Combustion economics

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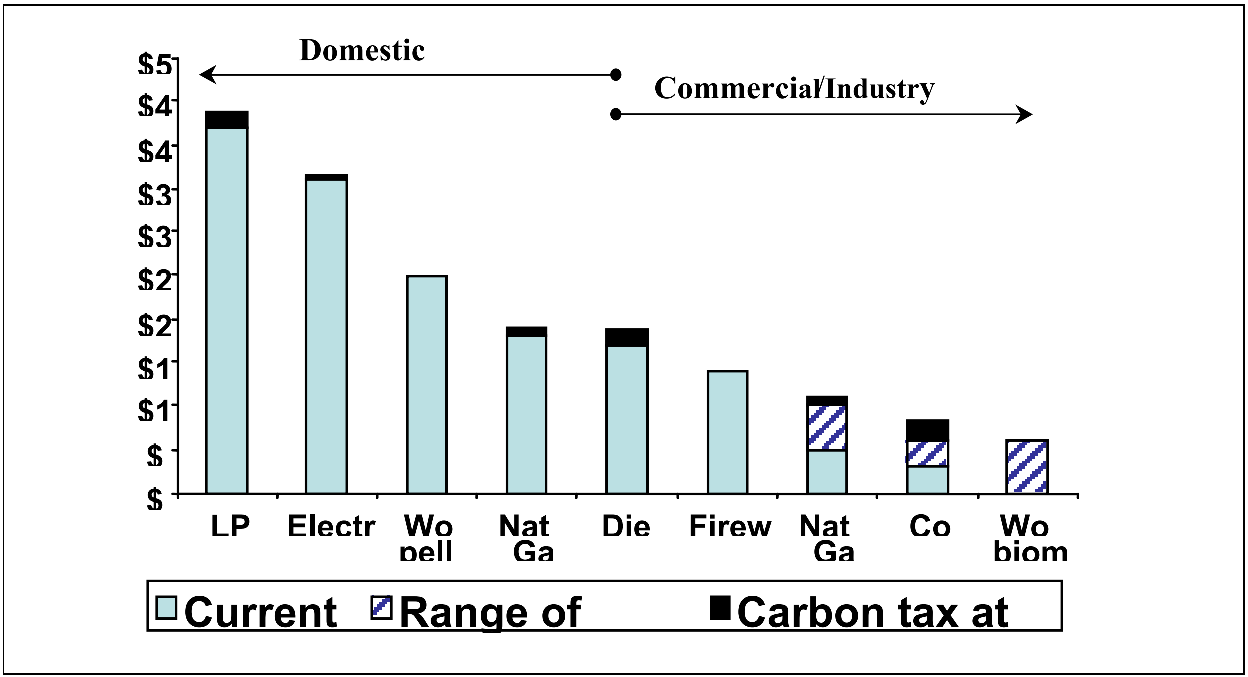
1. RELATIVE COST

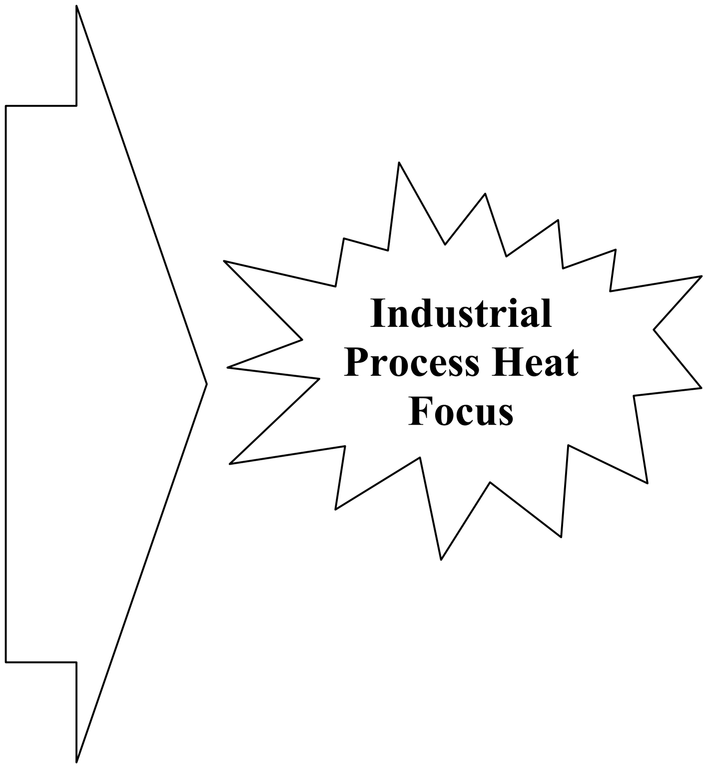
Relative Cost - Woody biomass has low relative cost, particularly if a carbon tax is applied to fossil fuels.



2. ATTRACTIVENESS OF ELECTRICITY

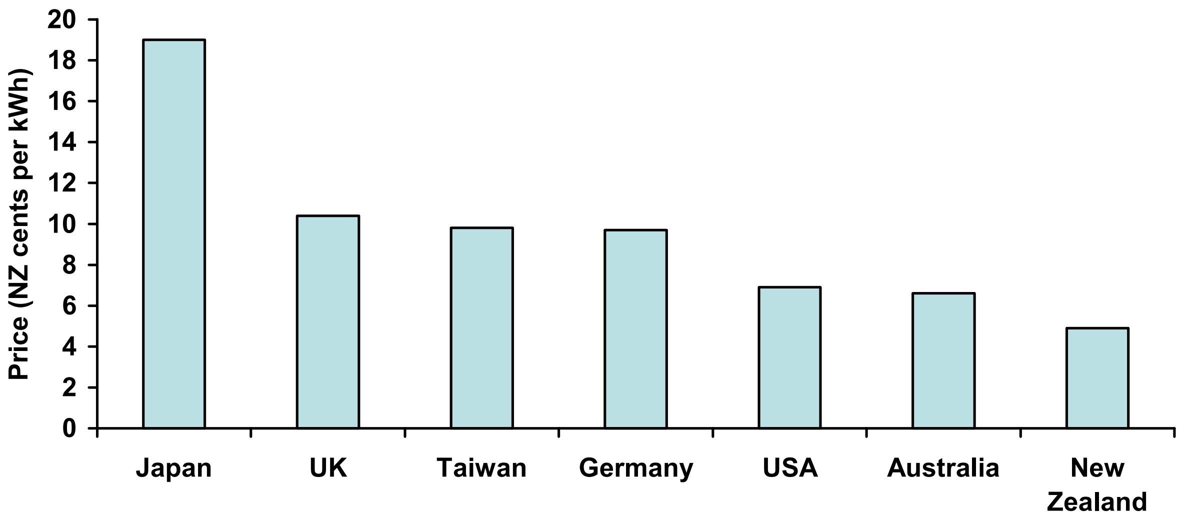
In New Zealand, industrial process heat is a more attractive application of bioenergy from woody biomass than electricity generation.

- Relatively low wholesale electricity price
- Relatively low level of assistance for renewables / carbon abatement
- Significant industrial sector processing / drying primary produce requires process heat <300°C for drying or other processing (dairy, timber, meat, wool)



3. NZ ELECTRICITY PRICES ARE RELATIVELY LOW

Electricity price to Industrial Users



4. ASSISTANCE FOR "NEW RENEWABLE" ELECTRICITY GENERATION IN NZ IS RELATIVELY LOW

	Level of assistance per kWh
Germany	Up to € 0.15 (~ NZ$0.30)
Australia	AUS$0.03 to $0.04 (effected through MRET scheme)
New Zealand	NZ$0.009 (assuming value of $15 / t CO_2 through "Projects" mechanism, 2008 to 2012 only, must demonstrate additionality)

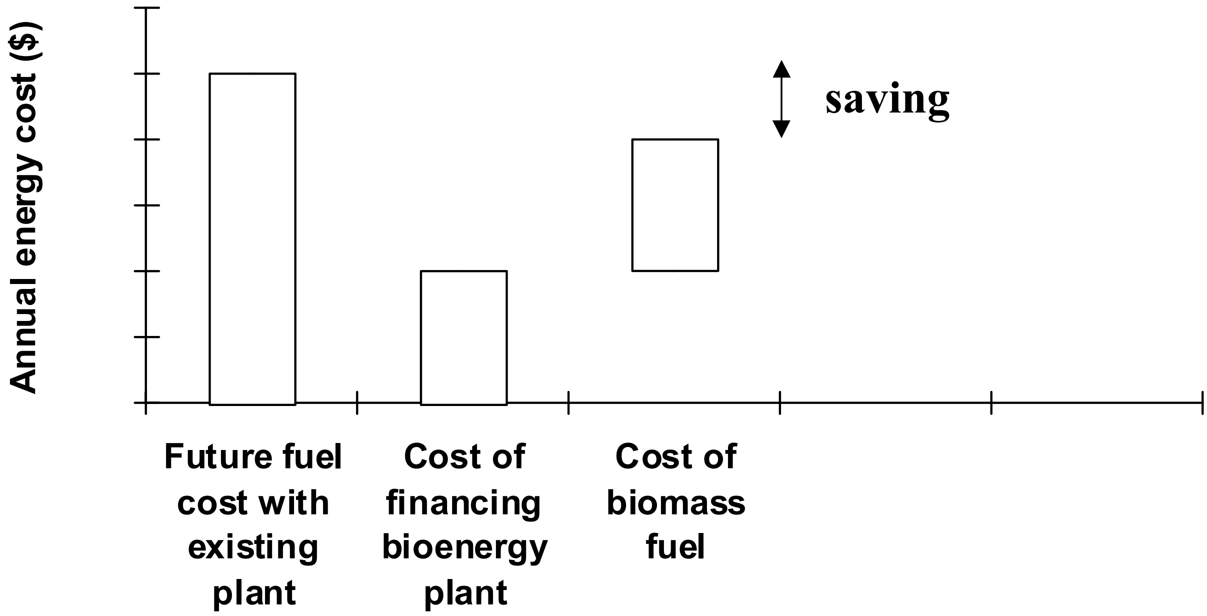
5. MARKET POTENTIAL

Most new potential users of bioenergy in NZ will be sites where they generate their own fuel, or where a fossil fuel is already being used.

Industry	Situation	Comments on potential for increased bioenergy use:
Timber drying	62% done using wood waste.	Much more on-site wood waste is available. Potential for industry expansion.
Dairy processing	Volume of milk dried is increasing, mostly done at very large sites	Most large North Island sites have gas turbine cogen. Some diseconomies of scale for biofuel transport.
Meat and wool processing	Mature industry. Mostly old plants using coal or natural gas.	Focus is on conversion from gas or coal, rather than new sites.

6. RELATIVE ECONOMICS

To replace existing gas or coal use, the total cost of bioenergy (including fuel and finance) must compete with fuel cost only for the existing plant

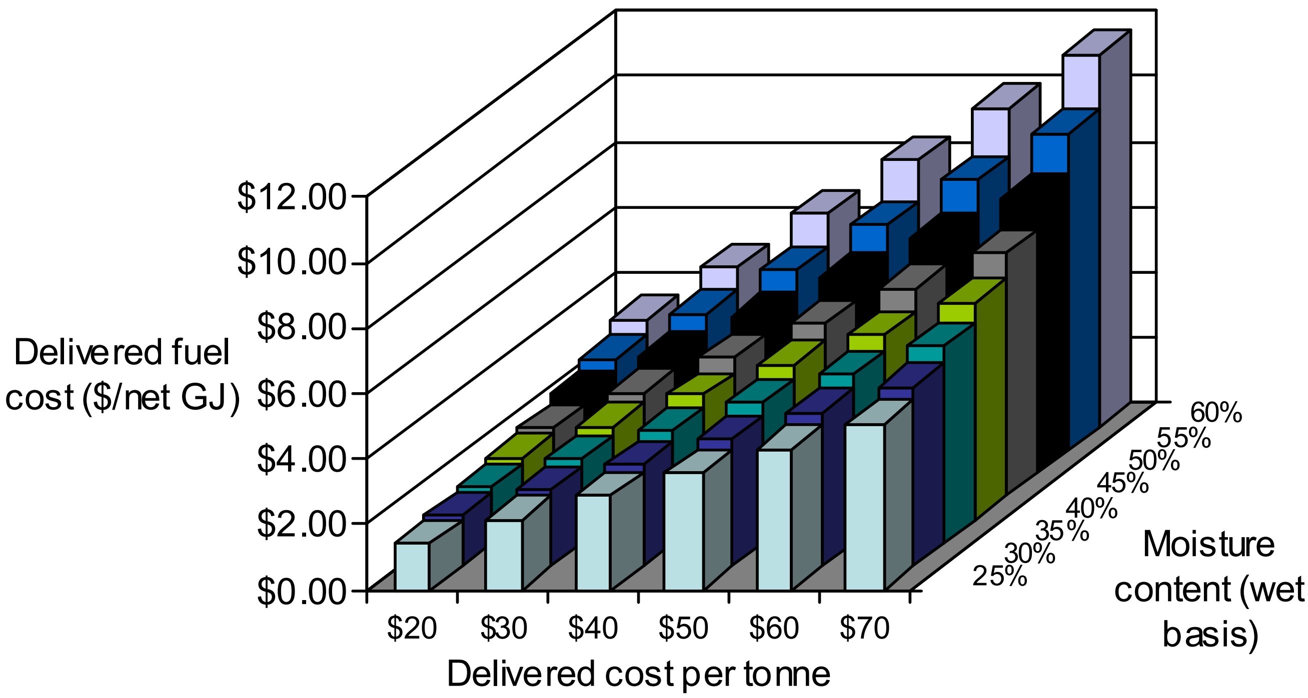


The saving must be more than sufficient to compensate:

- extra space required for the energy plant fuel storage and truck access
- inconvenience of more truck movements on site
- managing resource consent compliance
- higher operational costs

7. FUEL COST

Delivered fuel cost ($/GJ) is sensitive to delivered cost per tonne and moisture content



8. CAPITAL COST

Various fuel and equipment parameters affect the capital cost of the fuel storage and handling system

- Fuel storage system type – Steel silo vs wooden silo vs push floor
- Volume required for fuel storage – depends if waste produced on-site, otherwise depends on reliability of fuel supply chain.
- Type and variability of fuel determining its tendency to bridge, bind, jam or self-segregate - Key parameters are type of fibre (e.g. pine or hardwood, wood or bark, moisture content, particle shape, particle size)

Various fuel and equipment parameters affect the capital cost of furnace and boiler

- Fuel suitability for furnace type
  - Small particles, consistent size for pile burner
  - Larger chunks for vibrating grate
- Turndown requirements
- Emissions requirements
- High overall variabilty in capital cost

9. SUPPORT FOR RENEWABLES:

The typical likely value of support from NZ "Projects to Reduce Emissions" programme is low compared to capital cost and fuel cost. Example – Industrial steam user

- 5MW_{th} biomass boiler, displacing coal
- Capital cost $2.0M
- Annual abatement 12,000 tonnes CO_2
- Assume value is $15 / t CO_2e, and discount rate of 40% used for NPV
- NPV (at end 2003) of revenues from credits is $95,000, or 4.8% of capital cost, or $0.79 per net GJ of fuel delivered (during years 2008 to 2012 only)

10. SUMMARY

The drivers of combustion economics are very site specific.

10.1 National level

- Nature of industrial base
- Levels of support for renewables

10.2 Regional level

- Market prices of alternative energy sources
- Biomass fuel availability

10.3 Site level

- Nature of energy demand (utilisation, turndown, load swings)
- Cost of inconvenience
- Emissions requirements