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Eucalyptus in Great Britain
Species choice, yields and financial returns

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Woody Crops: Growing a Bioeconomy
9th Biennial Short Rotation Woody Crops Operations Working Group Conference, November 5-8, 2012, Oak Ridge, Tennessee
Contents

• Potential species
• Records of yields
• *Eucalyptus gunnii* growth curve
• Costs and revenues
• Economic analysis
• Risk
Potential species
Potential species

Figure 1: Comparison of latitude and area of Europe and Australia (adapted from Turnbull and Eldridge 1983. The natural distribution of *E. gunnii* (black) and *E. nitens* (grey) (Brooker and Kleinig 1990). (Leslie, Mencuccini and Perks 2011)
Figure 2: Growth and hardiness of eucalypts in Great Britain (Leslie, Mencuccini and Perks 2011)
Daneshill – Nottinghamshire

Woodchip harvested in June 2011 was 2076.4 tonnes or 85.83 tonnes / ha or 17.16 tonnes ha\(^{-1}\) year\(^{-1}\) (greenish) 
(6.95 tonnes acre\(^{-1}\) year\(^{-1}\))
(Wooddisse 2011)
Records of yields (volumes)

Red Marley – Worcestershire - second rotation coppice measured at 10 years old

<table>
<thead>
<tr>
<th>Species</th>
<th>Height (m)</th>
<th>Dbh (cm)</th>
<th>Stools ha(^{-1})</th>
<th>Stems ha(^{-1})</th>
<th>Vol m(^3) ha(^{-1})</th>
<th>Biomass odt ha(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. gunnii</em></td>
<td>17.19</td>
<td>13.2</td>
<td>2370</td>
<td>3792</td>
<td>248</td>
<td>193</td>
</tr>
<tr>
<td><em>E. dalrympleana</em></td>
<td>17.08</td>
<td>16.1</td>
<td>530</td>
<td>954</td>
<td>69</td>
<td>49</td>
</tr>
</tbody>
</table>

|              |            |          | 2900               | 4746              | 317                     | 242                    |

Assuming a dry density ~700 kg m\(^{-3}\)

(McKay 2010)
$E. \text{gunnii}$ growth

- **1st rotation**: 15 years – 26 m$^3$ ha$^{-1}$ y$^{-1}$ based on interpolated data from sites from across GB

- **2nd rotation**: 10 years - Red Marley – MAI Coppice = 30 m$^3$ ha$^{-1}$ y$^{-1}$ @ 10 years old
E. gunnii growth

\[
y = -8E-05x^2 + 0.0933x + 0.5778
\]

\[R^2 = 0.9085\]
E. gunnii growth

\[ y = 0.0465x + 7.9046 \]

\[ R^2 = 0.8248 \]
E. gunnii growth

![Graph showing growth of E. gunnii over age]

- **X-axis (Age (years))**: 0 to 20
- **Y-axis (Stem volume m³)**: 0 to 0.25

The graph illustrates the growth pattern of E. gunnii, with stem volume increasing over the years.
E. gunnii growth

Dbh @ 15 years = 16.3 cm
Height @ 15 years = 17.4 m

AFOCEL (2003) volume equation:
Stem volume =
$-5.04 + (0.03556 \times (dbh^2) \times \text{height}) \times 1000$

Tree volume @ 15 years = 0.16 m³
Income – 1st Rotation

- Stem volume @ 15 years = 0.16 m³
- Standing volume @ 2,500 stems/ha = 396 m³ ha⁻¹
- MAI = 26 m³ ha⁻¹ y⁻¹
- **Standing sales prices** for material of stem volume of 0.16 m³ for GB is approx £11 m⁻³ ($5 ft⁻³)
- So standing value = £4365 ha⁻¹ ($2587 acre⁻¹)

- Delivered biomass prices for the UK electricity sector are £30-60 odt⁻¹ (ex VAT) for UK feedstocks and a price range of £105-135 odt⁻¹ for imports ([DECC 2010](https://www.gov.uk/government/publications/uk-sustainable-bioenergy-platform-biomass-input-price-forecast-2010-2019))
Income – subsequent rotations

- Coppice volume @ 10 years = 300 m³
- MAI = 30 m³ ha⁻¹ y⁻¹
- 300 m³ @ 1.05 t m⁻³ = 315 tonnes wet weight or 150 tonnes dry weight (based on AFOCEL 2003)
- **Standing sales prices** for material of stem volume of less than 0.124 m³ for GB is approx £11 m⁻³ ($5 ft⁻³)
- So standing value = £3,300 ha⁻¹ ($2,138 acre⁻¹)

- In 55 years get 5 rotations
Establishment costs

- Biomass low value = effective low cost establishment, based on Irish approach
- Assumed 5% discount rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
<th>Unit</th>
<th>Number</th>
<th>Cost</th>
<th>Discounted Cost</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>Herbicide spray</td>
<td>ha</td>
<td>1</td>
<td>250.00</td>
<td>250.00</td>
</tr>
<tr>
<td>0</td>
<td>Ripping</td>
<td>hectare</td>
<td>1</td>
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<td>0</td>
<td>Cost of Trees</td>
<td>tree</td>
<td>2500</td>
<td>0.35</td>
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<td></td>
<td>Cost of planting 1000 trees</td>
<td></td>
<td></td>
<td>240</td>
<td>600.00</td>
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<tr>
<td>1</td>
<td>Spot spraying</td>
<td>tree</td>
<td>2500</td>
<td>0.08</td>
<td>200.00</td>
</tr>
<tr>
<td></td>
<td>Spot spraying</td>
<td>tree</td>
<td>2500</td>
<td>0.08</td>
<td>200.00</td>
</tr>
</tbody>
</table>

Total costs: 2250 | 2221.88
NDR @ 5% discount rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Operation</th>
<th>Cost/Revenue (£)</th>
<th>Disc Cost/Revenue (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Establishment</td>
<td>-1850</td>
<td>-1850</td>
</tr>
<tr>
<td>1</td>
<td>Herbicide</td>
<td>-200</td>
<td>-191</td>
</tr>
<tr>
<td>2</td>
<td>Herbicide</td>
<td>-200</td>
<td>-181</td>
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<tr>
<td>15</td>
<td>Harvesting single stems</td>
<td>+4365</td>
<td>+2100</td>
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<tr>
<td>25</td>
<td>Harvesting coppice</td>
<td>+3300</td>
<td>+975</td>
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<tr>
<td>35</td>
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<tr>
<td>45</td>
<td>Harvesting coppice</td>
<td>+3300</td>
<td>+367</td>
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<tr>
<td>55</td>
<td>Harvesting coppice</td>
<td>+3300</td>
<td>+225</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
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<td>+2043</td>
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</table>
NDR & IRR

Internal rate of return of c. 8%
## Comparison alternative
Sitka Spruce, YC20, 2500 stems ha\(^{-1}\), intermediate thin

<table>
<thead>
<tr>
<th>Year</th>
<th>Operation</th>
<th>Cost/Revenue (£)</th>
<th>Disc Cost/Revenue (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Establishment</td>
<td>-1850</td>
<td>-1850</td>
</tr>
<tr>
<td>1</td>
<td>Herbicide</td>
<td>-200</td>
<td>-191</td>
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<tr>
<td>2</td>
<td>Herbicide</td>
<td>-200</td>
<td>-181</td>
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<td>20</td>
<td>Thinning</td>
<td>+287</td>
<td>+108</td>
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<td>+559</td>
<td>+165</td>
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<tr>
<td>30</td>
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<td>+1102</td>
<td>+255</td>
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<tr>
<td>35</td>
<td>Thinning</td>
<td>+1055</td>
<td>+191</td>
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<td>40</td>
<td>Thinning</td>
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<td>+105</td>
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<td>Thinning</td>
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<tr>
<td>50</td>
<td>Thinning</td>
<td>+959</td>
<td>+84</td>
</tr>
<tr>
<td>55</td>
<td>Clear fell</td>
<td>+9125</td>
<td>+754</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>+12705</td>
<td>-434</td>
</tr>
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</table>
Risk
Figure 3: Minimum temperature for January (1961-1990). (Met Office undated)
Figure 4: Projections for Accumulated Temperature and Moisture Deficit for Great Britain (Broadmeadow, Webber, Ray and Berry 2009)
Conclusions

- Cold tolerant eucalypts possible crop
- Highly productive
- Higher returns than other trees
- But...Risk of cold damage
- Future risk not predictable
References


• Forestry Commission (2011) Sales contracts for standing coniferous timber from Forest Enterprise areas. Average Price for each Country, 1 October 2010 to 30 September 2011.


FCBA (no date) L’Eucalyptus. Expeces ligneuses pour la production de biomasse. FCBA. 4pp.