

Hydro Risk Curve Assumptions June 2009

Demand assumptions

- 1.1.1 Simulations are performed from the start of each month. The demand assumed in each month is shown in Table 1.
- (a) Annual GXP demand comes from the Commission's medium-term P50 forecasts of annual demand for North Island and South Island¹.
 - (b) Intra-year profile. Annual P50 forecast split into monthly amounts in proportion to average historical splits. Monthly quantities split into daily day/ night blocks using historical GXP data for relevant month between April 2006 and March 2007.
 - (c) Demand response. A conservative estimate of voluntary demand response to price of 2% has been assumed (and is subtracted from the annual GXP demand forecasts below). It is proportional to North Island and South Island demand.

Table 1: Monthly GXP demand assumptions

Month	North Island (GWh)	South Island (GWh)
Jul-09	2,396	1,312
Aug-09	2,367	1,315
Sep-09	2,151	1,253
Oct-09	2,146	1,260
Nov-09	2,044	1,251
Dec-09	1,976	1,226
Jan-10	1,990	1,197
Feb-10	1,894	1,155
Mar-10	2,126	1,285
Apr-10	2,055	1,219
May-10	2,255	1,301
Jun-10	2,372	1,358

- 1.1.2 Demand at Tiwai is forecast to be at normal levels from September 2009 onwards.

Supply assumptions

- 1.1.3 Supply assumptions are listed in Table 2. The table includes existing and new plant expected to be commissioned in 2009 and 2010.

¹ See <http://www.electricitycommission.govt.nz/opdev/modelling/demand/security>.

Table 2: Supply assumptions

Scheme	Capacity (MW)	Comment
Thermal plant (North Island)		
Huntly (units 1-4)	972	
Huntly U5 (e3p)	385	
Huntly U6 (P40)	50	
Otahuhu B	390	
TCC	380	
Whirinaki	156	
NPL	0	
Stratford peaker	200	Available from June 2010
Geothermal plant (North Island)		
Mokai	110	Profiled output
Ohaaki	65	Profiled output
Poihipi	53	Profiled output
Wairakei	177	Includes binary plant. Output profiled
Kawerau	100	Profiled output (95% capacity factor, 832 GWh p.a.).
Ngawha 2	15	Profiled output (95% capacity factor, 125 GWh p.a.)
Tauhara binary	19	Profiled output from September 2010 (95% capacity factor, 158GWh p.a.).
Cogeneration plant (North Island)		
Southdown	175	Scheduled as a thermal plant
Kaponga	20	Profiled output
Kinleith	41	Profiled output
Whareroa	54	Profiled output
Te Rapa	49	Profiled output
Hydro plant/schemes (North Island)		
Waikato	1,063	
Rangipo	120	Output linked to Taupo inflows
Tokaanu	240	Output linked to Taupo inflows
Matahina	80	Profiled output
Waikaremoana	141	Profiled output
Mangahao	42	Profiled output
Patea	32	Profiled output
Wheao	28	Profiled output
Mangaio	2	Profiled output
Waipa	8	Profiled output

Scheme	Capacity (MW)	Comment
Hydro plant/schemes (South Island)		
Waitaki	1,723	
Clutha	720	
Manapouri ²	728	Managed profile against storage and inflows
Cobb	32	Managed profile against storage and inflows
Coleridge	40	Managed profile against storage and inflows
Argyle	11	Profiled output
Wind schemes (North Island)		
Tararua I, II, III	151	Profiled output (45% capacity factor, 635 GWh p.a.).
Te Apiti	91	Profiled output (44% capacity factor, 350 GWh p.a.).
West Wind	143	Profiled output from July 2009 (46% capacity factor, 570GWh p.a.). Full capacity available from 2010 onwards.
Wind schemes (South Island)		
White Hill	58	Profiled output

Planned and forced outages

1.1.4 Thermal capacity assumptions for modelling risk curves include planned outages, forced outages, Huntly river heating limits and ancillary services requirements. A number of hydro outages have not been specifically modelled as they are considered not to impact on dry energy supply.

1.1.5 Table 3 summarises thermal station capacity and planned outages. Planned outages are as extracted from <http://pocp.redspider.co.nz>.

Table 3: Assumed planned outages for 2009 (as at May 2009).

Station	Derating (MW)	Start	End
Huntly units 1-4	243	26/09/2009	30/10/2009
	486	31/10/2009	2/11/2009
	243	3/11/2009	6/11/2009
	486	7/11/2009	15/11/2009
	243	16/11/2009	20/11/2009
	486	21/11/2009	22/11/2009
	243	23/11/2009	30/11/2009
	243	4/01/2010	1/04/2010
	243	1/11/2010	10/11/2010
	243	15/11/2010	24/11/2010

² Note that no adjustment has been made for the possibility of reduced Mararoa flows to Manapouri other than adjustments already made to handle high flows.

Huntly unit 5 (e3p)	385	5/12/2009	14/12/2009
Huntly unit 6 (P40)	50	20/04/2009	29/06/2009
	50	16/10/2009	18/10/2009
TCC	350	30/05/2009	31/05/2009
	375	31/10/2009	8/11/2009
	375	6/04/2010	11/04/2010
Southdown	65	27/06/2009	27/06/2009
	65	25/07/2009	25/07/2009
	65	22/08/2009	22/08/2009
	35	11/09/2009	18/09/2009
	100	19/09/2009	19/09/2009
	35	20/09/2009	9/10/2009
	125	10/10/2009	12/10/2009
	35	13/10/2009	16/10/2009
	100	17/10/2009	17/10/2009
	35	18/10/2009	23/10/2009
	65	14/11/2009	14/11/2009
	65	5/12/2009	5/12/2009
	65	16/01/2010	16/01/2010
	20	13/02/2010	13/02/2010
	Southdown peaker	50	27/06/2009
50		22/08/2009	22/08/2009
50		10/10/2009	12/10/2009
50		17/10/2009	17/10/2009
50		5/12/2009	5/12/2009
50		13/02/2010	13/02/2010

1.1.6 Rangipo capability was reduced over August-November 2009 to reflect planned outages over that period.

1.1.7 All thermal units are de-rated to allow by a forced outage factor of 3%.³

1.1.8 The following additional de-ratings have been applied to Huntly units 1-4:

- (a) *Maintenance outages*⁴: one Huntly unit is assumed to be out of service for maintenance three weekends in four.
- (b) *Ancillary services requirements*: Huntly has been de-rated by 130MW overnight to reflect spinning reserve (80MW) and frequency keeping (50MW)

³ See the discussion of forced outage factors in explanatory paper on development of a capacity adequacy standard

⁴ These are outages that can be scheduled at short notice to carry out necessary maintenance, typically on weekends.

requirements. These de-ratings have been applied to Huntly based on previous analysis⁵.

- (c) *Cooling water limits*: Huntly capacity has been de-rated over the summer as summarised in Table 4.

Table 4: River heating capacity limits on Huntly units 1-4

	Station MW Limits	
	Day	Night
Jan	729	729
Feb	722	729
Mar	729	729

- 1.1.9 The station capacity is assumed to be the lesser of planned availability or the river heating capacity limit over the summer months less forced outages, frequency keeping and reserves. Definitions of day and night are based on those in the market simulations: “day” is defined as 0600-2159, so the implementation of these assumptions is slightly more conservative over February days where the actual limit only applies from 0700 - 2200.

Transmission assumptions

- 1.1.10 Transmission limits are represented in the Energy Link model by setting combinations of lines to preset limits. Although this is potentially not as accurate as the full nodal representation used in the market scheduling and dispatch model (SPD), which is itself an approximation to the detailed physical characteristics of the grid, it is considered to be appropriate for minzone analysis. Half hourly analysis using the detailed version of the Emarket model has been previously undertaken to confirm this.
- 1.1.11 The limits for key lines are set out in Table 5.

Table 5: Key transmission constraint assumptions (MW sent)

Lines	Node From	Node To	Winter MW Limit	Summer MW Limit
BPE_HAY	BPE	HAY	670	614
BPE_LTN	BPE	LTN	760	694
BPE_TKU	BPE	TKU	670	614
BPE_TWT	BPE	TWT	762	694
BRK_BPE	BRK	BPE	1219.4	1219.4
BRK_SFD	BRK	SFD	869.1	710.2
CML_TWZ	CML	TWZ	914	780
GLN_HLY	GLN	HLY	762	694
GLN_TAK	GLN	TAK	762	695

⁵ See *Energy Security Assessment: Modelling & Analysis*, MED, Concept Consulting, and EnergyLink, February 2004. Available for download from <http://www.supplysecurity.org.nz/Docs/med-minzone-discussion-document-20040213.pdf>.

Lines	Node From	Node To	Winter MW Limit	Summer MW Limit
HAM_HLY	HAM	HLY	492.9	404
HAM_WKM	HAM	WKM	476.3	404
HAY_BEN	HAY	BEN	489/500	489/500
HAY_LTN	HAY	LTN	761.1	694.3
HLY_SFD	HLY	SFD	378.4	378.4
HLY_TAK	HLY	TAK	760.2	694.3
HLY_TWH	HLY	TWH	492.3	469.2
INV_NMA	INV	NMA	431	404
INV_ROX	INV	ROX	764	694
ISL_LIV	ISL	LIV	492	403
ISL_OPI	ISL	OPI	760.2	694.3
ISL_TKB	ISL	TKB	609.7	556.7
LIV_NSY	LIV	NSY	247	202
LIV_WTK	LIV	WTK	626	586
LTN_WIL	LTN	WIL	760	694
NSY_ROX	NSY	ROX	246	202
OTA_WKM	OTA	WKM	945	805
RPO_TNG	RPO	TNG	291.3	238.9
RPO_WRK	RPO	WRK	291.3	238.9
SFD_TMN	SFD	TMN	455.4	455.4
TKU_WKM	TKU	WKM	670	616
WRK_WHI	WRK	WHI	548.7	477.7

1.1.12 The following equation constraints were modelled.

- (a) Bunnythorpe_Haywards: $1 * BPE_HAY + -1 * HAY_LTN + 1 * LTN_WIL \leq 890$
- (b) Upper_North_Island: $-1 * HLY_SFD + -1 * HLY_TWH + -1 * OTA_WKM + 1 * ARI_BOB + 1 * HAM_HLY + 1 * ARI_PAK \leq 979$
- (c) Naseby_Roxburgh: $-1 * NSY_ROX + -0.35 * CML_TWZ \leq 253$
- (d) Stratford_Huntly: $-1 * HLY_SFD + 1 * SFD_TMNM \leq 550$