Chelan County Forest Products Campus Summit

Feasibility of Utilizing Small Diameter Biomass in Chelan County & the Western US

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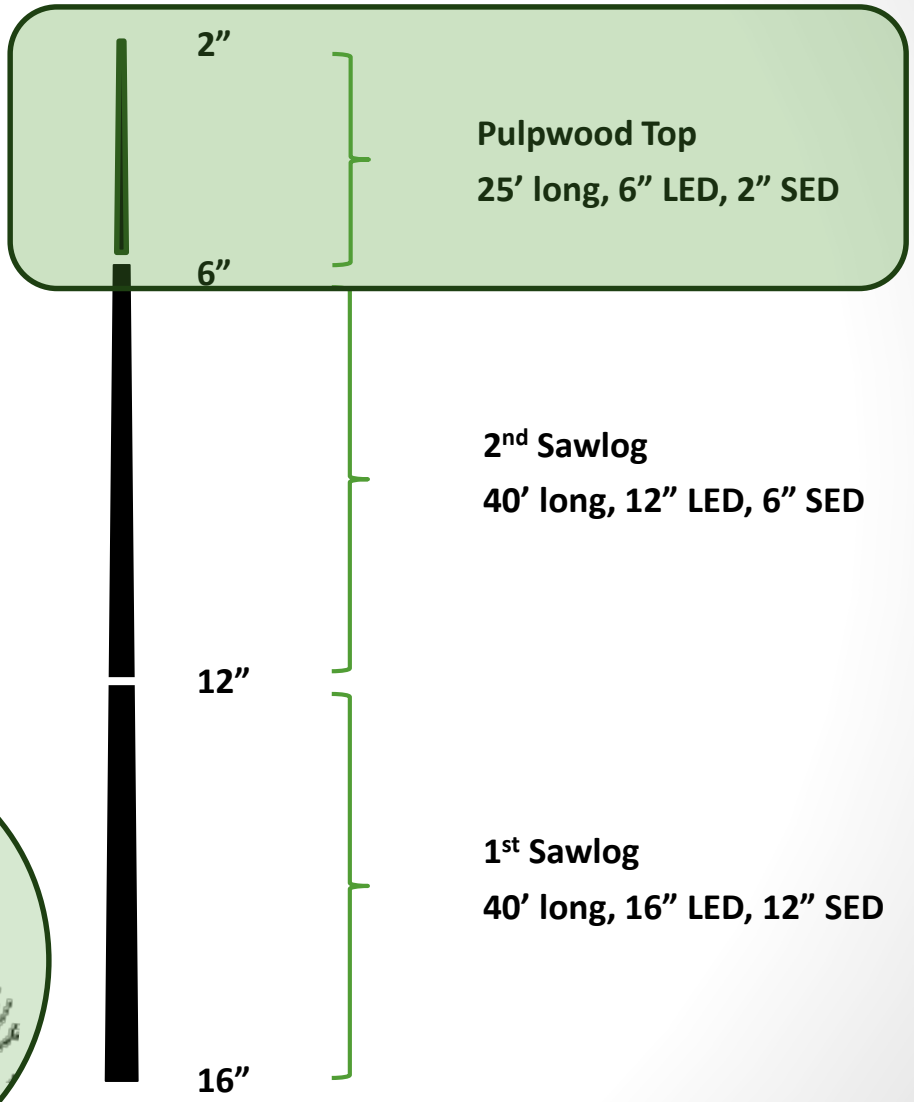
The Beck Group

- **Forest products planning and consulting services**
- **More than 40 years in business in Portland, OR**
- **Services:**
  - **Feasibility studies**
  - **Small diameter tree utilization**
  - **Capital project planning**
  - **Merger/Acquisition due diligence**
  - **Mill benchmarking**
  - **Raw material supply & demand**
  - **Mass Timber**
  - **Expert witness**

Where does Biomass Come From?

Sawlog Size Trees



Pulpwood Top
25’ long, 6” LED, 2” SED

2nd Sawlog
40’ long, 12” LED, 6” SED

1st Sawlog
40’ long, 16” LED, 12” SED

Where does Biomass Come From?

Small Sawlog Size Trees

80’

10”

2”

6”

Pulpwood Top

30’ long, 6” LED, 2” SED

1st Sawlog

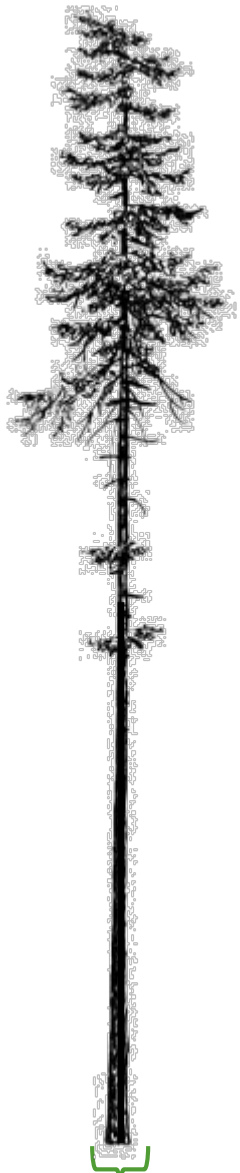
36’ long, 10” LED, 6” SED

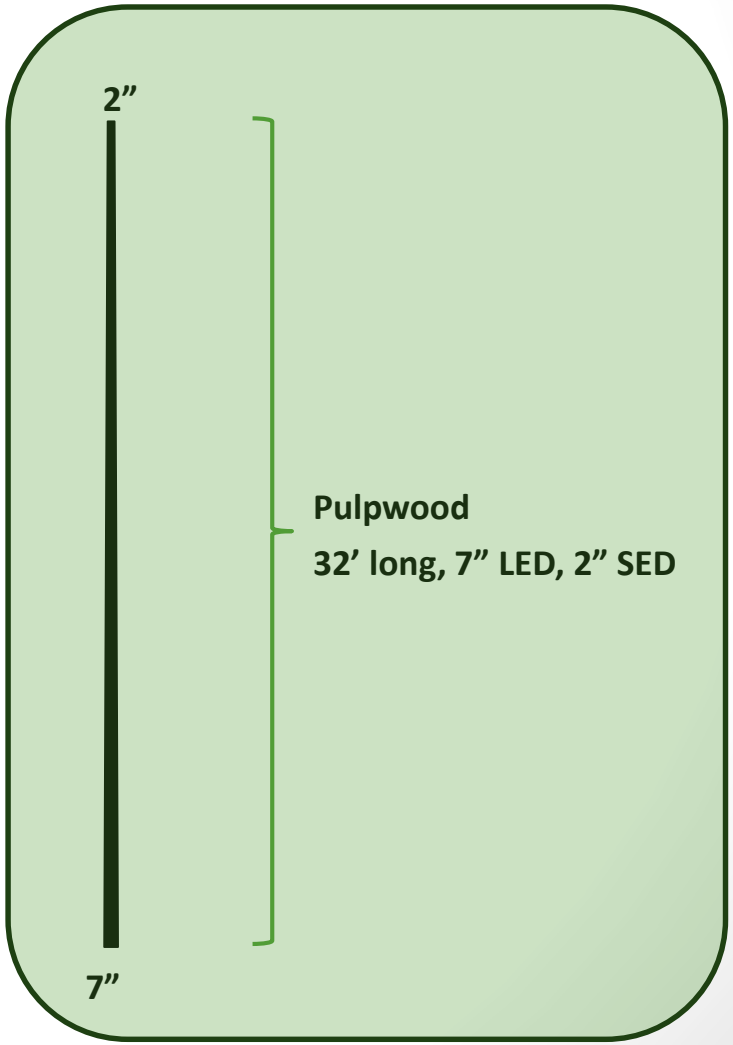
10”

Limbs & Top

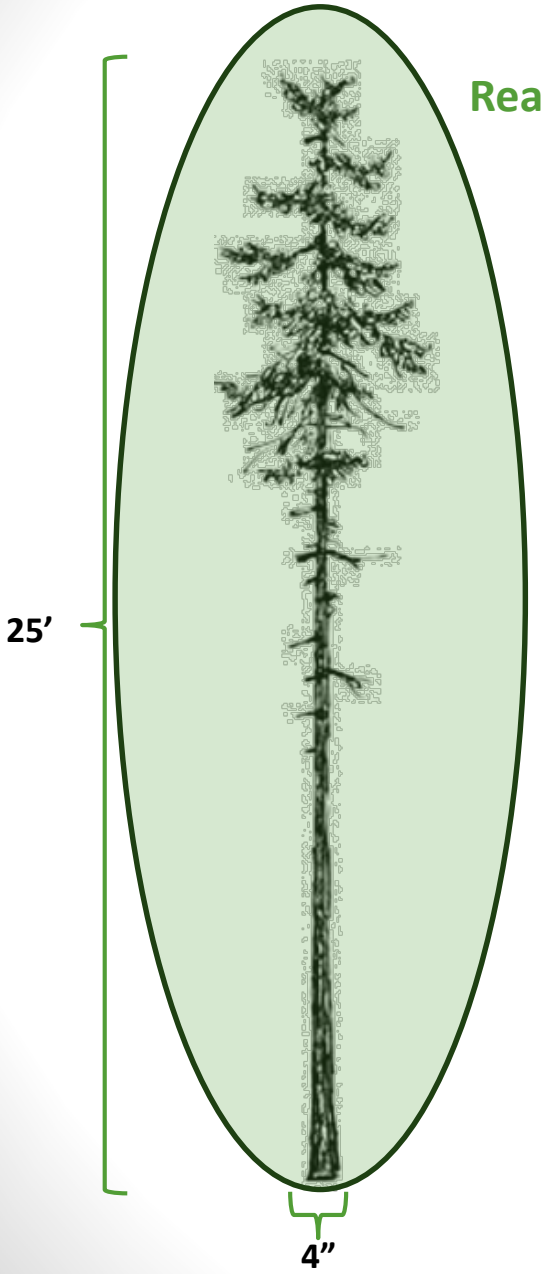
Where does Biomass Come From?

Pulpwood Size Trees



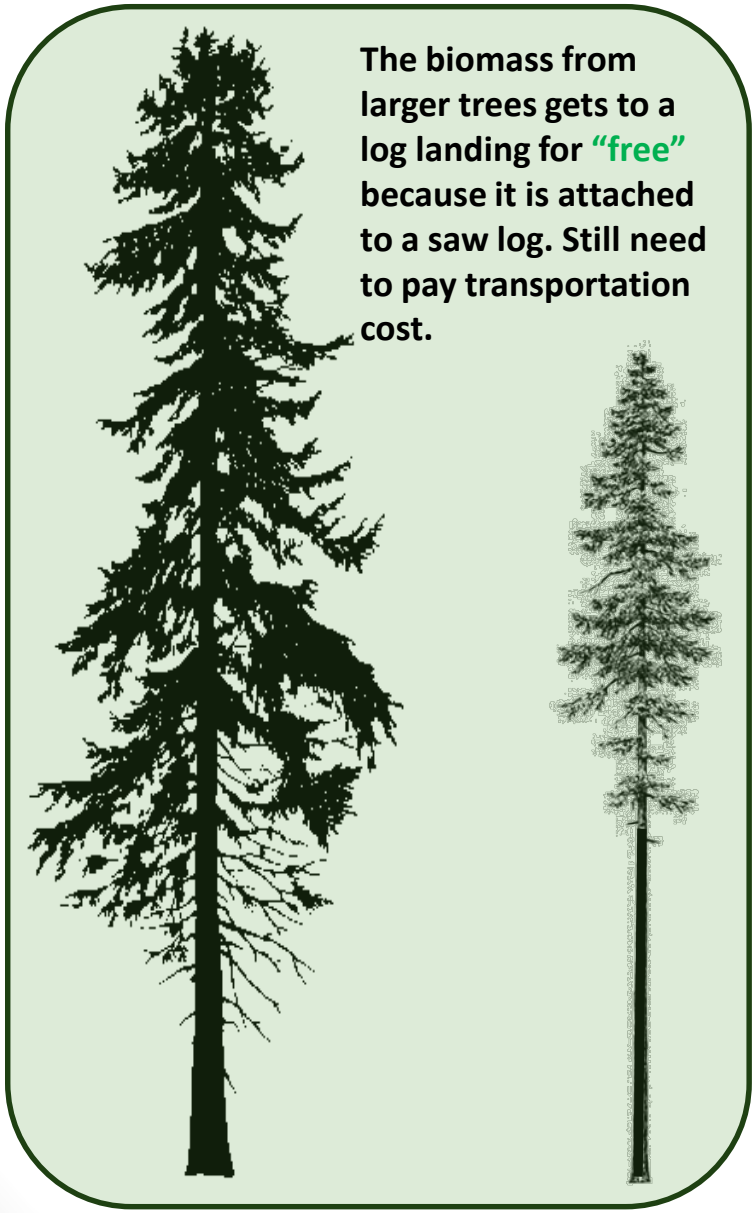


Where does Biomass Come From?



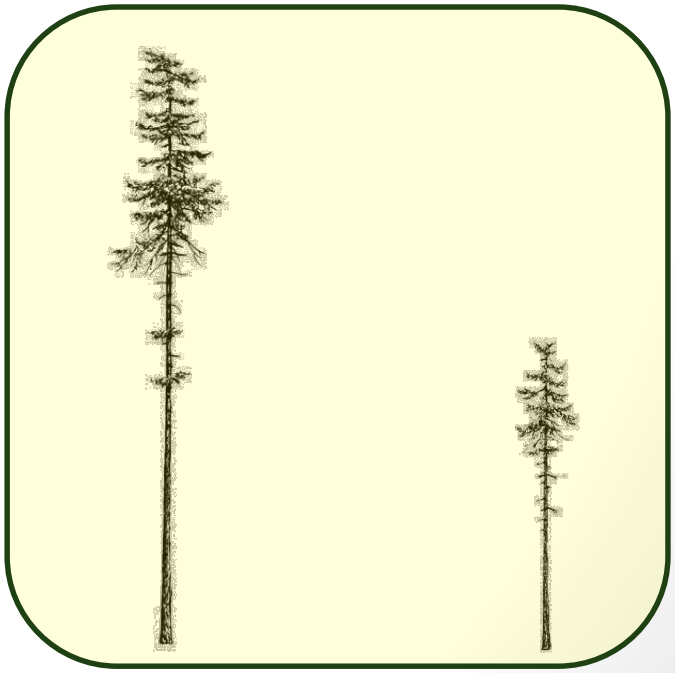
All Size Trees Produce Biomass, but….

110’



The biomass from larger trees gets to a log landing for “free” because it is attached to a saw log. Still need to pay transportation cost.

The biomass from smaller trees is much more costly because there is no saw log in each stem to subsidize the felling and skidding cost. And the piece sizes are much smaller, so logging productivity is lower, which in turn, means cost is higher… Exercise caution in planning



Sawlog Size | Small Sawlog Size | Pulpwood Size | Really Small

Raw Material Supply Key Points

1. Take the time to really understand what type of biomass is available

2. How much will it cost
   - Stumpage (if any)
   - Felling, skidding, processing, transport
   - Seasonality
   - The yield loss between raw material delivered and finished product shipped has net effect of increase delivered raw material cost

3. Who are other users (if any)?

4. Who are the owners (federal, state, Tribal, private)

Biomass Utilization Technologies

Count	Utilization Technology
1	**Bundled/Bulk Firewood** – converting wood into firewood bundles used for heating
2	**Small-Scale Biomass Power** – using wood to generate electricity < 10 MW, and direct combustion technology
3	**Large-Scale Biomass Power** – using wood to generate electricity > 10 MW, and direct combustion technology
4	**Gasification/IC Engine for Heat/Power** – gasifying wood and then combusting the gas to produce heat/power
5	**Densified Fuel Bricks/Logs** – converting wood fiber into "wood bricks" that are combusted for heating
6	**Biochar** – converting wood into biochar, used as a soil amendment and/or activated carbon
7	**Wood Pellets** – converting wood fiber into pellets that are used for home heating and/or power generation
8	**Charcoal** – converting wood fiber into charcoal for cooking
9	**OSB** – converting wood into engineered panels used as wall and roof sheathing and as a subfloor material
10	**Torrefied Wood Pellets** – converting wood fiber into pellets after they have been partially gasified
11	**Cellulosic Ethanol** – converting wood fiber into various liquid fuels
12	**Hydrogen** – converting wood fiber into hydrogen via electrolysis using biomass power
13	**Whole Log Chips** – chips made from whole logs, for paper manufacturing and other uses
14	**Extractives** - essential oils extracted from wood via steam distillation
15	**Post and Pole** – fence posts and short poles made from small-diameter stems
16	**Animal Bedding** – shavings used to bed animals, made directly from wood in log form
17	**Small-Scale Sawmill** – mill producing lumber that is semi-mobile or produces < 10 MMBF/year
18	**Veneer** – converting logs into veneer that is sold to plywood or laminated veneer lumber manufacturers

Technology Screening

Criteria Type	Max Score	Criteria
Timing	6	The business/technology can be constructed and be operational within 18 to 24 months of receiving financing.
Timing	6	The business/technology is such that it has a high likelihood of successfully obtaining required permits, licenses, etc., and they can be obtained within 18 to 24 months of receiving financing.
Timing	6	The business/technology can utilize an existing site to help speed the development process and lower development costs.
Raw Material	6	The business/technology will utilize otherwise unused raw materials (i.e., there is limited competition with existing users, or it is or complementary to existing users).
Raw Material	10	Raw material security – alternate source raw material (e.g., mill residuals) is not available to competitors at substantially lower cost.
Raw Material	6	The business/technology, in a single location, is scaled or can be expanded to utilize the amount of raw material harvestable in the supply region.
Raw Material	6	The business/technology does not require utilization of a specific tree species.
Economics	14	The business/technology economic structure is such that it can operate profitably (during the majority of an economic cycle) at the delivered raw material costs identified in the supply study.
Economics	4	The business/technology is such that the capital costs relative to revenues and operating costs mean the developer can reasonably expect to have a 10 year or less payback period.
Economics	14	The business/technology must be able to demonstrate that there is a defined and supportable market segment for the product, with potential demand from multiple customers.
Proven Technology	16	The business/technology proposed must have been successfully demonstrated in a commercial setting, at commercial scale, with similar raw material mix, for at least two years.
Proven Technology	6	The business/technology equipment vendors must be able to offer commercial warranties as to performance, environmental compliance, and completion, and must be able to bond such warranty through commercial sources.
Grand Total	100	

Technology Screening

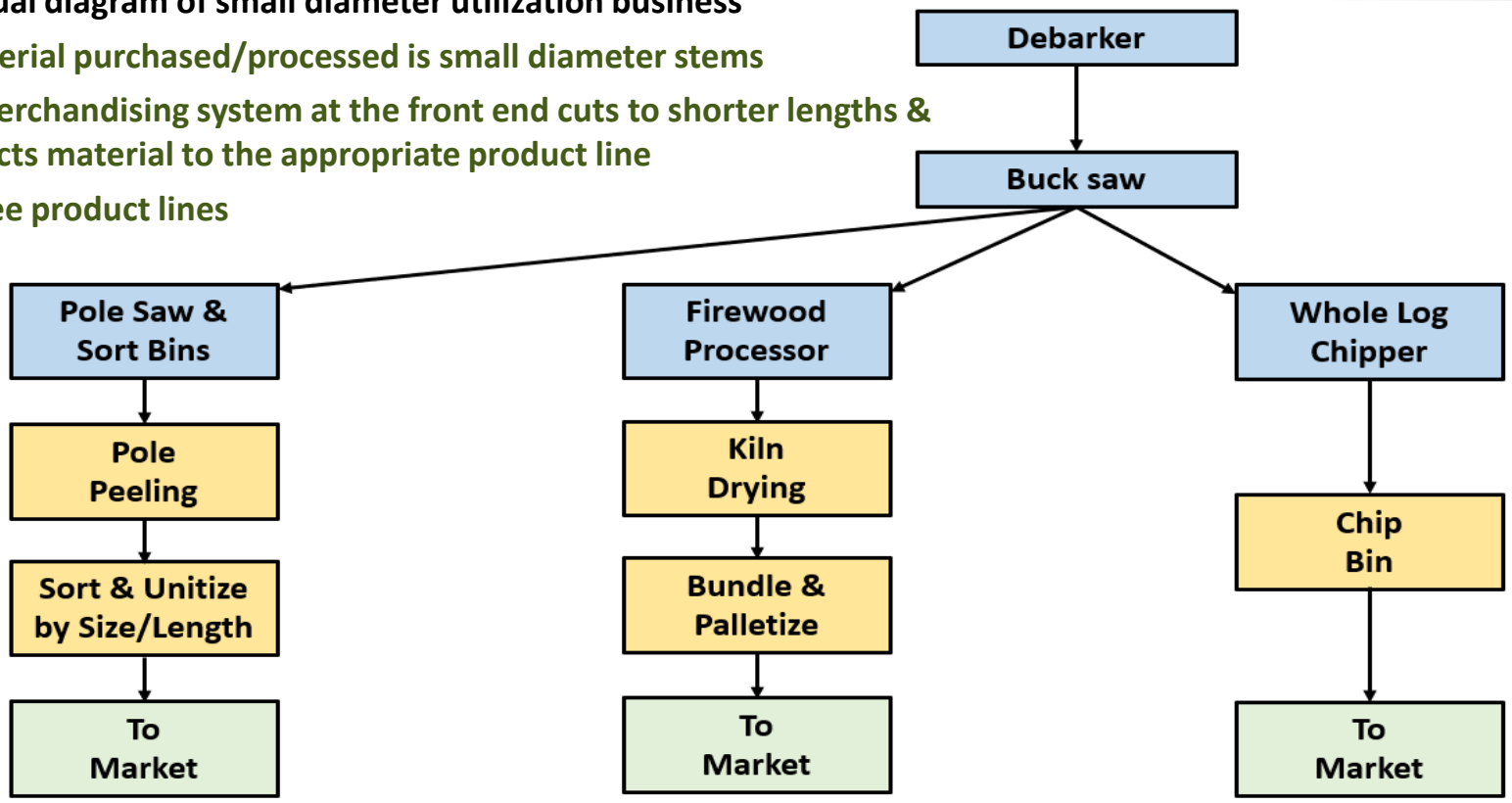
There are two often overlooked fatal flaws:

1. **Attempting to use small diameter roundwood as the feedstock for a technology that can also use mill by-products as a feedstock**
    - **Wood pellets is a classic example – sawdust from sawmills is a much less expensive feedstock than small diameter roundwood**
2. **Choosing a technology that is not commercially proven**
    - **May work at lab/pilot scale, but not industrial scale**
        - **Biomass to liquid fuel**
        - **Torrefied wood pellets**
        - **Electrical power via gasification with woods/logging slash fuel**
    - **May work from a technical standpoint, but market is unproven in terms of size (geographic), depth (volume), and price**
        - **Biochar**

Chelan County Biomass Utilization

Conceptual diagram of small diameter utilization business

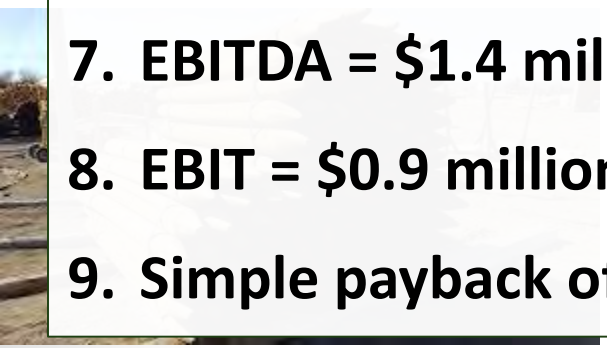
1. Material purchased/processed is small diameter stems
2. A merchandising system at the front end cuts to shorter lengths & directs material to the appropriate product line
3. Three product lines



Chelan County Biomass Utilization

Feasibility Analysis Results:

1. Utilize 53,000 green tons/year of biomass on 2 shift basis
   - 2,100 truckloads/year, or 8 to 9 truckloads/day
2. Average delivered raw material cost = $42/ton
3. $6.2 million capital investment
4. 27 hourly employees and 4 salaried staff
5. $7.6 million in annual revenue
6. $6.2 million in annual operating costs
7. EBITDA = $1.4 million
8. EBIT = $0.9 million
9. Simple payback of 4.7 years (EBITDA divided by CapEx)



Keys to Success

1. **Is there an Entrepreneur present?**
   - Cannot be a Wild-Eyed Dreamer
2. **Is the raw material supply:**
   - Secure?
   - Not cost prohibitive?
   - Not competing with existing users?
3. **Co-Location is optimal!!!**
   - Share resources to reduce costs & risk
     (e.g., truck scales, log yard space, rolling stock, supply contractors, staff, etc.)
4. **Design so the operation has the flexibility to produce multiple product lines**
   - Reduces the risk of not having “all eggs in one-basket”
   - Allows flexibility to shift balance of production to “hot” product/market