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How does Tissue Converting Efficiency and Waste Affect The Overall Tissue Process Energy Balance?

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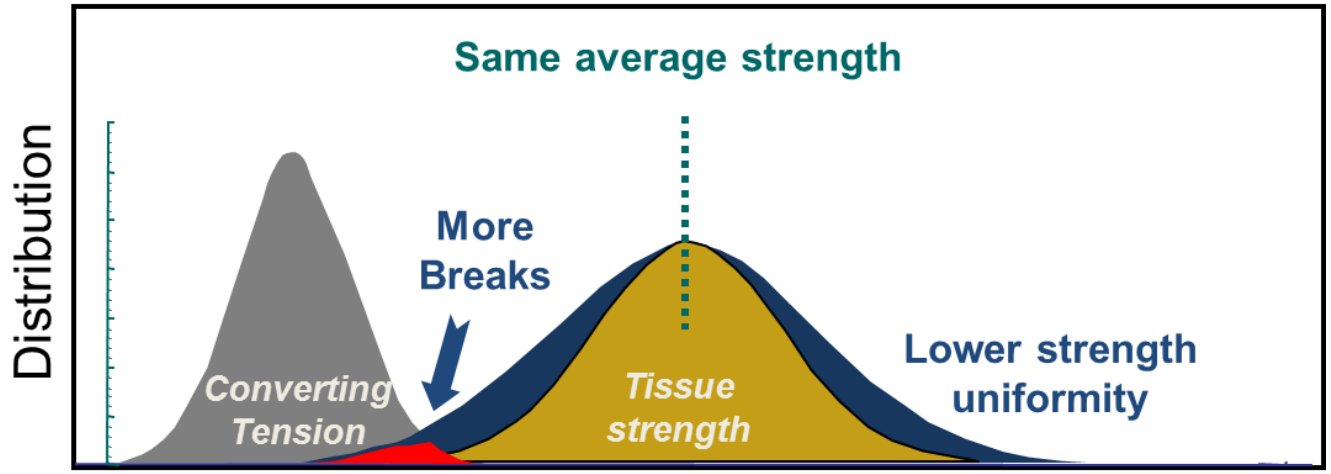
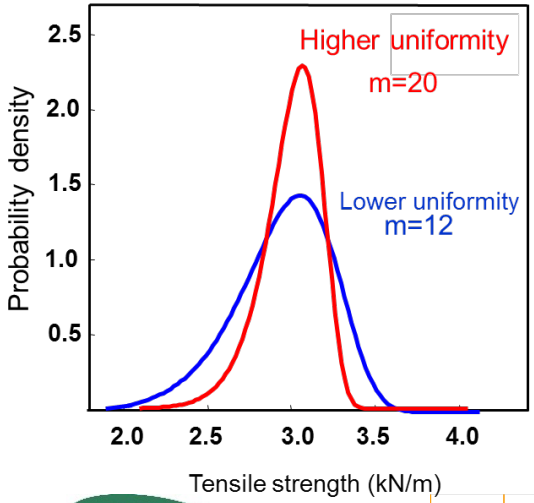
Tissue Converting Review

Tissue Converting gets little attention-cannot fix sheet!

TAPPI Tissue 2017 Converting Papers:

1. Sergio Tonarelli, Futura – Challenges of Advanced Base Sheet Converting
   - Parent Reel cycles (reel handling, thread up, dust hygiene, winding)
2. Peter Augustine, Perini, NA – Increased Productivity Focus
   - Lost production/changeovers
3. Frederic Parent & Nina Deng, FPInnovations –Tissue Non-Uniformity and Converting Performance
   - Low Converting Efficiency (40-70%) partially attributed MD/CD profiles
   - Base sheet variability follows Weibull distribution





Tissue Process Energy Management

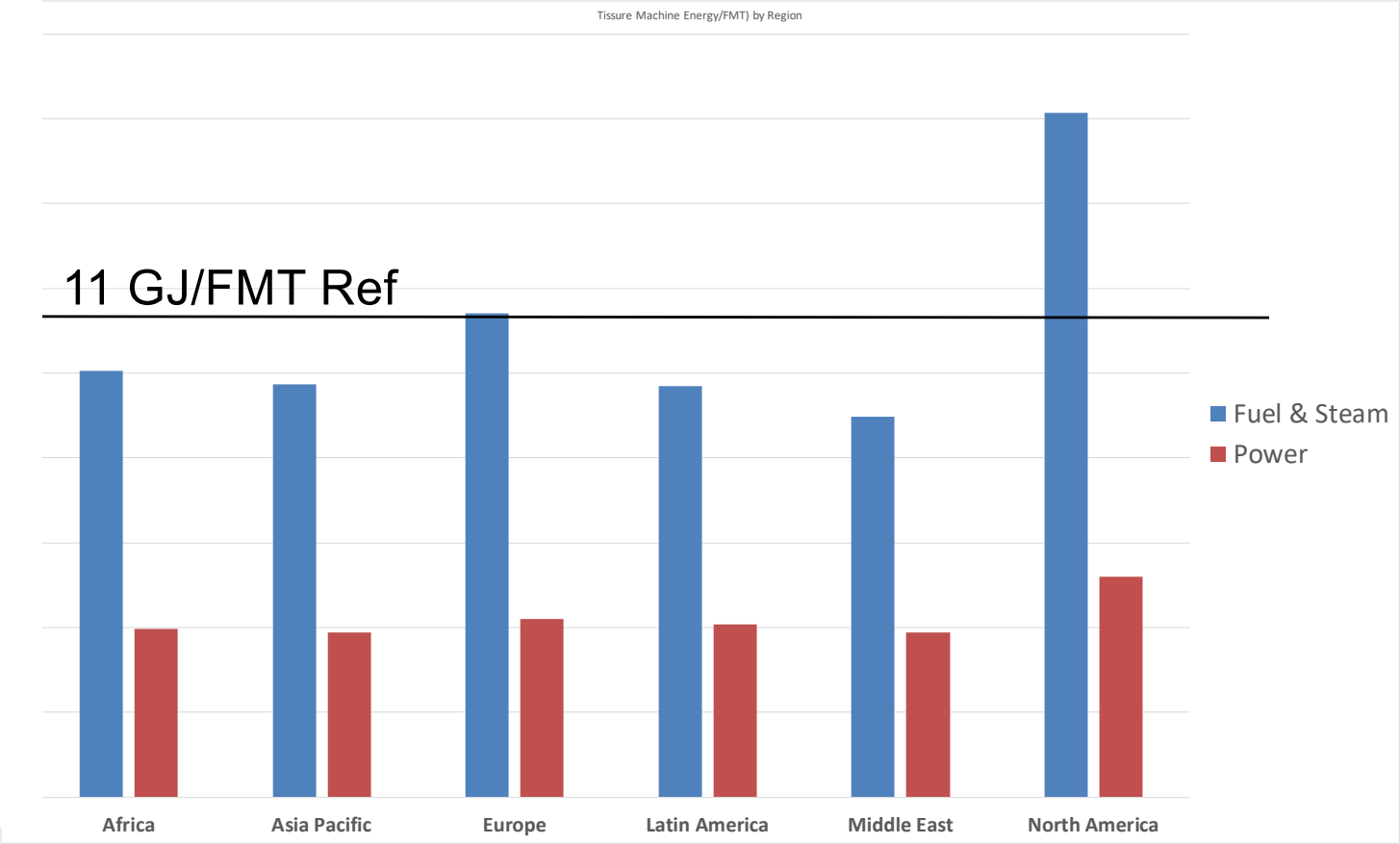
- **Tissue Machines are very energy intensive processes**
  - Energy represents about 14-18% of total mill costs*
  - Major factor in sustainability/carbon footprint
  - Get major management attention $$$
- **Tissue machine energy consumption/ton varies by:**
  - Product design (basis weight, furnish, creping setup)
  - Process *(dry crepe, wet crepe, TAD, Atmos, NTT, eTAD, QRT, ?)*
  - Machine speed and width *Intensity*
  - Machine design and *Technical Age*
- **Converting Plant is less energy intensive?**
  - How much energy is used per ton?
  - How does energy consumption vary by process or product?
  - What is the effect of converting plant efficiency and waste?
  - Does converting energy matter compared to tissue machine?

*Source: Fisher*Solve*™ © 2018 Fisher International, Inc.

Tissue Machine Energy Benchmarking

- Tissue Machine energy is key focus of mill benchmarking *(paper machine only excluding fiber line)*
  - **Electrical energy per ton**
    - ✓ Machine Drives, Stock, and Water Pumps
    - ✓ Vacuum Pumps
    - ✓ Hood and TAD Fans
    - ✓ IR dryers
    - ✓ Compressed air
  - **Heat Energy per ton**
    - ✓ Yankee Steam
    - ✓ Steam heated stock or water
    - ✓ Steam shower for drying or CD moisture control
    - ✓ Yankee and TAD Air Hoods (Steam or Gas heated)
    - ✓ IR dryers and CD moisture control (gas fired)

Regional Tissue Machine Fuel and Electricity per FMT *Tissue Machine Energy Only*



- *Note Conversion*
- *3.6 GJ= 1 MwH*
- *All data shown as GJ*

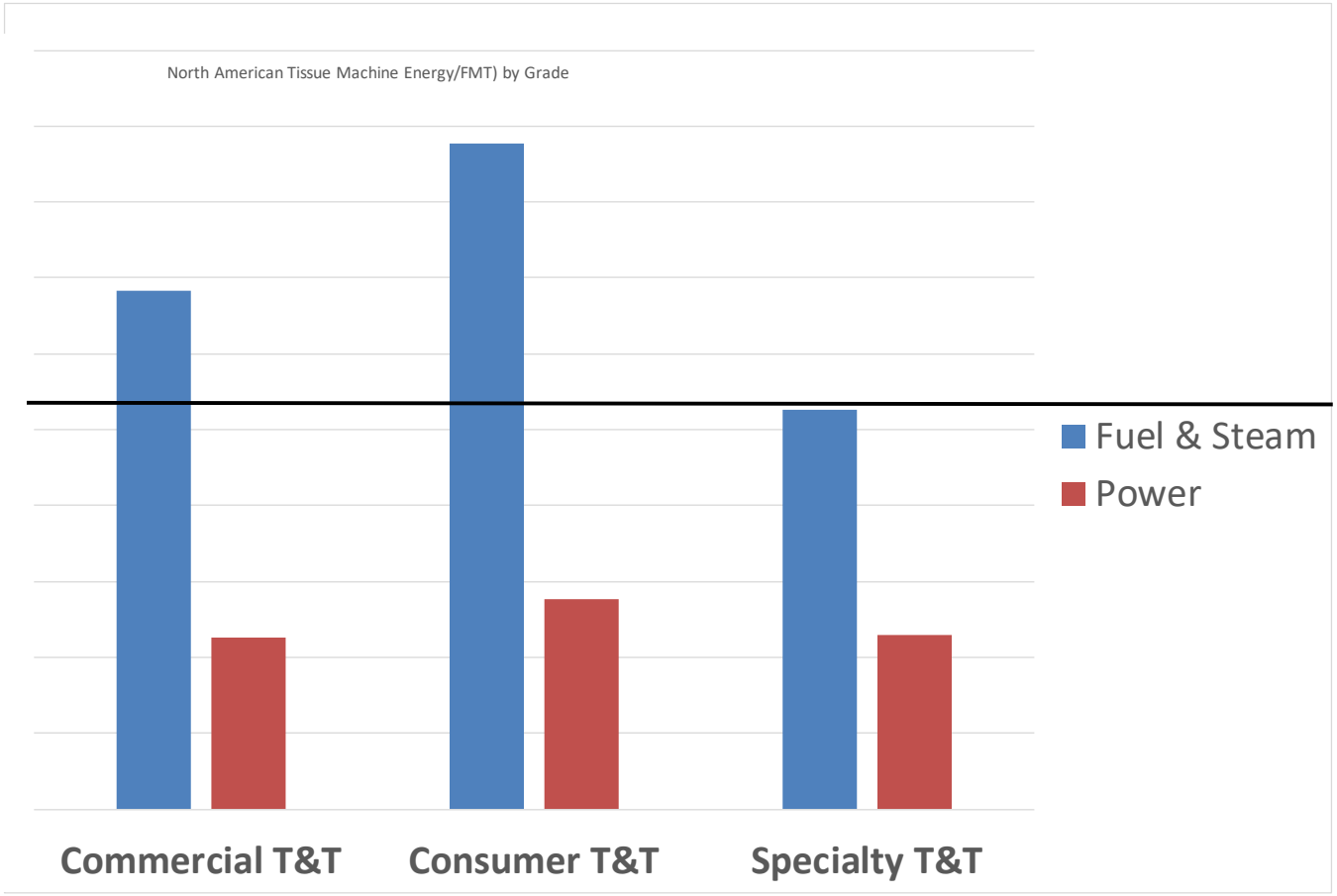
Tissue Machine Reference[1]
10.44 - 12.60 GJ/FMT

1Papermaking Part 2, Drying p22 Papermaking Science and Technology 2nd Ed 2009 Paper Engineers' Association/Paperi ja Puu Oy

- Results for TM production only *no fiber energy costs*
- North America = high heat energy consumption - Why?
  - Grade Structure, Product Design, Advanced Process Technology

Source: Fisher*Solve*™ © 2018 Fisher International, Inc.

North America Tissue Machine Energy Consumption GJ/FMT



11 GJ/FMT Ref

- Significant TM energy per ton differences between grades
- Consumer Tissue is highest consumption per ton.
  - Low moisture creping for softness
  - Advanced tissue technology

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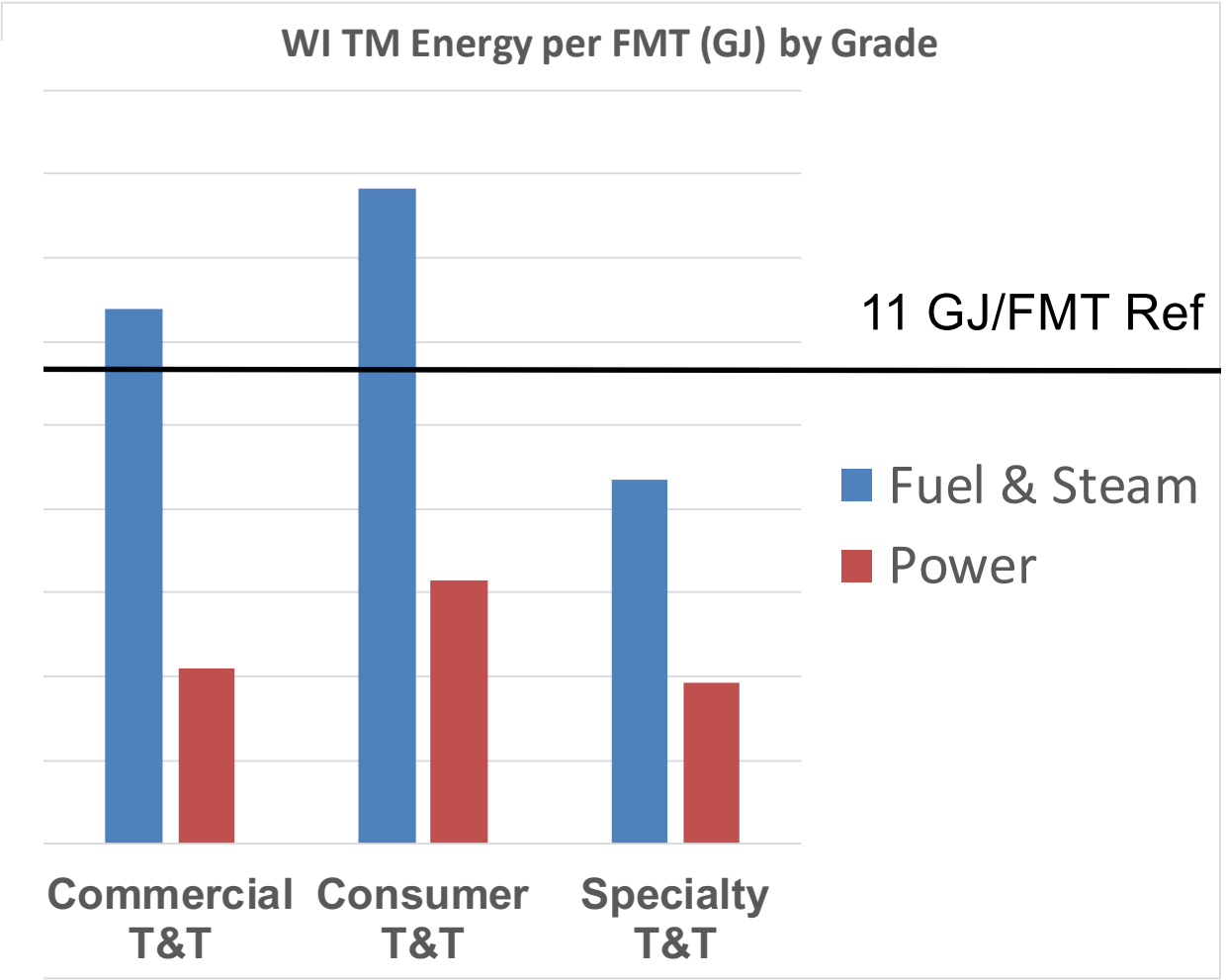
Wisconsin Tissue Production Energy GJ/FMT Commercial, Specialty, and Consumer Tissue Grades



Wisconsin Focus on Energy is Session Sponsor

- WI produces more tissue than any other State or Province in NA
- Basis for comparing Converting Energy to Tissue Machine Energy

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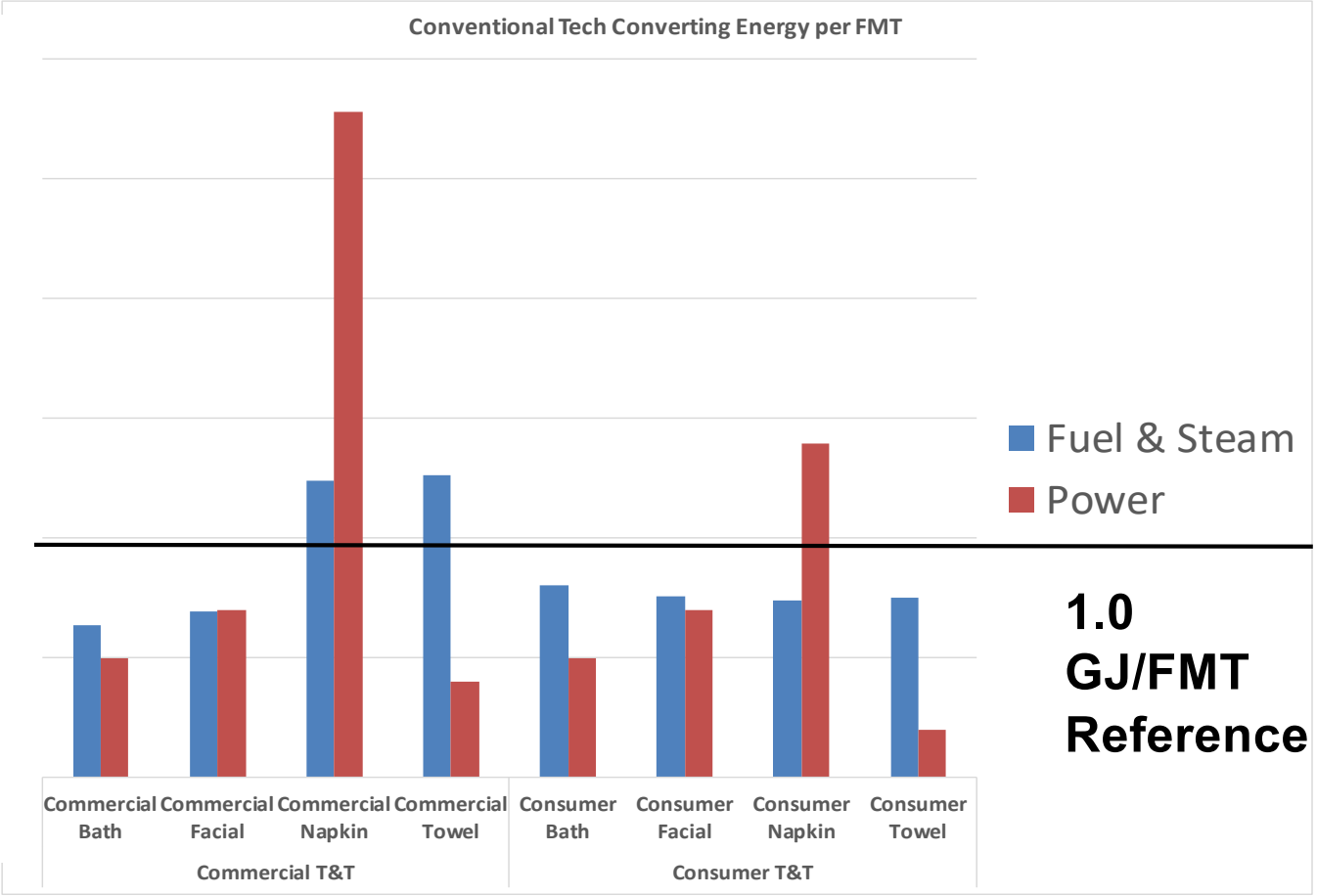
Converting Energy Components and Effects

- Direct Energy: focus on GJ/ton numerator
  - Building Environment – heat, air conditioning/ventilation, lighting
  - Compressed air – usage in newer processes decreasing
  - Machine Drives
  - Materials Handling

- Operations Opportunities: focus on GJ/ton denominator
  - How productive is the line (tons/hour)?
  - Line OEE – how much of time is used to run good product?
  - How much waste is created?
  - How do converted tissue product formats affect productivity?
  - Does advanced tissue technology base sheet impact productivity?

Converting Energy Consumption for Convectional Technology Paper



Tissue Machine GJ/FMT is **10-20X**[2] Converting GJ/FMT!

[2]Confirmed by major tissue producer

- Napkin Folding uses more Power/FMT → This makes sense
- Building Heat is generally greater than Power → *Wisconsin*

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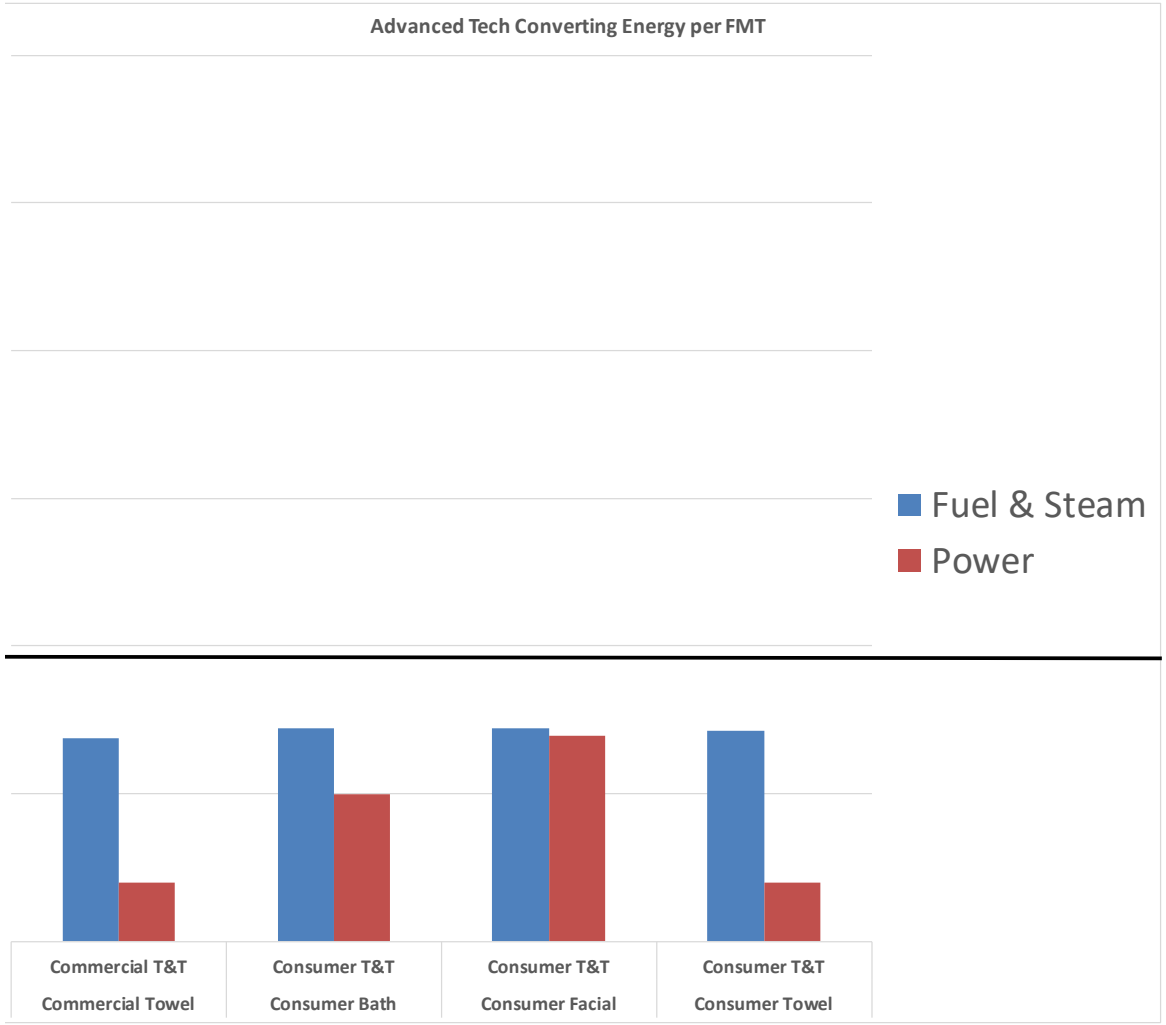
Converting Energy Consumption for Advanced Technology Paper



1.0 GJ/FMT Reference

- Folded product (Facial) uses most electric Power/Building Heat still largest factor
- But the more difficult base sheet has lower converting costs?

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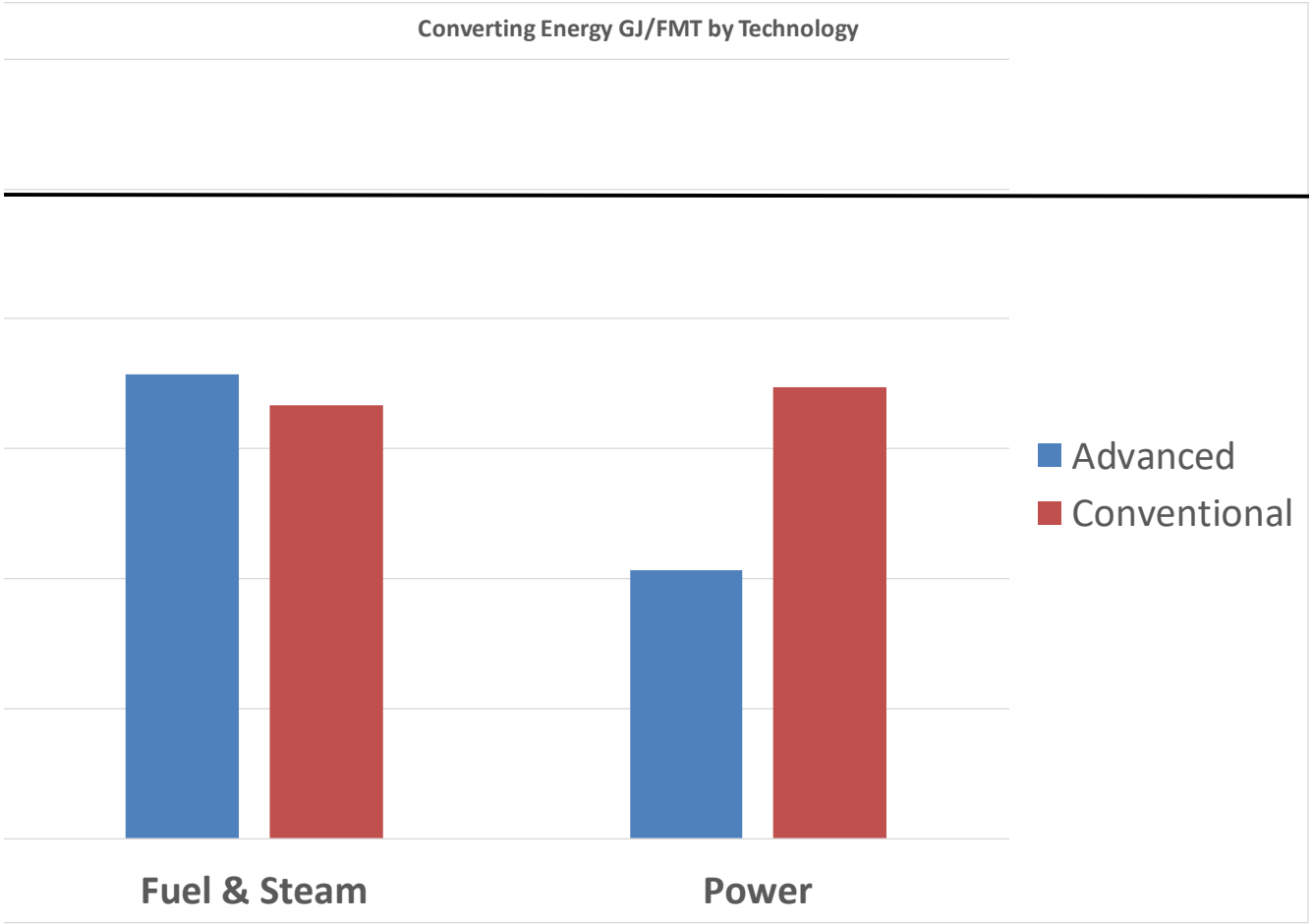
Comparing Base Sheet Technologies: Advanced Base Sheet Uses Less Electricity per FMT? *(Bath Tissue Only)*



1.0 GJ/FMT Reference

- Bulky, soft products with more cases per FMT convert easier?
- Maybe Advanced products get the best and newest converting equipment?

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Tissue Converting Energy Reduction Conclusions/Recommendations

1. The greatest opportunity for converting energy conservation starts on Tissue Machine.
   a) Tissue Machine consumes 10-20X energy per ton as converting plant (6-24X reported).
   b) Converting waste rates above 5% can consume more intrinsic tissue making energy than a well run converting plant.
   c) But 6% waste is considered good performance at some companies.
   d) Typical converting waste can run 8-9% when using rewinders.
   e) Transport of soft advanced tissue rolls can result in 13% waste.
   f) High converting waste and low efficiency can often be traced back to poor tissue uniformity.
2. Converting throughput is integral to low energy consumption/ton for plant lighting and heating/cooling loads.
   a) Bath-Towel lines typically run 60-65% OEE.
   b) Reported range 40-90%.
   c) Best performance is 80-90%
3. High efficiency converting equipment and best operating/maintenance practices can cut converting energy per ton by up to 40%

Questions for Further Study

- Can similar use of business intelligence identify value of Tissue Machine energy saving measures?
  - ✓ Steel versus Cast Iron Yankee
  - ✓ Shoe Press/Pressure Roll
  - ✓ Cogeneration for Tissue Machine energy efficiency
  - ✓ Others?

- Can Tissue converting operations be classified by Grade and Finished Products to compare energy efficiency?

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Thank you for your time.

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