ACHIEVING ENERGY OPTIMISATION IN COMPRESSED AIR SYSTEMS WITH SMART MONITORING

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Presented By :
Hidhay.K

WHO WE ARE ?

An Indo-Danish Company

EUROPE REGIONAL OFFICE

SYSTEL TECHNOLOGIES EUROPE ApS
Pilestraede 58, 112 Copenhagen,
Denmark.
Ph : +45 36990422

ASIA REGIONAL OFFICE

SYSTEL BUSINESS CENTER
#12 Sri Venkatalakshmi Nagar,
Singanallur, Coimbatore - 641 005.
India Tel. +91 - 098431 28715

- **20 Years of Experience**
- **Over 1600 Compressed Air Projects**
- **Contributing to 50 Million MWH of Energy Savings**
- **ISO 11011**

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OUR CLIENTELE

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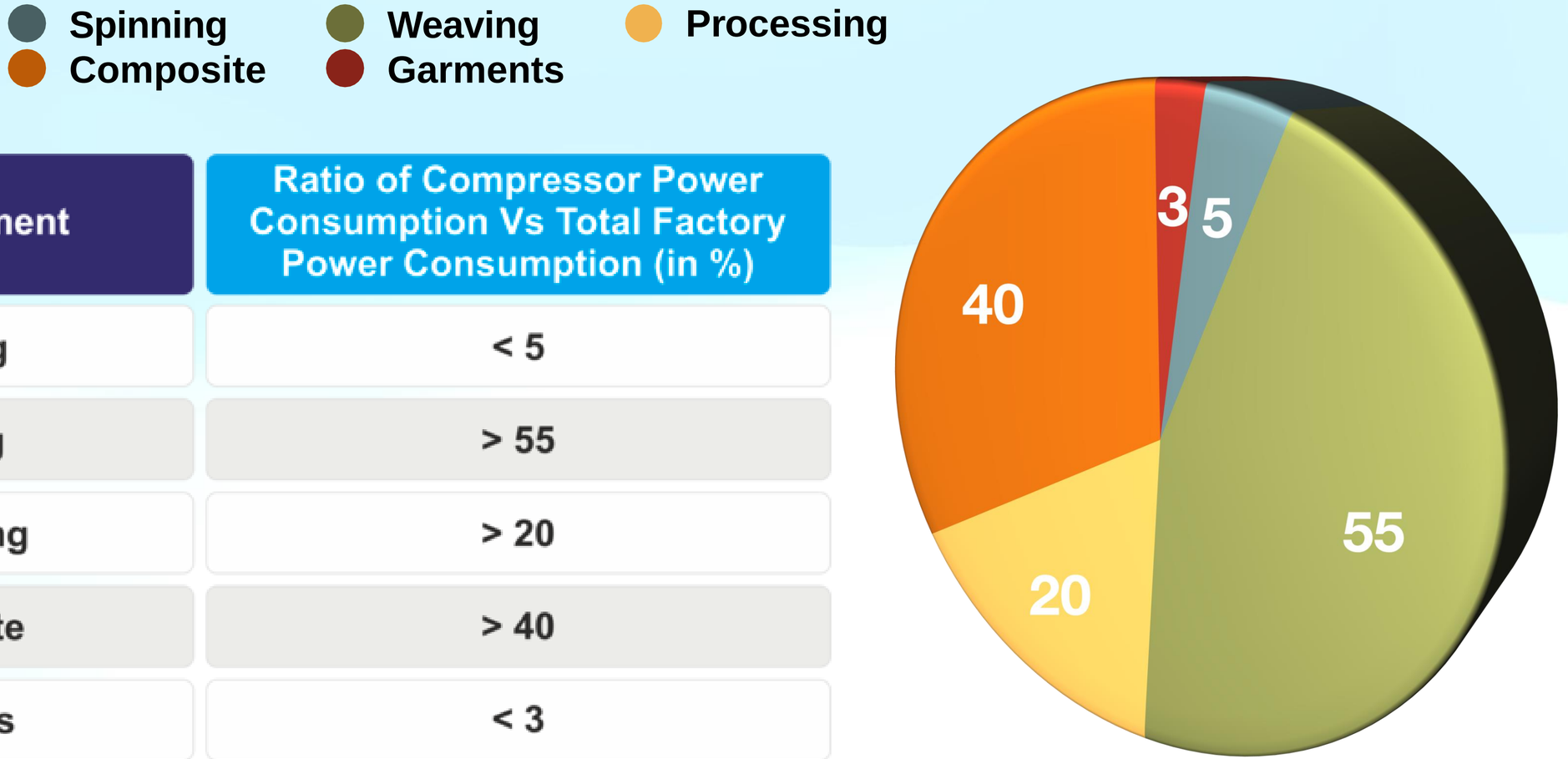
KEY TAKE AWAYS

- Overview of Textile Compressed Air Systems
- Understanding Compressed Air System Dynamics
- Importance of Digital Eco System
- How to Digitalize Your Compressed Air System
- Benefits to PAT Designated Factories

SECTION 1. OVERVIEW OF COMPRESSED AIR SYSTEMS IN TEXTILE INDUSTRIES

RATIO OF COMPRESSOR POWER CONSUMPTION VS TOTAL FACTORY POWER CONSUMPTION

Textile Segment	Ratio of Compressor Power Consumption Vs Total Factory Power Consumption (in %)
Spinning	< 5
Weaving	> 55
Processing	> 20
Composite	> 40
Garments	< 3



In %

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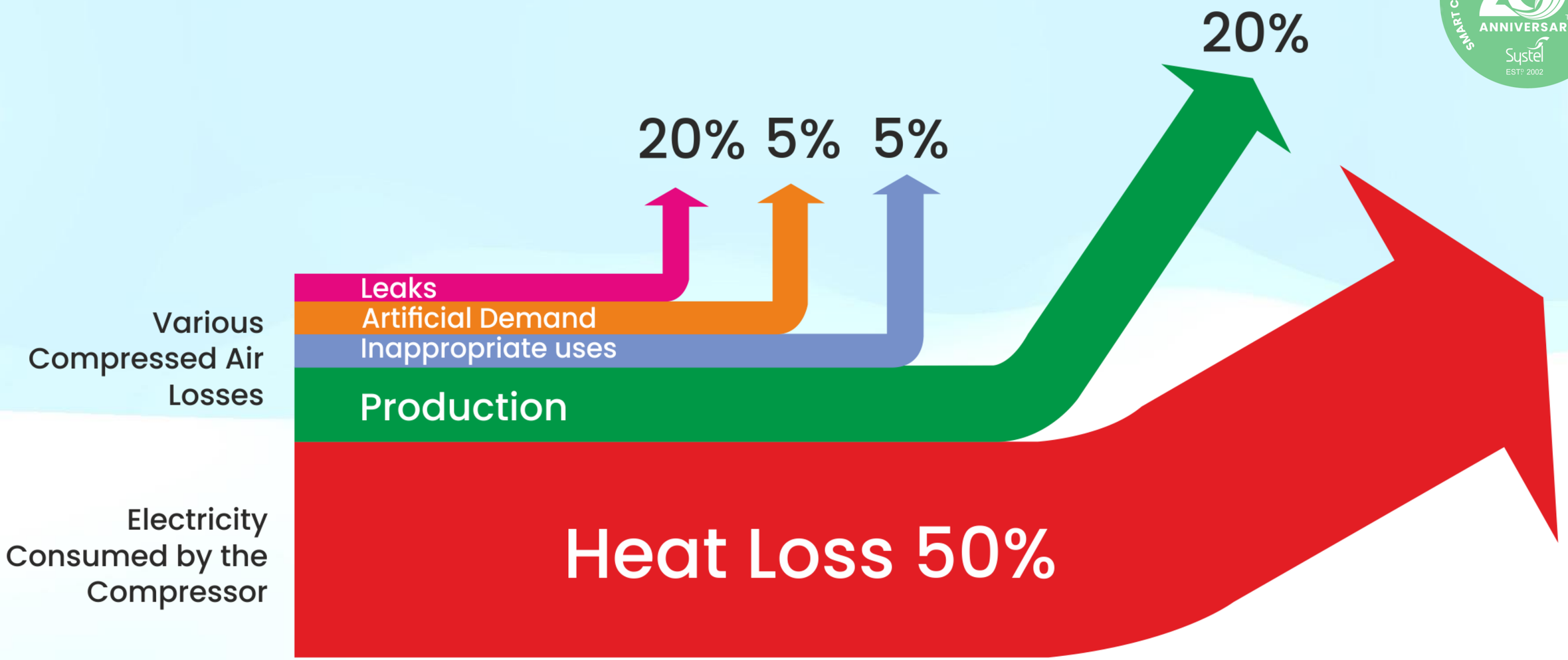
DISTRIBUTION OF COMPRESSOR INPUT ENERGY



AIR COMPRESSOR'S IMPACT ON SUSTAINABILITY

ANNUAL IMPACT OF A 100 KW SCREW COMPRESSOR*

- **870 MWH of Energy Consumption**
- **Rs 6.96 Million in Energy Costs**
- **7,00,000 Litres of Cooling Water Required Annually**
- **682 Tons of Annual Green House Gas Emissions**
- **1,30,000 Litres of Condensate Produced Annually**
- **3,40,000 Btu/hr of Thermal Energy**

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COMMON ENERGY WASTING HOTSPOTS

Can Waste Upto 20 % Energy

- High Specific Energy per CFM Produced
- Improper Modulation
- High Operating Pressure Set Points

Can Waste Upto 5 % Energy

- High Pressure Drop
- High Pressure Dew Point
- Excessive Air Wastage During Condensate Removal

Air Filters

Can Waste Upto 2 % Energy

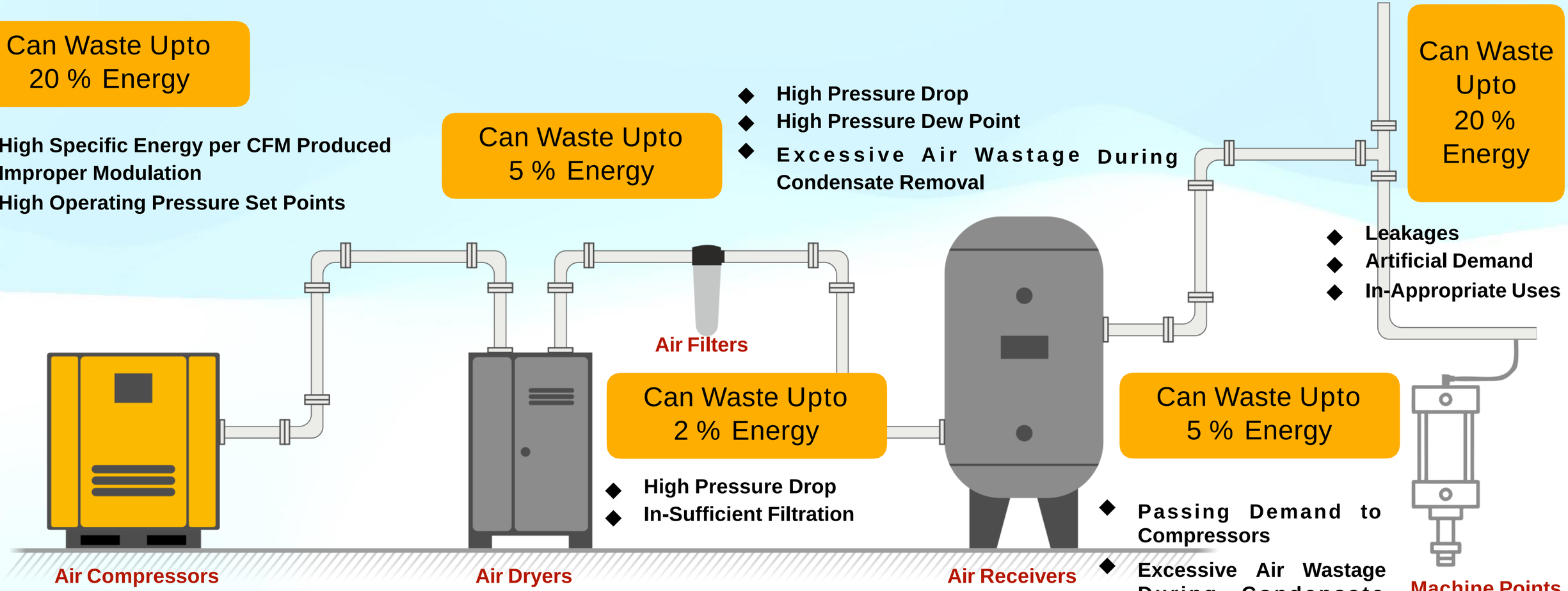
- High Pressure Drop
- In-Sufficient Filtration

Can Waste Upto 5 % Energy

- Passing Demand to Compressors
- Excessive Air Wastage During Condensate Removal

Can Waste Upto 20 % Energy

- Leakages
- Artificial Demand
- In-Appropriate Uses



Air Compressors

Air Dryers

Air Receivers

Machine Points

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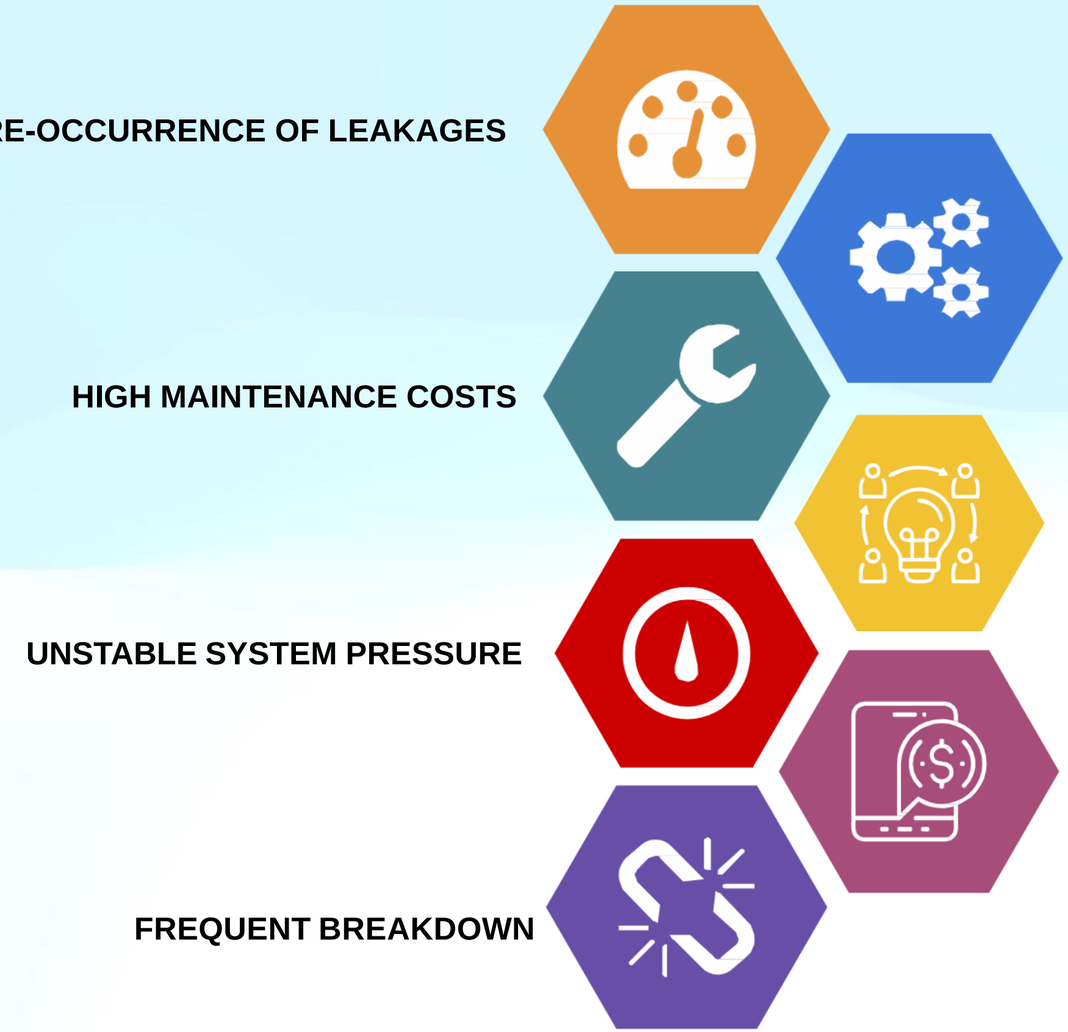
PAIN POINTS IN OPERATING A COMPRESSED AIR SYSTEM



RE-OCCURRENCE OF LEAKAGES

PRODUCTION INTERRUPTIONS

HIGH MAINTENANCE COSTS

HIGHER ENERGY COSTS

UNSTABLE SYSTEM PRESSURE

HIGHER COST OF OWNERSHIP

FREQUENT BREAKDOWN

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SECTION 2. UNDERSTANDING COMPRESSED AIR SYSTEM DYNAMICS

UNDERSTANDING AIR COMPRESSOR EFFICIENCY

- **ACFM Refers to Compressor Capacity Calculated Back to Factory Conditions**

Real Air Delivery Calculation		
Compressor Specification:		
Rated FAD	1000	CFM
Designed Temperature	20	C
Designed Operating Pressure	1000	mbar
Application Data:		
Inlet Temperature	35.00	
Ambient Humidity	50	%
Altitude	300	
Real Air Delivery	**903.45**	SCFM

Real Air Delivery may be upto 15 % Lower than the Rated Capacity

UNDERSTANDING AIR COMPRESSOR EFFICIENCY

- **You Compressors May be Far Less Efficient than you think**

Isentropic Efficiency

WHAT IS ISENTROPIC EFFICIENCY?

$$\frac{\text{ENERGY (KW) FOR IDEAL COMPRESSION PROCESS}}{\text{ACTUAL ENERGY (KW) CONSUMED}} = \%$$

REAL WORLD

- FRICTION LOSSES
- ELECTRICAL LOSSES
- INERTIAL LOSSES
- PRESSURE DROP
- MASS-FLOW LOSSES

Isentropic Efficiency as a function of Specific Power at Discharge Pressure

CALCULATING ISENTROPIC EFFICIENCY FROM SPECIFIC POWER

$$\eta_{isen} = \frac{16.52 \times \left(\left(\frac{p_2 + 14.5}{14.5} \right)^{0.2857} - 1 \right)}{P_{spec}}$$

p_2: DISCHARGE OPERATING PRESSURE IN PSIG

P_{spec}: SPECIFIC POWER

η IS FOR EFFICIENCY "ISEN" IS AN ABBREVIATION FOR ISENTROPIC

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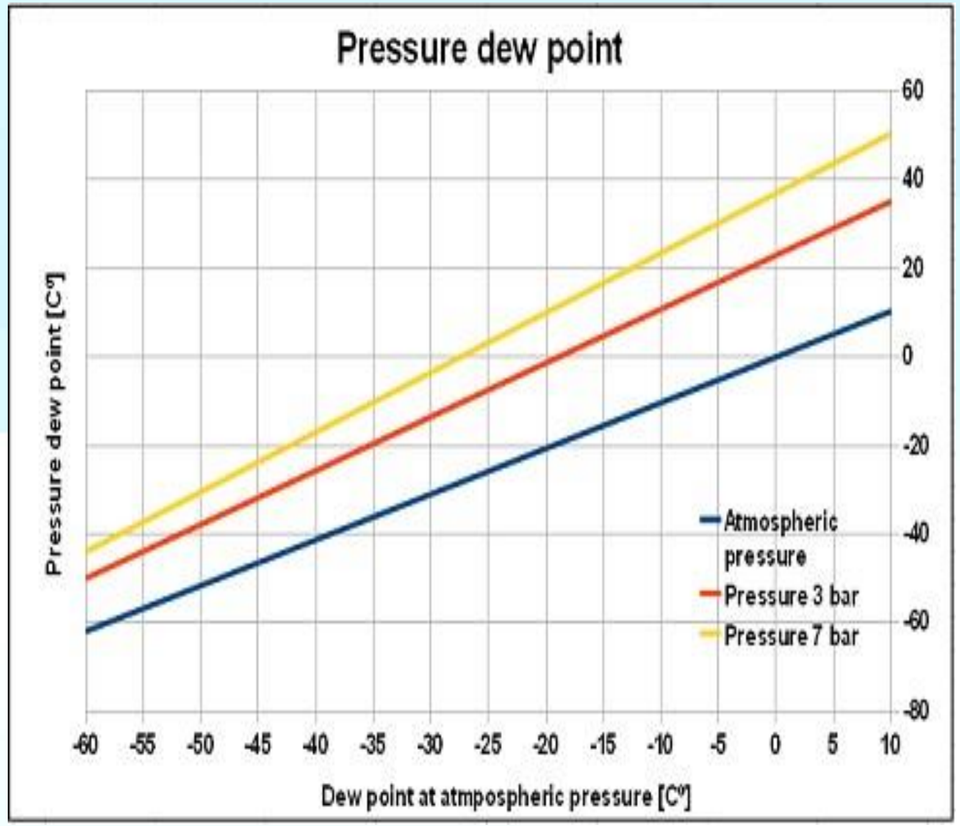
UNDERSTANDING AIR COMPRESSOR EFFICIENCY

Example of Specific Power and Isentropic Efficiency Comparison

Compressor	Drive Motor Nameplate Rating	Maximum Full Flow Operating Pressure	Full Load Operating Pressure	Rated Capacity at Full Load Operating Pressure	Input kW @ Rated Flow and PSIG	Specific Power kW/100 cfm	Isentropic Efficiency %
A	100 hp	125	115	455	89.4	19.6	73.3
B	100 hp	125	125	482	88.2	18.3	82
C	100 hp	125	115	494	89.9	18.2	78.9
D	100 hp	125	125	444	87.7	19.8	75.8

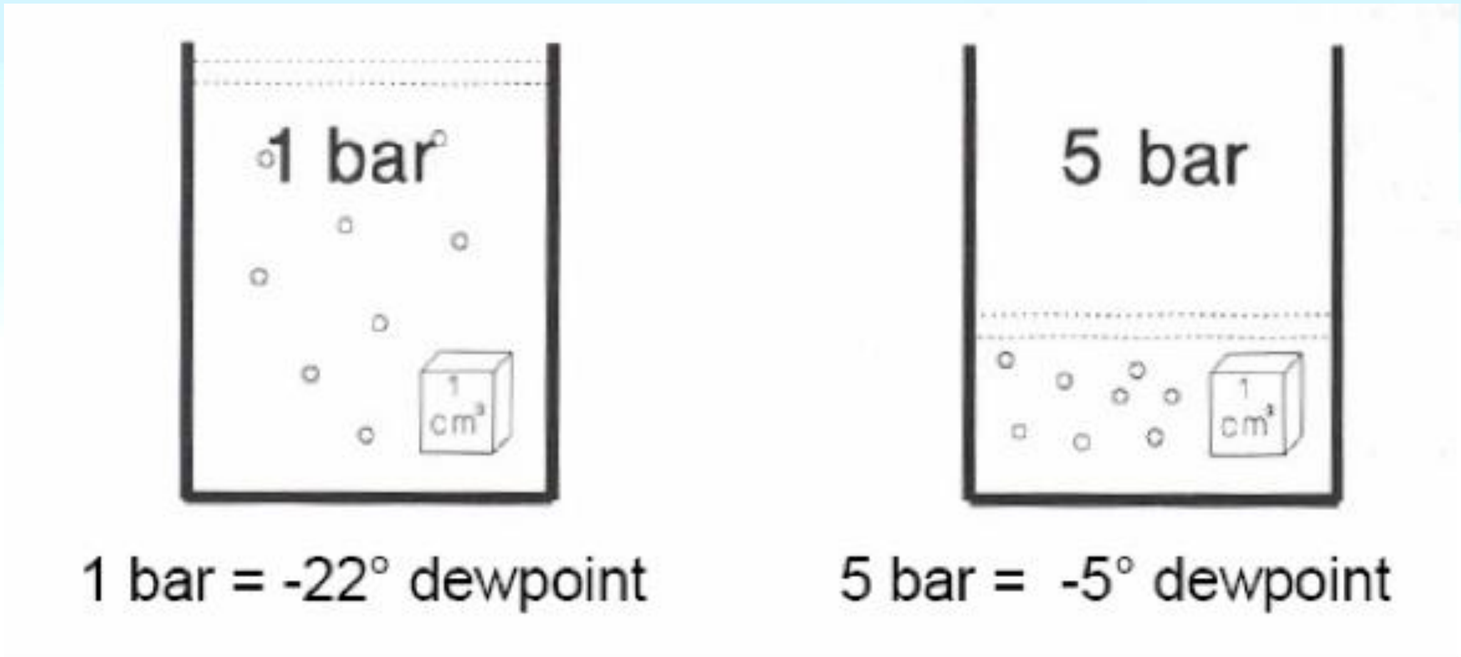
UNDERSTANDING AIR DRYER EFFICIENCY



Dew Point Is Simply the Temperature to Which Air Must Be Cooled for the Water Vapour Within To Condense Into Dew or Frost.

The Term Pressure Dew Point Is Encountered When Measuring the Dew Point Temperature of Gases at Pressures Higher Than Atmospheric Pressure.

UNDERSTANDING AIR DRYER EFFICIENCY



BENEFITS OF PRESSURE DEW POINT MONITORING

- Reduces Operating and Energy Costs.
- Improves Downstream Filter Life and Performance.
- Increase the Lifespan of Your Compressed Air System and its Components.
- Reduces Maintenance and Makes the Compressed Air System More Reliable and Efficient.
- Ensures Stable Quality of Your Products Through Less Problems in Operation of the System.
- Enables Fast Responses to Failures in Compressed Air Drying Through Permanent Monitoring of Pressure Dew Point.
- Reduces Risk of Bacteria, Fungus, and Yeast Built Up.
- Alerts You to Changes in Dryer Performance Before Moisture Appears in Your Plant.

UNDERSTANDING PIPING EFFICIENCY

Pressure Drop Due to Friction (in psi in 1,000 ft of pipe, 100 psig initial pressure)[1]								
Cubic Feet Free Air / Min	Equivalent Cubit Feet Compressed Air / Min	Pipe Diameter (inches)						
		1	2	3	4	6	8	10
10	1.28	0.28						
50	6.41	9.96	0.19					
100	12.82	27.9	0.77					
250	32.04		0.43	0.11				
500	64.28		19.2	8.34	2.55			
750	96.13		43.3	5.23	1.24			
1000	128.2		76.9	9.3	2.21			
1500	192.2			21.0	4.9	0.56		
2000	256.3			37.4	8.8	0.99		
2500	316.4				13.8	1.57	0.37	
3000	384.6				20	2.26	0.53	
4000	512.4				35.5	4.01	0.94	0.28
5000	632.8				55.6	6.3	1.47	0.44

[1]Pressure Drop is directly proportional to length of pipe and inversely proportional to the initial absolute pressure.

Velocity < 30 Ft / Sec

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SECTION 3. IMPORTANCE OF DIGITAL ECO SYSTEM

BENEFITS OF A DIGITAL ECO SYSTEM

- Keeps the Users Informed About System Dynamics
- Identifies Changes in System Performance
- Tracks Peak and Average Demand
- Alerts Users During Increased Leakage or Consumption
- Reduces System Maintenance and Hence Lowers Labour Costs
- Improves Compressed Air System Efficiency
- Saves Energy and Costs

COMPRESSED AIR FLOW MONITORING

- **FAULTY INTAKE VALVES REDUCE OUTLET FLOW WHILE CONSUMING SIMILAR POWER**

COMPRESSED AIR FLOW MONITORING

- **ORIFICE PLATE FLOW SENSORS INDUCE PRESSURE DROP AND WASTE ENERGY**

ILLUSTRATION FOR POWER SAVING BY AVOIDING PRESSURE DROP

Compressor Model & Reference	Rated Pressure		Rated Shaft Power at Rated Pressure in Kw	Discharge and Inlet Pressure at Oriface Flow Meter		Shaft Power at Discharge Pressure in Kw	Outlet Pressure at Oriface Flow Meter		Pressure Drop		Every 1 PSI increase in pressure will increase 0.5% Power	Power Saving Potential for 0.20 pressure drop in kw/hr (1292 - (1292-(2.76/2)%)	Power Saving Potential for 0.20 pressure drop per day	Cost per unit in Rs	Cost of Saving per day in Rs	Cost of Saving per Month in Rs	Cost of Saving per Year in Rs
	Kg/cm2	PSI		Bar	PSI		Bar	PSI	Bar	PSI							
HT Centac 1	7	99.53	1298	6.80	98.6	1292	6.6	95.84	0.20	2.76		18	432	4.15	1792.8	53784	645408
HT Centac 2	7	99.53	1298	6.97	101.1	1308	6.77	98.165	0.2	2.90		18	432	4.15	1792.8	53784	645408
Total												36	864		3585.6	107568	1290816

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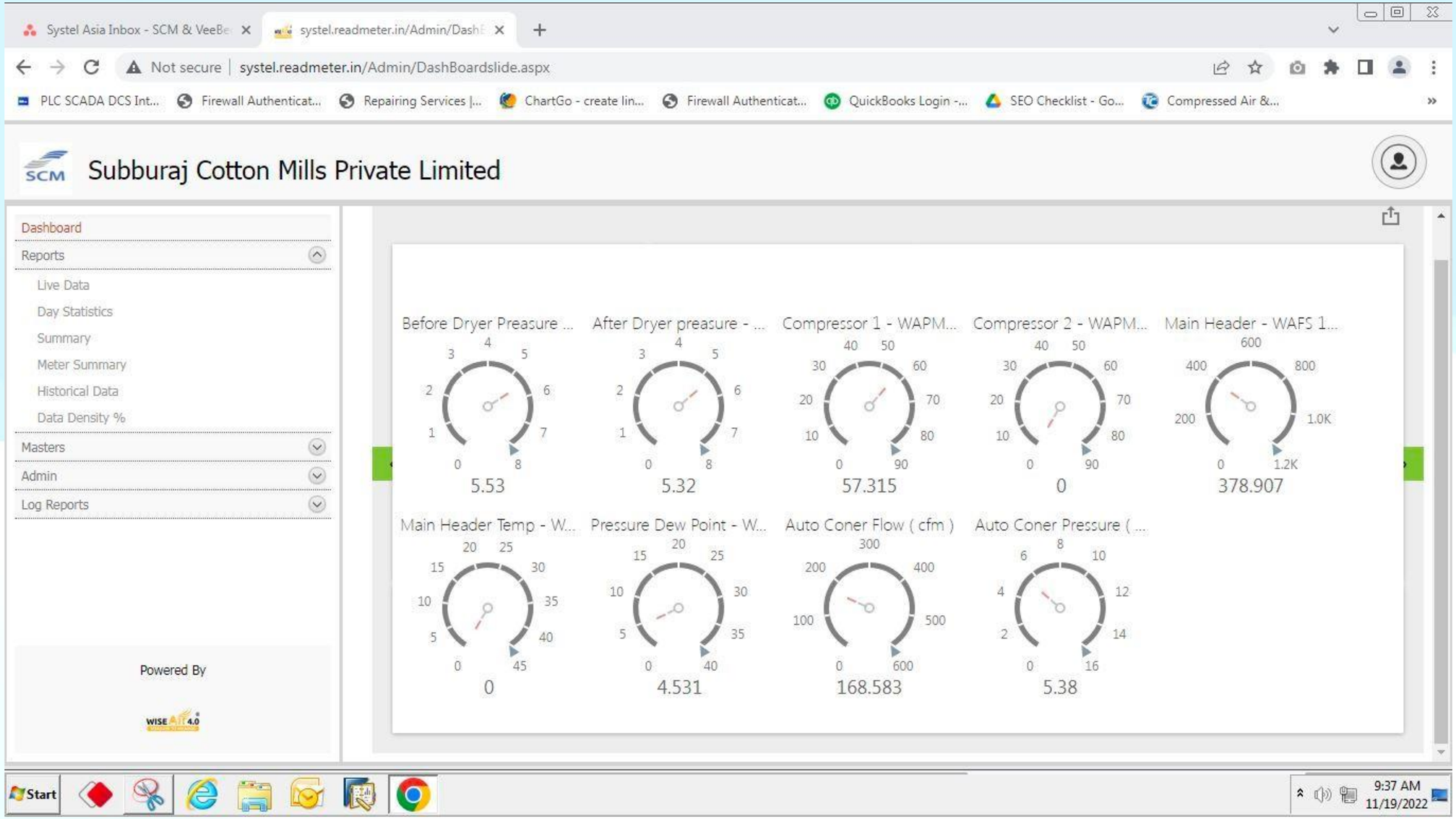
COMPRESSED AIR FLOW MONITORING



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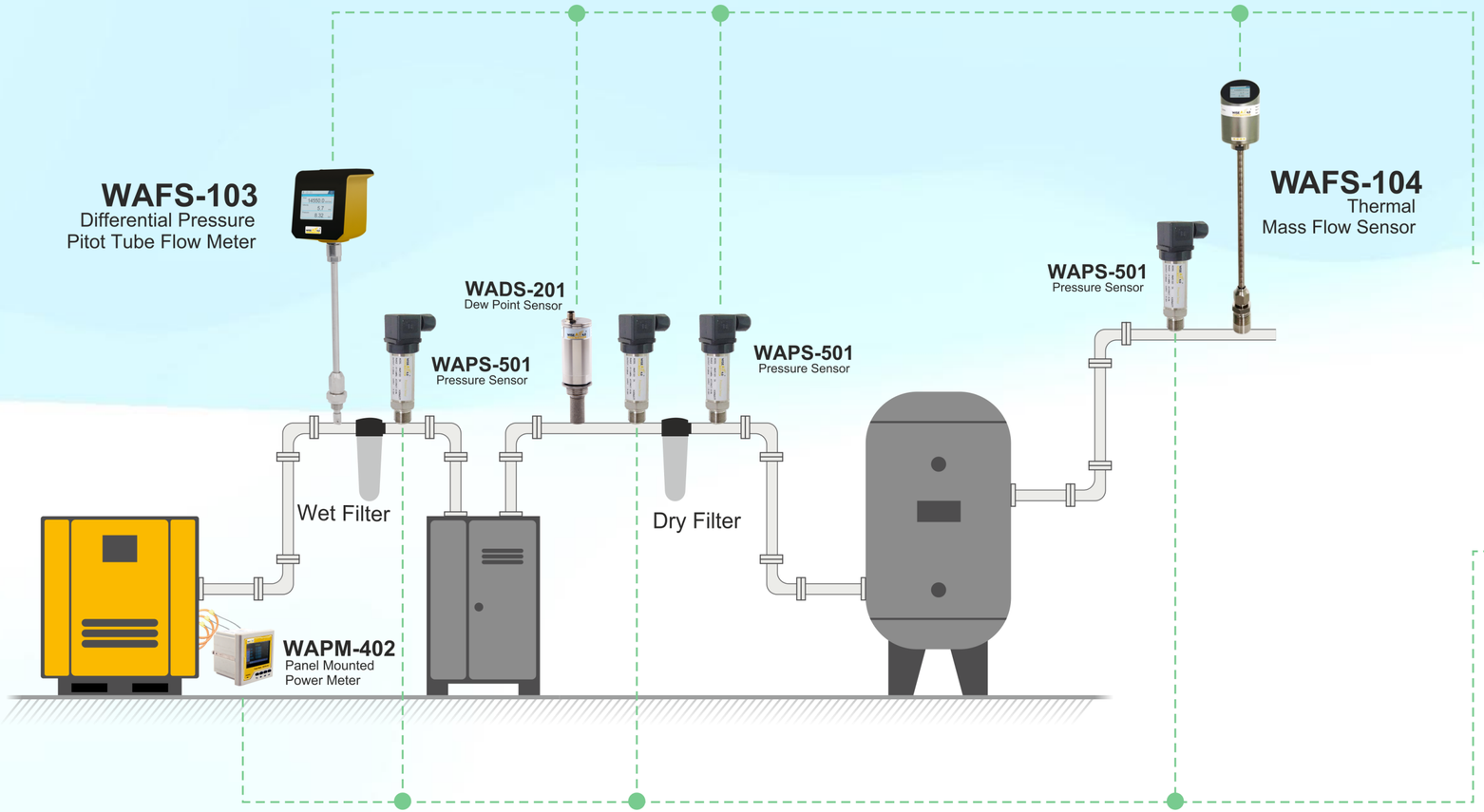
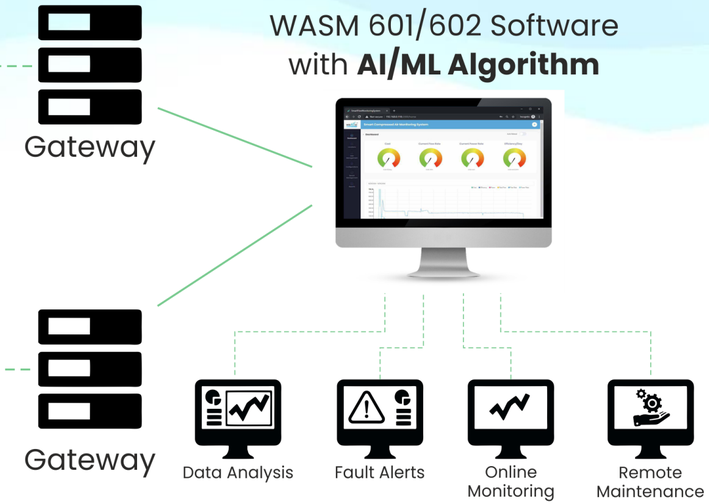
WHY IT MAKES SENSE TO CREATE A DIGITAL ECO SYSTEM

- **Reduced Downtime - Both Planned & Unplanned**
- **Predictive Maintenance Can Reduce Costs by upto 12 % Versus Scheduled Repairs**
- **Improved Overall Equipment Efficiency and Productivity**
- **Quantifiable Reduction in Compressed Air Energy Spend**
- **Real Time Monitoring Can highlight the Loss Sources**
- **Alerts Maintenance Staff of Machines Exhibiting Problems**

SECTION 4. HOW TO DIGITALIZE YOUR COMPRESSED AIR SYSTEM

SYSTEL’s SMART COMPRESSED AIR MONITORING SYSTEM





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SYSTEL’s SMART COMPRESSED AIR MONITORING SYSTEM

Features	Systel's Smart Monitoring Products	Nearest Competition
Field Accuracy	< 1%	> 7%
Air Balance	99%	< 70%s
IIoT	Full Compatibility	Partial or No Compatibility
Turn Down Ratio	3000 : 1	500 : 1
Repeatability	Outstanding	Average
Interoperability	Complete / Full	Limited / Partial
Data Complexity	Actionable Intelligence	Raw Data
Integration	Easy & Simple	Complex

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OUR SYSTEMATIC APPROACH

We'll work with you to uncover the pain points, and more crucially the quick wins that are hiding in your Compressed Air System

GAP ANALYSIS

CORRECTIVE ACTIONS

REMOTE MONITORING

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WHY THOUSANDS OF INDUSTRIES TRUST US ?

Zero Down Time

From Project kick-off to Sign-off

Scalability

Grow & Evolve Your Compressed Air System Digitalization at your own pace

Faster Return on Investments

Usually Payback less than 9 Months

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SECTION 5. BENEFITS TO PAT DESIGNATED FACTORIES

ACHIEVE YOUR PAT GOALS

- **Establish BEE Acceptable Standards of Compressed Air Baselining**
- **Achieve Energy Savings of Upto 30 %**
- **Reduce Upto 20 % of Your Green House Emissions ***
- **Be A Front Runner and Set Benchmark for Your Industry Peers**
- **Generate Revenues Through Carbon Trade Certificates**