



Environmental and Economic Impacts of Automatic Tube Cleaning System

Presented by:

John Gibbemeyer – George Mason University

Mike Richardson – Innovas Technologies

February 2019



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

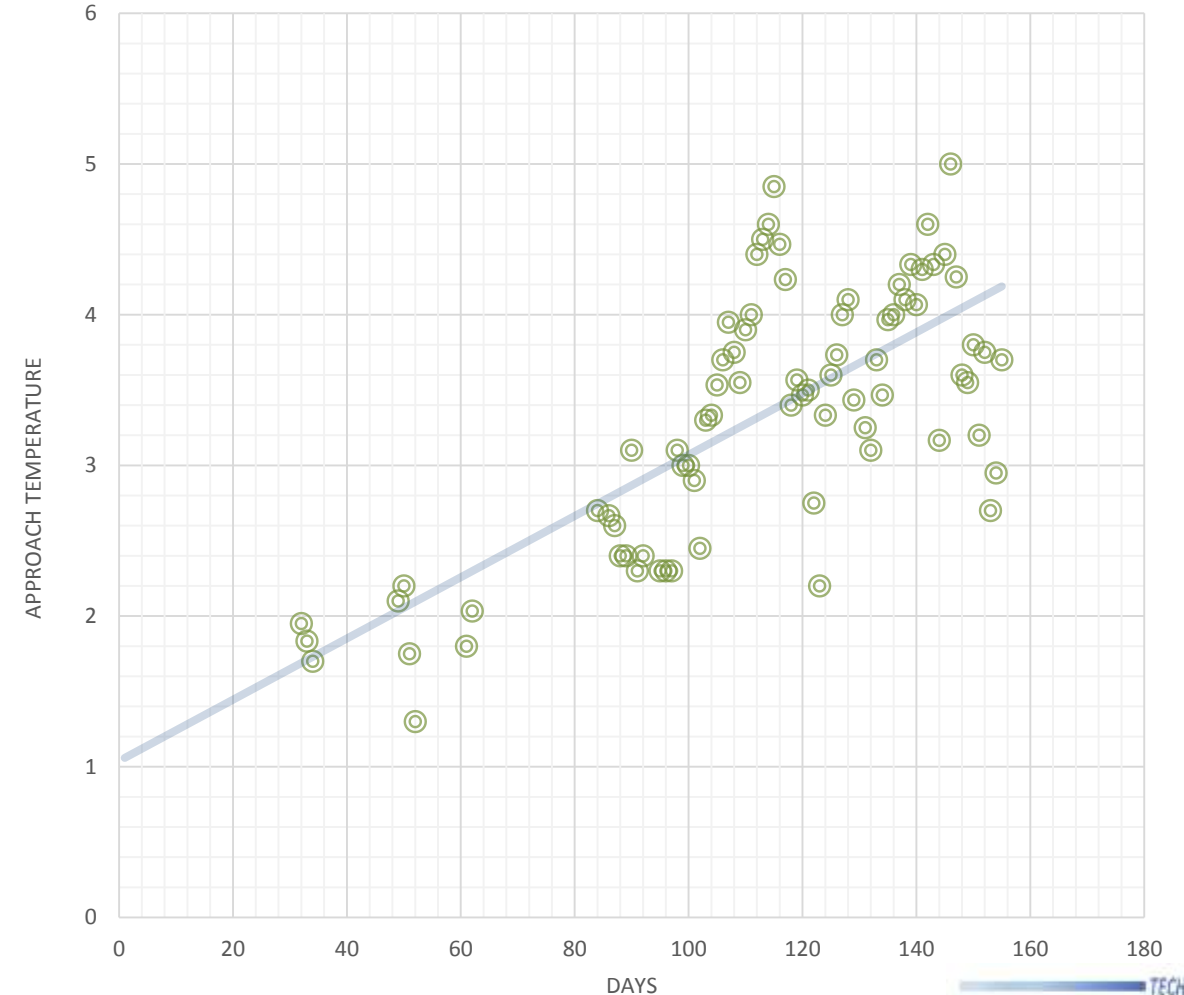


- >\$1.5 Billion wasted every year in USA due to chiller inefficiency



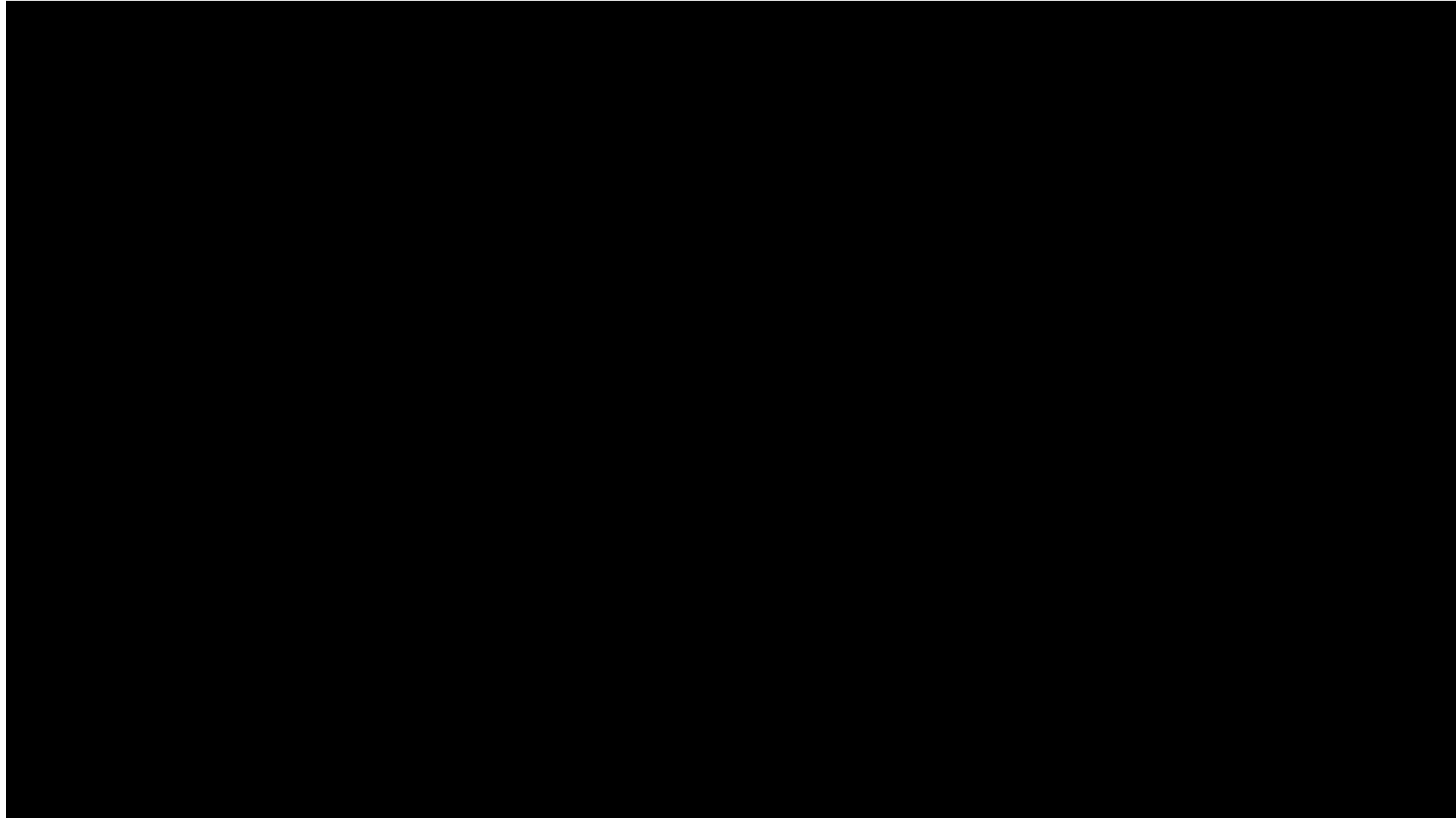
Before ATCS: George Mason University: Chiller #9

The Status Quo: Linear Chiller Fouling

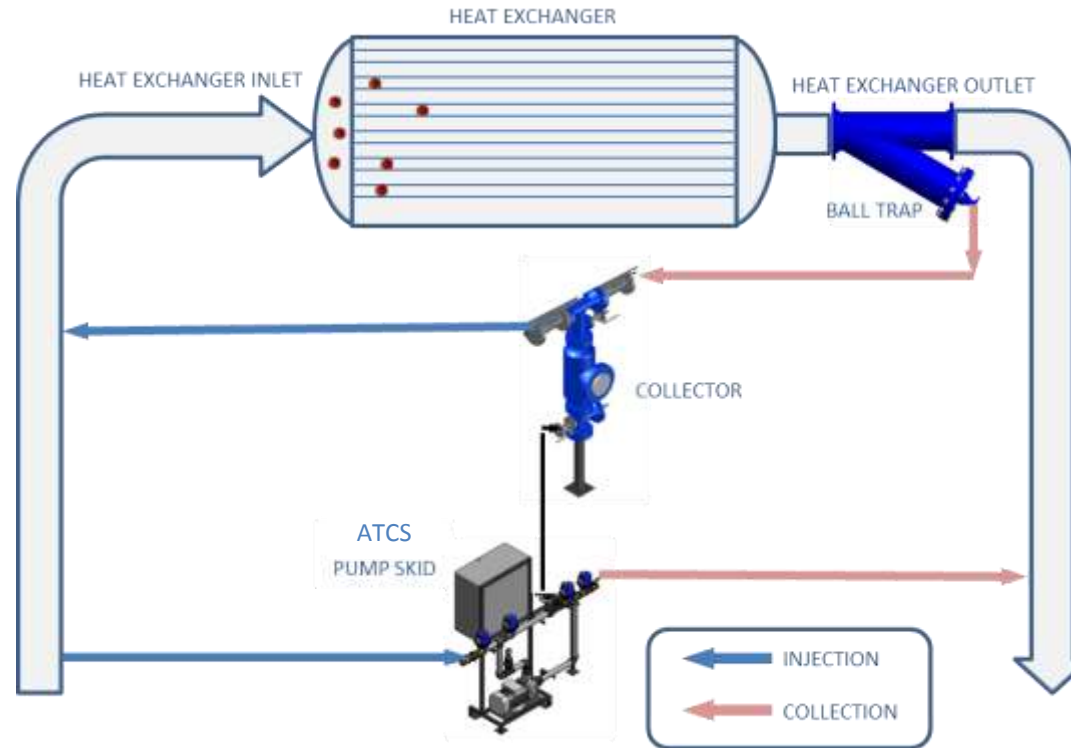


-The Solution-

How Auto Tube Cleaning Systems (ATCS) Work

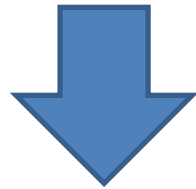


How Auto Tube Cleaning Systems (ATCS) Work



What It Does

- Constant cleaning of the tubes:



- No suspended solids can collect
- No biological colonies can form
- No seed particles form for scale growth
- No Fouling in your tubes.....

Automatic Tube Cleaning Systems (ATCS): Multiple Value Dimensions



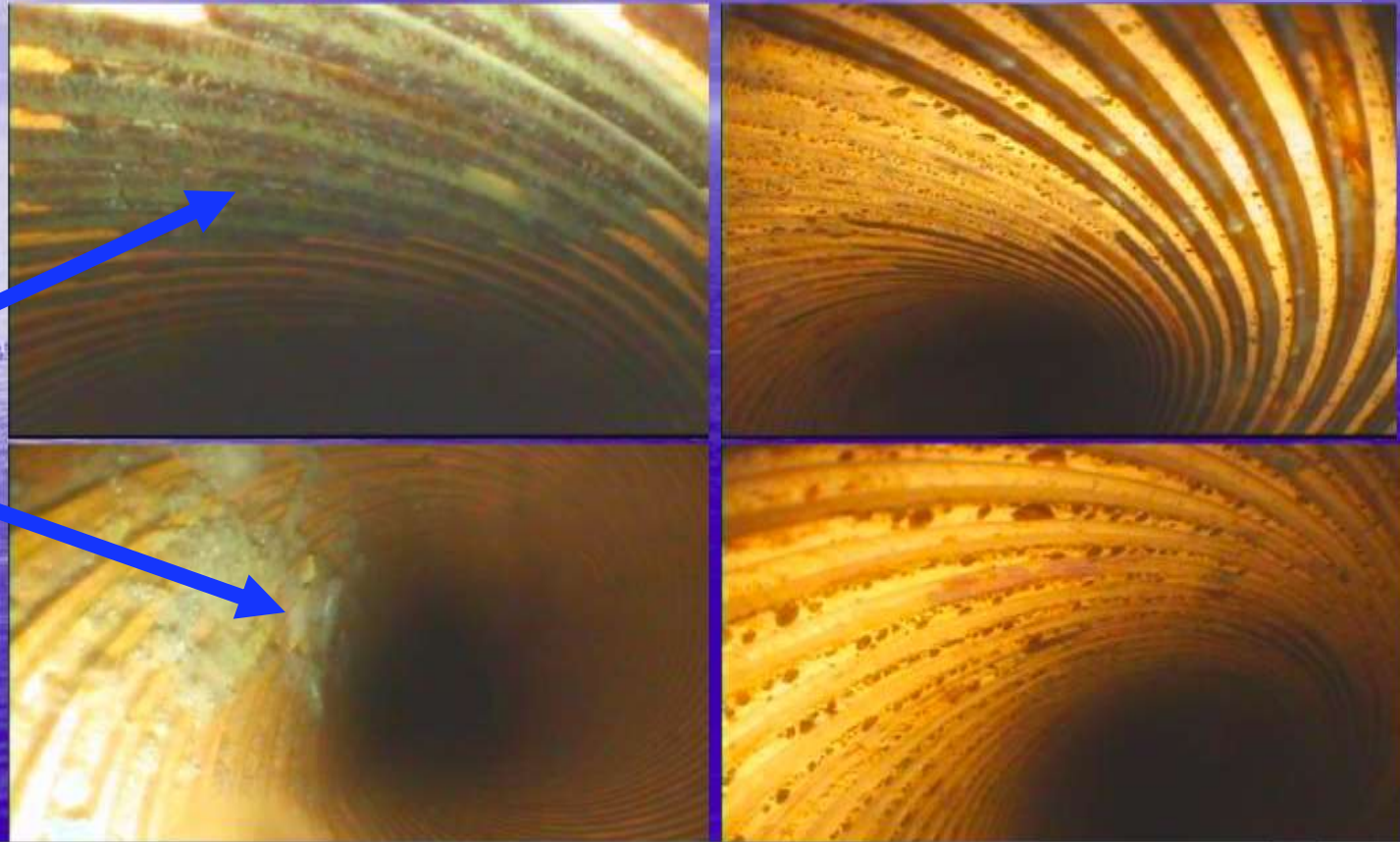
- Avg. chiller efficiency improves 5-15%
- Increase chiller cooling output up to 10%
- Reduce or eliminate manual tube brushing & chemical cleaning
- Improves chiller plant availability
- Reduce GHG emissions and environmental impact
- Reduces labor churn freeing team higher value tasks



Condenser Tubes Without ATCS

Clear Visual Evidence of Fouling

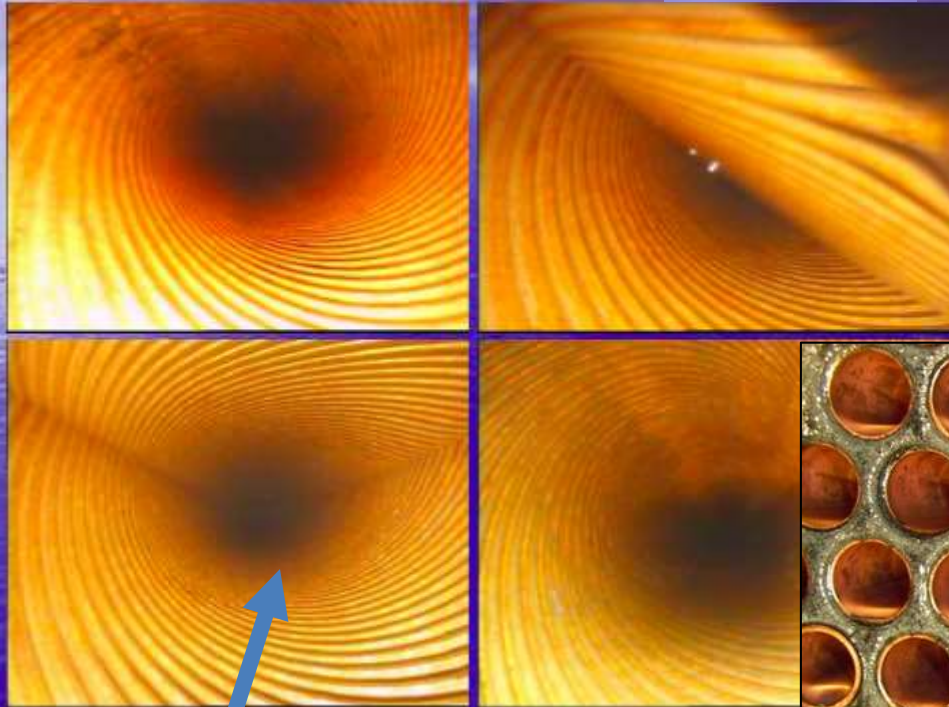
The Alfred Hospital Chiller #4
Videoscop image of condenser tubes without ATCS



Fouling

Condenser Tubes With ATCS

The Alfred Hospital – Chiller #3 With ATCS



Clear Visual Evidence of
Cleanliness as a Result of ATCS

Clean.....Perfectly.....



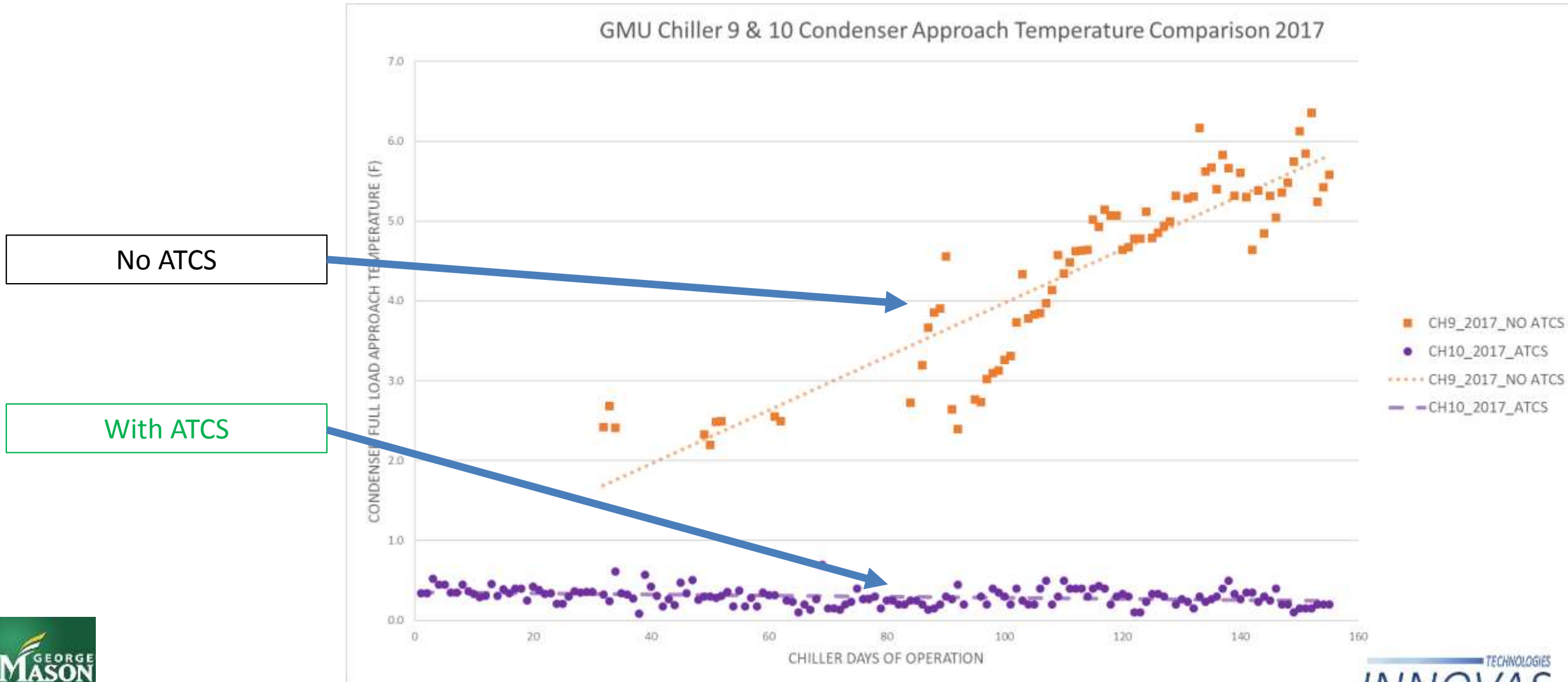
Evidence - George Mason University Case Study



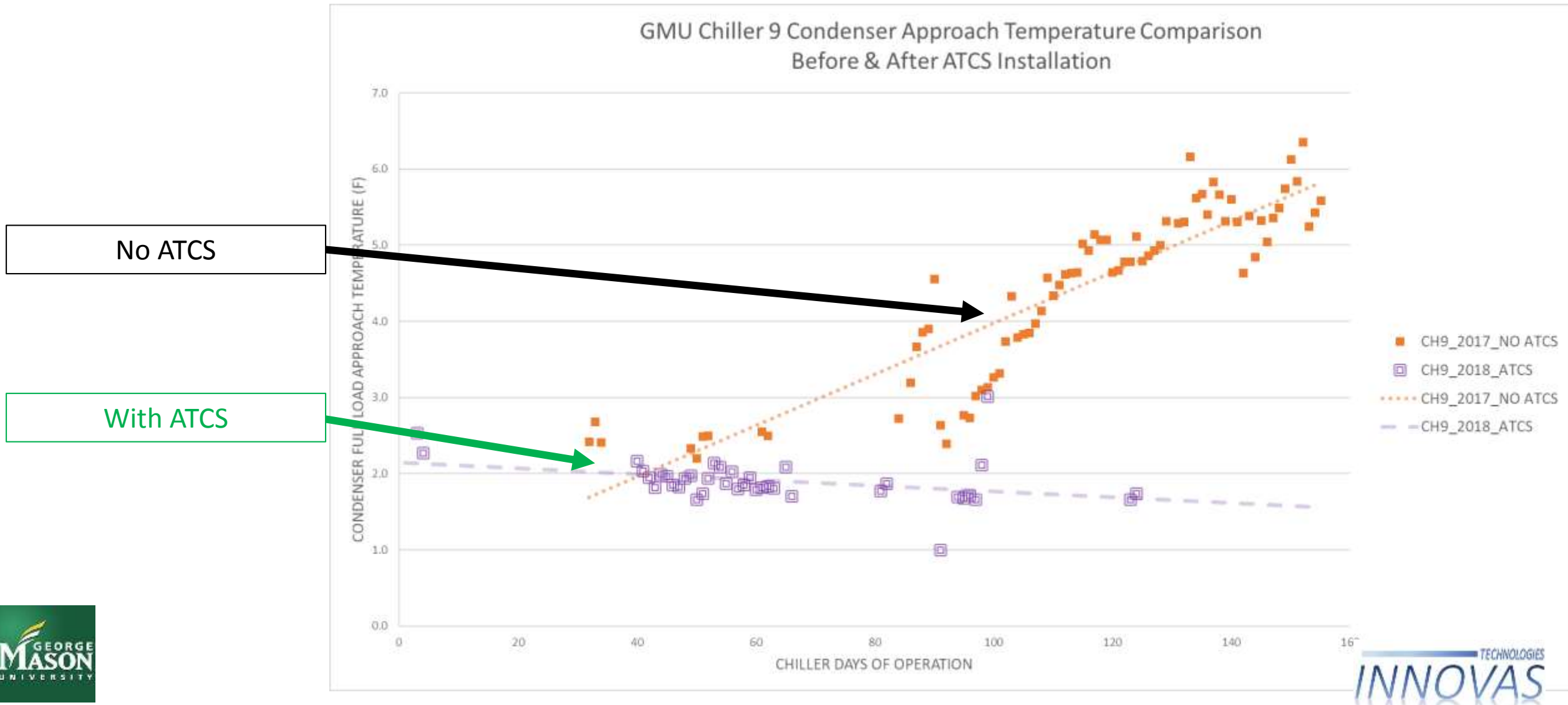
BACKGROUND INFORMATION:

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

2017: ATCS Maintains Chiller 10 Constant Approach Temp

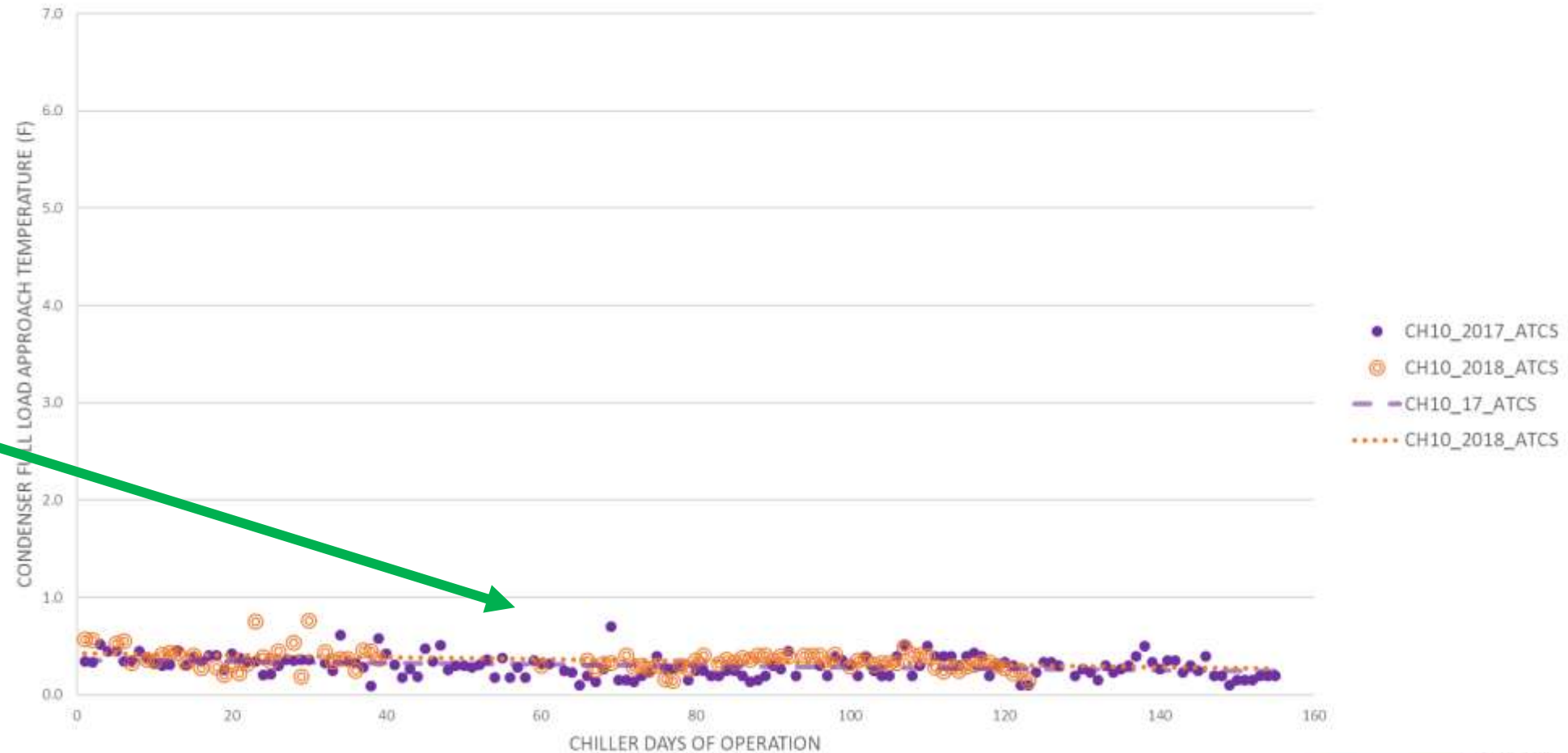


2017-18: Chiller 9 Approach Temp Flatlines After ATCS



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

GMU Chiller 10 Condenser Approach Temperature Comparison
ATCS Performance Continues for 2 Years

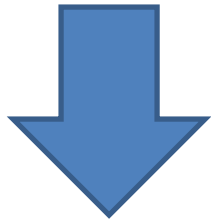


Consistent Results

With ATCS

GMU Savings Summary

- Energy Savings
- Maintenance Savings
- Green Cleaning



Total Team Adoption

Inputs:		
Chiller Inputs		Chiller 1
Chiller Capacity (tons)		6400
Rated Chiller Efficiency (kW/ton)		0.55
Chiller IPLV or NPLV (kW/Ton)		0.440
Energy Cost(\$/kW-hr)	\$	0.060
Annual Operating Hours		5000
Annual Tube Cleaning Cost (\$)	\$	5,000
ATCS % Efficiency Gain		10%
Helios System Cost		
Total System Purchase	\$	183,500
Installation Costs	\$	15,000
Energy Incentive Basis		0%
Annual Chiller Energy Savings		
Demand Savings (kW)		281.6
Energy Savings (kW-hrs)		1,408,000
Energy Cost Savings (\$)	\$	84,480
Tube Cleaning Cost Savings (\$)	\$	5,000
Total Chiller Cost Savings (\$/yr)	\$	89,480
Simple Payback		
Total System Cost	\$	198,500
Annual Cost Savings	\$	89,480
Simple Payback Period (yrs)		2.22

EPA Greenhouse Gas Equivalency

<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

- 910 Tons of Carbon per year
- Equivalent of:
 - 210 Cars or 2,420,566 car-miles
 - 111,400 gallons of gas
 - 1,082,306 pounds of coal burned
 - 173 homes yearly electrical use
 - 345 tons of waste recycled versus landfilled
- This environmental offset also has an economic benefit of roughly \$89,000 per year to GMU

Recap: George Mason University



George Mason University Case Study Summary Results

Average Chiller Efficiency Gain:	10%
Chiller Capacity Increase:	Up to 600 tons
Annual Energy Savings:	1,400,000 kW-hrs
Annual Cost Savings:	\$89,000
Project Lifetime CO2 Emission Reductions:	13,500 Tons
Project Lifetime Savings (15 Yrs):	\$1,335,000

-Consistent Performance Elsewhere-

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

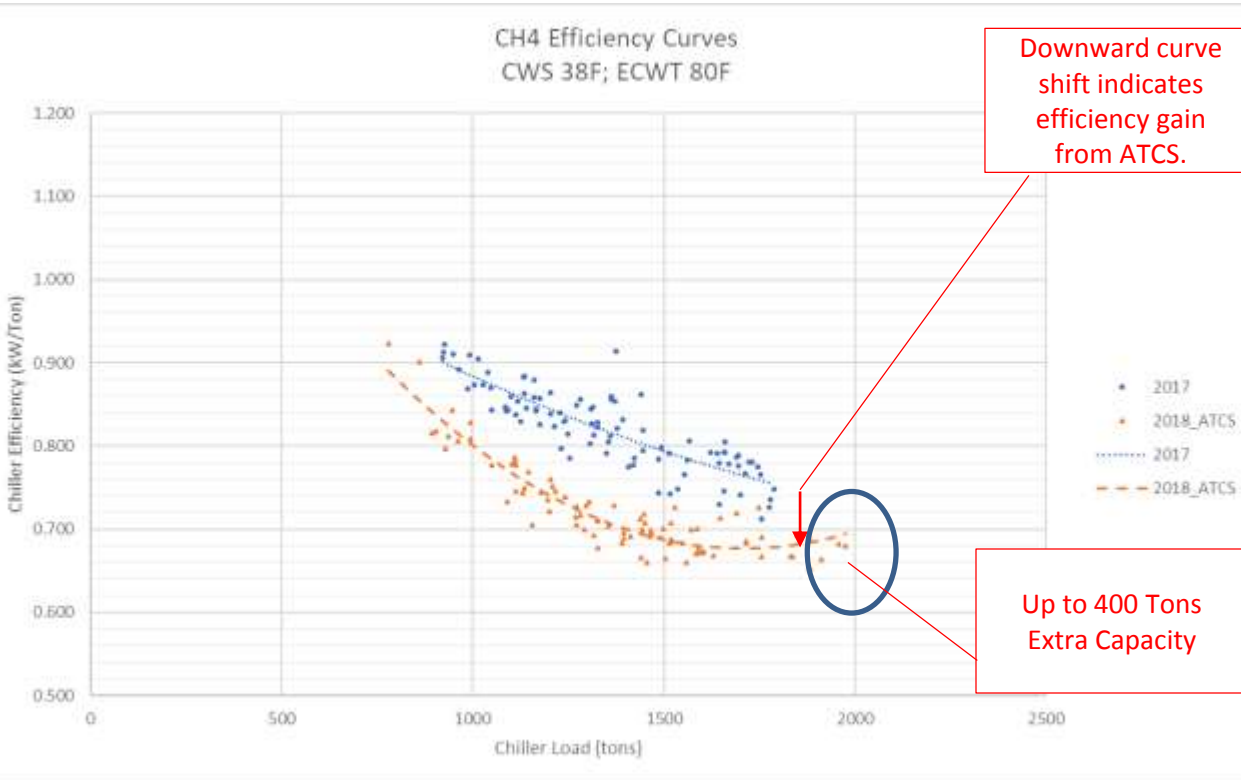
-Consistent Performance Elsewhere- Xcel Energy Case Study Results



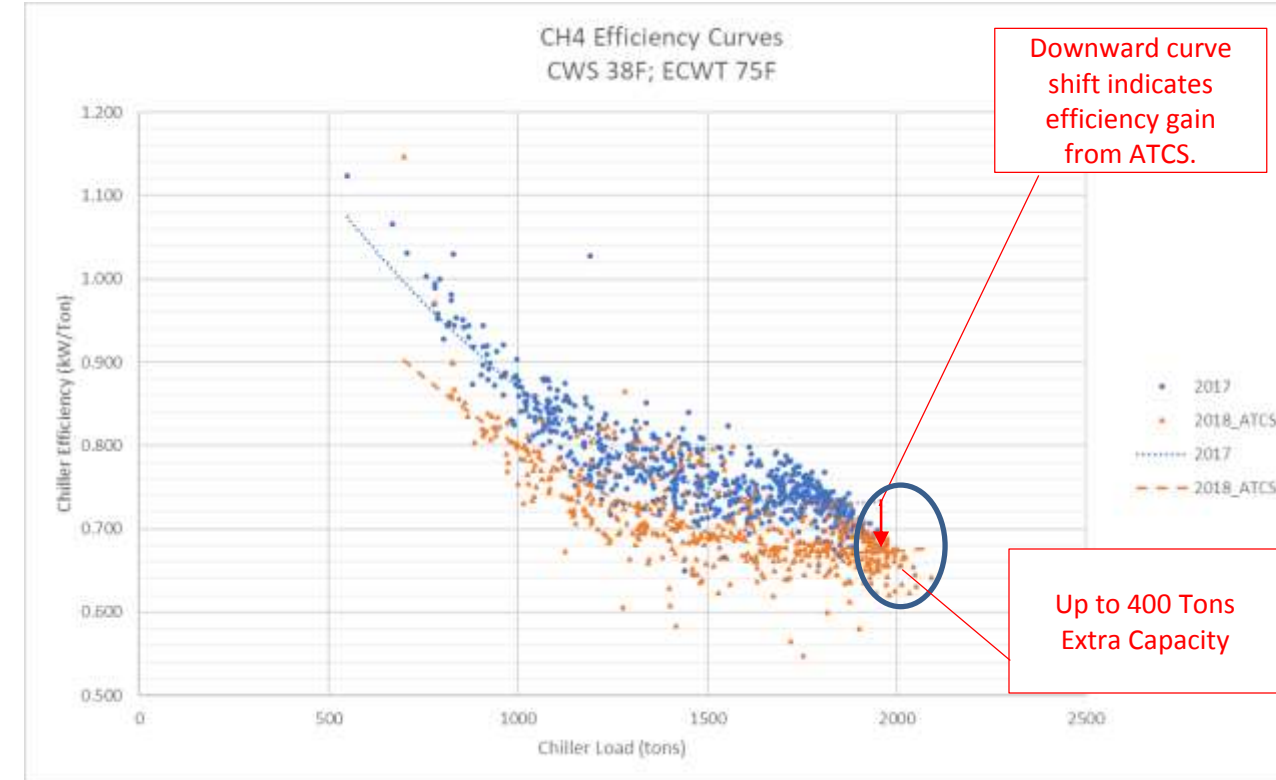
Xcel Energy Case Study Summary Results

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

XCEL Energy: Chiller 4 Efficiency Curves Before & After ATCS & Increased Capacity



Average Efficiency Gain After ATCS: 12%



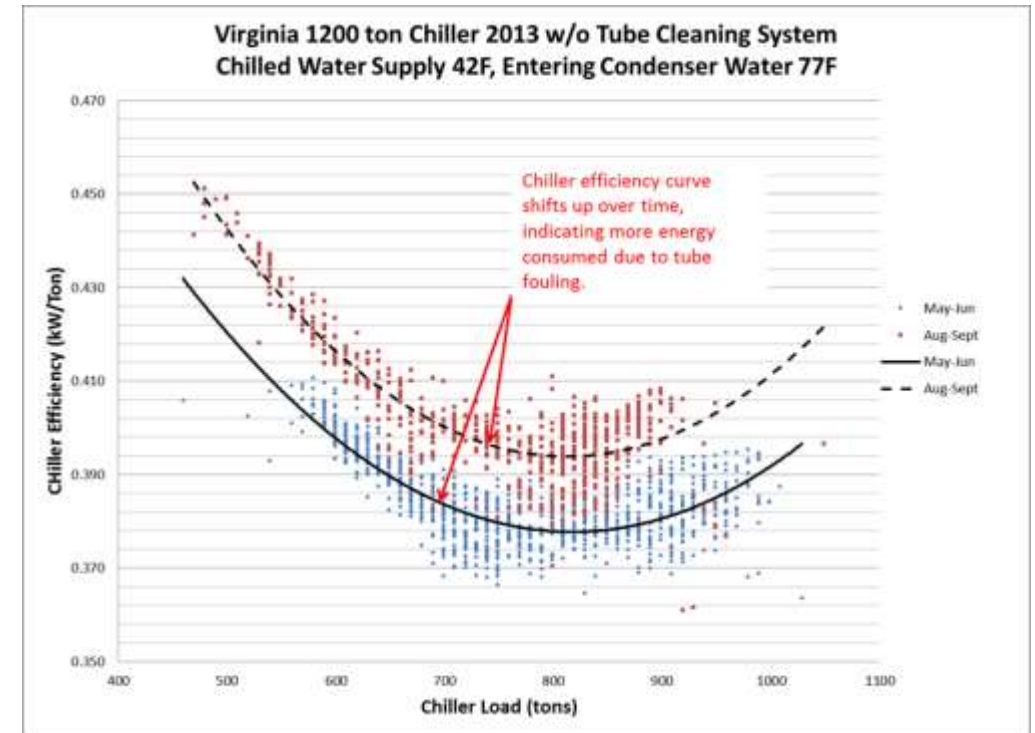
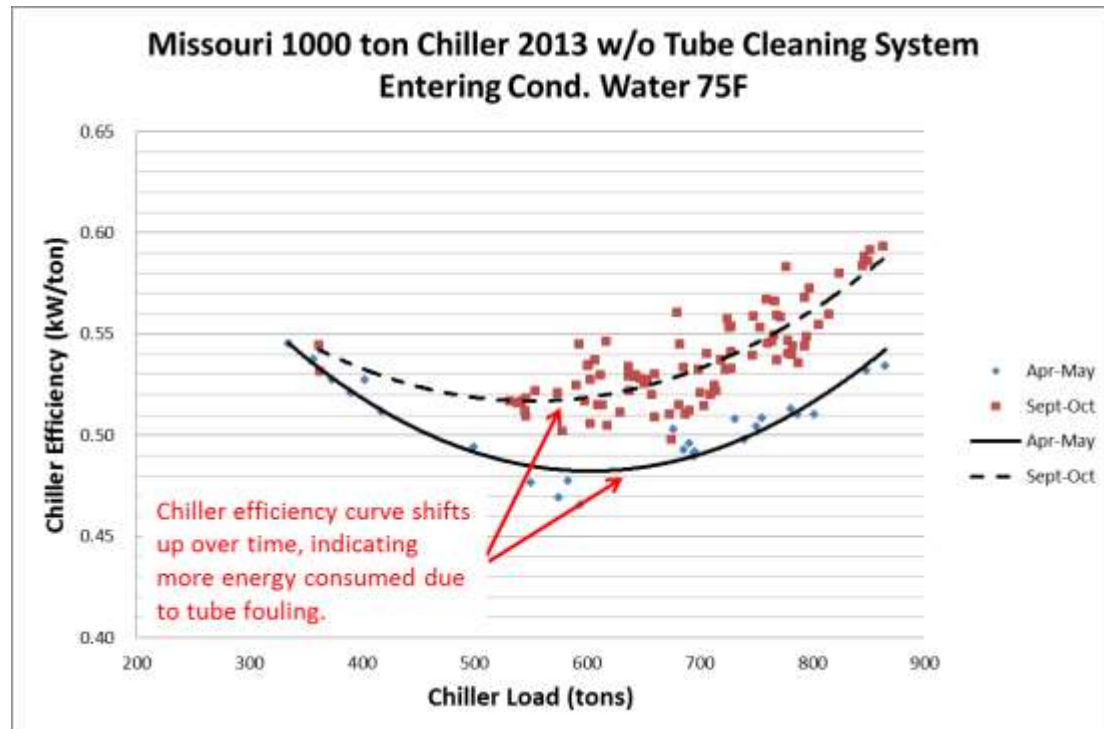
Average Efficiency Gain After ATCS: 9%

Summary: If Our True Goal is to Optimize Chiller Efficiency... Then The Status Quo Has To Be Changed

Chemical Treatment Alone

Is NOT

“Best In Class” Efficiency



Water Treatment +
Continuous Tube Cleaning =
True Optimized Efficiency