Introduction

- Ethanol as a fuel
- Production of ethanol
- Use of wood for ethanol
- Research and development
Ethanol as a Fuel

- Government policies include the use of alcohol in fuels.
- Ethanol can be used as a fuel with gasoline or diesel.
- NSW uses 30% of Australia's gasoline (~ 6 billion litres).
- NSW is mandating ethanol use:
  - 2% requires 120 million litres ethanol.
  - 10% requires 600 million litres ethanol.

Existing Ethanol Production

- Current production uses grains or sugar (syrup or juice).
- Production is relatively simple:
  - Conversion of grain starches to sugar.
  - Yeast fermentation of C₆ sugars.
  - Steam distillation of alcohol.
- Current Australian production capacity is about 190 million litres per annum.
Woody materials are suitable and economic as feedstocks for ethanol production (lignocellulosics).

The processes for production are more complex than present methods (for grains /sugars).

In Australia, a Research Pilot Plant will test feedstocks and efficiency levels. There are some Pilot Plants overseas.

Supported by forest and sugar industry investment (Willmott Forests).
The Research Pilot Plant is being constructed by Ethtech (Commercial Development Company) using licenced Apace technology (1 to 2 tonne dry material per day).

The focus is to develop a full scale plant as soon as feasible.

Ethtech is jointly owned by sugar growers and Willmott Forests.

Apace has researched ethanol production and use for 20 years.

Apace is a Research Company and has been working on ‘wood to ethanol’ for more than 20 years.

Apace has a series of innovative processes for production of sugars and ethanol from lignocellulosics (primarily from wood and bagasse):
- Strong acid hydrolysis.
- Acid recovery.
- Phase separation of alcohol.

Ethtec (using Apace technology) is developing a Pilot Plant to assess processes at a larger scale.
Residues to Revenues 2007

Ethanol from Wood

Process from Wood to Ethanol

- Lignocellulosics (including wood) have been used for ethanol production:
  - Cellulose - converts to C\textsubscript{6} sugars.
  - Hemicellulose - converts mainly to C\textsubscript{5} sugars.
  - Lignin - extracted as energy source.

- Low efficiency in the past:
  - Hemicellulose is not converted to alcohol.
  - High cost of steam distillation (high energy).
The stages in conversion of wood feedstocks are:

1. Feedstock comminution.
2. Feedstock pre-treatment (with strong acid).
3. Hemicellulose and cellulose hydrolysis (convert to sugar).
4. Lignin separation and combustion.
5. Hydrolysis reagent recycle (acid recovery).
7. Ethanol recovery (potassium carbonate separation).
Residues to Revenues 2007

Ethanol from Wood

Case Study - Full Scale Plants

- Full scale plants will vary in size and feedstock.
- Example (medium size):

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Radiata pine (wood and bark)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>150,000 dry tonne/year</td>
</tr>
<tr>
<td>Conversion efficiency</td>
<td>90%</td>
</tr>
<tr>
<td>Ethanol output</td>
<td>61 million litres/year</td>
</tr>
<tr>
<td>Lignin excess</td>
<td>10,000 tonnes/year</td>
</tr>
<tr>
<td>Waste</td>
<td>4,500 tonnes/year</td>
</tr>
</tbody>
</table>

(Recovered ethanol is in excess of 95% pure)
Residues to Revenues 2007
Ethanol from Wood

Feedstocks for Ethanol Plants

1. Use of woody materials as feedstock for ethanol production:
   - Pine thinnings and mill waste.
   - Hardwood thinnings and mill waste.
   - Bagasse.
   - Municipal waste.

2. Raw material prices higher than pulp.

3. Plants are not dedicated to one feedstock.
Additional Outcomes

1. Increased utilisation in existing plantations.
3. Higher utilisation at forest level (bark, total wood, etc).
4. Integration with other processing (mill or other waste).
5. At mandated 10% ethanol, NSW will require about 10 medium scale plants.
A Pilot Plant is being constructed to research the conversion of wood to ethanol.

The efficiency of the technology is being tested.

Full scale plants will provide significant options for use of woody materials.

There is planning for use in integrated systems.