Lessons Learned, Progress, and Development Needs for Processing and Handling Herbaceous Biomass

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Presentation Overview

- Company background (brief)
- Background on lessons learned (to date)
- Key challenges related to commercialization of feed handling concepts
- Approaches to overcome these challenges
- U.S. DOE's role in supporting industry needs in order to overcome these challenges

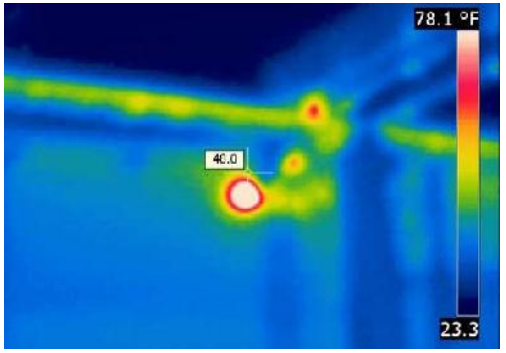
Supporting Clean Energy Sectors

Bio-Fuels

Biomass Power

Biomass R&D

Solar



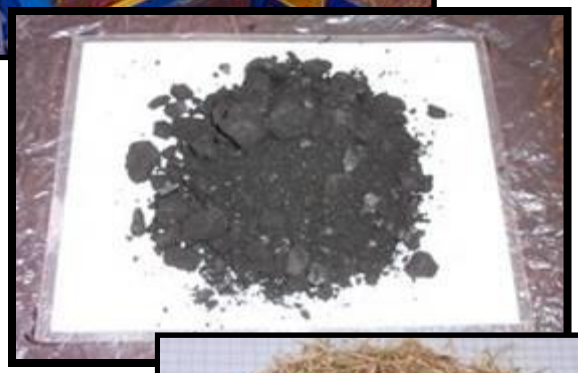
Energy Efficiency

Wind

Relatively "plug-and-play," known, off-the-shelf equipment, tangible examples abundant, bankable policies, market pull.

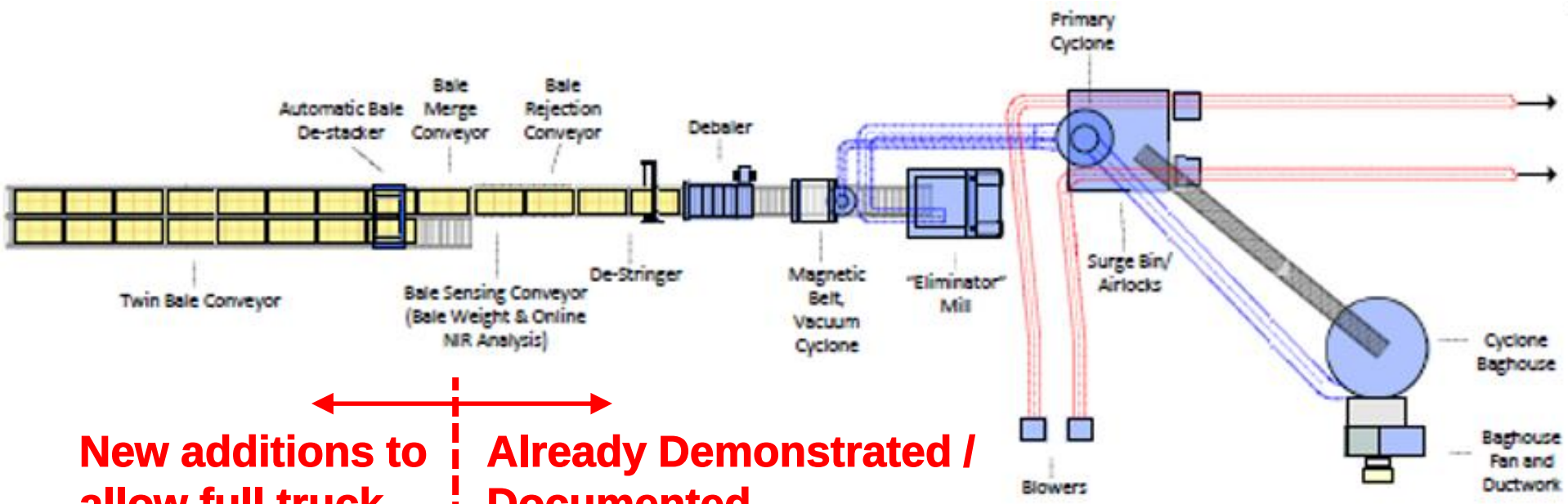
Original Lessons

- Ottumwa Generating Station
  - Alliant Energy / Mid-American
  - 726 MW, PRB Coal, 1982 startup
  - Twin furnace T-fired PC boiler
  - 2.5 to 5% heat input from switchgrass, 12.5 to 25 ton/hr
  - **Up to 200,000 ton/yr capacity**
  - Separate biomass injection, 2 - 4 ports
- Fuel
  - 3’ x 4’ x 8’ switchgrass bales
  - 2-step milling process to 1/8” minus
- Project ended in 2006
- Chariton Valley Biomass Project



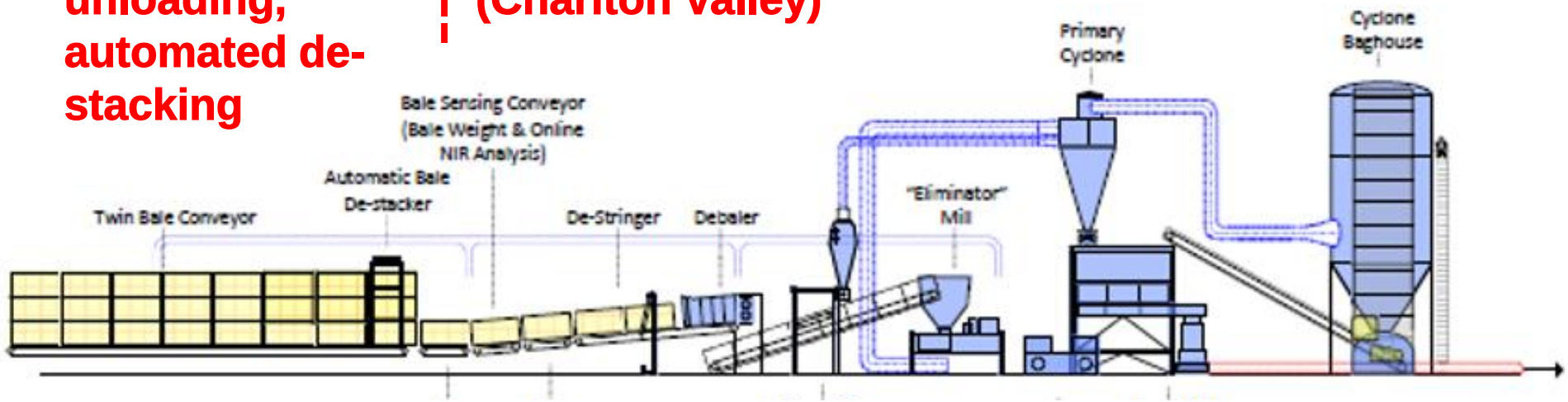
2000+ Hour Continuous Demo

Process Line Concept



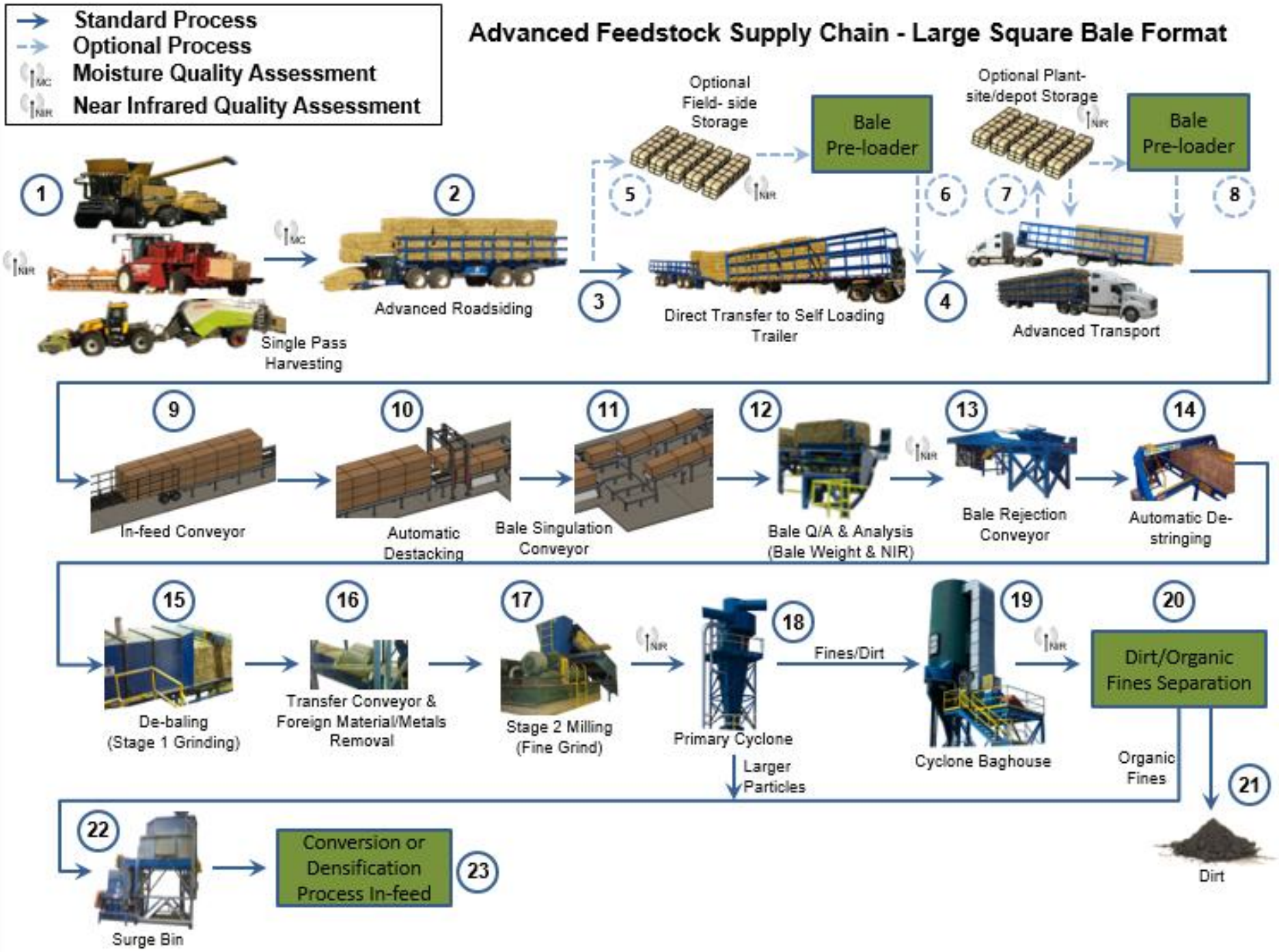
New additions to allow full truck unloading, automated de-stacking

Already Demonstrated / Documented (Chariton Valley)

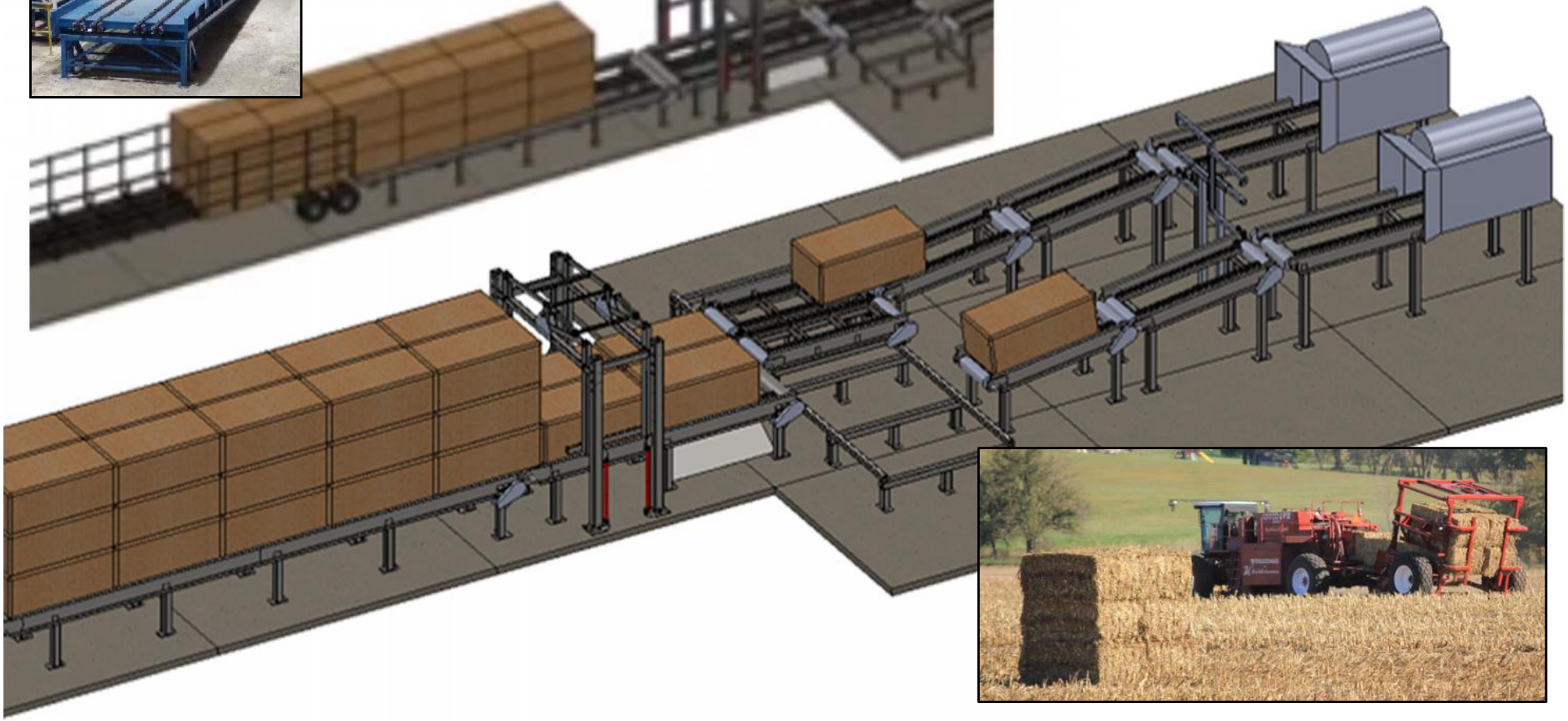


Key Lessons Learned

- Entire supply chain is important for facilitating reliable and efficient at-plant operations
  - Lower Quality Biomass = More Processing Problems
- More efficient loading / unloading needed
- Biomass is variable, guaranteed
  - Deal with it (robust handling system is critical)
- Predictive maintenance control systems needed
- Improved biomass quality diagnostics needed
- Demonstration-scale process facility(s) are needed
  - Regularly operating--the more the better
  - Need a processed material off-taker


Standard Process
Optional Process
Moisture Quality Assessment
Near Infrared Quality Assessment
Advanced Feedstock Supply Chain - Large Square Bale Format
1
Single Pass Harvesting
2
Advanced Roadsiding
3
Optional Field- side Storage
5
Bale Pre-loader
6
Direct Transfer to Self Loading Trailer
4
Optional Plant-site/depot Storage
7
Bale Pre-loader
8
Advanced Transport
9
In-feed Conveyor
10
Automatic Destacking
11
Bale Singulation Conveyor
12
Bale Q/A & Analysis (Bale Weight & NIR)
13
Bale Rejection Conveyor
14
Automatic De-stringing
15
De-baling (Stage 1 Grinding)
16
Transfer Conveyor & Foreign Material/Metals Removal
17
Stage 2 Milling (Fine Grind)
18
Primary Cyclone
Fines/Dirt
19
Cyclone Baghouse
20
Dirt/Organic Fines Separation
Organic Fines
21
Dirt
Larger Particles
22
Surge Bin
Conversion or Densification Process In-feed
23

Automated Square Bale Infeed



Bale Handling System

Vermeer

EQUIPPED TO DO MORE.

Feedstock Logistics Linkages










ANTARES Group Incorporated

FDC Enterprises Grasslands Services

OAK RIDGE National Laboratory

STATE

INL Idaho National Laboratory

Kelderman

PacificAg

Concluding Remarks

- Innovation investments are stymied in a market with little “pull”
  - DOE investments will continue to be very important
- Additional development needed on consistently delivering the desired spec material size with variable incoming material properties
- Suggestion: Public/private partnership(s) to establish one or more demonstration-scale biomass processing and handling “depot(s)”
  - With high potential for regular/frequent operation
  - Needs one or more material off-takers (paying)

High-volume Unloading Systems

Cotton Gin

Log Trailers

Sugar Mill

Example High-volume Infeed Systems

Exhibit 48 Long Term Test Burn Daily Tons Processed

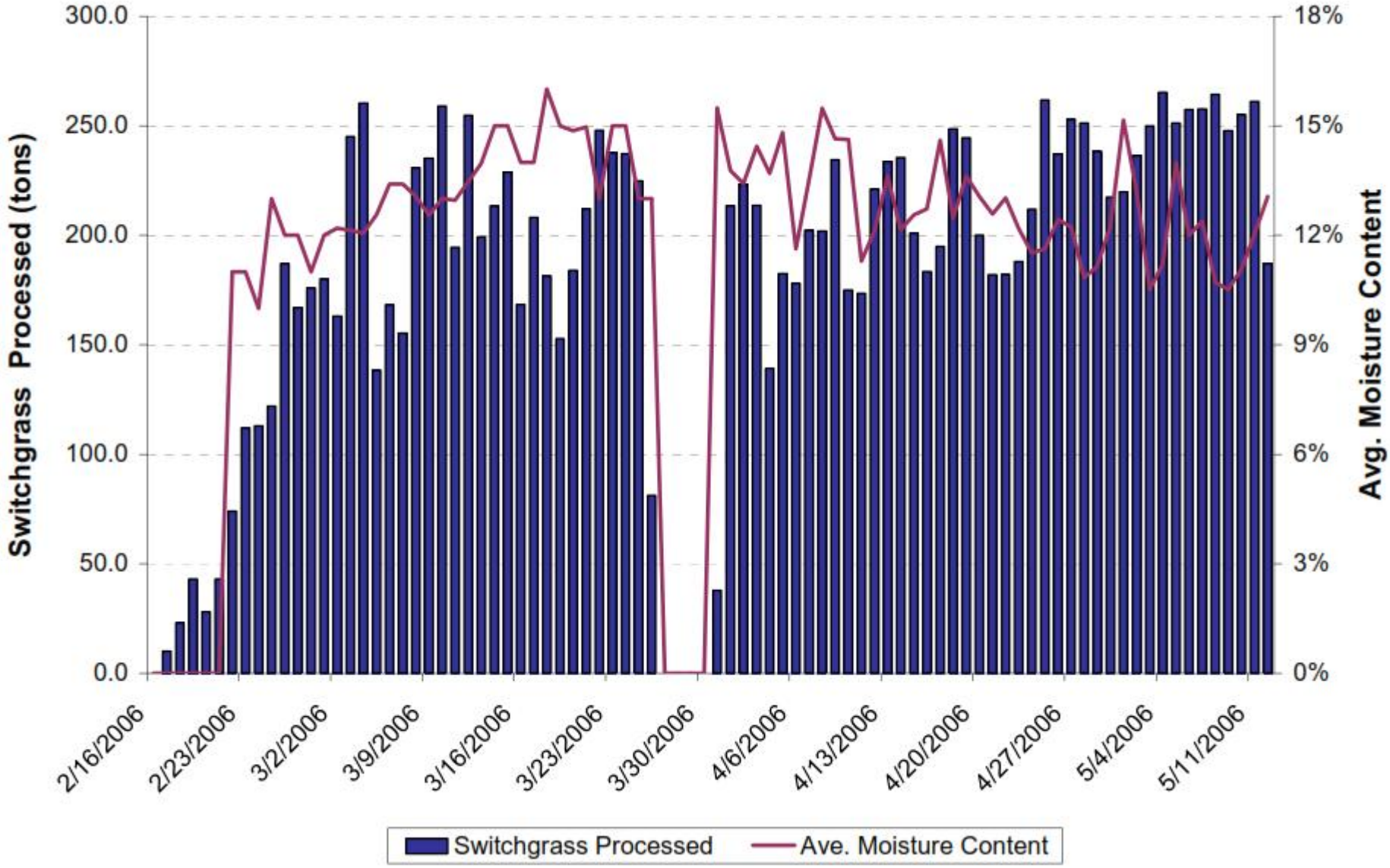


Exhibit 51 Long Term Test Burn Weekly Processing System Availability

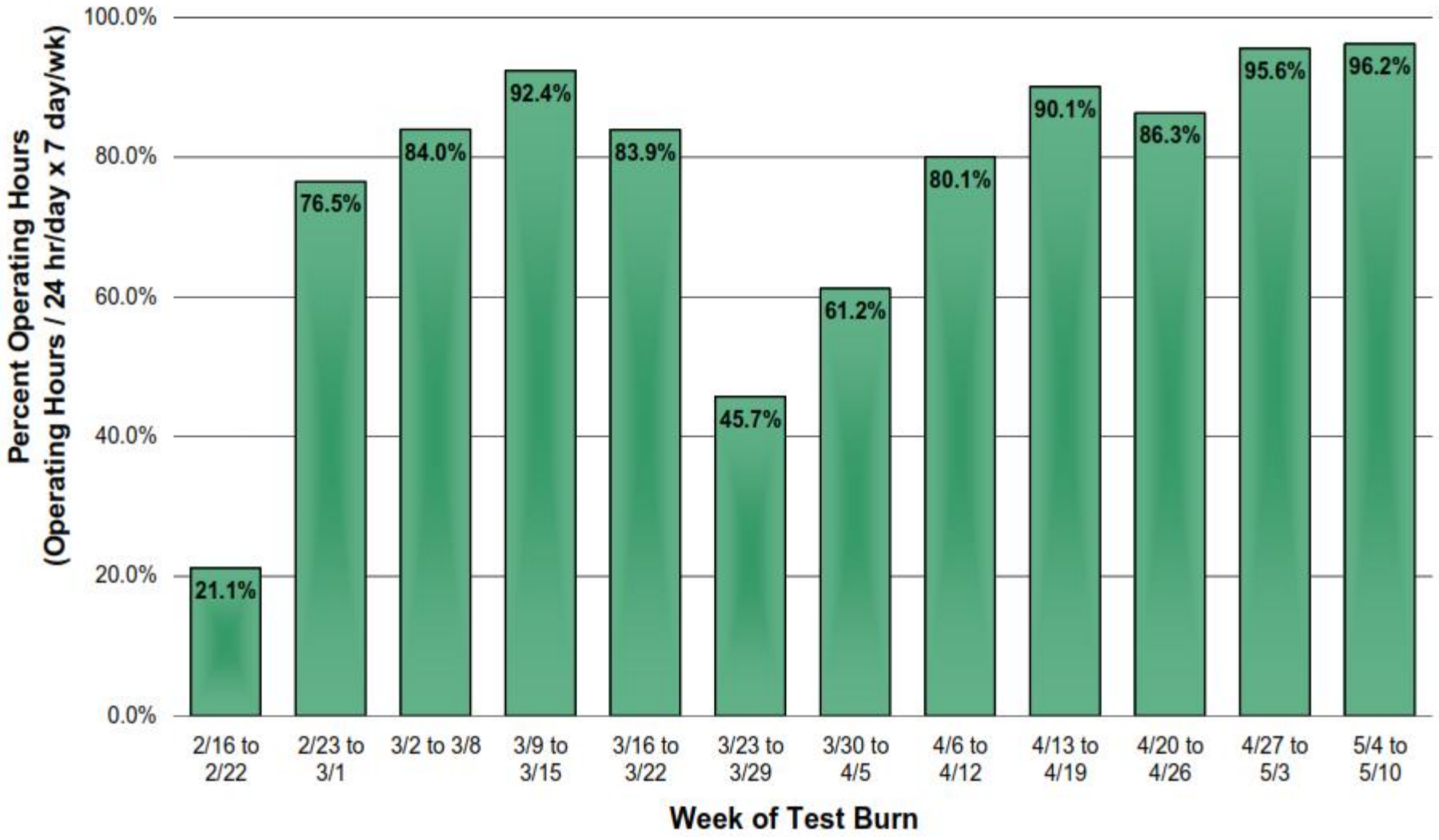


Exhibit 52 Long Term Test Burn Average Biomass Feed Rates (During Run Time)

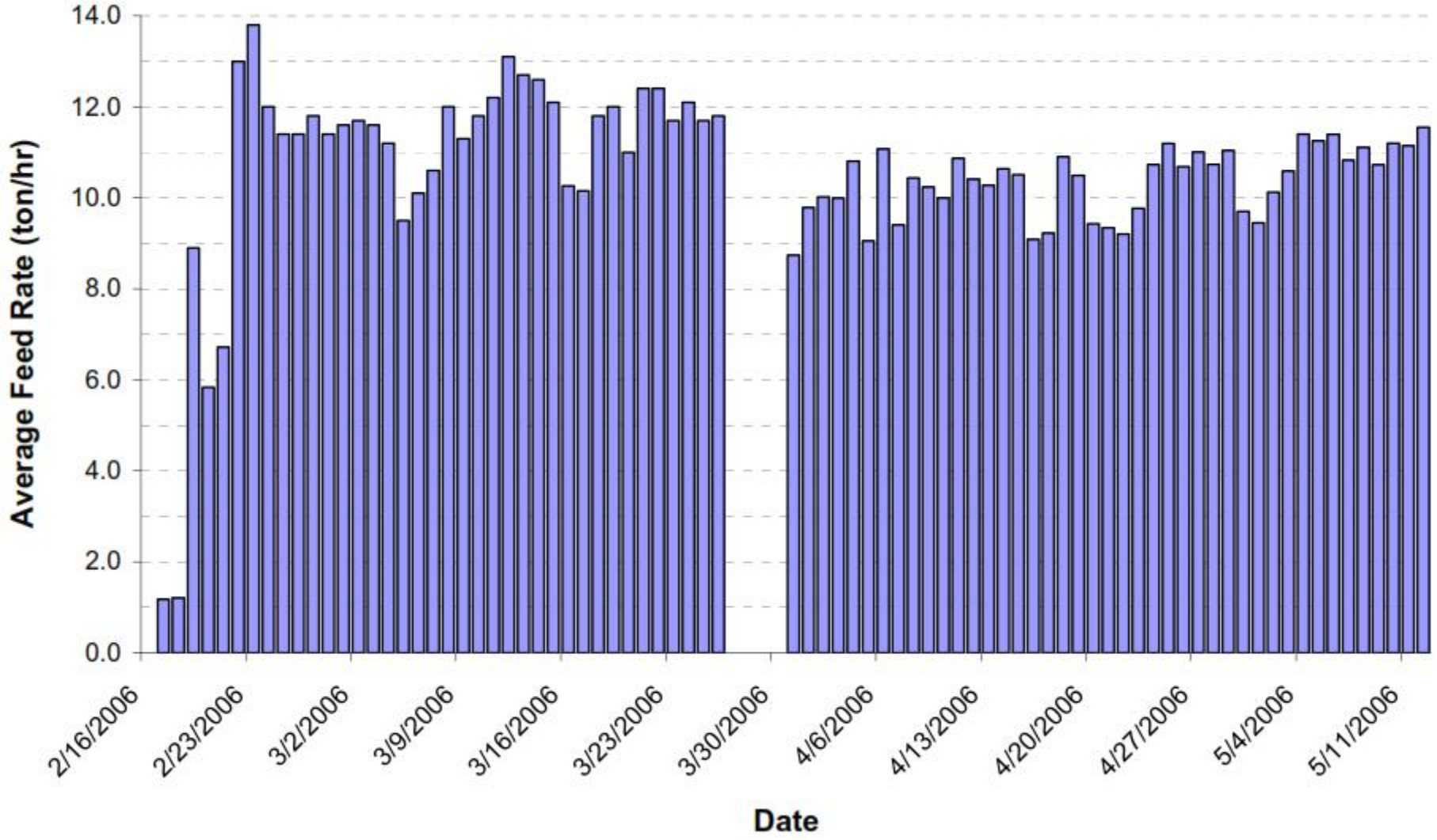


Exhibit 79 Feed Rate and Milling Power Versus Moisture Content