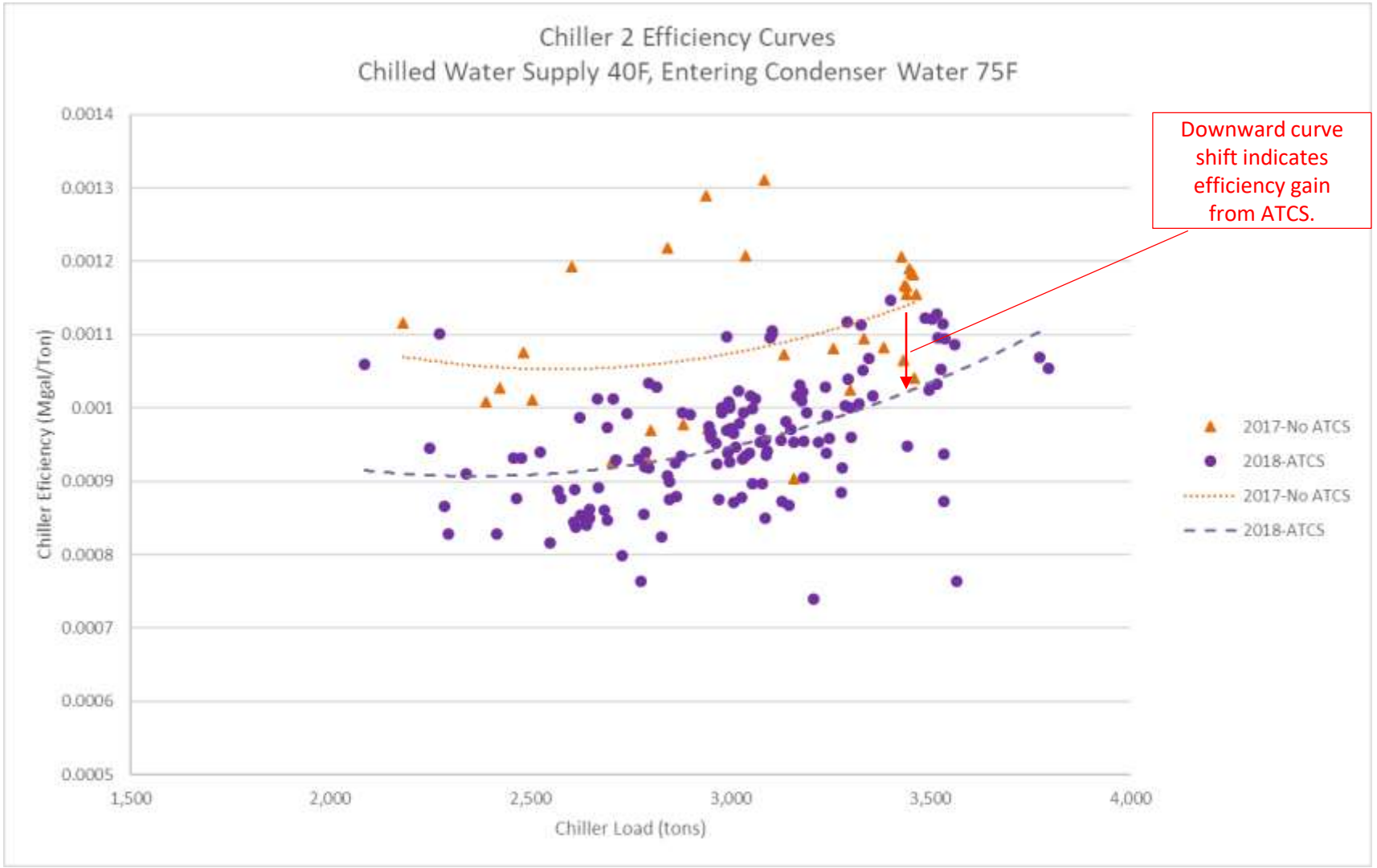
ATCS Increased Chiller Cooling Capacity!

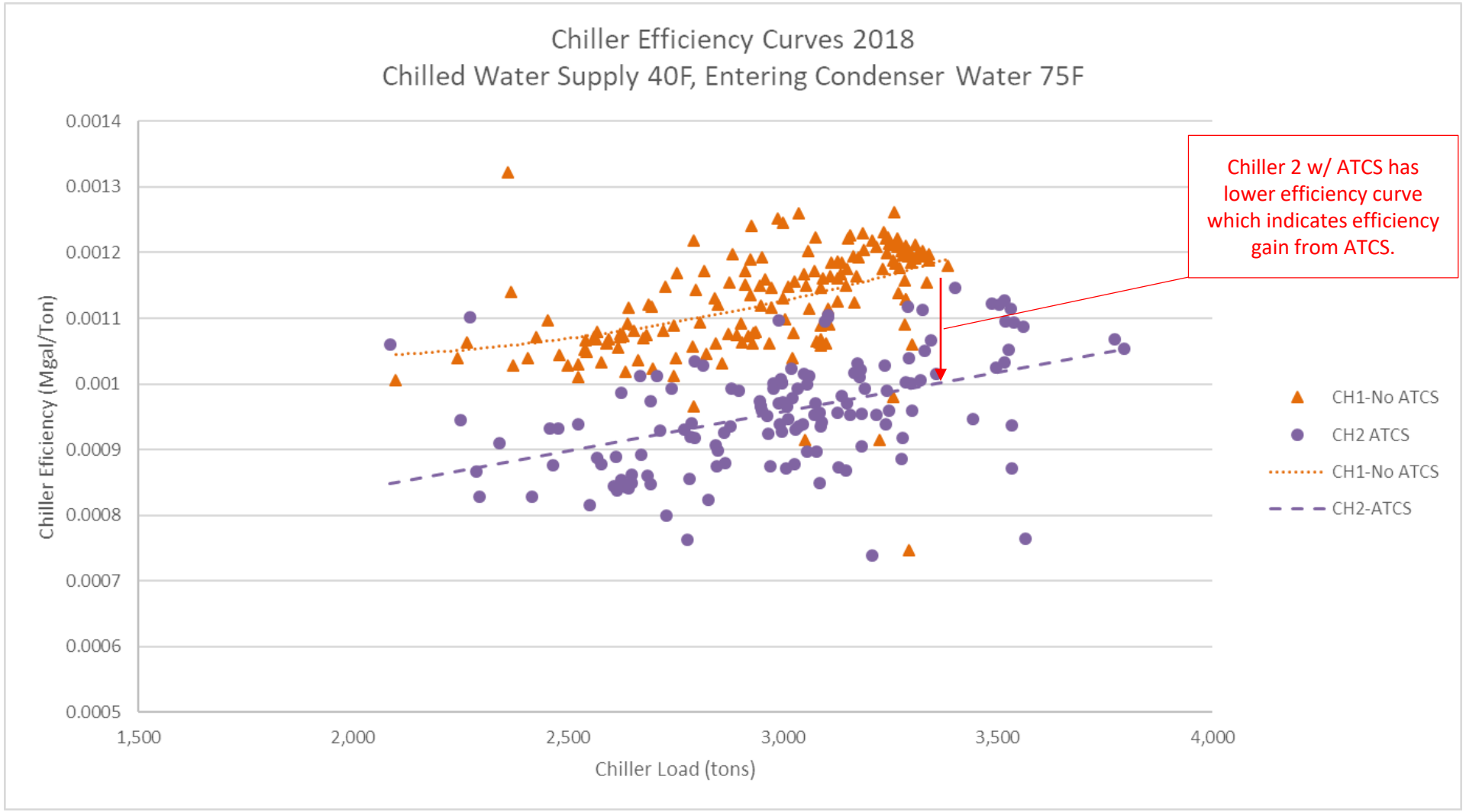


Chiller 2 Efficiency Curve Before & After ATCS



Average Efficiency Gain After Helios: 11%

Chiller Efficiency Curves Side by Side Comparison



Average Efficiency Advantage With Helios: 15%

University of Wisconsin Case Study Results

University of Wisconsin Case Study Summary Results	
Average Chiller Efficiency Gain:	12%
Chiller Capacity Increase:	Up to 400 tons
Annual Energy Savings:	10,370 MMBtu
Annual Energy Cost Savings:	$40,000
Project Lifetime CO2 Emission Reductions:	9,200 tons
Project Lifetime Savings (15 Yrs):	$850,000

Xcel Energy Case Study

BACKGROUND INFORMATION:

- **XCEL ENERGY DISTRICT COOLING PLANT – CHILLER 4**
- **2,500 NOMINAL TONS**
- **DENVER DOWNTOWN DISTRICT COOLING**

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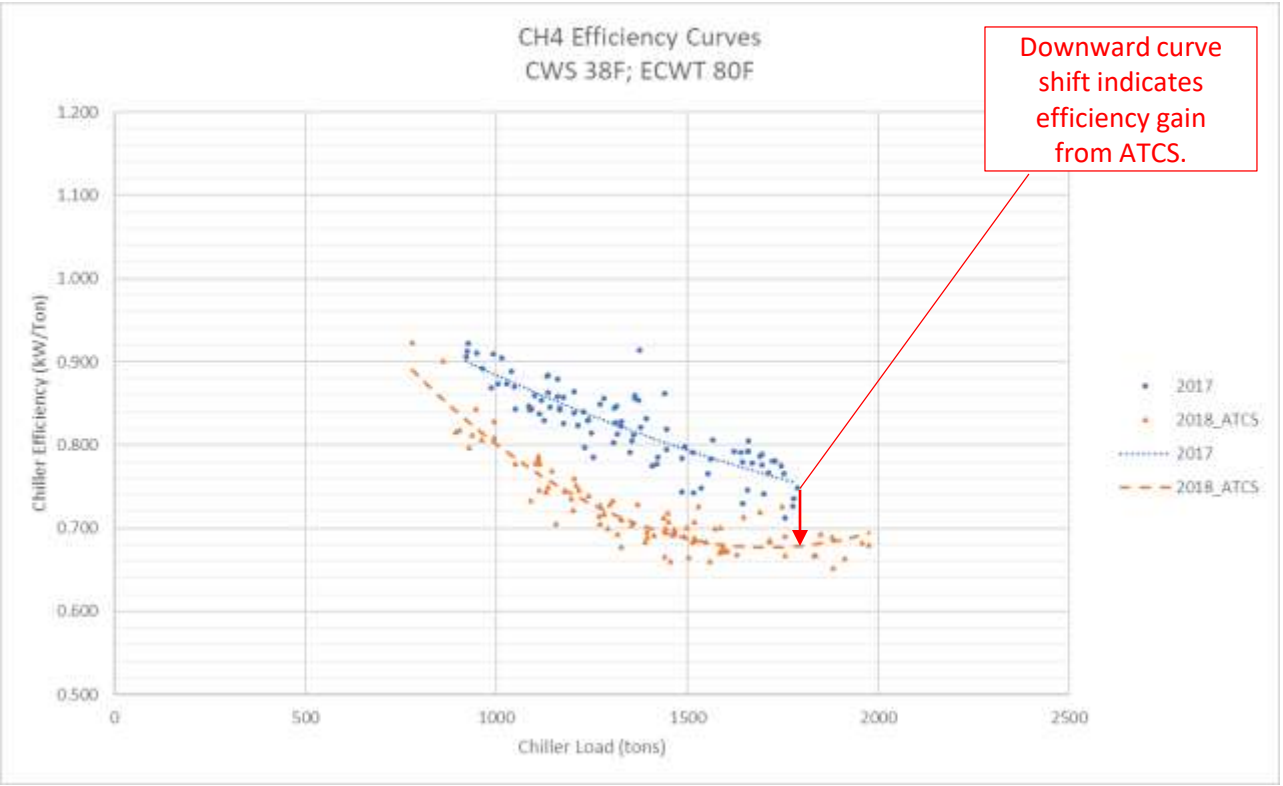
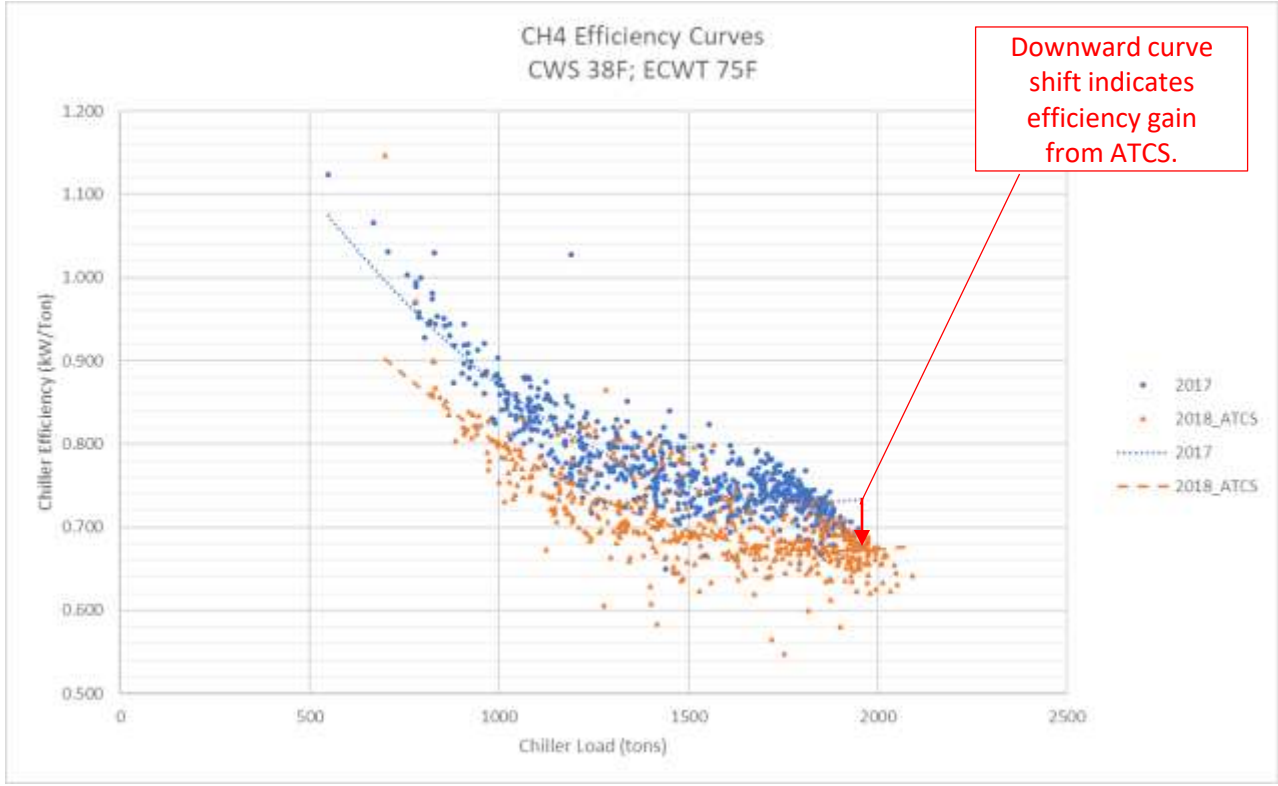
Chiller 4 Efficiency Curves Before & After ATCS



Average Efficiency Gain After ATCS: 12%



Average Efficiency Gain After ATCS: 9%

Xcel Energy Case Study Results

Xcel Energy Case Study Summary Results	
Average Chiller Efficiency Gain:	4%
Chiller Capacity Increase:	Up to 200 tons
Annual Energy Savings:	180,000 kW-hrs
Annual Cost Savings:	$20,000
Project Lifetime CO2 Emission Reductions:	2,200 Tons
Project Lifetime Savings (15 Yrs):	$410,000

George Mason University Case Study

BACKGROUND INFORMATION:

- CENTRAL COOLING PLANT CHILLERS 9 & 10
- 1,470 NOMINAL TONS EACH
- SHARED CHILLED & CONDENSER H2O HEADERS

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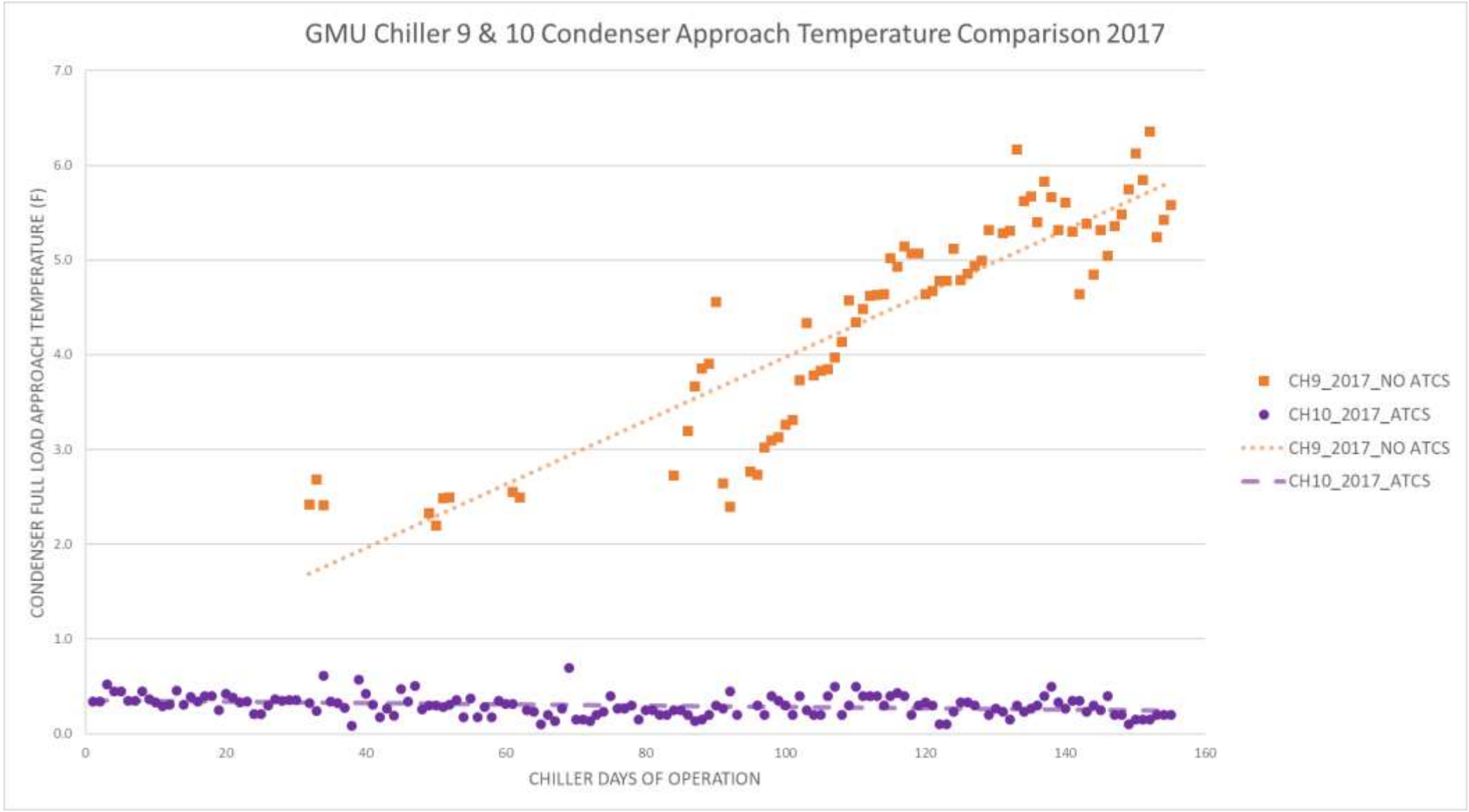
2017: ATCS Maintains Chiller 10 Constant Approach Temp



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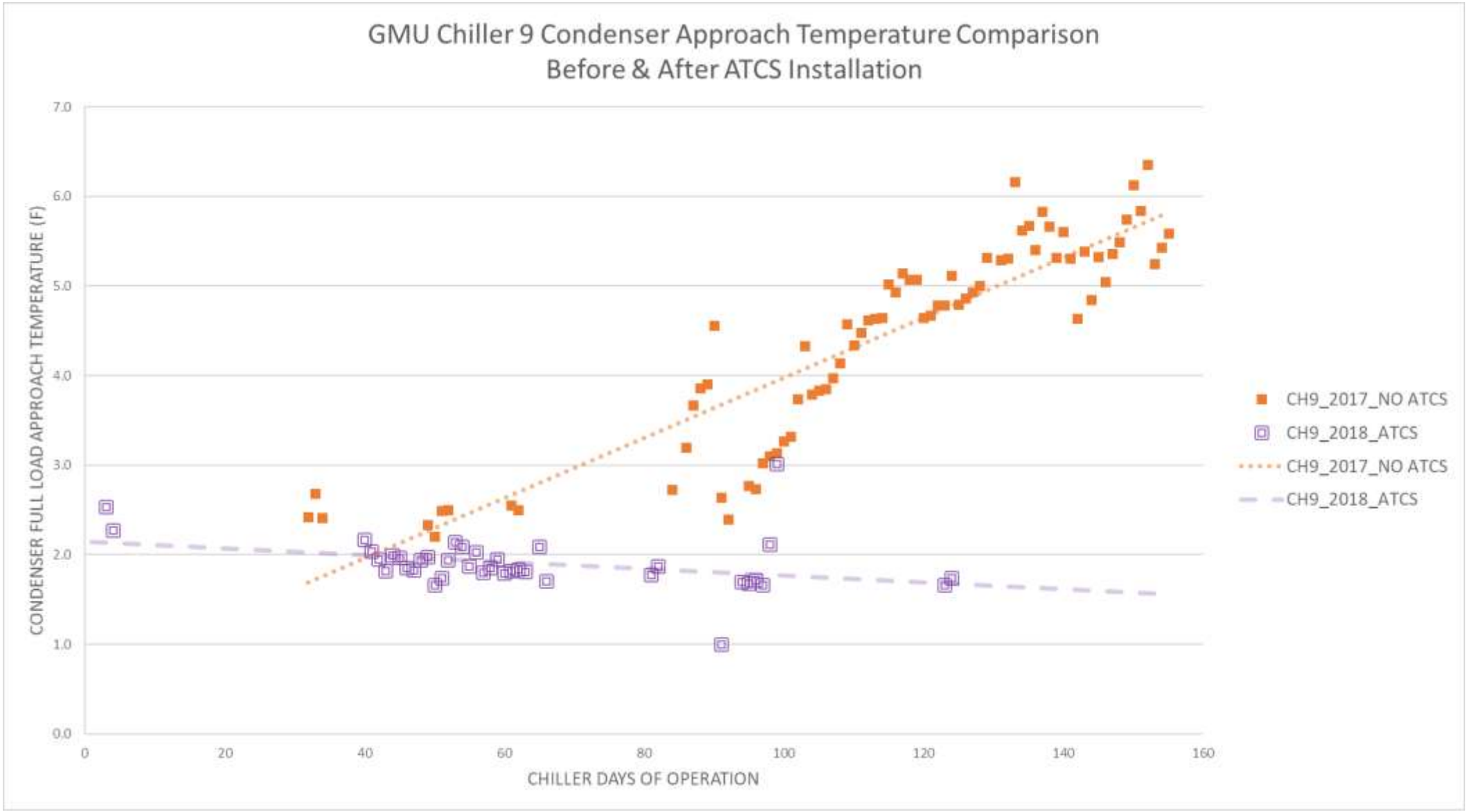
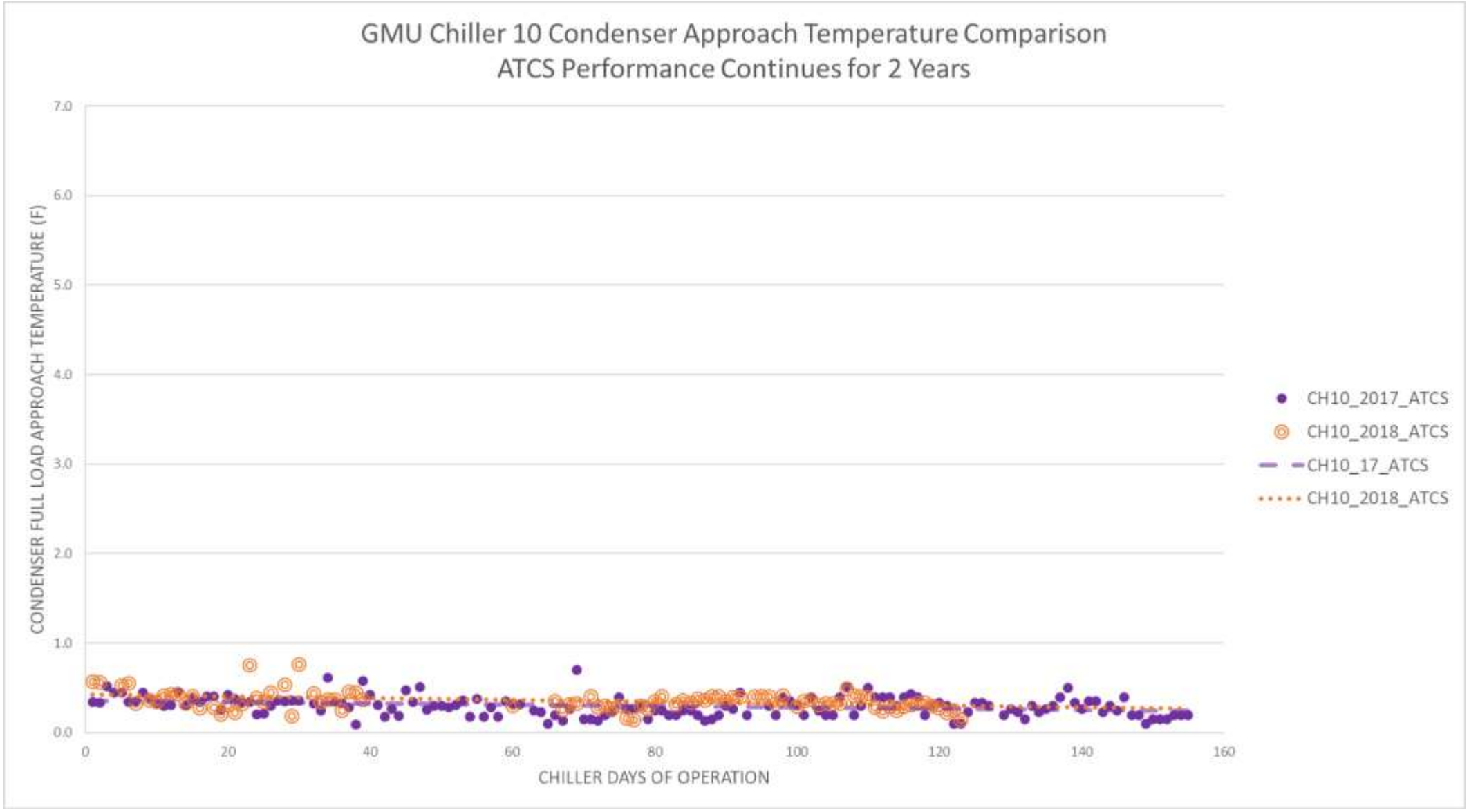
2017-18: Chiller 9 Approach Temp Flatlines After ATCS



2017-18: Chiller 10 w/ ATCS Continues Flatline Approach



George Mason University Case Study

George Mason University Case Study Summary Results	
Average Chiller Efficiency Gain:	10%
Chiller Capacity Increase:	Up to 200 tons
Annual Energy Savings:	550,000 kW-hrs
Annual Cost Savings:	$45,000
Project Lifetime CO2 Emission Reductions:	6,500 Tons
Project Lifetime Savings (15 Yrs):	$900,000

BACKGROUND INFORMATION

- CENTRAL COOLING PLANT CHILLERS 9 & 10
- 1,470 NOMINAL TONS EACH
- SHARED CHILLED & CONDENSER H2O HEADERS

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
- For optimum benefit, all tubes in tube bundle need to be the same size

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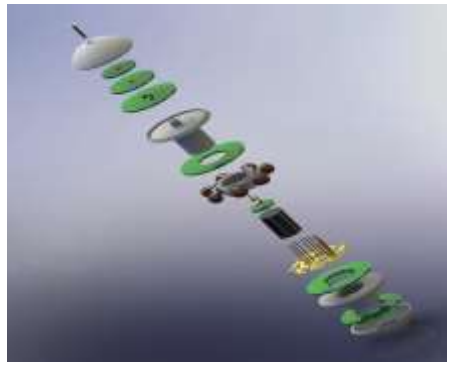
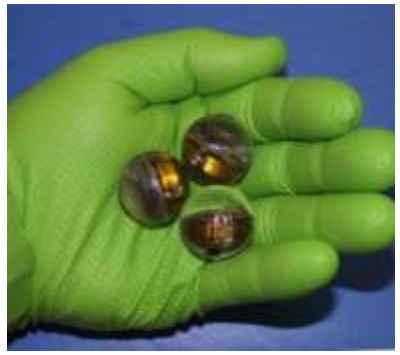
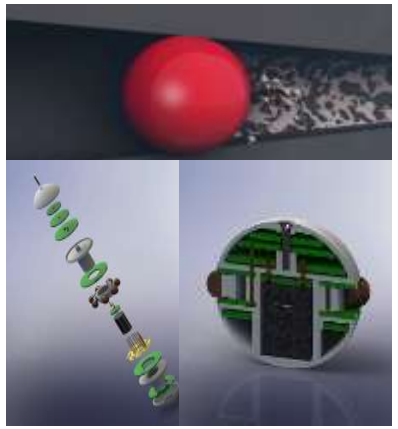
ATCS & Emerging Technologies

Introducing Mobile Micro-sensor Technology to Operating Chillers



Today:
Offline, Manual, Reactive





Tomorrow:
Real Time, Automated, Predictive

- Low Cost
- Condenser flow & temperature measurement
- Predictive failure prevention via vibration analysis
- Future to provide real-time tube NDE.
- Allows optimized condenser operation.
- Industrial IOT: automate a slow manual process

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Questions?

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How Auto Tube Cleaning Systems (ATCS) Work