Process Water Management (PWM) Program

Cam Metcalf, Executive Director

2nd International Workshop
Advances in Cleaner Production
May 22, 2009

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UNIVERSITY OF LOUISVILLE
J.B. SPEED SCHOOL OF ENGINEERING

Industrial

Process Water Management (PWM)

Use Environmental Performance to

- ✓ **Increase competitive advantage**
- ✓ **Achieve sustainability**

By implementing Process Water Management (PWM) for Pollution Prevention (P2) & Energy Efficiency (E2)

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Mission

KPPC is Kentucky's primary resource to help businesses, industries and other organizations develop environmentally sustainable, cost-saving solutions for improved efficiency.

Based at the University of Louisville J.B. Speed School of Engineering, KPPC provides technical information and assistance that is free, confidential and non-regulatory.

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Winner US EPA's 2007 National Water Efficiency Leader Award for NGO Category

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1. *" Business strategies built around*
2. *the radically more productive use of natural resources*
3. *can solve many environmental problems*
4. *at a profit"*

Amory Lovins, Hunter Lovins & Paul Hawken
"A Road Map for Natural Capitalism" 1999

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P2 = Source Reduction

- **P2 means "Source Reduction" and other practices that reduce or eliminate the creation of pollutants through:**
  - ✓ **increased efficiency in the use of raw materials, energy, water or other resources, or**
  - ✓ **protection of natural resources by conservation.**

Resource Management

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PWM Drivers

- Water intensive companies engage in PWM projects because it is a tangible, visible & a familiar media
- Water media is less complex than trying to attack everything at once
- Early successes help energize the team to identify other operations where significant environmentally related cost savings can be identified
- PWM connects to offline support operations such as RO units, DI units, boilers, air compressors & cooling towers

Plant Water Usage: Price or Cost

Cooling Towers/Chillers

Air Compressors

Boilers

Mop Water

Rectifiers/Welders

Manufacturing Plant

Production Line Stages

Pre-Rinse Stages

Alkaline Cleaning Stages

Post Rinse Stages

Multi-Stage Parts Washer

RO or DI Unit

Waste Water Treatment (WWT)

Incoming Fresh Water

Sanitary Usage

Outgoing Sewer Water

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Common Water Uses in Brazil

- ✓Cooling towers & chillers
- ✓RO units & DI water units
- ✓Boilers & water heaters
- ✓Once through cooling water
- ✓Cleaning & rinse water
- ✓Oil & water lubrication
- ✓Sanitary
- ✓Lawn care

“Cultural Technology”

- ✓ **Some client’s organizations are not ready to explore & implement new technologies or concepts**
- ✓ **The price & cost of water usage was not understood in “water intensive” industries**
- ✓ **PWM allows organizations to successfully address, demonstrate & deploy profitable environmental solutions**
- ✓ **7-step process provides internal structure for transition from reactive to proactive**

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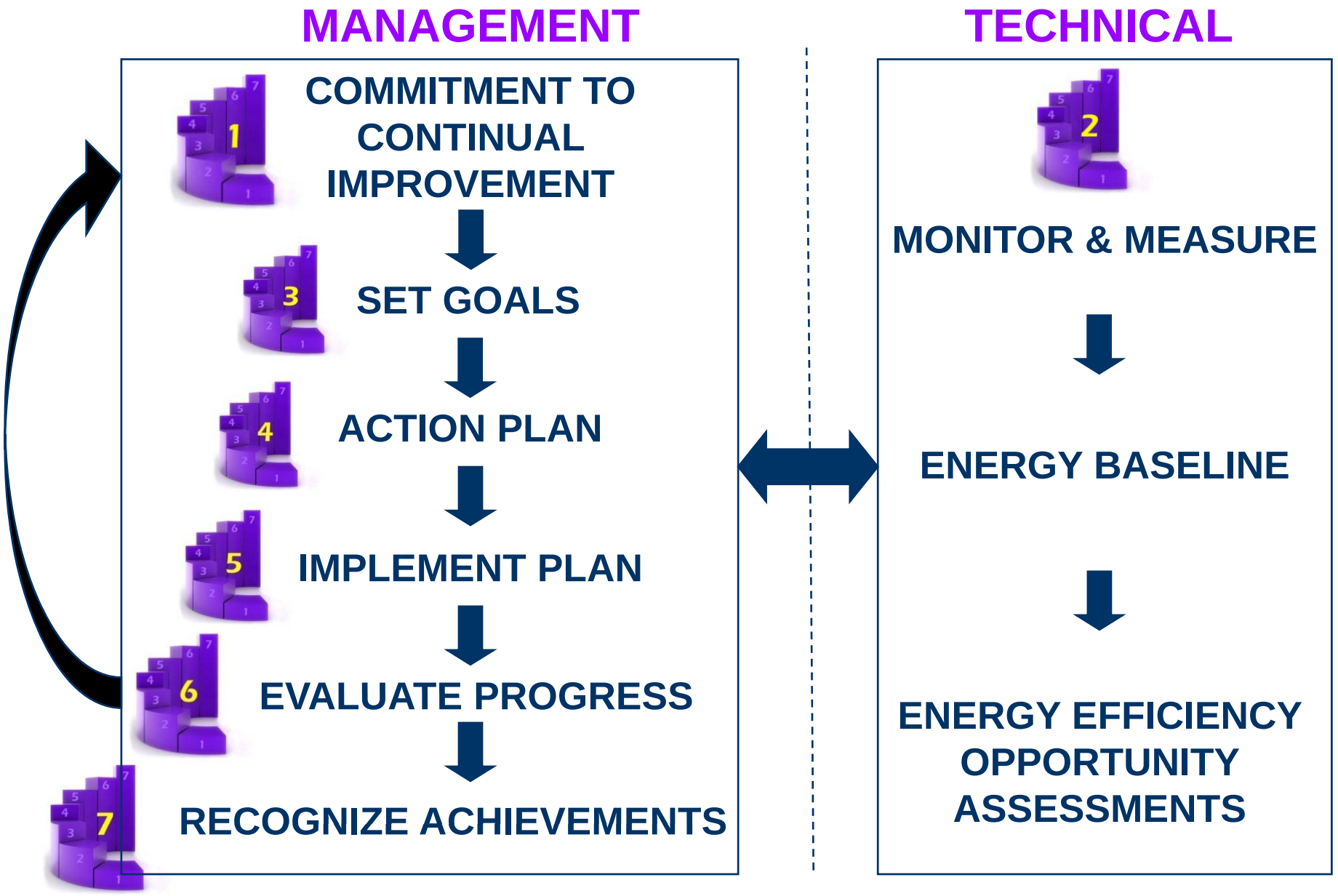
7-Step Process Water Management



Process Water Management (PWM) Process

Make Commitment to Continual Improvement

- ✓Water Conservation Policy
- ✓Cross-functional Water Team
- ✓Appoint Water Team Leader

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Water Conservation Policy

- ✓Creates a focus on water resources
- ✓Driver for water resource management
- ✓Provides direction in delivering mission
- ✓Provides objectives & targets
- ✓Supports sustainability
- ✓Changes behavior

Don't Just Pay the Bill!

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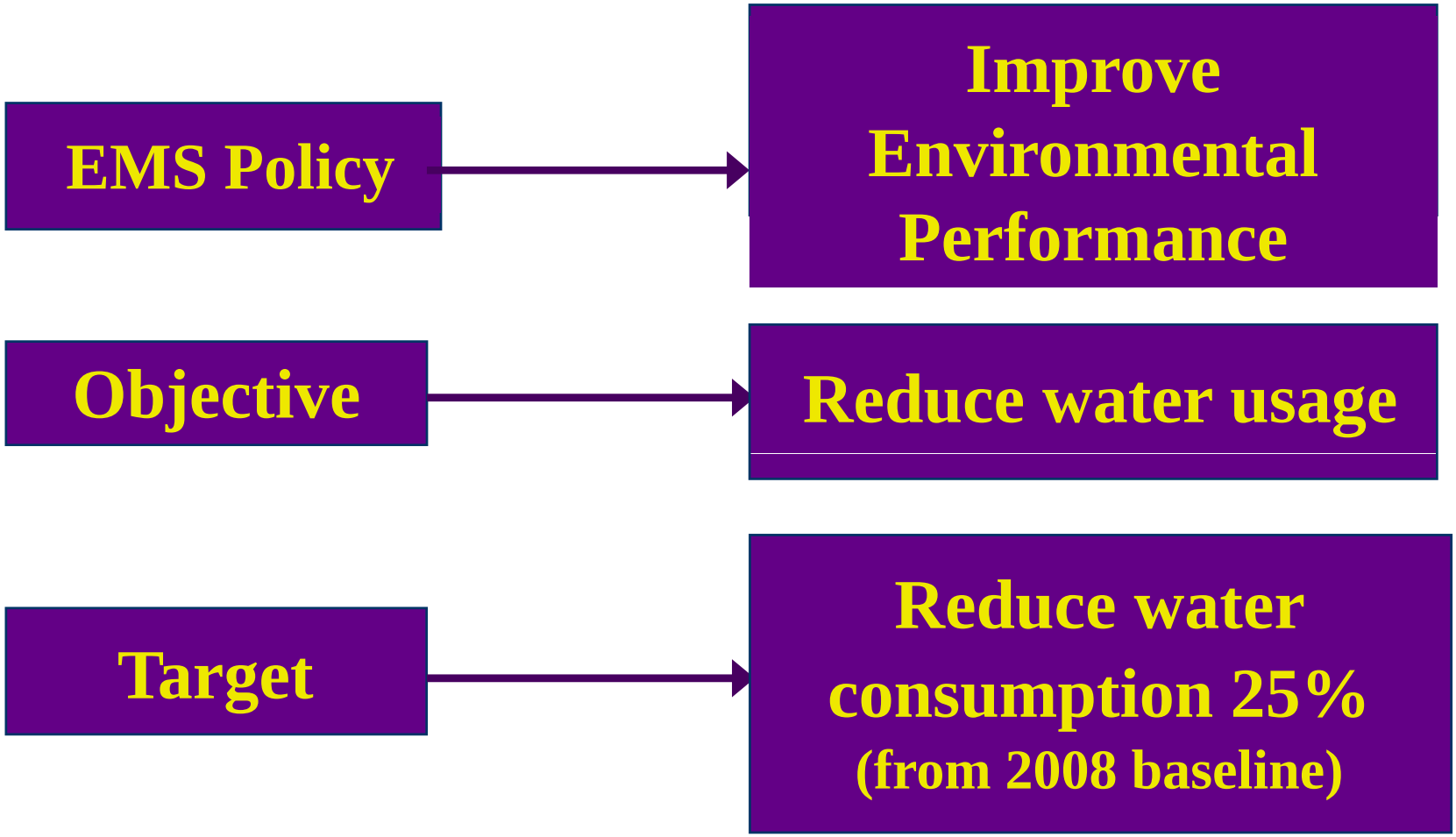
The Policy Drives Objectives & Targets



Environmental performance – measurable results based on the policies, objectives & targets!

Adopt a Team Approach for PWM

- Advising, coordinating & facilitating PWM implementation
- Completing PWM tasks & general responsibilities
- Gathering, organizing, evaluating & disseminating PWM information
- Developing PWM procedures (Controlled Processes)
- Representing all functional areas of the organization
- Managing the reactions to changes resulting from PWM implementation

Mission of the PWM Team

- Regularly meet to progress work
- Develop list of activities that impact the environment
- Develop list of regulatory requirements
- Develop objectives & targets
- Help with PWM implementation & operational controls
- Help with auditing & development of corrective actions

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Recommended PWM Team Members

- ✓Plant Manager or Director of Operations
- ✓Controller or Accounting Manager
- ✓Engineering Manager
- ✓Quality Manager
- ✓EHS Manager
- ✓Production Manager
- ✓Production Personnel (Hourly)
- ✓Vendors/Suppliers

Recommended PWM Team Members

- Include vendors/suppliers for:
  - ✓Paints & coatings
  - ✓Chemicals
  - ✓Water pre-treatment equipment
  - ✓Water post-treatment equipment
  - ✓Local POTW Operator (optional)
  - ✓Local Fresh Water Operator (optional)

Appoint a Water Team Leader

- **Water manager will:**
  - ✓ Set goals
  - ✓ Track progress
  - ✓ Promote the water management program
  - ✓ Help achieve goals by establishing water use performance as a core value
- **Not always an expert in water & technical systems. Must understand:**
  - ✓ How water management helps the organization
  - ✓ Its relation to financial & environmental goals (sustainability)
- **Depending on water usage & costs, full-time position or addition to other responsibilities**
- **Link to upper management to formalize commitment to continual improvement**

Water Team Leader Drives Implementation

- **PWM Implementation**
  - ✓ **Written Plan**
  - ✓ **Plan Schedule**
- **Plan Execution**
  - ✓ **PWM Implementation Team meetings**
  - ✓ **Management review meetings**

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PWM Implementation Plan

- **Structure & Responsibilities**
  - ✓ Top management
  - ✓ PWM Implementation Team
  - ✓ All of organization's employees
- **Process to develop & implement the PWM**
  - ✓ Consider PWM components
  - ✓ PWM Gap Assessment
  - ✓ Determine how to involve employees in process

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PWM Implementation Plan Schedule

- Sets implementation milestones (Timelines)
- Responsibility & resource allocation
- Not “etched in stone” (subject to change)

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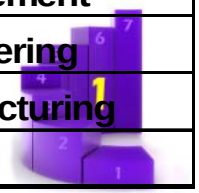
Action Plan Example

7 Step Planning Program			
Step			
1. Commitment to Continual Improvement	Cross Functional Team Na	Title	Department
1.1 Identify Cross Functional Team			
List team names in the next column.			
Recommended Team Members			
•Plant Manager/Director of Operations	John Smith	Plant Manager	Management
•Controller/Accounting Personnel	Jim Hogue	Controller	Accounting Dept.
•Engineering Manager			
•Quality Control Manager			
•Quality Assurance Manager			
•EHS Manager			
•Production Chemist			
•Logistics-Shipping			
•Production Maintenance Supervisor			
•Production Supervisor			
•Hourly personnel			
•Vendor /Suppliers (s)			
1.2 Water Conservation Policy	Responsibility		
1.2.1 Develop the policy	John Smith	Plant Manager	Management
	Joe Ford	EHS Manager	Engineering
	Ted Brown	Production	Manufacturing
	23		



Process Water Management (PWM) Process

Assess Performance & Opportunities

- ✓Track & monitor water use & costs
- ✓Develop baseline (& benchmark)
- ✓Identify water reduction opportunities

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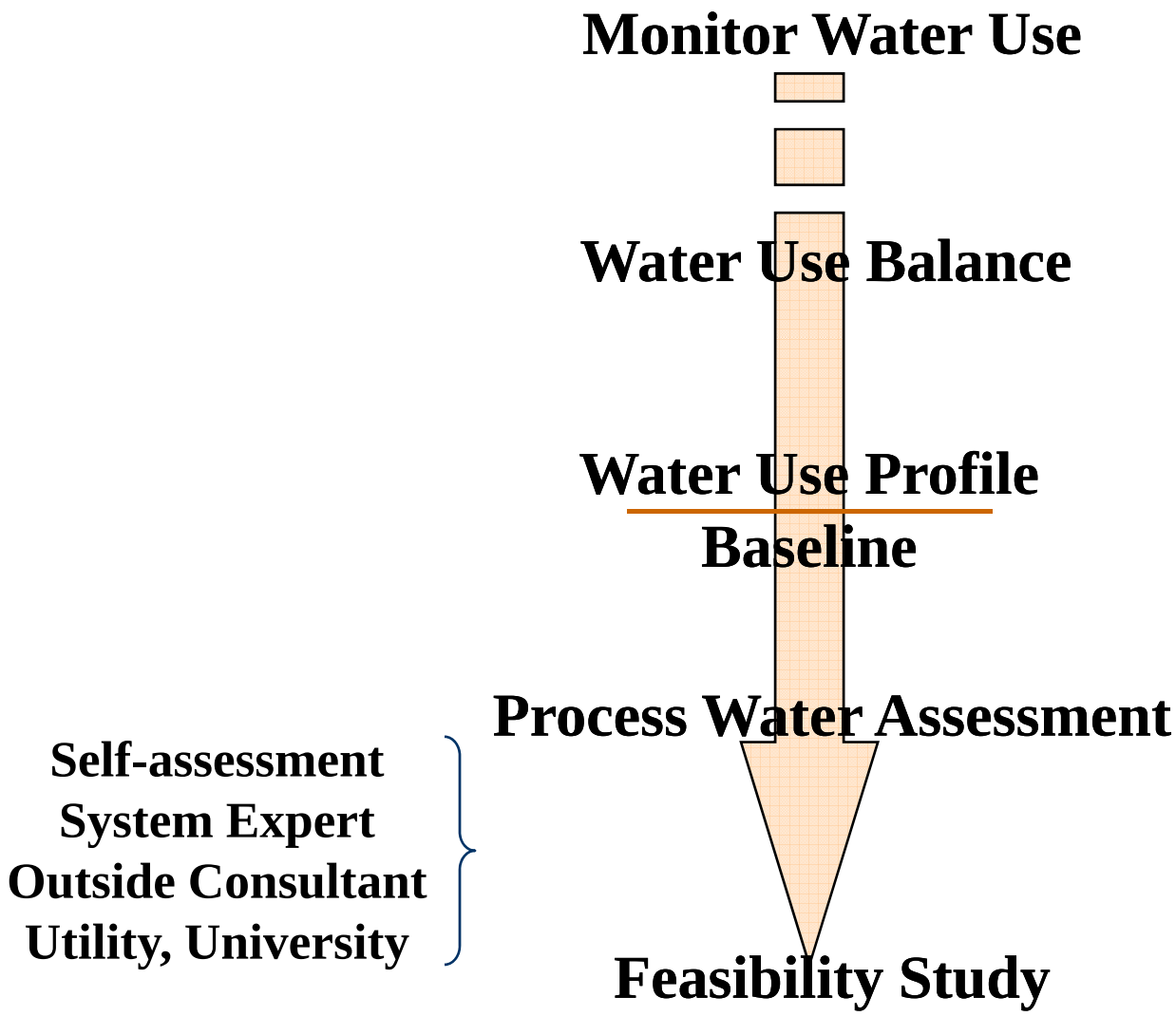
Assess Performance & Opportunities

- **Evaluating current & past water use & costs for all water intensive processes**
- **Analyze water use to:**
  - ✓ **Improve process water performance**
  - ✓ **Identify water use reduction opportunities**
  - ✓ **Gain financial & environmental benefits**

Key Aspects

- ✓ Understand the production stages
- ✓ Data collection & management
- ✓ Data analysis
- ✓ Baselines (& benchmarking)
- ✓ Technical water use assessments
- ✓ Supports sustainability
- ✓ Changes behavior

How do I find PWM Opportunities?



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Things to Check

- Data collection for selected processes
  - ✓ Find existing and/or historical data
  - ✓ Develop current data
  - ✓ Identify & fill data gaps
- Monitor, track & verify monthly usage & costs
  - ✓ Water, natural gas, electrical & other
  - ✓ Chemicals
  - ✓ Wastes (both hazardous and non-hazardous)
  - ✓ Verify measurements of cubic feet or gallons
  - ✓ Are we paying sewer surcharges?

KPPC's Excel Spreadsheet Tool Kit

- **Provides a "utility" cost & usage analysis**
- **Provides the client user with a means of tracking each process for usage & costs:**
  - ✓ **Water, sewer, raw materials, natural gas, fuel oil, propane, electric (including ancillary & treatment processes)**
- **Ongoing tracking of processes to identify trends & recognize unexplained increases in cost or usage**

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Analyze Existing Data

WATER USAGE DETAIL			12.12.07				
SIGNIFICANT H2O USERS			Source:	Water Study			
PROCESS	MEASURED	H20 MONTHLY	H20 ANNUAL	USAGE		H2O FLOW	MEAS.
DESCRIPTION	FLOWRATE	USAGE GALS.	USAGE GALS.	MEASURED	COMMENTS	STATUS	NEEDED
	DAILY gals.	or Tank Cap.					
Line A - Parts Washer	300	6,000	72,000	Yes	3 tank capacity	Continuous	
Line A	97,200	1,944,000	23,328,000	Estimated	Multiple overflows	Continuous	Yes
Line B	69,600	1,392,000	16,704,000	Estimated	Multiple overflows	Continuous	Yes
Line C	Unknown	365	Unknown	Estimated	Pit capacity??????	Continuous	Yes
Coating	Unknown	3,400	Unknown	Estimated	Multiple overflows	Continuous	Yes
Plant Sanitary	6,180	123,600	1,483,200	Estimated	Based on 20gal/person		
Total	167100	3,342,000	40,104,000				
Invoiced Usage		6,000,000	72,000,000				
		2,658,000	31,896,000		Unaccounted for usage		

Source: Cost Improvement Water Study

Water & Sewer Rate Increased 35% per year for 3 years

2006 Cost = $265K 2007 = $357K 2008 = $482K

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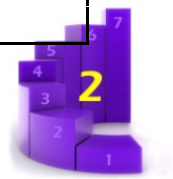
Utility Data Analysis

UTILITY BILL ANALYSIS FOR WATER AND ENERGY				4/4/2008 11:01	
			Cubic Foot =	7.4805	
FRESH WATER	Monthly	Monthly	Monthly	Monthly	Monthly
	Cubic Ft (CF)	CF to GALS.	Gallons	Invoice	Cost/Gal.
FISCAL MONTH	CF from Inv.	CF times 7.4805	D or Inv. Gals.	Inv. Amt.	
JANUARY	34,000	254,337	254,337	$3,000	0.012
FEBRUARY	45,000	336,623	336,623	$3,500	0.010
MARCH	45,000	336,623	336,623	$3,500	0.010
APRIL	54,000	403,947	403,947	$4,500	0.011
MAY	0	0	0	$0	#DIV/0!
JUNE	0	0	0	$0	#DIV/0!
JULY	0	0	0	$0	#DIV/0!
AUGUST	0	0	0	$0	#DIV/0!
SEPTEMBER	0	0	0	$0	#DIV/0!
OCTOBER	0	0	0	$0	#DIV/0!
NOVEMBER	0	0	0	$0	#DIV/0!
DECEMBER	0	0	0	$0	#DIV/0!
TOTAL	178,000	1,331,529	1,331,529	$14,500	0.011

Additional Data from WWT

			WWT Tracking	Jan-2008	
Date	Time	Gallons	One Day Change	Month To Date	Average Per Day
1-Jan	11:30 PM	1,681,339.0	10,915.9	--	--
2-Jan	11:30 PM	1,686,419.8	5,080.8	5,080.8	5,080.8
3-Jan	11:30 PM	1,696,031.3	9,611.5	14,692.3	7,346.2
6-Jan	11:30 PM	1,701,627.0	5,595.7	20,288.0	6,762.7
7-Jan	11:30 PM	1,707,969.7	6,342.7	26,630.7	6,657.7
8-Jan	11:30 PM	1,717,723.1	9,753.4	36,384.1	7,276.8
9-Jan	11:30 PM	1,725,615.1	7,892.0	44,276.1	7,379.4
10-Jan	11:30 PM	1,731,896.0	6,280.9	50,557.0	7,222.4
13-Jan	11:30 PM	1,742,203.7	10,307.7	60,864.7	7,608.1
14-Jan	11:30 PM	1,749,043.8	6,840.1	67,704.8	7,522.8

Source: WWT Operator Tracking



Benefits of Water Balance

- Determine which processes to concentrate efforts on for reducing & eliminating water usage
- Establishes a baseline over which efficiency improvements can be tracked & benchmarked
- Effective tool to determine & compare economic feasibility of various water use improvement strategies

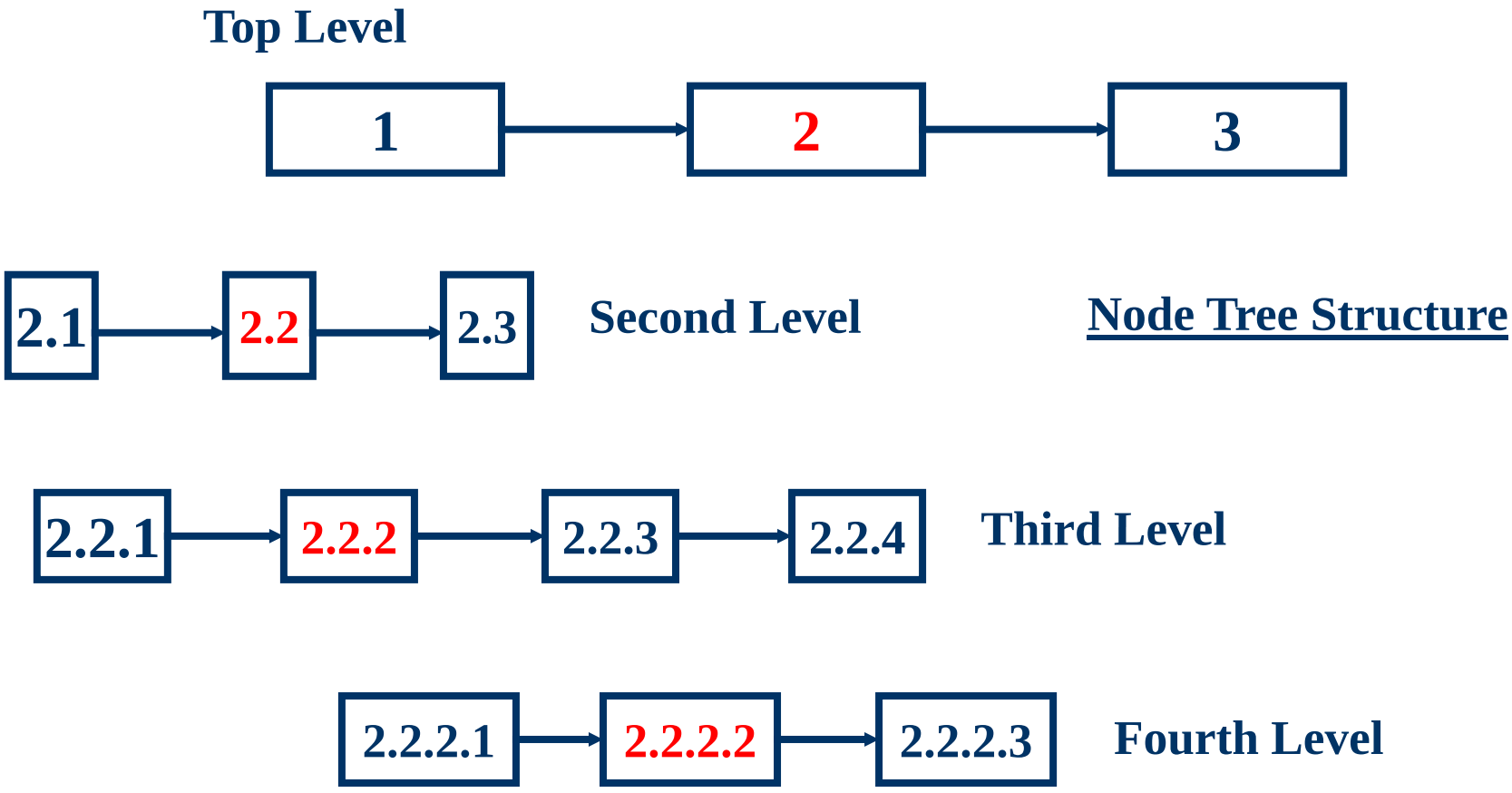
PWM Tools

- **Flowcharts**
  - ✓ Schematic of production path from start to finish
  - ✓ Verify existing or create flowcharts
    - Production line stages
    - Off-line support stages
- **Process Mapping**
  - ✓ Input/output assessment technique
  - ✓ Reveals the known & unknown

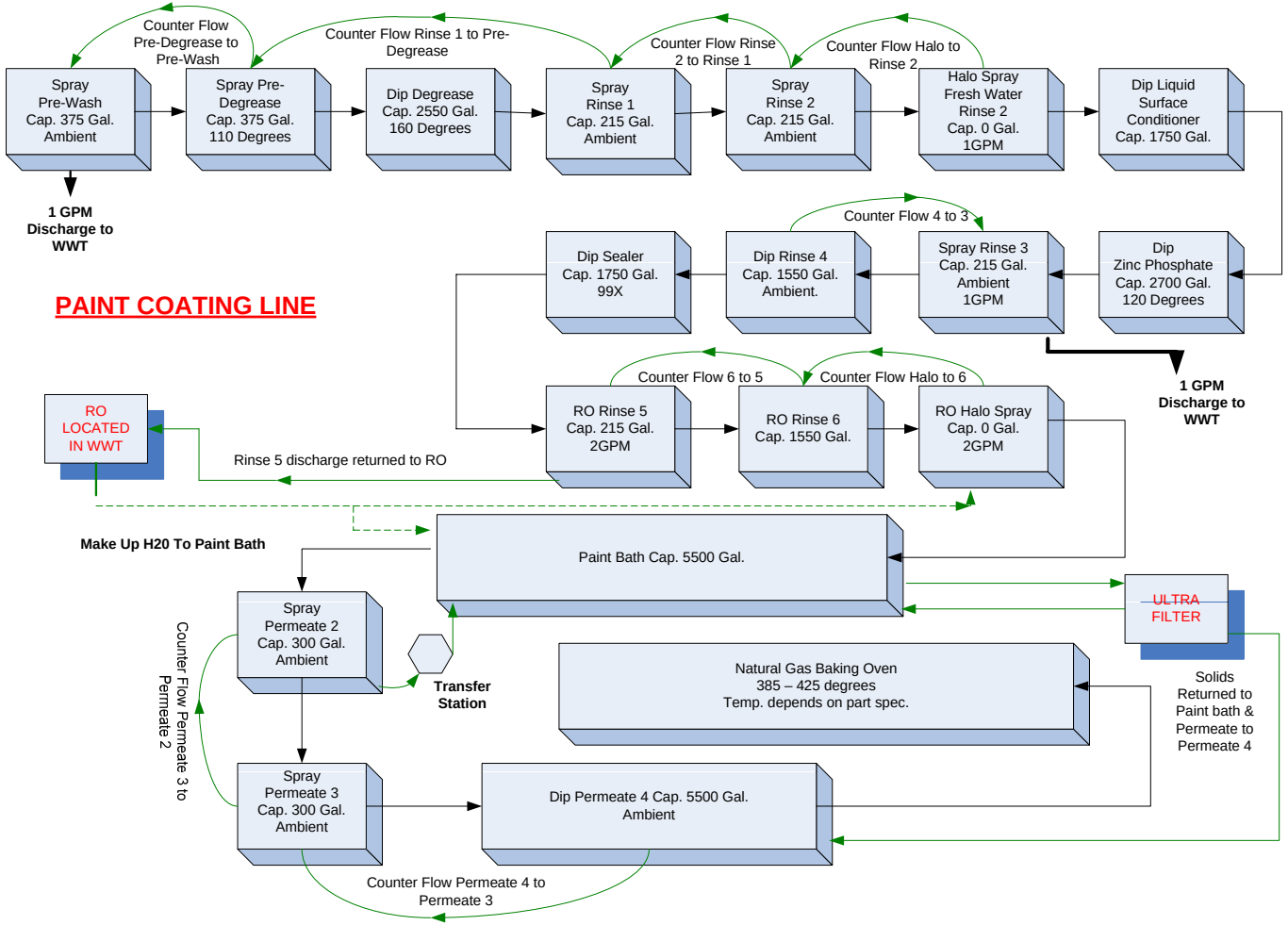
Why Use Process Maps?

- It is challenging to notice everything by simply walking around the organization
- Difficult to see the relationships between work items in different parts of documents
- If you turn your flowchart into a map, you instantly improve your thinking
- Not as busy as process lists, flowcharts & other process diagrams

Hierarchical Process Maps



Calibration with the Client: Understanding Their Systems



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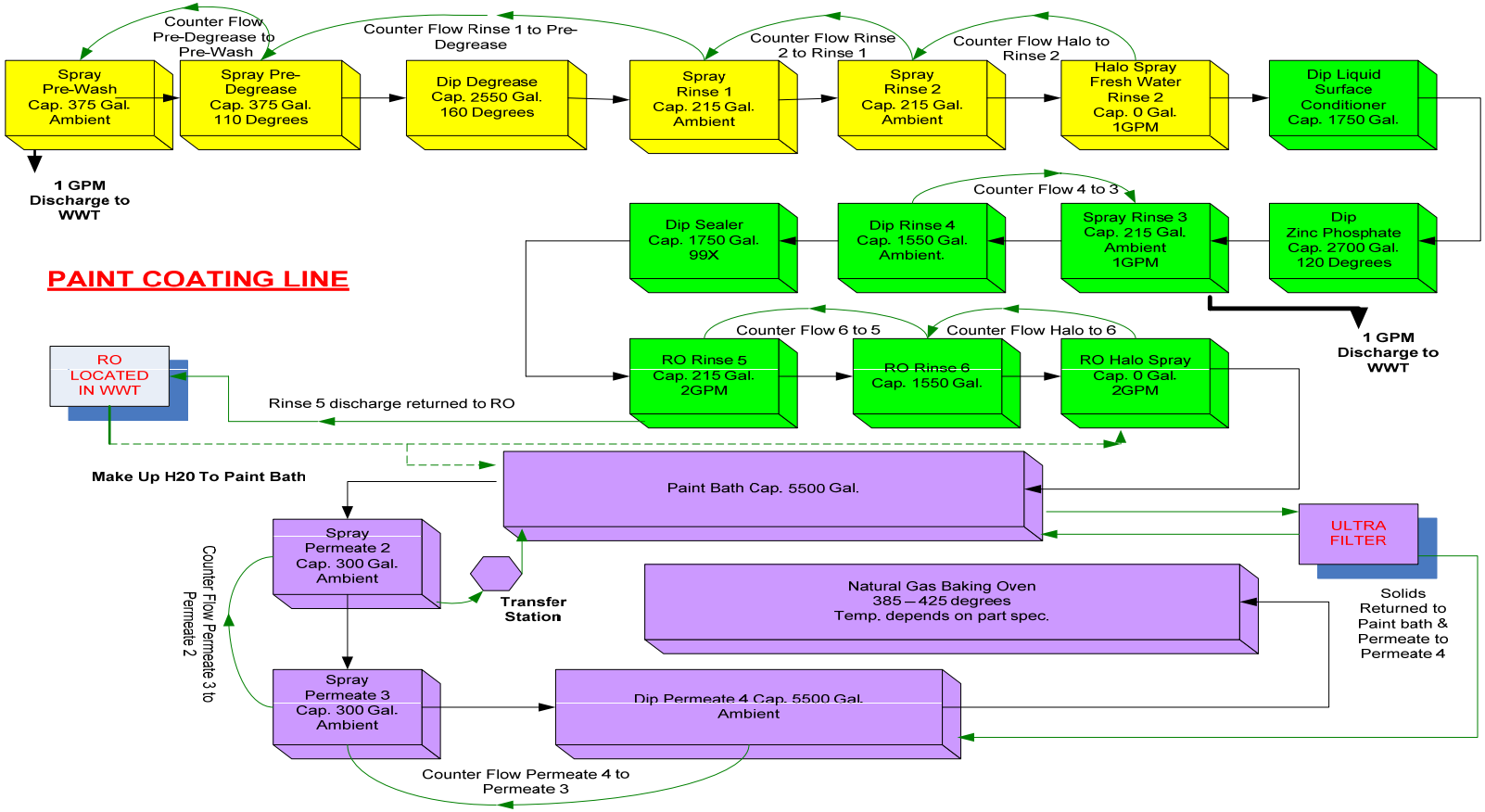
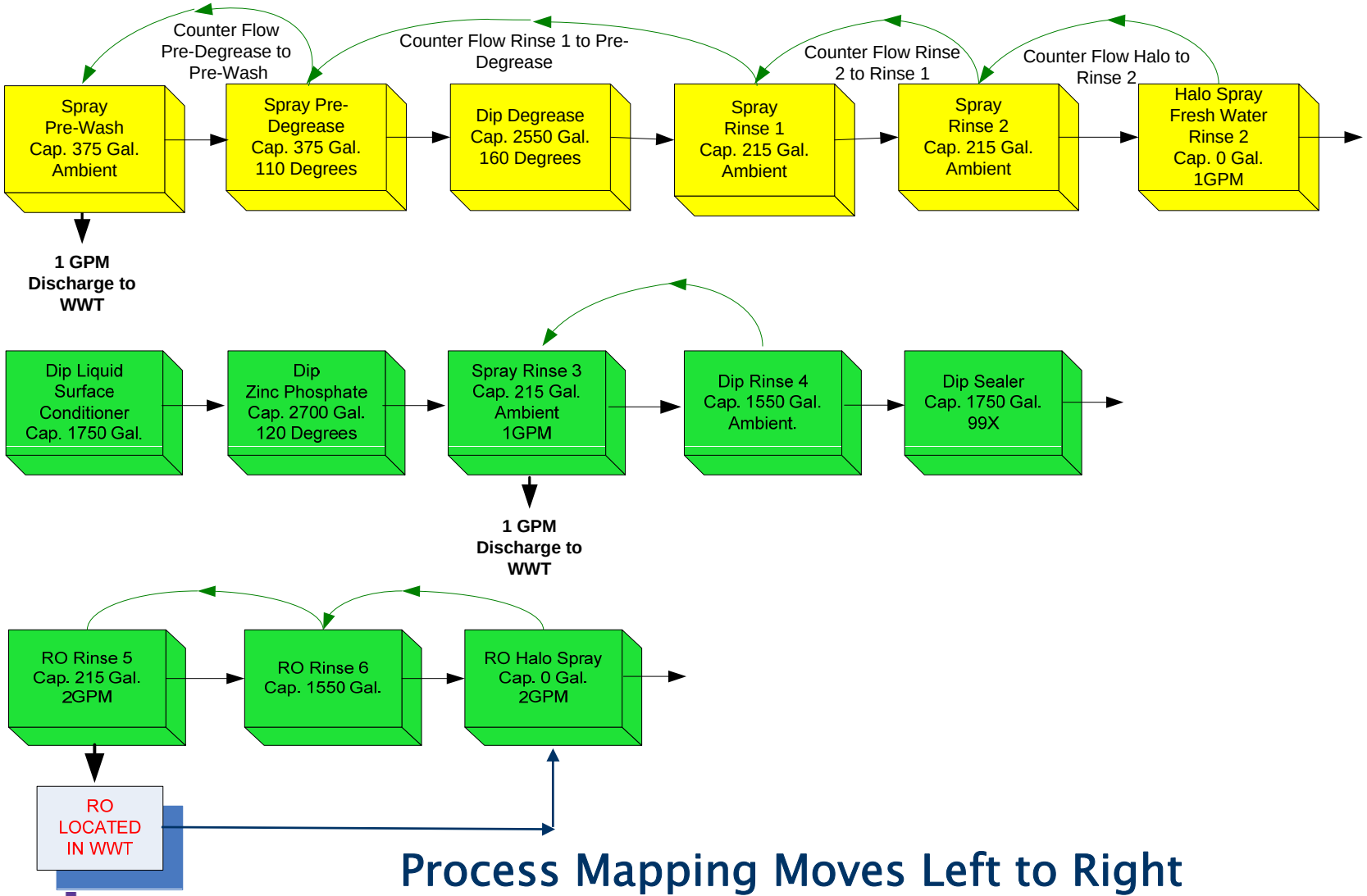
Grouping :Managing Transition to Process Mapping



Paint Coating Line Process Map



Process Mapping Moves Left to Right

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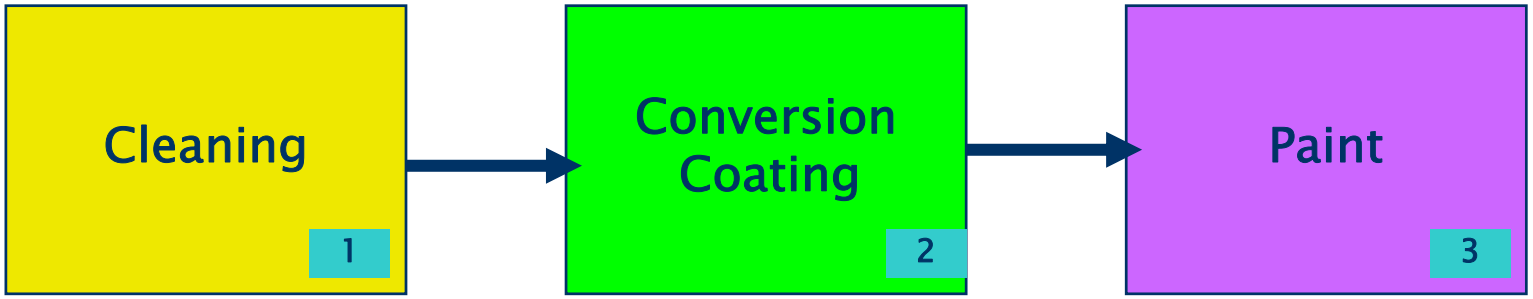
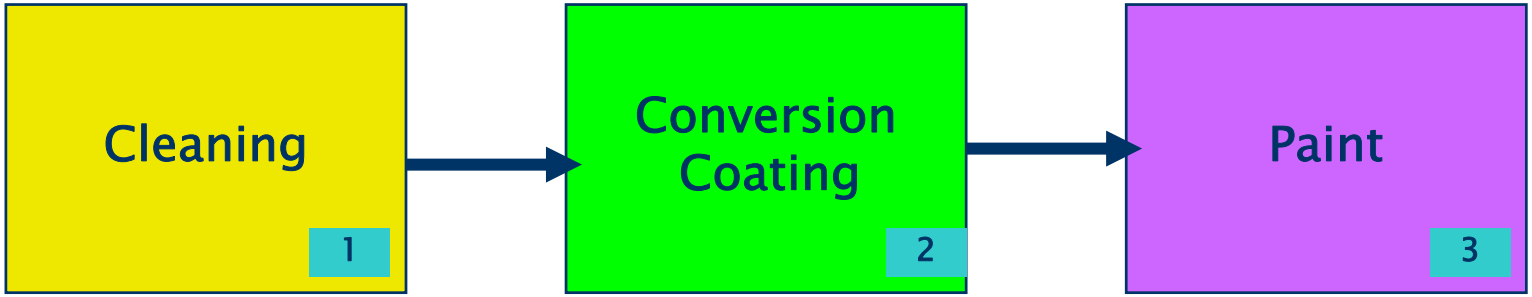
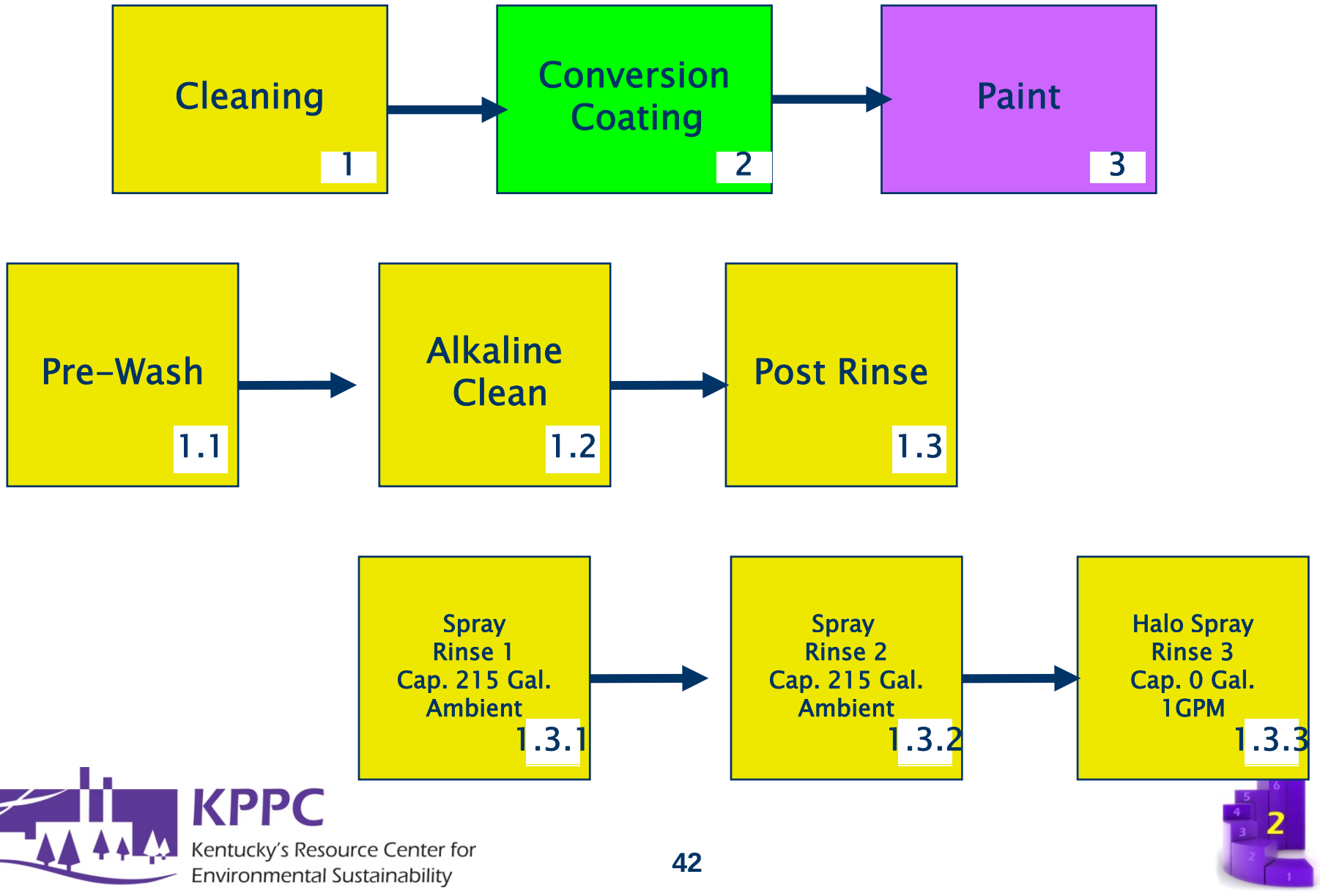
Process Mapping



Process Mapping: 2 Levels

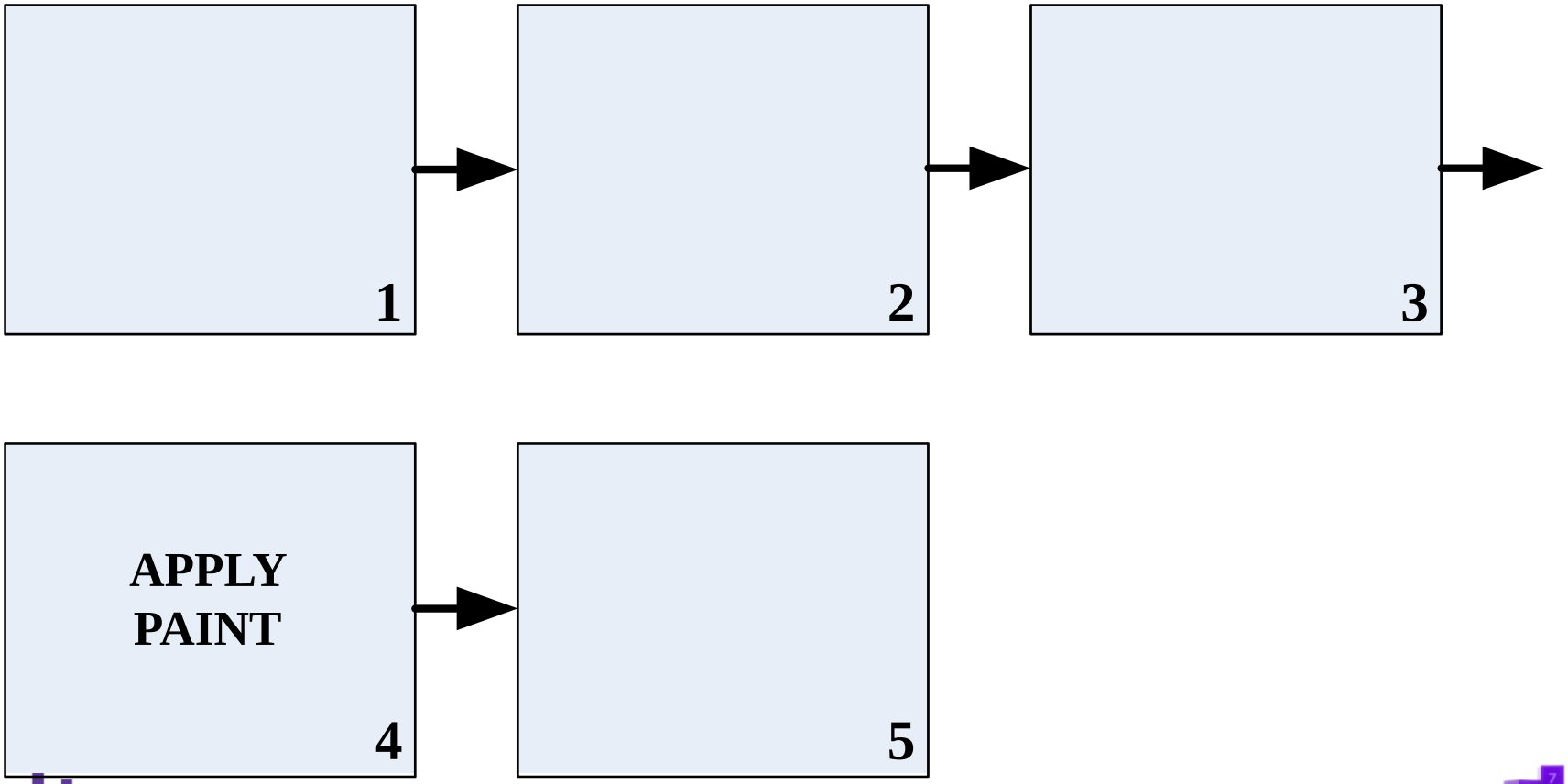


Process Mapping: 3 Levels



Process Map of Painting Activities

What are the 5 main processes or activities associated with painting?



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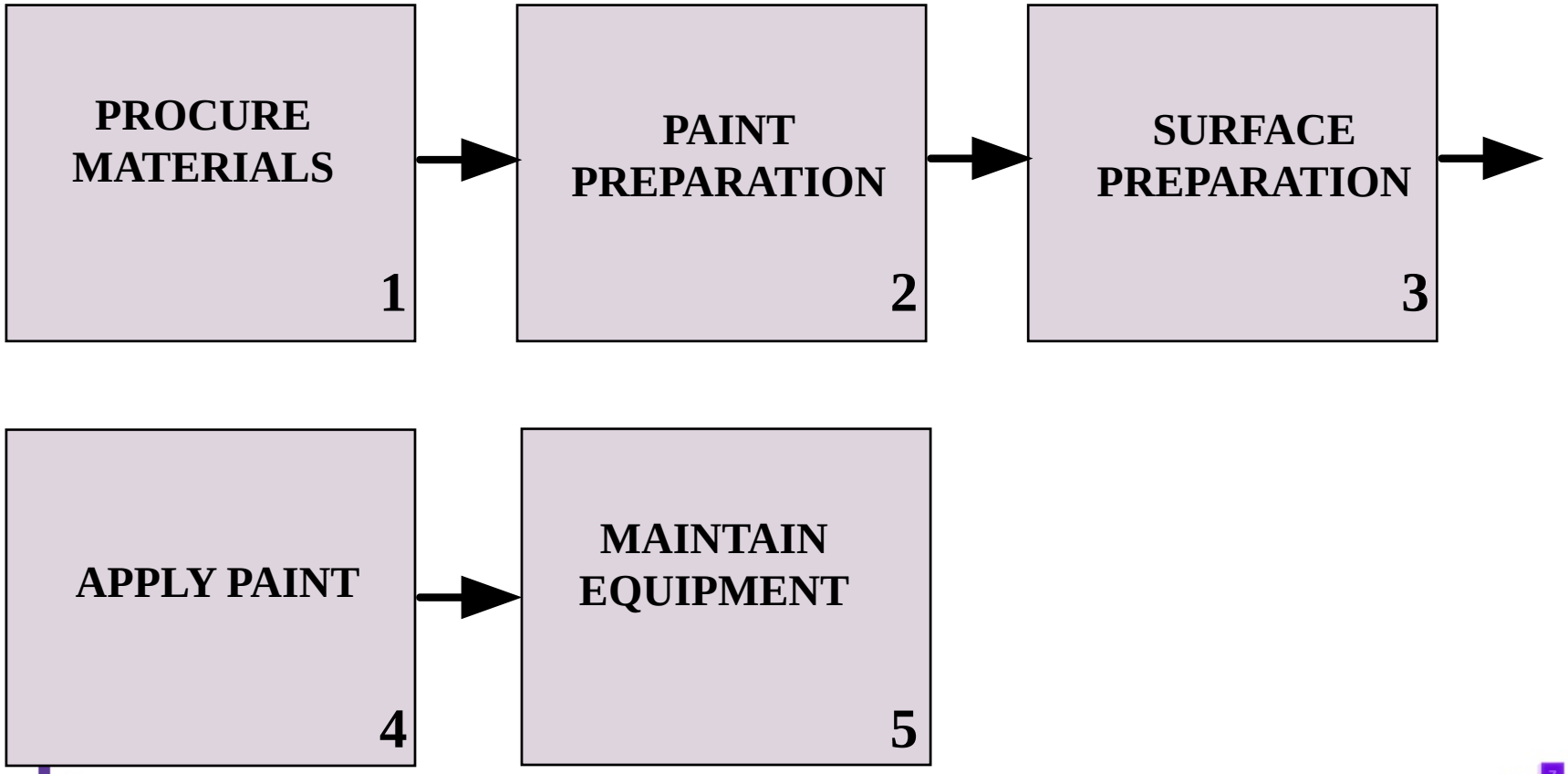

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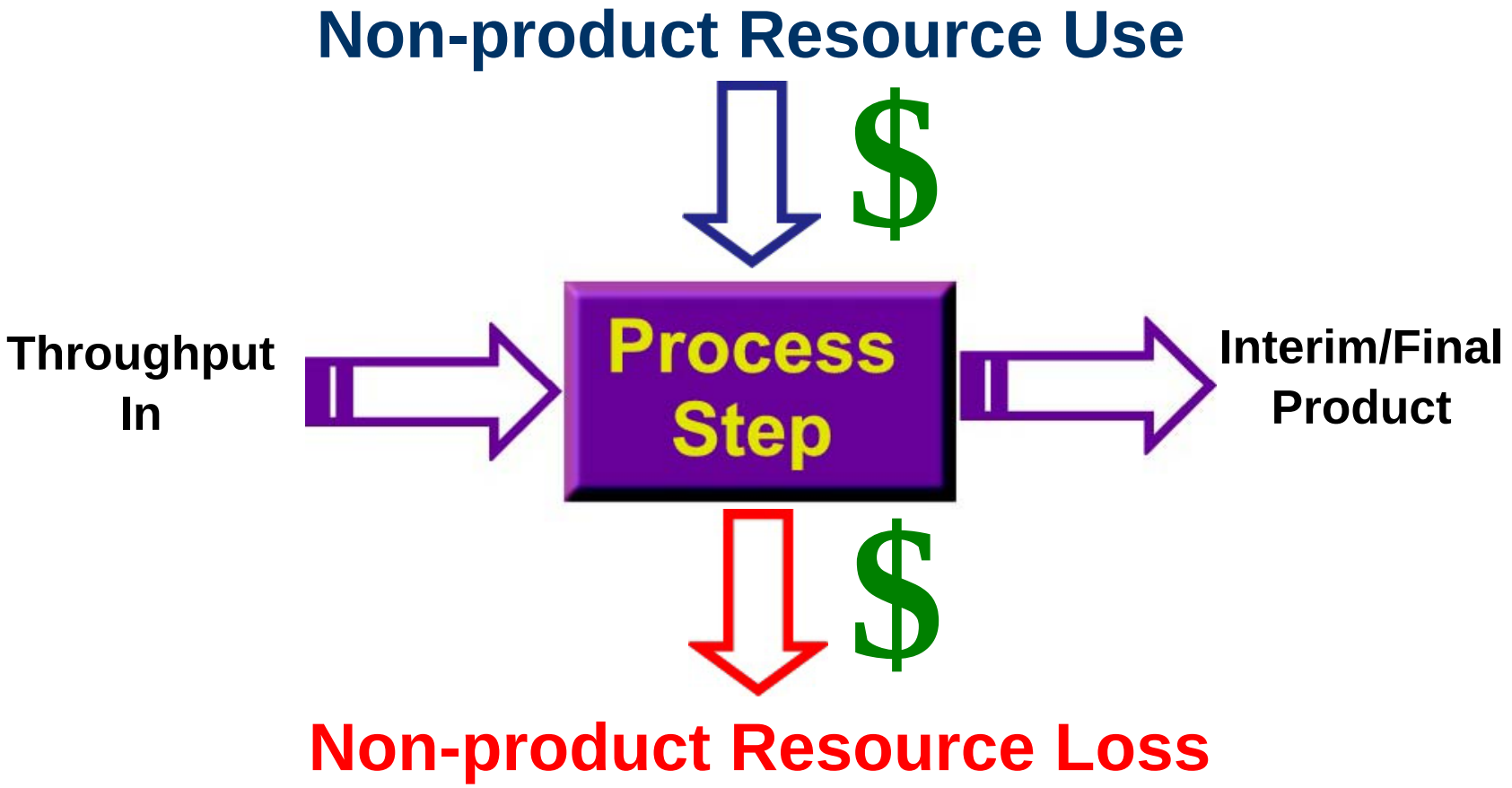
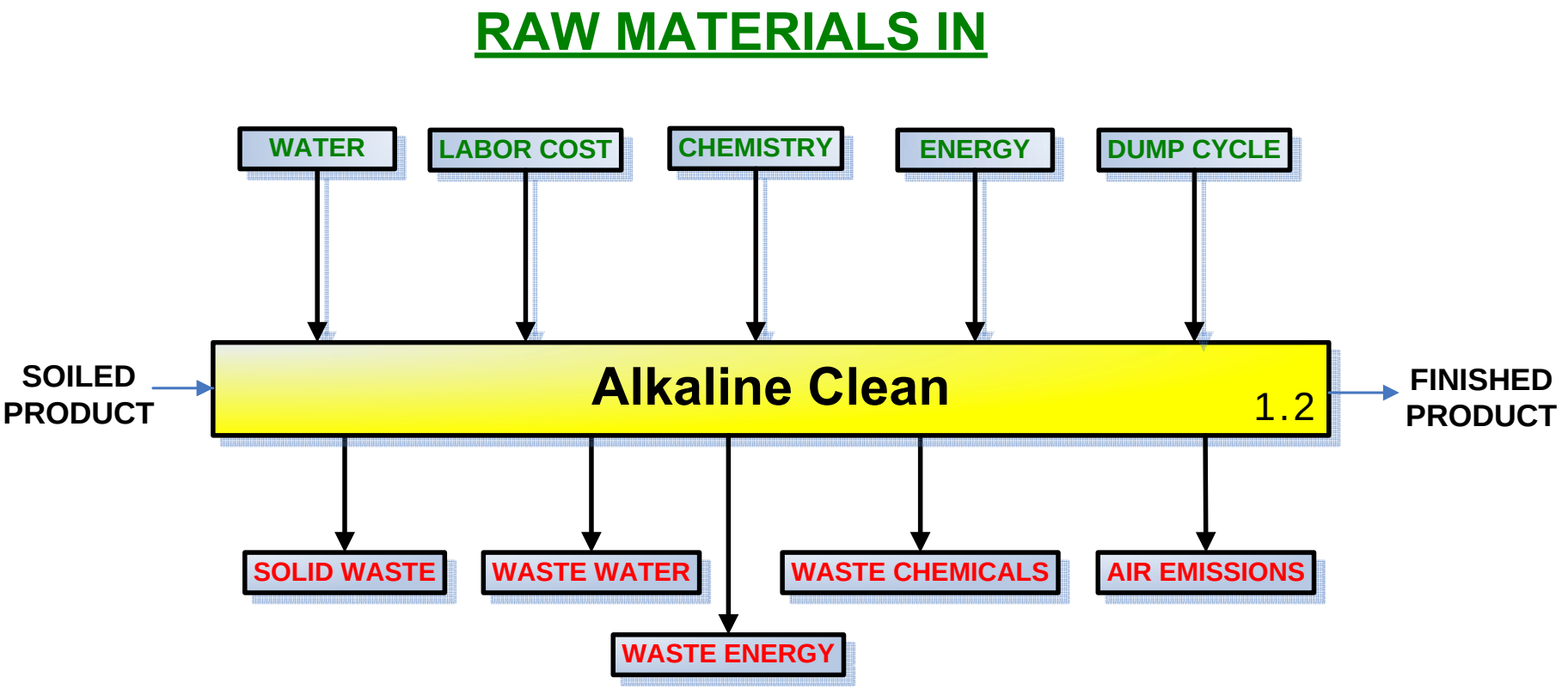
Resource Accounting



Cleaning Station Input/Output Map



Process Station Water Data

PROCESS DETAILS FOR COST OF WATER CALCULATIONS						4/4/2008 11:13		
WATER USES			GALS. OF H20 = Cubic Feet Times 7.4805					
PROCESS DESCRIPTION	Add Ea. Mon.	Add Ea. Mon.		Add Ea. Mon.				
Enter process name below	Monthly	Monthly	Monthly	Monthly	Monthly	Annual	Annual	
	Water IN	Water IN	Water In	Water	Water cost	Water	Water	
Enter process name	Usage	Usage		Usage	Per	Usage Gals.	Cost	
	Cubic Ft.	Gallons	Gallons	Cost	Gallon	To Date	To Date	
WATER								
Cooling water	45,000	336,623	336,623	$673	0.0020	673,245	$1,346	
PreTreatment water--RO	0	0	0	$0	#DIV/0!	0	$0	
Rinse water	60,000	448,830	448,830	$898	0.0020	897,660	$1,795	
Re-circulate water	0	0	0	$0	#DIV/0!	0	$0	
Secondary process re-use	0	0	0	$0	#DIV/0!	0	$0	
Secondary non-process re-us	0	0	0	$0	#DIV/0!	0	$0	
Steam	0	0	0	$0	#DIV/0!	0	$0	
Oil Skimmer	45,000	336,623	336,623	$673	0.0020	673,245	$1,346	
	0	0	0	$0	#DIV/0!	0	$0	
TOTAL	150,000	1,122,075	1,122,075	$2,244	0.0020	2,244,150	$4,488	

Source: KPPC Excel Process Data Gathering Program

Process Station Chemical Data

				Add Ea. Mon	Add Ea. Mon.	Add Ea. Mon	Add Ea. Mon
Unit Size LBS.	Unit Size GALS.	Unit cost per/lb.	Unit cost per/gal.	Monthly Usage LBS.	Monthly Usage GALS.	Monthly Cost LBS.	Monthly Cost GALS.
0	55	0	10	0	55	$0	$550
30	0	5	0	30	0	$150	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
0	0	0	0	0	0	$0	$0
30	55	5	10	30	55	$150	$550
		Annual	Totals	360	660	$1,800	$6,600

Source: KPPC Excel Process Data Gathering Program

Process Station Electrical Data

ELECTRICITY USES			Watt hour	multiply by	0.001 = KWH		
ELECTRICAL			Monthly	Monthly	Monthly	Annual	Annual
EQUIPMENT			Usage	Cost	Cost	Usage	Cost
DESCRIPTION			of	per	of	of kWH	of kWH
			KWH	KWH	KWH	To Date	To Date
Delivery Pump(s)			Add Ea. Mon.		Add Ea. Mon		
			650	1.6	$1,040	7,800	$12,480
			0	0	$0	0	$0
			0	0	$0	0	$0
			0	0	$0	0	$0
			0	0	$0	0	$0
TOTAL THIS GROUP			650		$1,040	7,800	$12,480

Source: KPPC Excel Process Data Gathering Program

Typical Process Findings: Usage & Costs

- ✓ Supplied water – price per gallon or cubic foot
- ✓ Sewer discharge price
- ✓ Water usage – GPM input & output
- ✓ Chemical costs
- ✓ Dump cycles/cleaning frequency
- ✓ Electrical & maintenance costs
- ✓ Waste water generated & treatment cost
- ✓ Other wastes & environmental impacts
- ✓ Heat energy (Gas, Boiler, etc.)

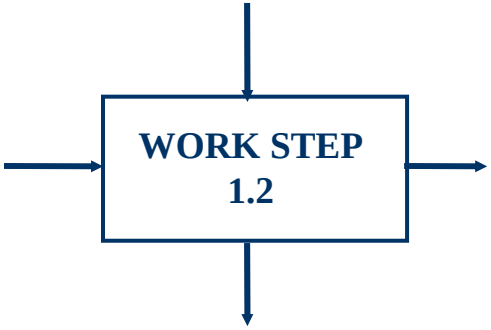
Data Clarification/Verification

- **What happens once flowcharts & data are developed & collected?**
  - ✓ **Obtain agreement through review with:**
    - **Operators**
    - **Quality control**
    - **Vendors**
    - **Engineering**
    - **Accounting**
- **What do we do with collected data?**
  - ✓ **Develop method for using data:**
    - **Calculations**
    - **Understanding**
    - **Applying data to PWM**

Resource Accounting Sheet

DESCRIPTION OF WORK STEP

NON-PRODUCT RESOURCE INPUTS



NON-PRODUCT RESOURCE LOSSES

SPREAD SHEETS: RESOURCE ACCOUNTING
COST ACCOUNTING

DATA BASES: SUPPORTING PROCESSES
REGULATORY ISSUES
EQUIPMENT
SOP's and BMP's
EMS ASPECTS

Process Water Management (PWM)

Set Goals

- ✓Performance goals
- ✓Clear & measurable goals
- ✓Guide daily decision-making

Goals, Objectives & Targets

- ✓ **Benchmarking Objectives (Reduction from 2008 levels)**
  - **water usage & cost** **10%**
  - **chemical usage & cost** **15%**
  - **sewer cost** **10%**
  - **energy usage & cost** **10%**

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Set Goals

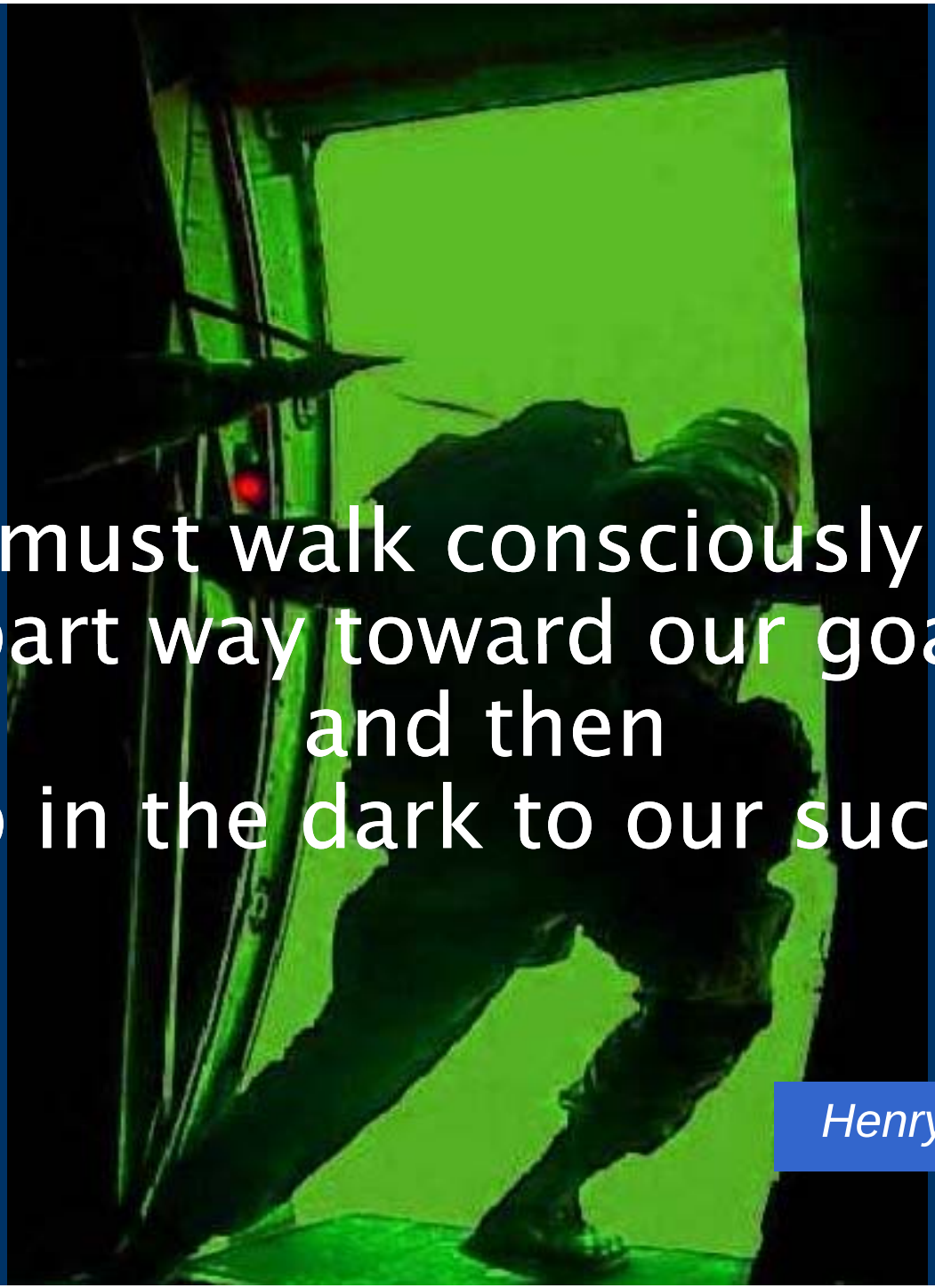
- **Performance goals**
  - ✓ Drivers for energy & water management activities
  - ✓ Promote continuous improvement
- **Setting clear & measurable goals**
  - ✓ Critical for understanding intended results
  - ✓ Developing effective strategies
  - ✓ Reaping financial gains
- **Well-stated goals**
  - ✓ Guide daily decision-making
  - ✓ Basis for tracking & measuring progress

Goals, Objectives & Targets

- **Objectives – overall environmental goals an organization sets out to achieve (attainable)**
  - ✓ **Develop procedures & work instructions to *Control* processes**
  - ✓ **Develop programs to *Improve* processes**
  - ✓ **Develop programs to *Investigate* feasibility for improvements**
- **Targets – detailed performance requirements that are set & met to achieve the environmental objectives (reasonable)**

Action Plan Example

7 Step Planning Program	Planning Date					
Step	Task	Status	Start	Finish	Complete	Responsible
3. Set Goals						
3.1 Alkaline Clean	Reduce water usage by 10%	Open	2/1/2008	4/1/2008		Team
	Reduce chemcial usage by 15%	Open	2/1/2008	4/1/2008		Team
	Reduce sewer cost by 10%	Open	2/1/2008	4/1/2008		Team
	Reduce energy usage by 10%	Open	2/1/2008	4/1/2008		Team
	Reduce wastewater cost by 10%	Open	2/1/2008	4/1/2008		Team



We must walk consciously only
part way toward our goal,
and then
leap in the dark to our success.

Henry David Thoreau

Process Water Management (PWM)

Create Action Plan

- ✓Roadmap to improve water use performance
- ✓Ensures a systematic process
- ✓Regularly updated to reflect achievements

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Create Action Plan

- ❑ **Roadmap to improving performance**
- ❑ **Successful organizations use action plans to:**
  - ✓ Ensure a systematic process
  - ✓ Implement water performance measures
  - ✓ Support goals & objectives
- ❑ **Action Plans are regularly updated to reflect:**
  - ✓ Recent achievements
  - ✓ Changes in performance
  - ✓ Shifting priorities, interests & drivers
  - ✓ Behavioral changes → sustainability

Action plan should:

- Identify person & job responsibilities for ensuring plans completion (define roles & provide authority)
- Identify specific activities (tasks & sub-tasks)
- Set deadlines for each of the identified activities/tasks

Create PWM Checklists

- **Process station checklist:**
  - ✓GPM – in & out
  - ✓Retention time/cleaning frequency
  - ✓Chemicals
- **Technology application checklist:**
  - ✓Conductivity controller
  - ✓Back flow system
  - ✓Secondary use potential w/out modification
- **Chemical substitute checklist:**
  - ✓Lower cost
  - ✓Environmentally friendly
  - ✓Less treatment demands

Technology Determination Checklist

TDI DETERMINATION CHECKLIST				4/1/2008 15:35				
STAGE NUMBER	PROCESS STATION DESCRIPTION	CONDUCTIVITY CONTROLLERS	COUNTERFLOW RINSES	FLOW RESTRICTORS	CHEMICAL UPGRADE	OILSEPARATOR/ SKIMMERS	ULTRA FILTER SYSTEM	TEMPERATURE REDUCTIONS
Process Station 1	RINSE-0VERFLOWING							
Process Station 2	RINSE-0VERFLOWING							
Process Station 3	RINSE-0VERFLOWING							
Process Station 4	RO H20 DISCHARGE							
RO Unit								
Multi-Stage Washer								
Spinner Washer								

Tracking Processes Example

7 Step Planning Program	Planning Date					
Step	Task	Status	Start	Finish	Complete	Responsible
4. Create Action Plan						
4.1Line A						
4.1.1 Process Station 1	Obtain current data on this statior	Open	2/12/2008	3/12/2008		Jim Brown
4.1.2 Process Station 2	Obtain current data on this statior	Open	2/12/2008	3/12/2008		Jim Brown
4.1.3 Process Station 3	Obtain current data on this statior	Open	2/12/2008	3/12/2008		Jim Brown
4.1.1 Process Station 1	Research Technology Options	Open	2/28/2008	3/28/2008		Jim Brown
4.1.2 Process Station 2	Research Technology Options	Open	2/28/2008	3/28/2008		Jim Brown
4.1.3 Process Station 3	Research Technology Options	Open	2/28/2008	3/28/2008		Jim Brown

Process Water Management (PWM)

Implement Action Plan

- ✓Investigate & verify options
- ✓Develop & justify capital investment
- ✓Develop a timeline
- ✓Identify resources

Implement Action Plan

- **Rinse or Cooling Water**
  - ✓ **Purchase and install input/output flow meter**
  - ✓ **Purchase and install conductivity controller**
  - ✓ **Test substitute chemical**
  - ✓ **Ongoing monitoring & measuring**

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Implementing Action Plans

- **Clearly outline the following elements:**
  - ✓ **Means to accomplish your objective & target (human, financial & technology)**
  - ✓ **Specify the necessary employee training (skills), communication & outreach activities to ensure successful implementation of the plan**
  - ✓ **Lessons learned from performance improvements**
- **Update for changes in activities, processes or raw material usage**

Implementation Program

- **Technology options:**
  - ✓Identify and verify options
  - ✓Develop & justify capital investment
- **Team member responsibility:**
  - ✓Develop a timeline
  - ✓Identify resources
  - ✓Investigate alternate chemicals/materials
  - ✓Investigate post secondary water uses
  - ✓Verify data calculations
  - ✓Other tasks based on Step 2 information
  - ✓Support the goals & objectives

Implement Action Plan

5	Implement Action Plan			
5.1	Create communication plan for employees, customers & stakeholders	GREEN	1-Dec-07	31-Mar-08
5.2	Raise awareness with energy facts & figures (E2 Tips in Internal Communication)	GREEN	1-Dec-07	31-Mar-08
5.3	Build capacity through training & best practices	GREEN	1-Dec-07	15-May-08
5.4	Motivate with incentives & recognition	GREEN	1-Dec-07	31-May-08
5.5	Track and Monitor - update, review & identify necessary corrective actions	GREEN	1-Dec-07	15-Jun-08
5.6	Consider Purchasing ENERGY STAR labeled equipment	GREEN	1-Dec-07	15-Jun-08
5.7	Consider Designing new facilities to ENERGY STAR specifications	GREEN	1-Dec-07	15-Jun-08
5.8	Consider Implementing KY National Energy Education Development (NEED) program	GREEN	1-Dec-07	15-Jun-08
5.9	Consider Becoming a KY School Plant Management Association (KSPMA) member	GREEN	1-Dec-07	15-Jun-08

Action Plan Example

7 Step Planning Program	Planning Date					
Step	Task	Status	Start	Finish	Complete	Responsible
5. Implement Action Plan						
5.1 Line A						
5.1.1 Process Station 1	Verify payback	Open	3/20/2008	4/1/2008		Joe Louis
5.1.2 Process Station 2	Verify payback	Open	3/20/2008	4/1/2008		Joe Louis
5.1.3 Process Station 3	Verify payback	Open	3/20/2008	4/1/2008		Joe Louis

Process Water Management (PWM)

Evaluate Progress

- ✓Review water use data & activities
- ✓Compare effectiveness to performance goals
- ✓Document “best practices”
- ✓Create new action plans
- ✓Set new performance goals

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Evaluate Progress

- **Evaluating progress includes:**
  - ✓ Formal review of water use data & activities
  - ✓ Compares it to your performance goals
- **Review should include:**
  - ✓ Looking at effectiveness
  - ✓ What activities & projects were successful
  - ✓ Documenting “best practices”
  - ✓ Goals that were not met (determine root cause, decide corrective & preventative actions)
- **Formal review process results are used to:**
  - ✓ Create new action plans
  - ✓ Set new performance goals

Continual Improvement Cycle

- ✓ Educate & understand
- ✓ Monitor & measure
- ✓ Maintain & calibrate
- ✓ Track & document
- ✓ Improve & advance
- ✓ Investigate other technologies
- ✓ Review other company successes

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Measuring & Managing is Important

❑ Opinion Leader Quotes:

- ✓ **"**Internal metering at multiple points **is the most helpful assessment tool to determine water use."**

  Bristol-Myers Squibb

- ✓ **"The** cost savings **from proposed water conservation measures often provide the additional funds needed to** achieve paybacks **from energy efficiency upgrades in a reasonable period."**

  Johnson Controls

- ✓ **"Health, safety and environmental personnel found that** employee education **was key to the plant's success,** making wise water use a habit."

  Gerber Products

Action Plan Example

7 Step Planning Program	Planning Date					
Step	**Task**	**Status**	**Start**	**Finish**	**Complete**	**Responsible**
6. Evaluate Progress						
6.1 Line A						
6.1.1 Process Station 1	Verify technology is working	Open	6/1/2008	Ongoing		John Brown
6.1.1 Process Station 1	Verify technology is working	Open	6/1/2008	Ongoing		John Brown
6.1.1 Process Station 1	Verify technology is working	Open	6/1/2008	Ongoing		John Brown

Process Water Management (PWM)

Recognize Achievements

- ✓Facility, team & individuals
- ✓Water use & cost reductions
- ✓Discharge/pollution reductions
- ✓State & National Recognition & Awards Programs

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Recognize Achievements

- ❑ Facility/team/individual success
- ❑ Financial rewards
- ❑ Competitive advantages
- ❑ Community recognition
- ❑ Environmental performance:
  - ✓ Pollution prevention
  - ✓ Energy savings
  - ✓ Water savings
  - ✓ Emissions reduction
  - ✓ Other

PWM Management Review

- **Review should address:**
  - ✓ **Environmental performance against the objectives & targets**
  - ✓ **Policy's suitability**
  - ✓ **PWM assessment & evaluation of water use reduction results & cost savings**
  - ✓ **Status of corrective & preventive actions**
  - ✓ **Recommendations for improvement**

Step 7 Action Plan Example

7 Step Planning Program	Planning Date					
Step	Task	Status	Start	Finish	Complete	Responsible
7. Recognize Achievements						
7.1 Line A						
7.1.1 Process Station 1	Recognize Technology Success	Open	8/1/2008	8/10/2008		Plant Manager
7.1.1 Process Station 1	Recognize Technology Success	Open	8/1/2008	8/10/2008		Plant Manager
7.1.1 Process Station 1	Recognize Technology Success	Open	8/1/2008	8/10/2008		Plant Manager

7 Step Action Plan Example

7 Step Planning Program	Planning Tracking						
Step	Task	Status	Start	Finish	Completed	Responsible	Resource(s)
1. Commitment to Continual Improvement	Cross Functional Team						
1.1 Identify Cross Functional Team							
	John Smith-Plant Manager	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
	Jim Hogue-Controller	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
	John Brown-Production Manager	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
	Joe Louis-EHS Manager	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
1.2 Create a Water Conservation Policy							
1.2.1 Write Water Policy	John Smith-Plant Manager	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
	Jim Hogue-Controller	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
	John Brown-Production Manager	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
	Joe Louis-EHS Manager	DONE	2/12/2008	2/28/2008	2/28/2008	Team	Team Members
2. Assess Performance & Opportunties							
2.1 Line A-Rinse Station 1							
2.1.1 Process Station 1	Measure input & output GPM	Open	2/12/2008	3/12/2008		Jack Brown	Portable Flowmeter-Engineering
2.1.2 Process Station 2	Measure input & output GPM	Open	2/12/2008	3/12/2008		Jack Brown	Portable Flowmeter-Engineering
2.1.3 Process Station 5	Measure input & output GPM	Open	2/12/2008	3/12/2008		Jack Brown	Portable Flowmeter-Engineering
2.1.4 Process Station 1	Verify water in & out flowchart	Open	2/12/2008	3/12/2008		Jim Smith	See Engineering for drawing
3. Set Goals							
3.1 Line A-Rinse Station 1	Reduce water usage by 15%	Open	2/1/2008	4/1/2008		Team	Accounting records/other data
	Reduce sewer cost by 10%	Open	2/1/2008	4/1/2008		Team	Accounting records/other data
	Reduce energy usage by 10%	Open	2/1/2008	4/1/2008		Team	Accounting records/other data
4. Create Action Plan							
4.1Line A-Rinse Station 1							
4.1.1 Process Station 1	Obtain current data on this station	Open	2/12/2008	3/12/2008		Jim Brown	Accounting & other records
4.1.2 Process Station 2	Obtain current data on this station	Open	2/12/2008	3/12/2008		Jim Brown	Accounting & other records
4.1.3 Process Station 3	Obtain current data on this station	Open	2/12/2008	3/12/2008		Jim Brown	Accounting & other records
5. Implement Action Plan							
5.1 Line A-Rinse Station 1							
5.1.1 Process Station 1	Verify payback	Open	3/20/2008	4/1/2008		Joe Louis	Accounting Dept.
5.1.2 Process Station 2	Verify payback	Open	3/20/2008	4/1/2008		Joe Louis	Accounting Dept.
5.1.3 Process Station 3	Verify payback	Open	3/20/2008	4/1/2008		Joe Louis	Accounting Dept.
6. Evaluate Progress							
6.1 Line A-Rinse Station 1							
6.1.1 Process Station 1	Verify technology is working	Open	6/1/2008	Ongoing		John Brown	Production Manager/Accounting
6.1.1 Process Station 1	Verify technology is working	Open	6/1/2008	Ongoing		John Brown	Production Manager/Accounting
6.1.1 Process Station 1	Verify technology is working	Open	6/1/2008	Ongoing		John Brown	Production Manager/Accounting
7. Recognize Achievements							
7.1 Line A-Rinse Station 1							
7.1.1 Process Station 1	Recognize Technology Success	Open	8/1/2008	8/10/2008		Plant Manager	Accounting Dept.

Water Conservation Technologies & Practices

Cam Metcalf, Executive Director

2nd International Workshop
Advances in Cleaner Production
May 20, 2009

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UNIVERSITY OF LOUISVILLE
J.B. SPEED SCHOOL OF ENGINEERING

Leveraging P2: Technology Diffusion

- Develop programs to ***Investigate*** feasibility for improvements
- Final Report on Pilot Study:
  - ⇨ Develop quality control instructions
  - ⇨ Calibration procedures
- Full-Scale Implementation

- Determine Actual Results & Overall Cost Savings of Project
- Finish the "Action Plan" with Lessons Learned
- Technology Diffusion/Demonstration/Transfer/Deployment

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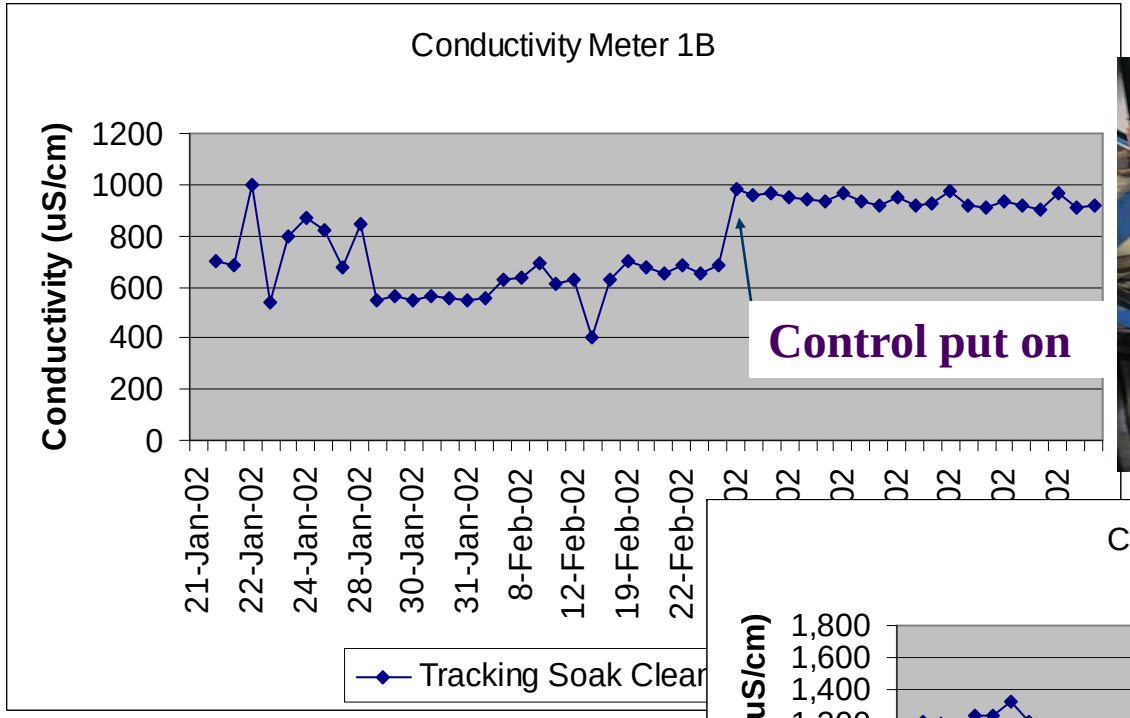
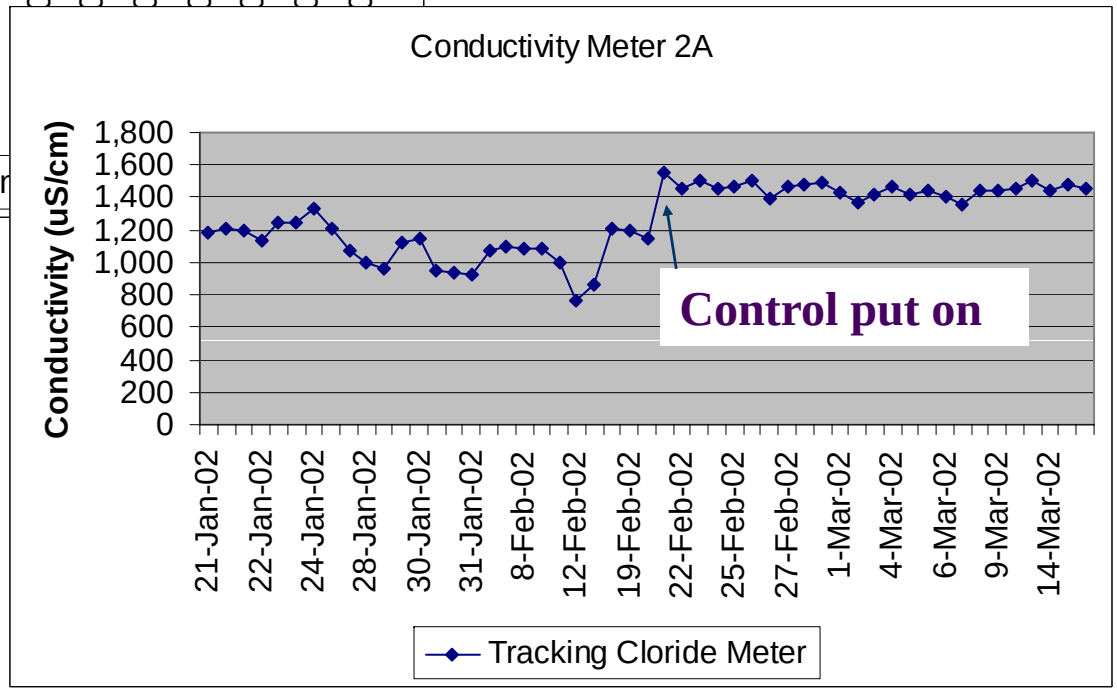
EPA WATER EFFICIENCY LEADER AWARD

Common Process Water Technologies

- **Conductivity controllers**
  - ✓ Better rinse water management
- **Counter flow rinses**
  - ✓ Efficient rinse water use
- **Flow restrictors**
  - ✓ Minimize rinse water usage
- **Chemical upgrade**
  - ✓ New technologies help reduce water consumption

Operational Control & Monitoring & Measurement





EPA WATER EFFICIENCY LEADER AWARD

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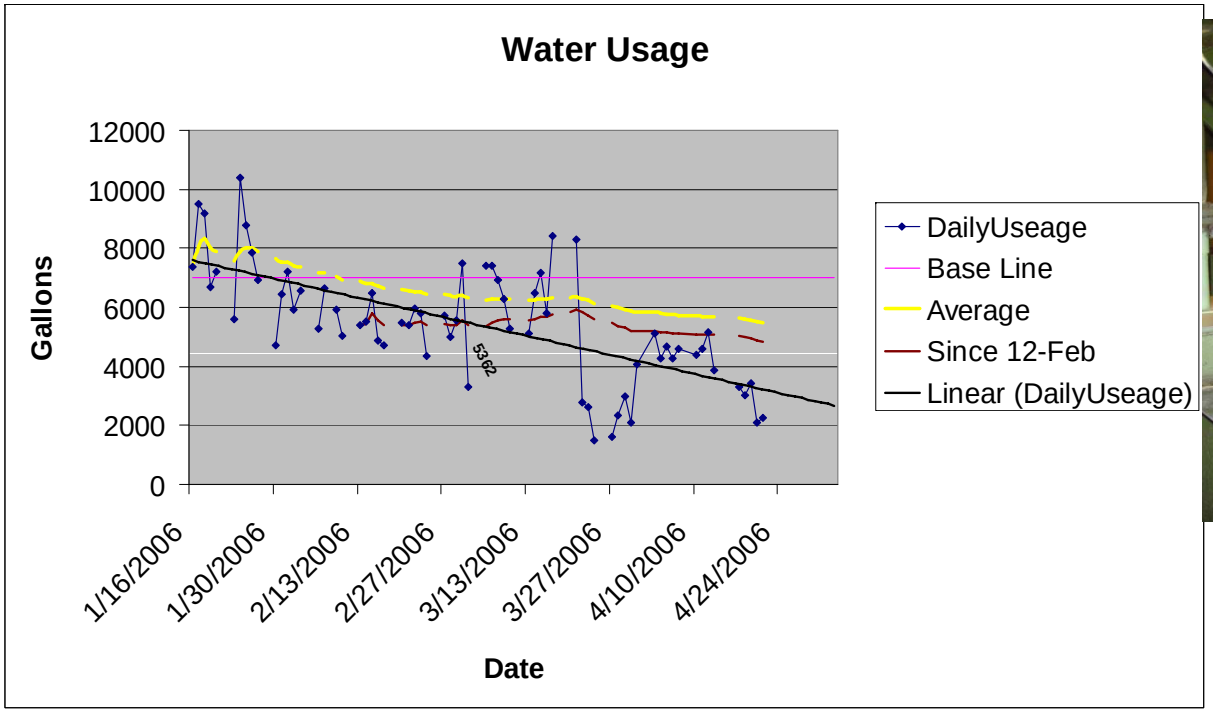
Conductivity Rinse Water Controllers for Electro Deposition Paint Line

Automobile Parts Manufacturer

- **Before trial used 7,600 GPD**
- **After 3 months trending to 2,700 GPD**
- **Conserves water resources**
- **Saves money in treatment chemicals & sludge hauling**



EPA WATER EFFICIENCY LEADER AWARD

Two & Three Stage Conductivity Controlled Rinse Tanks

EPA WATER EFFICIENCY LEADER AWARD

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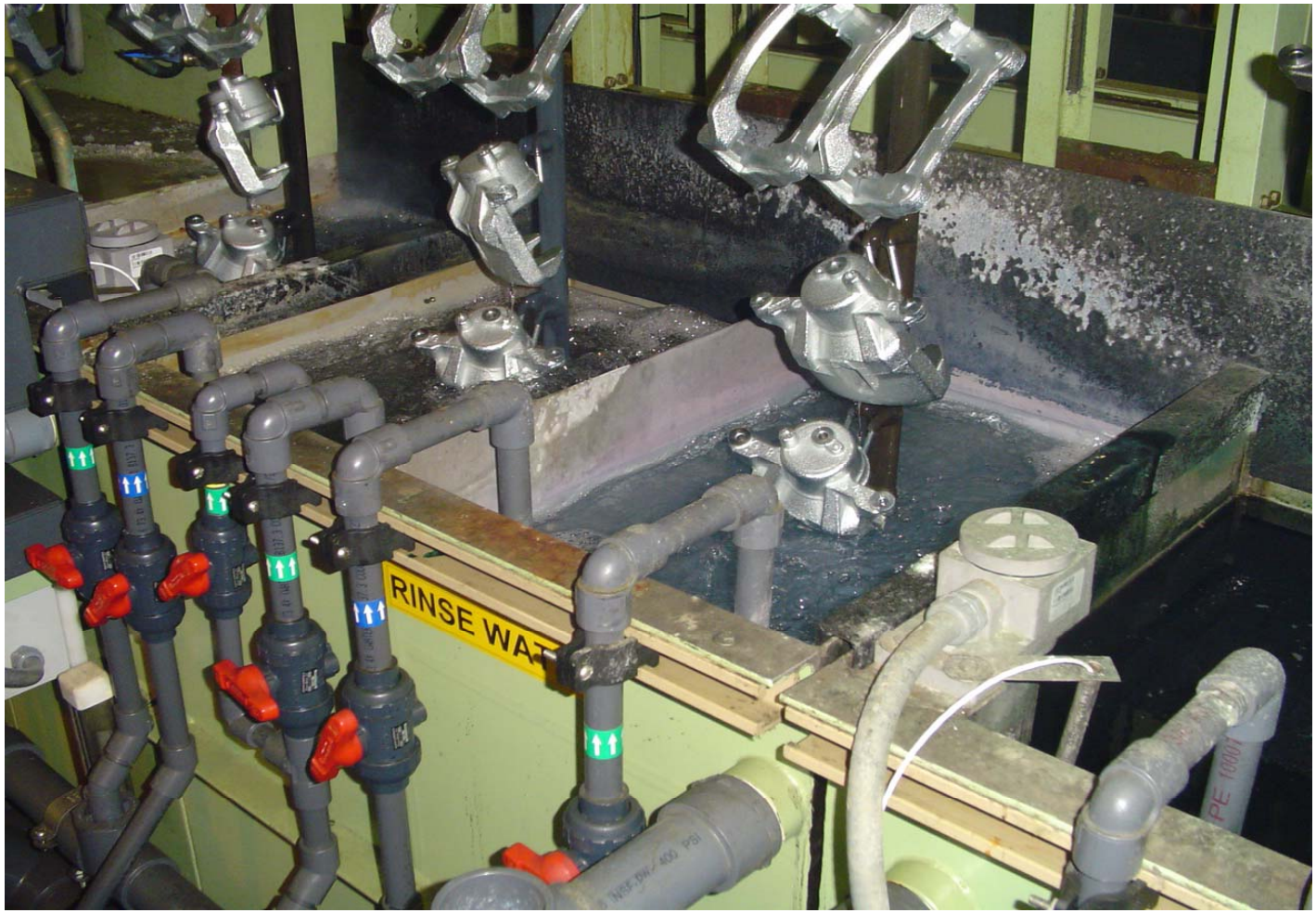
Two Stage Counter Flow Rinse



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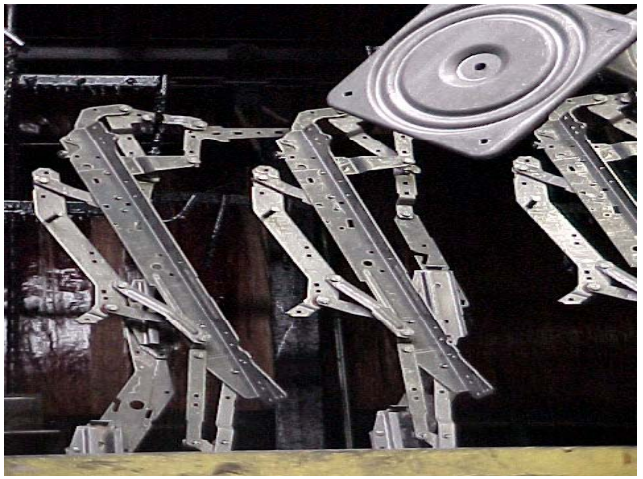
EPA WATER EFFICIENCY LEADER AWARD

Low Temperature Conversion Coating

Manufacture of Reclining Chair Parts

- **Previously used high temperature multi-step phosphated process**
- **Successfully trialed single step non-phosphated experimental material at ambient temperatures**
  - ✓ **Reduced H_2O usage from 93,000 g/yr to 13,000 g/yr or ~ 86% (NO DRAINS)**
  - ✓ **No sludge technology/minimize solid waste**
  - ✓ **Tank life extended from 7 wks. to 18 wks.**
- **Substituted water-based paint (cures @ 225^{O}F) for solvent-based paint (cures @ 325^{O}F)**
- **Saved $200,000 in energy (2005 prices)**
- **Improved quality performance**



Processed parts to paint

Cross hatch adhesion test

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EPA WATER EFFICIENCY LEADER AWARD

Common Process Water Technologies

- **Oil separators/skimmers**
  - ✓ Extends dump cycles
  - ✓ Cleaner rinses mean less over-flow
- **In-process recycling with ultra-filters**
  - ✓ Extended bath life
  - ✓ Cleaner rinses means less over-flow
- **Nozzle alignment-maintenance attention**
  - ✓ Reduce cross contamination
- **Reduce “once through cooling”**
  - ✓ Re-use upstream
  - ✓ Install chiller

Extended Acid Pickle Tank Life

Zinc Plating Job Shop

- Contaminants build up causing high HCl acid consumption
- Trialed new acid additive technology to remove metals & extend acid life
- Monitored results with atomic absorption analyzer
- Some success with zinc noted
- Test inconclusive due to customer objection to changes

Adding additive to HCl pickle bath

Typical atomic adsorption screen

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ELECTROLESS NICKEL PLATING BATH TREATMENT

Reduce Nickel Concentration by 90% in Spent Plating Baths

Plate Out the Spent Bath on Metal Shavings Generated

Nickel Coated Metal Shavings Recycled

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EPA
WATER EFFICIENCY
LEADER AWARD

The Thoroughbred Center

- Training for thoroughbred horses
- 700 to 800 horses
- Several barns, 3 racetracks
- KPPC examined water bills
  - ✓Found sewer charges
  - ✓The center has no sewers
  - ✓Resulted in $14,000 credit

Found Money

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EPA WATER EFFICIENCY LEADER AWARD

PWM Benefits

- **Process Water Management is a process of continual improvement:**
  - ✓ **Define water usage goals**
  - ✓ **Organize the water management project (s)**
  - ✓ **Implement steps to increase water use efficiency**
  - ✓ **Regularly assess water performance**
  - ✓ **Involve all levels of the organization**
- **Financial returns from PWM**

PROGRAM SUMMARY	GALLONS	POUNDS	KWHs	MM BTUs	DOLLARS
WATER					
Water Use Reduce Gallons	2,128,688,200				
$ Savings Meter & Sewer $$					$1,431,727
CHEMICALS					
WWT Chemical LBS. Savings		175,200			
Other Chemical LBS. Savings		2,256,170			
$ Chemical Savings $$					$411,955
ENERGY					
Electricity = KWH			5,552,401		
Natural Gas = BTUs MM				131.87	
$ Energy Savings $$					$1,133,966
WASTE					
Solid Waste LBS.		5,107,300			
Liquid Waste Reduce Gallons	30,513,600				
$ Waste Savings $$					$433,050
SAVINGS & INCOME					
$ Other Savings $$					$671,643
$ Income Produced $$					$16,987
OUTCOMES =	2,159,201,800	7,538,670	5,552,401	131.87	$4,099,328
	GALLONS	POUNDS	KWHs	MM BTUs	DOLLARS

TRAKM

The future of water is critical!

- ✓SAVE WATER wherever possible
- ✓Learn & implement process water management
- ✓Process water is a re-useable resource
- ✓Overlooked source of cost savings
- ✓Improves competitive advantage
- ✓Encourage environmental performance
- ✓Support sustainability

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EPA WATER EFFICIENCY LEADER AWARD

Protect Our Natural
Resources And

Avoid This
Questions?

KPPC Contact Info

Cam Metcalf ……..…cam.metcalf@louisville.edu

Kentucky Pollution Prevention Center (KPPC)
Shelby Campus, University of Louisville
Louisville, Kentucky 40292

Phone: (800) 334-8635 Ext. 8520965 or
(502) 852-0965

Fax: (502) 852-0964

MVP 2

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