

Establishing wood fuel resource volumes

Peter Hall



Outline

- Know your demand
- Types of wood residues
- Tools and resources for estimating biomass availability
 - Estimating wood residue volumes
 - By Region (15) or Territorial Authority (66 in NZ)
 - Estimating volume by plant location (on a road)
- Questions

Wood fuel demand

Calculate what you need;

- Plant size
- Conversion efficiency
- Operating hours / plant utilisation / turn down
- Fuel type (specification, moisture content)

Do some sensitivity analysis

- Utilisation
- Fuel moisture content

Set a fuel specification and stick to it

Wood fuel demand calculator

Wood Biomass Fuel Demand Calculator

Wood fired heat plant

Alter only

clear cells

Wood Type
Softwood

Fuel Moisture Content	52	% wb	Hours / day	Days/year	
Plant Conversion efficiency	85%	%	16	350	
Plant size (MWth)	10				
MJ / tonne	7,790.6			Hours / p. a.	
kiloWatts / tonne of fuel	2,164			5,600	
kW / tonne utilised	1,839				
Annual hours	5,600		Load Factor	63.9%	
kiloWatt hours	56,000,000		Kindle or Turn down (TD) mode		
Megawatts	10		TD or Kindle hours	2800	Hours p.a.
			Turn down load	5%	% of full load
	Fuel Demand		MW p.a. from TD	1,400	MW / p. a.
Tonnes per annum	31,091		Fuel for TD ops.	647	t / p. a.
Tonnes per day	88.8				
Tonnes per hour	5.6				
Wood price	55	\$ / tonne			
Fuel cost	7.06	\$ / GJ			
Annual fuel cost	\$ 1,709,997	\$ / p. a.			
Monthly Fuel cost	\$ 142,500	\$ / mth			
Daily Fuel cost	\$ 4,886	\$ / day			
Energy production fuel cost	\$0.04	\$ / kWh			

WOOD ENERGY KNOWLEDGE CENTRE



Renewable energy

> [Wood energy knowledge centre](#)

> [Types of wood energy](#)

> [Why use wood energy?](#)

> [Producing wood for energy](#)

> [Using wood as energy](#)

> [Frequently asked questions](#)

> [Tools and calculators](#)

> [Bioenergy](#)

> [Biofuels](#)

> [Solar](#)

> [Hydro](#)

> [Wind](#)

> [Geothermal](#)

Tools and calculators

Below are some tools and calculators relating to wood energy that may assist you:

- [Biomass calorific value calculator](#)
- [Biomass boiler investment tool](#)
- [Biomass cogeneration investment tool](#)
- [Biomass volume to mass converter](#)
- [Energy unit converter](#)
- [Wet/dry basis converter](#)
- [Cutover residue calculator](#)
- [Residue recovery costing tool](#)
- [Residue transport cost calculator](#)
- [CO² emission calculator](#)
- [Return on investment calculator](#)
- [On-site resource assessment tool](#)
- [Supply curve tool](#)
- [Wood waste valuation tool](#)
- [Landing residue calculator](#)

Residue recovery systems



Fuel specification - Two options

1. Get a plant installed and supply fuel that meets its fuel specification
2. Figure out what fuel you have locally, and what is the cheapest and get a heat plant that suits your fuel;
 - Bark
 - Sawdust
 - Hogged forest residues
 - Mixed fuel (to meet a large demand)
 - Off-cuts
 - Shavings
 - Municipal wood waste

Fuel specification

Fuel specification – key parameters;

- Moisture content
- Particle size
- Ash content (contamination)

Off specification fuel will lead to problems with;

- Boiler output (to low)
- Emissions (to high)
- Clinker / ash

Types & Volume of wood residues available

Mill residues

- sawdust
- bark
- offcuts / boxwood
- shavings

Mill residues – data table (2007)

Based on processing 13.9 million m ³ roundwood			
Wood supply region	Residue production ('000 tonnes)	Estimated residue used as bioenergy ('000 tonnes) *	Residues available ('000 tonnes)
Northland	288	288	0
Auckland	256	91	164
CNI	2,139	1,508	631
East Coast/Hawkes Bay	373	299	74
SNI	267	130	137
Nelson/Marlborough	316	357	-41
West Coast	73	69	4
Canterbury	149	83	66
Otago/Southland	263	241	23
Total	4,123	3,066	1,099
Existing markets		Estimated Residue used ('000 tonnes)	
Wood Pellets		200	
Landscaping and other uses		100	
Estimate of residue available			799

* Estimate of fuel used derived from capacity in the heat plant database (EECA, 2007)



Phone your local wood processors and ask

Mill residues

- Dynamic
 - Mill closures
 - Mill changes (shifts / volumes)
- Estimates possible
 - wood processing database
 - heat plant database
 - estimate what is being produced and what is already being used – by region or territorial authority



Phone your local wood processors and ask

Municipal wood waste – includes green, C&D (est. 2007)

Total wood waste to landfill (No NZ Waste strategy)

REGION	2005	2010	2015	2020	2025	2030
North Island						
Northland Region	23,500	25,166	26,952	28,863	30,911	33,103
Auckland Region	233,208	264,111	299,109	338,744	383,632	434,468
Waikato Region	57,190	61,732	66,634	71,925	77,637	83,802
Bay of Plenty Region	36,466	39,401	42,572	45,997	49,699	53,698
Gisborne Region	8,000	8,858	9,809	10,862	12,028	13,318
Hawke's Bay Region	25,177	26,175	27,212	28,290	29,410	30,575
Taranaki Region	13,839	14,118	14,403	14,693	14,989	15,292
Manawatu-Wanganui	37,477	38,080	38,694	39,317	39,950	40,593
Wellington Region	120,041	128,429	137,403	147,004	157,276	168,265
Total North Island	554,899	606,071	662,786	725,695	795,531	873,115
South Island						
Tasman Region	8,767	9,453	10,194	10,993	11,854	12,783
Nelson Region	8,285	8,639	9,008	9,393	9,794	10,212
Marlborough Region	8,372	9,117	9,929	10,813	11,775	12,823
West Coast Region	5,859	6,097	6,345	6,603	6,871	7,150
Canterbury Region	83,150	91,265	100,173	109,950	120,681	132,460
Otago Region	39,154	42,346	45,799	49,533	53,572	57,940
Southland Region	24,922	25,147	25,374	25,603	25,834	26,068
Total South Island	178,508	192,065	206,822	222,887	240,382	259,436
Total New Zealand	733,407	798,136	869,607	948,583	1,035,913	1,132,551

In-forest residues

Landing residues



- steep land

Cutover residues

- flat land

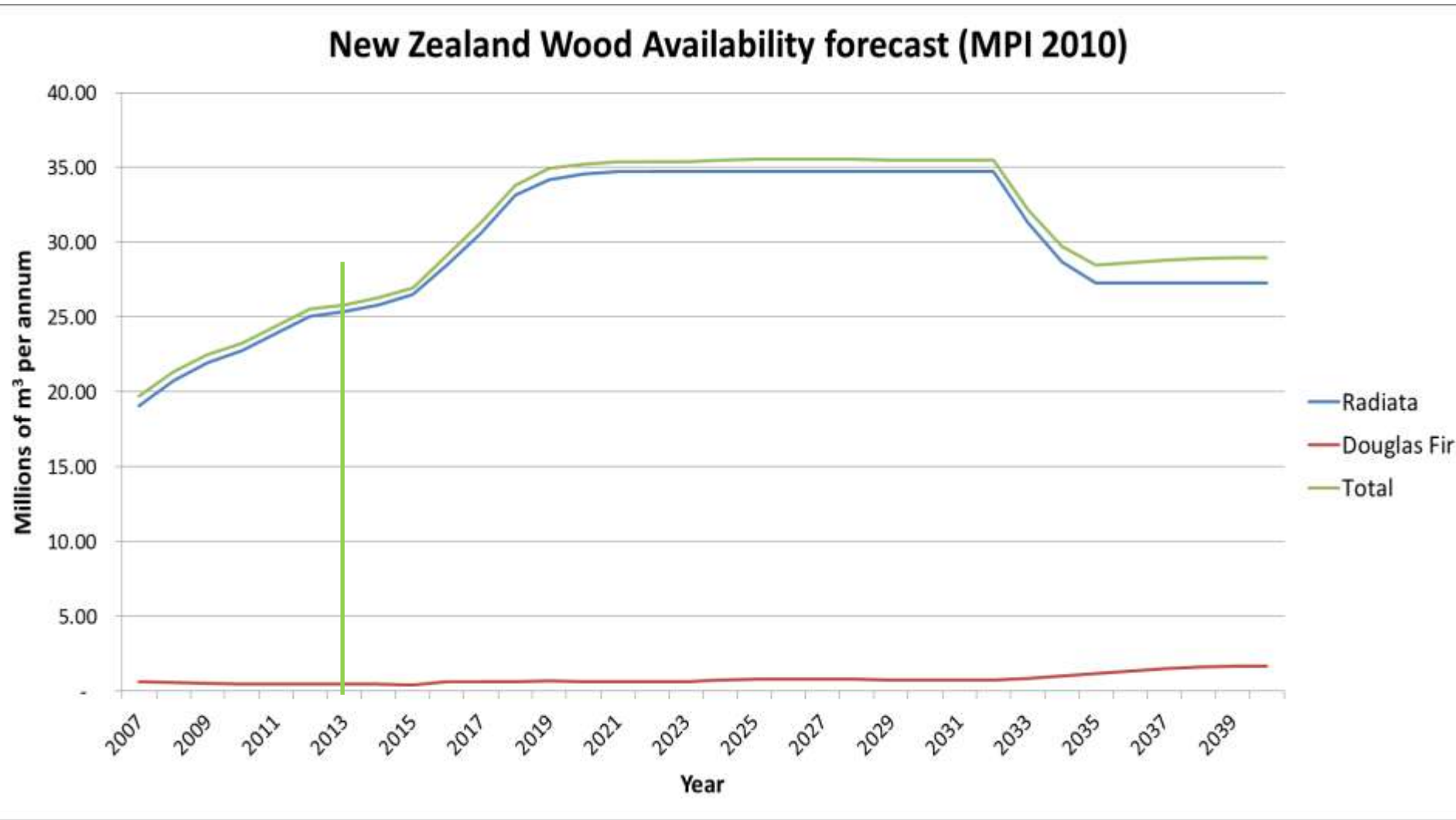


Tools for assessing forest residues availability

- Ministry of Primary Industries data underpins estimates of forest resources;
 - National Exotic Forest Description (NEFD)
 - Yield tables
 - Wood Supply forecasts
- Derivatives from these;
 - Spreadsheets used to derive Regional or Territorial Authority level wood supply
 - Log volume (TRV)
 - Pulp log
 - Logging residues
 - landing, cutover (flat or steep)

NZ - Potential log harvest volume

Fluctuates over time affecting in-forest residue volumes



Source – MPI Wood availability Forecasts 2010 – Scenario 5



In-forest residues data tables

Example; Landing residues by MPI Wood Supply Region, m³ per annum

	Regional landing residue supply					
	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	2033 - 2037	2038 - 2042
Northland	202,128	97,812	228,831	135,768	112,810	120,912
CNI	363,699	431,648	646,511	606,332	432,309	391,204
East Coast	110,502	98,286	236,106	129,973	49,082	92,899
Hawkes Bay	68,967	56,659	255,008	117,612	96,437	88,740
SNI	93,735	88,261	261,052	118,558	53,383	50,656
Nelson Marlborough	134,363	129,150	282,318	139,838	129,199	119,993
West Coast	14,330	4,296	16,673	10,421	13,021	13,070
Canterbury	55,569	65,091	138,051	69,266	58,533	47,007
Otago Southland	110,930	107,447	255,515	164,663	167,132	212,241
National Total	1,154,223	1,078,649	2,320,065	1,492,432	1,111,905	1,136,722

In-forest residues data tables

Example; Cutover residues by MPI Wood Supply Region, m³ per annum

	Regional Ground based cutover residue supply					
	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	2033 - 2037	2038 - 2042
Northland	272,612	113,230	270,642	156,705	123,663	124,883
CNI	510,520	431,825	607,273	597,619	433,834	379,022
East Coast	44,982	37,323	88,665	50,053	18,404	35,274
Hawkes Bay	38,644	35,573	130,307	66,403	50,088	45,089
SNI	102,412	90,813	264,556	122,484	55,231	47,776
Nelson Marlborough	128,695	92,921	215,287	107,536	91,780	86,508
West Coast	24,742	5,679	28,066	21,429	20,943	11,075
Canterbury	124,788	110,127	267,627	135,249	78,347	50,845
Otago Southland	125,061	80,036	249,779	254,531	118,813	84,872
National Total	1,372,455	997,526	2,122,203	1,512,009	991,103	865,343

	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	2033 - 2037
Far North	109,078	34,684	88,862	49,111	54,307
Whangarei	36,855	15,991	33,626	20,103	15,138
Kaipara	38,532	30,966	53,679	19,196	14,069
Auckland	17,663	16,170	52,663	47,357	29,295
Thames-Coromandel	10,184	8,904	16,731	13,052	19,442
Hauraki	550	4,639	6,942	3,589	743
Waikato	4,503	16,469	33,030	27,448	10,157
Matamata-Piako	851	1,401	1,375	750	1,764
Hamilton City	7	4	10	8	14
Waipa	976	1,319	4,431	2,932	685
Otorohanga	2,393	2,165	9,868	6,876	4,135
South Waikato	30,574	79,580	77,530	84,766	61,308
Waitomo	7,089	6,518	50,128	28,399	22,345
Taupo	135,293	122,409	127,478	167,390	149,063
Tauranga City	3,409	209	500	223	1,649
Ruapehu	45,798	29,202	102,602	55,842	16,555
Western Bay of Plenty	10,564	31,474	34,663	22,891	13,614
Rotorua	18,170	38,684	48,887	65,658	51,017
Kawerau	740	229	829	290	310
Whakatane	51,209	77,413	126,244	116,556	74,290
Opotiki	41,389	11,029	5,265	9,663	5,217
Gisborne	110,502	98,286	236,106	129,973	49,082
Wairoa	32,632	10,059	125,134	43,140	42,684
Hastings	28,072	37,081	95,862	54,310	49,627
Napier City	278	40	295	-	-
Central Hawkes Bay	7,984	9,478	33,716	20,162	4,126
New Plymouth	2,092	1,441	4,934	3,283	757
Stratford	5,743	2,748	13,725	1,813	2,317
South Taranaki	3,618	8,024	18,602	7,407	1,309
Wanganui	12,142	15,097	45,336	18,357	12,461
Rangitikei	6,124	7,404	44,594	20,229	4,394
Manawatu	3,822	4,027	10,434	4,368	1,259
Palmerston North City	2,181	1,231	1,933	437	1,174
Horowhenua	2,422	5,023	7,354	3,164	4,029
Tararua	6,796	8,091	31,094	9,099	4,904
Kapiti Coast	4,290	1,822	4,790	2,948	665
Upper Hutt City	4,611	2,877	4,586	3,688	2,751
Porirua City	1,257	2,751	1,128	407	98
Wellington City	106	368	1,241	153	-
Lower Hutt City	589	-	358	92	6
Masterton	26,547	16,264	51,222	19,811	12,517
Carterton	7,293	4,480	8,706	14,837	2,342
South Wairarapa	4,103	6,611	11,015	8,467	2,400

- Landing Residues;**
- cubic metres per annum
 - by year
 - by territorial authority
 - North Island



	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	2033 - 2037
Tasman District	20,828	39,501	55,295	46,316	71,812
Nelson City	37,471	26,612	64,979	27,454	14,011
Marlborough District	19,442	17,537	63,182	24,789	32,970
Kaikoura District	56,621	45,500	98,862	41,278	10,405
Buller District	3,591	1,465	3,022	2,918	1,690
Grey District	4,239	1,161	3,946	2,152	3,946
Westland District	6,500	1,670	9,706	5,351	7,385
Hurunui District	9,339	18,691	32,411	27,193	19,700
Waimakariri District	6,373	10,704	15,478	9,099	4,224
Selwyn District	5,603	4,071	13,614	5,083	3,942
Christchurch City	3,194	2,332	6,984	3,030	4,744
Ashburton District	2,082	884	4,854	1,884	1,901
Mackenzie District	4,249	3,374	5,271	2,173	3,160
Timaru District	4,220	4,531	12,961	3,072	3,017
Waimate District	20,509	20,505	46,478	17,732	17,845
Waitaki District	8,452	5,732	16,848	14,773	12,609
Queenstown-Lakes District	571	232	1,407	715	624
Central Otago District	3,589	1,513	4,387	1,495	2,556
Dunedin City	11,611	10,213	13,270	6,703	6,796
Clutha District	26,527	29,808	77,383	52,369	57,006
Southland District	23,656	27,517	60,163	39,484	63,983
Gore District	1,034	1,614	4,476	2,753	742
Invercargill City	1,673	1,051	1,774	3,322	4,071

Landing Residues;

- cubic metres per annum
- by year
- by territorial authority
- South Island

Not all residues are equal

- Wood processing residues
 - Clean, close by, size reduced – in demand
- Municipal wood wastes
 - Mixed, often dirty, cheap, reasonably close by, most needs size reduction and screening, treated component
- Forest residues
 - Contamination varies, mixed stem, branch, bark; needs size reduction / screening, often far away
 - Different locations in-forest (landing / cutover) mean different costs
 - Distance = cost
 - Handling = cost

GIS based forest biomass supply modelling

- Use NEFD derived tables as an input to GIS Forest Biomass supply model
- ArcMap
 - Toolbox
- Calculate volume by distance

GIS based biomass supply model

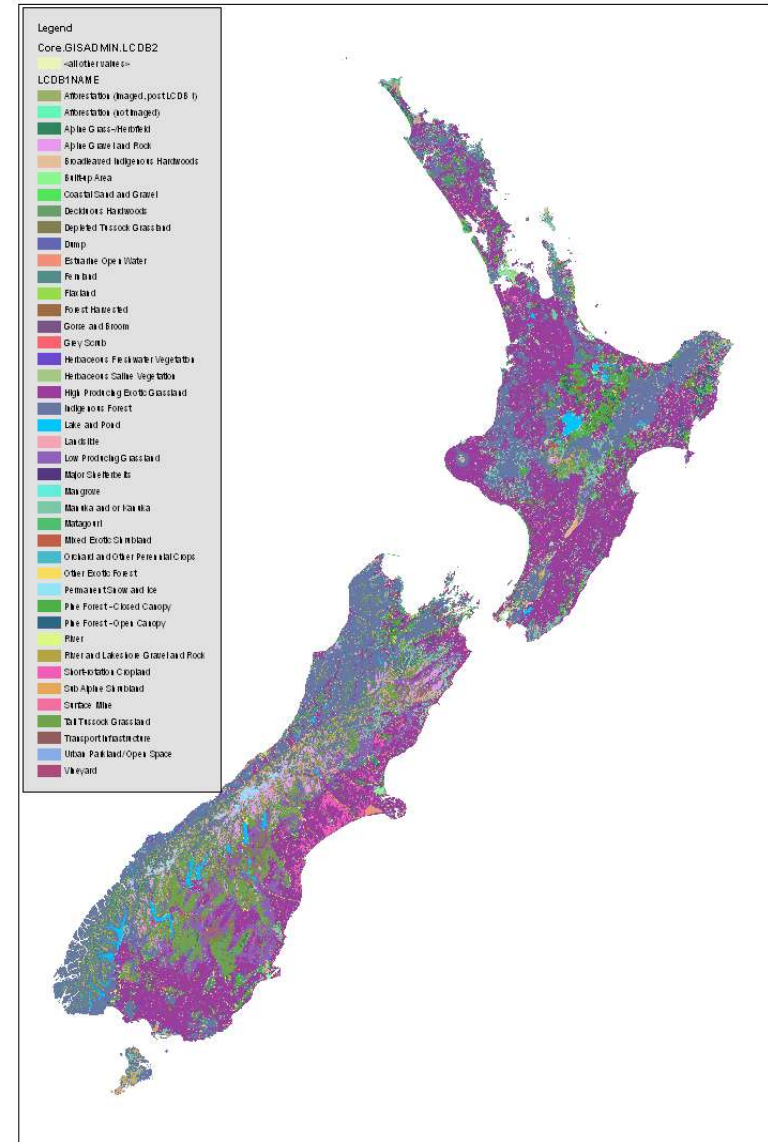
- LCDB3
 - Forest area layer
- Slope layer
- Roads layer
- NEFD area by age and yield
- Local authority boundaries

Generates

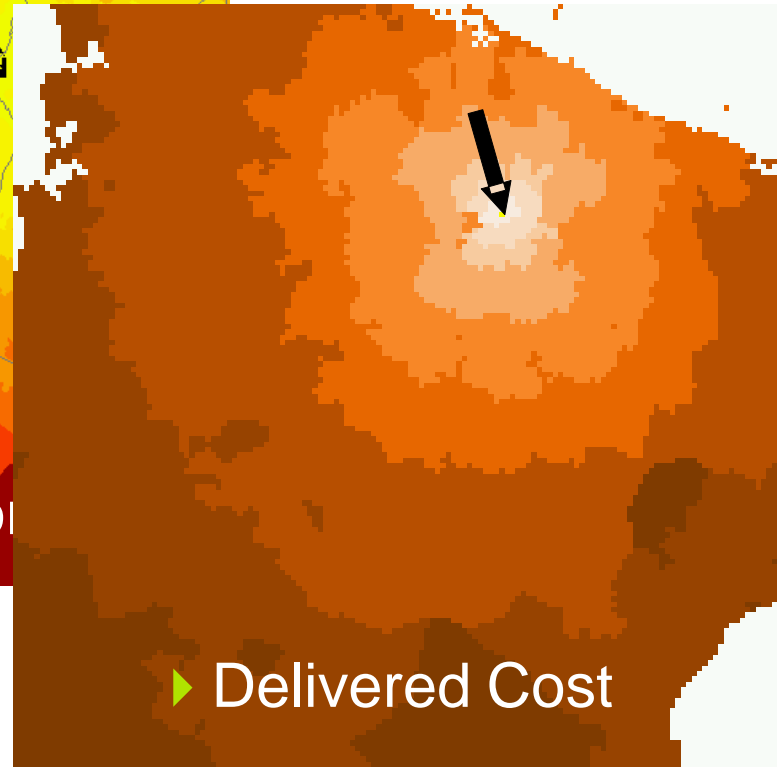
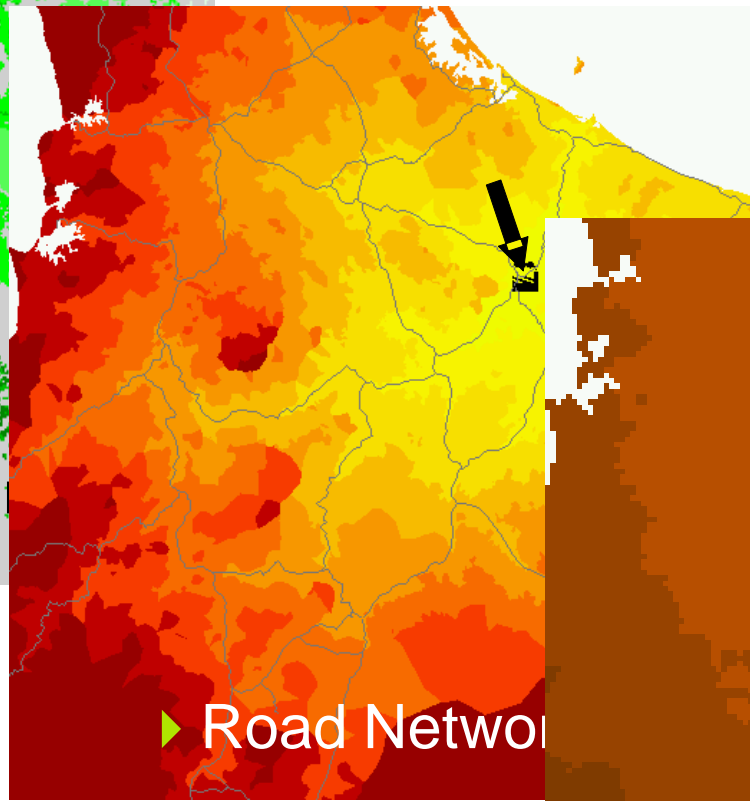
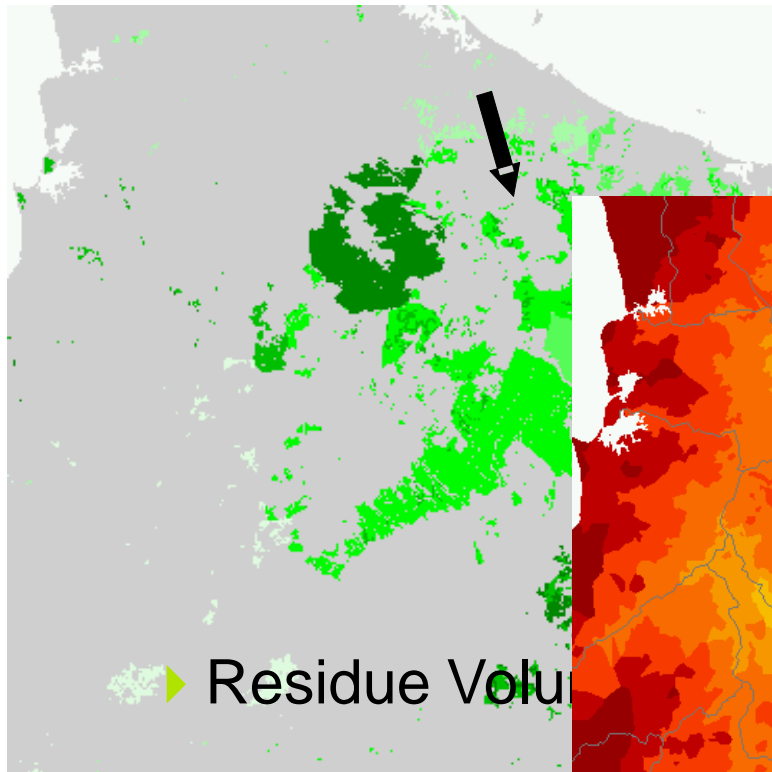
- Volume by distance
- Apply transport costs

Enables

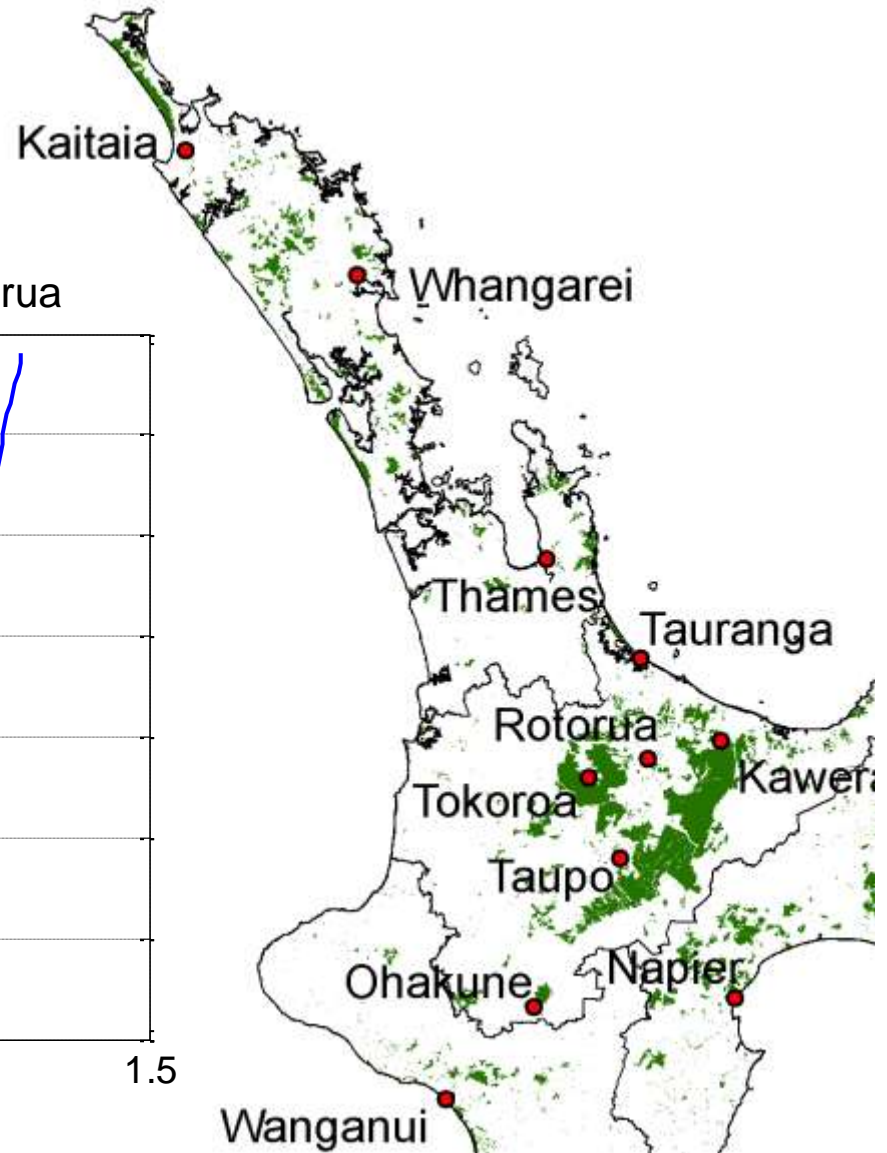
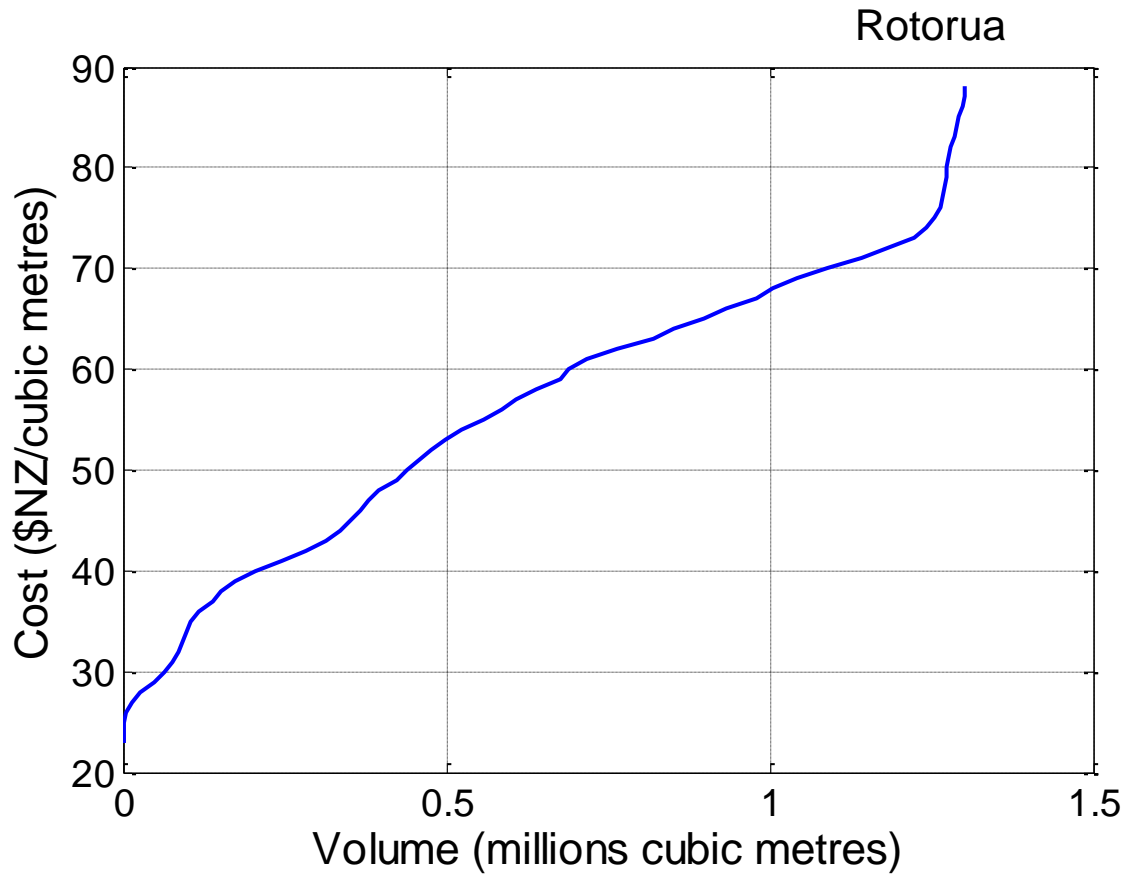
- Comparisons of sites,
 - Location & over time



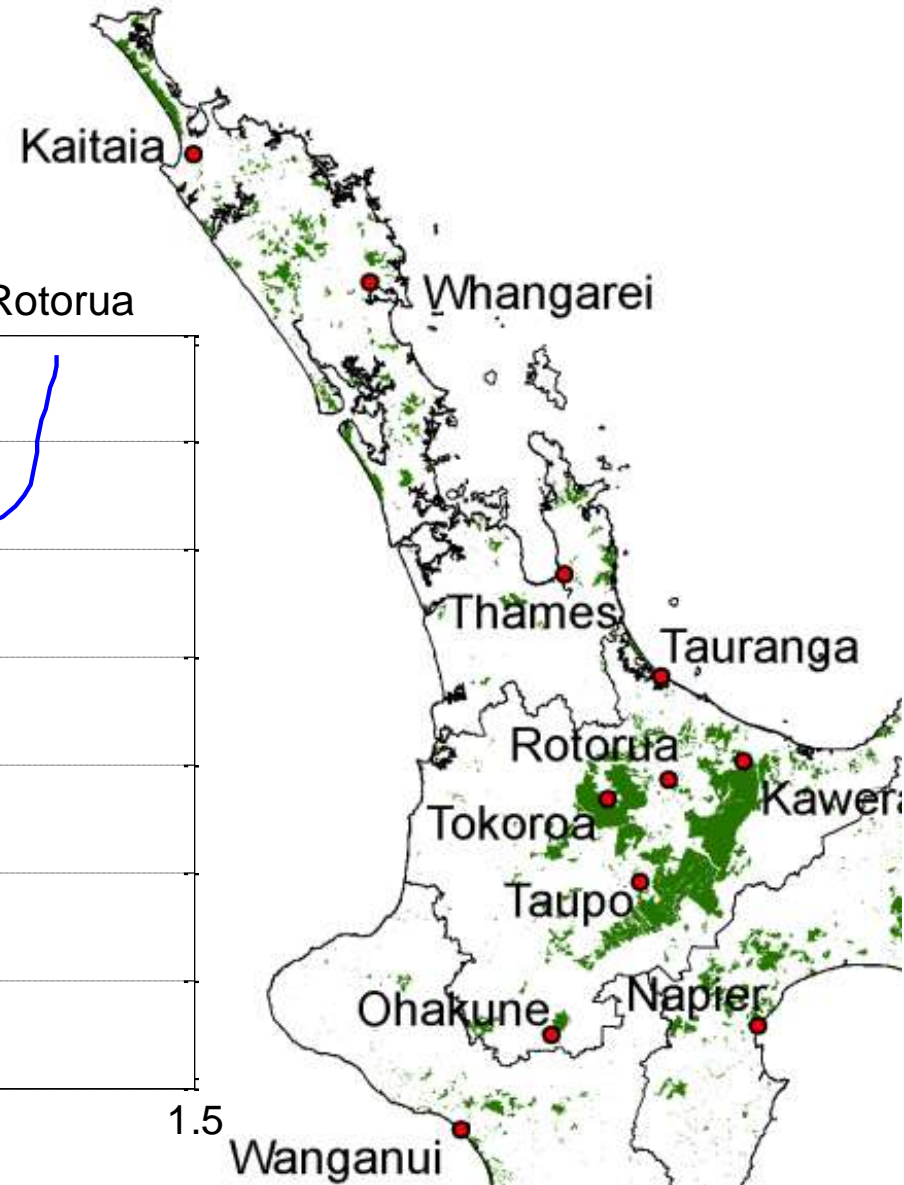
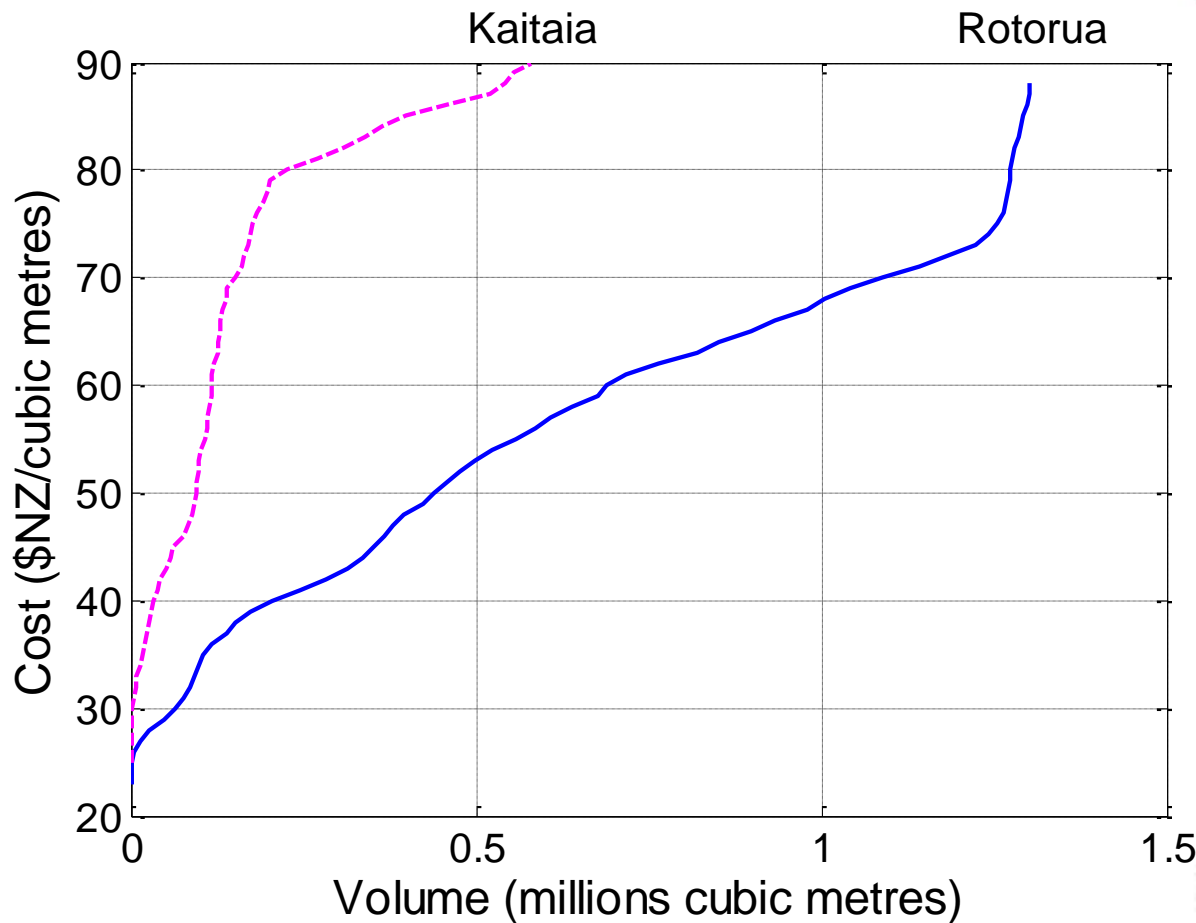
GIS Systems for Feedstock Analysis



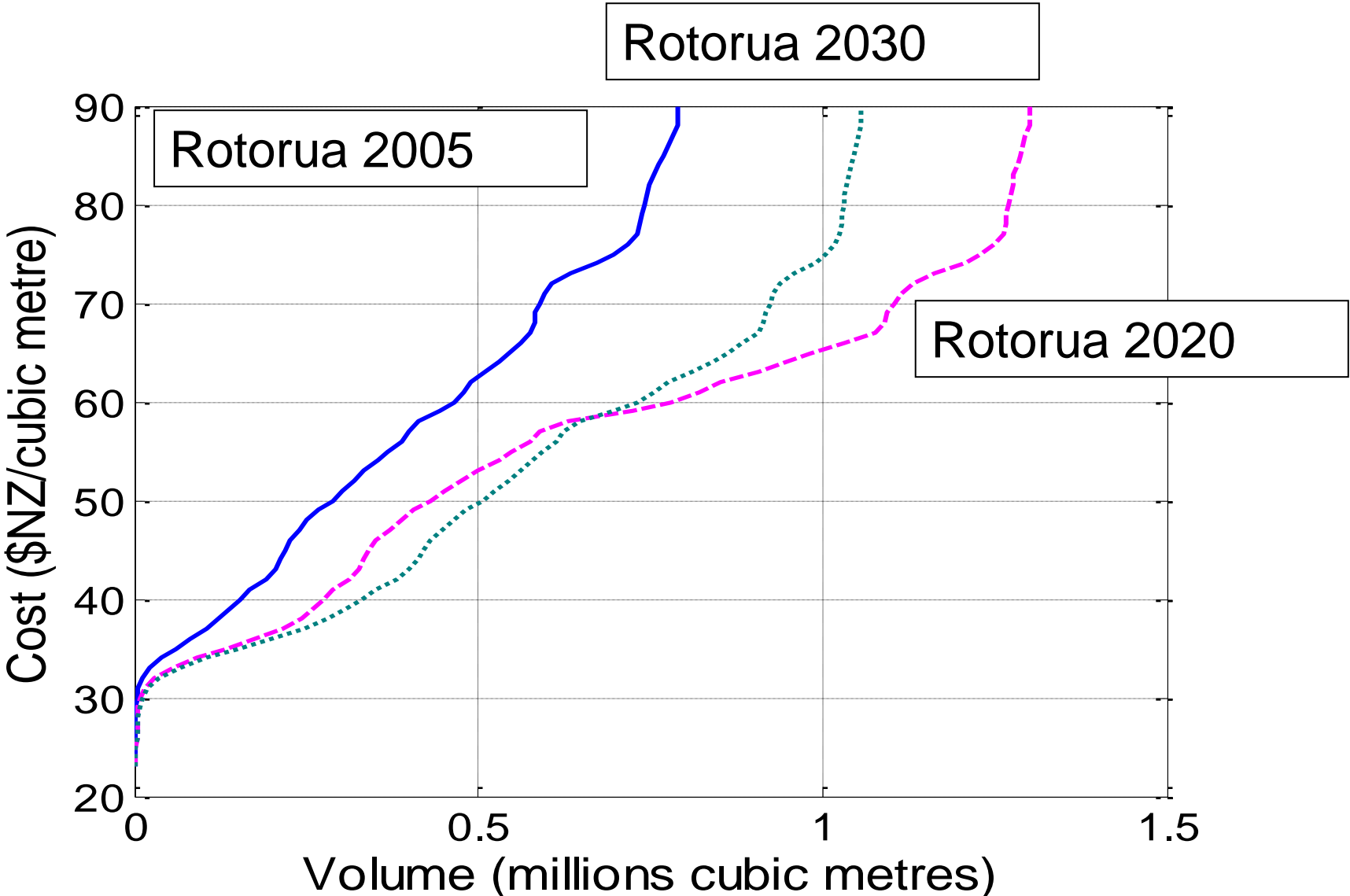
Develop cost supply curves



Location comparison

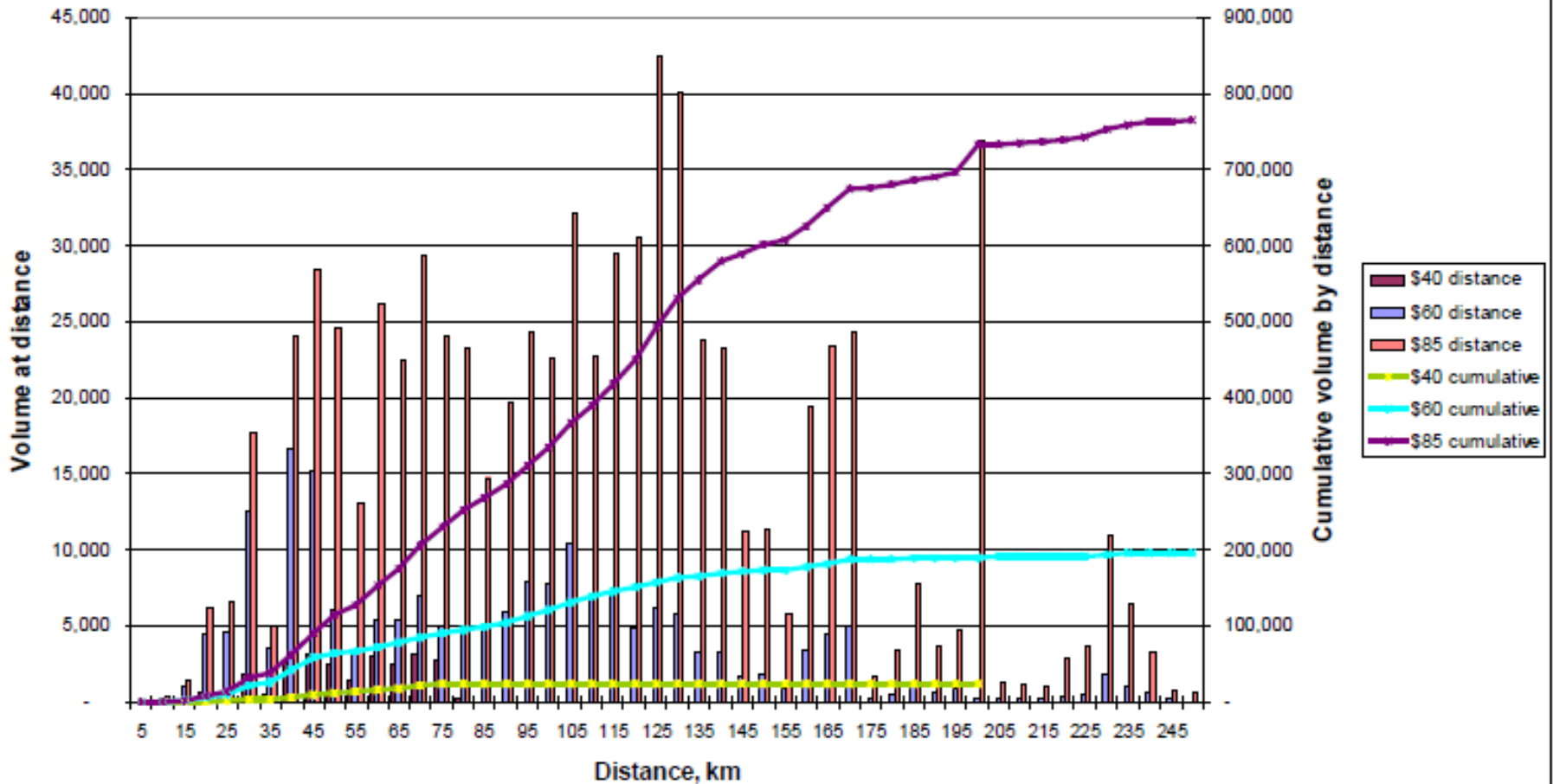


Comparison over time (forest age class)



Volume by cost limit

Mataura, 2015, all prices

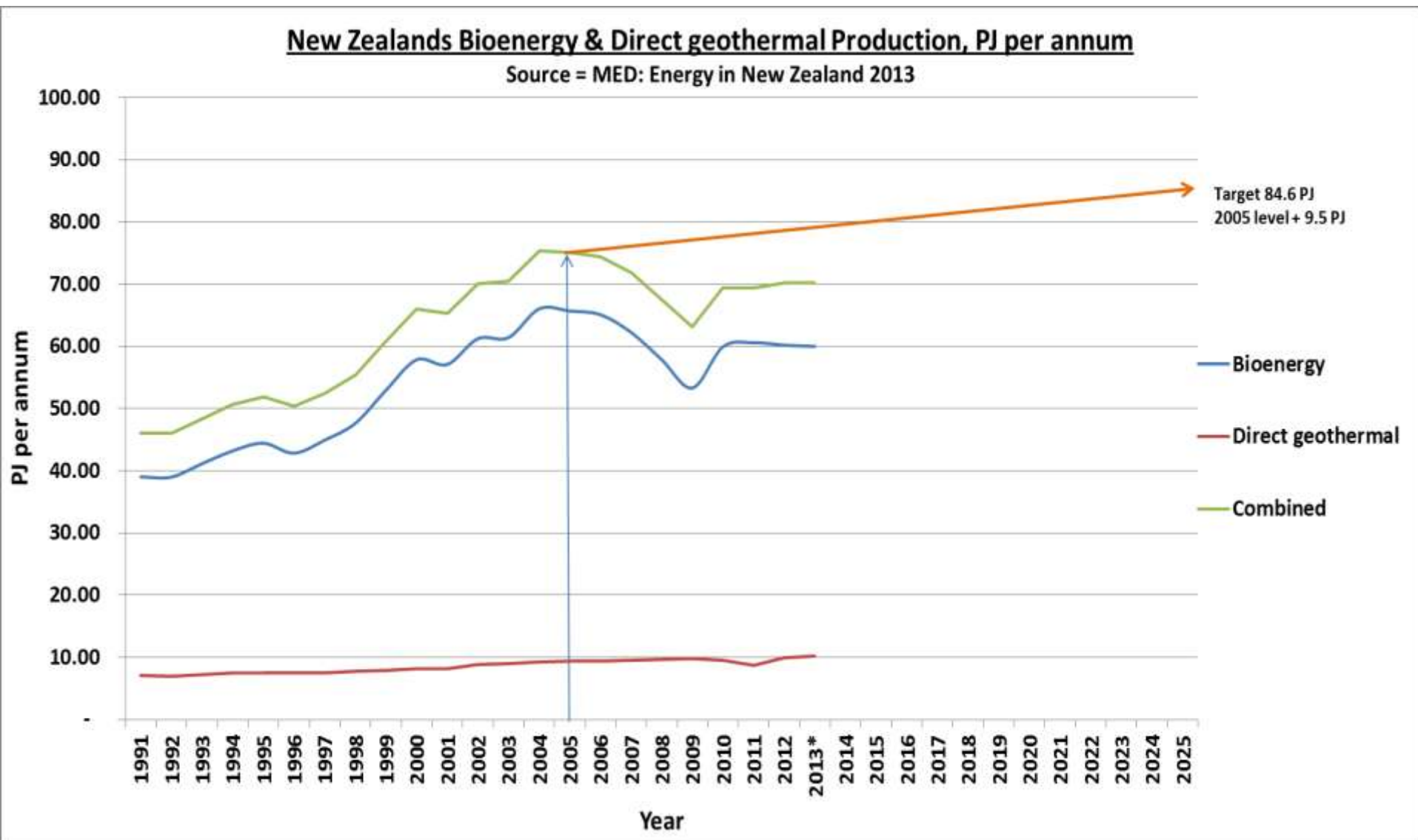


Summary

- Estimate your fuel demand & range
- Work out your fuel specification
- Identify potential supplies / suppliers
 - Wood processors
 - Municipal wood waste
 - In-forest residues
- Is there enough?
 - Case and site specific
 - Forest residues available and increasing in most regions
 - Needs careful analysis and some leg work

How well are we doing on renewable heat targets?

- set 2008; 2005 levels + 9.5 PJ by 2025



Is there enough wood?

Yes

2015

need 9 PJ

= 1.3 M m³ wood

NZ has

~3.9 M m³ of wood

2025

need ~14.6 PJ

= 2.1 M m³ of wood

5.8 M m³ of wood

Barriers;

Cost

Consistency / Continuity

What can we do?

- More under-pinning data
 - Heat plant data base (being revised)
 - Wood processing database (drafted)
 - Link / integrate these two datasets (by site / location)
 - allow estimates of production and consumption at a local level
 - New MPI Wood supply forecasts due late 2014 / 2015
 - Revise high level in-forest residue forecasts
 - More up-to-date data on MWW / trends
- Build confidence in wood supply availability
- Up to date data on residue recovery systems
 - review of developments in Europe / North America
 - Identify high productivity / low cost options

Any Questions?



Peter Hall

07 343 5849

peter.hall@scionresearch.com



**Be like a tree;
Onwards &
Upwards &
Bigger every year**