RENEWABLE HEATING & HOT WATER WITH WOOD PELLETS

Webinar 1
Attributes of wood pellet fuel

Marcus Baker

www.ecohotwater.co.nz
WOOD PELLET FUEL

What are wood pellets?

• Biomass fuel that is 100% renewable
• Made in NZ from waste wood, sawdust & post harvest forest residue
• Diverts wood waste from landfill and forest residues from aerobic decomposition
• Biomass has lowest carbon emissions of any fuel in NZ at 0.003 kgCO₂e / kWh
• Direct replacement of fossil fuels for space heating, DHW & process heat
Huge potential for diversion of unused wood waste to biomass

Annually wood waste sent to landfill in NZ:

- 250,000 tonnes to municipal landfills (council controlled)
- 1.2 MILLION tonnes to non-municipal landfills (commercial / private)

PLUS post harvest residue from forestry
Two main forms of woody biomass for boilers:

- Wood chip in a wide range of different grades
- Wood pellets

Wood chip needs to be used close to the production site otherwise it is uneconomical and has high transport carbon emissions. Wood chip is better suited for larger loads and locations with dedicated on-site energy services personnel, e.g., hospitals, food processors.

Energy density, moisture content, and fuel performance vary depending on contract.

Wood pellets have more easily defined fuel performance, easier fuel handling, boilers, and fuel transfer are more automated, and less intervention is required. They are more appropriate for sites without skilled personnel on-site for energy needs, e.g., apartment buildings, offices, aged care facilities, smaller hospitals, schools, swimming pools, smaller covered horticulture.
WOOD PELLET FUEL

Technical attributes of wood pellets as fuel

- Certified manufacturing = guaranteed quality control & production to ISO standards
  - Nature’s Flame – DINplus
  - Azwood – ENplus
- Approximately 10% less energy dense than coal

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Per tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy density</td>
<td>5.1 MWh per tonne 18 GJ per tonne</td>
</tr>
<tr>
<td>Physical density</td>
<td>650 kg per m³</td>
</tr>
<tr>
<td>Moisture content</td>
<td>&lt; 8%</td>
</tr>
<tr>
<td>Ash content</td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>
PELLET FUEL PRODUCTION PROCESS

1. Fibre inputs trucked to site and stored
2. Input fibre added to feedstock reception
   - Product stored awaiting processing
3. Product screened for metal & oversize before drying
   - Product dried to required moisture content
4. Fibre conveyed to dryer
5. Dried product/dry input fibre conveyed to Hammermill
6. Product refined to required size
7. Fibre conveyed to dry storage
8. Pellets conveyed to bulk storage
   - Pellets readied for customer, bagging if required
9. Product stored ready for bagging or bulk delivery
10. Pellets conveyed to pellet presses
11. Product pressed into pellets and cooled
12. Fibre conveyed to dry storage
13. Product moisture allowed to homogenise
AVAILABILITY OF PELLET FUEL

NZ manufacturers

• Azwood – Nelson
• Niagara – Invercargill
• Nature’s Flame – Taupo
• Waipapa Pine – Whangarei

Up to 15 year guaranteed supply contracts offered

All manufacturers are increasing production of pellets as demand rises

Bulk delivery by truck with no manual handling required through-out country
PRICE OF PELLET FUEL

Price varies depends on number of factors

Price range for commercial, bulk deliveries across NZ

- 5.8c to 8.3c per kWh
- $15.69 to $22.51 per GJ
- $296 to $425 per tonne

Up to 15 year price contracts being offered

Contrast with commercial prices now being quoted for natural gas at <11c/kWh and electricity at <20c/kWh

Three year contracts generally absolute maximum for commercial fossil fuels & electricity
## COMPARISON OF DIFFERENT HEAT SOURCES

<table>
<thead>
<tr>
<th>Heating technology</th>
<th>Fuel</th>
<th>Reduction in CO2 emissions if replaced with pellets</th>
<th>Real world example for building with DHW use of 10,000L per day (204MWh/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Annual CO2 emissions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calculated annual running cost</td>
</tr>
<tr>
<td>Pellet boiler</td>
<td>Wood pellets</td>
<td>Base case</td>
<td>599</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$16,320</td>
</tr>
<tr>
<td>Heat pump</td>
<td>Electricity (COP 3)</td>
<td>-91%</td>
<td></td>
</tr>
<tr>
<td>Gas boiler</td>
<td>Natural gas</td>
<td>-98%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPG</td>
<td>-99%</td>
<td></td>
</tr>
<tr>
<td>Diesel boiler</td>
<td>Diesel</td>
<td>-99%</td>
<td></td>
</tr>
</tbody>
</table>

What will the cost of fossil fuels & electricity be in 2025 and beyond? Are all fossil fuel installations already stranded assets?

Costs / kWh - pellets $0.08, electricity $0.17, NG $0.11, LPG $0.18, diesel $0.10
<table>
<thead>
<tr>
<th></th>
<th>Gas Current</th>
<th>Gas Forecast</th>
<th>Wood pellets 12T deliveries</th>
<th>Wood pellets 28T deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat energy required (approx.)</td>
<td>0.8 MWh per year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel consumption at plant efficiency</td>
<td>1.2 MWh at 70% efficiency</td>
<td>0.9 MWh at 85% efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per kWh</td>
<td>$0.05</td>
<td>$0.11</td>
<td>$0.07</td>
<td>$0.06</td>
</tr>
<tr>
<td>Annual cost</td>
<td>$60,300</td>
<td>$129,200</td>
<td>$63,300</td>
<td>$56,700</td>
</tr>
</tbody>
</table>
## EXAMPLE OF COST COMPARISON WITH GAS BOILER

<table>
<thead>
<tr>
<th></th>
<th>Current Gas</th>
<th>Forecast Gas</th>
<th>12T deliveries</th>
<th>28T deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost vs current gas</strong></td>
<td>$2,989</td>
<td>- $3,608</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost vs forecast gas</strong></td>
<td>$68,837</td>
<td>-$65,848</td>
<td>-$72,445</td>
<td></td>
</tr>
<tr>
<td><strong>Annual carbon emissions kg</strong></td>
<td>229,004</td>
<td>3,031</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CO2 emissions</strong></td>
<td>100%</td>
<td>-99%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Payback for pellet boiler system at forecast gas price</strong></td>
<td>4 to 4.3 years</td>
<td>4 to 4.3 years</td>
<td>4 to 4.3 years</td>
<td>4 to 4.3 years</td>
</tr>
</tbody>
</table>
FACTORS THAT IMPACT PRICE OF PELLET FUEL

1. Manufacturer
   • Nature’s Flame
   • Azwood
   • Niagara
   • Waipapa Pine

2. Annual tonnage
   • Price breaks depend on annual tonnage, generally
     • <50 tonnes (255 MWh)
     • <100 tonnes (510 MWh)
     • <500 tonnes (2,550 MWh)
   • Can be usually be split between different sites if same fuel manufacturer
FACTORS THAT IMPACT PRICE OF PELLET FUEL

3. Freight cost determined by distance from fuel bulk depot to site.

Fuel store depots:

• Azwood – Nelson, Dunedin & Christchurch – South Island deliveries only
• Nature’s Flame – Taupo & Christchurch – both North & South Island
• Niagara – Invercargill – lower half of South Island
• Waipapa Pine – Whangarei – not currently distributing to commercial customers, plans to expand
FACTORS THAT IMPACT PRICE OF PELLET FUEL

4. Maximum tonnage in each delivery
   • Larger store optimises cost of fuel by reducing proportional cost of freight per tonne
   • Varies depending on storage capacity at site
   • Blower trucks available nationally – some variation in capacity depending on location
   • Generally maximum with blower = 12 tonnes (truck) or 28 tonnes (truck & trailer)
STORAGE OF WOOD PELLETS

Convert existing coal store bunker

Previously dump truck now blower delivery

Delivery grate with pellets instead of coal
Create a new fuel storage room with sloping floor

1m³ = 650kg pellets

Construction work required

Some space lost with sloping floor to each auger

Longer & taller is better than shorter & wider

Multiple augers can feed multiple boilers, reducing space loss
Create a new fuel storage room with supplier fuel storage system
No construction work for sloping floor or bulk head wall/s required
Requires blower truck delivery
Can handle humid environments
Maximises available space if design includes adjustable sides
<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Footprint</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.84 x 1.44</td>
<td>2.65m²</td>
<td>3 tonnes</td>
</tr>
<tr>
<td>2.30 x 1.84</td>
<td>4.23m²</td>
<td>5 tonnes</td>
</tr>
<tr>
<td>2.58 x 2.04</td>
<td>3.74m²</td>
<td>6 tonnes</td>
</tr>
<tr>
<td>2.58 x 2.58</td>
<td>6.66m²</td>
<td>8 tonnes</td>
</tr>
</tbody>
</table>

More sizes and capacities available to suit different spaces and arrangements.
**Example of Pellet Storage + Delivery in 8 Storey Aged Residential Care Facility, Auckland**

- **Sub-basement level 1**: 128kW pellet boiler with automatic vacuum fuel delivery from bulk fuel bags
- **Basement level 2**: Pellet fuel deliveries by blower truck connects to fitting in service bay wall, fills bulk pellet fuel bags in sub-basement
- **Ground floor**: 2 x 8 tonne bulk pellet fuel bags
- **Sixth storey**: Boiler flue termination at roof
- **Second storey**: Eight storey building including two basement levels

**Notes:**
- Must retain some residual pellets before delivery otherwise...
MSDS HAZARDS + FIRE SAFETY

✓ Not classified as Hazardous Substance
✓ Not classified as Dangerous Good
✓ No Hazchem Code allocated
✓ No Emergency Procedure Guid
✓ Spillage requires “sweeping or vacuuming”

✓ Auto-ignition temperature of 200°C
✓ Fire can be fought with N₂, CO₂, foam, sand, water spray or fog
✓ Thermal decomposition products include CO & CO₂
MSDS HAZARDS + FIRE SAFETY

✓ Not classified as Hazardous Substance
✓ Not classified as Dangerous Good
✓ No Hazchem Code allocated
✓ No Emergency Procedure Guid
✓ Spillage requires “sweeping or vacuuming”

✓ Auto-ignition temperature of 200°C
✓ Fire can be fought with N₂, CO₂, foam, sand, water spray or fog
✓ Thermal decomposition products include CO & CO₂
Designers and distributors of renewable heating & hot water systems

Marcus Baker

marcus@ecohotwater.co.nz

07 312 3382 – 021 027 50220

www.ecohotwater.co.nz