



Opportunities on the Bioenergy Wave

Brian Cox
Executive Officer
Bioenergy Association of NZ

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Increasing Sources of Bioenergy

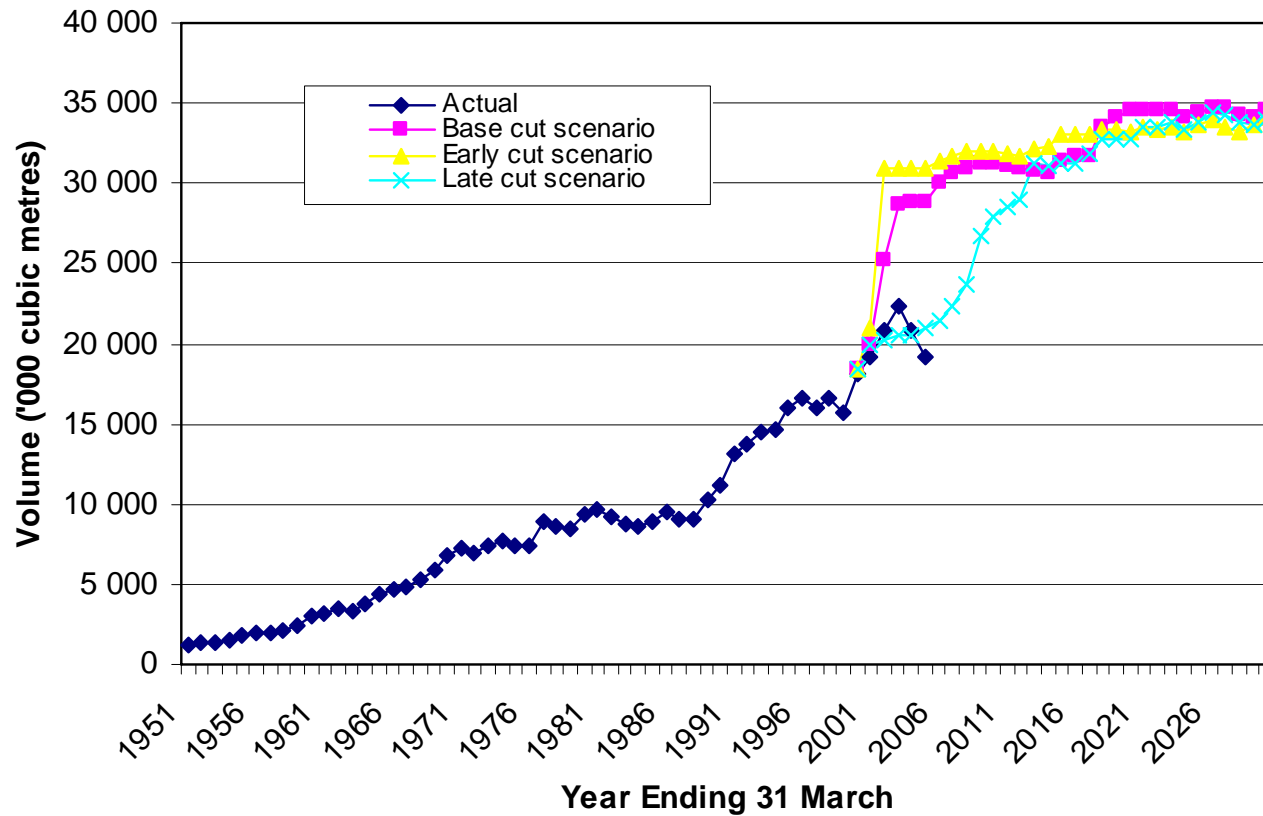
- Woody biomass
 - Wood processing residues
 - Forest harvest residues
 - Purpose grown crops
- Municipal waste
 - Solid domestic refuse
 - Commercial refuse
 - Sewage
- Agricultural and food
 - Processing residues
 - Harvest residues
- Algae

Rich Foresters Throwing \$\$ Away

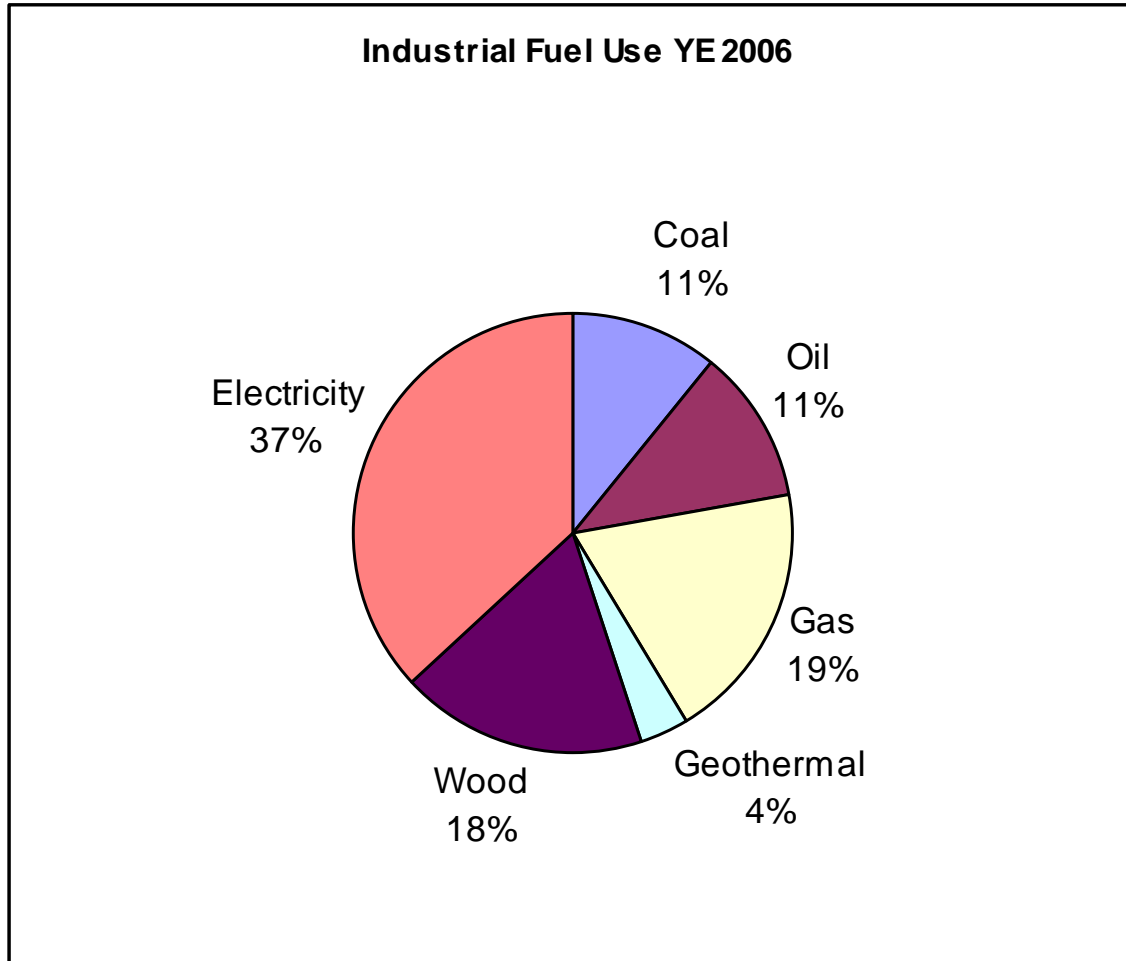


Increasing Forest Sources

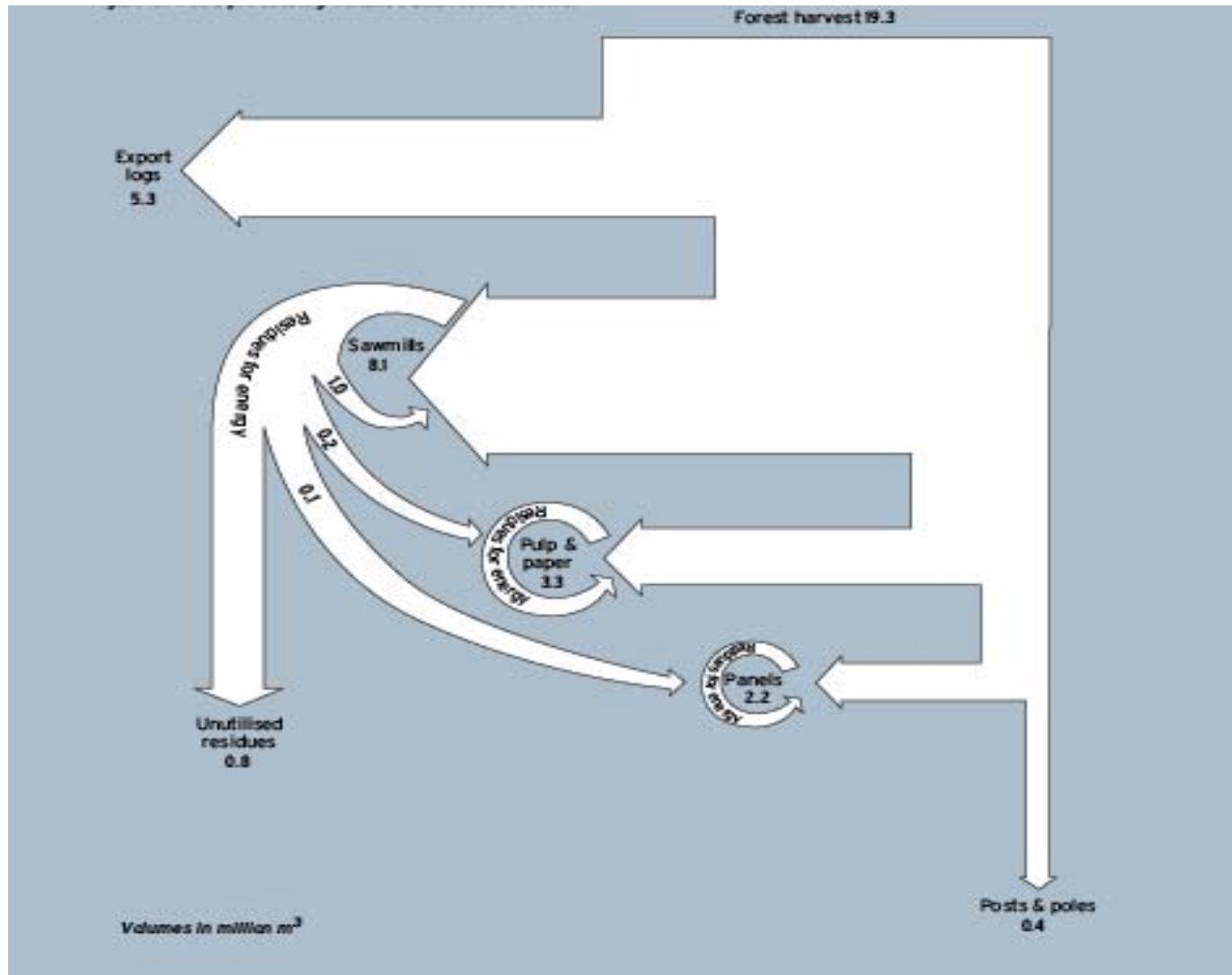
Harvest Scenarios



Opportunity for Fuel Substitution

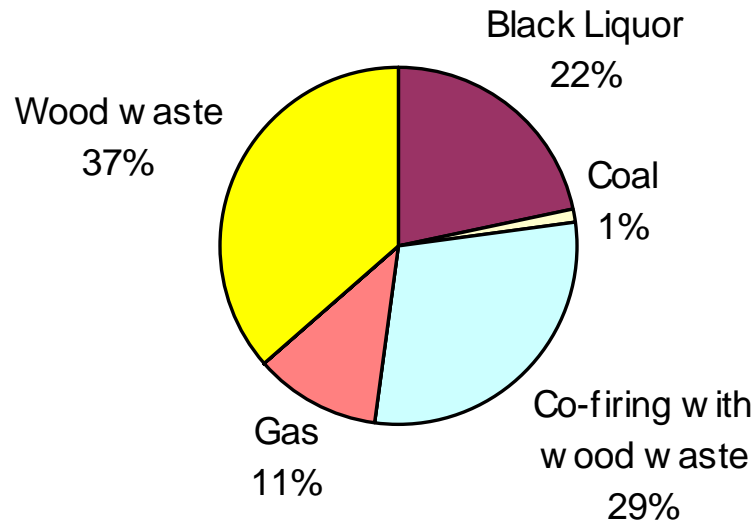


Woody Residues Availability



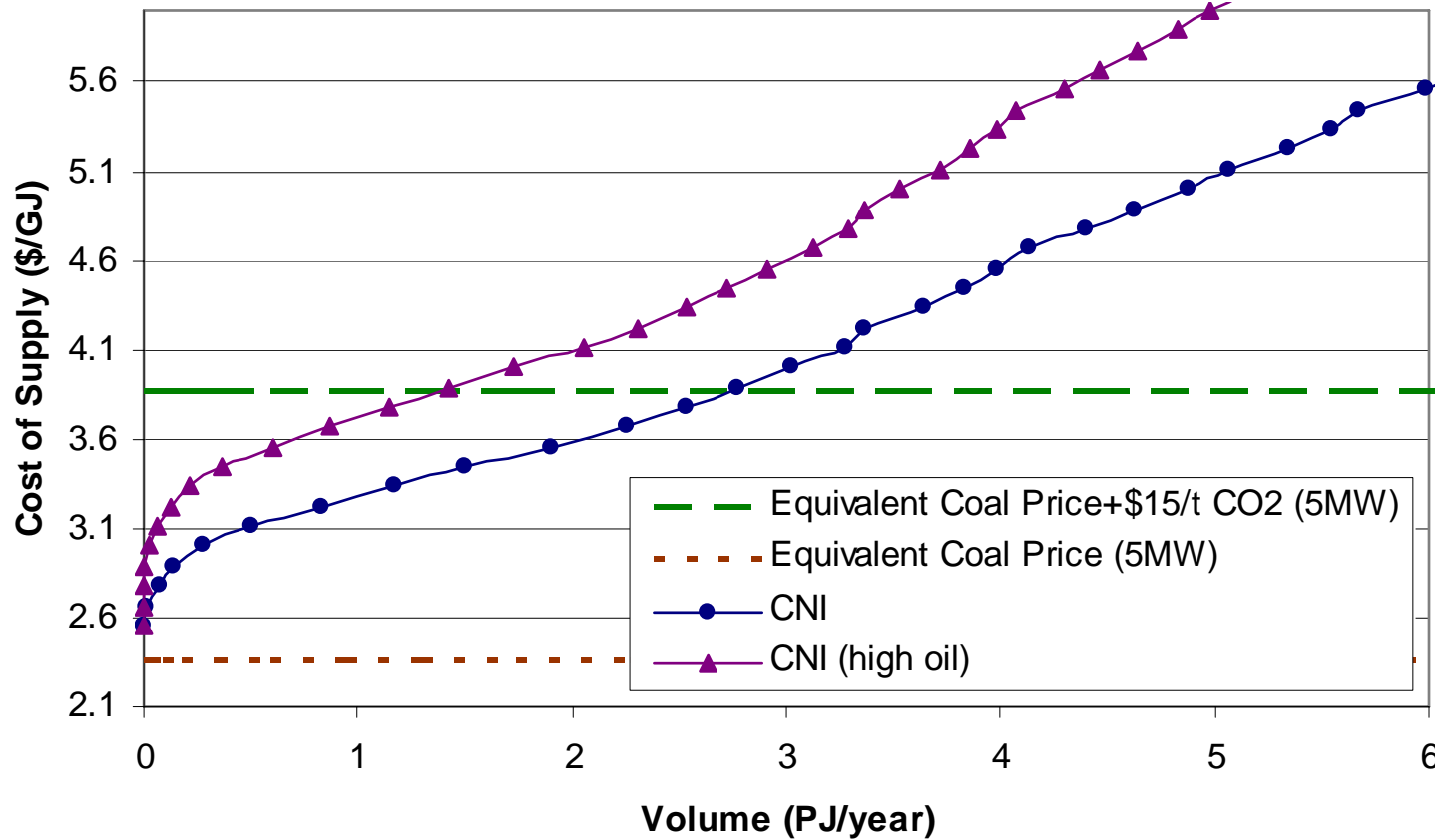
Wood Processing Fuel Sources

Wood Processing Heat Plant Energy Use

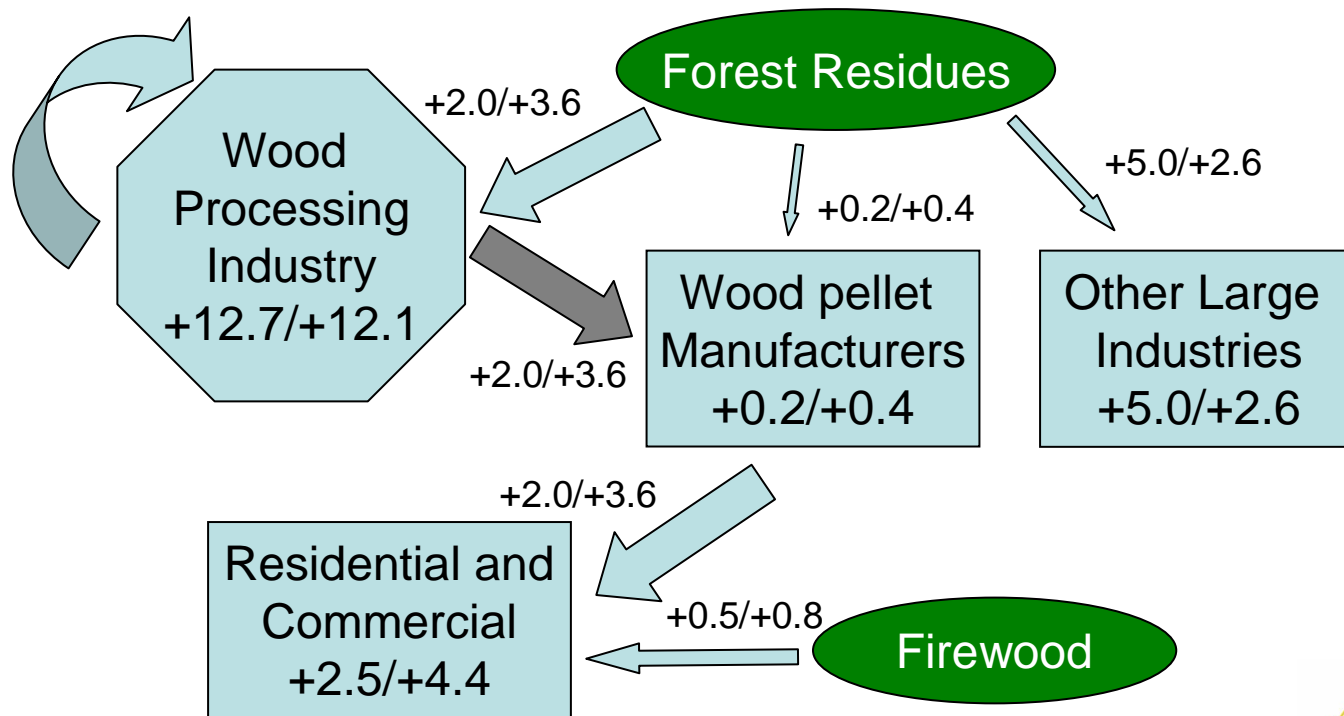


Forest Residue Costs are Reducing

CNI 2020



Developing Wood Residue Market



2020/2030

On-site Residue Processing Technology



Heat Plant Opportunities

- Most people focus on electricity and forget heat
- Heat opportunities are local
- Bioenergy, geothermal and solar heat is economic now
- Heat and cooling information is poor
- Few published role models or case studies



Woody Biomass as Fuel for Heat

- Fuel most within control of wood processors
- Uses waste materials
 - Forest residue
 - Process waste
- May require backup from coal, gas, forest residue or imported fuel
- Need to focus on fuel handling and processing
- Economics improved when biomass processed to be homogenous fuel

Residues Turned into a Valuable Commodity

- Pellets
 - Has all the good characteristics of coal
- Chipping and hogging in the forest
 - Already economic
 - Ease of handling and transport
 - Reduced transport costs

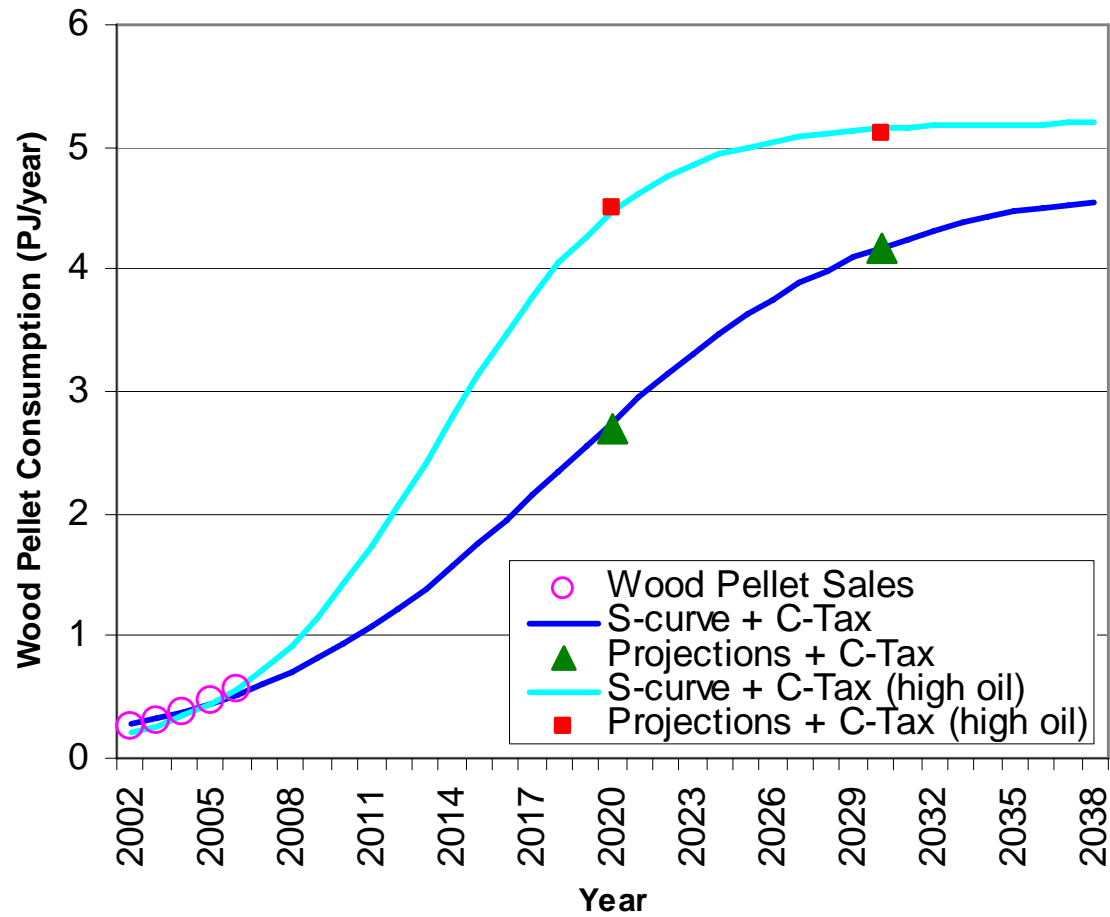


Wood Pellets/Chip

- Quality fuel
 - Wide range of applications – schools, hotels, institutions
 - Ease of residential use
 - Has the good characteristics of coal
 - Can be combusted in low cost burners
- Barriers
 - Access to fuel
 - Experience
 - Cost of alternative fuels



Possible Uptake of Pellets/Chip

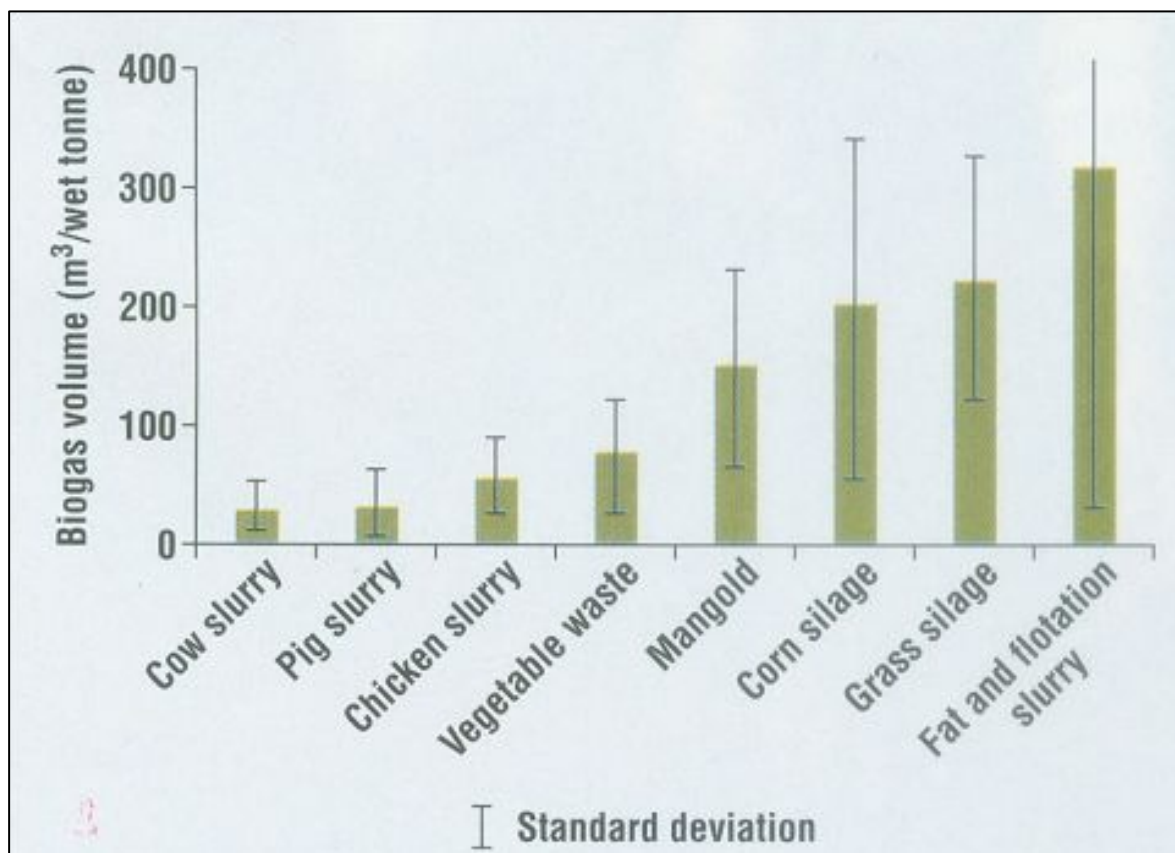


Biogas Opportunities

- Anaerobic Digesters installed to process
 - Dairy shed effluent
 - Wastewater treatment
 - Food waste
 - Meat works effluent
 - Dairy factory effluent
 - Organic fraction municipal solid waste



Biogas Yield



Yield m³/tonne

Biogas Byproducts

- Low calorific value biogas
 - Heat plant
 - Engines
 - Electricity production
- Fertiliser
 - Liquid Fertiliser
 - Humus Material
 - Solid Pellet Fertiliser
 - Nitrogen Extract
- Cleaned wastewater



Liquid Biofuel Feedstock Options

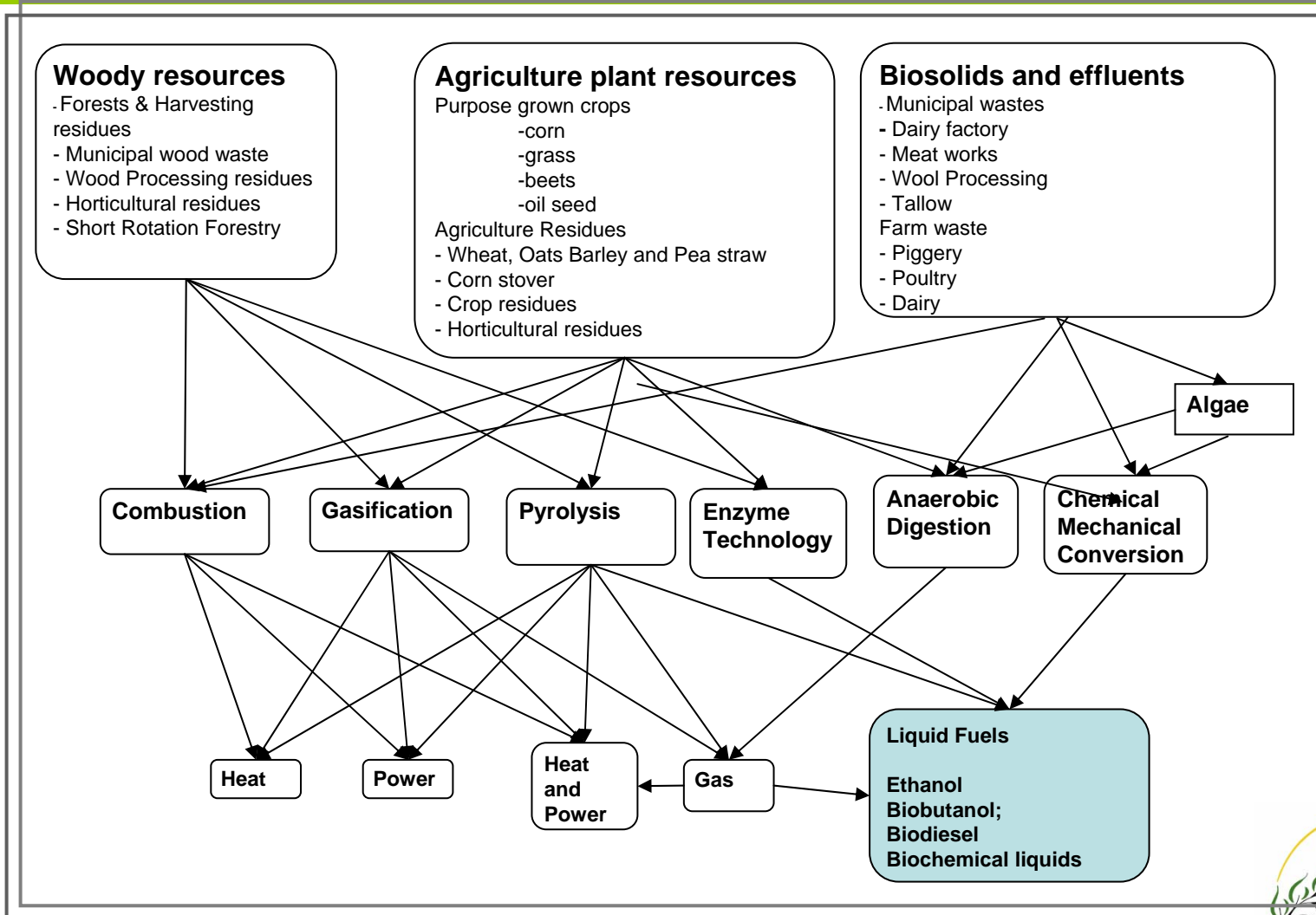
- Ethanol
 - Whey
 - Grain, grass and sugar crops
 - Woody biomass
 - Biodiesel
 - Cooking oils / Tallow
 - Algae
 - Oil seed crops
 - Woody biomass -> bio-oil
- Woody biomass is the biggest opportunity but also most difficult
- Whey, cooking oils, tallow are economic now but limited supply
- Crops economic and extensive availability

Current Liquid Biofuel Production

- Ethanol
 - NZ has well established industry based on whey
 - Sugar crops have been grown in southland
 - Well established 1st generation technologies
 - Significant international research
 - 2nd generation technologies => grasses, straw, stover

- Biodiesel
 - NZ has small but established industry
 - used cooking oil
 - Tallow
 - Is already underway
 - Biodiesel NZ – rape seed oil
 - Large scale processing plant underway
 - Already >6,000ha of oilseed rape is in the ground in NZ

Range of Liquid Biofuel Paths to Follow



Agriculture and Horticulture Processing Residues

- Whey
 - As a by-product limited by dairy processing
- Tallow
 - As a by-product limited by animal processing
 - Price set by export market
- Used cooking oil
 - Contamination from different oils
- Straw
 - Avoids emissions from burning
- Waste paper
 - Contamination
 - Zero additional collection costs
- Food processing residues
 - Seasonal supply
 - Competition from other uses

Quality and consistency of supply of feedstock is critical

Arable Crops for Liquid Biofuel

- Currently well established cropping industry
 - Existing equipment for growing and harvesting
 - Experienced in efficient growing techniques
 - Established distribution and storage arrangements
- Liquid biofuel crops value to farmers
 - Provides an additional revenue stream
 - Extends number of crops in a rotation
 - Improves land management
 - Can provide a secure market
- However competition from other land uses



Algae

- Laboratory scale is proven
- Issues of scale for move to commercial operation
- Need to focus on technologies that use less land
- Issues of harvesting
- Energy intensive conversion to liquid biofuels

What Is The Barrier To Using Bioenergy

- Alternative energy sources are still cheaper
- Few role models
- Unknown cost structure
- Lack of long term contracts for fuel supply
- Reliable known fuel quality
- No leaders
- No entrepreneurs

No drive to gain value from residues