



OUR NAME IS INNOVATION

# How to Successfully Apply Energy Efficiency Techniques in the Pulp and Paper Industry

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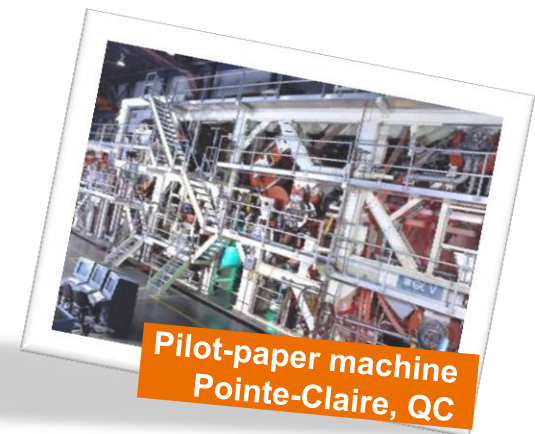
FPIInnovations – Pulp, Paper and Bioproducts, Pointe-Claire, QC, Canada

# Agenda

- About Us
- Years of experience
- Our knowledge
- P&P context
- Integrated forest biorefinery
- What is Process Integration and who can benefit from it
- Success factors for optimal implementation of energy efficiency
- Examples
- Conclusions

# About Us

- **A not-for-profit world leader** specialized in the creation of scientific solutions in support of the Canadian forest sector's global competitiveness
- **Unique forest R&D centre** offering full value chain solutions, from forest management to consumer products
- **Annual operating budget** of approximately **\$90 million**
- **Membership of approximately 210 throughout Canada**, including industrial and government members
- **World-class R&D facilities**, pilot plants and satellite offices
  - 300+ patents in key forest processing markets
  - 100+ patented technologies and processes
  - 100+ R&D projects
  - 11 R&D programs
  - 1 pilot paper machine/ 1 CT imaging centre
  - 7 pilot plants



# Years of Experience

## **Forest Products Laboratories of Canada**

– later became Forintek Canada Corp.

## **Forest Engineering Research Institute of Canada**

– a private, not-for-profit R&D organization aimed at improving Canadian forest operations

## **Canadian Wood Fibre Centre**

– established from NRCan in 8 Canadian Forest Service locations

1918

1925

1975

1979

2006

2007...

## **Pulp and Paper Research Institute of Canada**

– a private, not-for-profit research and technology organization

## **Canada's Wood Products Research Institute\***

– a private center for the development of scientific and technical knowledge, applications and solutions to enhance the wood products sector

## **FPInnovations**

– On April 1, FPInnovations was established as a result of the merger of Forintek, Paprican, Feric and a partnership with CWFC.

# Several Collaborative Research Program

**Biorefinery & Energy**



**Forest Operations**



**Biomaterials**



**Market Pulp**



**Paper, Packaging  
Consumer Products**



**PIT**



**Wildfire Operations**



**Wood Products  
Manufacturing**



**Advanced Building  
System**

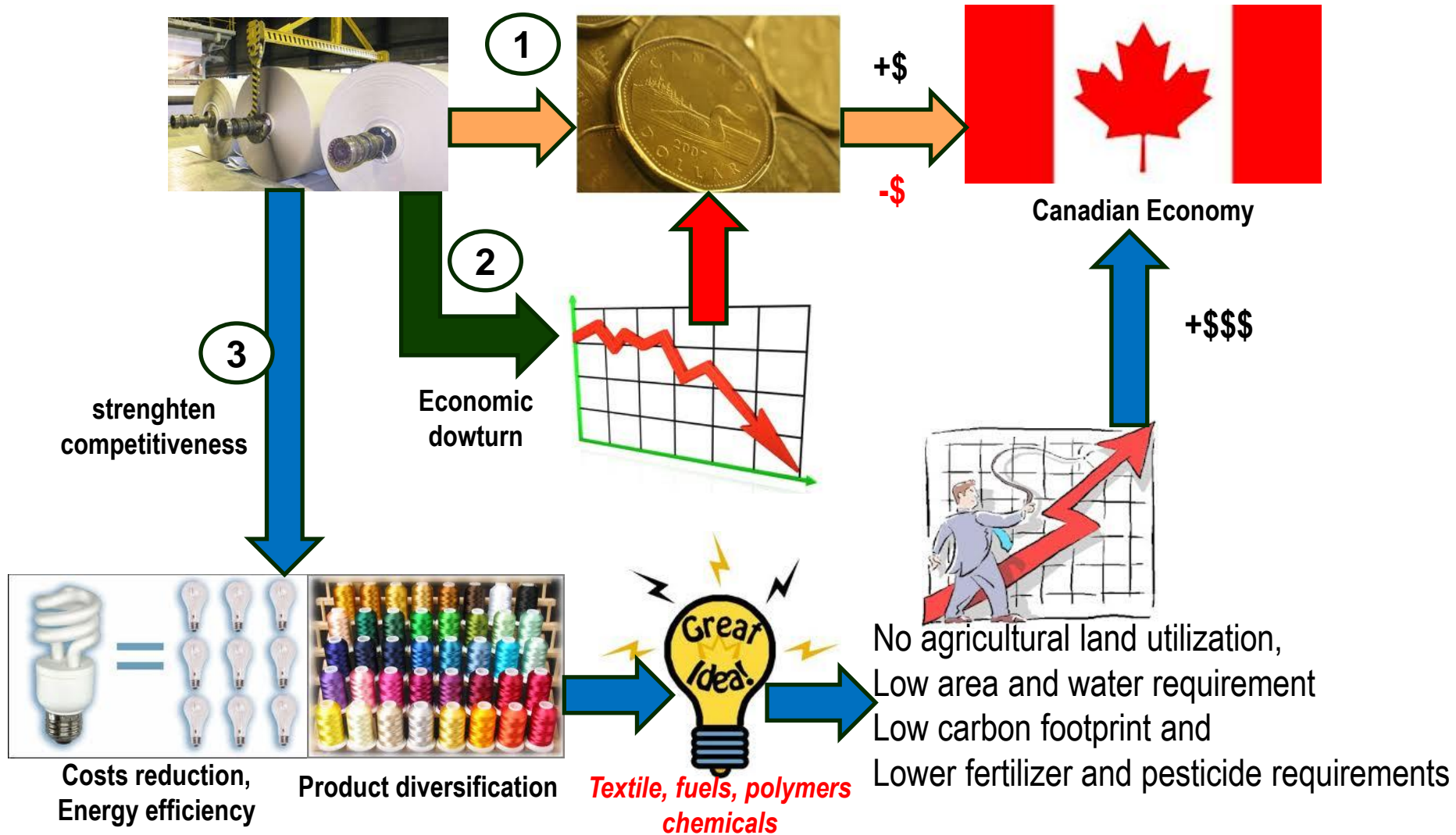


**Ressource  
Assessment**



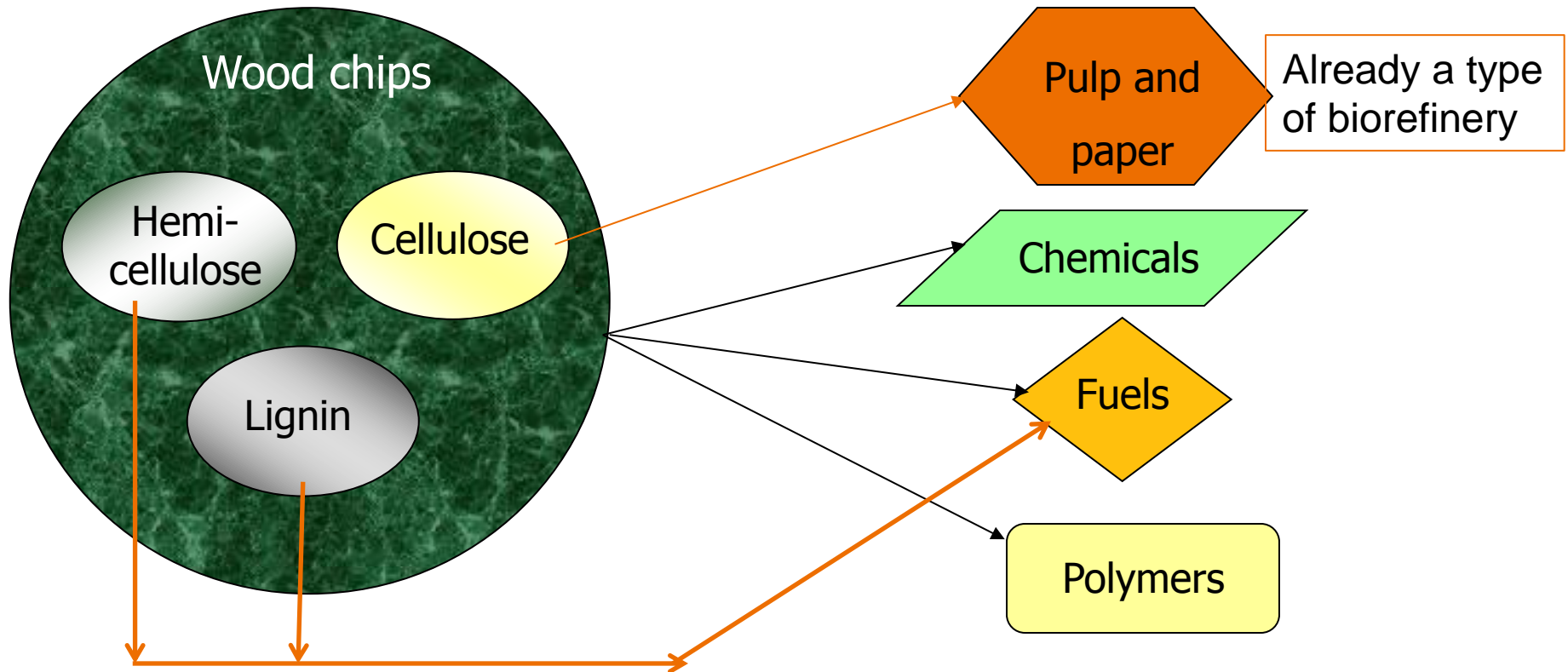


# Introduction



# Forest Biorefinery/Pulp and Paper

The Forest Biorefinery is the utilization of forestry biomass to produce a spectrum of products by various extraction and transformation pathways



# P&P Industry

- P&P is Canada's most energy intensive manufacturing industry:

25%  
total manufacturing  
consumption

30% total  
manufacturing  
cost

55% energy  
generated  
from biomass

Water conservation  
alternatives

Energy efficiency  
technologies

- Energy efficiency of the P&P process strongly related to proper management of water and steam

**Systematic energy optimization is required to improve the energy efficiency of P&P process in a cost effective way**



# Context – Pulp and Paper



Industry transformation:  
Changes in process operation,  
configuration, utility system



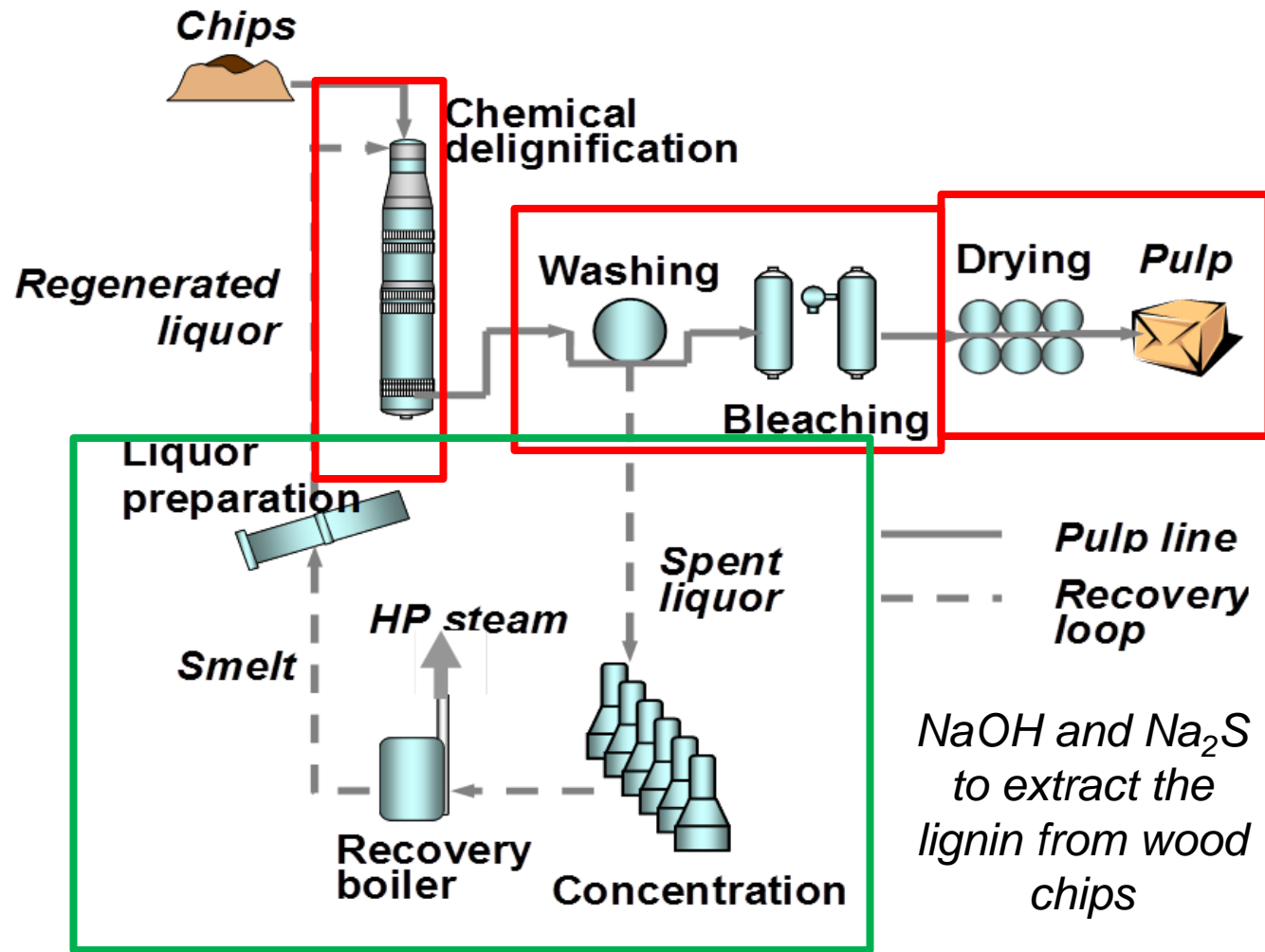
Needs to improve  
(Opportunities)



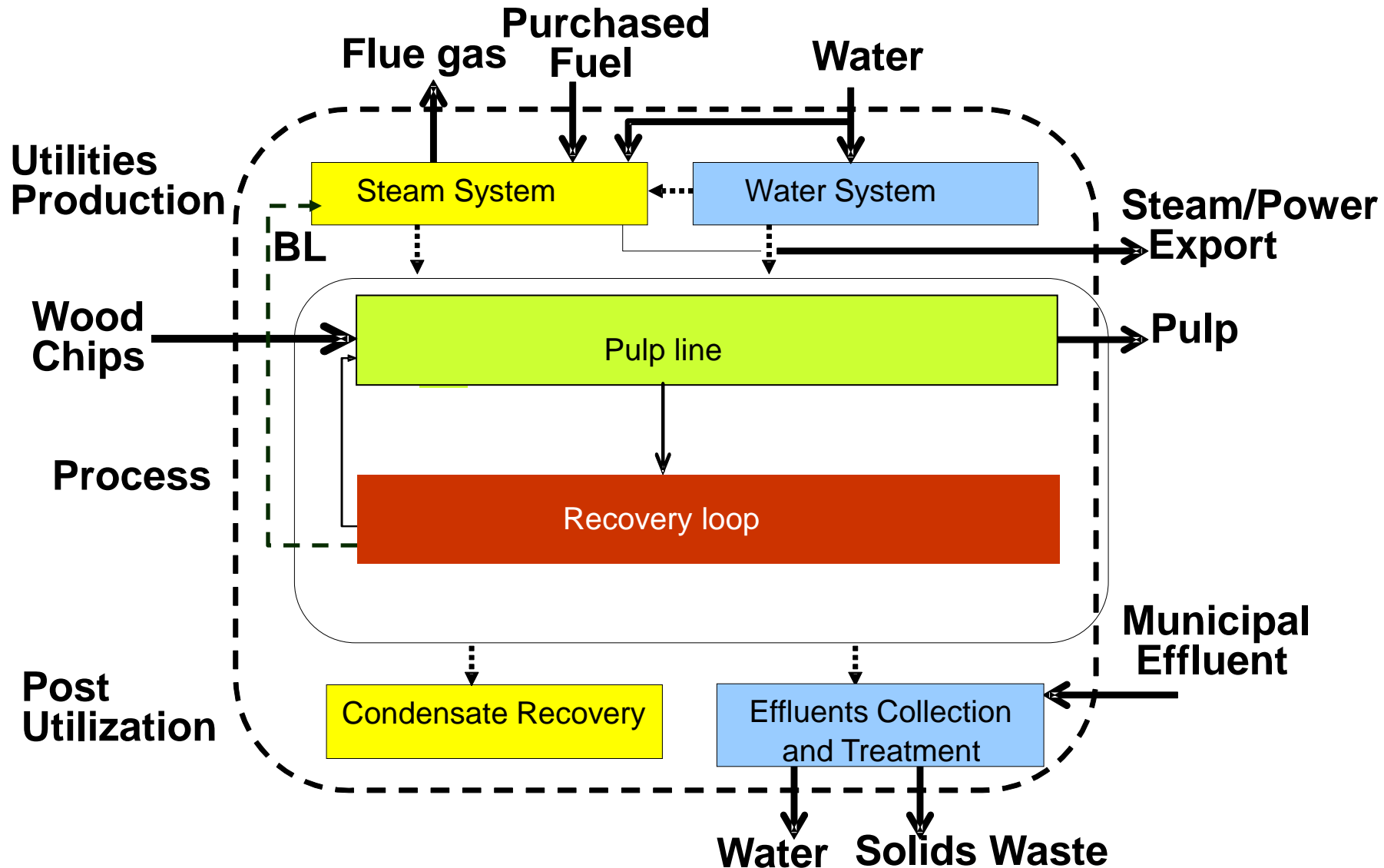
Reduce energy costs  
Diversify revenue

- **Optimize use of utility system capacity (boilers & turbines)**
- **Improve current heat recovery measures**
- **Identify new heat recovery measures**
- **Diversify revenues: New products**

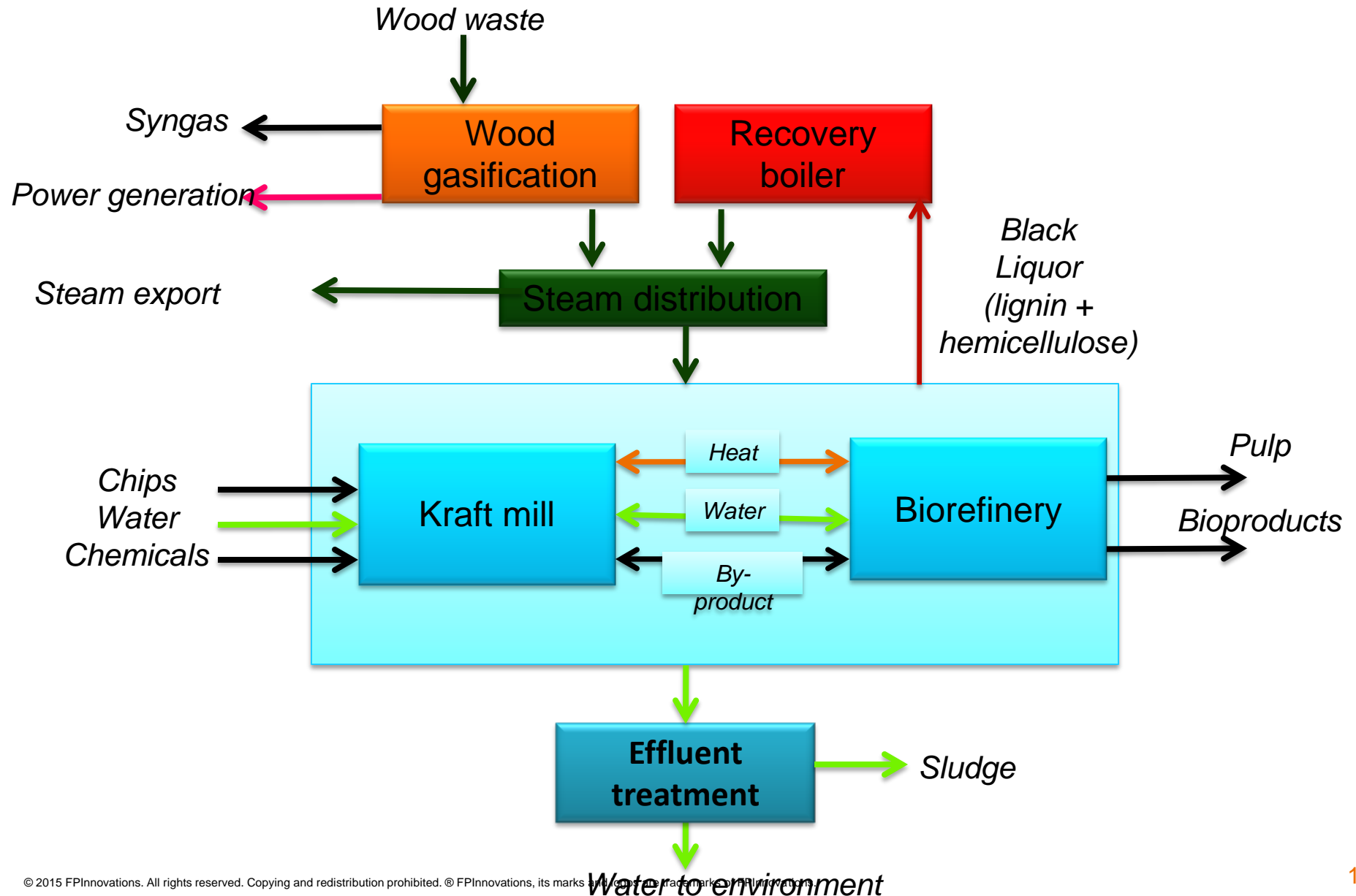
# Kraft Process



# Kraft Process - Utilities



# Green Integrated Forest Biorefinery

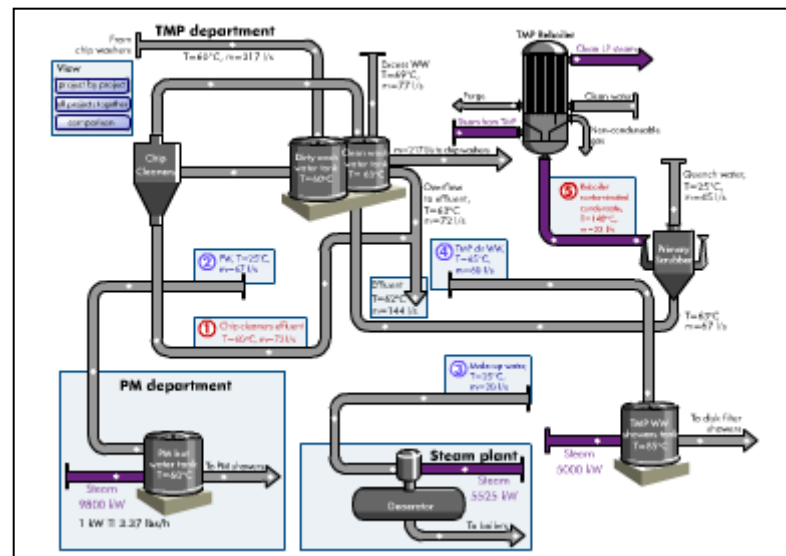


# Green Integrated Forest Biorefinery

- Implementation of biorefining units into existing pulp and paper mills:
  - Maintaining the manufacturing of their core product
- **Advantages** over autonomous grassroots biorefineries
- Kraft mills well suited
  - Infrastructure, support networks, direct access to raw materials, attractive utility costs and qualified manpower
- **Challenges:** (Energy efficiency must be improved)
  - Reduction of BL (lignin + hemicellulose) calorific value
  - Increase energy demand
  - Increase water consumption and effluent production

# Process Integration: System Approach for Efficient Energy Recovery

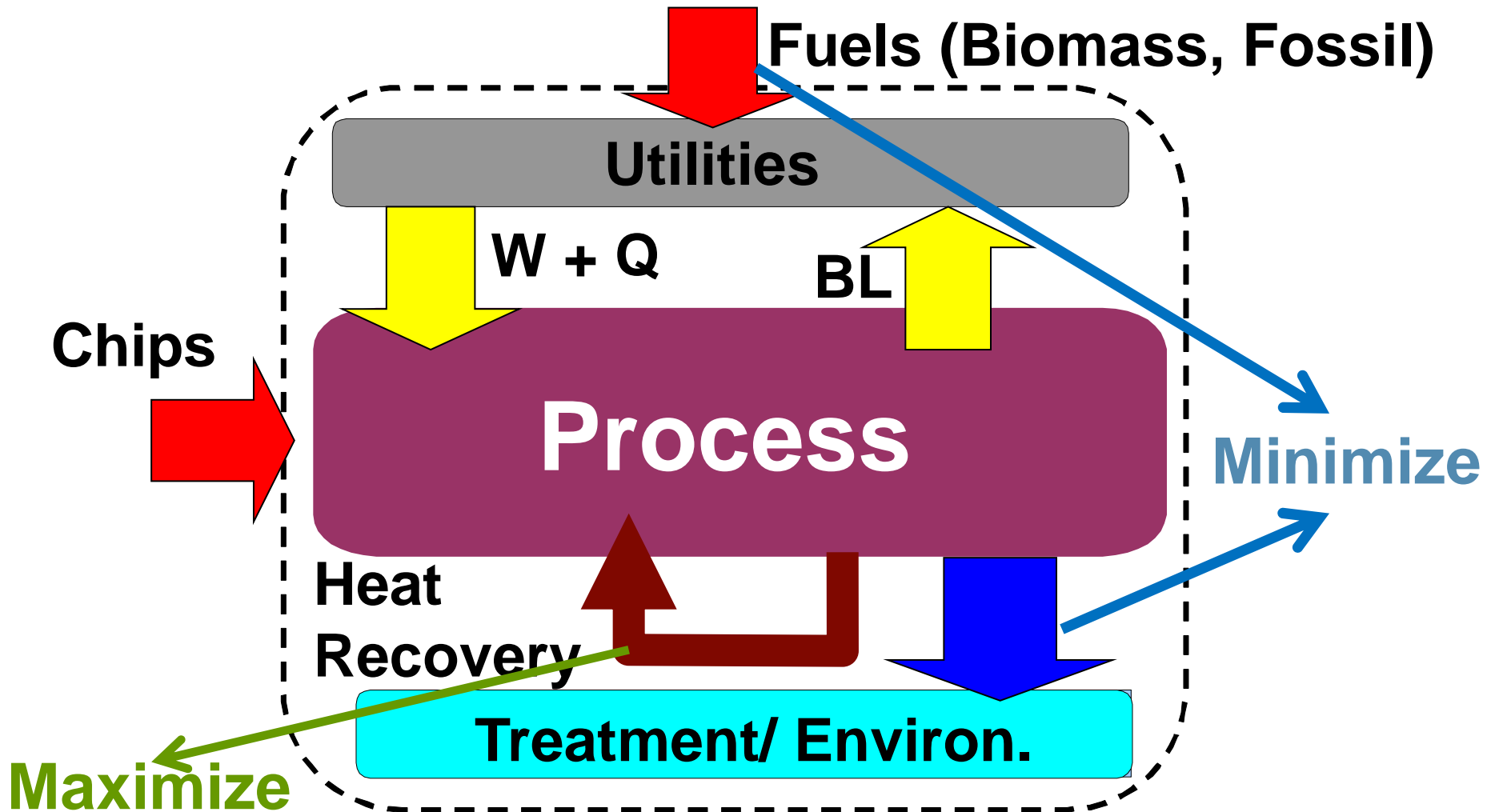
- **Site-wide approach** for identifying and correcting inefficiencies in **complex industrial processes**
- A **global analysis** of the entire process including the interactions between its different parts
- Determines where heat is being used, where it should be recovered and what would be the **best use for that heat throughout the facility**
- Recognized as **best available technique** for efficient heat management in P&P industry



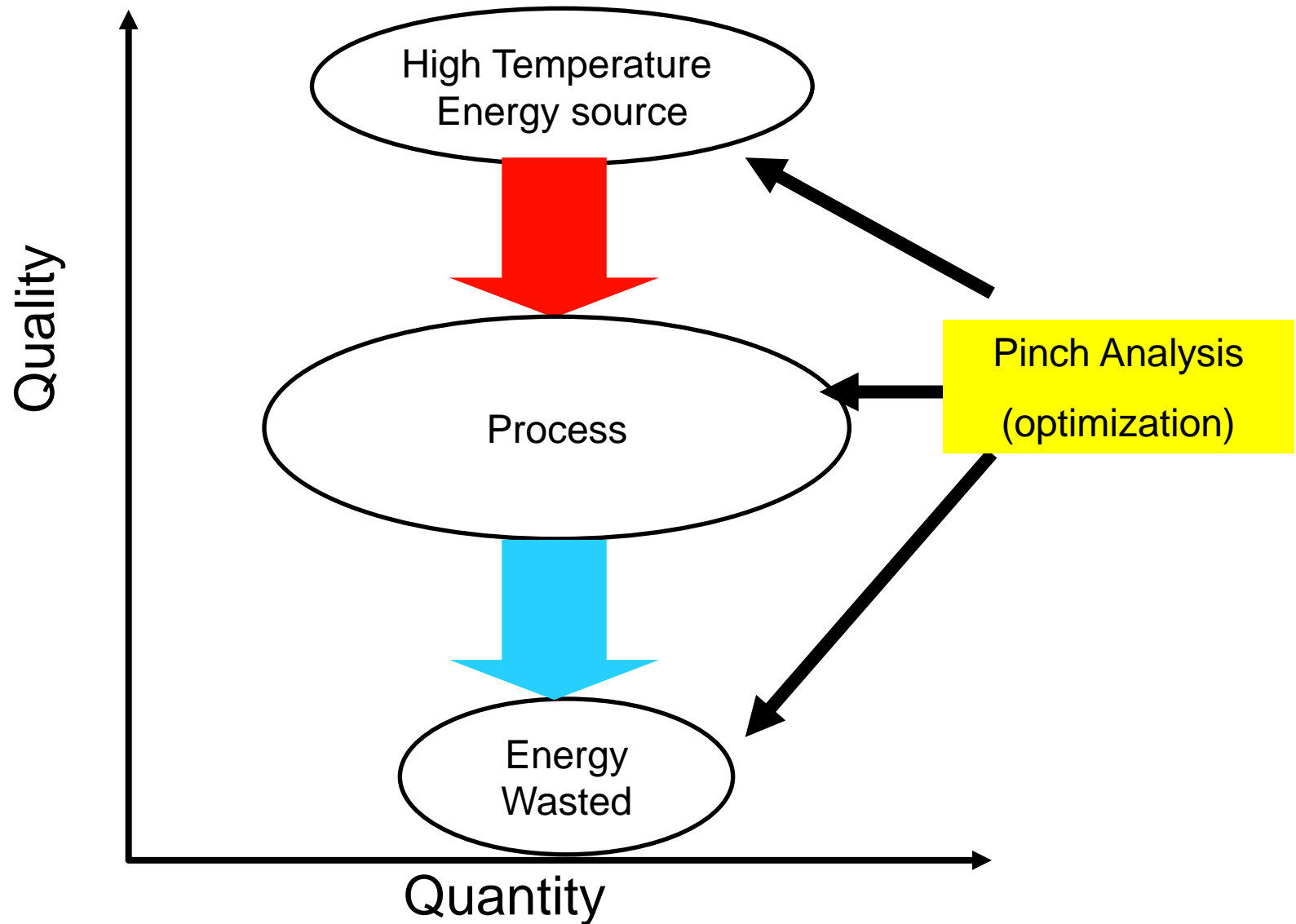
Through PI studies 10 to 30% thermal energy savings are possible cost-effectively



# Kraft Process- Energy Flows

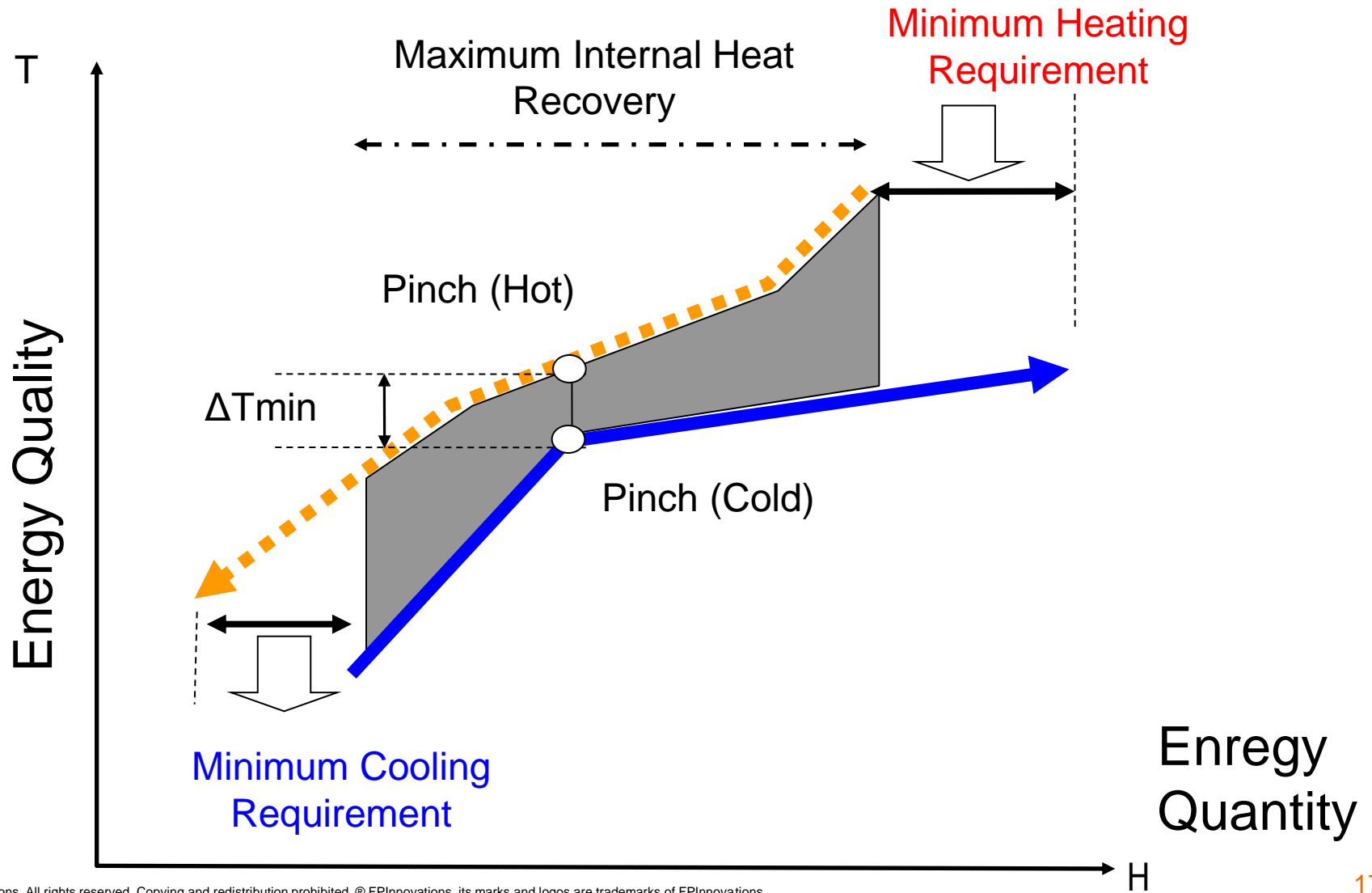


# Principle of Pinch Analysis

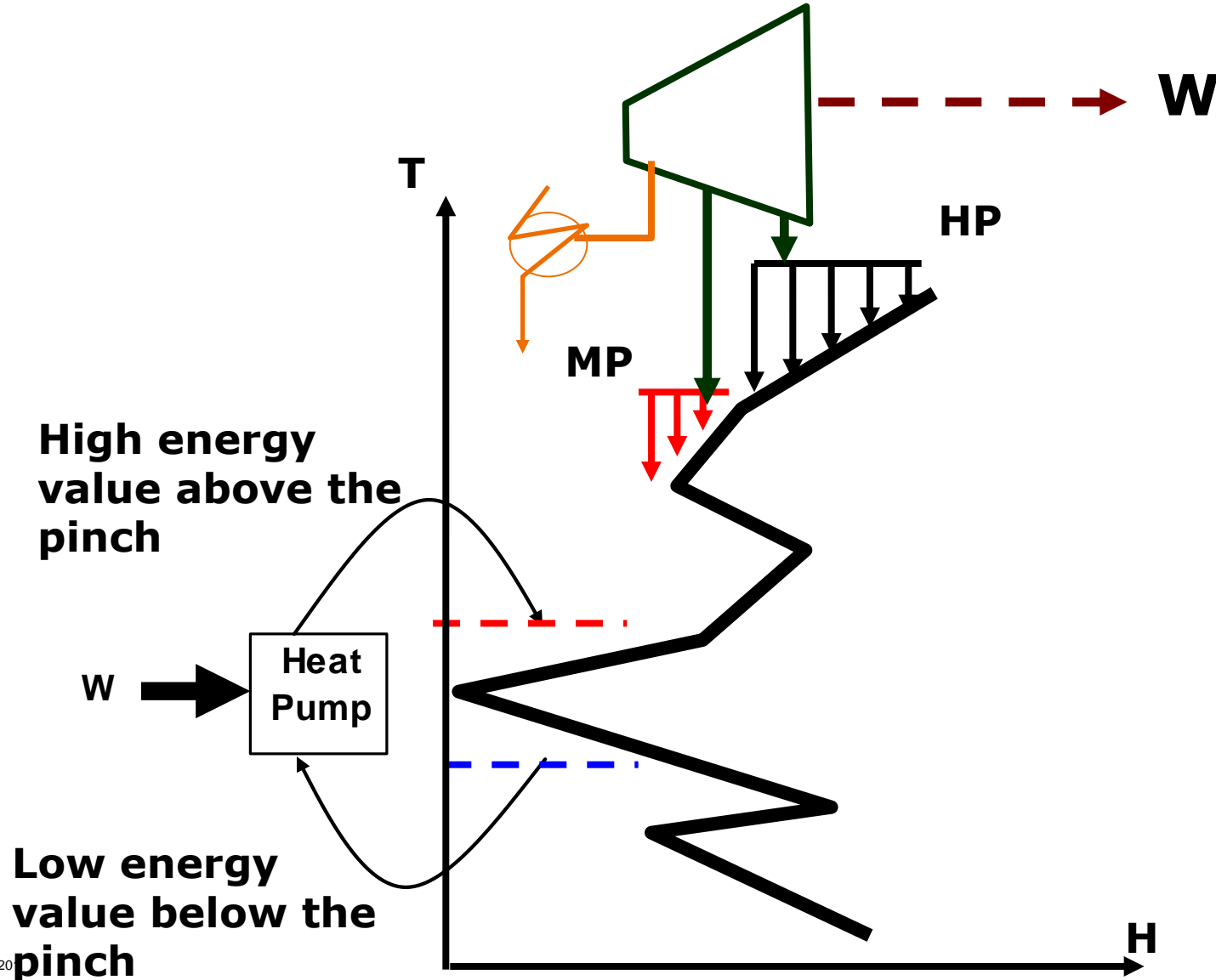


# Pinch Diagram

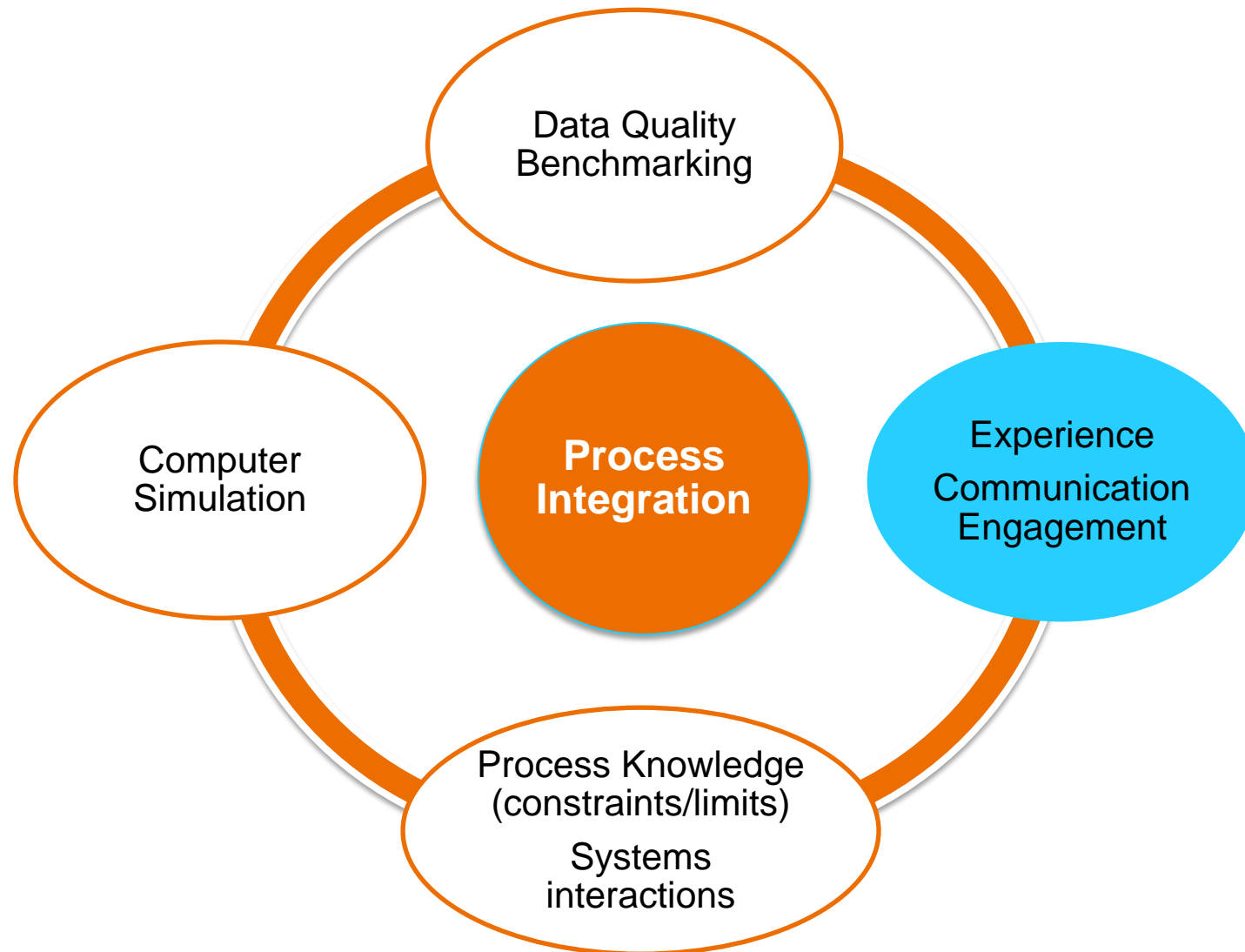
## An Energy Balance for Optimal Heat Transfer



# Grand Composite Curve: Optimal Utilities Positioning



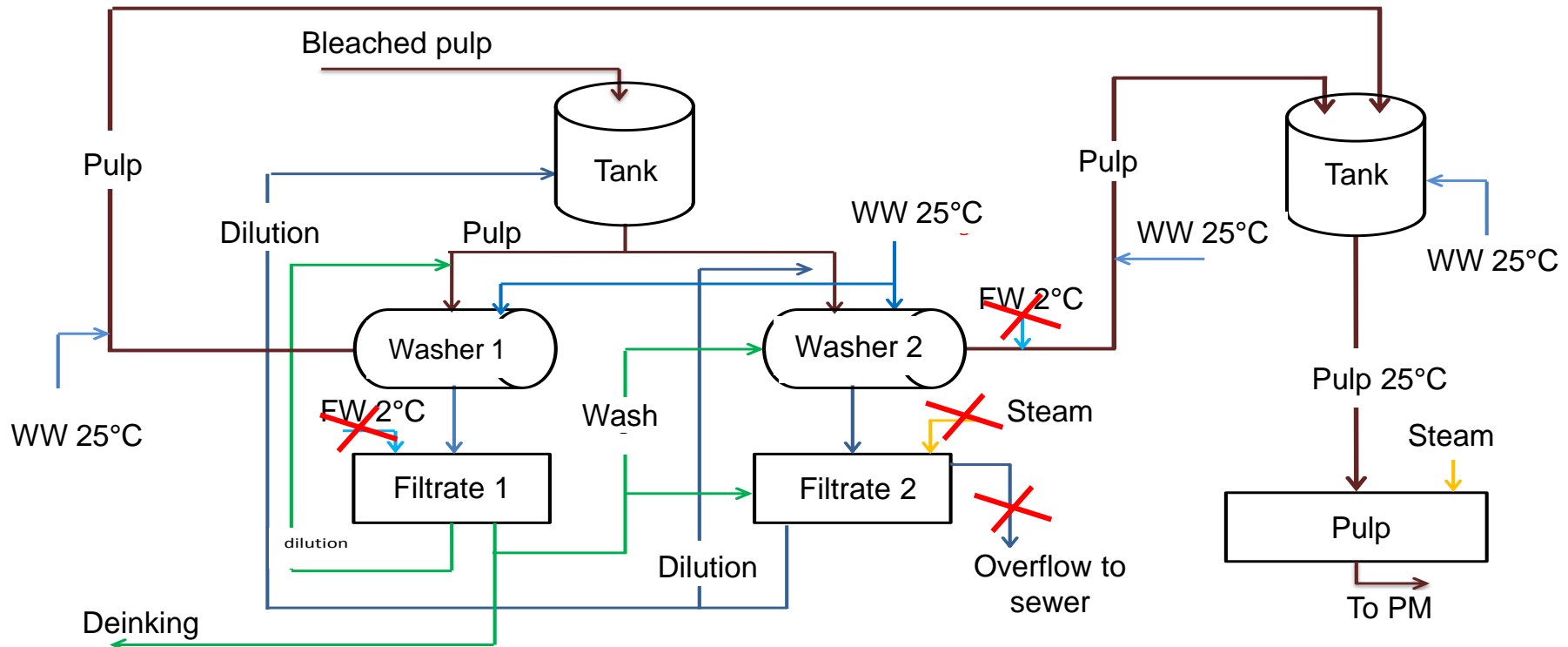
# Key Factors for a Successful Application of a Process Integration Study



# Example: Identifying Effects of Water Reduction Measures in Energy Consumption

## ■ Solution

- Reduction of fresh water usage
- Reutilization of white water (sent to sewer)
- Overhaul level control of the tank





# Example: Identifying Effects of Water Reduction Measures in Energy Consumption

- **Benefit**

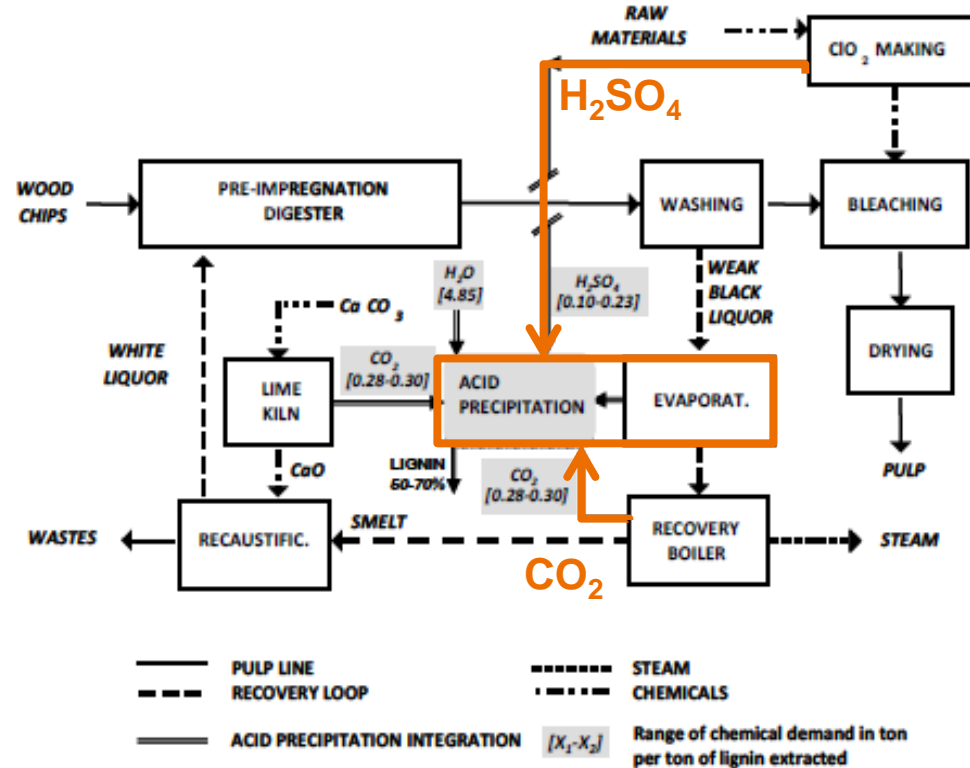
- Optimal utilization of equipment in place/ low capital investment
- Reduce water consumption and steam utilization
- Additional benefits after project implementation: increasing reutilization of washer filtrate for pulp dilution

Savings: 0.3 M\$/year  
Additional savings: 0.2 M\$/year

# Optimal Integration of Biorefining Technologies

## Lignin Extraction

- Evaluate **impacts** on:
  - Chemicals balance
  - Effluent treatment plant
  - Overall energy balance
- Identify **opportunities for material and heat integration** to reduce steam and chemical consumption

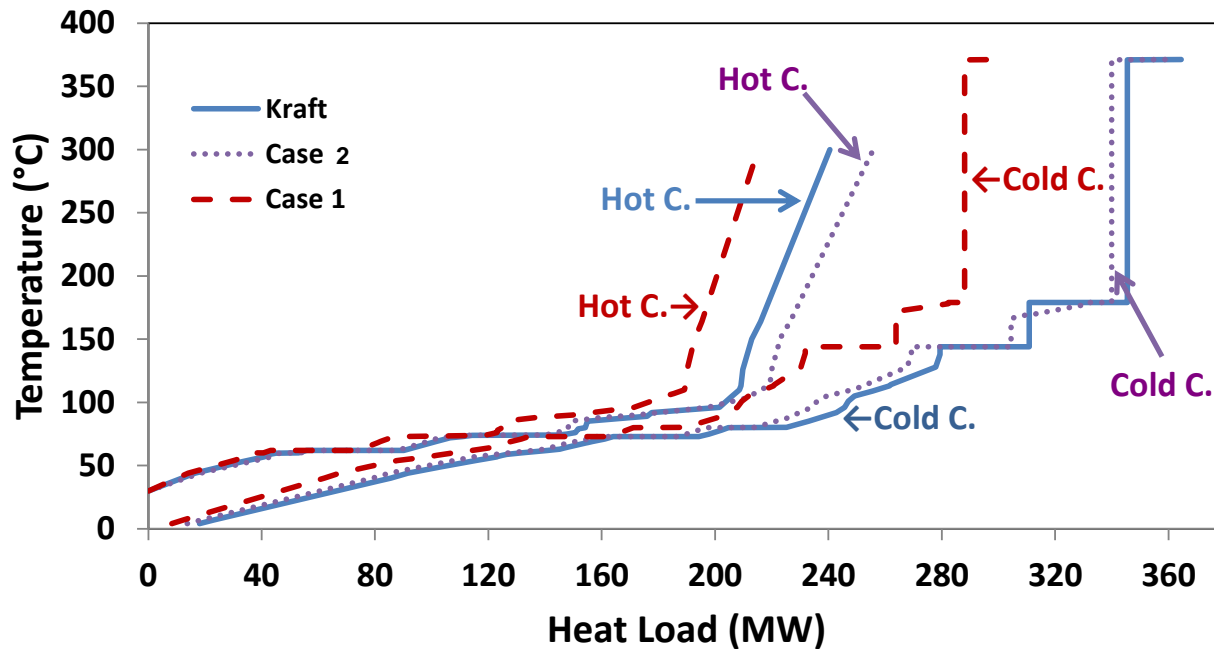


Périn-Levasseur, Z., Benali, M. & Paris, J., Lignin extraction technology in a Kraft pulp mill, ECOS 2010, CDR, Man.61 Lausanne (Suisse) (2010).

# Optimal Integration of Biorefining Technologies

## Hemicelluloses Extraction

### (Kraft conversion to dissolving pulp)



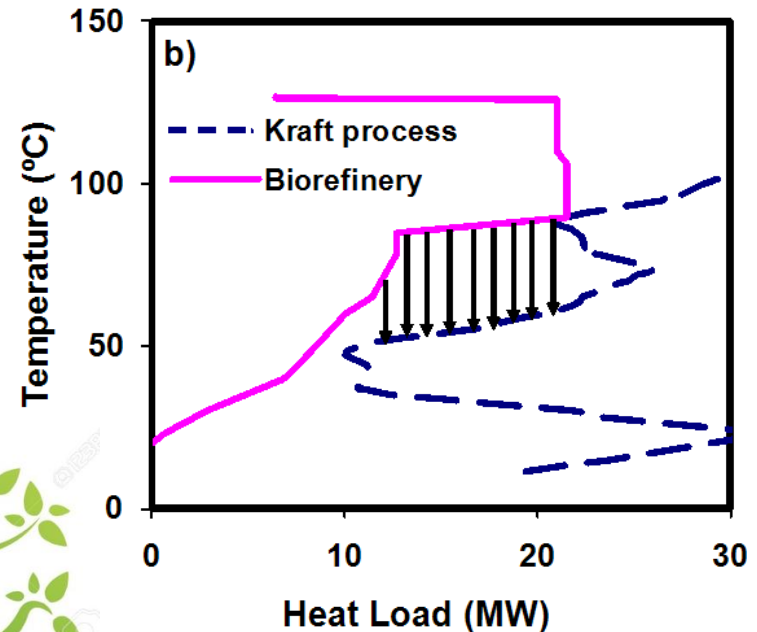
New reaction conditions and digesters → Decrease minimum heating requirement → Excess heat reduced in dissolving pulp

**The effects of operating conditions changes are identified**

# Optimal Integration of Biorefining Technologies

## Hemicelluloses Extraction (Bioethanol)

- Evaluate **impacts** to the utility system
- Identify **interactions** between ethanol plant and Kraft mill
- Identify **opportunities for heat recovery** to reduce overall steam consumption of the site



# Additional benefits: Developing of an Energy Mindset Towards Energy Measures

## ■ **Context**

- PI study requires constant communication with mill personnel
- Mill provides expertise and knowledge on process configuration
- At the same time, staff better understand PI principles

## ■ **Solution**

- Mill take closer look to process and identify easy solution towards energy usage
  - Condensate recovery
  - Steam trap repair
  - Boiler operation strategies modifications

## ■ **Benefit**

- Mill personnel develop an energy culture
- PI and energy efficiency linked to decisions regarding mill operations
- Continuously looking at how energy efficiency can be improved

# Conclusions

- **P&P mills can recover M\$** through the implementation of **energy efficiency** measures
- **Energy optimization** is required for a sustainable forest biorefinery
- **Success of application of energy efficiency techniques is** based on
  - Closed collaboration with mills
  - Expertise of pulp making process
  - Advanced PI techniques
  - Development of an energy culture among mill personnel
- **Thermal energy savings of 10 to 30%** are possible, leading to:
  - Reduced fuel use
  - Increased power generation
  - Water conservation
  - Debottlenecking (increased throughput)
  - Financial gains
  - Improved profitability of forest biorefinery





NOTRE NOM EST INNOVATION

# Merci ! / Thank you !

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Suivez-nous



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