Examining the future of nature gas usage in the Australian National Electricity Market.

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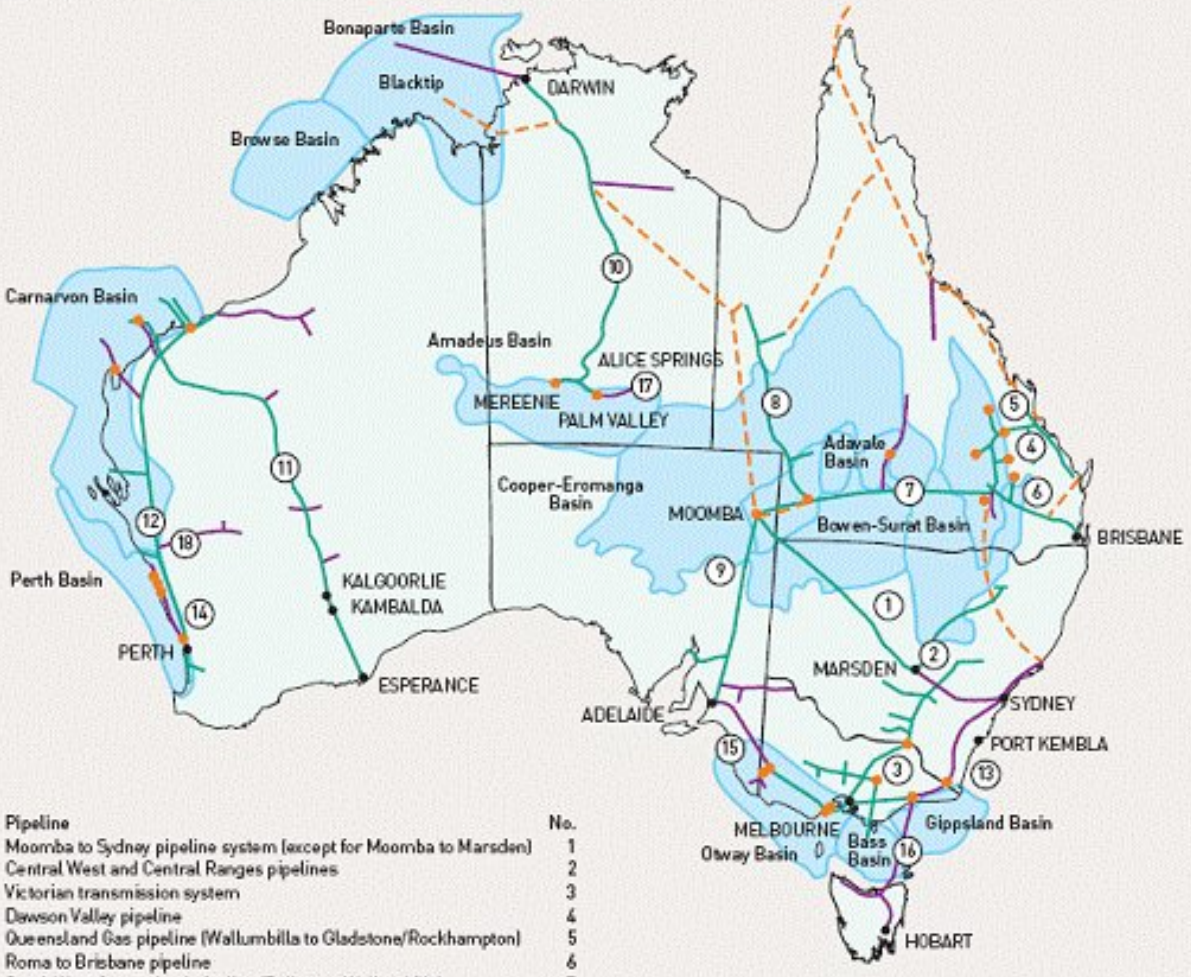
- A natural tension has arisen in the Australian natural gas market between electricity generators and export markets.
- With export markets being made available to natural gas producers, the price of methane will rise to meet the international market position.
- Rapid price inflation could place gas generation assets at a distinct disadvantage against coal fired electricity production.

Ramp Gas

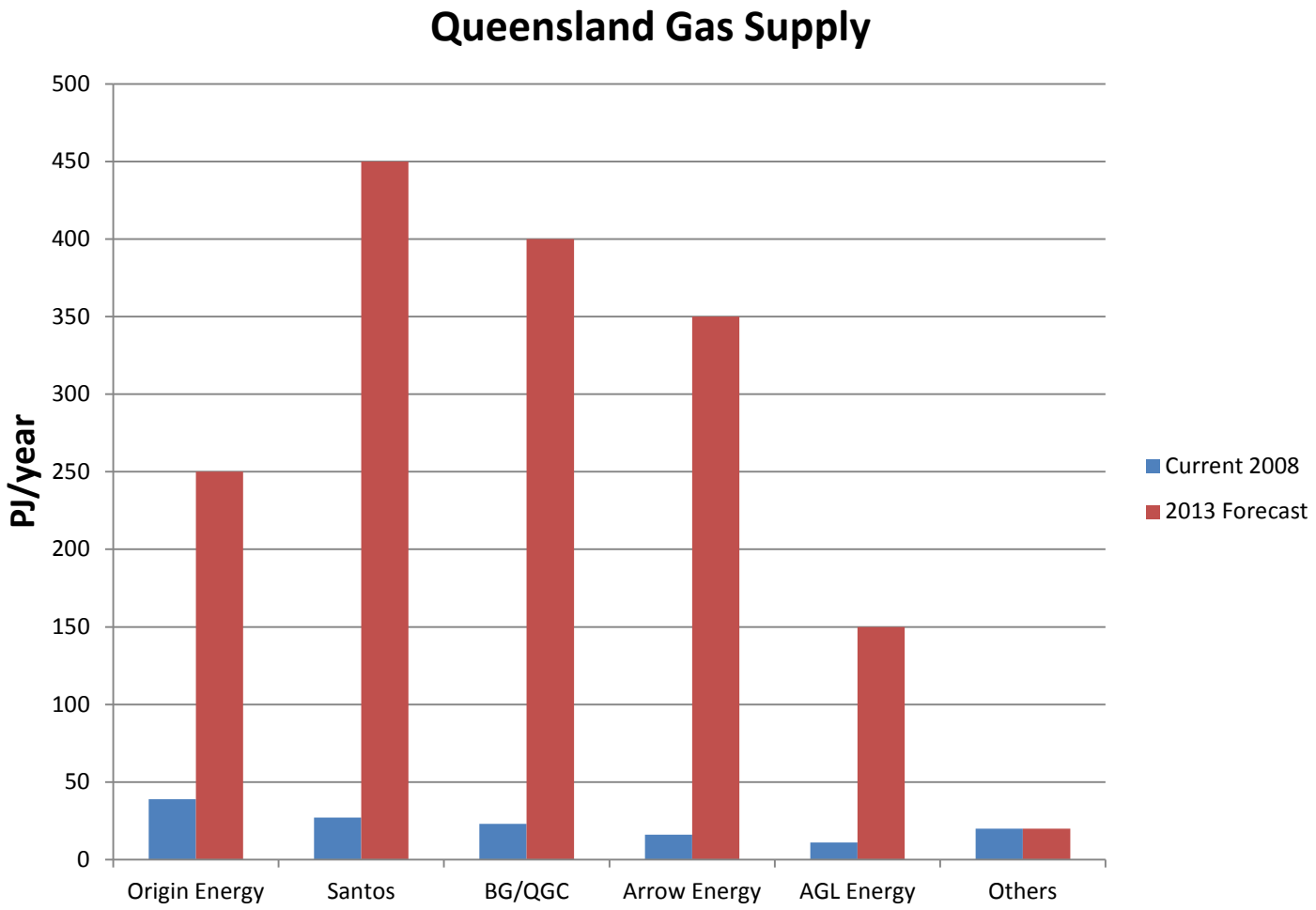
- Before LNG export can begin, wells will have to be installed to gauge the proven reserves for each site.
- This process will provide a significant amount of excess supply of natural gas for the electricity market before exports begin.
- The expected price of Coal Seam Methane for electricity generators is expected to drop from $3.5/GJ to $1.8/GJ

Major gas transmission pipelines and proposed pipelines in Australia



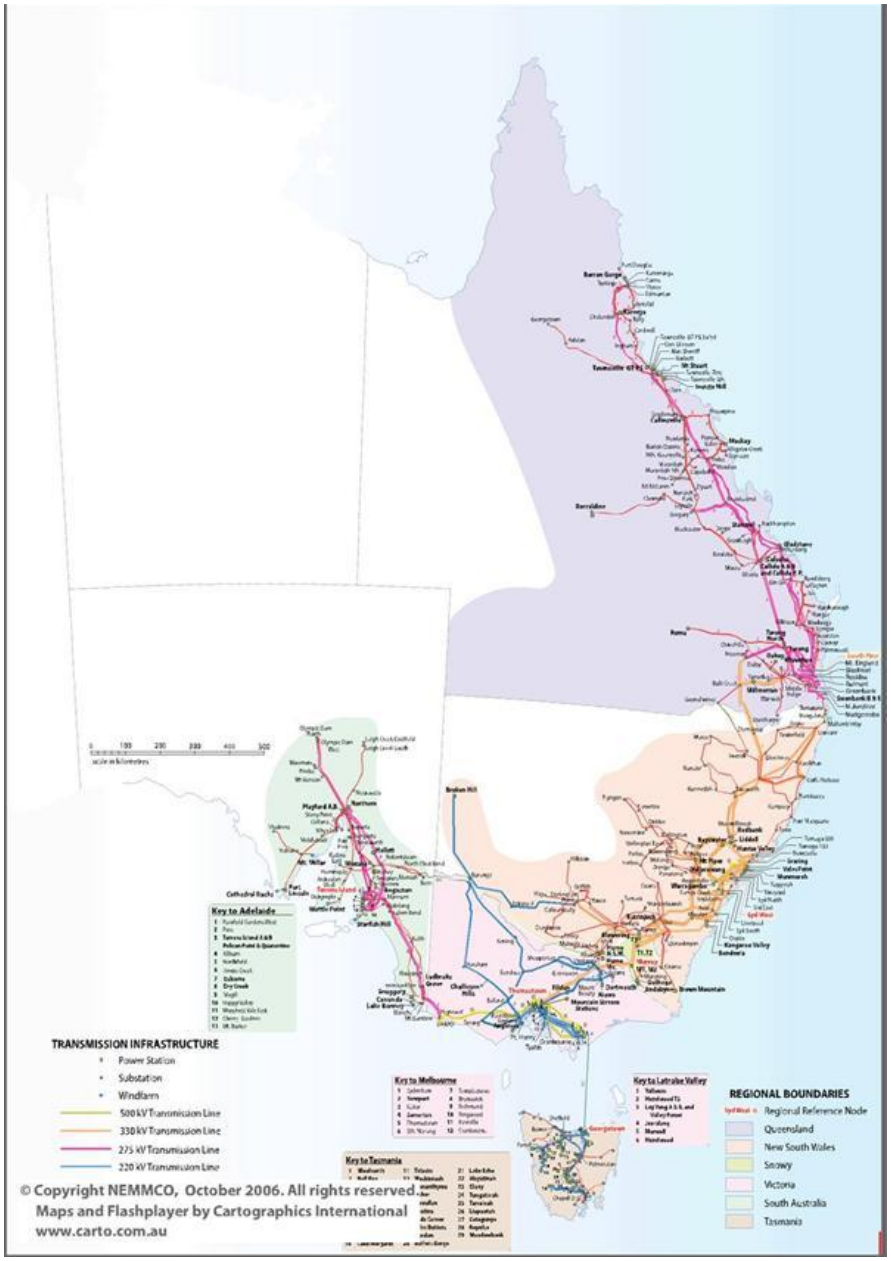
Pipeline	No.
Moomba to Sydney pipeline system (except for Moomba to Marsden)	1
Central West and Central Ranges pipelines	2
Victorian transmission system	3
Dawson Valley pipeline	4
Queensland Gas pipeline (Wallumbilla to Gladstone/Rockhampton)	5
Roma to Brisbane pipeline	6
South West Queensland pipeline (Ballera to Wallumbilla)	7
Carpentaria pipeline (Ballera to Mt Isa)	8
Moomba to Adelaide pipeline system	9
Amadeus Basin to Darwin pipeline	10
Goldfields Gas pipeline	11
Dampier to Bunbury Natural Gas pipeline	12
Eastern Gas pipeline (Longford to Horsley Park)	13
Dongara to Perth/Pinjarra (Parmelia)	14
SEA Gas pipeline	15
Tasmanian Gas pipeline	16
Palm Valley to Alice Springs	17
Midwest pipeline	18

Gas supply


Queensland Gas Supply
PJ/year
500
450
400
350
300
250
200
150
100
50
0
Origin Energy
Santos
BG/QGC
Arrow Energy
AGL Energy
Others
Current 2008
2013 Forecast

The National Electricity Market

- Black and Brown coal-fired power stations compose **85%** of generation.
- 7000MW of installed gas generation
- The average Emissions Intensity Factor (EIF) for electricity generation is 1.12.



Emissions Trading

- A Carbon Pollution Reduction Scheme (CPRS) for Australia
- Garnaut Review
  - Broad coverage, little or no grandfathering
  - Compensation to households
- White Paper
  - Assistance to stationary energy production for 5 years
  - 130million credits (~26mill/year) will be allocated to higher emitting generators
  - Equalized emissions intensity factor
    - Brown and less efficient black EIF reduced to 0.86 t e-CO2/MWH

Modeling Assumptions:

- Energy usage and new plant entry timing forecasts from NEMMCO's SOO 2008.
- National Emissions Trading Scheme to be introduced in 2011.
- Emissions abatement pathways CPRS -15% and Garnaut 450ppm.
- Firms bid SRMC for off-peak and SRMC + VO&M during peak time
- In equilibrium, capital costs are recovered during capacity constrained maximum price periods (VOLL)
- Bidding behaviour determines position in the merit order of dispatch and market prices

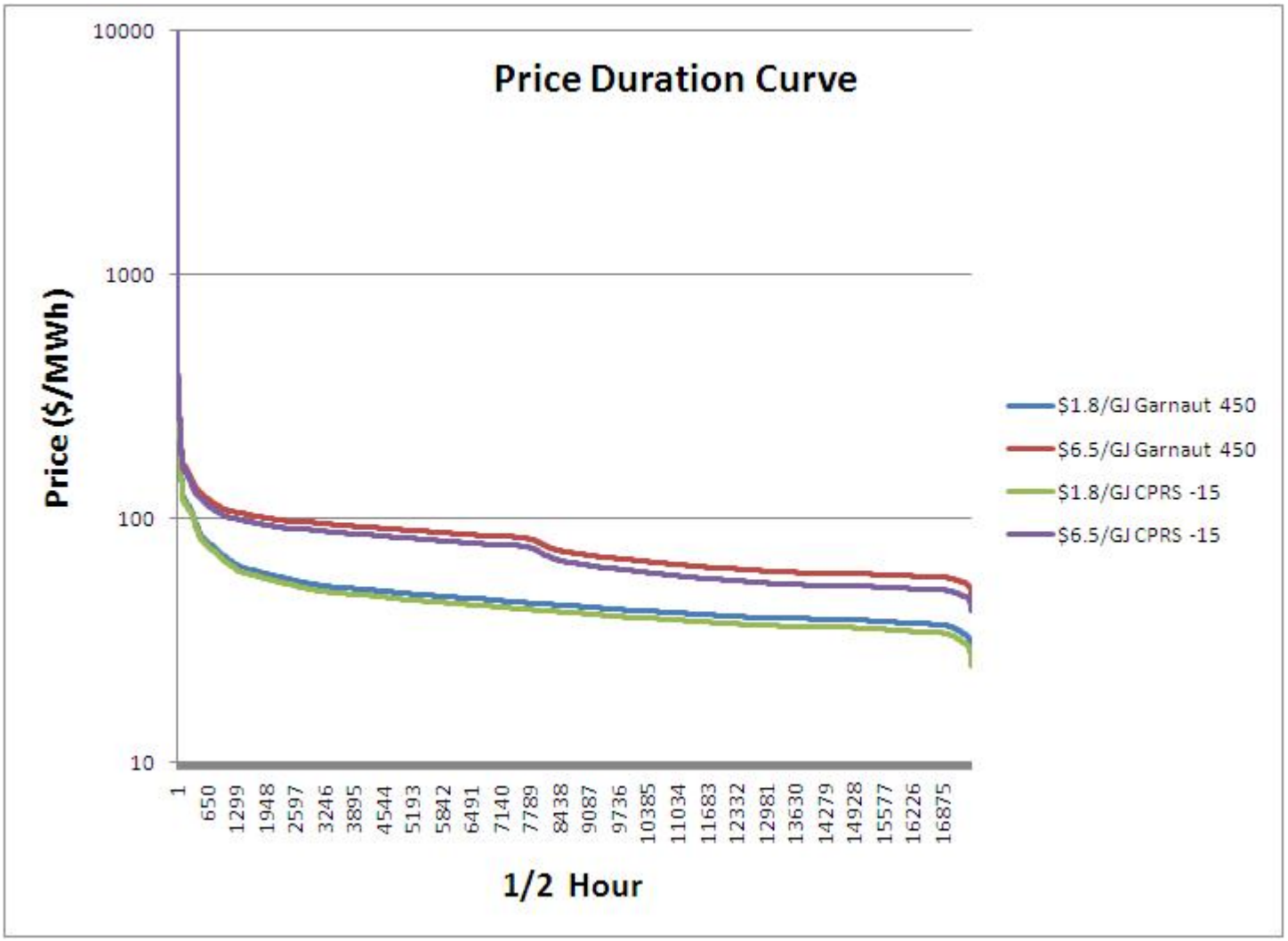
Plexos Simulates

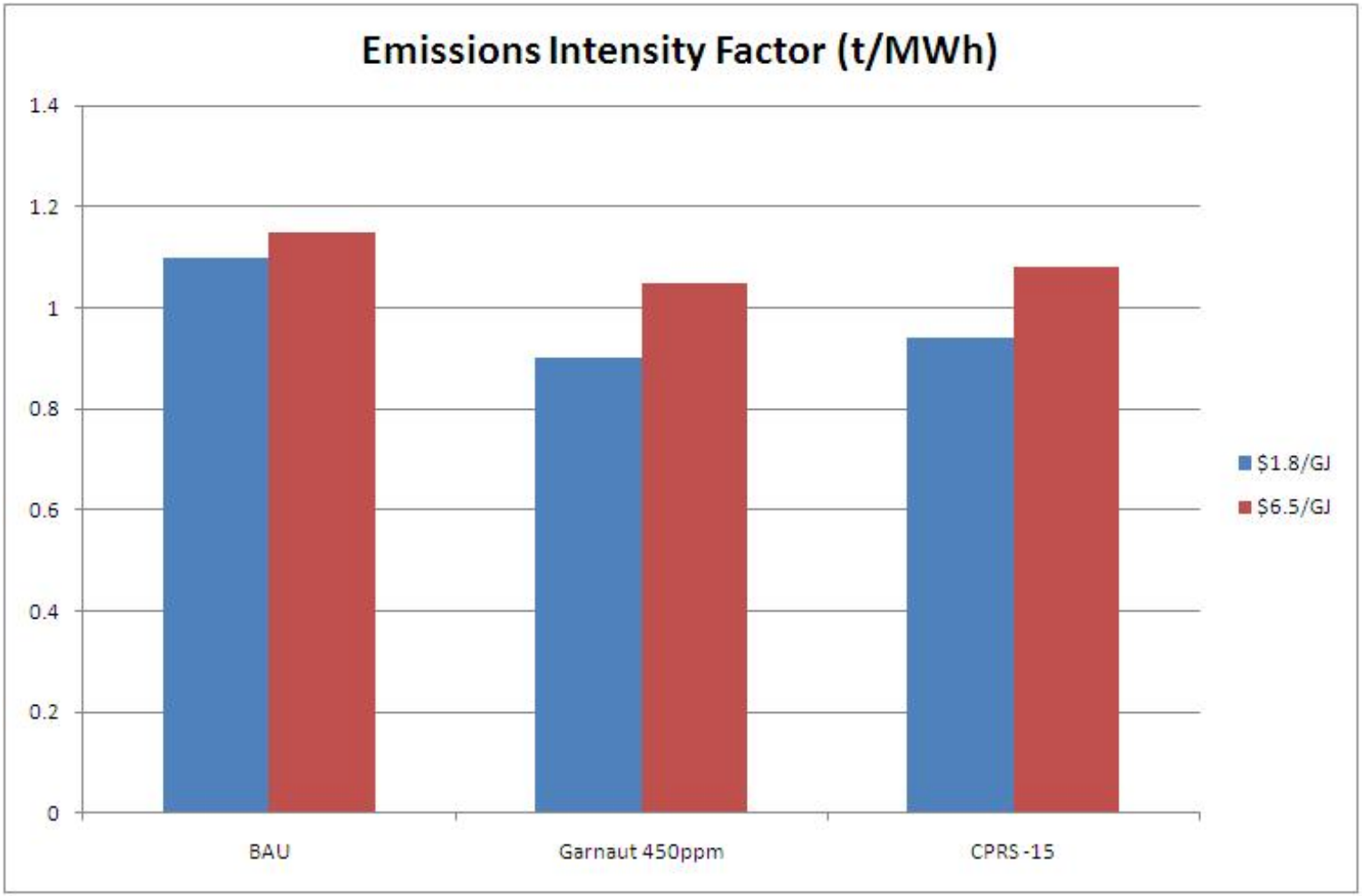
- Optimal dispatch of generators across the NEM.
- Optimal bid stack formulation for each station for Short Run and Long Run Marginal Cost (SRMC and LRMC) recovery.
- Merit order of dispatch formulated based on bid stack.
- Physical operating characteristics of each generating unit
- Portfolio optimisation and emissions profiles
- Transmission and Interconnector flows.

Time frame for analysis

- 2013-2018
- First wells in QLD to be in place ready for LNG exports
- Growth of supply of NG in QLD and the other mainland states of the NEM
- Pipelines joining all NEM states to create a gas grid
- First LNG plant to come online
- Installed capacity of GT plant across the NEM to grow a further 9GW of installed capacity (16GW)

- Gas generation will increase from a Capacity Factor of approx 35% to 85%
- Brown coal marginalized particularly Hazelwood in Victoria with an EIF of 1.35t/MWH
  - At \$40/t e-$C0_2$ and ramp gas available this station should back off.
- Average spot prices: (Demand Weighted Average for all states to form a national price)
  - \$52/MWh with ramp gas
  - \$84/MWh following the commencement of export


Price Duration Curve
Price ($/MWh)
10000
1000
100
10
1
650
1299
1948
2597
3246
3895
4544
5193
5842
6491
7140
7789
8438
9087
9736
10385
11034
11683
12332
12981
13630
14279
14928
15577
16226
16875
1/2 Hour
$1.8/GJ Garnaut 450
$6.5/GJ Garnaut 450
$1.8/GJ CPRS -15
$6.5/GJ CPRS -15


Emissions Intensity Factor (t/MWh)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
BAU
Garnaut 450ppm
CPRS -15
$1.8/GJ
$6.5/GJ

Conclusions

- Modelling suggests that a significant increase in gas prices will weaken the prospect of gas fired generation as a intermediate solution to reduce emissions.
- Ramp Gas availability will for at least 3 years place significant pressure on Brown Coal generation assets in the merit order of dispatch.

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  - Plexos for Power Systems will be available for research and teaching purposes for free later this year.