Innovation in Biomass Transport

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Outline

- Importance
- Modes of transport and current status
- Logistical issues in biomass transport
- Pipeline transport of biomass
- Economics

Transportation Cost of Biomass

- Truck transportation cost is between 30-40% of total delivered cost of biomass to an ethanol plant.

- Truck transportation cost of biomass for power plants at optimum scale (% of total power cost):
  - Whole forest – 14%
  - Agricultural residue – 25%
  - Forest harvest residue – 38% (*Kumar et al., 2003)*

A major cost component of total bio-product cost

Main Issues in Biomass Transport

- Low bulk density of biomass.
- High moisture content.
- Highly dispersed.

Modes of Biomass Transport

Modes	***Status***
Truck Transport	Most Commonly Used
Rail Transport	Used in Forestry Industry
Pipeline Transport	Future Technology

Biomass (Forest Residues) Transport by Truck

Source: VTT, Finland

Biomass Transport in Chipped Form by Truck

Source: VTT, Finland

Biomass Transport in Pellet Form by Rail

Source: DRC, British Columbia

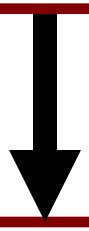
Logistical Issues in Biomass Transport

- Truck transport of biomass is used for transporting 300,000 – 500,000 tonnes per year.
- At this scale biorefinery size would be

  < 5% of current oil refinery and hence would be uneconomic.
- A typical oil refinery is more than 100,000 barrels/day.

Logistical Issues in Biomass Transport (cont'd)

100,000 barrels/day biorefinery



About 15 million dry tonnes/yr of biomass (at ethanol yield of about 378 L/dt).

Logistical Issues in Biomass Transport (cont'd)

		Capacity (M dry tonnes/year)			
Mode	**Moisture Content**	**0.5**	**2**	**6**	**15**
		Units per hour			
Trucks (20 t per load)	**50%**	**6**	**23**	**68**	**171**
Rail (50 t per car)	**50%**	**2**	**9**	**27**	**68**

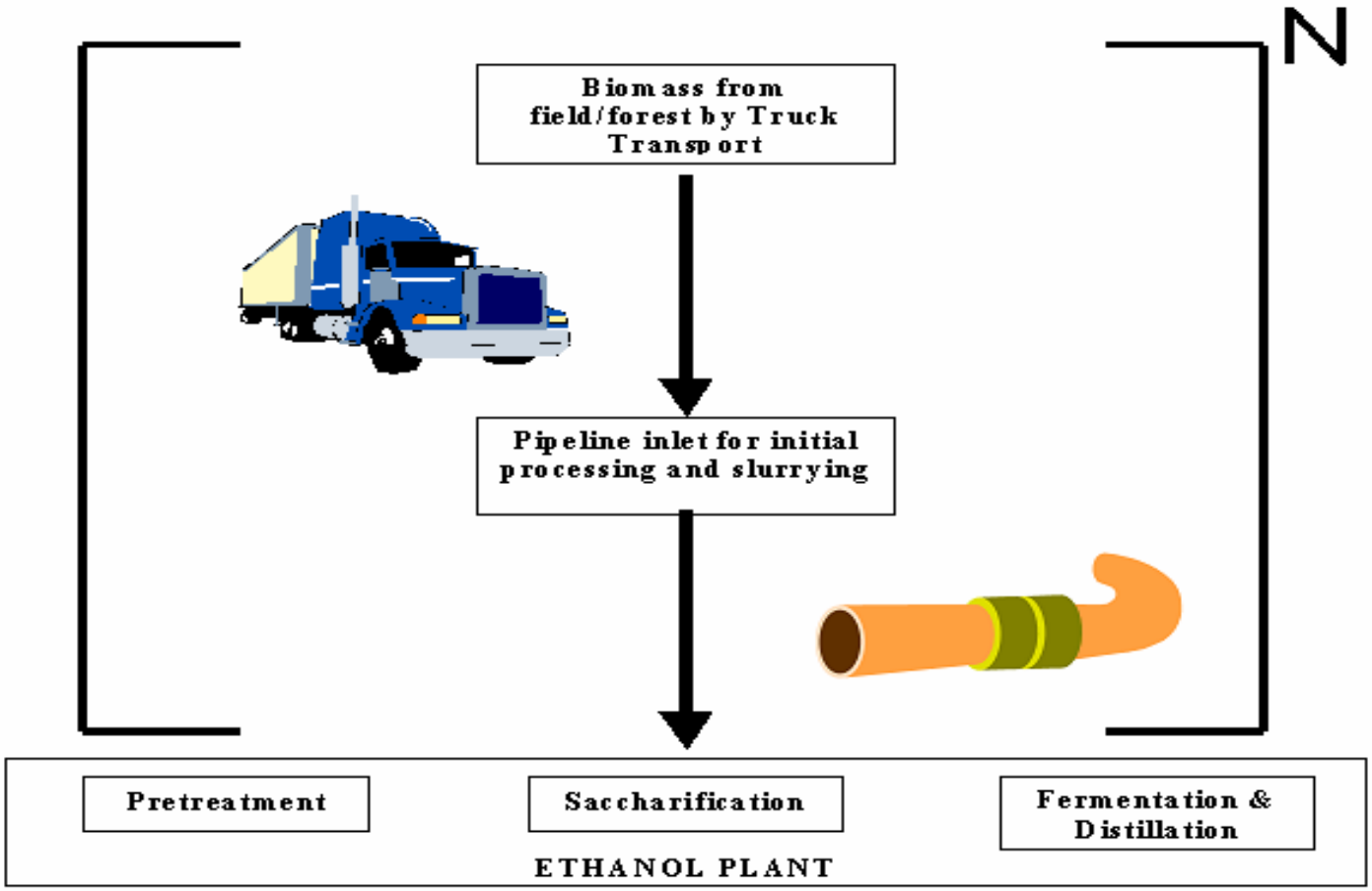
Large Scale Transportation Through Pipeline

- Pipelines allow aggregation of biomass.
- Fossil fuel power plants don’t depend on highway truck delivery.
- Could be used as a reactor.

Approaches to Pipeline Transport

- Two-way pipeline transport
  - Pipeline for biomass slurry.
  - Pipeline for carrier fluid return.
- One-way pipeline transport
  - Pipeline for the biomass slurry.
  - No pipeline for carrier fluid return.

Model for Ethanol Plant Supplied by Pipeline Transport



Cost of Biomass Transport

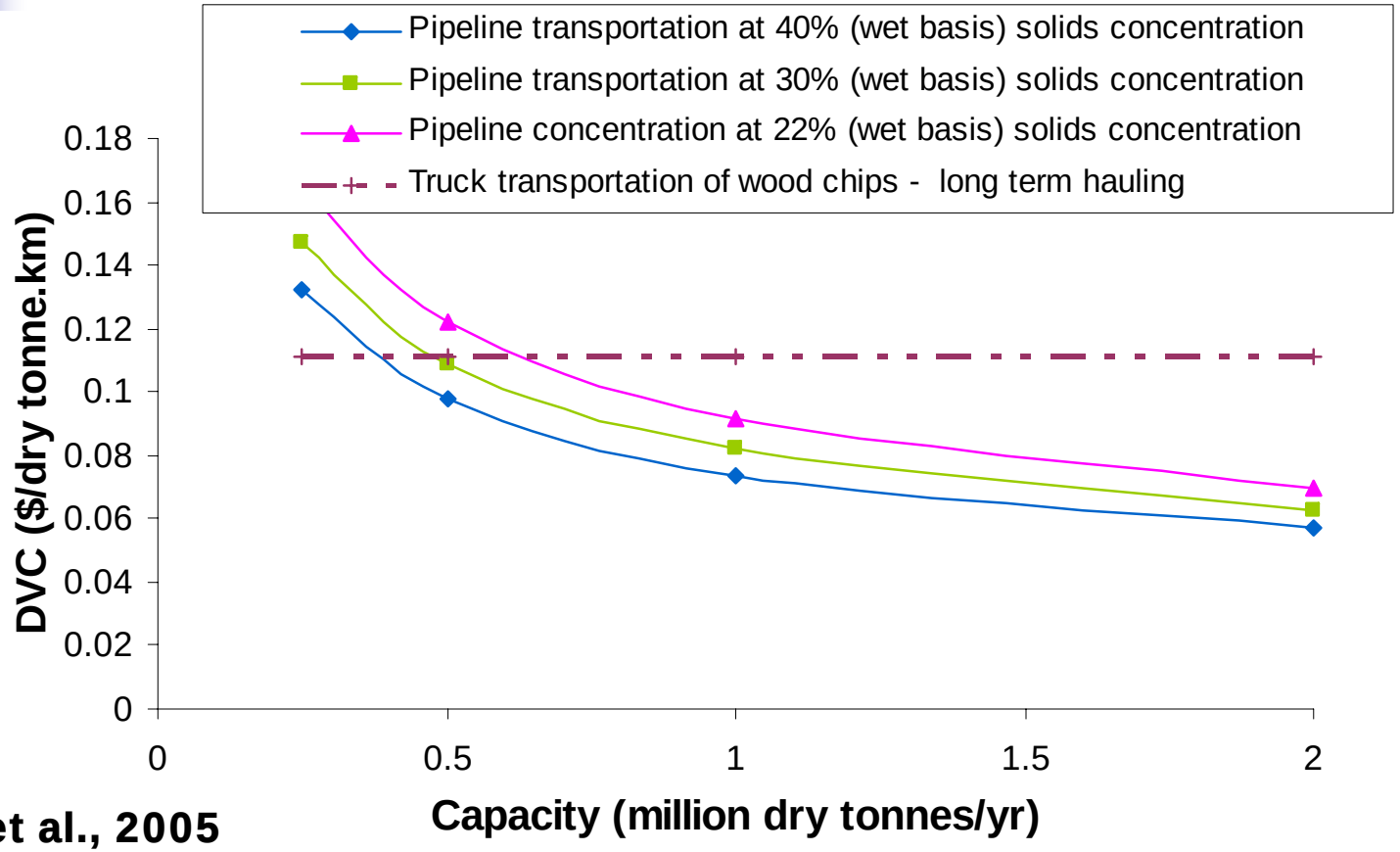
Modes	Cost ($/dry tonne)
Truck	4.98 + 0.1114*d
Rail	14.5 + 0.0209*d
Pipeline (at 2 M dt and 30% conc.)	1.47 + 0.1023*d

d – one way distance of transport in kms

Economics of Biomass Transport

- Truck Transport: Not affected by scale
- Rail Transport: Not affected by scale
- Pipeline Transport: Has an economy of scale

Economics of Biomass Transport (cont'd)



Kumar et al., 2005

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