

Bioenergy in the Avon: Current and near term opportunities for commercial farm forestry.

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by

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This presentation:

- **Introduction**
- **Four likely technologies**
- **Progressive development & hurdles**

Planting trees will help to avoid this



But how do we promote tree planting
at the scale required?



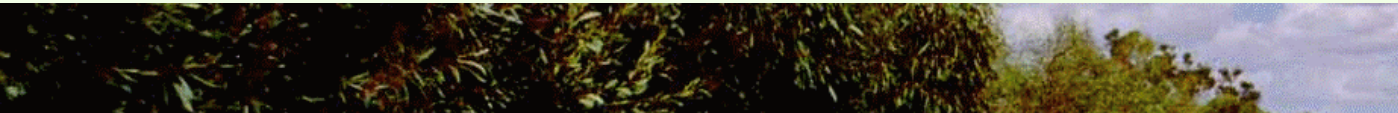
Could this be the answer?





Selection of case studies

1. What bioenergy technologies can be used right now to support farm forestry in the Avon?
2. What bioenergy technologies are likely to be commercially available in the short term to provide further markets for farm forestry ?



Selection of case studies, cont'd

Electricity?

At small scale, in dryland areas, and with a cost for biomass feed: it is uneconomic.

Integrated Wood Processing?

To be discussed separately.

University research?

Remember the time and cost to move from a bioenergy idea to a commercial business...

E.g: Dynamotive pyrolysis technology development over >20 years



←
1. Pilot scale
2 TPD

→
2. Demo. Scale
15 TPD



←
3. Full scale
100 TPD

→
4. Full scale
200 TPD



Consider four technologies in turn:

- **Wood pellets**
- **Fast pyrolysis**
- **Biomass to liquids - “BtL”**
- **Biomass to ethanol**

Wood pellets

How? Ground, dried wood, pressed through a die.

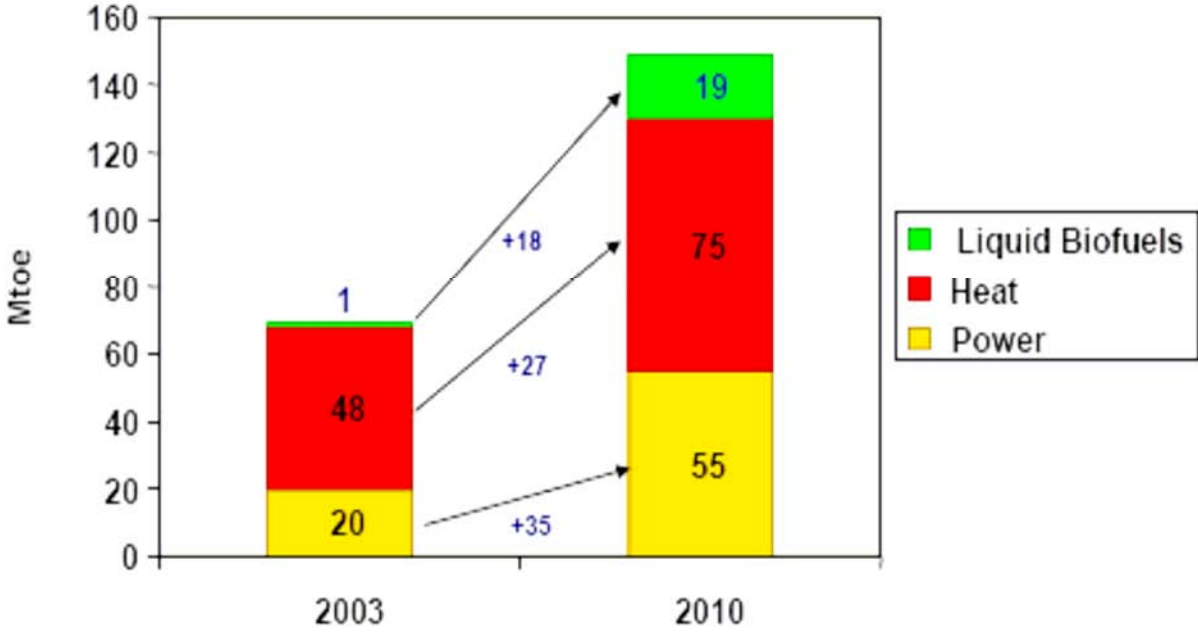
Technology?
Readily available now.



Why? Makes wood easier to transport and use.

Markets? – available now in Europe and Japan.

EU 25 Biomass Action Plan



Pellets: little use in Australia, but large markets in European Union.

European pellet prod'n capacity in 2006 was 8.5 M tonnes.
“Proposed” growth in European bioenergy market for heating alone, equivalent to 65 million tonnes of pellets per year!

Markets? : from stoves to power stations

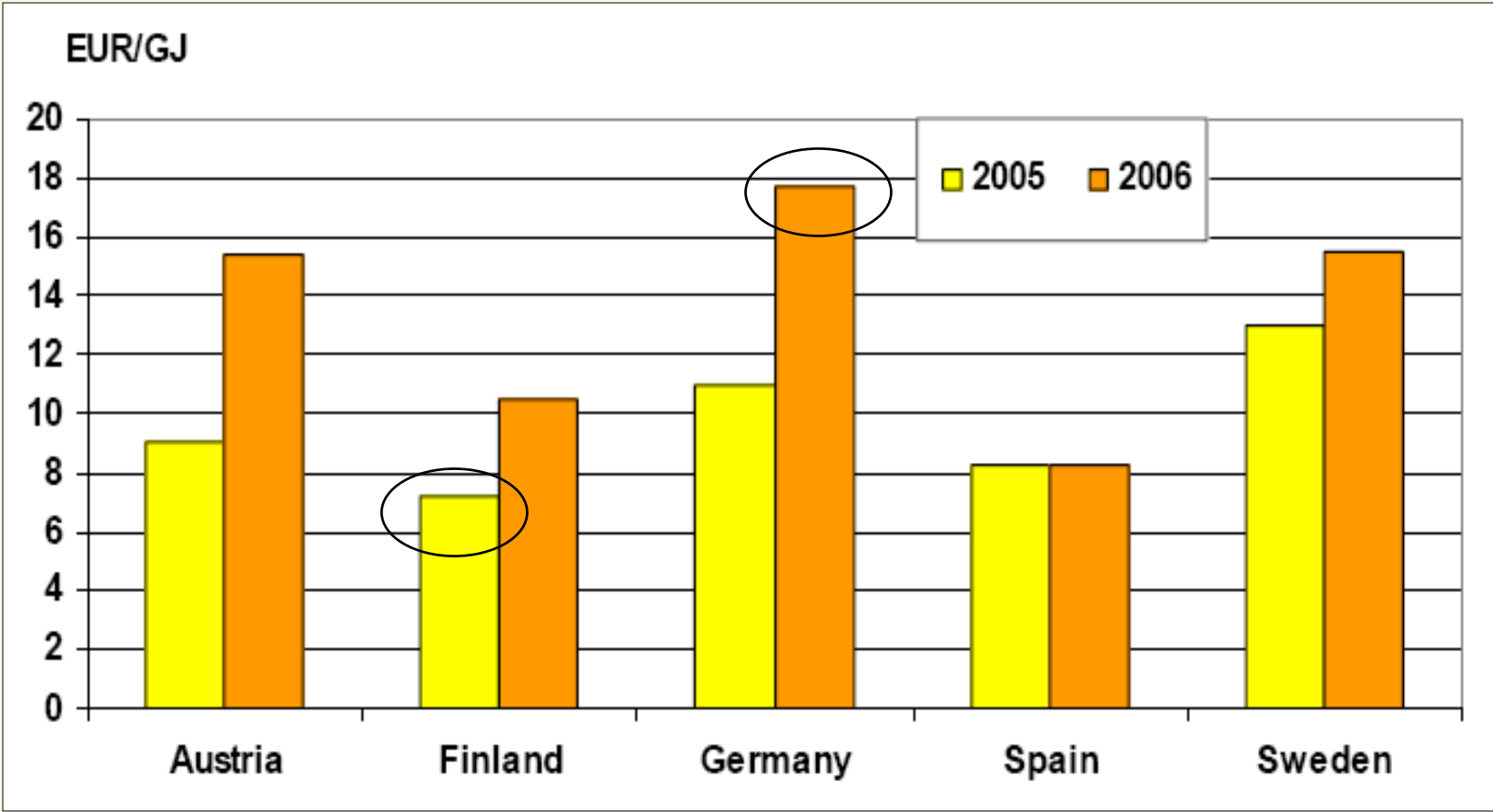


Typical pellet-fired
heater for domestic use

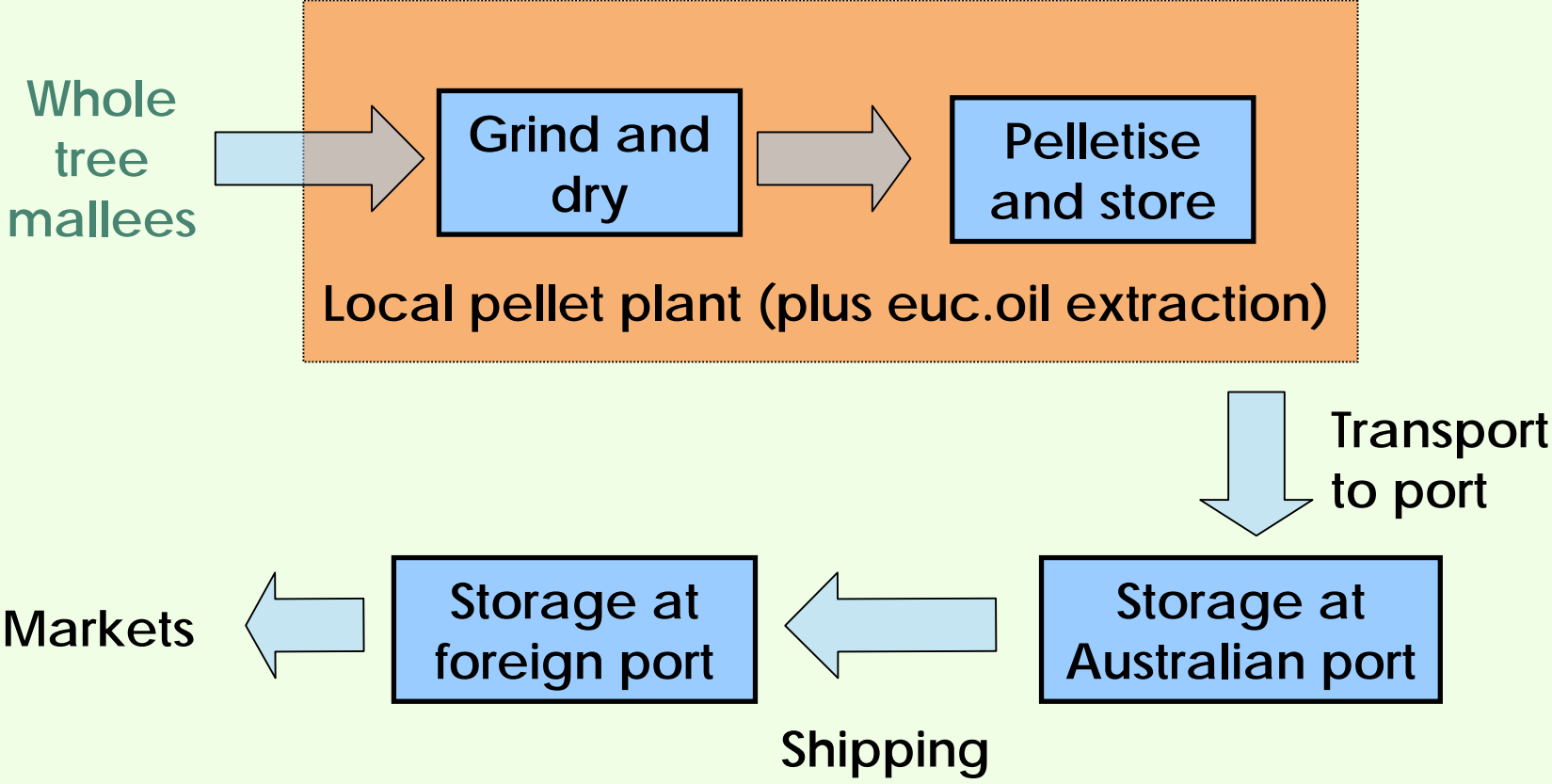


The 570MW Avedøre-2 power plant
in Denmark, during construction

European pellet prices vary between countries, and from year to year



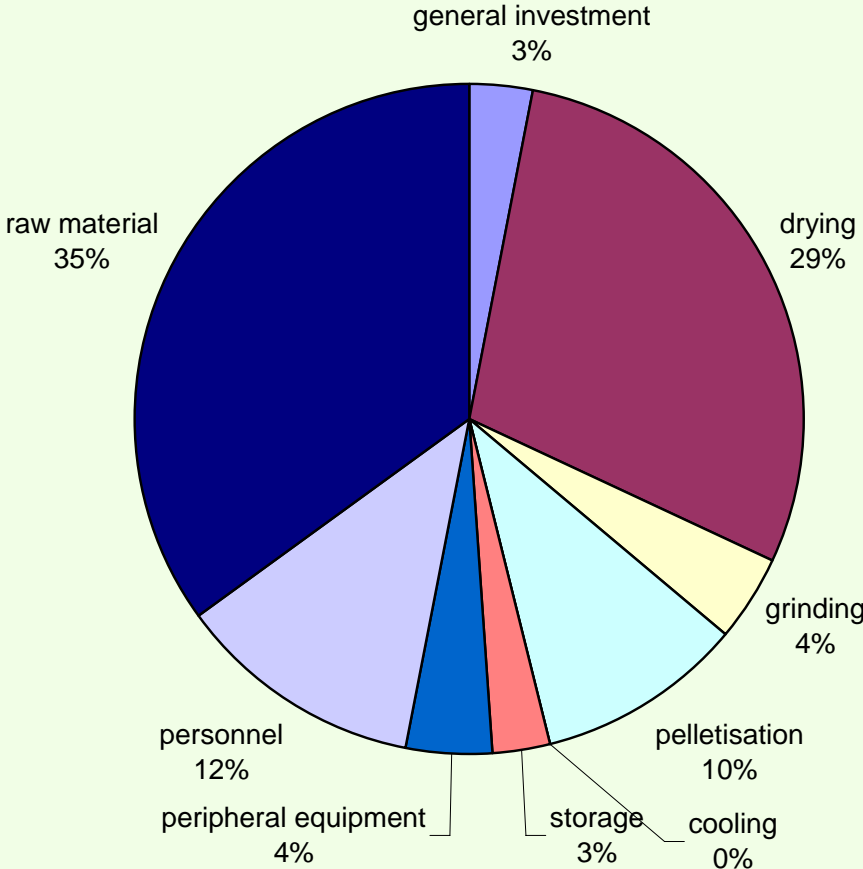
The steps from farm to market



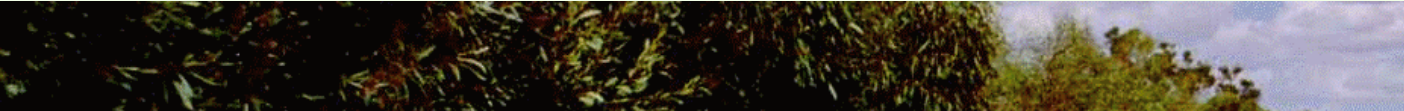


Summary of costs for typical large pellet plant, in Austria

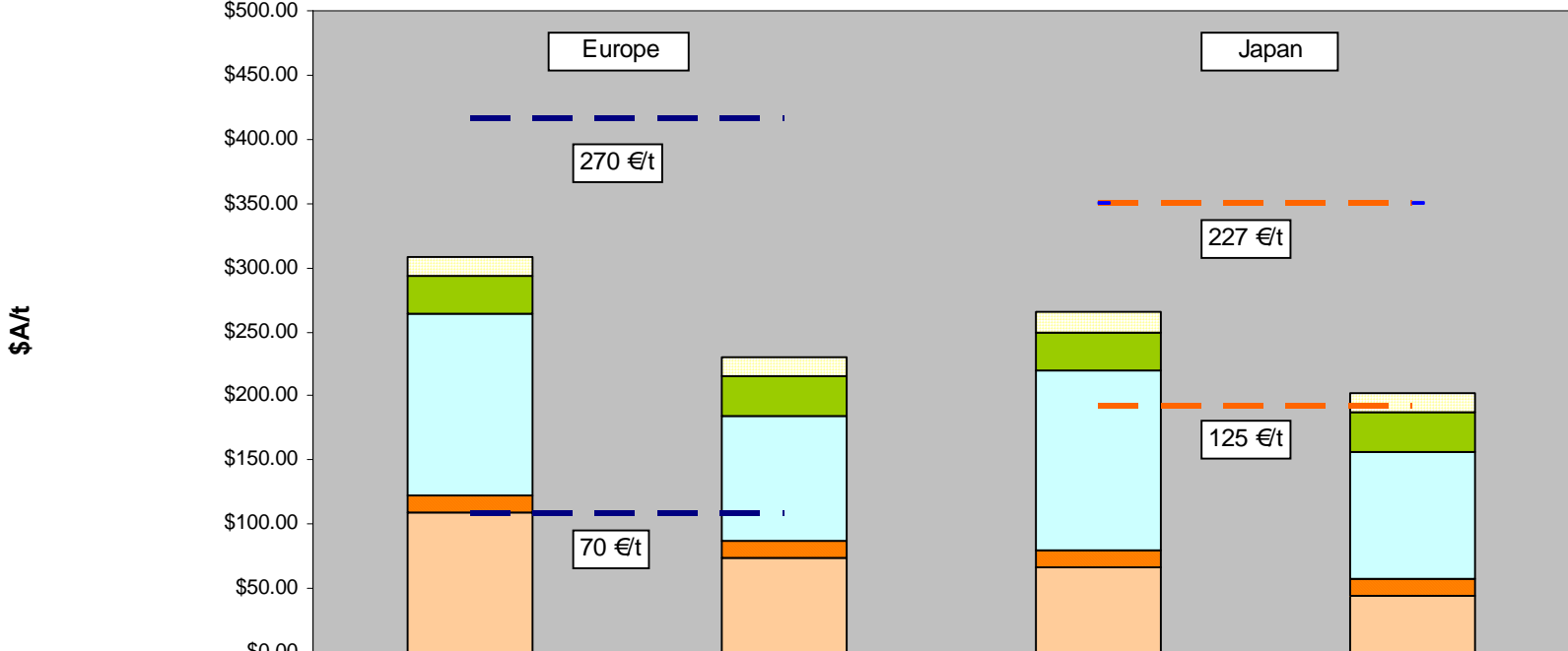
Wet Raw Material



In Australia: different costs for feed and drying. Add transport to final cost



Cost estimates for plants in the Avon



| Scenario | Plant Cap: 25,000 tpa, Shipments 25,000 t | Plant Cap: 75,000 tpa, Shipments 50,000 t | Plant Cap: 25,000 tpa, Shipments 25,000 t | Plant Cap: 75,000 tpa, Shipments 50,000 t |
|----------|---|---|---|---|
|----------|---|---|---|---|

| | | | | |
|--------------------------|----------|---------|----------|---------|
| Port Costs | \$14.95 | \$14.95 | \$14.95 | \$14.95 |
| Growers Feed Price | \$30.00 | \$30.00 | \$30.00 | \$30.00 |
| Production costs | \$140.77 | \$98.54 | \$140.77 | \$98.54 |
| Transport to Port | \$13.20 | \$13.20 | \$13.20 | \$13.20 |
| Shipping | \$109.64 | \$73.25 | \$65.96 | \$44.88 |
| Market Price JPN - Low | | | 192.31 | 192.31 |
| Market Price, JPN - High | | | 349.23 | 349.23 |
| Market Price EU - Low | 107.69 | 107.69 | | |
| Market Price, EU - High | 415.38 | 415.38 | | |

Scenario

Wood pellets - summary

- Technology is available now.
- Suits small or large plants in Avon.
- Large and growing product markets overseas.
- Some product pricing implies good profit, but some implies loss.
- Production and transport prices can be “locked down”. Key uncertainty is market.
- An opportunity that is worthy of further work.



Fast pyrolysis:

Rapid heating of wood to approx. 500⁰C, with no oxygen present.

Works with any biomass

Converts biomass into:

- Oil (about 60 – 70% by weight)
- Charcoal
- Combustible gases

Commercial plants already operating in North America



Using the oil for heat and power generation:

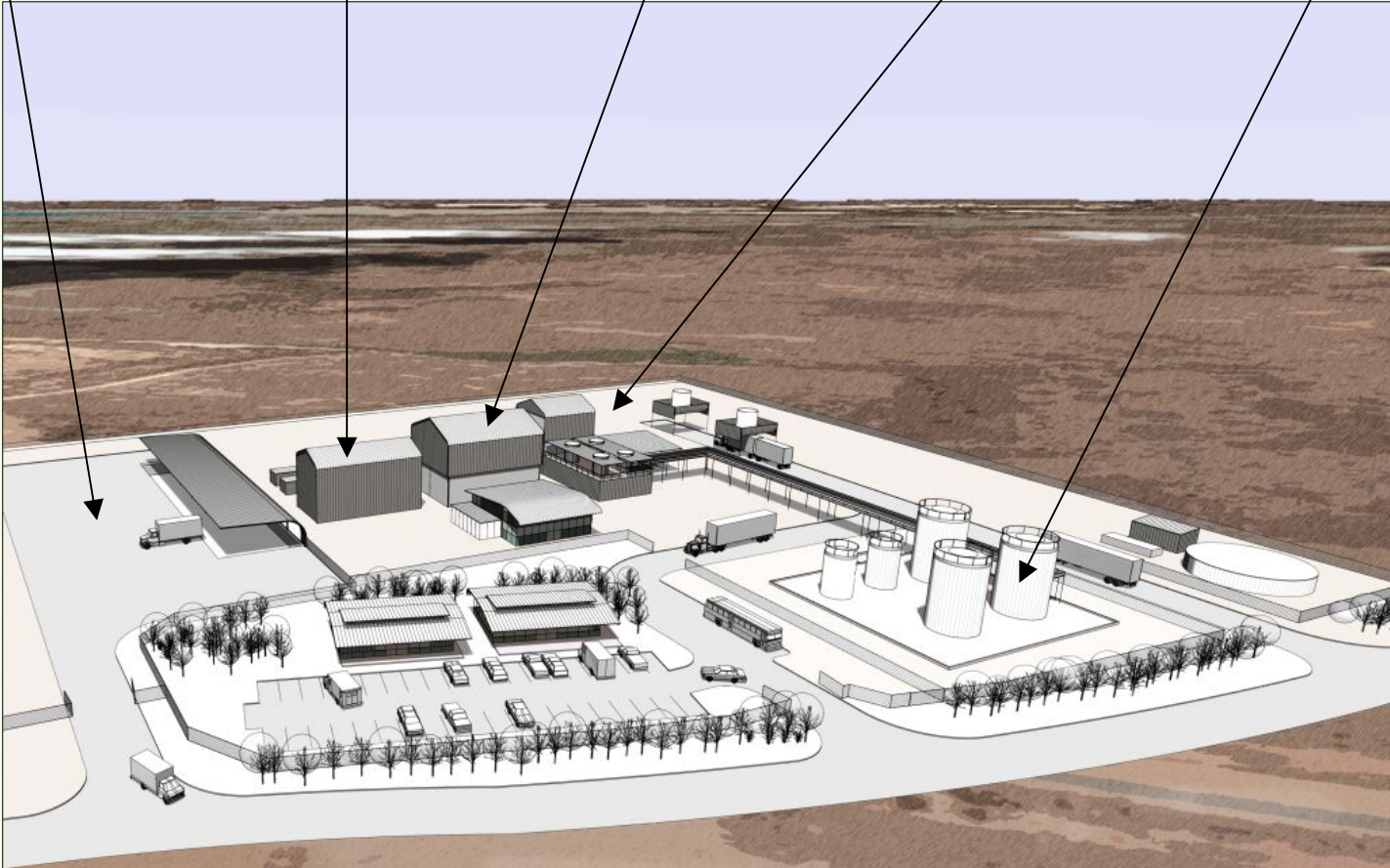


Pyrolysis oil can be used:

- in boilers for steam and electricity.
- in gas turbines for power generation.

As a replacement for a variety of fossil fuels, it provides efficient, reliable, base load heat and power.

Pyrolysis oil not yet used commercially in engines, but R&D is underway in Australia and overseas.



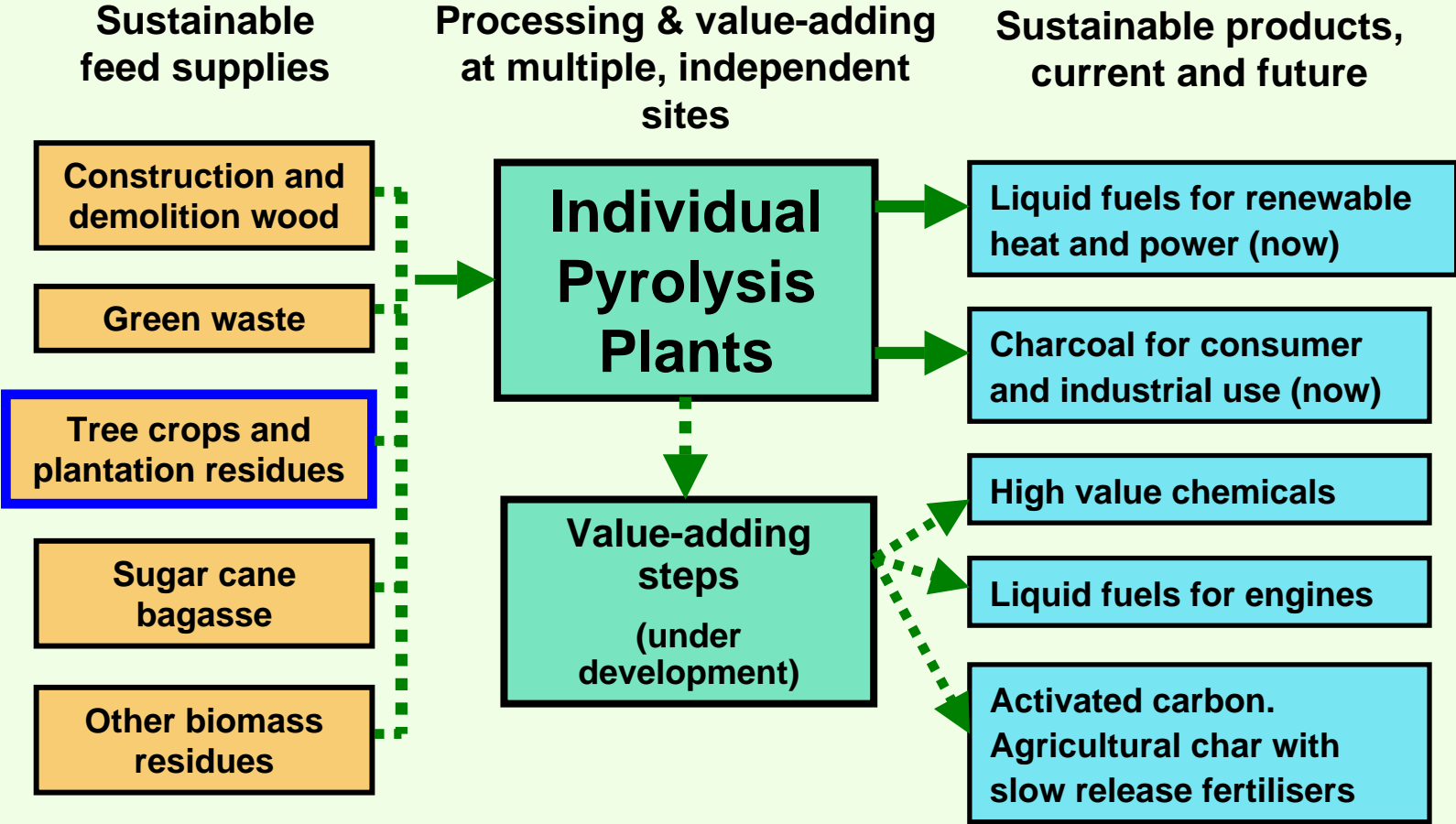
Typical layout for 200 TPD pyrolysis plant

Pyrolysis as a biorefinery

- Already used to extract food flavourings.
- Can extract phenolics to make high value resin chemicals.
- High value resins make the remaining oil more competitive for energy.
- Commercialisation work is underway



Multiple opportunities for business growth:

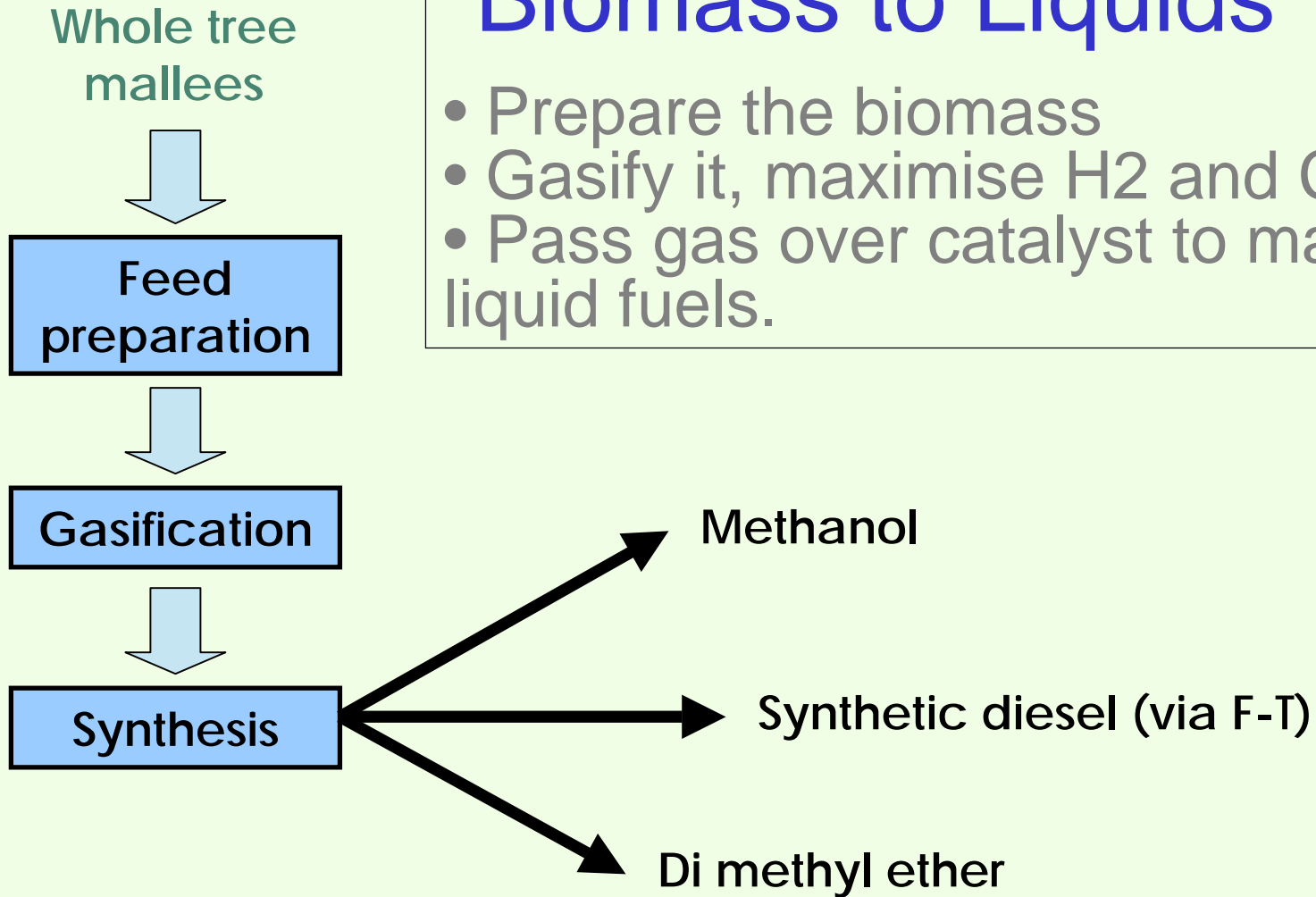


Pyrolysis - summary

- Commercial overseas now.
- Each plant: ~ 100,000 tonne green feed per year.
- Now: local niche markets for energy. Bigger markets in Asia, but transport costs are barrier.
- Next five years: World-wide R&D to improve pricing, energy markets and co-products.
- Renewable Oil Corp. keen to develop multiple mallee projects, when co-product revenues help offset transport costs to Asian markets.

“Biomass to Liquids”

- Prepare the biomass
- Gasify it, maximise H₂ and CO
- Pass gas over catalyst to make liquid fuels.



Technology is “near” commercial



Demonstration plant in Germany, almost completed

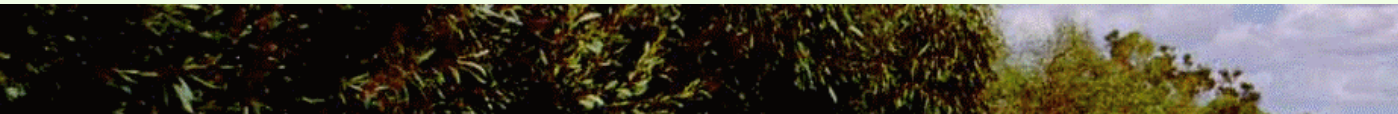
Strengths

- Diesel fuel, made from wood!
- Large markets for commodity fuel into existing infrastructure.
- Choren: well funded German technology developers working with Shell, Volkswagen and others.
- Additional development underway by other groups.



Challenges

- Basic process is straightforward, but optimisation for consistent quality fuels is much more complicated.
- Huge scale – 1 million dry tonnes per year of feed means approx. 100,000 ha of trees for just one plant. Current total mallee planting is less than 15,000 ha.
- First commercial plant in Europe is several years away, and will need to operate for some time to identify cost improvements.



Biomass to liquids – moving forward

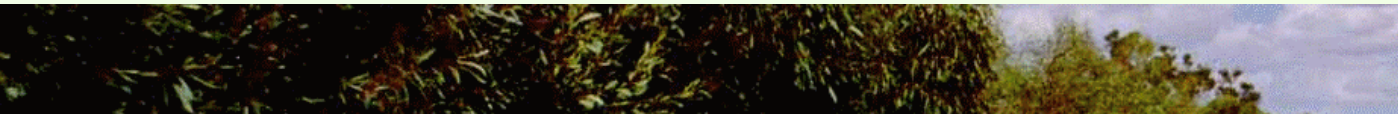
This is an opportunity for five to ten years out.....

- Follow progress over next few years, particularly by Choren in Germany.
- If progress is satisfactory, examine the use of mallee as a feed material.
- Become a credible supplier of large quantities of biomass feed.



Ethanol as a fuel

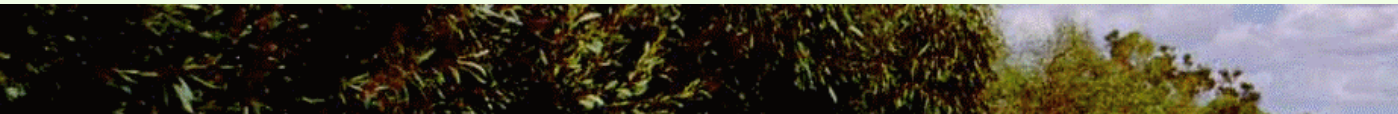
- Already well established as petrol additive.
- Already made from molasses in Australia.
- Major production in US from corn. Australian grain-to-ethanol plants under development.
- Current process – recover sugars and ferment them. Concentrate (distil) the ethanol produced.





Biomass to ethanol

- Wood contains sugars, bound up into polymers.
- Releasing these sugars will provide feed for fermentation to produce ethanol. Can use steam, acids or enzymes to help release the sugars.
- Or: gasifying the wood releases H₂ and CO for synthesis to ethanol (similar to BtL).



Timeline and funding

- Developed to pilot scale overseas ten years ago.
- US Dept of Energy funded enzyme research over past few years – 30 fold improvement.
- Feb 2007: US DOE funding for six different commercial prototypes plants in USA.
- Total grant and private funds targeted for US developments: ~ US \$1.2 billion by 2011.

Ethanol or synthetic diesel?

- WA market for ethanol as blend with petrol = limited local market before transport required to other markets.
- Synthetic diesel = easier to integrate into WA fuels market.
- But at this stage see how both technologies progress towards commercialization in next five years.
- Both can be major users of mallee biomass.

A possible timeline for development in the Avon

Now – Confirm market prices, then export wood pellets to Europe and possibly Japan. Use existing mallees and blue gum residues. Plant more mallees.

In five years - First of multiple pyrolysis plants for Asian fuel and chemicals markets. Needs 100,000 tonnes (10,000 ha) of trees per plant

In ten years – first diesel or ethanol plant, using at least one million tonnes per year of biomass.

Pellet business... what should growers do now?

Gain better understanding of pellet markets:
pricing and commercial terms for purchase.

If above is ok, refine costs for pellet
manufacture & transport. Find a business
partner for pellet plant?

Confirm a delivery quantity and cost of mallees,
including cost impact of euc. oil extraction.

Whole tree delivery not yet commercialised....

No large scale harvest & delivery system yet...

Cost-effective, large scale harvesting of whole tree mallees must have purpose-built equipment.
E.g. 20 tonne per hour, 40 h/week, 50 week/y.

Cost of mallees to Narrogin IWP not economic.

So, short term cost penalty for mallees delivered to pellet plant.

- May be offset initially by high prices for eucalyptus oil into existing markets.
- But in longer term, greater production will mean euc.oil seeks new, lower priced markets.

More work on harvest & delivery needed

Longer term growth. Why mallees?

- Mallees can be a WA success story, but they still need to compete for these businesses. There is huge demand in Europe & USA.
- So, sell the environmental credentials and the professionalism of the WA mallee industry.
- Sell the proximity to Asian markets that cannot grow their own biomass.
- Plantation residues could be competition, or a short term supply of biomass while mallees grow – but they also influence the cost base.

Longer term growth, cont'd.

The “chicken and egg” – trees are planted before plants are built, but who will plant the quantities required without up front \$\$\$ help?

Will carbon or other environmental trading mechanisms provide the momentum?

How much does it cost to harvest and deliver a mallee competitively on a large scale? Who will guarantee that estimate?

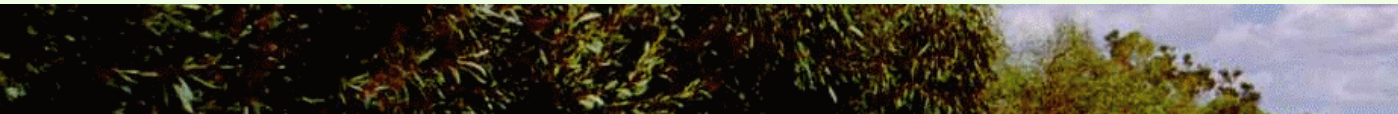
No large scale harvest & delivery = no long term business.



The bioenergy future looks good

Several international technologies exist now or are being commercialized over next five years. Large markets exist for products. In 2020:

- Three million tonnes per year of commercial biomass sales, from 300,000 hectares or more planted to mallees.
- Multiple processing plants, based in WA's country towns. Jobs, cash flows, local value-adding.
- Major salinity protection on and off-farm.





Thank You

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