Densified Wood Products

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Thorne Bay, May 19 2009

"A tree is a tree - how many more do you need to look at"

Ronald Reagan, California Governor

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Densified Wood Products

Densified wood product family

- *Fire logs*
  - Wood (Presto logs, briquettes, pucks etc)
  - Wood and wax (Duraflame, Pine Mountain)
- *Pellets*
  - Domestic
  - Commercial/dirty
- *Bricks*
- **Ingredients**
  - Small clean wood particles
  - Pressure and heat

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Why densify?

- High energy content
- Low moisture content
- Clean and convenient
- Consistent product
- Stoves meet air quality (EPA but not PM 2.5)
- Global commodity product
- Growing market

- **Why not?**
- Equipment intensive
- Energy input (70-80kWh/t)
- Expensive end-product

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Densified Products – Typical Process

1. Chipping
2. Screens
3. Drying
4. Grinding
5. Conditioning
6. Compression (heat)
7. Cutting
8. Cooling
9. [Packaging]
10. Storage

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Firelogs

- Campfires
- Existing stoves/fires
- Smaller markets
- Boilers

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Wood pellets

- Invented in 1970s (ID)
- Uses
  - Fuel (seasonal)
  - Animal bedding/litter
  - BBQ pellets
- Markets:
  - N America: 1.5-2 million tons/year
  - Europe: 10-12 million tons/year

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Wood pellets for heat

- Domestic grades – big demand in USA?
  - $320-350/ton
- Commercial grades:
  - European demand now (co-firing with coal in power plants $110-150/ton FOB)
  - Future US market?

Pellet press

Roller

Die

Current industry

- 90+ plants in USA
- 10,000-40,000 tons/yr typical plant production (biggest is 500,000 tons/yr)
- N American production ~2.7m tons
- Global over capacity
- 60,000 tons optimal
- Simple process requires much optimization – many variables

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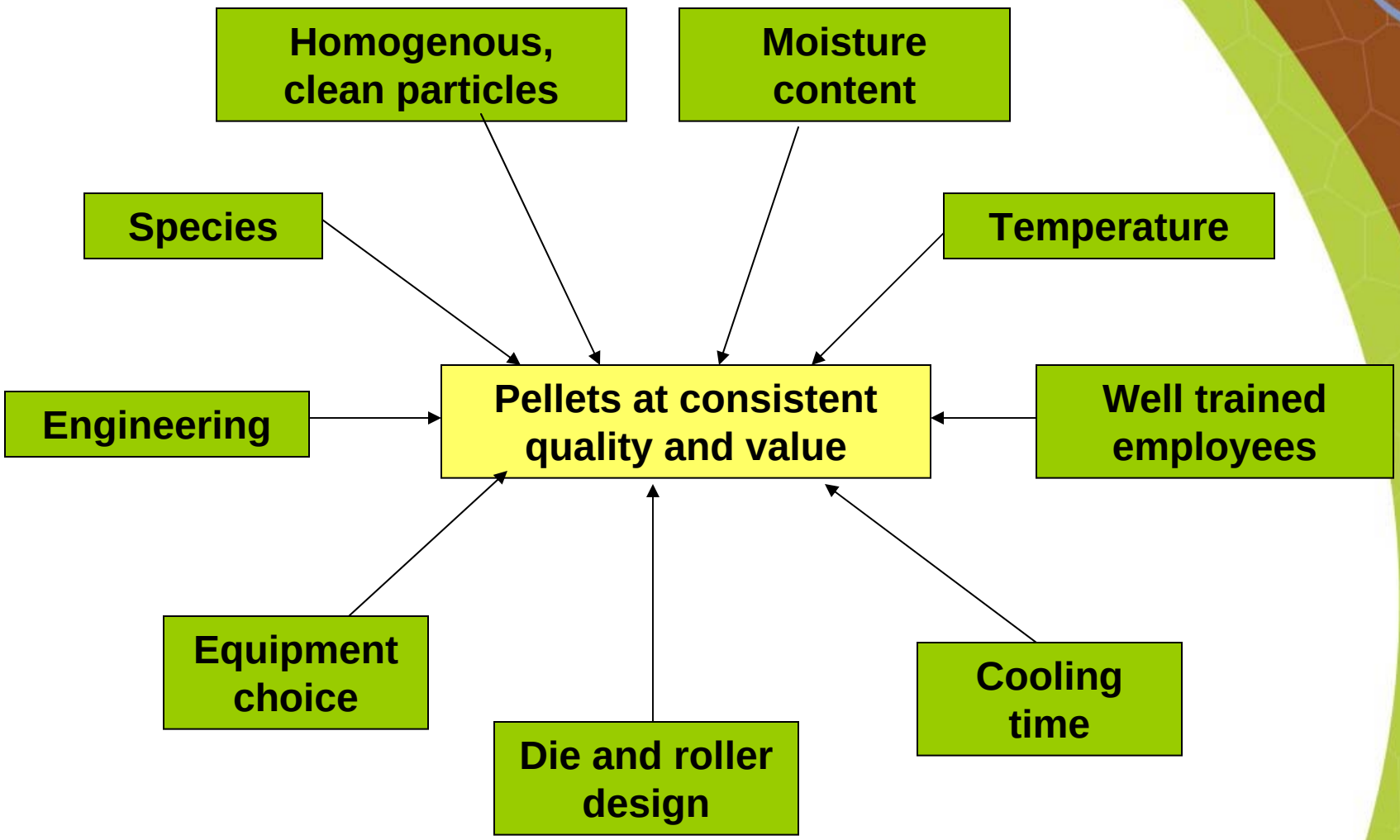
Pellet manufacturing variables



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Densified fuel feedstock

- For domestic market (<1% ash)
  - Less than 10% MC
  - **Clean** chips, shavings or sawdust
  - Pay up to $50/BDT
  - 100 mile sourcing radius
  - Delivery: 0-1000+ miles

- Possible to use any biomass (high ash)
  - Limited market (for pellets)
  - Tool wear
  - Consistency

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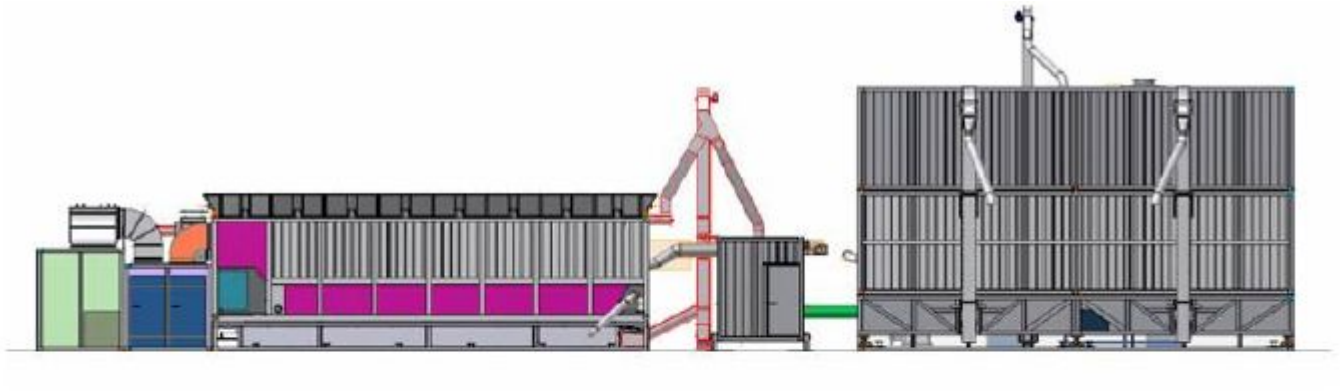
Example: 40,000 ton/yr pellet facility

- 100 BDT/day
- $5.5-$7m build cost
- 24/7 operation
- 3-5 acre site
- 30-35 jobs

Rapidly re-deployable units

- BioJoule (UK) – 10,000 tons/yr pellets
- ~$1.2m



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Cost hierarchy for pellets

1. Feedstock $$$$$
2. Workforce $$$$
3. Drying $$$
4. Pelleting $$
5. Finance $

Source: Buhler

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Why do densified fuels make sense?

- Small to mid-scale
- Proven technology
- Can use small diameter logs (debark and chip)
- Potential to use dirty material
- Local market

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General challenges

- Seasonal markets (cash flow)
- Air quality restrictions
- Market development (stoves vs pellets)
- Quality control
- Surviving the first year
- Raw material supply
- Overcapacity
- Commodity product = downward price pressure

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SE Alaska

- **Challenges**
  - Distance from lower 48 market
  - Limited local market for pellets
  - Transportation infrastructure
- **Opportunities**
  - Long heating season
  - Distance from lower 48 manufacturers
  - Fossil fuel costs
  - Market for products that compete with cordwood

Strategies

- Partner with an existing densified fuel manufacturer
  - Technical expertise
  - Market access
- Scale according to biomass resource base
- Make a product that competes with cord wood, eg bricks
  - Slash feedstock
  - Bigger local market
  - Less technical challenges

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Project Examples

- Go big
- Go local
- Go high value
- Go micro

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Go big - Enligna

- 200,000 ton pellet mill in Sacramento
- Start with export market (Europe) – long term contracts
- Develop local markets for:
  - Domestic pellets
  - Commercial pellets
- Diversified feedstocks to manage supply risk

Go local – Bear Mountain FP

- 10,000 ton brick mill in Sonora
- Make a product that competes with cordwood
- Forest health benefits a selling point
- Build on existing brand
- Use forest slash
- Develop local markets for commercial pellet

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Go high value – 3,000 tons/yr

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Go micro – 2,000 tons/yr

Densified Fuel

- Fuel cubes