



### 3. Energy-Economic Scenarios

#### 3.1. Scenario design

A scenario is a set of alternative assumptions regarding the inputs to modelling exercises such as the Gas Market Review study. Key direct inputs for the GMR modelling include:

- Domestic and export gas demand
- Energy prices, particularly international oil prices
- Carbon prices
- Gas production costs
- Gas reserves estimates and projections

In many studies some of these inputs are related back to more fundamental variables such as economic growth.

Scenarios are intended to provide alternative views of how economic outcomes and policy settings relevant to natural gas and energy usage could develop over the next 20 years. They are framed in order to allow significantly different, but not unrealistic, inputs to be used while remaining reasonably internally consistent.

For the 2011 GMR three scenarios have been developed – they are referred to as High, Medium and Low scenarios, largely because they are correlated with High, Medium and Low economic parameters, though the economic parameters are not the only parameters that change from scenario to scenario. It is noted that the scenarios correspond to high, medium and low gas demand scenarios for both the domestic and export sectors, though that is not their direct purpose.

In conducting the GMR we recognise its many similarities with the Gas Statement of Opportunities (GSOO) conducted by AEMO and believe it is desirable for the studies to have as many shared inputs as possible. This is particularly the case for domestic demand, though not for export demand (the 2010 GSOO predates the commitment of two Gladstone export projects) or supply parameters (the supply methodologies of the two studies differ too widely).

#### 3.2. Key scenario variables

In the 2010 GMR the key scenario variables were identified as:

- Economic parameters including economic growth and associated commodity prices
- Carbon policies, specifically the price of carbon
- LNG development in Queensland
- Oil and gas prices consistent with each set of the above
- Electricity market assumptions: demand, policy settings and gas input prices.

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For the 2010 GSOO AEMO used scenario structures consistent with those used for power transmission planning. Although the labels are different, the scenarios broadly line up as High=Fast, Medium= Decentralised and Low=Slow. The scenarios are outlined in Table 3-1.

■ **Table 3-1**                      **2010 GSOO Scenario Outline**

Scenario	Fast Rate of Change	Decentralised World	Slow Rate of Change
<b>Economic growth</b>	High	Medium	Low
<b>Population Growth</b>	High	Medium	Low
<b>Global carbon policy</b>	Strong	Strong	Weak
<b>Centralised supply-side response</b>	Strong	Weak	Moderate
<b>Decentralised supply-side response</b>	Strong	Strong	Weak
<b>Energy prices</b>	High oil & gas	Moderate oil & gas	Moderate oil & gas
<b>Emission targets below 2000 in 2020</b>	25%	15%	5%

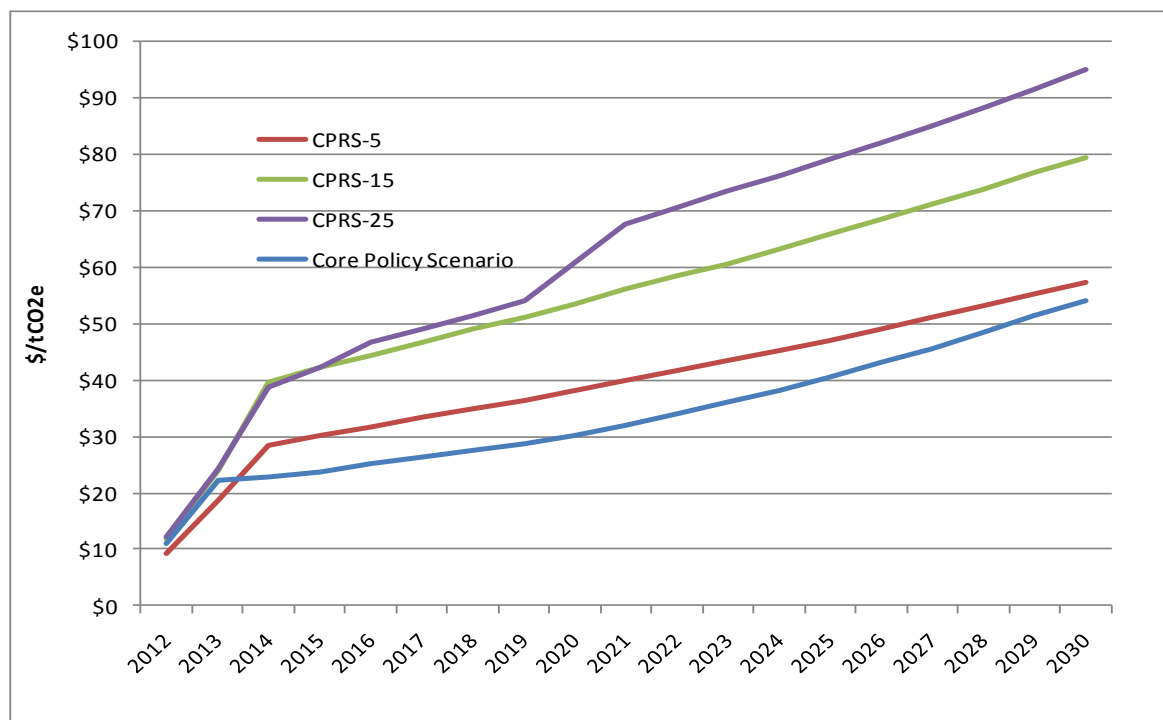
Of these assumptions only the energy price assumptions in the Slow scenario are not suitable for the GMR, where it is important to assess the impact of low prices on LNG demand. The change from moderate to low gas prices will not materially change the Low domestic forecast. The 2011 GMR scenarios are outlined in Table 3-2. The carbon scenarios expressed as carbon prices are shown in Figure 3-1, together with carbon prices in the Core Policy Scenario of the carbon pricing scheme announced by the Commonwealth Government on 10<sup>th</sup> July 2011. The Core Policy Scenario prices are slightly below the prices achieved in the Low scenario – as carbon prices are less influential on study outcomes than some other factors this does not invalidate study projections.



■ **Table 3-2** 2011 GMR Scenario Outline

Scenario	High	Medium	Low
<b>Economic growth</b>	High	Medium	Low
<b>Emission targets below 2000 in 2020</b>	25%	15%	5%
<b>LNG Development</b>	Refer to section 5	Refer to section 5	Refer to section 5
<b>Energy prices</b>	High oil & gas Oil – \$US140/bbl Gas - \$A7-9/GJ \$US/\$A =1.00	Moderate oil & gas Oil – \$US100/bbl Gas - \$A5-7/GJ \$US/\$A =0.80	Low oil & gas Oil – \$US60/bbl Gas - \$A4-5/GJ \$US/\$A =0.60
<b>Electricity market assumptions</b>	As per 2010 GSOO	As per 2010 GSOO	As per 2010 GSOO

■ **Figure 3-1** Carbon price assumptions (real \$2010)

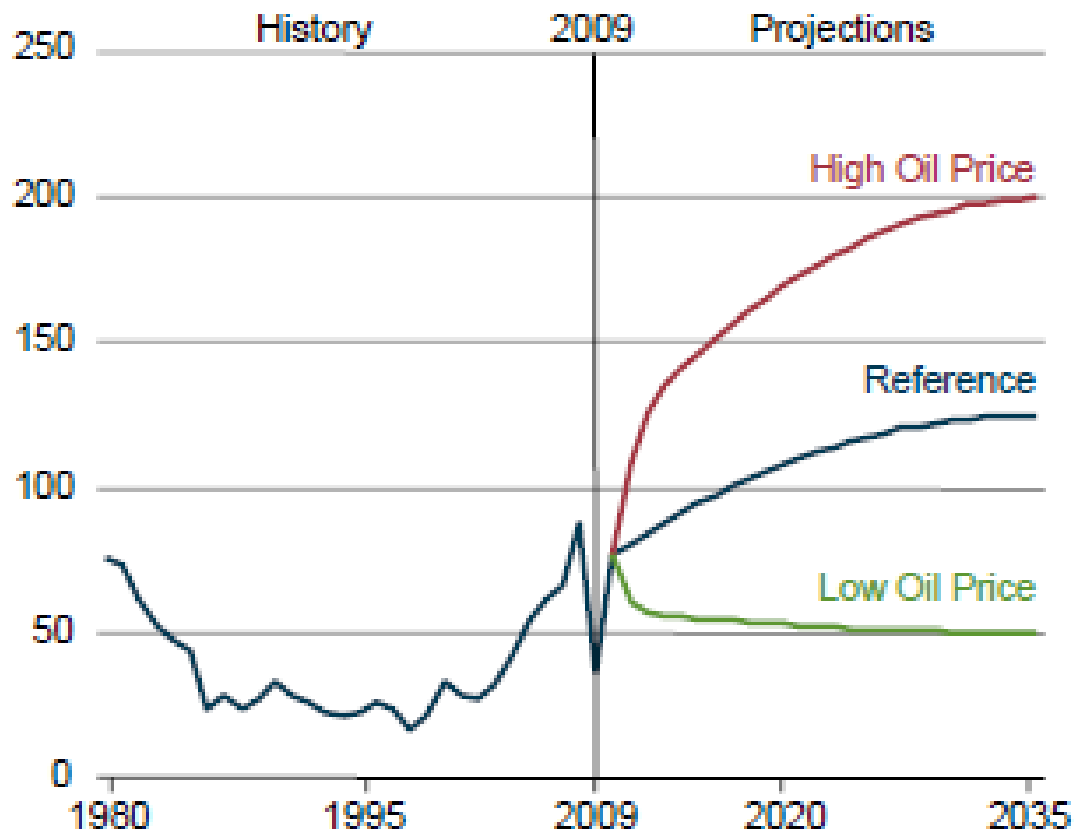


Note: the 2012 calendar year price assumes start-up on 1 July 2012



Oil price scenarios have been adopted from the US Energy Information Administration Annual Energy Outlook 2011 (Figure 3-2). In the Medium and High scenarios the values have been deliberately chosen to represent the medium term outlook which will impact on LNG pricing and potentially domestic pricing over the next 5-6 years when the Gladstone LNG projects will be starting up. Variable exchange rates have been selected on the basis that the \$A is strongly commodity price dependent – a rate of 0.80 \$US/\$A is KPMG Econtech’s medium term projection<sup>4</sup>.

■ **Figure 3-2 EIA Oil Price Projections (\$US/bbl, annual average)**



<sup>4</sup> Australian, National, State and Industry Outlook 2010 No3. KPMG Econtech, March 2011.



## 4. Domestic demand projections

Demand for gas within eastern Australia is considered in two major components, defined as:

- ❖ Utility and large industrial demand, which is comprised of two subcomponents
  - Utility - residential, small business and larger commercial and industrial customers who are supplied principally from distribution mains.
  - Large industrial demand –customers consuming significant quantities (typically more than 1 or 2 PJ) who are supplied principally from transmission mains.
- ❖ Gas for power generation (GPG) including large cogeneration projects

For the 2010 GMR, MMA utilised 2009 GSOO forecasts for the utility and large industrial sector and its own forecasts for the GPG sector. For the 2011 GMR, to further facilitate comparison with the GSOO, both sets of forecast are based on the 2010 GSOO demand forecasts.

The GSOO modelling methodologies, key drivers considered and the use of scenarios are described below:

- Utility demand was modelled using regression analysis taking into account population, size and number of dwellings, gas connection numbers, retail gas prices, energy efficiency policies and weather and climate change.
- Large industrial customer demand was projected following discussions with the operators and proponents of large industrial projects focused on assumptions related to key drivers under each of the three scenarios. The key drivers considered included economic growth, commodity prices, exchange rate, carbon pricing and pricing of gas and other fuels.
- Gas for power generation (GPG) has been modelled based on assumptions related to electricity demand, timing and price of carbon emissions, renewable energy schemes, fuel prices and availability of alternative fuels and technologies. In GSOO 2010 GPG demand projections under the three scenarios were provided by AEMO's Market Modelling group, using the National Electricity Market five-node constrained model
- Projected gas usage for LNG took into account expected global LNG demand under the scenarios and the proposed CSG based Gladstone export projects.

Demand projections for the GSOO 2009 and 2010 documents were produced by a combination of external consultants and in-house modelling by AEMO (see Table 4-1).



■ **Table 4-1: Source of domestic demand projections in GSOO 2010**

	<b>GSOO 2010</b>	<b>Comment</b>
<b>Utility</b>	Core Energy	Econometric
<b>Large Industrial Demand</b>	MMA	Discussions based on scenarios
<b>GPG</b>	AEMO	Modelling consistent with scenarios

Source GSOO 2010 page 94

Utility and Large Industrial Demand outputs have been combined in the GSOO report by major pipeline zone. GPG is provided separately, again by pipeline zone.

The next two sections describe the GSOO demand projections for Utility and Large Industrial Demand and GPG Demand respectively, after which the Total Demand projections adopted for the 2011 GMR are presented.

#### **4.1. Utility and Large Industrial demand**

Projected growth over the period 2010 to 2030 in the GSOO 2010 scenarios in each of the relevant zones is illustrated in the following figures. Utility and large industrial demand is largely driven by economic growth assumptions, with some gas price effects. Consequently, the fast, decentralised and slow scenarios generally result in medium, high and low demand respectively.

It is noted that the 2010 GSOO and the 2010 GMR use different names for gas market zones. To facilitate an understanding of the demand forecasts, the GSOO terminology is used in this section, and to facilitate comparisons with the 2010 GMR the GMR terminology is retained elsewhere. The following table lists the GSOO and GMR zone names.



■ **Table 4-2 GSOO and GMR domestic zone names**

GSOO	GMR
Roma to Brisbane pipeline (RBP)	Brisbane
Queensland Gas Pipeline (QGP)	Gladstone
Carpentaria Gas Pipeline (CGP)	Mt Isa
North Queensland Gas Pipeline (NQGP)	Townsville
Tarong zone	Tarong
NSW/ACT	NSW
Victoria	Victoria
South Australia	South Australia
Tasmanian Gas Pipeline (TGP)	Tasmania

#### 4.1.1. Queensland

##### 4.1.1.1. Roma to Brisbane pipeline (RBP)

- The major customers served from the RBP are:
- IncitecPivot Limited (IPL) at Gibson Island for the production of ammonia, urea and ammonium sulphate
- BP Oil Refinery and adjoining Cogeneration Plant at Bulwer Island
- Distribution loads in and around Brisbane
- Generation customers at Swanbank and Oakey.

According to the Bulletin Board, in 2010 about 63 PJ flowed through the RBP. According to both GSOO 2009 and GSOO 2010, the utility + large industrial demand was about 50 PJ.

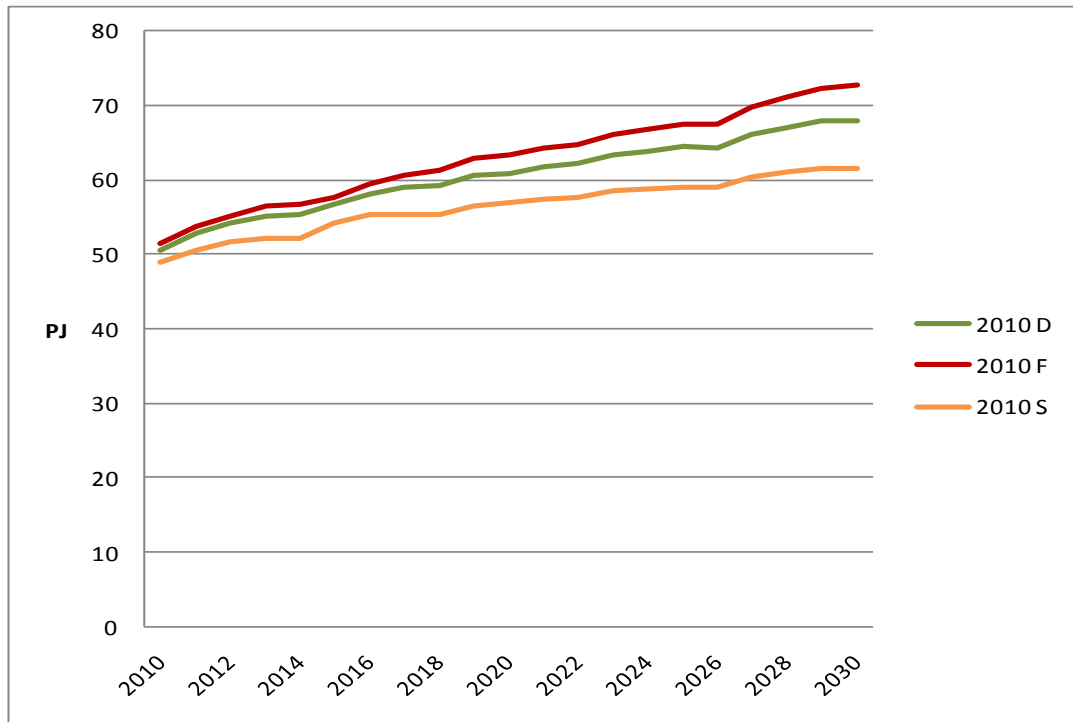
Projected growth of the Utility plus Large Industrial Demand load offtaking from the RBP over the period 2010 to 2029 under the GSOO 2010 scenarios is illustrated in Figure 4-1. The results are very similar for all scenarios.

■ **Table 4-3: Comparison of RBP growth rate projections over the period 2010 – 2030, % pa**

	GSOO 2010
Decentralised	1.6%
Fast rate of change	1.8%
Slow rate of change	1.2%



■ **Figure 4-1: Comparison of GSOO utility plus large industrial demand projections for RBP zone, 2010 – 2030, PJ**



Source: spreadsheets provided with GSOO

#### 4.1.1.2. Queensland Gas Pipeline (QGP)

The major customers served from the QGP are:

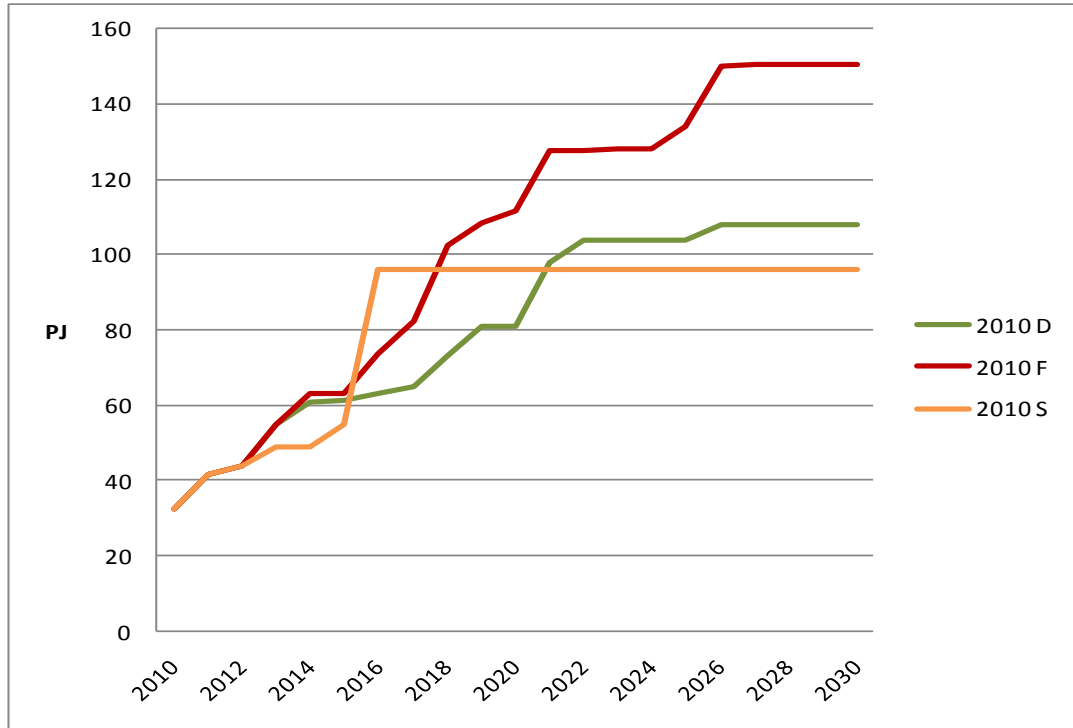
- QAL alumina refinery
- Rio Tinto alumina refinery at Yarwun
- Orica’s Yarwun chemical complex which manufactures chlorine, sodium cyanide and ammonium nitrate
- Boyne Island aluminium smelter
- QMAG at Parkhurst

According to the Bulletin Board, in 2010 about 33 PJ flowed through the QGP and this is approximately the level used as the base for that year in GSOO 2010.

Projections from GSOO 2010 are shown in Figure 4-2.



■ **Figure 4-2: Comparison of GSOO utility plus large industrial demand projections for QGP zone, 2010 – 2030, PJ**



Source: spreadsheets provided with GSOO

All projections show significant, lumpy increases over the period related largely to cogeneration and potential expansions at the alumina plants. The medium and low projections are similar with gas consumption in the Slow economic growth scenario close to gas consumption under the Decentralised economic growth scenario in 2015 and 2016. This appears to be due to a large industrial project made attractive under the Slow scenario, even though the gas price is the same under both these scenarios.

■ **Table 4-4: Comparison of QGP growth rates projections over the period 2010 – 2030, % pa**

	GSOO 2010
Decentralised	6.6%
Fast rate of change	8.4%
Slow rate of change	5.9%



At this stage, we consider it unlikely that gas prices will be sufficiently low to allow a major new industrial project to proceed and have reduced gas consumption by 30 PJ pa in the slow rate of change scenario from 2016. This reduces the growth rate under the slow scenario to 3.8% pa.

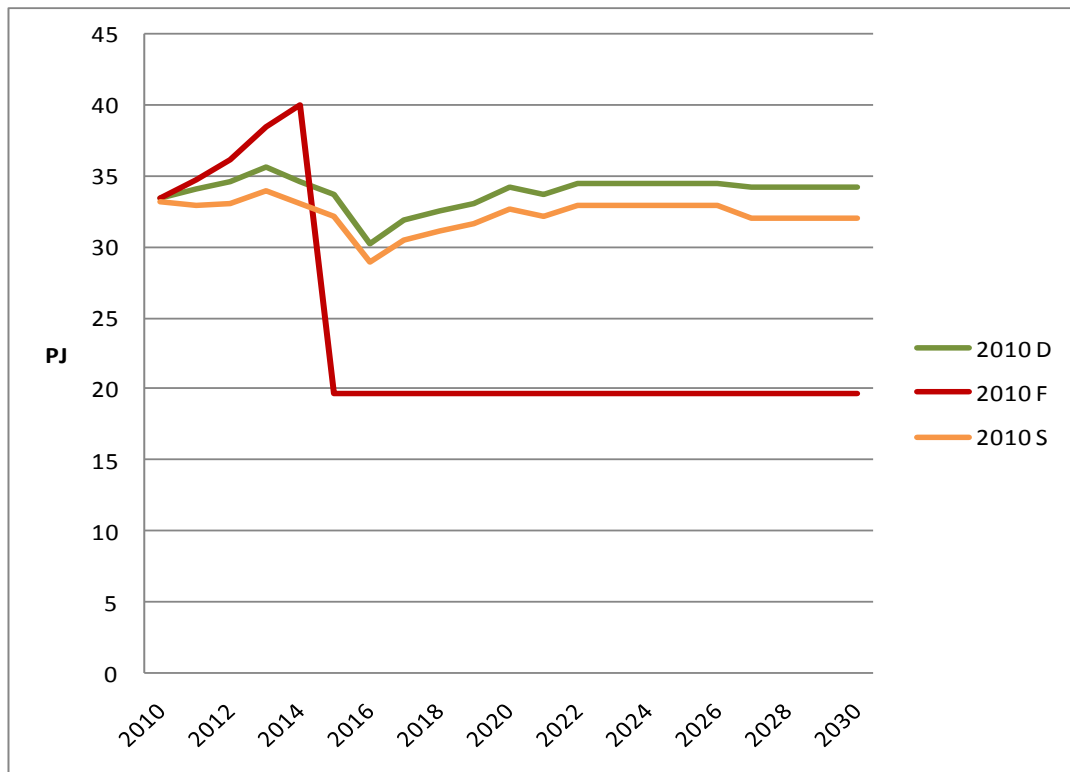
**4.1.1.3. Carpentaria Gas Pipeline (CGP)**

The major customers served from the CGP are:

- Mica Creek Power Station (MCPS) and Xstrata Power Station at Mount Isa both of which use gas to generate power mainly for mining loads at Xstrata and other mines in the region including the Century Mine
- IPL’s ammonium phosphate plant at Phosphate Hill
- Cannington and Osborne mines.

The entire CGP load is modelled as utility and large industrial demand in the GSOO because Mt Isa is not part of the National Electricity Market. The starting load in 2010 in GSOO was about 33 PJ, which is consistent with CGP flows in that year.

- **Figure 4-3: Comparison of GSOO utility plus large industrial demand projections for the CGP zone, 2010 – 2030, PJ**



Source: spreadsheets provided with GSOO



Growth in the region depends upon a number of key factors, including:

- Expanded and new mining projects
- Efficiency of power stations supplying power to the mines and mineral developments
- Whether electricity will continue to be generated from gas transmitted through the CGP, or if, alternatively, power is imported through a cable from the national grid, from either central or northern Queensland.
- Mine life

Direct import of power, displacing some generation from gas, has the greatest impact on projected gas usage on the CGP. Such import is envisaged in the Fast Change scenario in GSOO 2010, reducing gas demand by about 20 PJ pa.

GSOO 2010 was developed at a time of uncertainty about the impact of the (then) Resources Super Profit Tax (RSPT). While this may have impacted on the medium scenario assessment, we have retained the GSOO 2010 version.

#### **4.1.1.4. North Queensland Gas Pipeline (NQGP)**

Apart from the Townsville Power Station, the major customers served from the NQGP are:

- Queensland Nickel at Yabulu
- CRL

According to the GSOO 2010, demand at Moranbah is also included within demand for this zone. This presumably refers to the IPL/Dyno Nobel ammonium nitrate plant at Moranbah, and this is consistent with 2010 and 2011 GMR modelling.

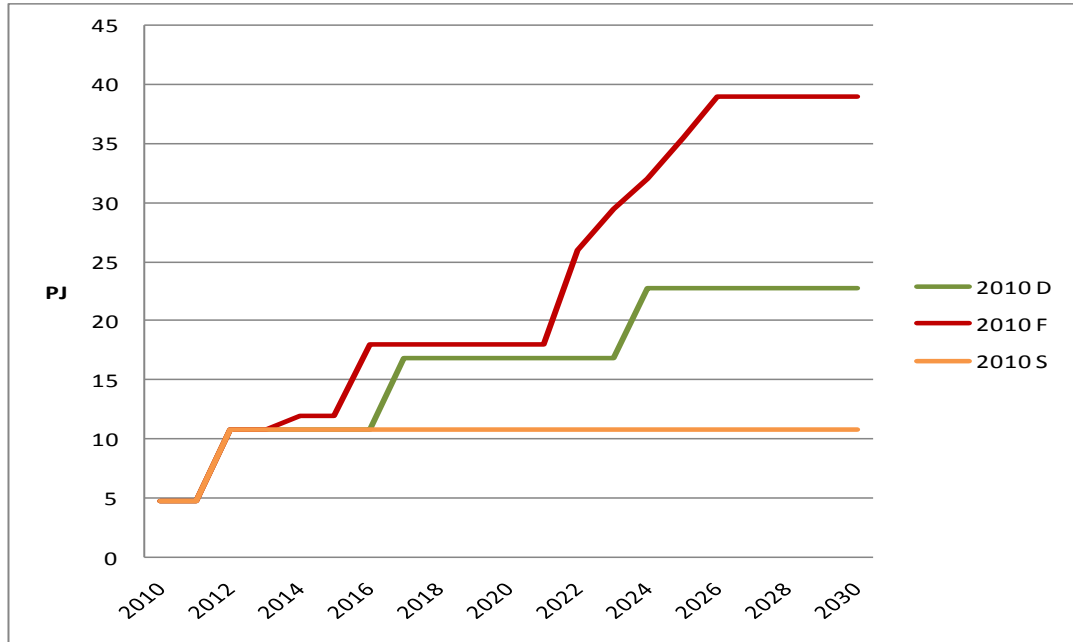
The projections are provided in Figure 4-4.

#### **4.1.1.5. Queensland aggregate**

Aggregate projections for Queensland are shown in Figure 4-5.

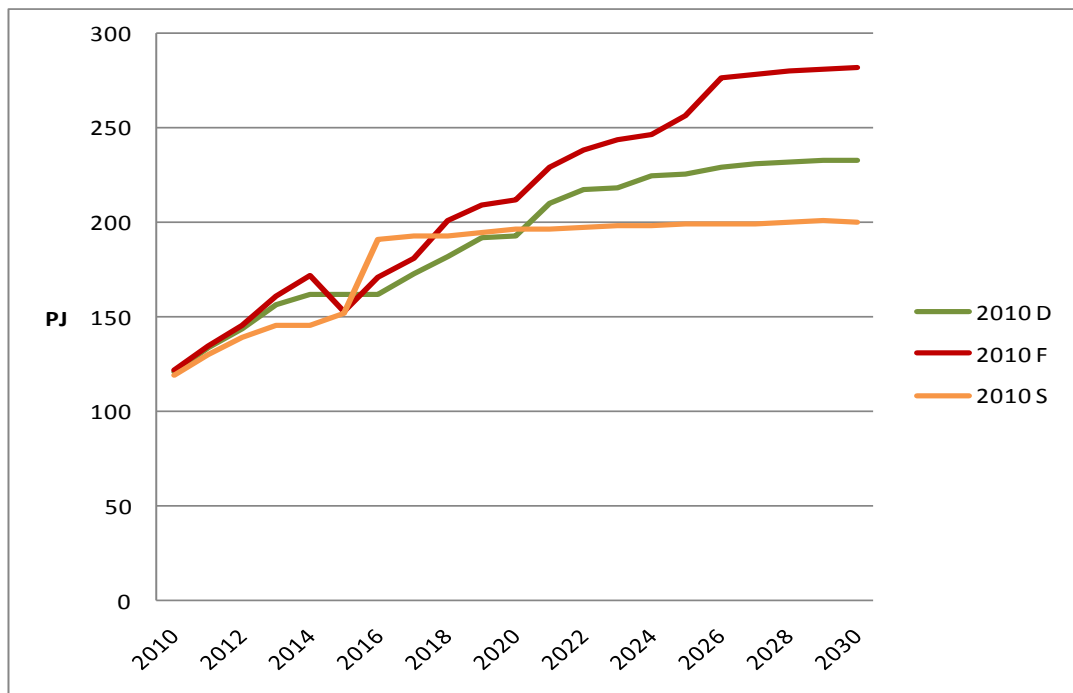


■ **Figure 4-4: Comparison of GSOO utility plus large industrial demand projections for NQGP zone, 2010 – 2030, PJ**



Source: spreadsheets provided with GSOO

■ **Figure 4-5 Comparison of GSOO utility plus large industrial demand projections for Queensland, 2010 – 2029, PJ**

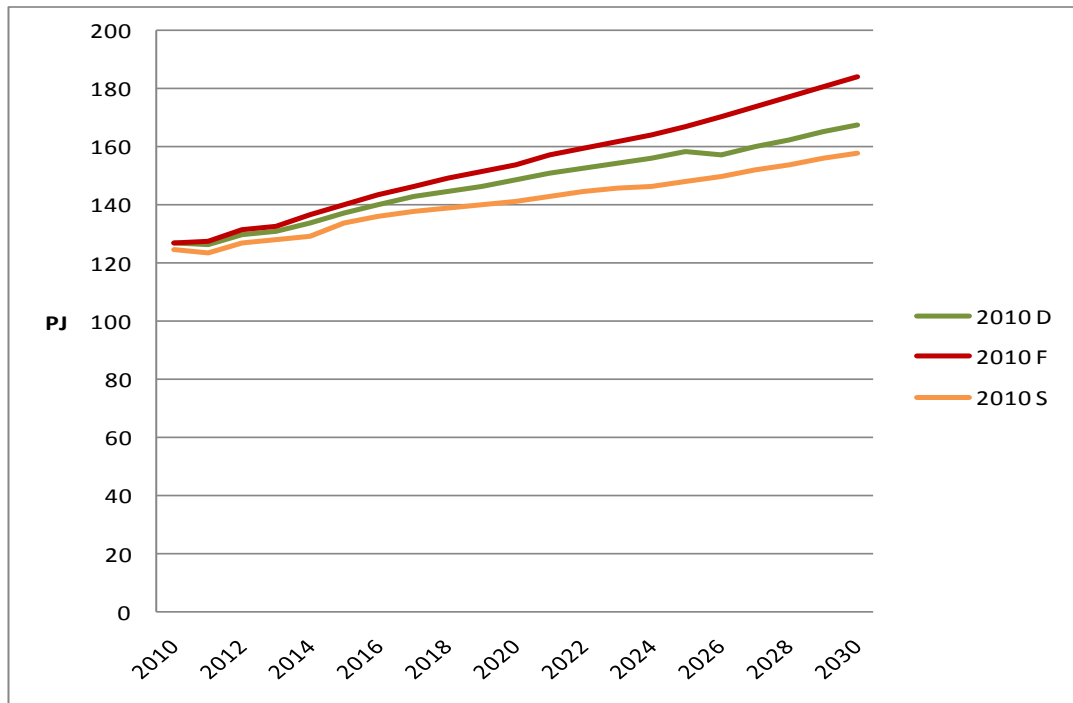




**4.1.2. NSW/ACT**

Projected growth over the period 2010 to 2030 under the GSOO 2010 scenarios is illustrated in Figure 4-6. According to data included in the Bulletin Board, the combined Moomba to Sydney Pipeline (MSP) and Eastern Gas Pipeline (EGP) load in 2009/10 was about 145 PJ, which is about the combined utility, large industrial demand and GPG load in GSOO 2010. As a result, we consider the starting point for GSOO 2010 to be reasonable.

■ **Figure 4-6: Comparison of GSOO utility plus large industrial demand projections for NSW/ACT, 2010 – 2030, PJ**



Source: spreadsheets provided with GSOO

■ **Table 4-5: Comparison of NSW/ACT growth rates projections over the period 2010 – 2030, % pa**

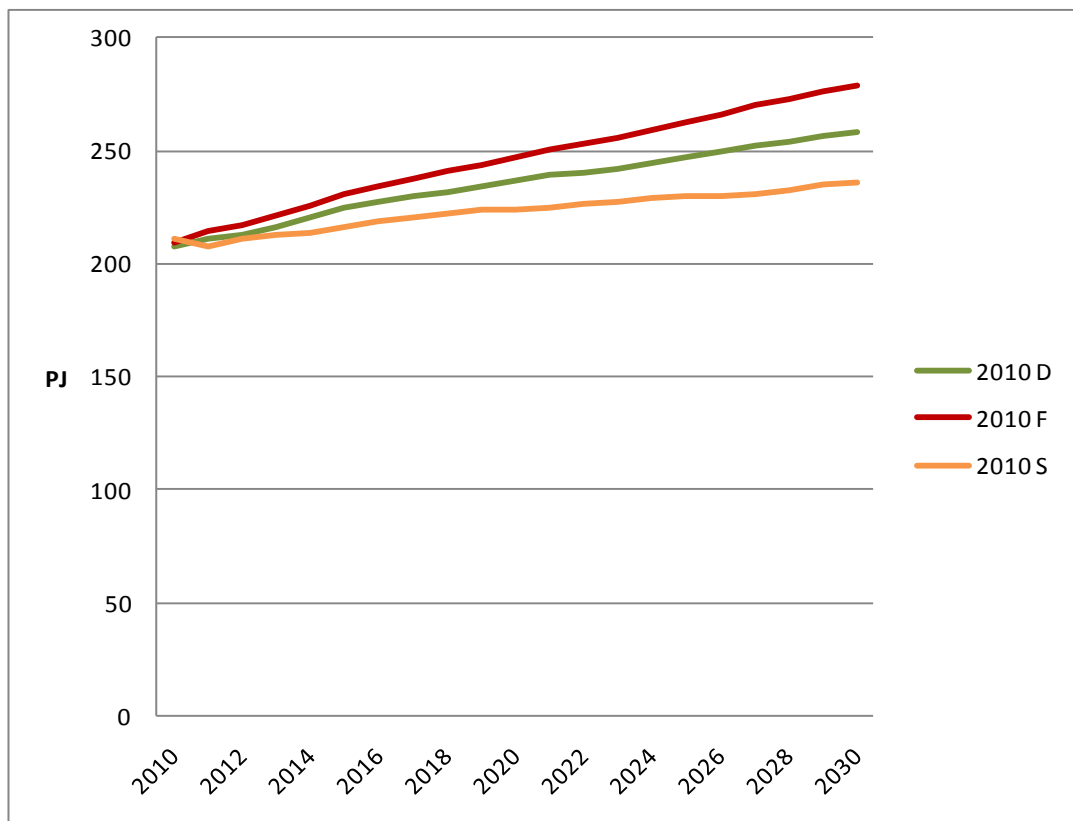
	<b>GSOO 2010</b>
Decentralised	1.4%
Fast rate of change	1.9%
Slow rate of change	1.2%



**4.1.3. Victoria**

Projected growth over the period 2010 to 2030 under the GSOO 2010 scenarios is illustrated in Figure 4-7. The growth rates over the period 2010 to 2030 are provided in Table 4-6.

■ **Figure 4-7: Comparison of GSOO utility plus large industrial demand projections for Victoria, 2010 – 2030, PJ**



Source: spreadsheets provided with GSOO

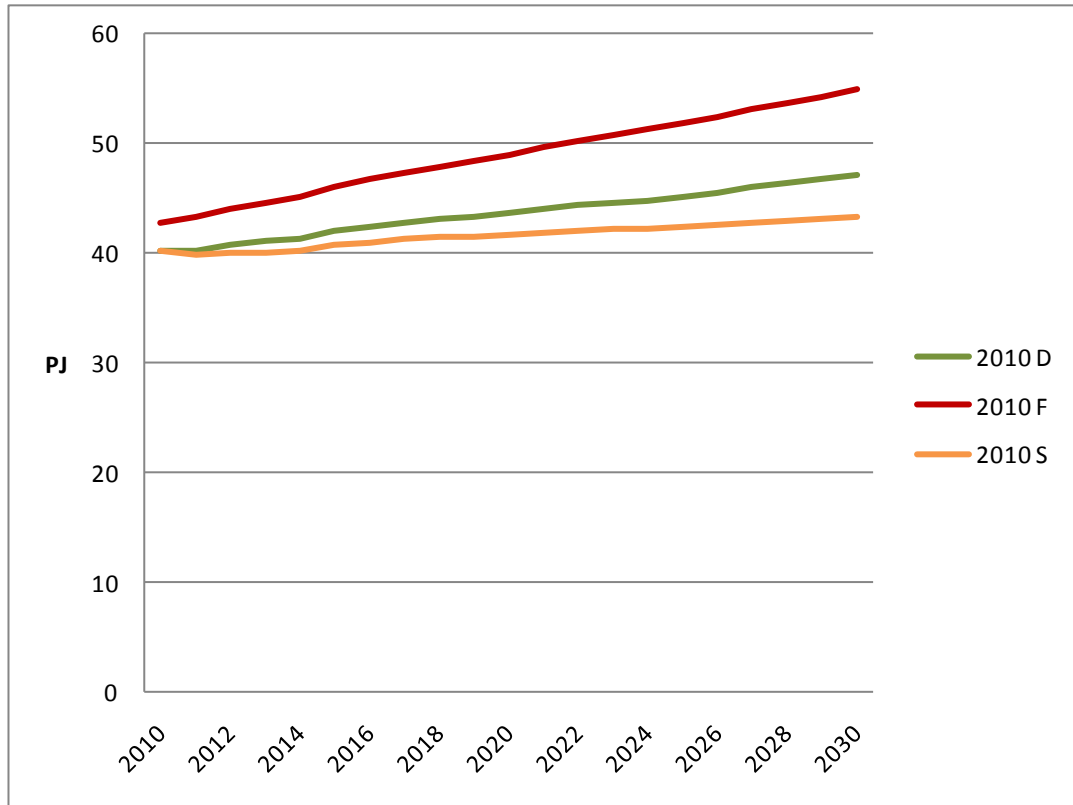
■ **Table 4-6: Comparison of Victorian growth rates projections over the period 2010 – 2030, % pa**

	<b>GSOO 2010</b>
Decentralised	1.1%
Fast rate of change	1.5%
Slow rate of change	0.6%



**4.1.4. South Australia**

- **Figure 4-8: Comparison of GSOO utility plus large industrial demand projections for South Australia, 2010 – 2030, PJ**



Source: spreadsheets provided with GSOO

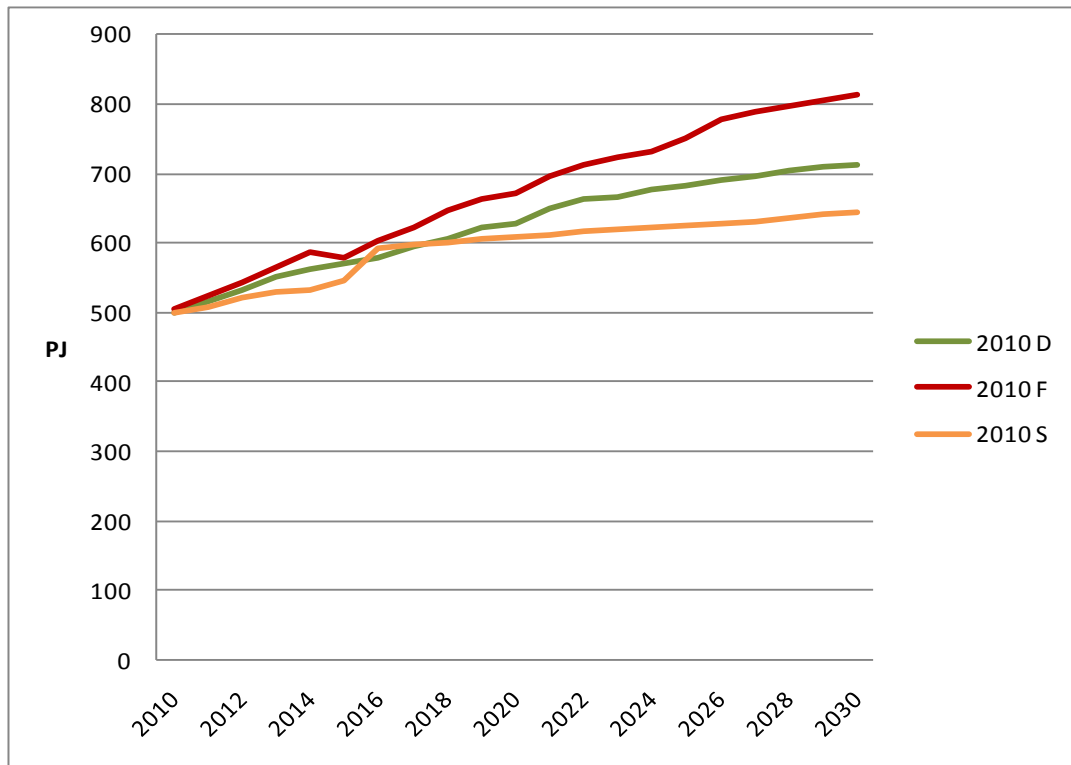
Projected growth in the utility and large industrial customer category in GSOO 2010 is modest and appears to exclude the potential expansion of Olympic Dam (for which expansions were expected in the medium and high cases in 2009). It is assumed that any Olympic Dam expansion has been modelled in GPG.

**4.1.5. Eastern Australia**

Aggregate projections for eastern Australia are shown in Figure 4-9. The aggregate includes the small Tasmanian load which is not discussed above.



- **Figure 4-9 Comparison of GSOO utility plus large industrial demand projections for eastern Australia, 2010 – 2030, PJ**



#### 4.2. Gas for Power Generation

GPG demand is driven by a wider range of effects than utility and large customer load, particularly carbon policy assumptions and decentralisation, as well as economic growth and gas price. While in the 2009 GSOO the medium, high and low scenarios generally resulted in medium, high and low demand in each zone, for 2010 the scenarios outcomes are very mixed, with the Decentralised being highest in some zones and the Fast being highest in other zones.

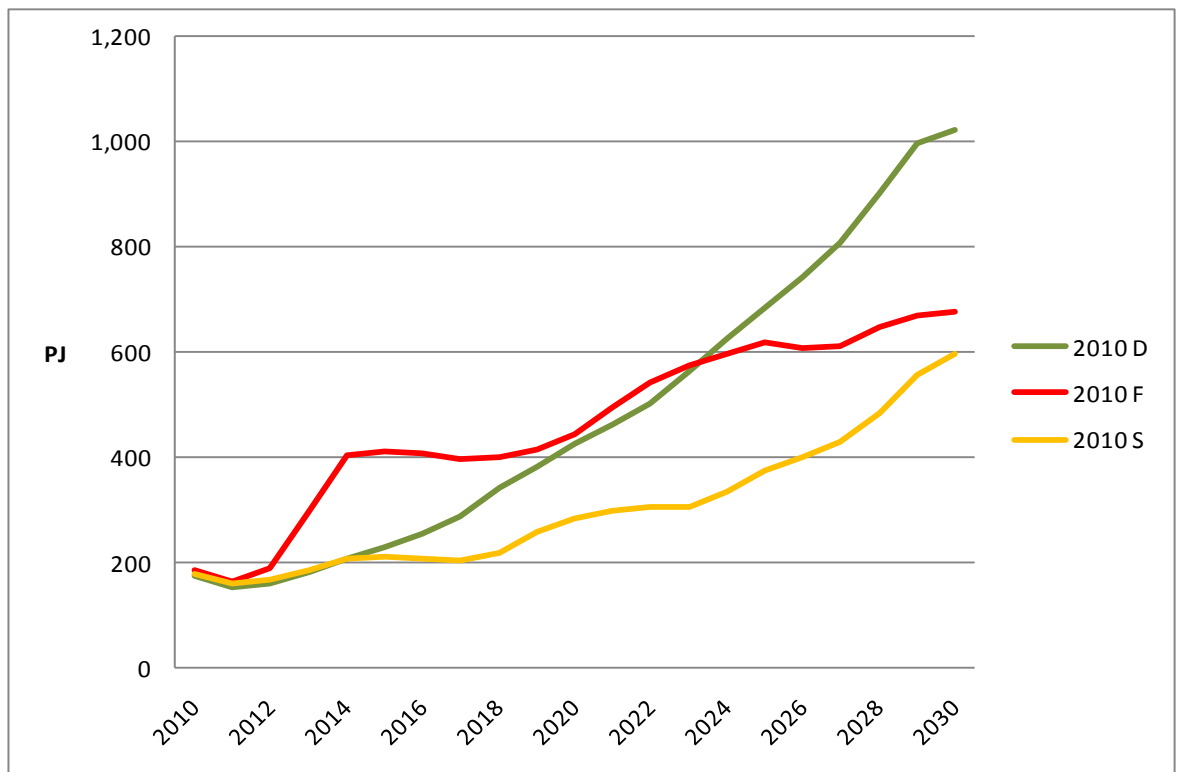
This may well reflect details of the scenario assumptions, however the aggregate outcome in the Fast scenario is a doubling of GPG load from 200 PJ to 400 PJ between 2012 and 2014 (Figure 4-10), mostly in Victoria due to assumed retirement of brown coal generating plant. This outcome appears implausible for a number of reasons:

- It requires Victorian gas fired generation, including the Mortlake plant under construction, to run at 75% capacity factor, exceptionally high for mostly open cycle plant. It is unlikely that other as yet uncommitted plant would be built in the timeframe.



- Victorian peak gas demand exceeds current gas production and pipeline capacity by 2013 (GSOO)
- In the current state of the gas market it is unlikely that gas will be contracted at a price that makes this attractive.

■ **Figure 4-10 Comparison of GSOO GFG demand projections for eastern Australia, 2010 – 2030, PJ**



In view of the fact that in the long-run the 2010-Decentralised scenario is higher than the 2010-Fast scenario we have elected to define high, low and medium scenarios for the 2011 GMR as follows:

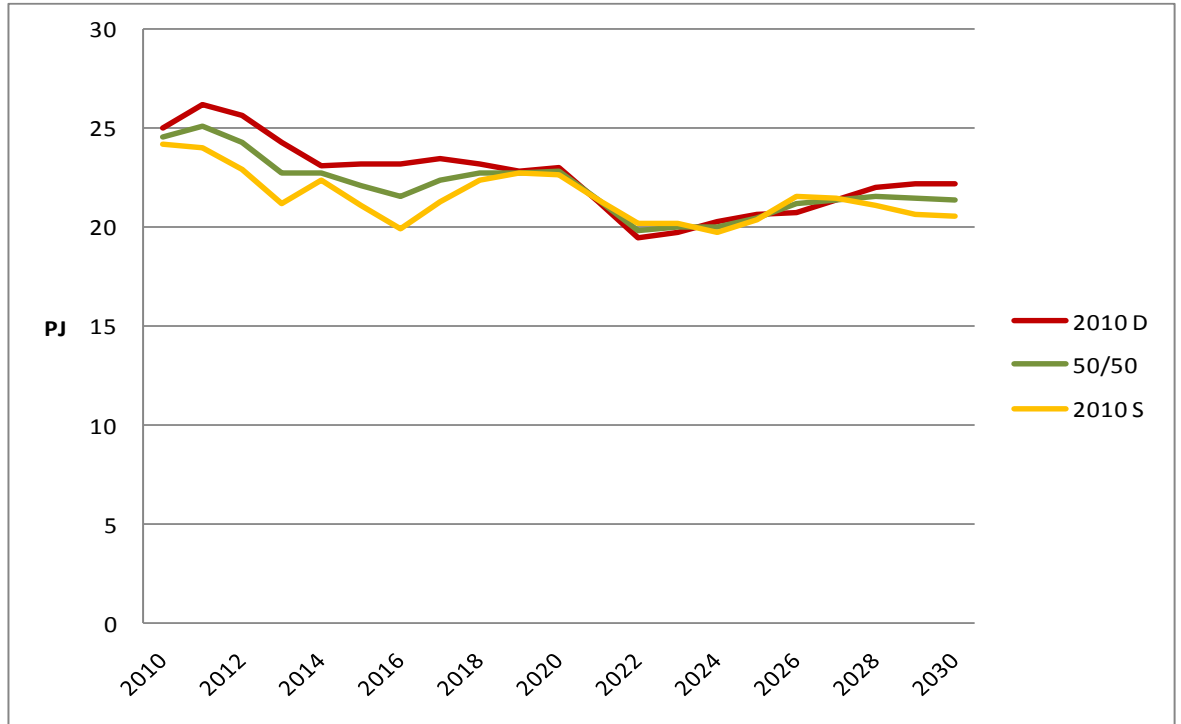
- High- 2010-Decentralised
- Low- 2010-Slow
- Medium – average of high and low (50/50)



4.2.1. Queensland

4.2.1.1. Roma to Brisbane pipeline (RBP)

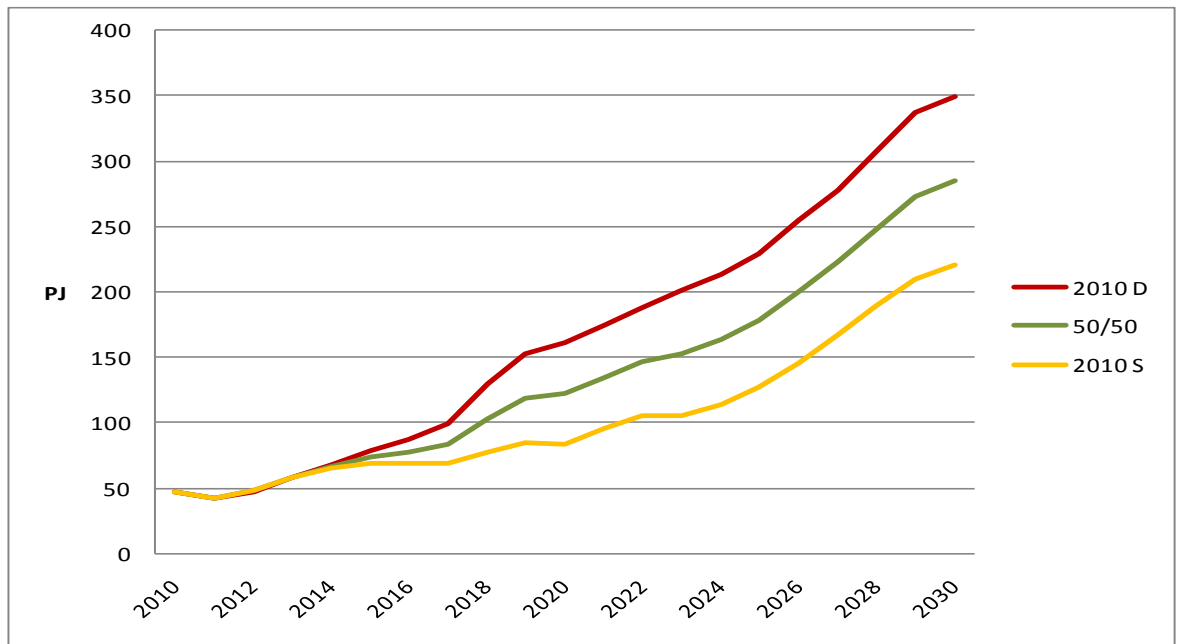
■ **Figure 4-11**      **2010 GSOO GFG demand projections for the RBP zone 2010 – 2030, PJ**





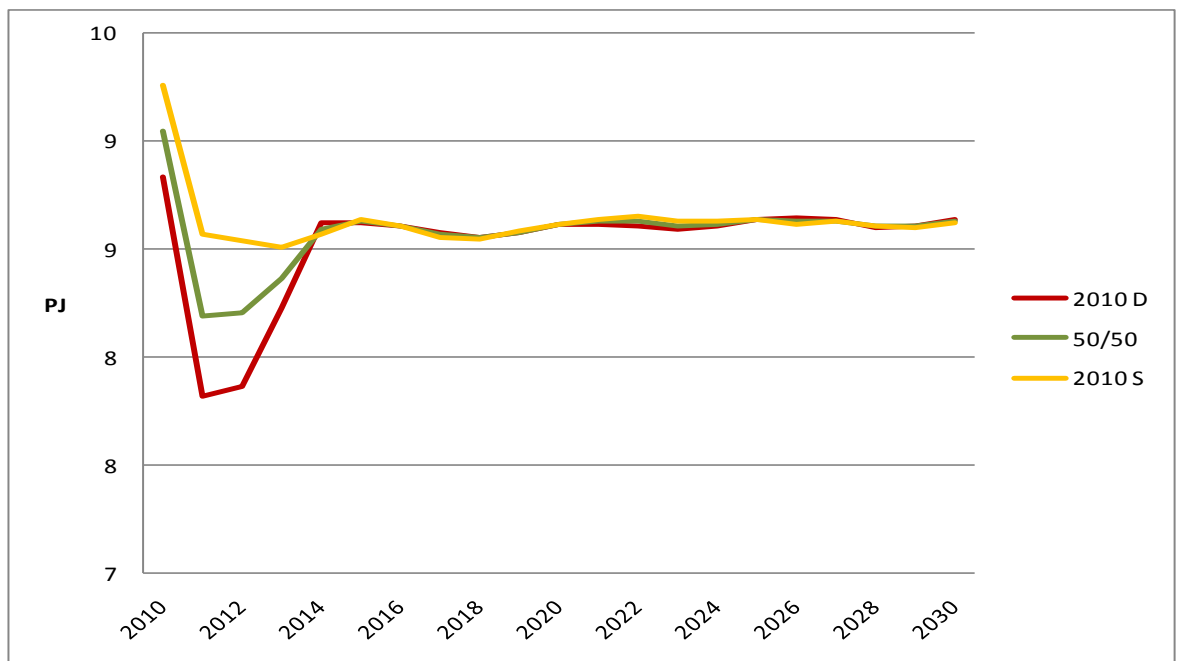
4.2.1.2. Tarong zone

■ **Figure 4-12** 2010 GSOO GFG demand projections for the Tarong zone 2010 – 2030, PJ



4.2.1.3. North Queensland Gas Pipeline (NQGP)

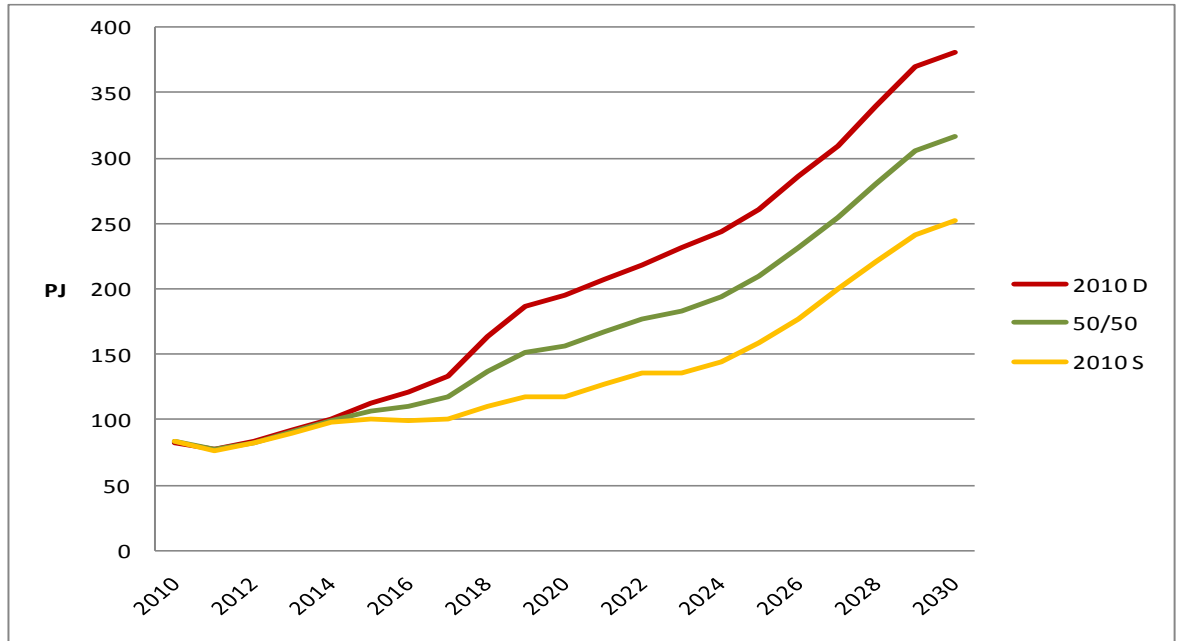
■ **Figure 4-13** 2010 GSOO GFG demand projections for the NQGP zone 2010 – 2030, PJ





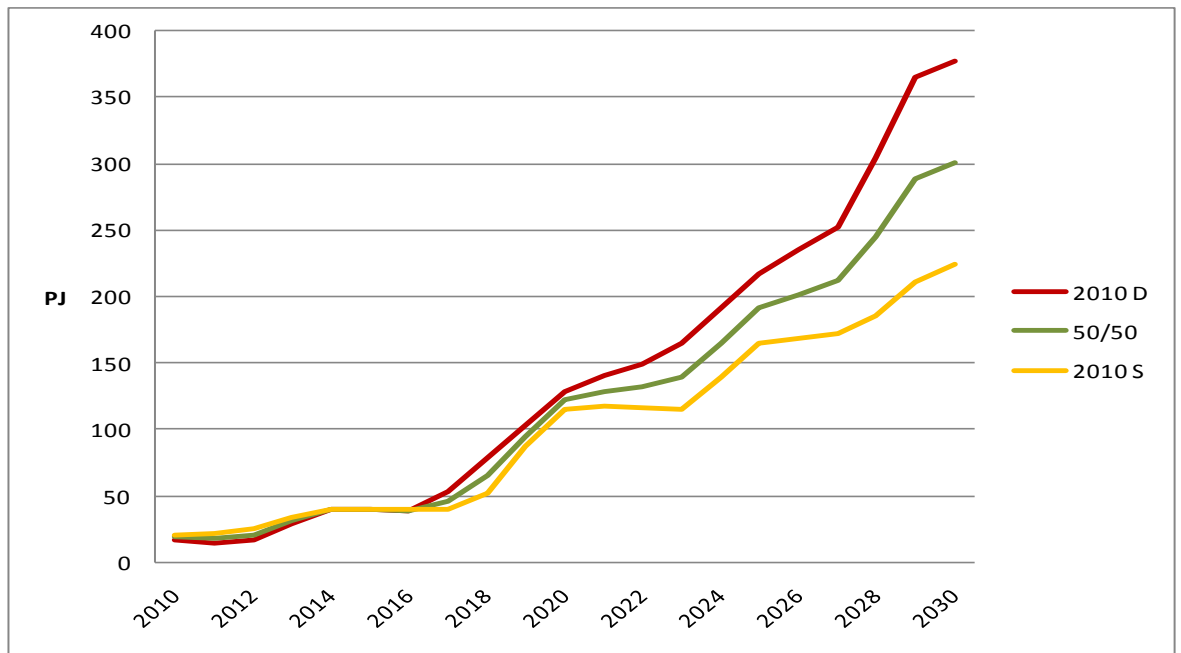
**4.2.1.4. Queensland aggregate**

■ **Figure 4-14**      **2010 GSOO GFG demand projections for Queensland 2010 – 2030, PJ**



**4.2.2. NSW/ACT**

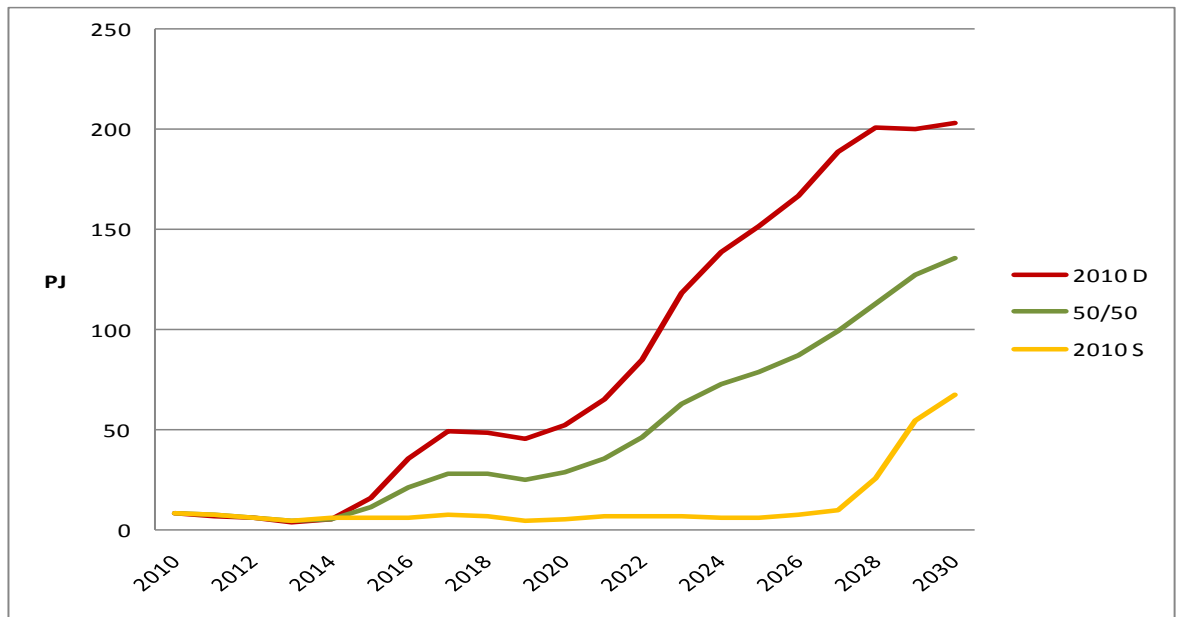
■ **Figure 4-15**      **2010 GSOO GFG demand projections for NSW/ACT 2010 – 2030, PJ**





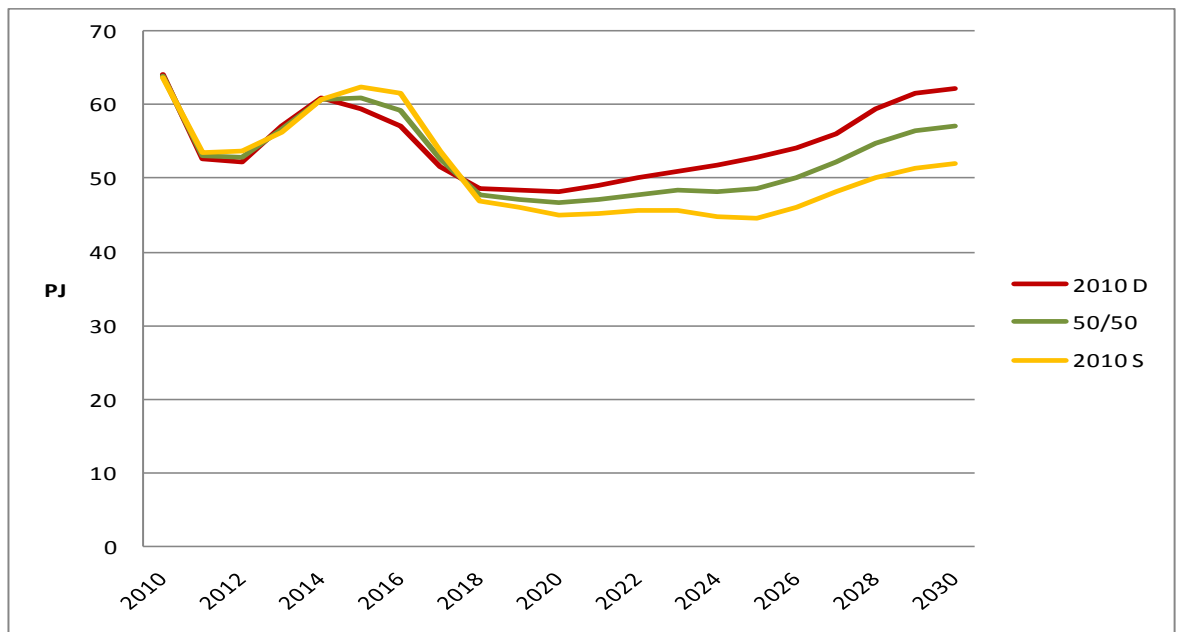
4.2.3. Victoria

■ **Figure 4-16** 2010 GSOO GFG demand projections for Victoria 2010 – 2030, PJ



4.2.4. South Australia

■ **Figure 4-17** 2010 GSOO GFG demand projections for South Australia 2010 – 2030, PJ

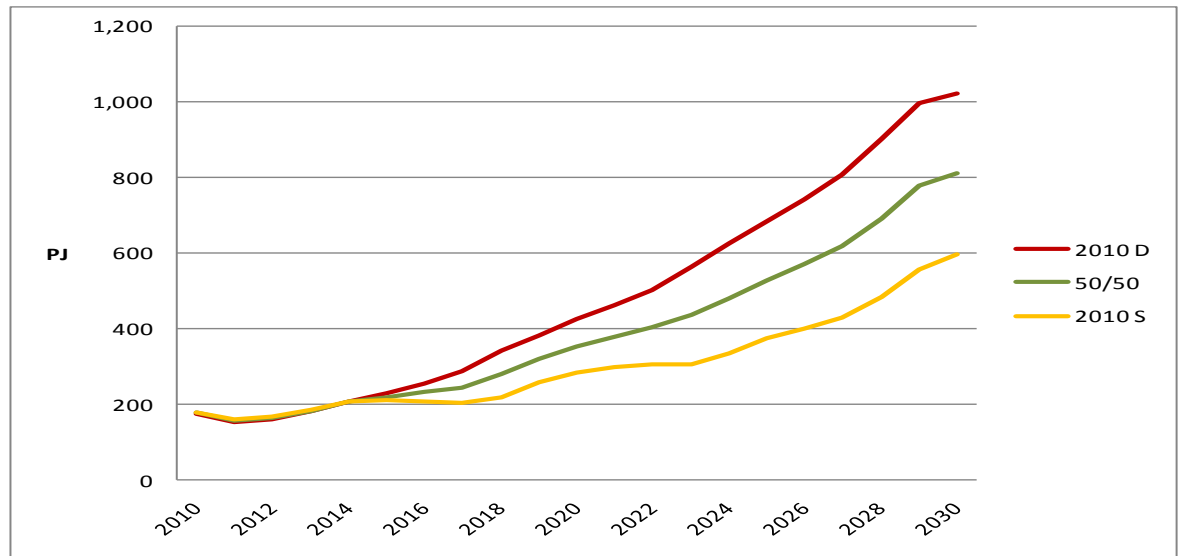




#### 4.2.5. Eastern Australia

The eastern Australian aggregate includes the small Tasmanian load which is not discussed above.

■ **Figure 4-18 2010 GSOO GFG projections for eastern Australia, 2010 – 2029, PJ**



#### 4.3. Total domestic gas demand

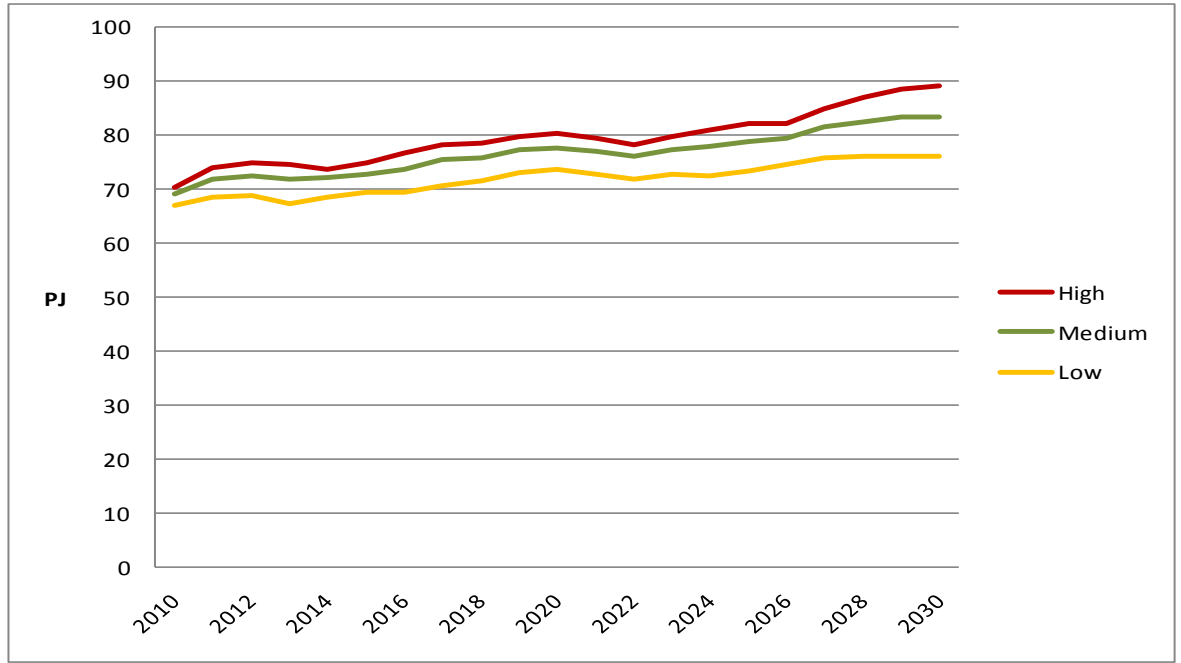
The following charts include the adjustments to GSOO forecasts referred to above.

##### 4.3.1. Queensland

##### 4.3.1.1. Roma to Brisbane pipeline (RBP)

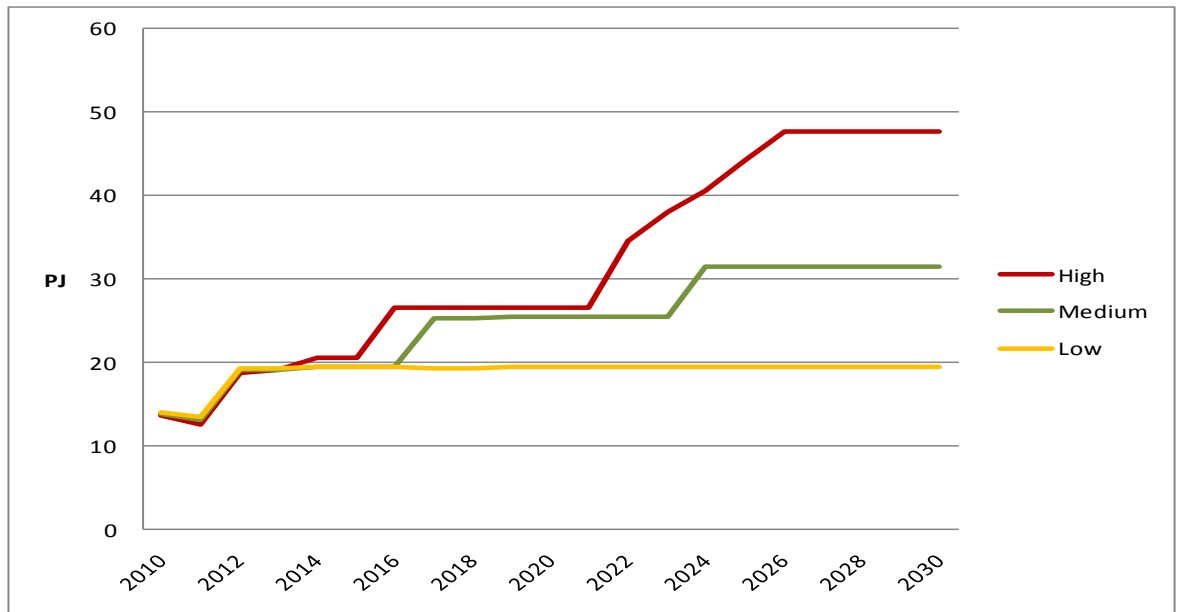


■ **Figure 4-19**      **2011 GMR Total demand projections for the RBP zone 2010 – 2030, PJ**



**4.3.1.2. Queensland Gas Pipeline (QGP)**

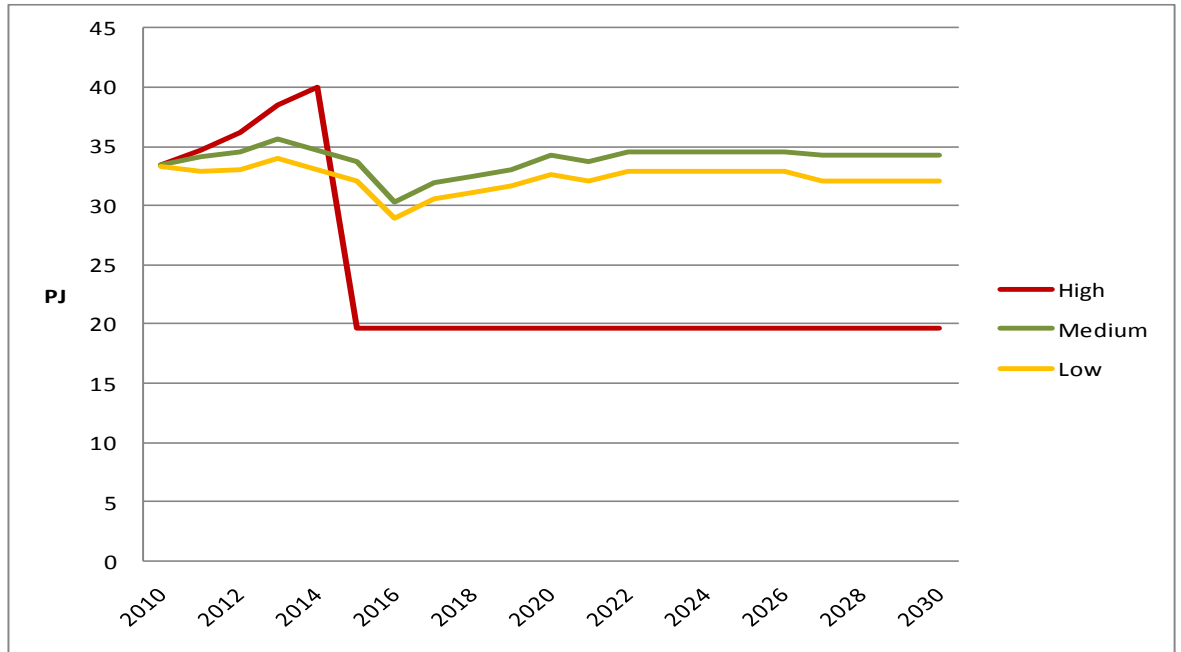
■ **Figure 4-20**      **2011 GMR Total demand projections for the QGP zone 2010 – 2030, PJ**





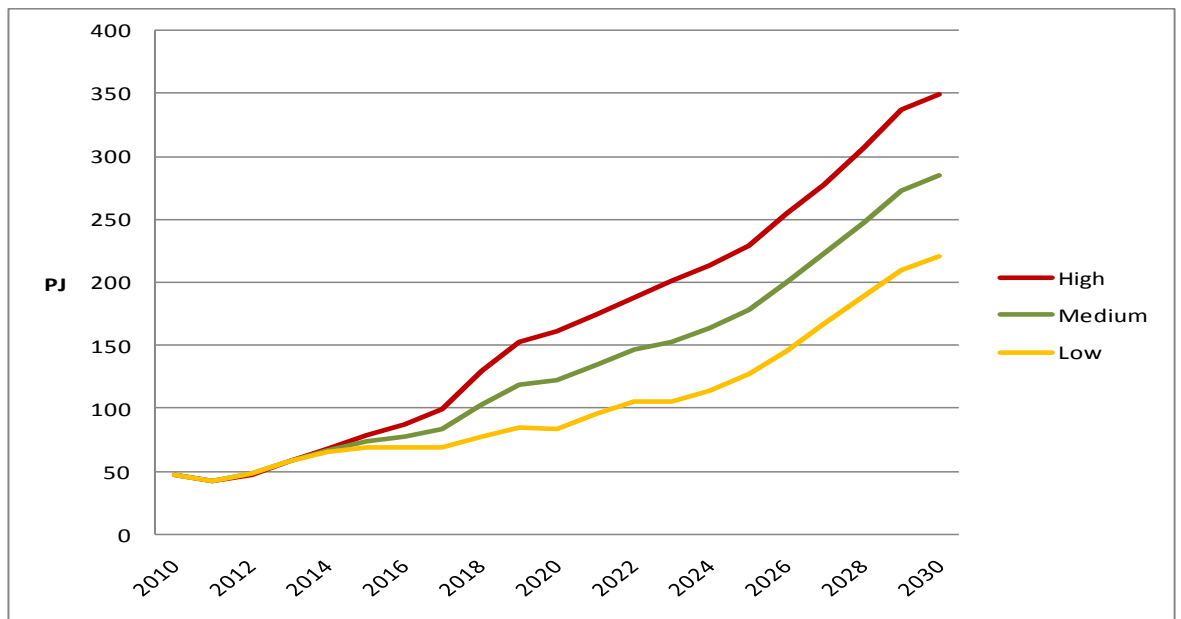
4.3.1.3. Carpentaria Gas Pipeline (CGP)

■ **Figure 4-21** 2011 GMR Total demand projections for the CGP zone 2010 – 2030, PJ



4.3.1.4. Tarong zone

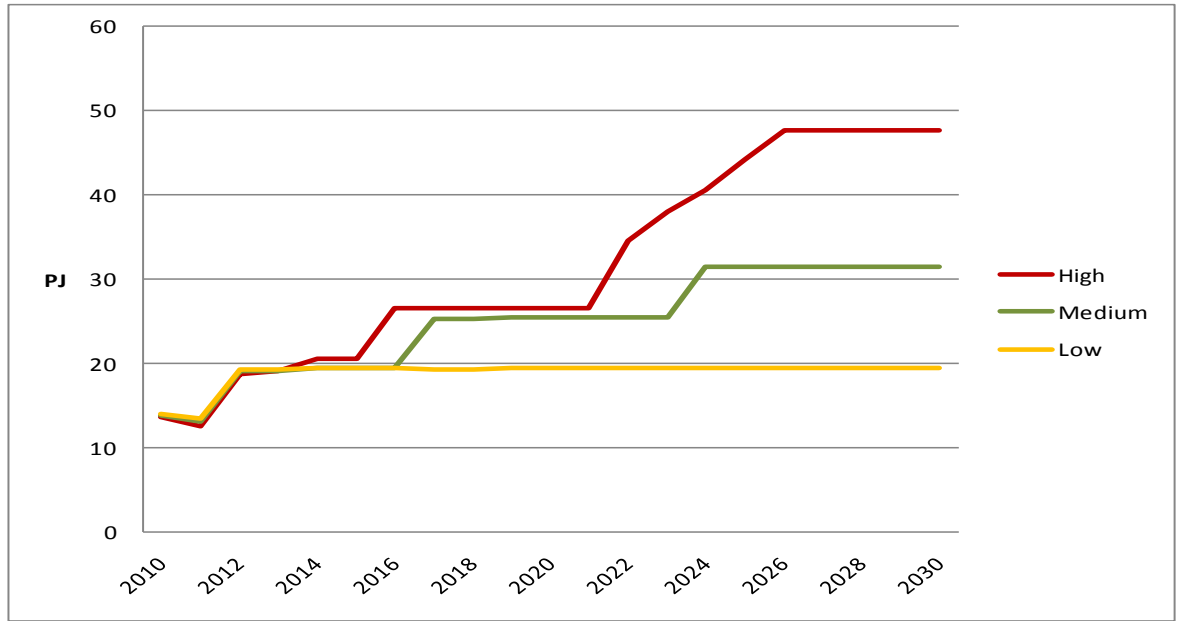
■ **Figure 4-22** 2011 GMR Total demand projections for the Tarong zone 2010 – 2030, PJ





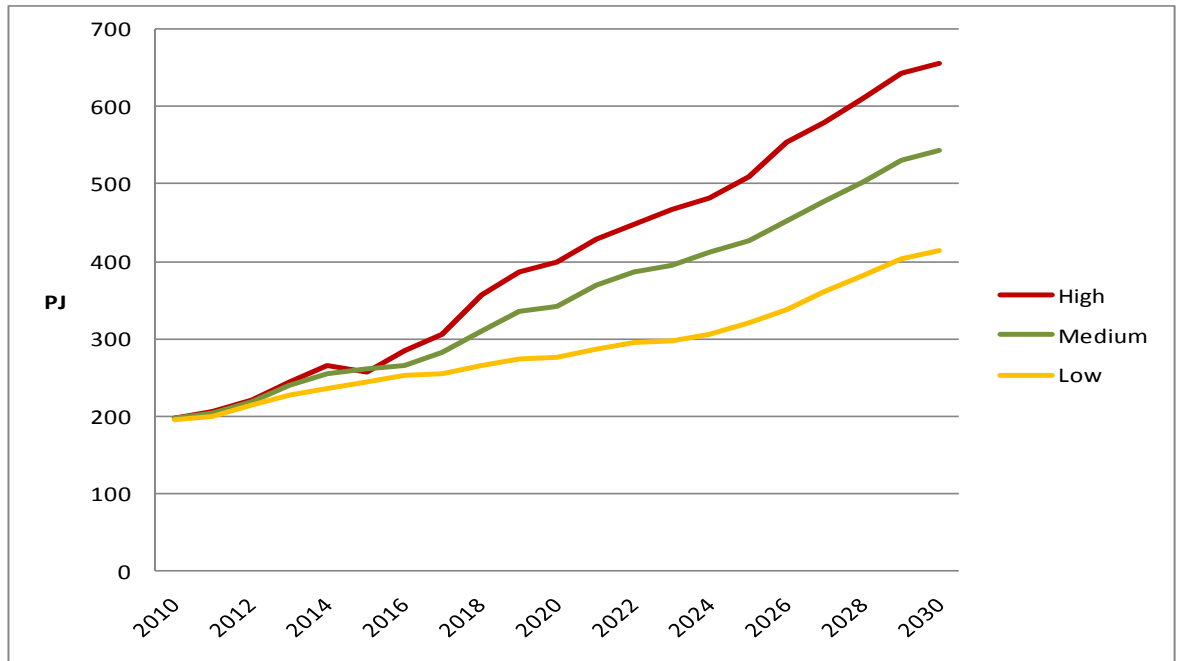
4.3.1.5. North Queensland Gas Pipeline (NQGP)

■ **Figure 4-23** 2011 GMR Total demand projections for the NQGP zone 2010 – 2030, PJ



4.3.1.6. Queensland aggregate

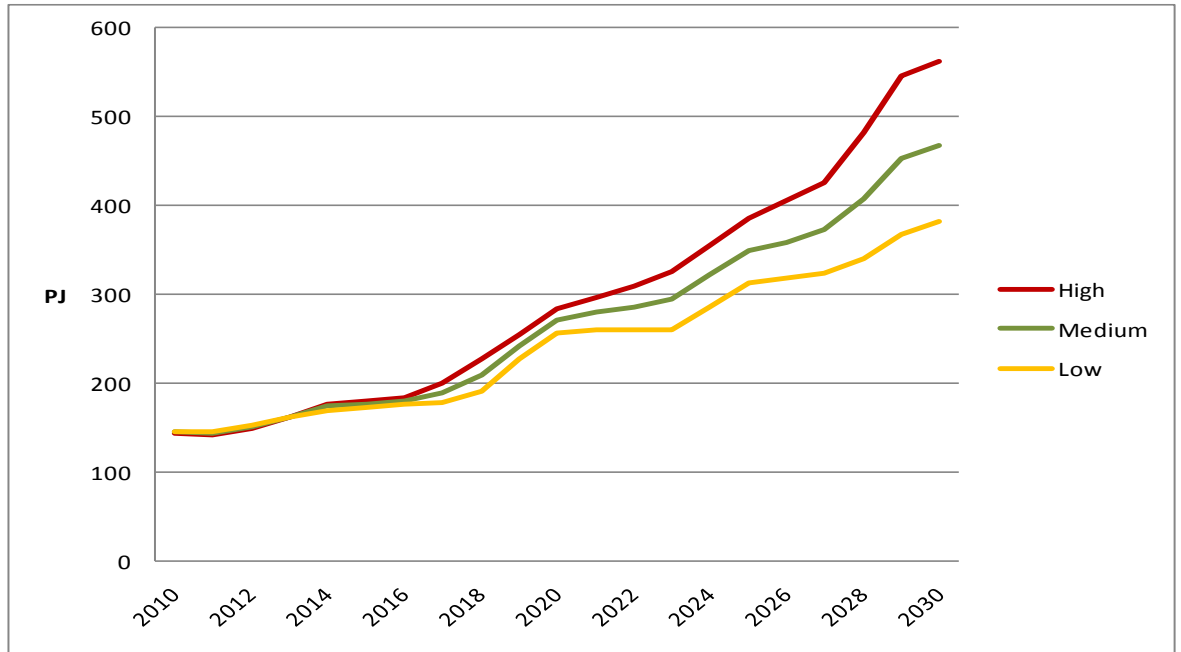
■ **Figure 4-24** 2011 GMR Total demand projections for Queensland 2010 – 2030, PJ





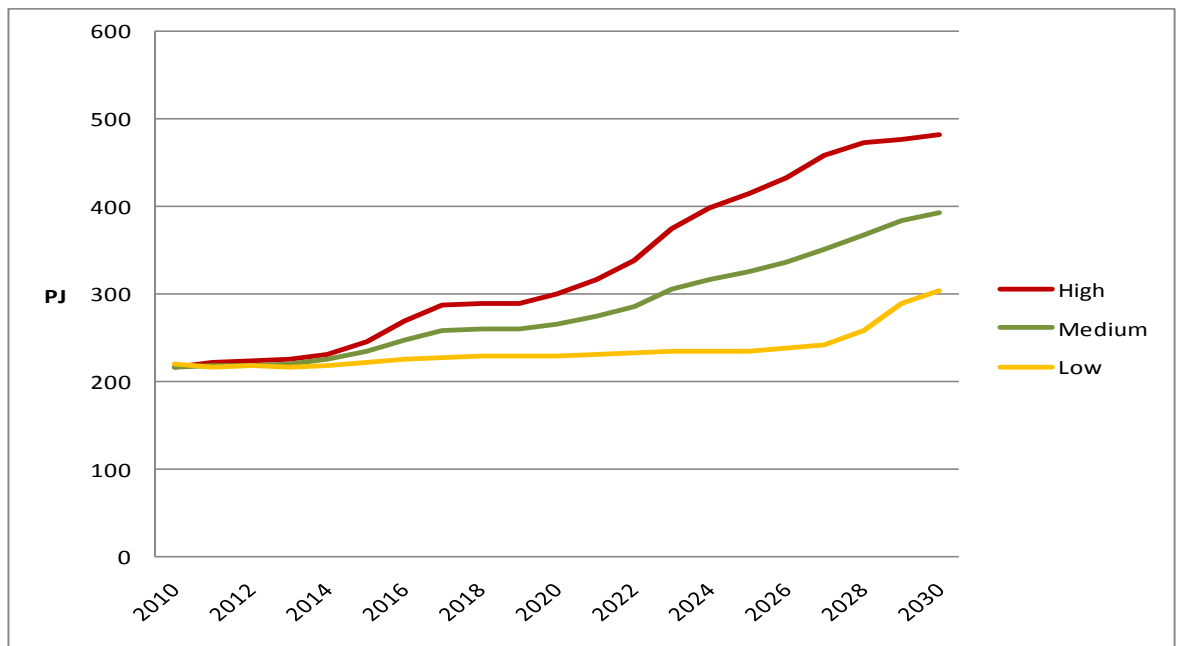
4.3.2. NSW/ACT

■ **Figure 4-25** 2011 GMR Total demand projections for NSW/ACT 2010 – 2030, PJ



4.3.3. Victoria

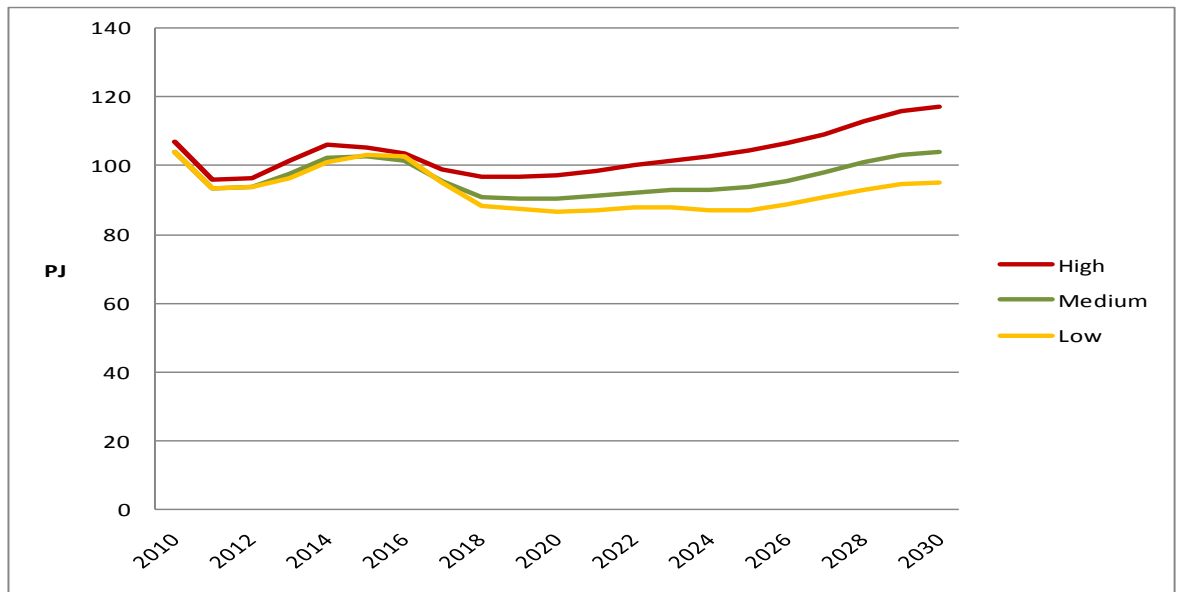
■ **Figure 4-26** 2011 GMR Total demand projections for Victoria 2010 – 2029, PJ





**4.3.4. South Australia**

■ **Figure 4-27** 2011 GMR Total demand projections for South Australia 2010 – 2030, PJ



**4.3.5. Eastern Australia**

The eastern Australian aggregate includes the small Tasmanian load which is not discussed above.

■ **Figure 4-28** 2011 GMR Total demand projections for eastern Australia 2010 – 2030, PJ

