

Maintaining Momentum toward Carbon Neutrality

Session Name: AEE Chapter Meeting

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Sanofi Global Engineering and Asset Management

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Discussion Summary

This presentation shares with you some technologies for consideration in achieving a carbon neutral future. A quick review of Sanofi products and environmental goals will be reviewed.

An overview of new technologies and implementation of the International standard for energy management systems (ISO 50k) will also be discussed.

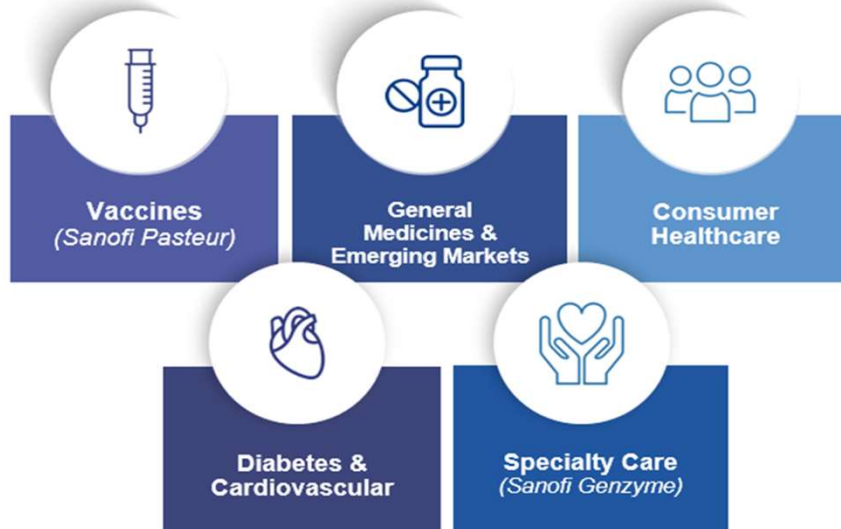
The importance of creating an energy roadmap and the interrelationship between AI and ISO 50k will be reviewed. Ongoing energy & water reduction pilots will also be shared.



About Sanofi

Supporting healthier lives across the continuum of care

Our 5 Global Business Units:



SANOFI 



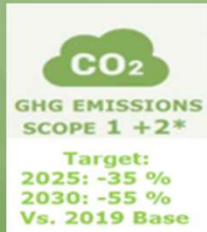
DISEASE PREVENTION

EVERYDAY HEALTH & WELLNESS

CHRONIC DISEASES

RARE DISEASES

Sanofi Environmental Goals



CO₂ Emissions Scope 1+2

Target: 2025 - (-35%)
2030 - (-55%)



Renewable Electricity

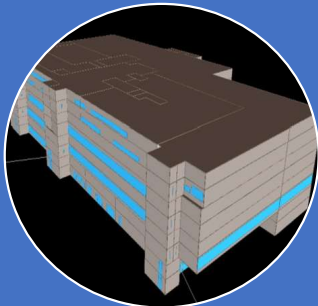
Target: 2025 - 75%
2030 - 100%



Energy Usage (Gas + Elect)

Target: 2025 - (-15%)
Vs. 2022 Baseline

Defining the Main Pillars of Focus



Energy Optimization

Combining RCx/Ocx (sustainable commissioning™), data analytics, ISO 50k, and energy modeling



Carbon Reduction

Implement energy conservation measures, electrification (gas to electric), solar, wind, hydro



Energy & Water Reduction

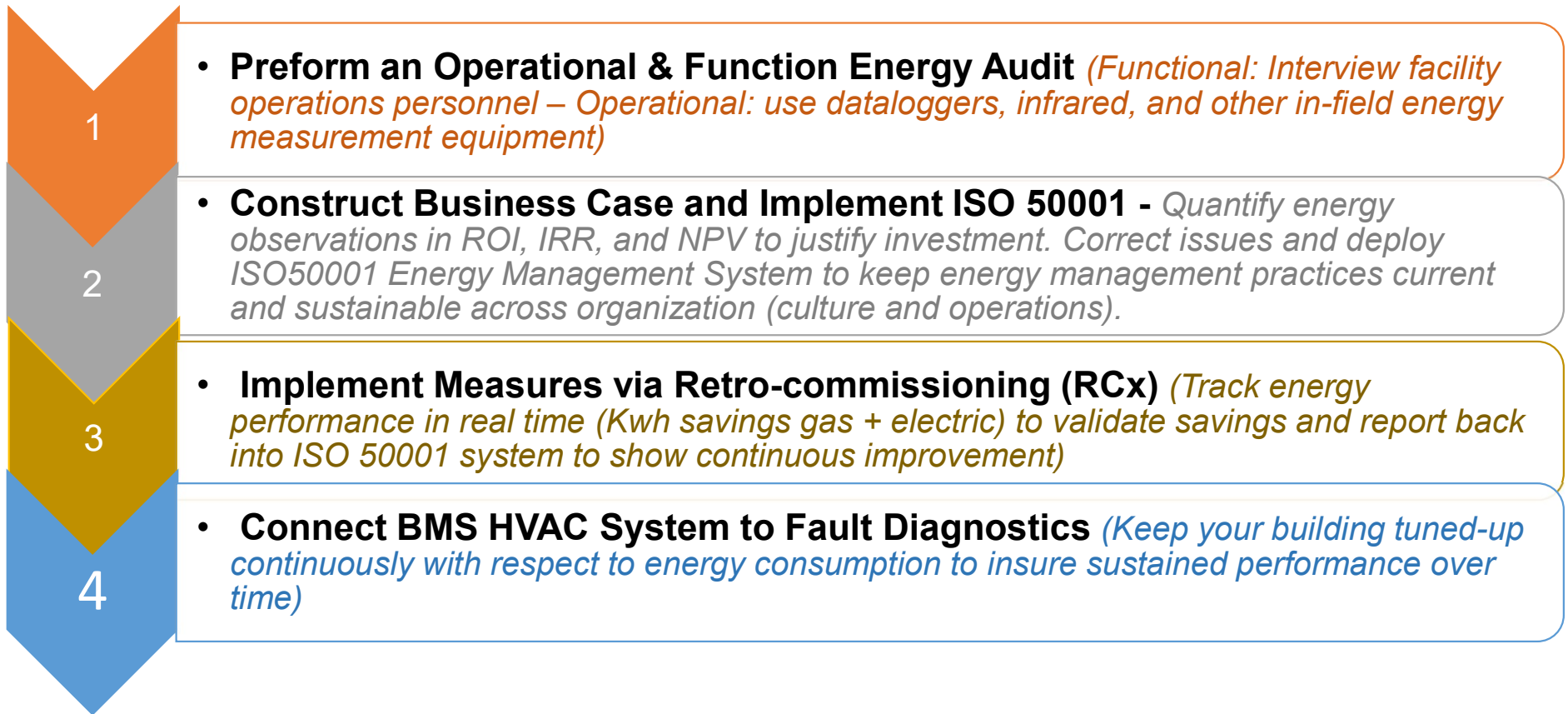
Increasing existing equipment efficiencies with new technologies



Continuous Improvement

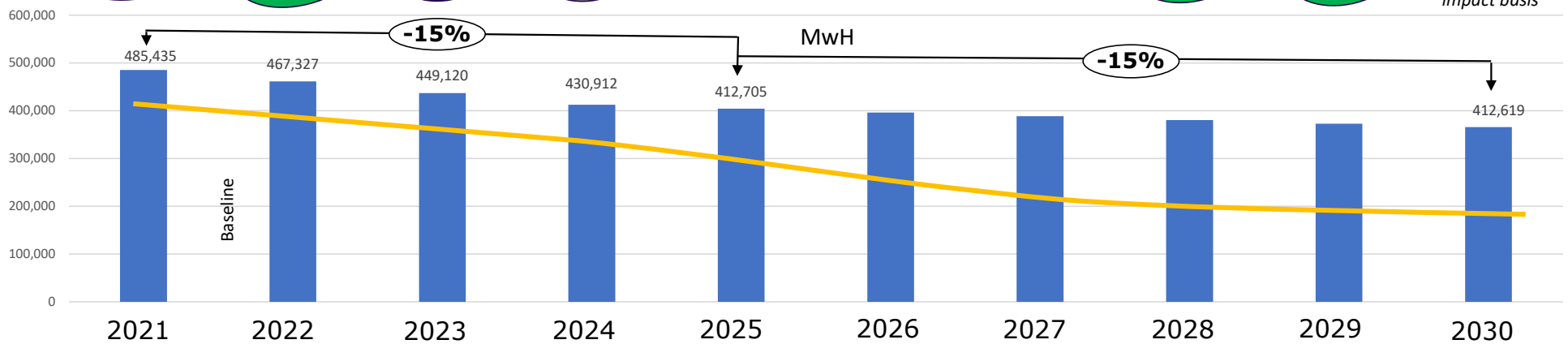
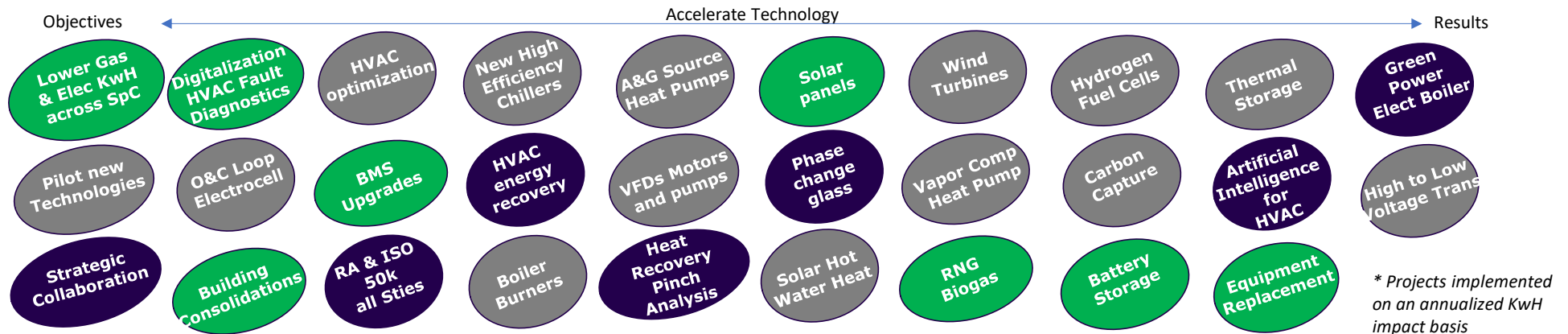
Derive a Sustainable Business Concept

Implementation of the Sustainable Commission™ Process involves a 4-step process:



Define the Energy Roadmap

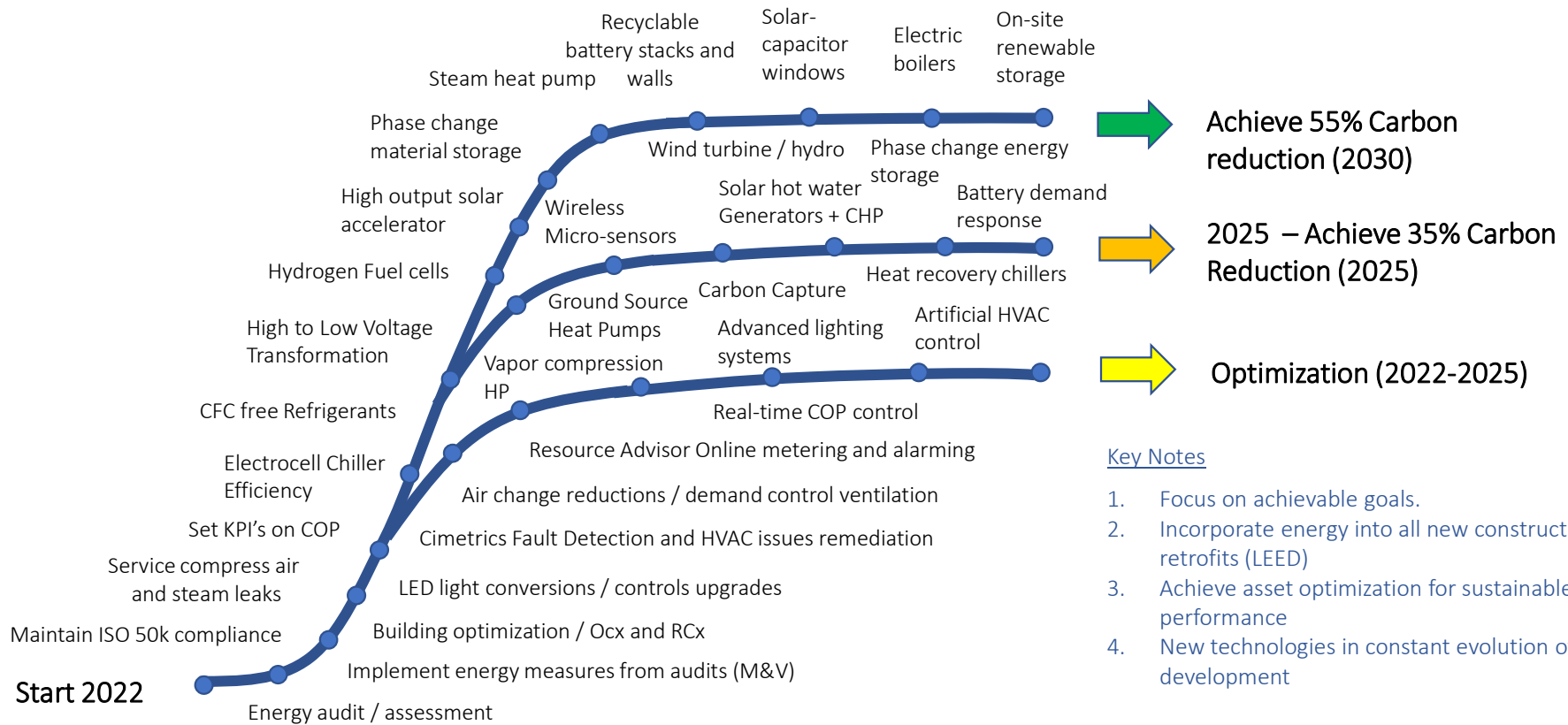
We are addressing climate change by reducing MWh Gas and Electric consumption from our facilities by -15% by end of 2025 (vs 2021). We must complete 56 MWh of projects by 2025.



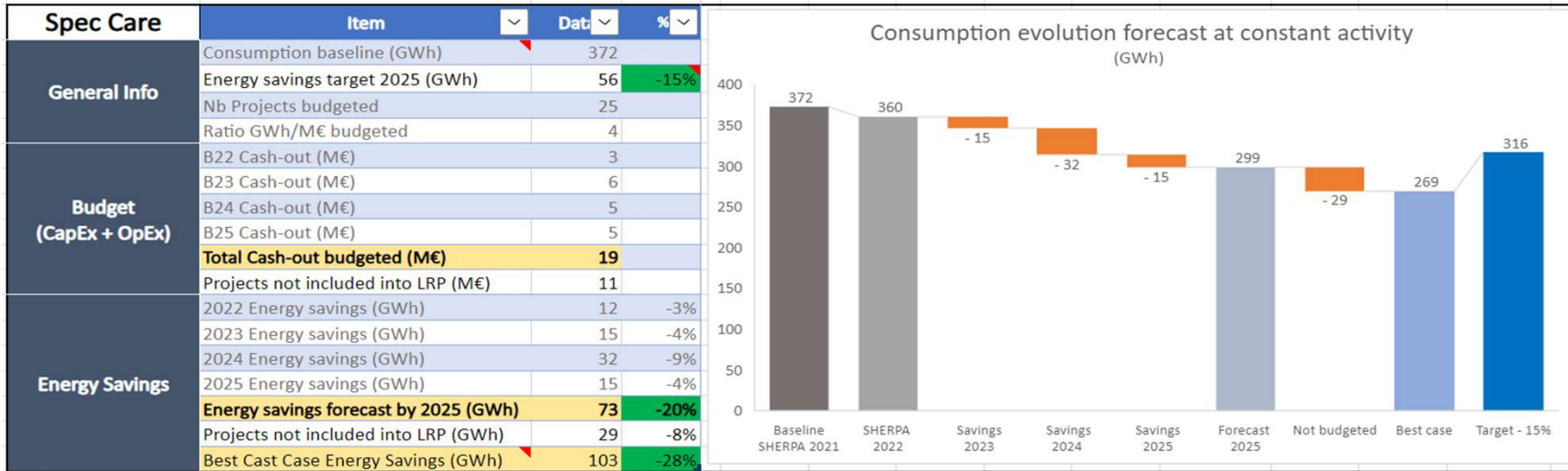
* 15.5 GWh Gas + Elect Projects Implemented in 2022

Target Carbon

What technologies will you use in your roadmap?

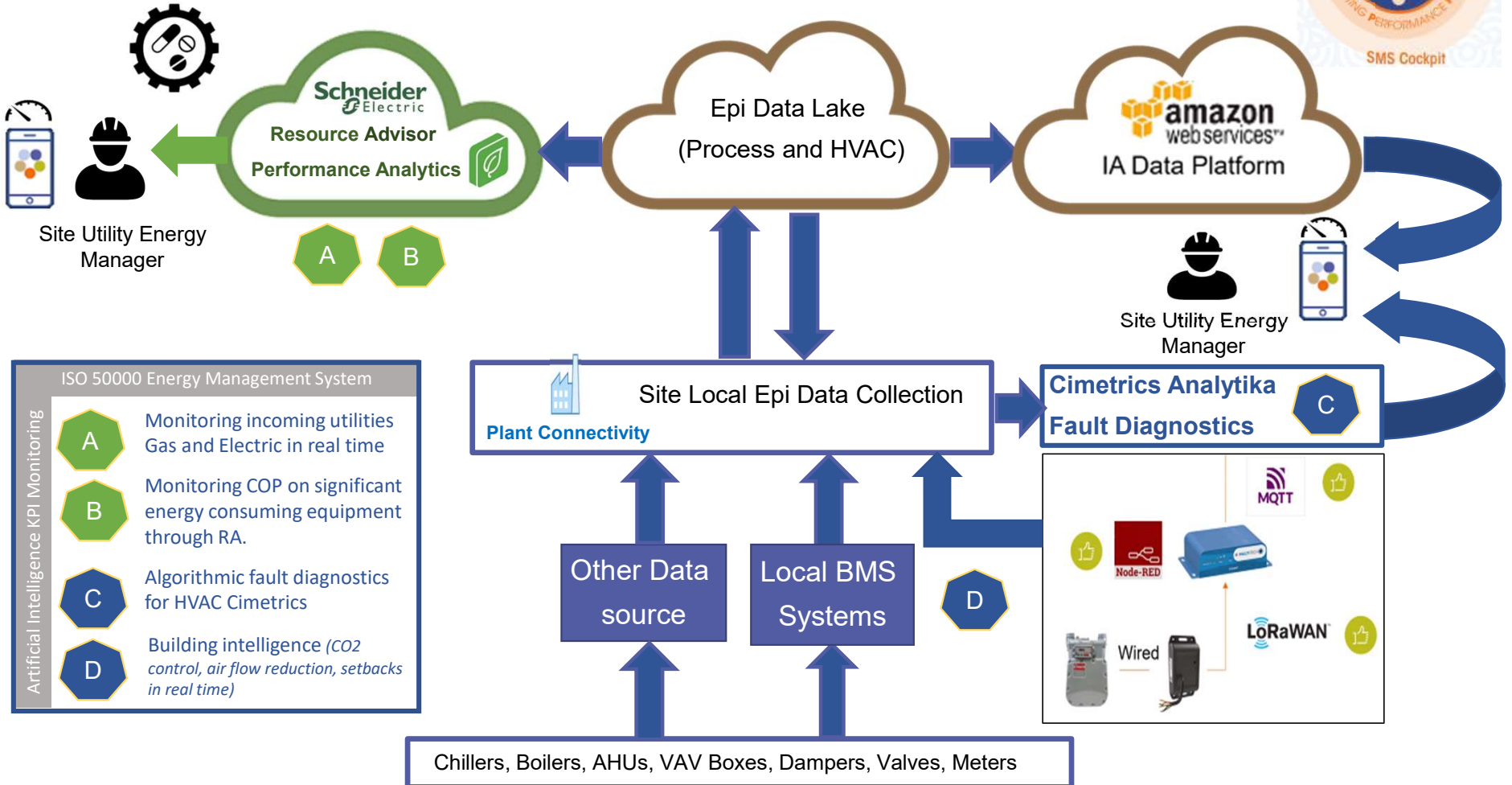


Energy Roadmap and Itemization Examples



Project General Information						Total Project Estimation				Implementation					
Site	Project Name	Project Count	Shine n°	EE25 Program	Actual Project Phase	Total CapEx (k€)	Total OpEx (k€)	Total Electricity savings (MWh/year)	Total Gas savings (MWh/year)	Included in Budget - LRP ?	Not included in Budget (k€)	B22 Cash-out (CapEx + OpEx) (k€)	B23 Cash-out (CapEx + OpEx) (k€)	B24 Cash-out (CapEx + OpEx) (k€)	B25 Cash-out (CapEx + OpEx) (k€)
						10296.55	661	26585	25148.8		4029.9	776.7	1098	2409	1622
Framingham	8NYA Install Electrocell precipitator for condenser water loop	1	P22131331	Chillers	Phase 6 - Commissioning	192.7	0	364	0	YES		192.7			
Framingham	68NYA Sapient plug load management	1	P21127408	Metering	Phase 5 - Construction	213	0	429	0	YES			223		
Framingham	70NYA Chiller plant optimization. Chilled water temp reset, etc.	1	P19115598	Chillers	Phase 5 - Construction	0	38	110	0	YES					38
Framingham	AHUs 45, 49, 74NYA Optimization	1	P21127408	HVAC	Phase 5 - Construction	91	182	759	358	YES			80	220	
Framingham	80NYA AHU-1 replacement and night and weekend setbacks. Part of renovation project	1	P19115584	HVAC	Phase 6 - Commissioning	180	0	140	4	YES		200			

Understanding the Value of Digitalization



Why ISO 50001 ?

NBN EN ISO 50001:2018

INTERNATIONAL
STANDARD

ISO
50001

Second edition
2018-08

**Energy management systems —
Requirements with guidance for use**

*Systèmes de management de l'énergie — Exigences et
recommandations pour la mise en œuvre*

The ISO50001 system ensures leadership is committed to reducing energy with a focus on the environment.

A successfully implemented system results in improved energy performance through the planning, supporting, and monitoring of key process indicators (KPIs).

The process helps assist in facilitating culture change (employee awareness) around responsible use of energy and energy management proficiency to avoid carbon taxes.



Using AI to Interface with the ISO50001 System

DEFINE QUALIFICATIONS

< 1GW/year	No specific energy management requirements
1 – 28 GW/year	Identify site Significant Energy Uses (SEUs)
>28 GW/year or sites with a certified energy management system	All energy management requirements

DEFINE BASELINE METHODOLOGY

The energy baseline normalization is done by a simple adjustment:

Formula:

$$Baseline_{year\ x} = Real_{year\ x} \left(a \left(\frac{Nb\ Hrs_{worked_{ref}}}{Nb\ Hrs_{worked_{real\ year\ x}}} \right) + b \left(\frac{HDD_{ref}}{HDD_{real\ year\ x}} \right) + c \left(\frac{CDD_{ref}}{CDD_{real\ year\ x}} \right) + d \right) - e$$

DEFINE BOUNDARIES

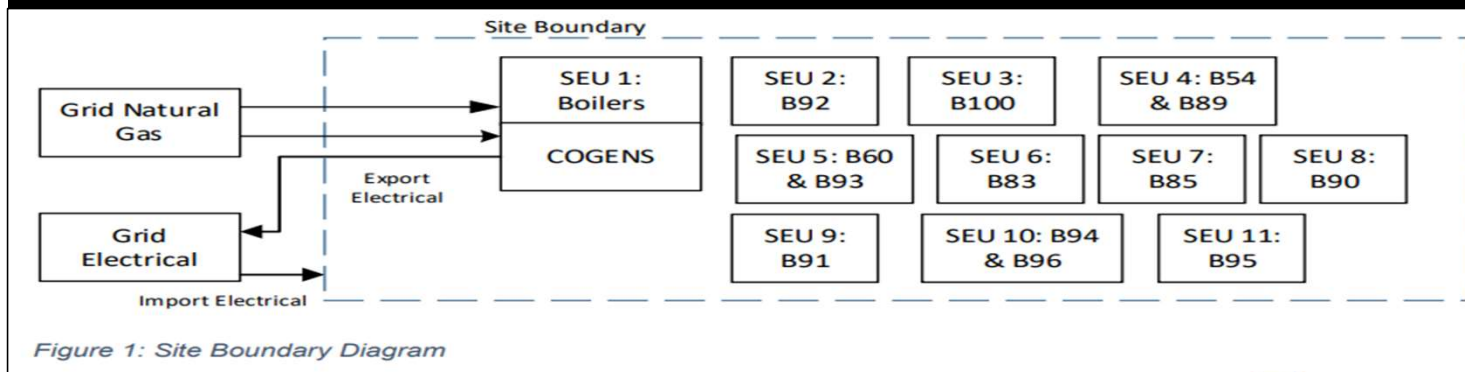
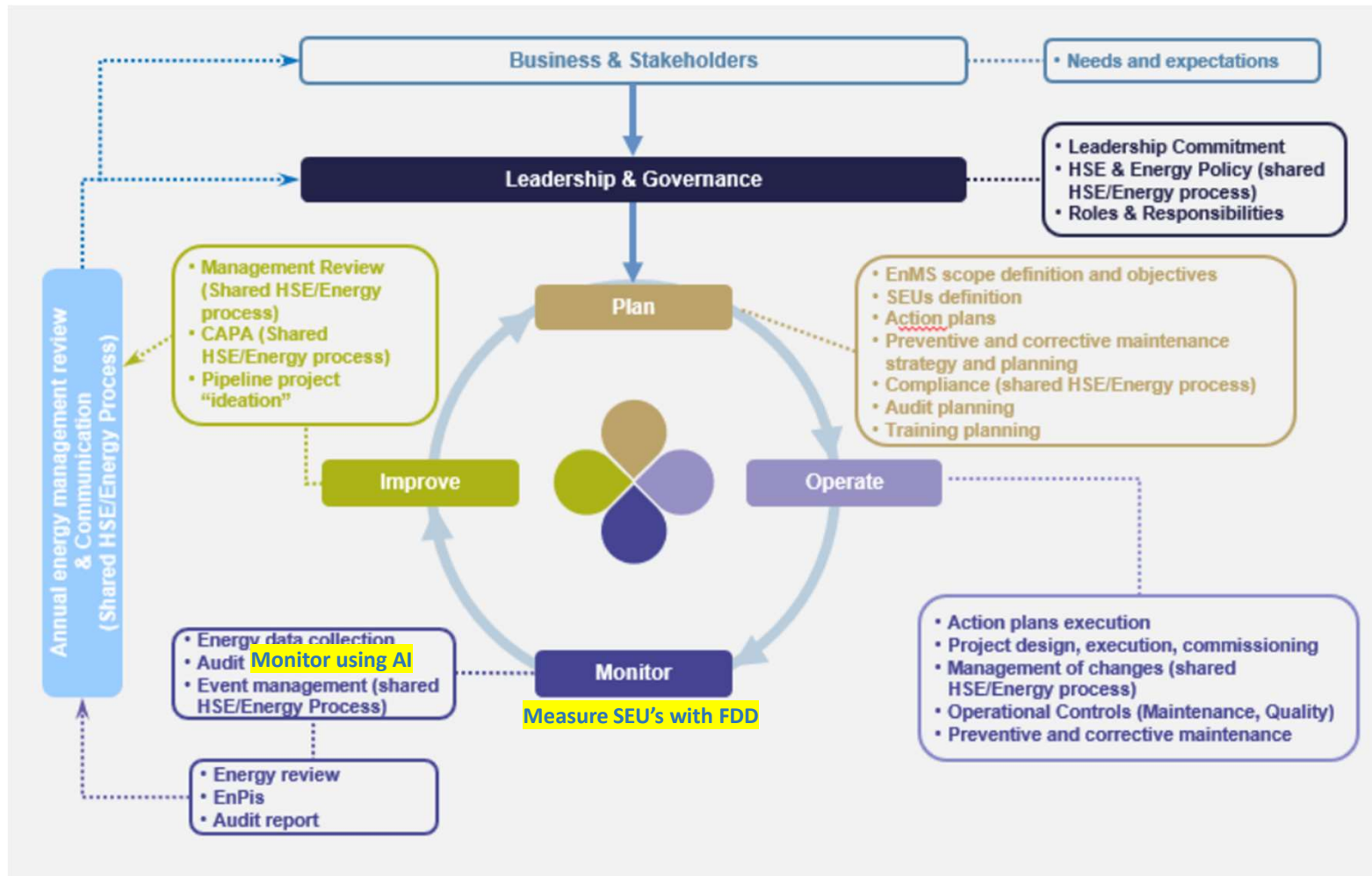


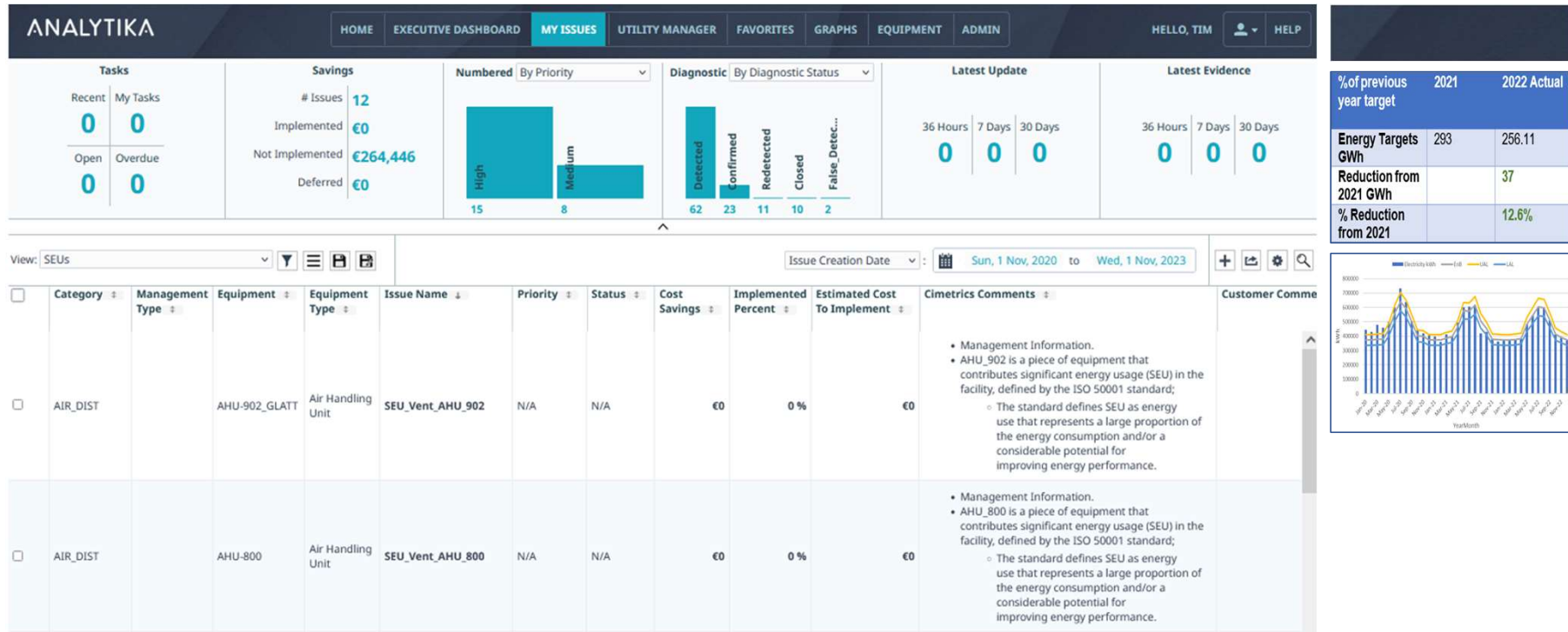
Figure 1: Site Boundary Diagram

Using AI to Interface with the ISO Systems

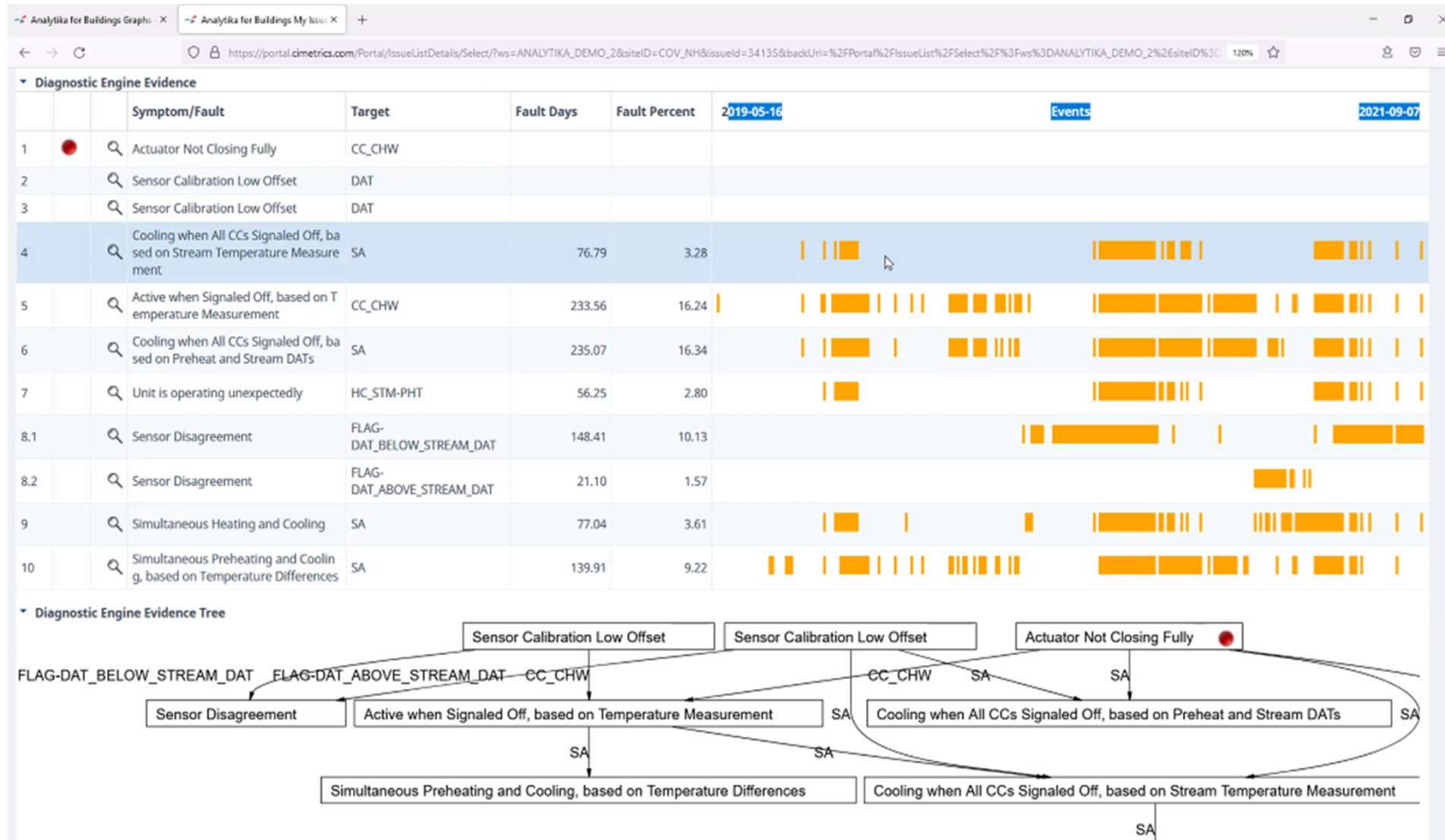


Using Analytika to create Energy Performance Reports

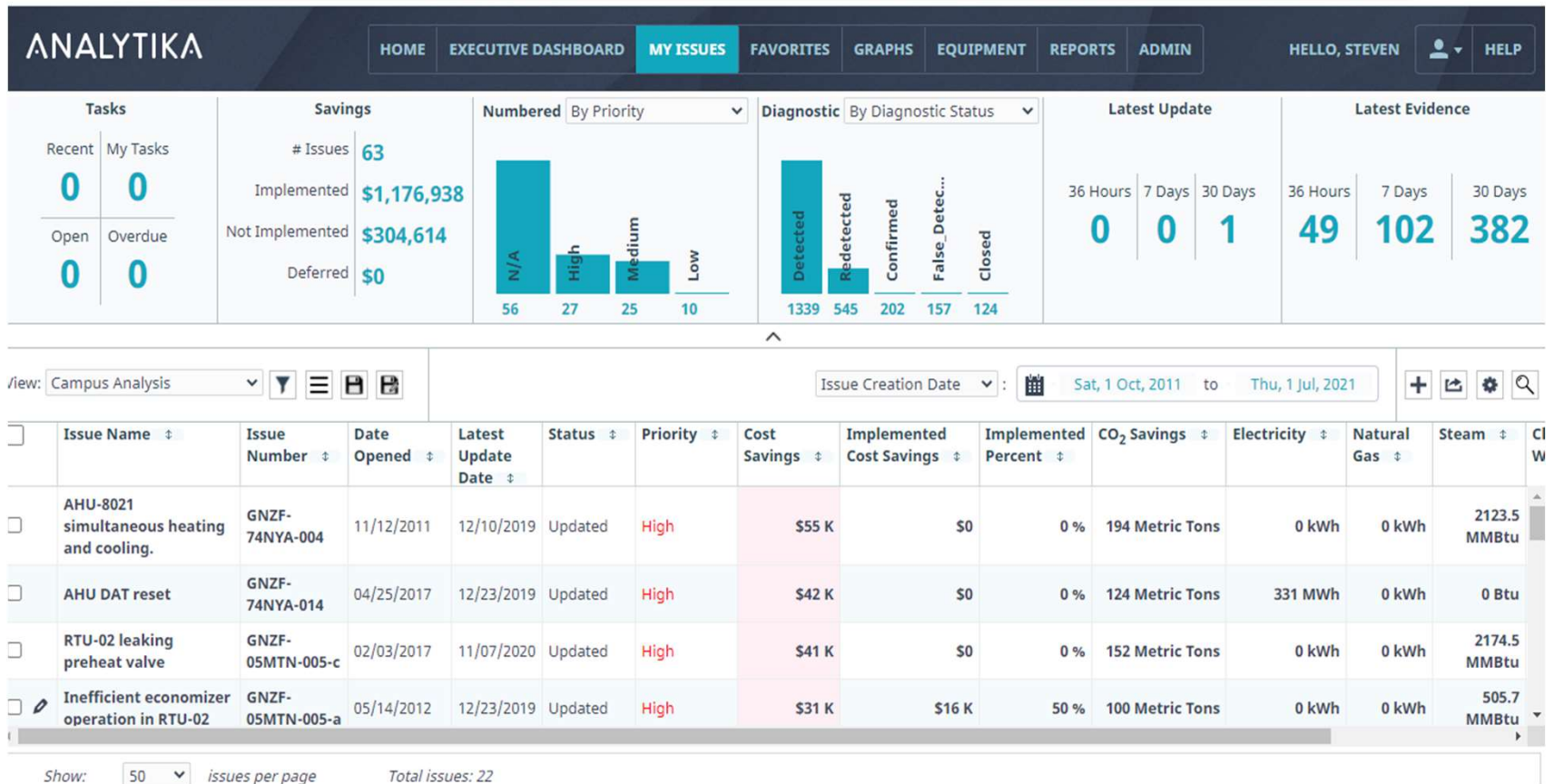
MEASURE KPIs and SEUs in REAL TIME ADDRESSING ANY DEVIATIONS



Using Analytika for Root Cause Analysis



Realized Savings Analytika



Technology Pilots



water stewardship

Our objectives

- Reduce our *global water withdrawals* by 15% by 2030
- Implement *water stewardship and water efficiency plans* for 100% of our manufacturing sites by 2030

Global Performance 2022

13% reduction of global water withdrawals since 2019

13% reduction of water withdrawals in scarcity areas

Sanofi was scored A- on the CDP Water Security questionnaire



New Technology Pilots

Open Cell Cooling Towers – 10%+ Chiller Savings, 20% Water Savings

What is an Electrocell?

An Electrocell is an electrostatic precipitator that removes contaminants from open condenser water systems down to 1 micron.

This low maintenance piece of equipment cleans water through electrolysis with the use of static mixers versus using traditional filtration devices. The media is re-usable.

The unit purifies the water so there is no longer build up of debris on the inside of chiller tubes increasing heat transfer through the changing of water properties.



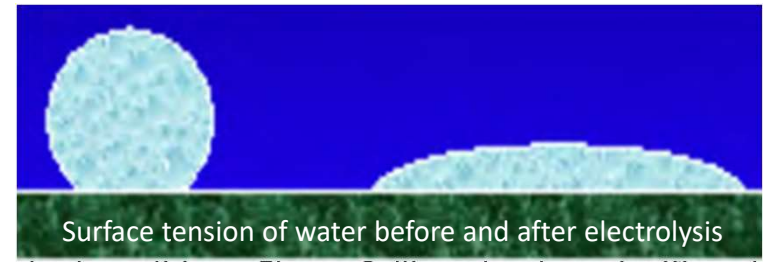
New Technology Pilots

How dose it work: The ElectroCell high-voltage patented DC electrode technology acts as a capacitor within a grounded metal vessel. The energy is dissipated in the form of a static field through a dielectric insulator. Its potential is to the grounded pipe surface. This static field acts as a mechanical dissolved solid separator, which in turn relaxes the water and reduces surface tension throughout the entire system. Heat transfer resistance factors in a typical system are as follows:

1. Biofilm (R_1)
2. Mineral surface deposit (scale) (R_2)
3. Suspended Solids (R_3)
4. Boundary layer (R_4)



Piping before and after treatment



Surface tension of water before and after electrolysis

The fourth resistance factor is seldom mentioned because it is constant under standard conditions. ElectroCell's technology significantly reduces the BL and surface tension of the condenser water (which is closely related to viscosity). Accordingly, we transition to turbulent flow at a reduced velocity as predicted by the Reynold's (Re) number formula.

$$Re = \rho v D / \mu = \text{fluid density} \times \text{fluid velocity} \times \text{pipe internal diameter} / \text{fluid dynamic viscosity}$$

Taken together, reduction in the four heat transfer resistance factors have its greatest affect in the tube bundle within the condenser heat exchanger. Significant reduction from the 4 heat transfer resistance factors increases overall heat transfer capability (heat flux) reducing system power per delivered ton as described below.

Decreased delta T across the temperature bundle (on the water side and refrigerant side)

- q = heat flow rate (W = J/s)
- A = area that the heat is flowing through (m^2)
- ΔT = temperature difference across layer ($^{\circ}C$)
- U = conductance of the layer (W/m^2K)

$Q = U * A * (T_2 - T_1)$ $U = 1/RT$ where $RT = R_{\text{copper tube}} + R_1 + R_2 + R_3 + R_4$, where $R_{\text{copper tube}}$ is constant. As R_1, R_2, R_3 and R_4 decrease, U increases, because Q is essentially constant that follows so T_2 must decrease, and ΔT must also decrease resulting in an average temperature decrease across the water side and refrigerant side of the condenser heat exchanger.

New Technology Pilots

Electrocell Installation, customized skid to fit narrow space



EC-6000 as installed in the 70 NYA chiller plant in Framingham Massachusetts



Magnetic rod removed for cleaning



Condenser water before start-up (looks clean)



Particles removed from condenser water in 1 week

Note: If installed on the closed loop side of the system, system will clean all piping and coils resulting in higher heat transfer.

Savings Summary from 3 Pilots

IMVP Validated Savings

International Measurement and Verification Protocol

Validated Annual Savings from 3 Electrocell Installations (8, 55, 70 NYA)

- Measured Electrocell Annual MWh Savings 2,038 MWh
- Site Energy Reduction Electricity 3.2%
- Annual Metric Tons Carbon Avoided 456 MTCO₂

Total Annual Savings Water and Electricity \$ 403,714

- 15 Year Equipment Net Present Value (at 4.5%) \$ 4,1m
- Opex/Capex Investment for Sanofi (3 Installs) \$ 715k
- Internal Rate of Return (15 Year) 80%
- Simple Payback on Investment 11 Months
- Gallons of water saved Annually 6.1m



Conclusion & Discussion



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About your Presenter



Steven Driver, Ph.D. has over 35 years of experience in engineering, project management, mechanical system design, commissioning, and energy auditing. Steve is an alumnus of Northcentral University where he earned his Ph.D. in Engineering and Technology (2010) with a concentration in building commissioning.

Steve is also an alumnus of Norwich University (2004) where he earned his MBA specializing in Engineering Administration and Northeastern University (1997) where he completed his graduate certificate in mechanical systems engineering.

Steve is a board-certified energy manager (CEM) and auditor (CEA). At this time, he has acquired three copyrights, two publications, and several U.S. patent associated with Sustainable Building Commissioning™ technology. Having completed numerous energy audits Internationally, Steve continues his mission to reduce carbon emissions and cost through the promotion of innovative technologies.