Energy Efficiency Frontier—Lean and Green Refining

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RETHINK PAPER:
Lean and Green

What is Focus on Energy?

Wisconsin utilities' statewide program for energy efficiency and renewable energy

Presentation Topics

- Energy intensity
- Best practices in refining
- Wisconsin case studies
- Emerging technology—currently in progress
- Energy efficiency support
- Q&A

Energy Intensity

- Energy intensity = energy input per unit through
- Typical metrics and ranges of refining energy intensity:
  - Kilowatt-hour per tonne: 40 to 100 kWh/t
  - Horsepower-day per Ton: 2 to 5 hp-d/T
  - Refer to this as “direct” refining energy
- Push this lower to realize direct refiner energy savings
- Indirect energy savings realized by optimizing refining:
  - From reduced scrap (fewer breaks, improved first sheet quality)
  - Due to getting on a new grade in less time
  - Due to better sheet drainage
  - Both thermal and electrical energy savings

Refining Energy Intensity Challenge

- Can PM refining energy intensity be reduced from present:

  10% 17% 31% More?

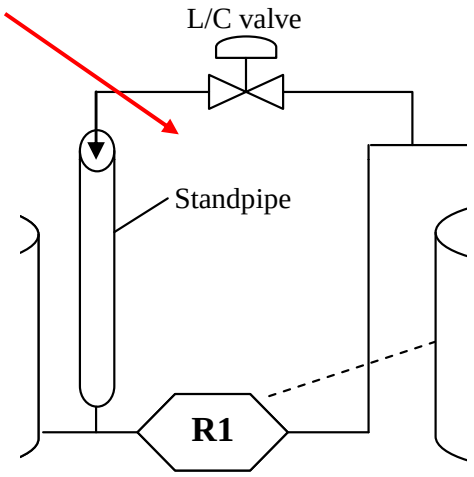
- Benefits beyond direct refiner electricity reduction
  - Better formation and sheet dewatering (energy, cost, quality)
  - Optimized drying energy (energy, cost)
  - Lower refiner maintenance (reliability, cost)
  - Longer refiner component life, e.g., plates (uptime, cost)
  - Fewer press breaks (uptime/production, cost)
  - Other benefits?
- Imagine the potential energy savings: locally, nationally, globally

Best Practices in Refining

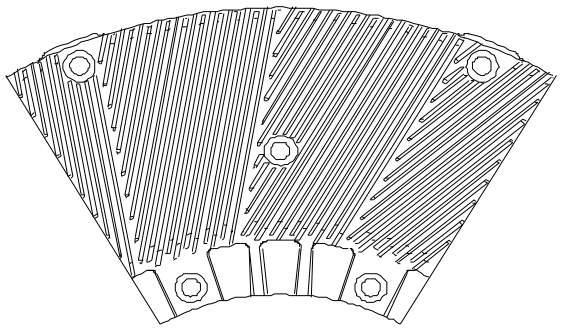
- Reduce “no-load” and “wide spot in the pipe” refiners
- Run low intensity plate designs, especially on hardwood
- Check refiner mechanical condition regularly
- Refine each pulp type separately, if possible
- Shut down tickler refiners when possible
- Operate in design hydraulic flow ranges
- Upgrade double disk refiners with splined rotors
- Consider modern energy-efficient designs when replacing refiners (including duo-flo mode)
- Minimize stock flow through deflakers

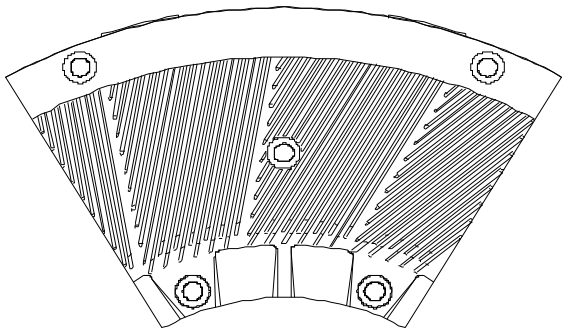
Refining Best Practices to Improve Energy Efficiency—Low-cost approaches

- Add recirculation control with standpipe, respond to machine needs
- Downsizing plates within existing refiner



(Refiner)





Case Study—Shawano Specialty Mill: Mono-To Duo-Flo Mode Conversion

Mono-flow mode:

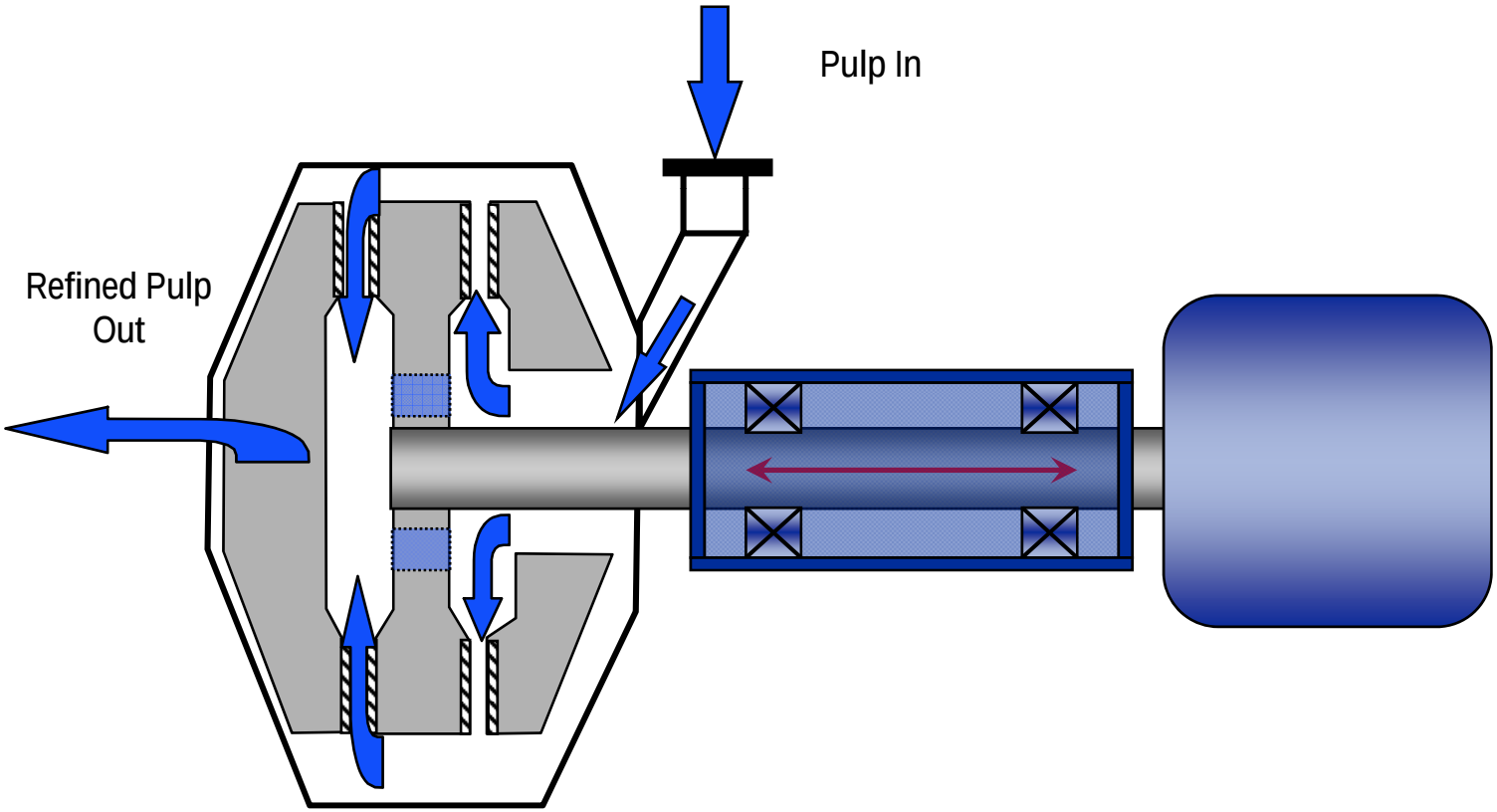


Diagram courtesy of GL&V

Case Study—Shawano Specialty Mill: Mono-To Duo-Flo Mode Conversion

Duo-flow mode:

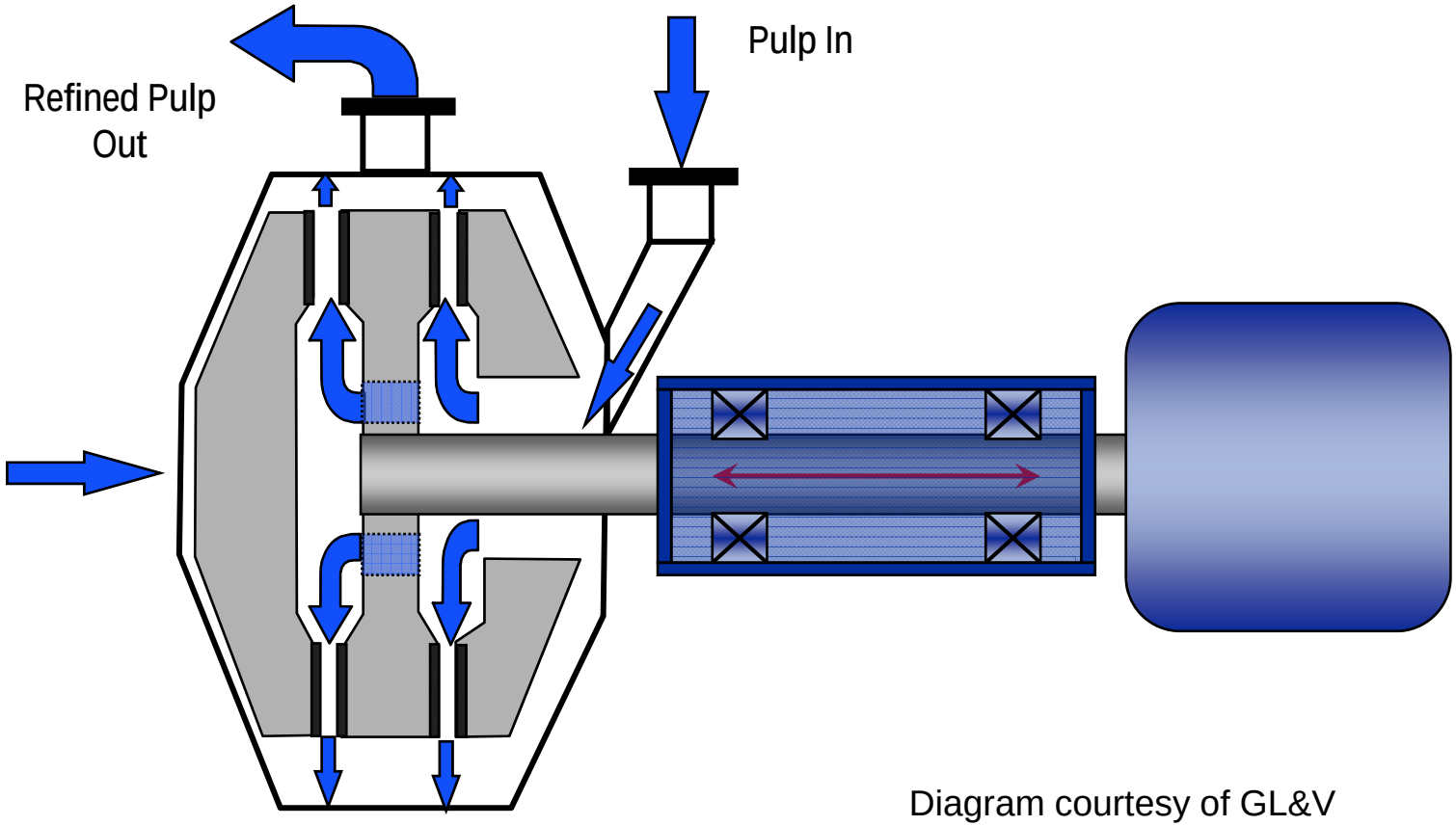


Diagram courtesy of GL&V

Case Study—Shawano Specialty Mill: Mono-To Duo-Flo Mode Conversion

- Two 508-mm (20-inch) refiners operated side by side
  - One in duo-flo mode
  - One in mono-flo mode (considered for conversion)
- Focus measurement and verification (M&V)
  - Controlled, steady-state conditions
  - Stock samples taken throughout trials conducted
  - Power metering equipment on each refiner motor switchgear
  - Flow and pressure measurements
  - M&V results documented in a written report
- Expectation: up to 20% less energy use in duo-flo mode
- Actual: 18.5% energy reduction, associated cost savings
- Simple payback range: 2.5 years to less than 10 months

Case Study—Shawano Specialty Mill: Project Implementation Results

Mono-flo vs. Duo-flo Refiners – annual energy savings, based on side-by-side comparison					
Location	**Demand Reduction Observed**	**Hours of Operation**	**Calculated Energy Use Reduction**	**Blended Utility Rate**	**Total Cost Savings**
Little Rapids Corp. Shawano Specialty	**18.5%**	**8,350**	**> 250 MWh/yr**	**Confidential**	**Confidential**

Focus on Energy photo with use permission from Shawano Specialty Paper

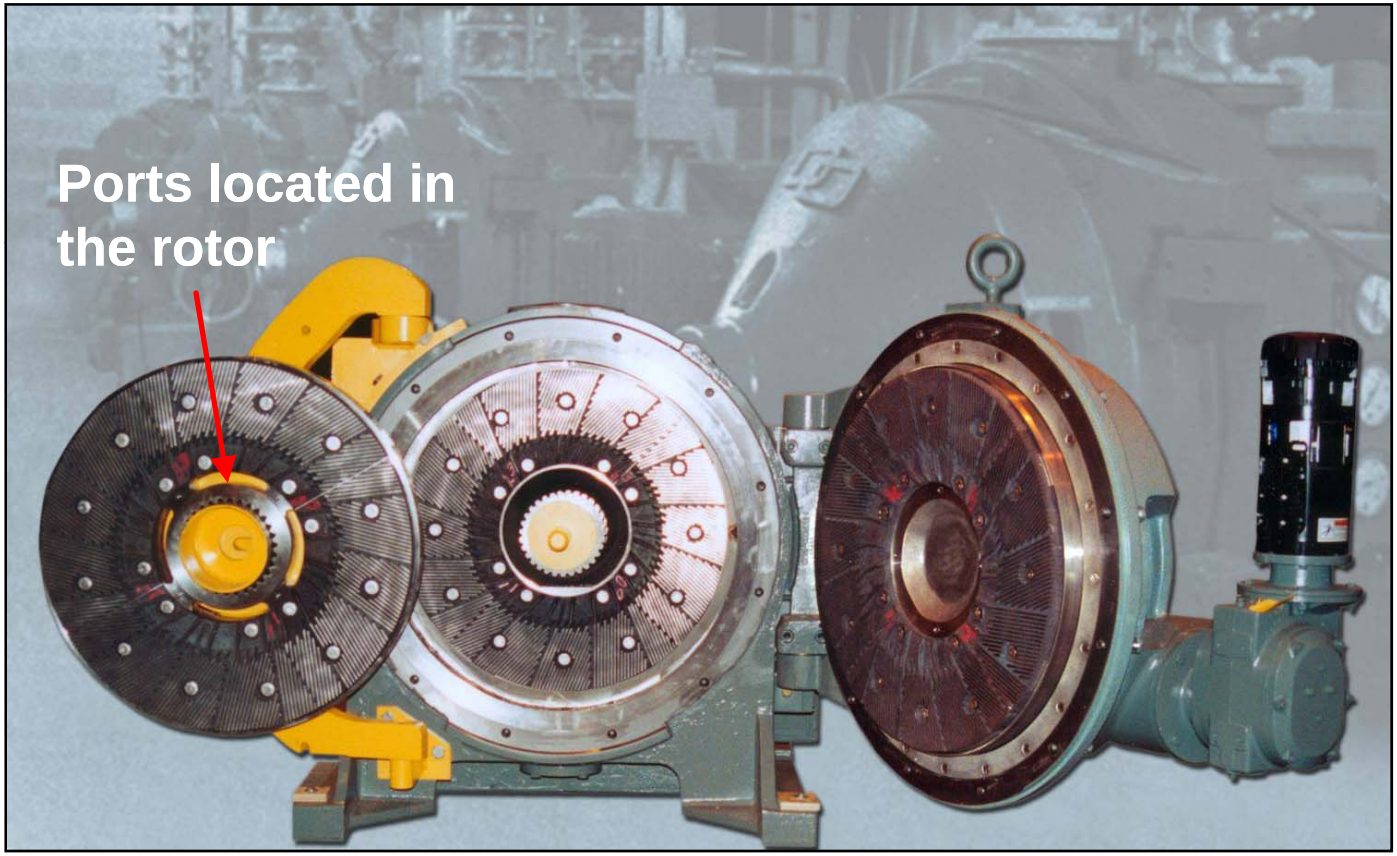
Payback ~ 2 years

Energy efficiency incentive applied based on energy savings, project cost

Case Study—Wausau Paper: Splined Rotor Refiner Upgrade

- Two (2) 700-hp refiners
  - Converted from mono-flo to duo-flo mode
  - Splined rotor upgrade implemented
- Power metering before and after project
- Employed data logging equipment on refiner motor switchgear
- Energy savings:
  - Expected 25%
  - Actual 31% decrease in kW demand
  - Annualized electrical energy savings ~ 25% (~ 3.1 million kWh/year)
  - Cost ~ $161k Savings ~ $184k/yr Payback ~ 11 months

Case Study—Wausau Paper: Splined Rotor Refiner Upgrade



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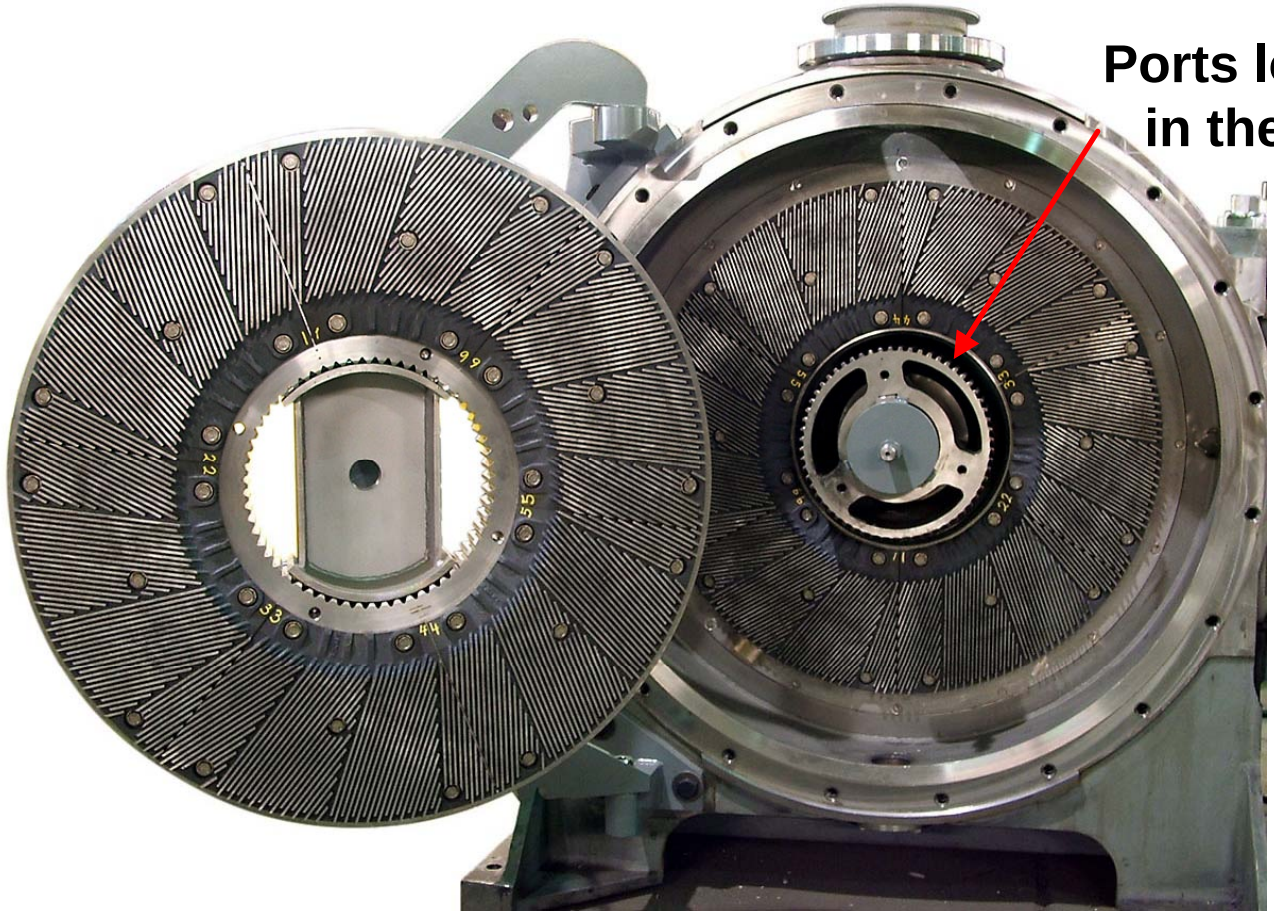
Case Study—Wausau Paper: Splined Rotor Refiner Upgrade



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Case Study—BPM Inc., Peshtigo, Wisconsin: Brief Mill Background

- 2006 paper mill restart after bankruptcy purchase
  - Restarted as non-integrated mill (sulfite pulp mill shuttered)
  - Two paper machines – specialty papers, MG, waxing grades
- 2007 formed mill-wide energy team
- 2009 Co-recipient Statewide/Wisconsin Paper Council award for energy efficiency based upon 2008 efficiency improvements
- 2009 pledged US-DOE *Save Energy Now* LEADER program
  - Voluntary 25% reduction in energy intensity in 10 years vs. baseline
  - Tapped into technical assistance such as energy assessments
  - Exceeding voluntary reduction commitment

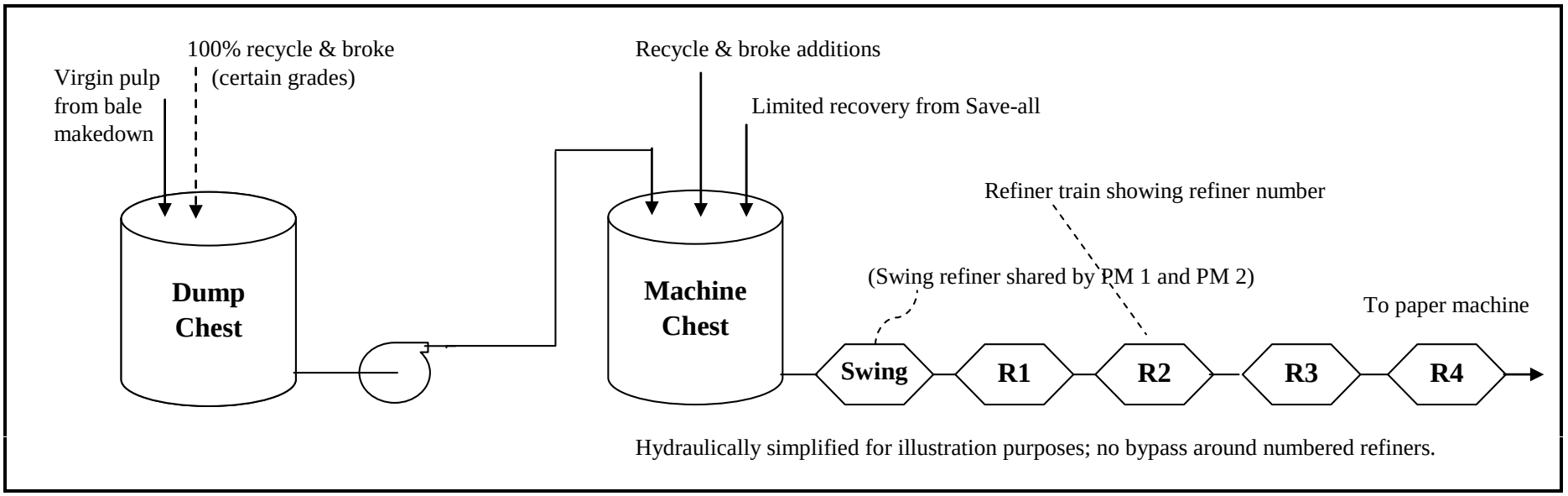
Case Study—BPM Inc., Peshtigo, Wisconsin: Energy Team Formed (2007)

- General manager, paper mill manager, technical manager, plant engineer, and invited guests participate and contribute
- Focus energy advisor and energy specialist part of team
- WPS (energy supplier) account executive part of team
- Monthly meetings on site – minutes and action items recorded
- Energy efficiency ideas, studies, and projects implemented
- Assigned engineer to energy efficiency project management
- Currently in fifth year of aggressive energy efficiency pursuit
- Mill energy team process led to refining optimization project

Case Study—BPM Inc., Peshtigo, Wisconsin: Physical Changes and Refining Optimization

E-team identified refining as offering significant energy reduction potential:

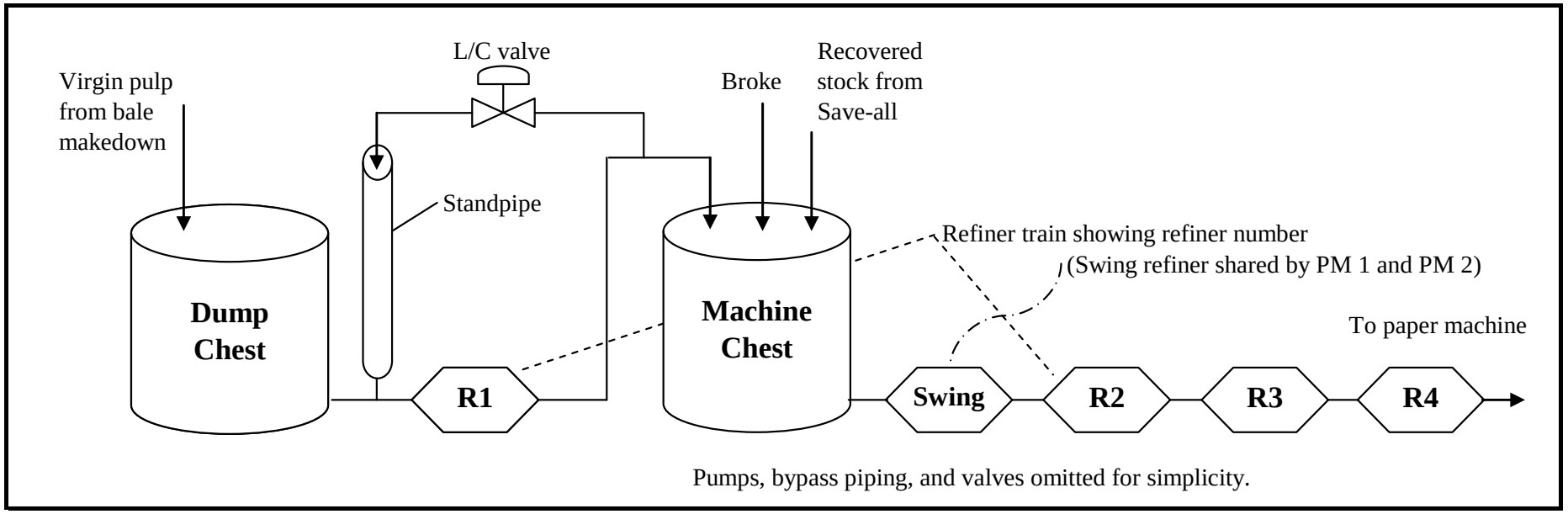
- No bypass between machine chest and #1 PM stuff box
- Recycle furnish required pumping through entire refiner train
- Over-refining suspected of causing other problems



Case History #3 BPM Inc., Peshtigo, Wisconsin: Physical changes and refining optimization

Modifications to refiners and process flow:

- Bypass around each DD refiner (piping and valves)
- R1 dedicated to virgin pulp via process flow change
- R1 addition of recirculation control and standpipe, based on machine needs
- R4 retrofit with 584-mm (23-in) plates, from 660-mm (26-in)



Case Study—BPM Inc., Peshtigo, Wisconsin: Refining Optimization and Emerging Technology

- Began with interest in controlling freeness
- Discovered fiber morphology analyzer using optical sensing
- Introduced technology to a mill willing to trial as beta site
- Developed project
- Ran trials in mode simulating full project implementation
- On single grade, made the same quality paper:
  - Using 151.4 kW less demand (one refiner instead of three)
  - Annualized energy savings over 1 million kWh/year
- Developing control algorithms presently
- Pursuing emerging technology deployment financing
- Focus offering technical services and eligible efficiency incentive

Case Study—BPM Inc., Peshtigo, Wisconsin: Refining Optimization and Emerging Technology

- Project name: Fiber Stream Optimization
  - Vetted the fiber morphology analyzer technology 2-3 years ago
  - Reconnected with the maturing tech at TAPPI PaperCon 2010
- BPM predicted energy savings:
  - >150 kW at refiner, > 1 million kWh/year direct at refiner
  - Indirect energy savings could surpass direct (scrap, on-grade, etc.)
- More mills interested in beta site case study so far
- First four (4) interested mills larger, much higher refining capacity:
  - 4.8 MW of predicted electrical demand reduction possible
  - 41 million kWh/year of estimated electrical energy reduction
  - Yet-to-be-quantified thermal energy savings

Energy Efficiency Guidance and Assistance

- The most cost-effective “new” energy source: energy efficiency
- Wisconsin industrial energy efficiency resources:
  - Focus on Energy statewide program
  - Utility companies and respective account executives
- USA energy efficiency resources:
  - US-Department of Energy, Industrial Technologies Program, EERE
  - DSIRE (database of state incentives for renewables and efficiency)
  - US-EPA Energy STAR in Pulp and Paper
  - US-EPA CHP Partnership
- ACEEE – American Council for an Energy-Efficient Economy
- TAPPI:
  - National and regional/local chapters
  - Standards and TIPs
- Vendors and consultants can be excellent resources

Lean and Green Refining: Conclusions

- We can reduce energy intensity in refining
- Establish goals/targets for energy intensity reduction
  - Mill or paper machine level energy reduction targets
  - Individual process energy intensity reduction targets
- Seek technical and financial assistance
- Implement best practices for efficiency first
- Seek new developments and new technologies:
  - Refining processes
  - Refining equipment
- Seek financial incentives if available/eligible to implement:
  - Best practices projects
  - Emerging technologies

Questions?

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