Harvesting and Processing Biomass
Experiences and Challenges

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Biomass Business Manger

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Forage Solutions

Environmental Solutions

Specialty Excavation

Solutions for UG Installations

Corn Residue Harvesting

Methods vs. Yield

1. **Corn cobs only** – removes *15% of residue
2. **Direct bale** – removes *25% of residue
3. **Rake/Bale** – removes *50% of residue
4. **Shred or chopping corn head/rake/bale** – removes up to *75% of residue

*Approximate removal rates

Corn Residue Harvesting

Challenges

- Tight harvest window
- Moisture level variations
- Corn variety
- Sustainability
- Dirt/Ash content vs. residue yield
- Long-term storage
- Current equipment built for typical farming applications

Common Energy Crops

Switchgrass

Miscanthus

Energy cane

King grass

Arundo

Process

- Switchgrass, Miscanthus – single harvest after frost
  - ➢ Mow – (rake option) – bale
- King, canes, Arundo…. tropical
  - ➢ Mow – dry down - bale




Energy Crops - Challenges

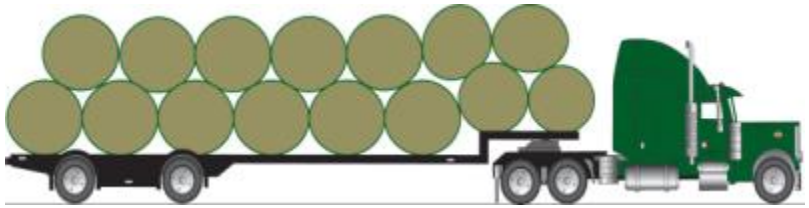
- Mowing tall, high-volume crops
- Moisture content at harvest
  - Weather – fall, cool temps, frost, rain/snow
  - Tropical customer understanding of higher moisture bales and the impact to storage
- Ash content during harvest




Storage of Biomass Bales

- Single row vs. stack
- Gravel bed vs. dirt
- Tarp vs. building
- Round vs. square
- Netwrap vs. twine

Round vs Square



Purchase price (1/3)

HP to operate (1/2)

Storage – moist climates

12x – units sold annually

Continuous baling

Trailer loading/hauling

Common Ground

Similar performance in most crops

Bale density

Crop preparation and bale handling

Feedstock Specifications being defined – OEM needs clarification

- Food grade vs Fuel grade biomass
- Consistency
- Moisture content / range impacts harvest window
- Ash content
- Density - truck weight & quantity, distance, energy to harvest, cost to manufacture/operate
- Next process – grind, material size, can we create more value in field
- Who is the customer? farm – custom – regional center - plant
- Feedstock value (farm ROI)
  - Harvest cost
  - Harvest impact
  - Market need

Many opportunities to improve once specifications are clear

Biomass Processing

- Biomass moisture and ash levels are critical
  - Effects productivity, consistency, wear, etc.
  - Storage and harvest methods important
- Need for flexibility in product and size
  - One solution is not the answer for everyone
- Multiple pass processing tends to be more efficient method when pelletizing or fermenting
  - Contaminants
- In plant vs. infield processing
- Diesel vs. electric
- Must have dust control
- Feeding the “System” capacity

Processing Biomass Non-Woody

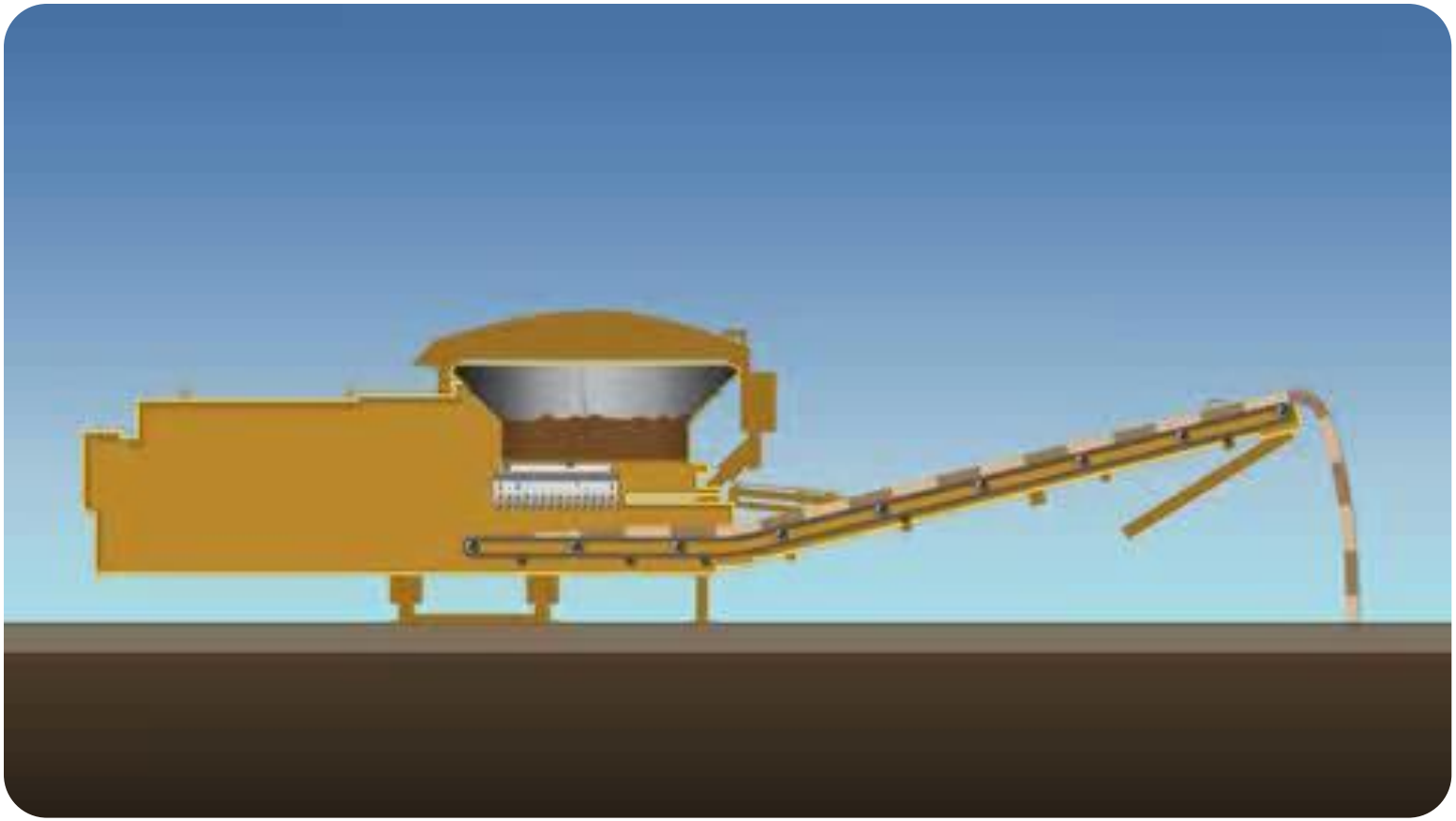
Bioscreen Kit

- Better size control
- Variable moisture OK
- Lower maintenance costs

Processing Biomass

- TG5000
  - Loader option
  - Diesel or electric
  - Trailer or skid
  - 540 HP
  - Bioscreen
- Biomass
  - Round or square
  - Loose, bulky material
  - No longer than tub dia.

How a Tub Grinder Works

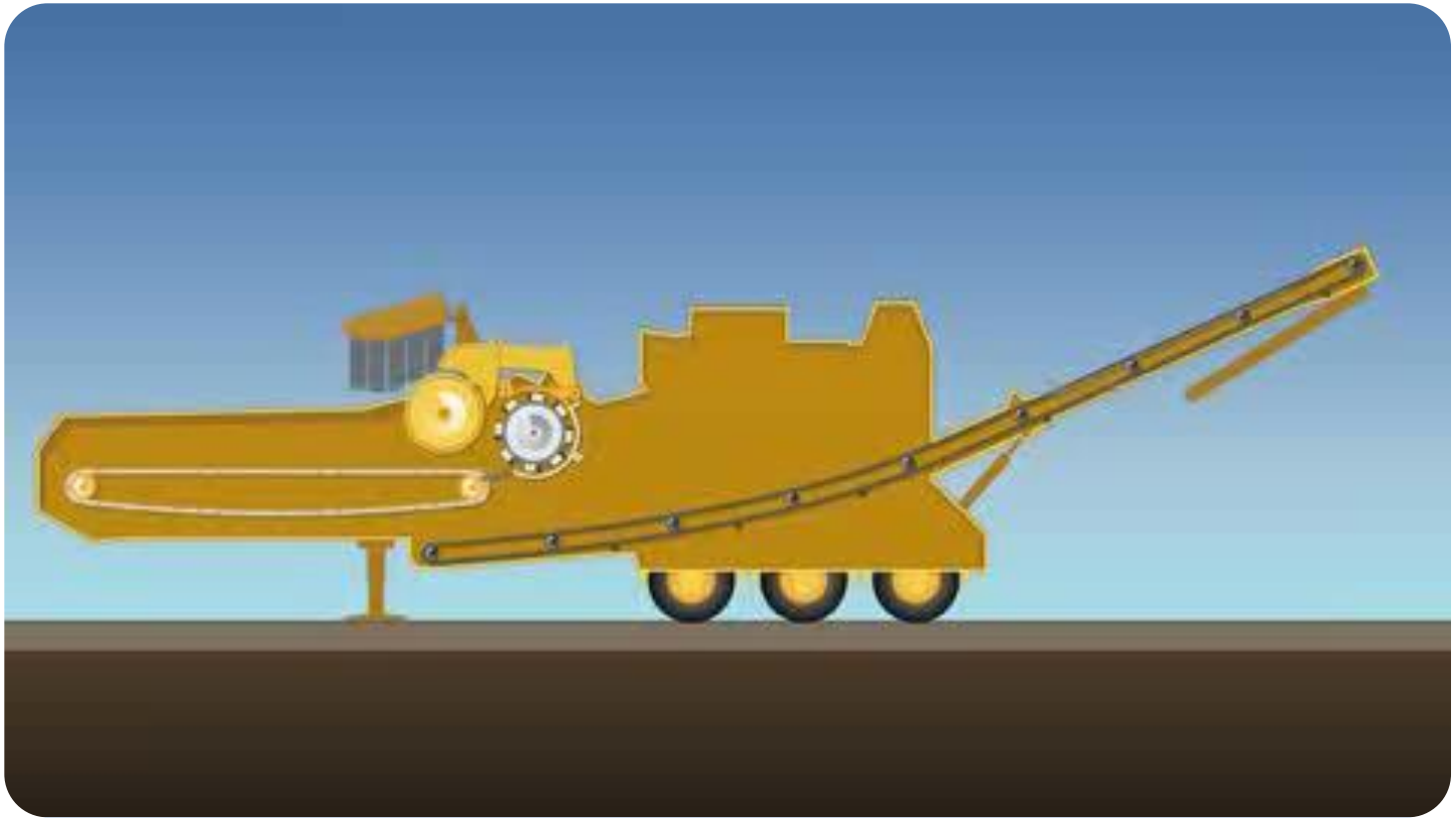


Processing Biomass

- HG6000
  - Diesel or electric
  - Trailer or skid
  - 700 HP
  - Bioscreen

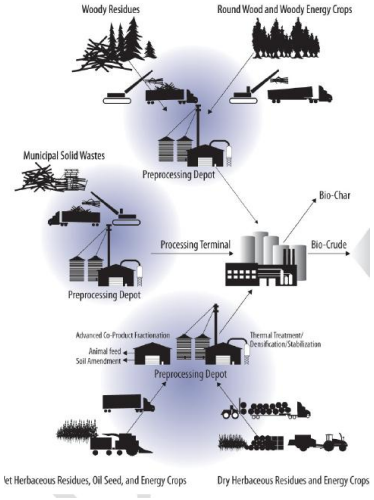
- Bales –
  - Large square or up to 4’ dia. round
  - Logs, brush, C&D

How a Horizontal Grinder works



Biomass Opportunities - *Equipment Evolution*

- Higher duty cycle products to harvest & process
- Flexibility in processing equipment
- Profitability: land owner – harvester – storage site - transport – process – energy producer
- Contaminants (ash) & varying moisture
- Logistics of low-density biomass
- Consistent feedstock to end user
- Year-round supply – storage
- Commercial scale supply



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BIOMASS MARKET POTENTIAL

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