6 | February| 2014

Equipment Dashboards Improve Energy Use

What will you learn today?

- Why did GMCR chose to go down this road?
- How did it happen?
- What is the potential to save through these improvements?
- What are the results thus far?

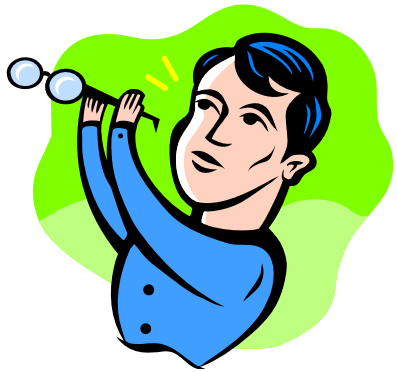
Energy Efficiency Toolbox

- Policy
  - Legislation
- Economic
  - Incentives and Rebates
- Technological
  - Building Design and Equipment Choice
- Behavior Science

Influencing energy use

- How do we affect actions?
- How do we motivate?
- How do we make it easy?

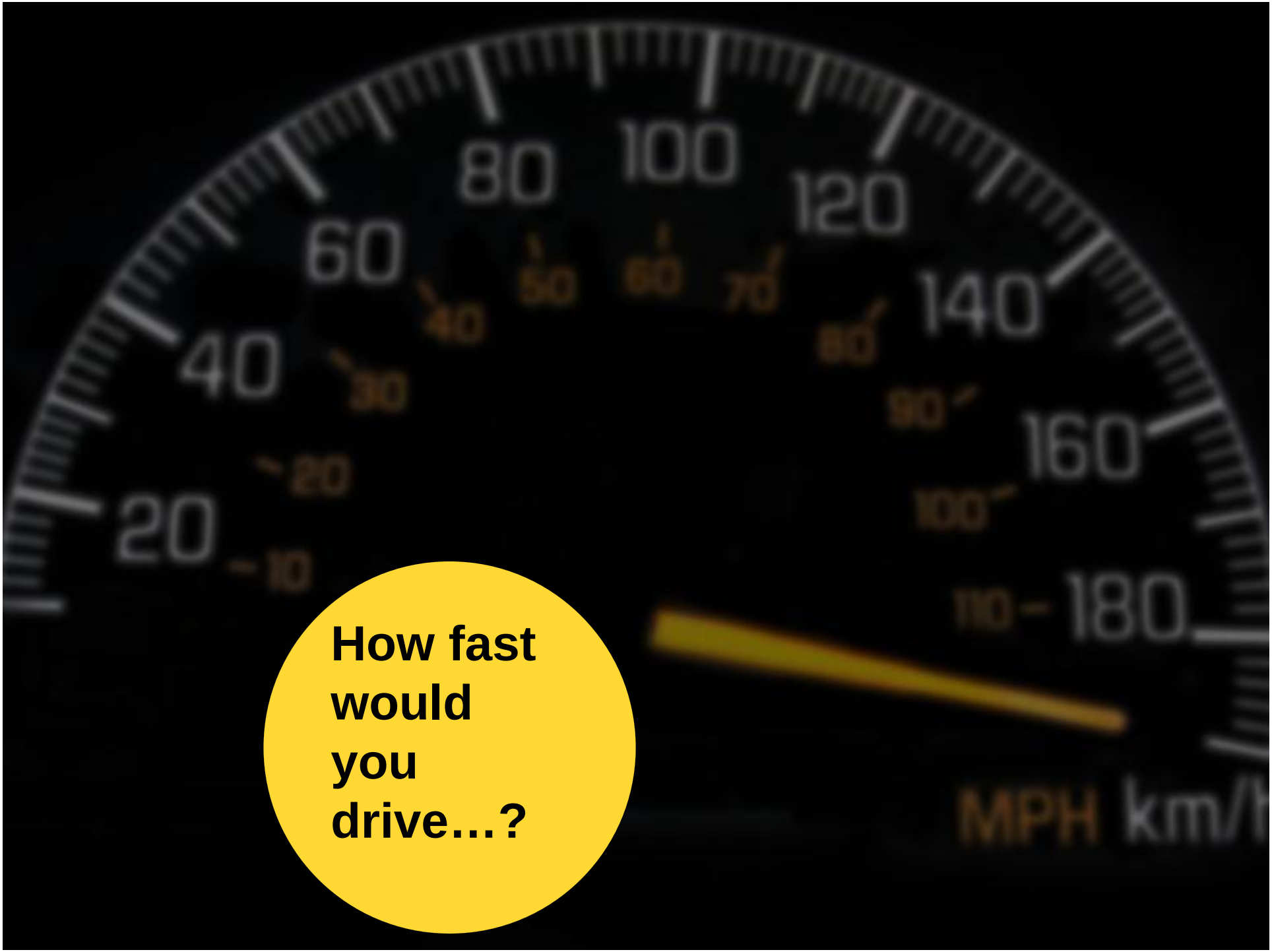
How do we make energy VISIBLE?



And…….

Engage Employees

to improve energy use.


How fast would you drive…?

Team Approach

- Nick Stevenson – Green Mountain Coffee Roasters (GMCR)
- Josh Dalmer – Temperature Controls of Vermont (TCV)
- Greg Baker – Efficiency Vermont
- GMCR Engineering and Controls Teams
- GMCR Manufacturing Teams

Who is Green Mountain Coffee Roasters?

UNIQUE BEVERAGE & APPLIANCE MODEL

HOLISTIC SYSTEM DESIGN & EXECUTION

THRIVING BRANDS WITH AN OPEN ARCHITECTURE

TALENT / VALUES / CULTURE

MUTUALLY BENEFICIAL PARTNERSHIP CAPABILITY

GMCR - Manufacturing

- Castroville, California
- Essex, Vermont
- Knoxville, Tennessee
- Sumner, Washington
- Waterbury, Vermont
- Williston, Vermont
- Windsor, Virginia
- Montreal, Canada

GMCR Environmental Policy

Green Mountain Coffee Roasters, Inc. Environmental Policy

Green Mountain Coffee Roasters, Inc. (GMCR), a premier processor and distributor of coffee and associated products, is implementing this Environmental Policy in order to protect and preserve human health and the environment from potential impacts of our activities, products, and services.

GMCR is committed to actions consistent with an environmental conscience in our business operations.

- We strive to consider the environmental impact of our actions.
- We foster a spirit of continuous environmental improvement in our products, practices and programs.
- We engage employees to promote their environmental awareness.

Accordingly, GMCR is committed to:

- Using this environmental policy as a framework for setting and reviewing environmental objectives and targets.
- Continually improving our environmental management system as a framework to meet objectives and targets.
- Meeting the requirements of applicable federal, state, and local environmental regulations; and to other requirements to which we subscribe.
- Preventing and reducing pollution; and reducing the environmental impacts of our energy use and waste generation.
- Understanding the environmental impacts of our manufacturing processes and working to use sustainable resources.
- Evaluating the views of interested parties.

Updated August 2012

Historical Approach for Energy Reduction at Manufacturing Sites

http://www.gmcr.com/Sustainability/SustainableProducts/Operations/Energy.aspx

Fiscal 2012 Facility Energy Efficiency Performance Relative to Targets[1]	Fiscal 2012 Target	Fiscal 2012 Actual
Vermont, multiple locations	0%	7%
Knoxville, Tenn.	-3%	0%
Sumner, Wash.	0%	5%
Castroville, Calif.	-5%	0%

[1] All targets are relative to fiscal 2011 measurements and results are calculated as the percentage difference in the normalized energy metric (therms/$1,000 of net sales, including affiliate sales).

Energy Efficiency Initiatives

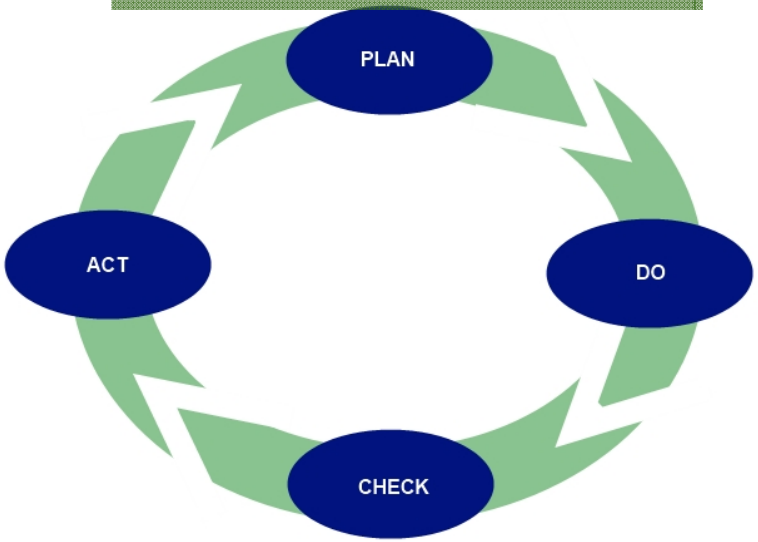
To drive ongoing energy efficiency improvements, we set targets for all but the newest of our manufacturing facilities by forecasting the expected number of sales dollars to be produced per facility and developing a corresponding target for energy use (the goal for new facilities is to develop a baseline of energy use). During fiscal 2012, three of the four facilities over-performed relative to their targets for more efficient energy use — two of them for the second year in a row — thus reducing costs and using less energy per sales dollar generated compared to the previous year. The Castroville, Calif., facility saw an increase in energy use over the targeted amount.

History of GMCR Energy Reduction

- Energy Metric = $\frac{\text{Total Energy Consumed}}{\text{Allocated Sales Dollar per Site}}$
  - Numerator
    - All Energy Consumed (Electricity and Fuel) at site for all processes (Roasting, Packaging, Distribution, Infrastructure)
    - Captured Monthly two weeks after Month End
  - Denominator
    - Many Variables included in Allocated Sales Dollars that influence metric
      - Price Fluctuations
      - Product Mix Changes
      - Outsourced Roasting / Packaging

Historical Approach: Shortcomings

Missing other critical influences:
- New processes
- New equipment
- Users



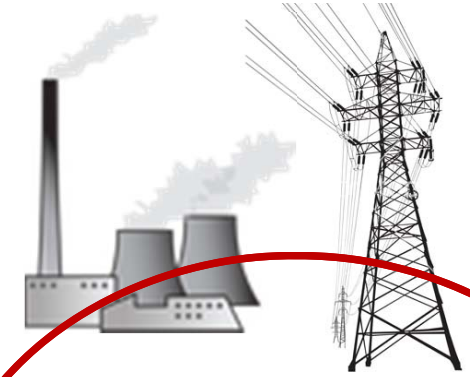
- Can't tell what happened, then you can't tell what action to take next.
- Efficiency calculated by estimates instead of actuals

- Limited to installing better equipment
- Missing opportunity for engagement.

- Change in metric doesn't necessarily correlate to operational efficiency:
  - Outsourcing (ie, roasting, distribution)
  - Changing product mix (powders)
  - Insourcing (nitrogen generation)

Historical Approach

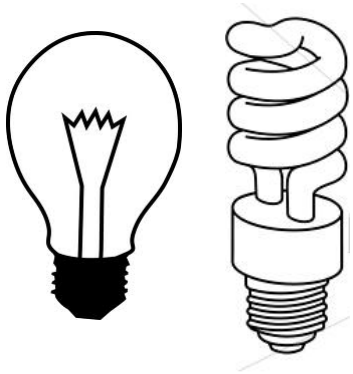
Supply Efficiency



Design and Purchasing Choices

- Air Compressors & Loop
- Nitrogen Generators and Distribution
- Power Factor
- Power Rates
- Lights
- HVAC & Insulation

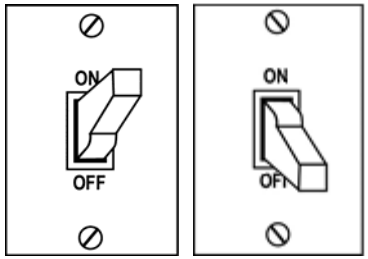
Machine Efficiency



Design and Purchasing Choice

- Packaging Machines
- Grinders
- Roasters & Pollution Controls

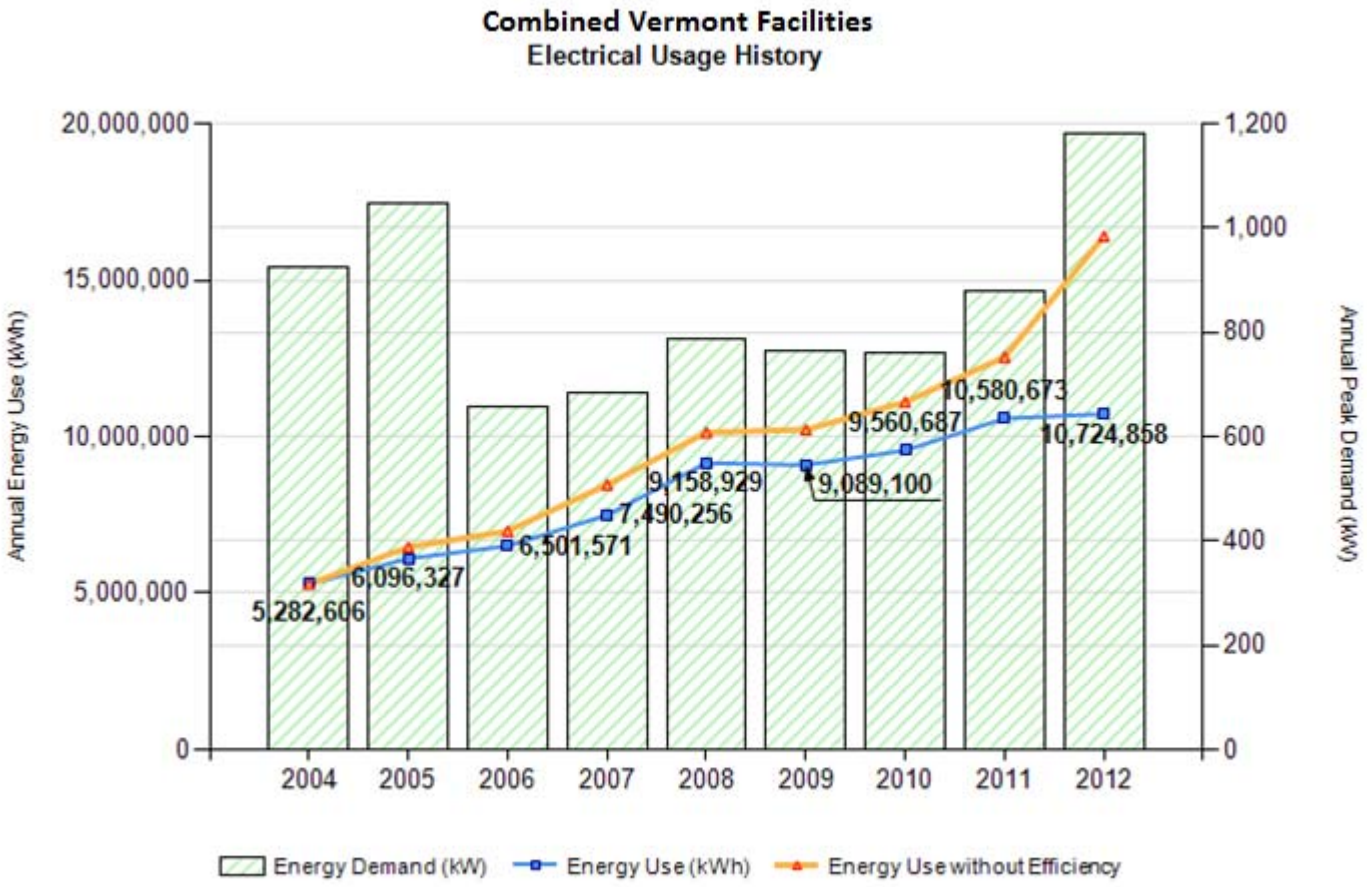
Machine Use



Choice in Use

- OEE
- Set points
- Idling
- Peak Shaving

Historical Approach – "Results"



Essex Plant Design

GREEN MOUNTAIN COFFEE ROASTERS ESSEX PLANT

PROJECT SIZE:	COMPLETED:	PROJECT COST:	LOCATION:	PROJECT TYPE:
468,100 SF	AUGUST 2013	$30 MILLION	ESSEX JUNCTION, VT	MANUFACTURING/DISTRIBUTION/OFFICE

Annual Electrical Savings
4,468,336 KWH
Cost Savings
$568,819

Operating Cost Savings (gas & electrical)
$2,198,673
EVERY YEAR!

Annual Natural Gas Savings
1,751,390 CCF
Cost Savings
$1,629,854

98 Hot Water Heating Plant

2021 Regenerative Thermal Oxidizers for Roasting & Flavoring

6097 Coffee De-gas Ventilation System

1,395,291 Gallons of Gasoline Consumed

28,944 Barrels of Oil Consumed

Annual Emissions Reductions
12,446
Metric Tons of CO_2 Equivalents

662 Homes for One Year

Carbon Sequestered Annually By
319,128
Tree Seedlings Grown for 10 Years

804 Compressed Air Plant

629 Chilled Water Plant

252 Lighting

GMCR Essex Staff Services
LEED FOR COMMERCIAL INTERIORS (V2009)
Project ID: 1000023773

61 POINTS
GOLD

		SUSTAINABLE SITES	15
5	SS1	Site Selection	
7	SS2	Development Density and Community Connectivity	
2	SS3.2	Alternative Transportation-Bicycle Storage and Changing Rooms	
2	SS3.3	Alternative Transportation-Parking Availability	
		WATER EFFICIENCY	8
8	WE1	Water Use Reduction	
		ENERGY AND ATMOSPHERE	22
5	EA1.1	Optimize Energy Performance-Lighting Power	
1	EA1.2	Optimize Energy Performance-Lighting Controls	
6	EA1.3	Optimize Energy Performance-HVAC	
4	EA1.4	Optimize Energy Performance-Equipment and Appliances	
5	EA2	Enhanced Commissioning	
3	EA3	Measurement and Verification	
		MATERIALS AND RESOURCES	5
1	MR1.1	Tenant Space-Long-Term Commitment	
2	MR2	Construction Waste Management	
2	MR4	Recycled Content	
		INDOOR ENVIRONMENTAL QUALITY	6
1	IEQ3.1	Construction IAQ Management During Construction	
1	IEQ4.2	Low-Emitting Materials-Paints and Coatings	
1	IEQ4.5	Low-Emitting Materials -Systems Furniture and Seating	
1	IEQ6.1	Controllability of Systems-Lighting	
1	IEQ7.1	Thermal Comfort Design	
1	IEQ7.2	Thermal Comfort - Verification	
		INNOVATION IN DESIGN	3
1	ID1.1	Optimize Energy Performance-Equipment and Appliances	
1	ID2	LEED Accredited Professional	



CLIENT: GREEN MOUNTAIN COFFEE ROASTERS
OWNER: REM DEVELOPMENT, LLC.
ARCHITECT: JOSEPH ARCHITECTS, LLC.

CONSTRUCTION MANAGER (INTERIOR): ENGELBERTH CONSTRUCTION
MECHANICAL DESIGN BUILD ENGINEER: VERMONT HEATING & VENTILATING CO.
ELECTRICAL DESIGN BUILD CONTRACTOR: LAMBERTON ELECTRIC

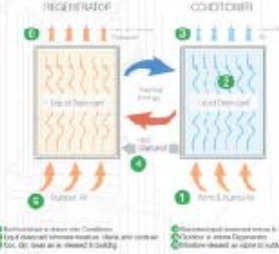
CIVIL ENGINEER: LAMOUREUX DICKINSON
VERMONT GAS
EFFICIENCY VERMONT

Chilled Water Plant
- 900 Ton water cooled chilled water plant
- Three (3) ultra high efficiency centrifugal chillers, 0.532 kW/ton
- Integrated building management controls optimize chiller loading with chiller efficiency
- Building management controls optimize chilled water and condensing water pumping speeds
- Reset differential pressure control based on critical valve
- 13°F design evaporator / coil delta temperatures
- One (1) 500 Ton fiberglass modular cooling tower
- Ten (10) VFD driven 5 HP direct drive fans on cooling tower
- 200 ton capacity of dry coolers for 100% economizing in winter operation.

Annual Savings
$138,400
1,087,000 KWH

Hot Water Heating Plant
- Four (4) 3,000,000 BTU/Hr Low NOx Natural Gas Fired Hot Water Boilers
- Low temperature condensing application
- 15:1 burner turndown ratio to match energy input directly to fluctuating system loads
- System coils are designed around low temperature of 160°F with a 40°F delta
- The condensing boilers are rated at 93.0% efficiency at 7% input rating
- Building management controls to optimize pumping speeds
- Reset differential pressure control based on Critical valve

Annual Savings
$45,132
72,700 KWH



Dehumidification System
- Low Relative Humidity (RH) specification for specialty packaging
- Cutting edge liquid desiccant system
- Technology utilizes a natural, salt water solution to extract humidity from the air while cooling at the same time.

Annual Savings
$32,760
80,000 KWH

Compressed Air Plant
- 650 HP High Efficiency Compressed air plant
- Two (2) Kaeser 200 HP screw compressors
- One (1) 250 HP variable speed compressor for highly efficient load matching
- Multi-compressor sequencer controls
- Modular refrigerated air dryer
- Engineered compressed air distribution system
- Automatic no loss drains
- Direct heat recovery from compressor room

Annual Savings
$62,477
400,000 KWH

Indoor& Outdoor Lighting and Controls
Lighting Power Density
- Manufacturing plant average 0.68 watts per SF is 59% better than the Vermont Energy Code
- Staff services office area average 0.76 watts per SF is 34% better than the Vermont Energy Code
- Networked lighting controls
- Lighting controls include occupancy sensors for the staff services areas
- High efficiency LED lights in office area
- Warehouse average of 0.75 watts per SF is 38% better than Vermont Energy Code
- LED fixtures illuminate the truck bay canopy

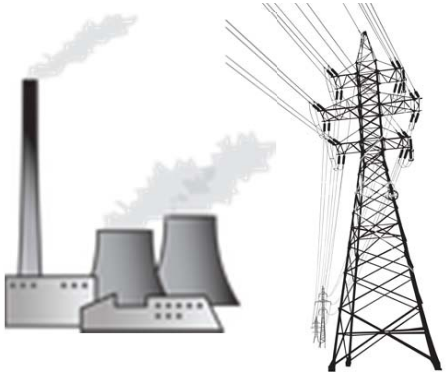
Annual Savings
$330,076
2,592,899 KWH

Coffee De-Gas Ventilation System
- The process exhaust system utilizes 60 HP of exhaust and makeup fans operated off VFD controls to remove process contaminants
- The engineered air circulation system and controls manage multiple air flows from adjacent areas in the plant to minimize energy of conditioned exhaust or untreated ventilation air

Annual Savings
$41,106
70,516 KWH

New Approach

Supply Efficiency



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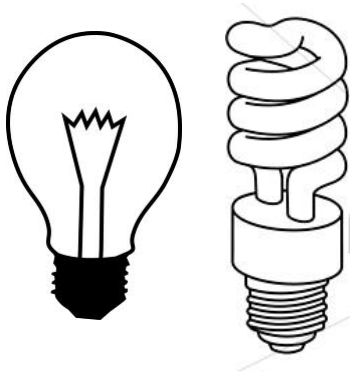

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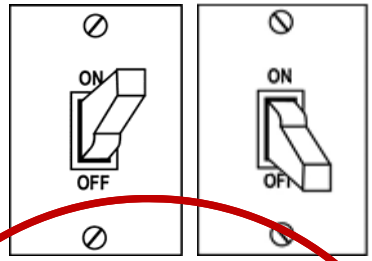
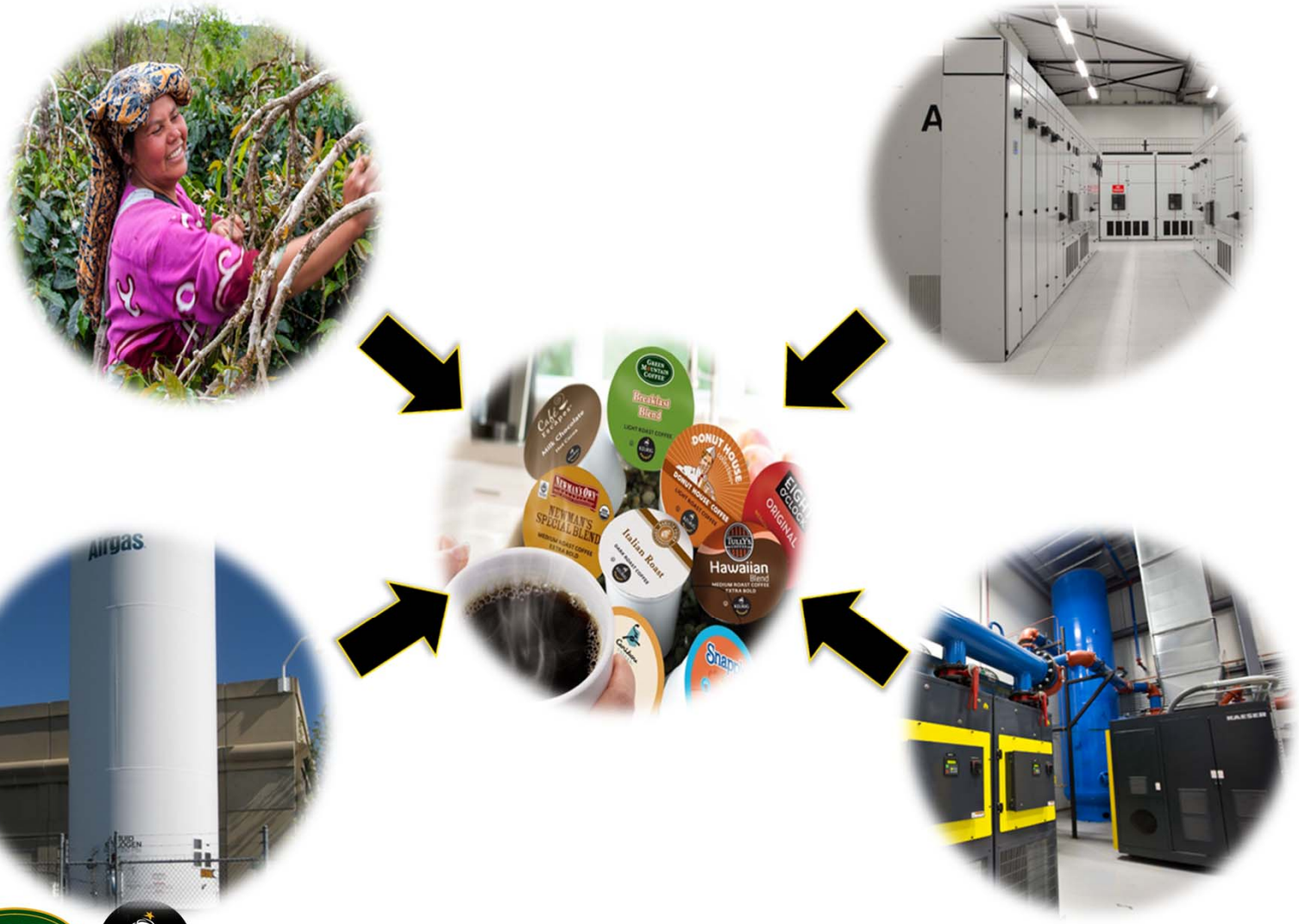


Choice in Use

- OEE
- Set points
- Idling
- Peak Shaving

Manufacturing K-Cups



Metering Infrastructure Needed

Metering Component Selection

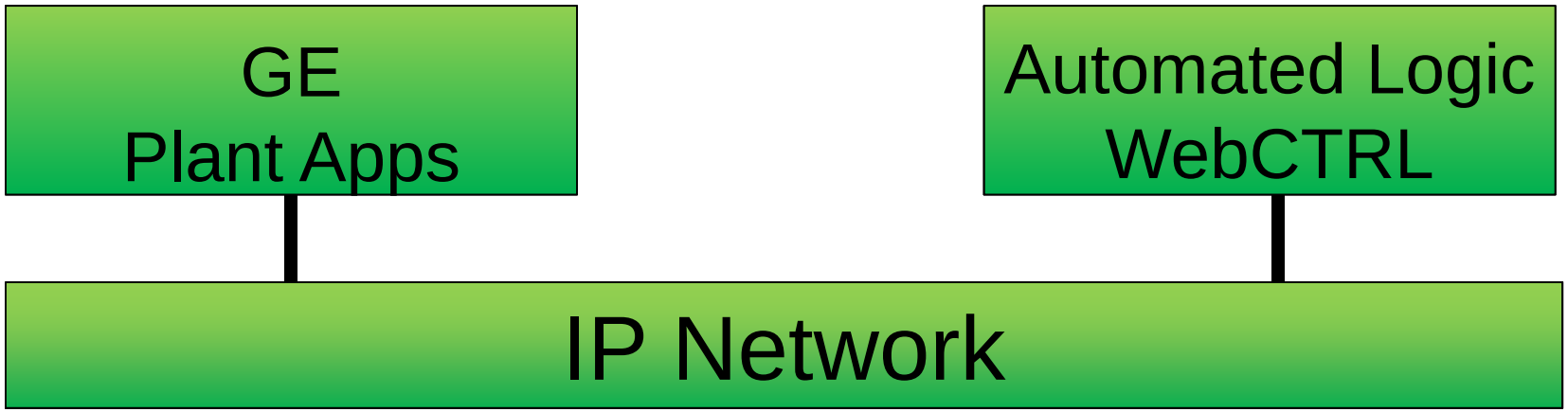
Value & Practicality?

Performance & Speed?

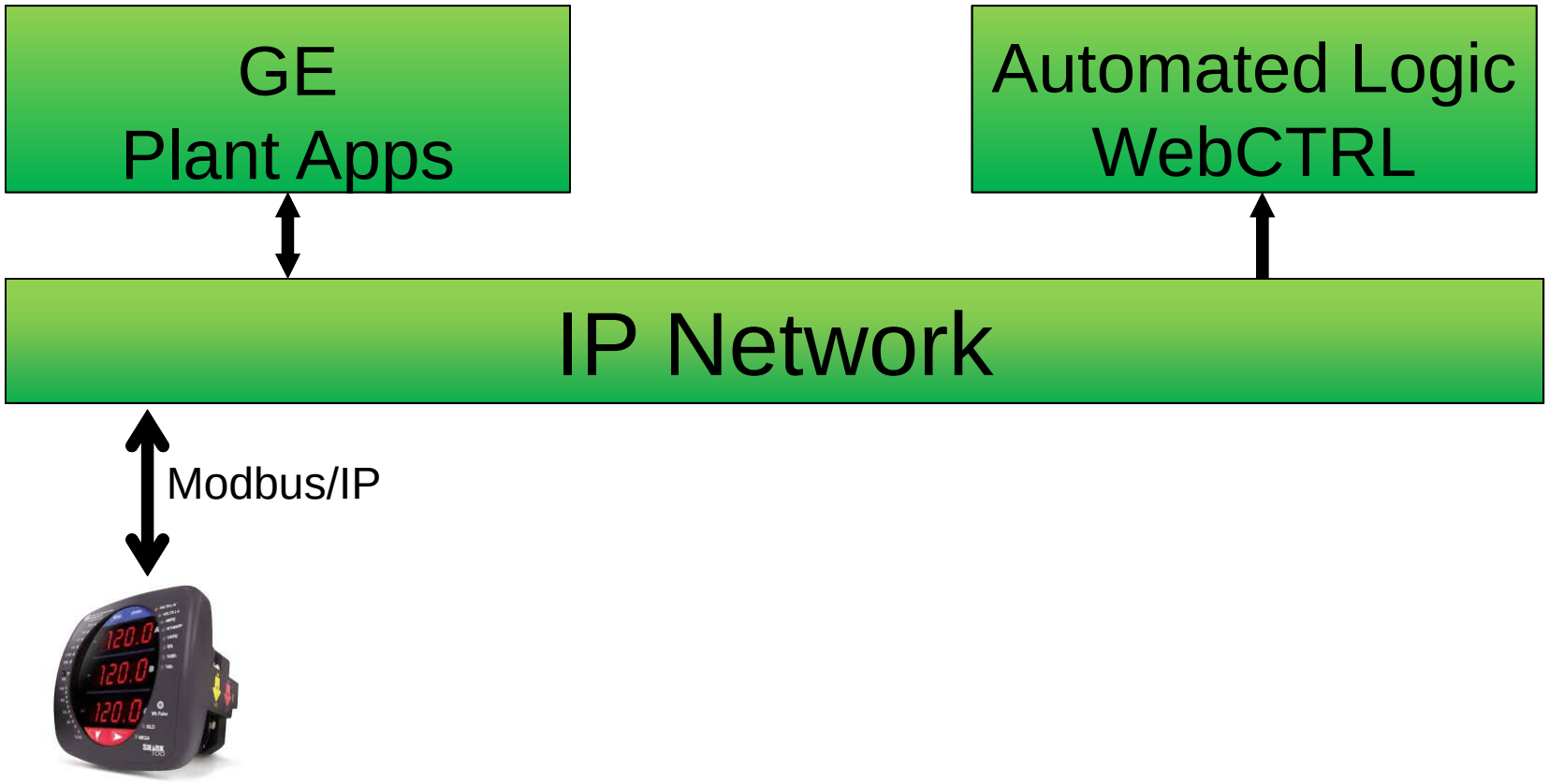
“Open” architecture?

“Closed” architecture?

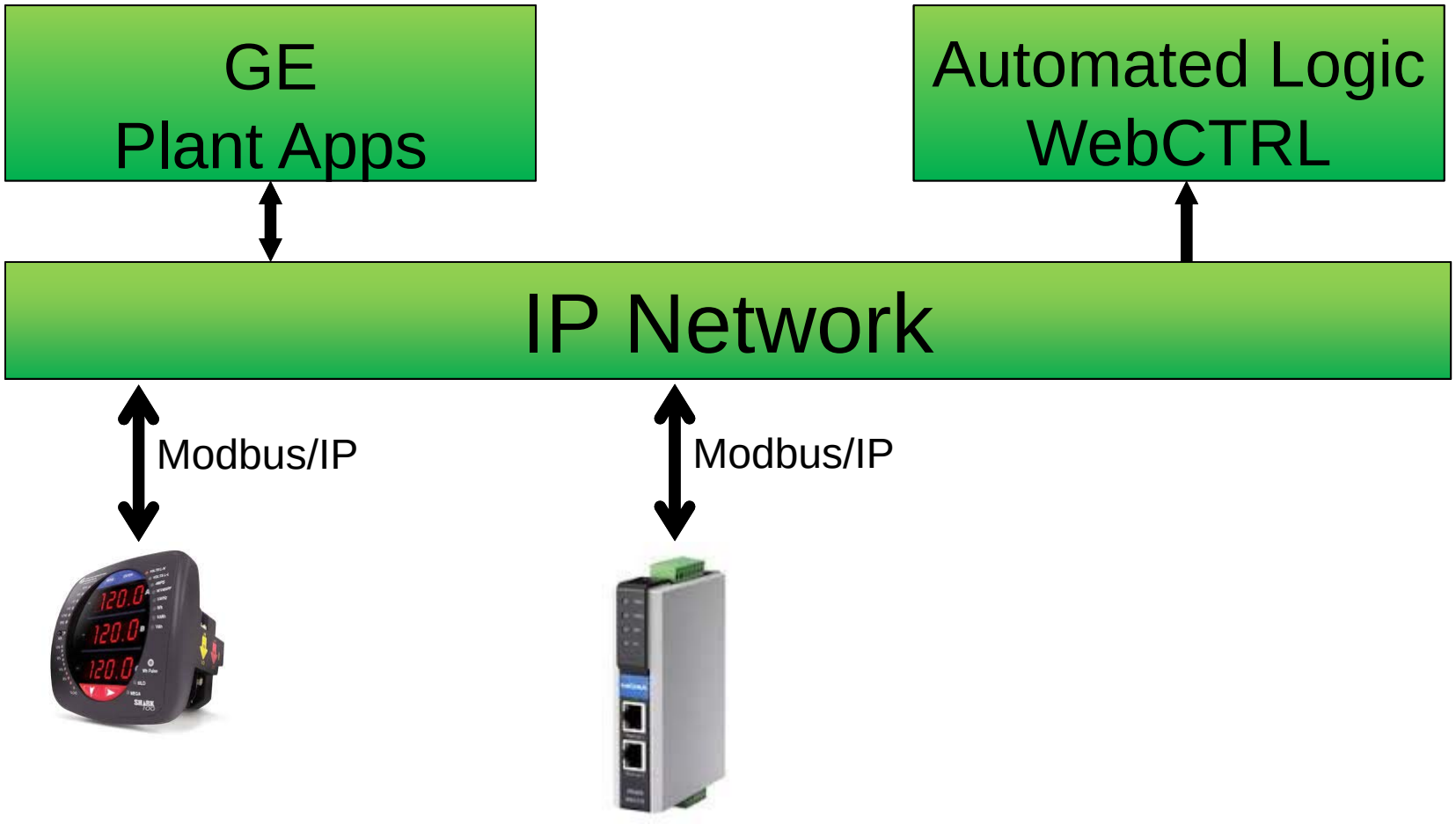
Existing Infrastructure



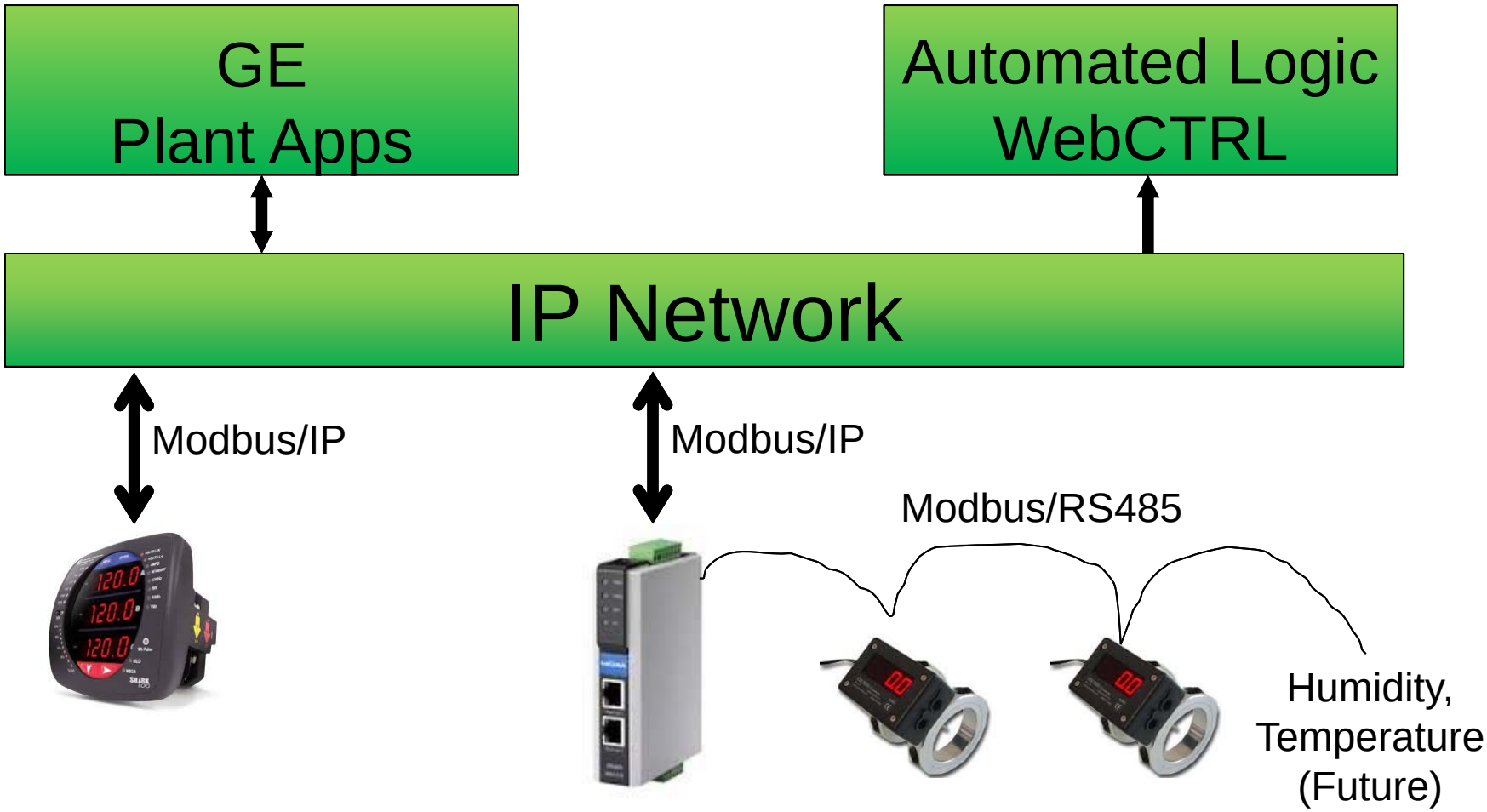
+ Electric Meter



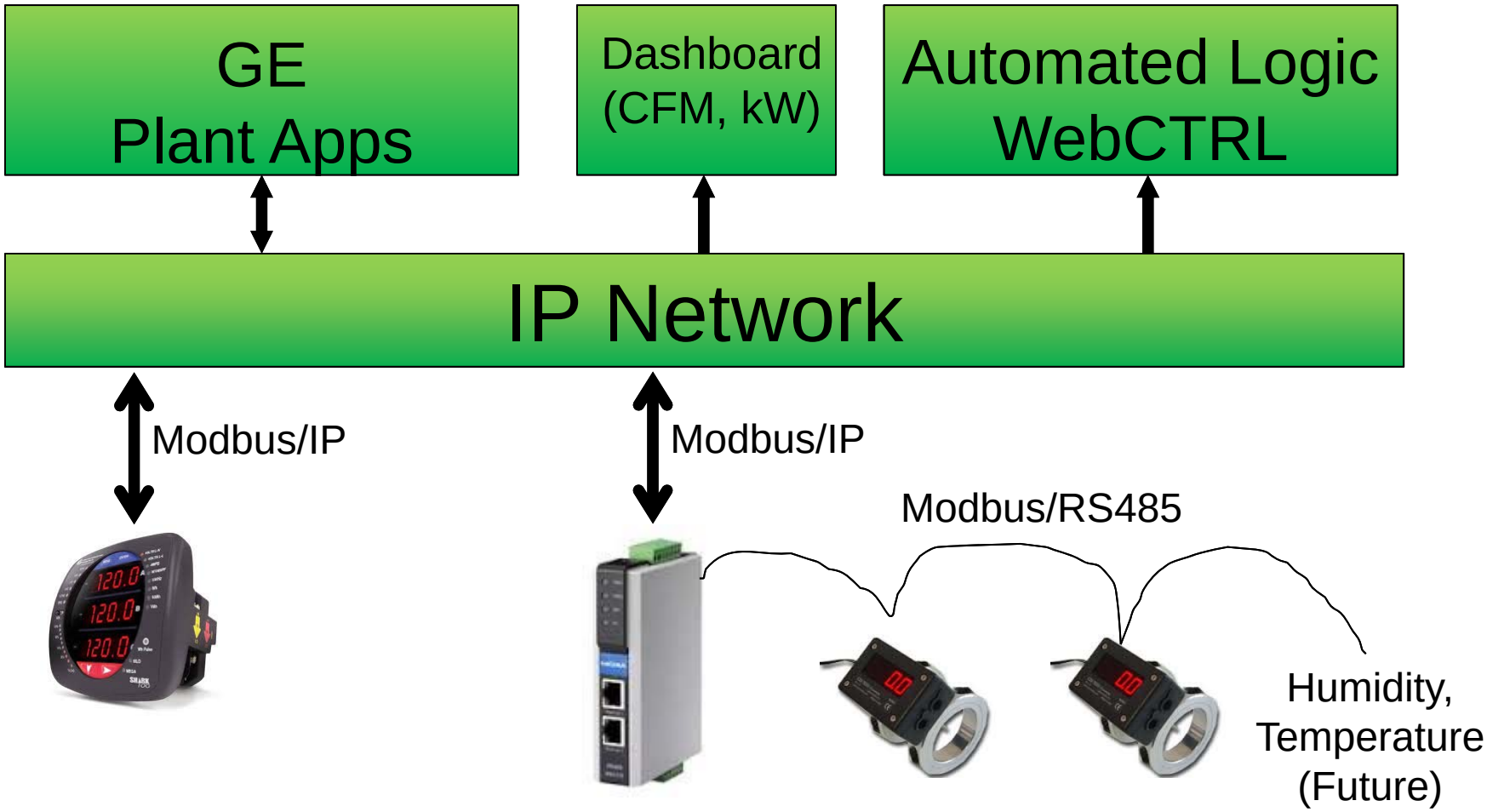
+ Modbus Serial to IP Router



+ CA & N2 Flow Meters



+ User Display



Dashboard Goals

1. **Visualize overconsumption.**
2. **Elevate the value of energy.**
3. **Driving decisions…**
   and <u>solutions</u>…
   to the point of cost

What is the potential?

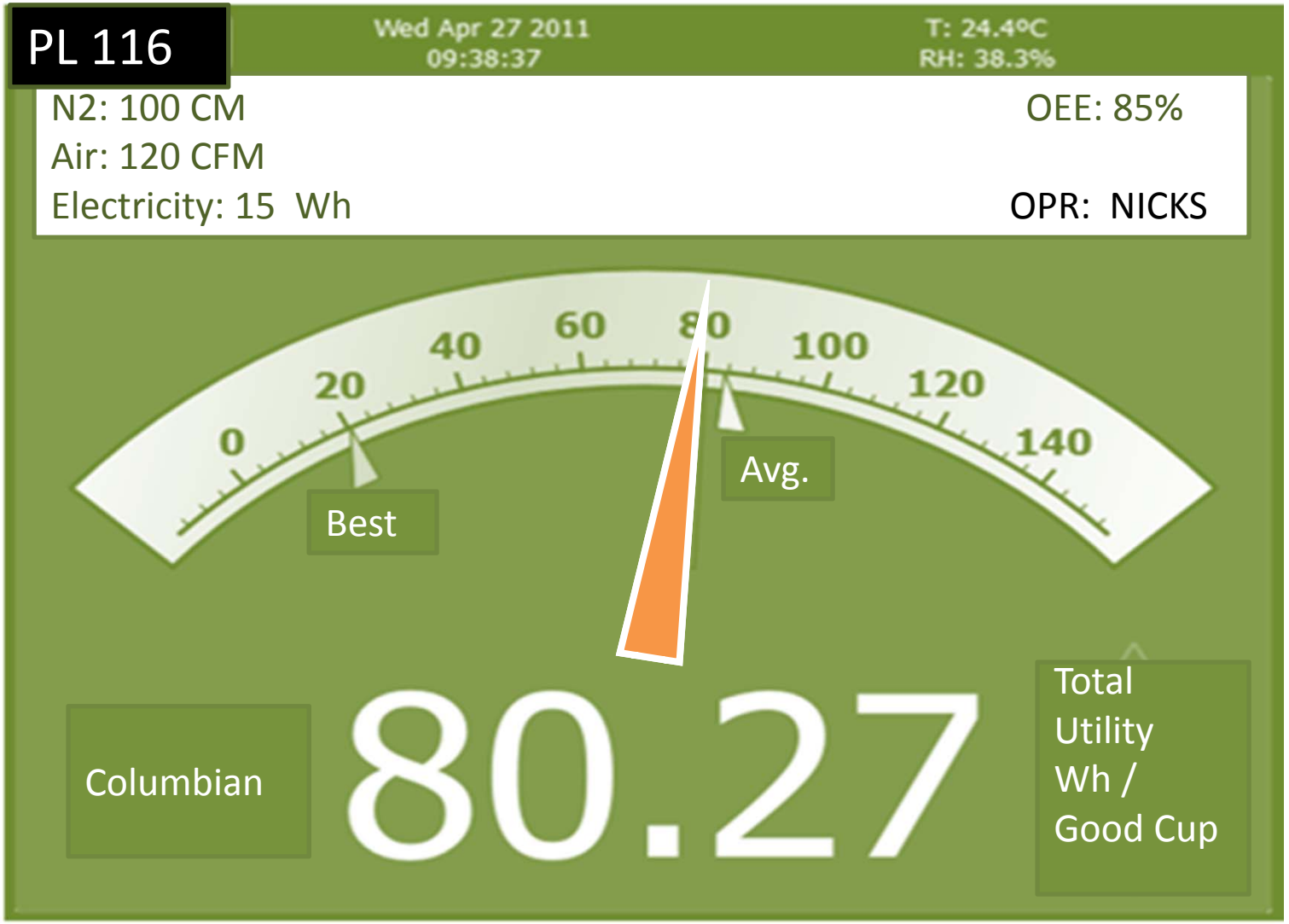
- Savings from operational improvements are 3% of Annual Usage.
- Operational improvements:
  - Process Changes
  - Maintenance Efforts
  - Employee Engagement

How do I get buy-in?

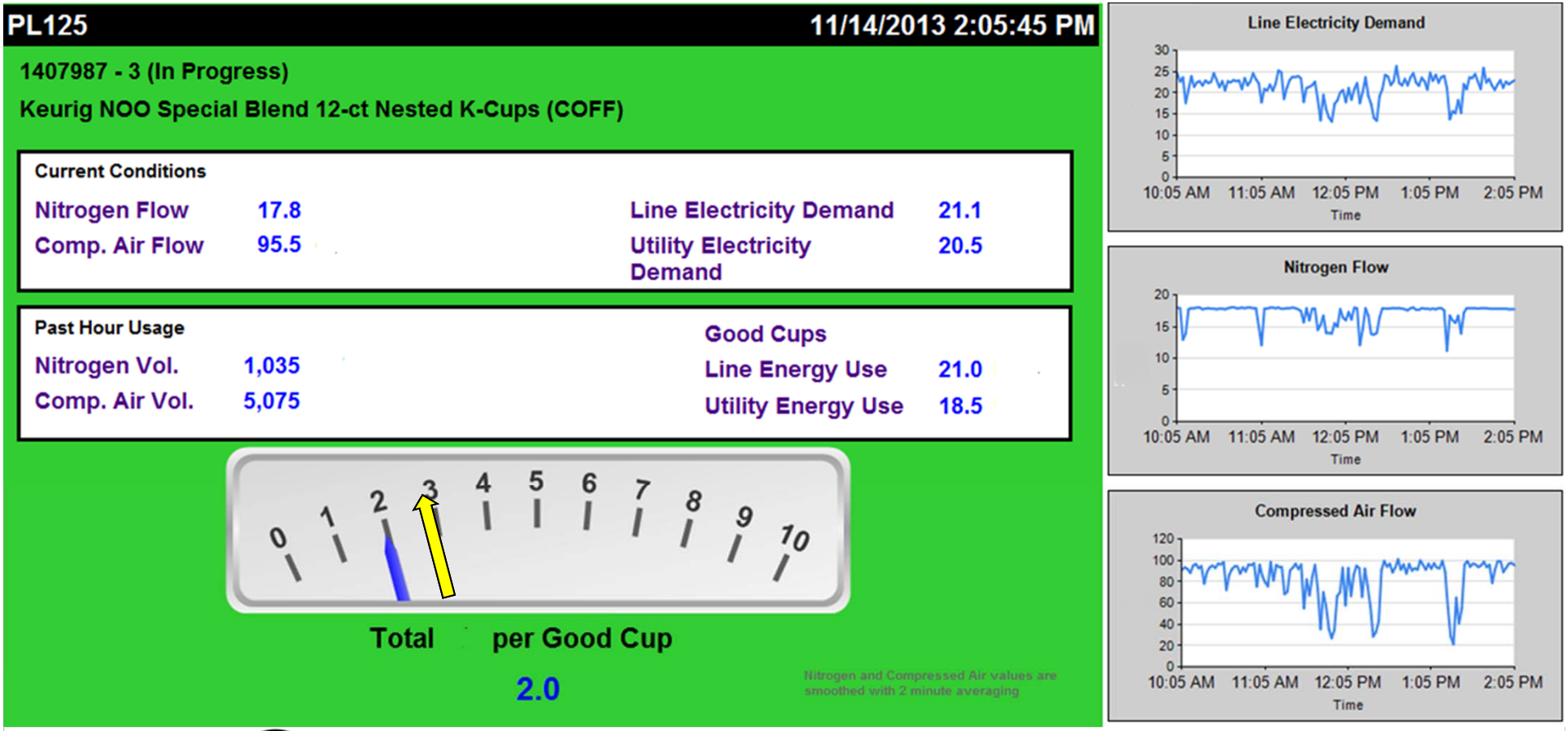
- **Engage employees in the process**
  - **What can this "tool" do?..**
  - **How can it help me in my day ..**
- **Find a Champion…**
- **Recognition and Rewards..**


SPEED
LIMIT
55
MPH

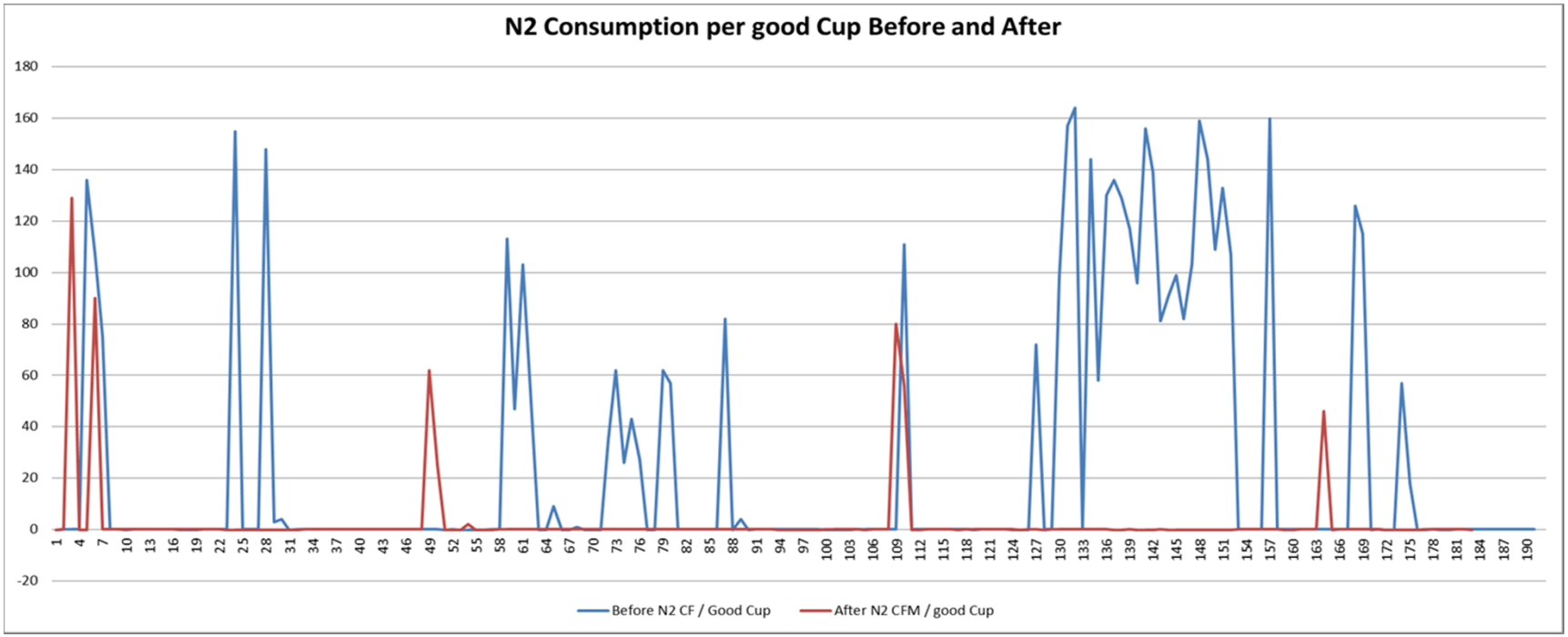
Interface – Rough Sketch



Keurig Packaging Line Dashboard



Initial Pilot Results



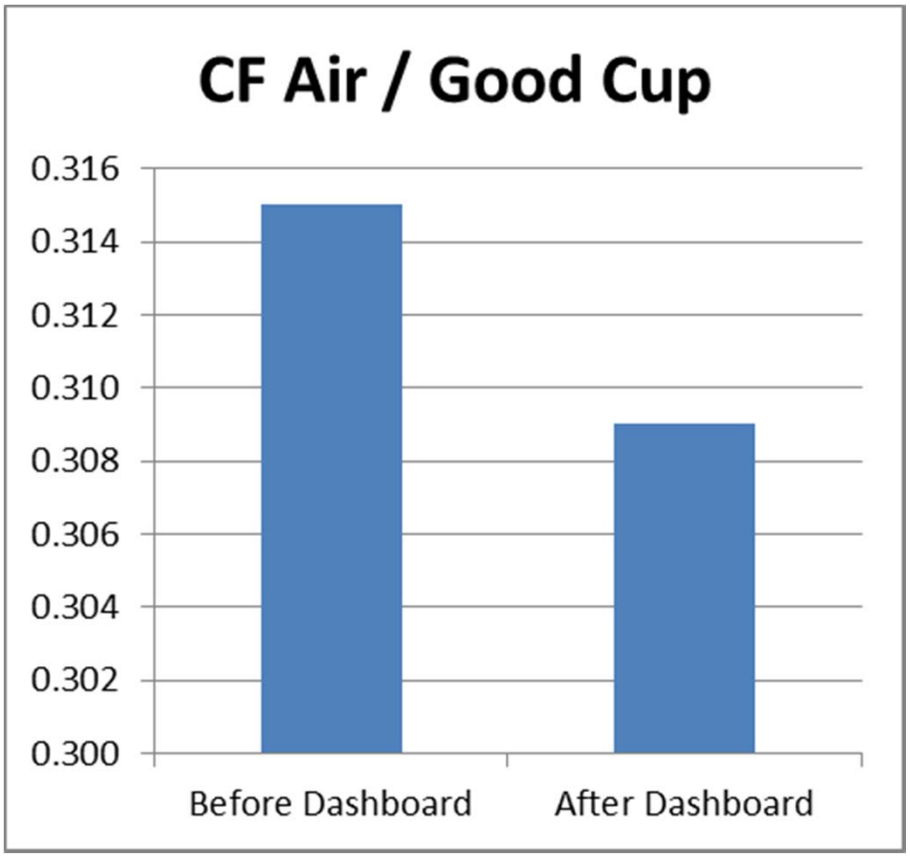
Dashboard showed nitrogen gas leaking by.

$70,000 est. savings from before installing dashboard.

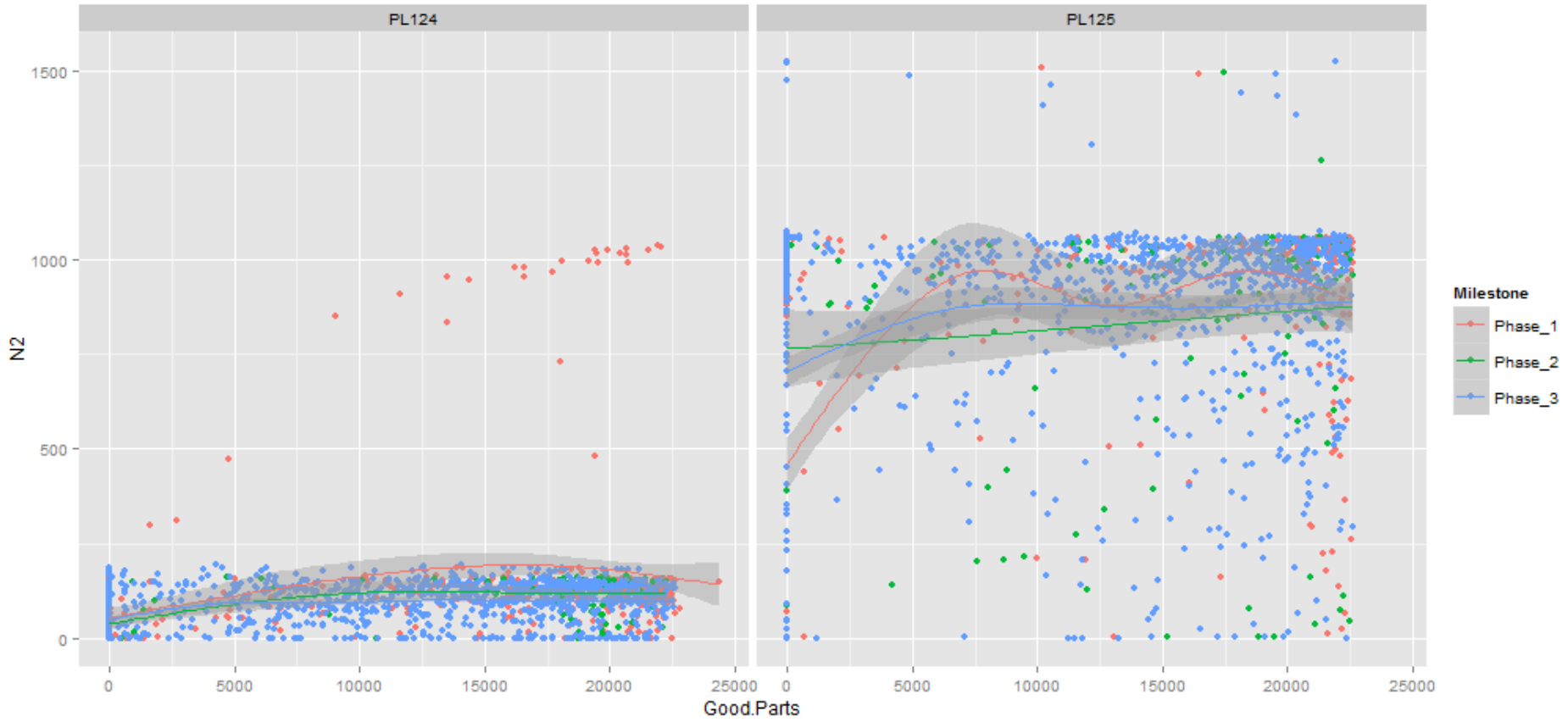
Initial Pilot Results

Dashboard has helped reduce compressed air use.

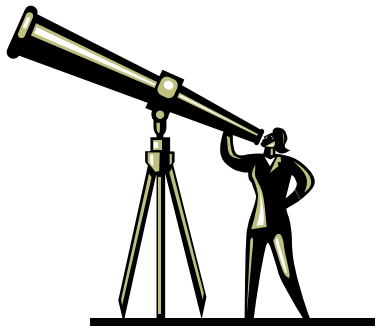
2% savings from before installing the dashboard



Initial Pilot Results



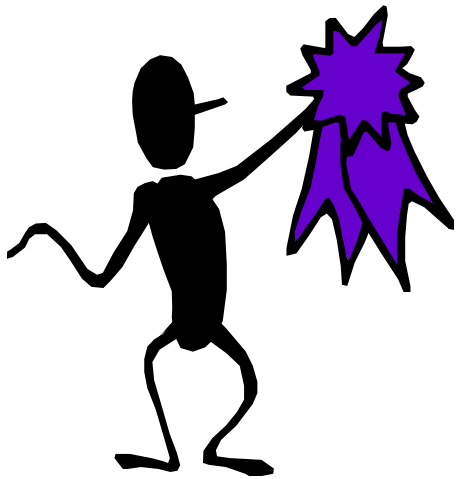
Looking Forward



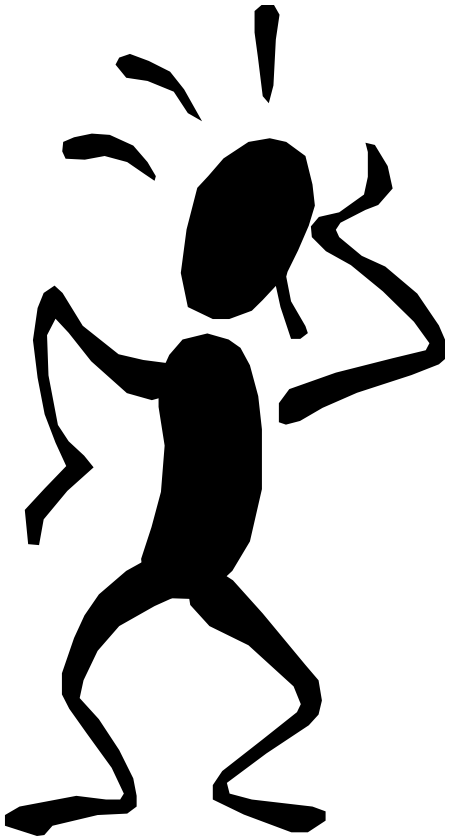
- Organization's commitment
- Energy Committees
- Reward System
- Lean Six Sigma Green Belt Program

Future Rewards System

- Recognition for Ideas that are implemented
- Owner Cards
- Performance Management



Lessons Learned



Questions