Analysing economic and demographic trajectories in NSW regions experiencing CSG development and operations.

Milestone 4. Economic effect of CSG activity under different scenarios.

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- Globally, the **development of the CSG industry** is expected to **continue** as gas consumption increases in the **transition to other sources of energy** production (AEMO 2016; Lacey & Lamont 2014).

- Operational challenges generated by **social and regulatory factors** may **limit** or stop the development of **CSG activities at local or regional scales** (Lacey & Lamont 2014).

- **Empirical assessments** of the economic effects of CSG development could **inform** the selection of CSG activity levels that **balance competing interests**.

Analysing Economic and Demographic Trajectories in NSW Regions Experiencing CSG Development

- **Milestone 1:** Collection and synthesis of data.
- **Milestone 2:** Economic baseline for NSW CSG regions.
- **Milestone 3:** Assessing linkages between regional economic indicators and CSG industry activity in NSW 2001-2011.
- **Milestone 4:** Assessing the economic effect of CSG activity under different scenarios

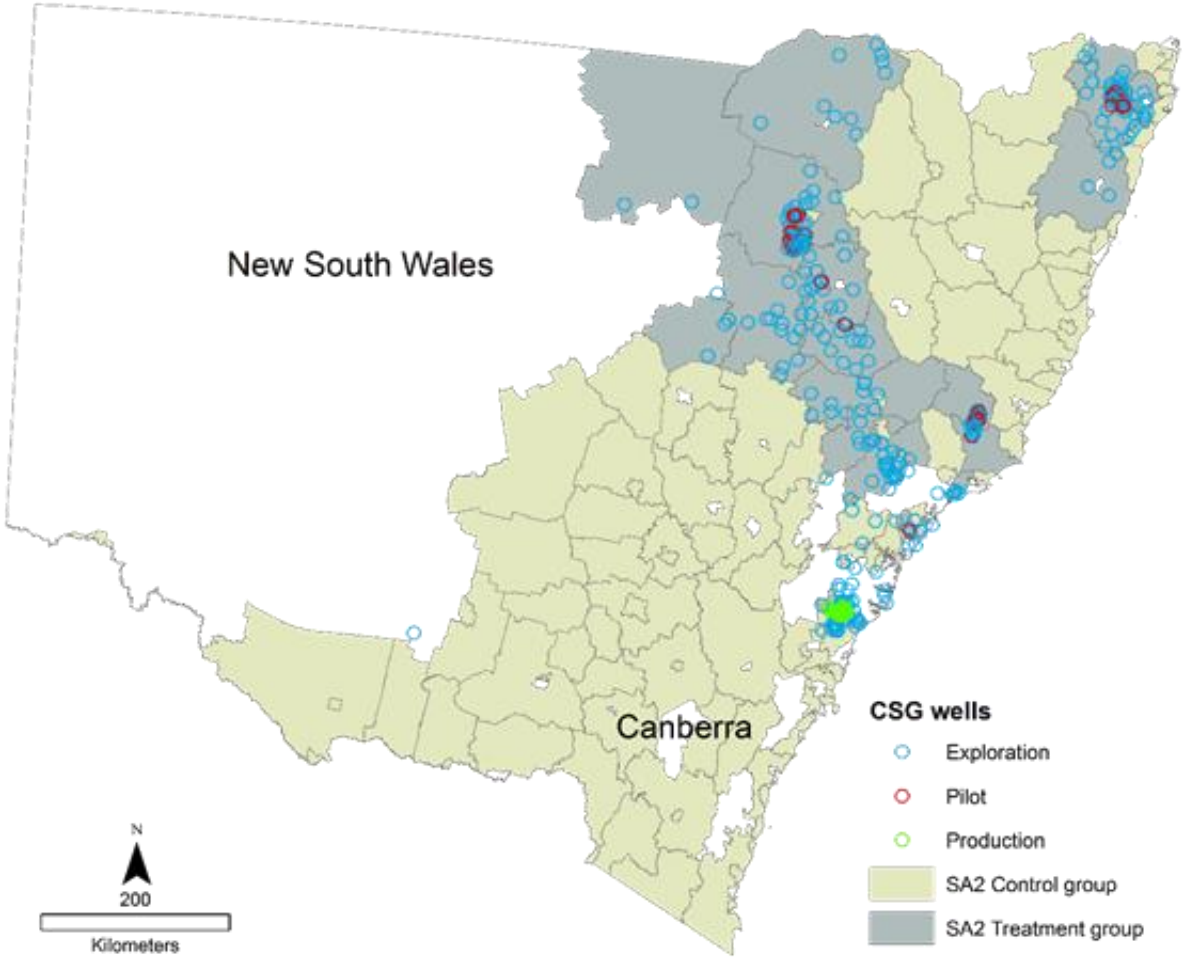
Milestone 2: Economic baseline for NSW CSG regions.

- Identification of **CSG and non-CSG regions** with **similar** socioeconomic and environmental **characteristics**.
- **Baseline** to determine changes associated with CSG development.
- **Summary statistics** indicate that **CSG regions** had **similar income** levels in **2001** than **non-CSG regions**.
- In **2011**, these levels were noticeably **higher for family income** and **slightly higher for individual income**, compared with non-CSG regions.

Milestone 3: Assessing linkages between regional economic indicators and CSG industry activity in NSW 2001-2011.

Spatial and temporal **changes in family income** are influenced by:

- **Crop and livestock profitability** (e.g. climate, land productivity).
- **Human and economic capital** (e.g. job experience, education level, access to services/infrastructure).
- **CSG and traditional mining activity** (e.g. coal prices, terms of trade).
- **Region specific characteristics** for which no data is available (e.g. innovation/risk aversion attitudes).



Milestone 3: Results of the statistical model

Parameters	Estimate		Parameters	Estimate	
Dependent variable			**Socioeconomic factors**		
Family income			Higher education	0.1772	***
CSG activity indicators			Median age	4.4563	***
CSG region	6.3085	**	Median age squared	–2.5146	***
CSG well density	0.0026		Remoteness/accessibility index	–0.1006	***
Average soil and topographic characteristics			Agricultural employment	–0.0256	**
Bulk density	0.3278	**	Mining employment	–0.0022	
Clay content	–0.0307		Manufacturing employment	–0.0513	***
Elevation	0.0381	**	Thermal coal price	0.2931	***
Slope	0.0033		Non-CSG well density	–0.0007	
Average climatic conditions			**Intercept**	8.8663	***
Rainfall	–0.1253	***	**Error variance parameters**		
Rainfall variability	0.0003		Var. of unobserved heterogeneity / Var. of random disturbances	6.4219	***
Maximum temperature	–0.0366		Spatial error correlation	0.2880	***
Maximum temperature variability	–0.0576	***	R-squared	0.9760	

Significance codes: '***' 0.01 '**' 0.05 '*' 0.1. All continuous variables were log transformed. Balanced dataset: 414 observations (114 control regions, 24 treatment regions, and 3 periods). Source: Marcos-Martinez et al., (2017)

Milestone 3: Assessing linkages between regional economic indicators and CSG industry activity in NSW 2001-2011.

- **Statistical analysis of income and employment changes** in 24 CSG regions (treatment group) relative to 114 regions without CSG wells (control group).
- **CSG regions** had around **6% higher median personal and family income** than regions in the control group, on average.
- Findings **consistent** with CSG income effects in **Queensland** (Fleming & Measham, 2015).
- **No** linkages between CSG industry activity and **indirect employment**. The industry may need larger activity before influencing local employment.

Assumptions:

- The **coefficients** of the indicator variable CSG region and well density continue to hold into the future.
- **Future CSG activity** occurs only within the identified CSG SA2 regions.
- Increases in gas demand generate **higher energy prices** that result in regulatory and social license changes **reactivating the CSG industry**.
- We assume that **3.4% of the existing CSG wells are retired per year** based on the average rates during the period 2001-2014

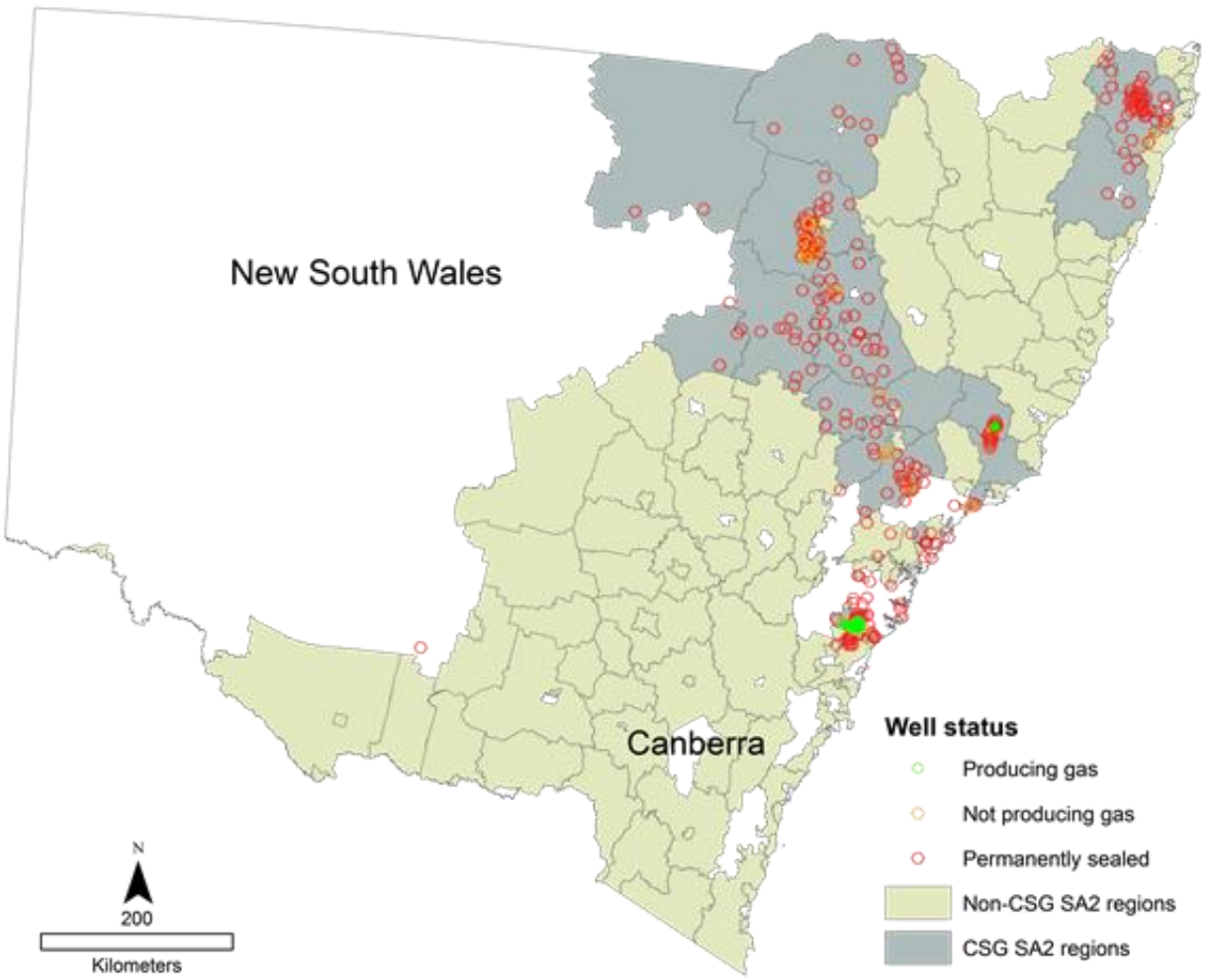
Scenarios:

1) **Business as usual.** The industry continues its current trend of declining CSG activity in NSW.

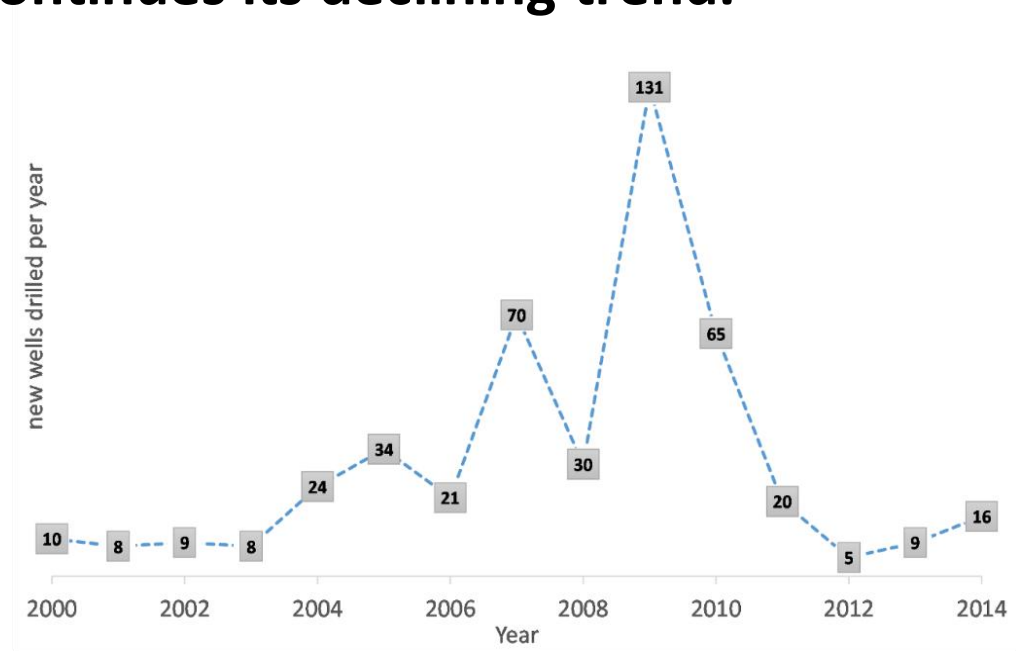
2) **Increasing gas demand** reactivates CSG activity in the study region **at 2010-14 averages**.

3) Increasing gas demand reactivates CSG activity in the study region **at maximum 2010-14 level**s.

Scenario 1. Business as usual. The CSG industry continues its declining trend.



Status of CSG wells drilled during the period 2000-2014.



Wells drilled per year (2000-2014).

Outcomes:

If CSG activity stops or concentrates in few regions the **CSG family income effect** would **only** continue **in regions still experiencing CSG activity**.

If CSG activity deviates significantly from historical patterns, the income effect would need to be re-estimated with an **updated set of CSG and control regions**.

Scenario 2. Increasing gas demand translates into new CSG activity at average 2010–14 levels.

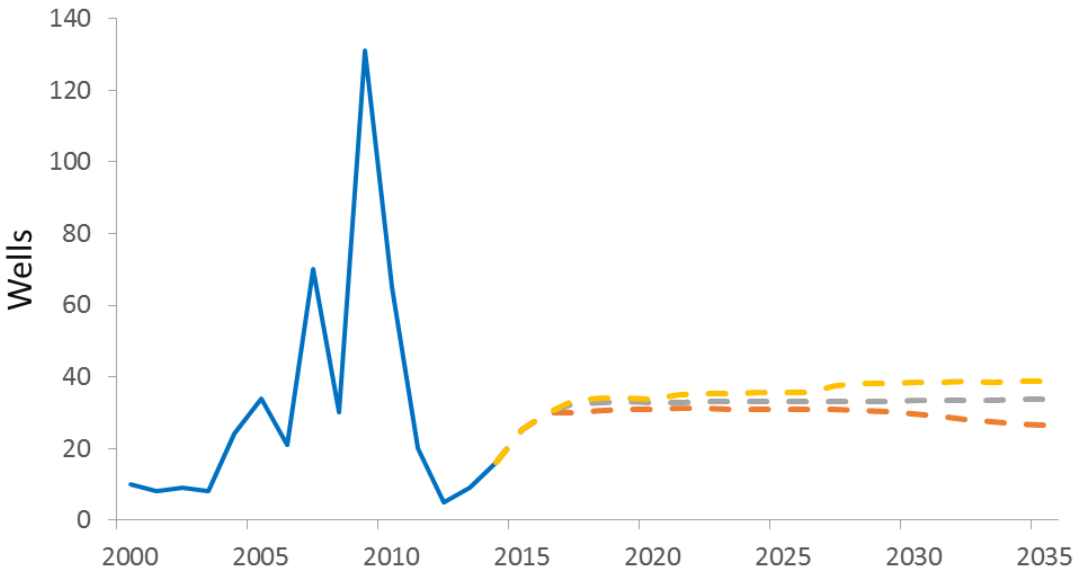
The 2016 National Gas Forecasting Report (NGFR) (AEMO 2016) projects **Australian gas consumption to 2036** under three scenarios:

- **Weak**. Low **population** and economic **growth** and increased **energy** efficiency.
- **Neutral**. Average trend in population and economic growth and medium energy efficiency uptake.
- **Strong**. Strong population and economic growth and high energy efficiency uptake.

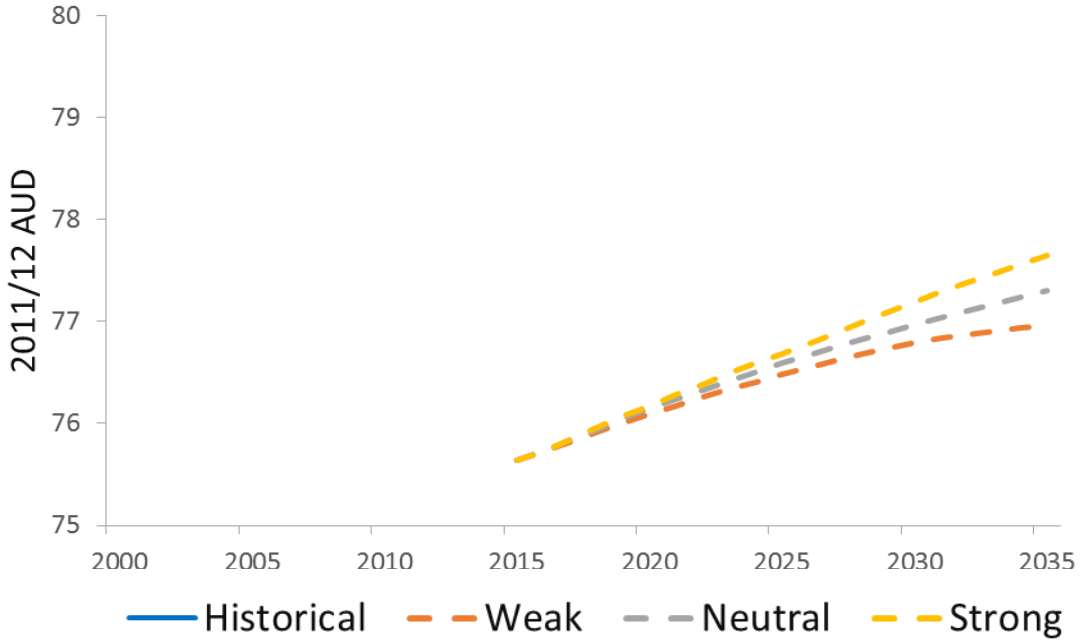
Scenarios 2 &3 specific assumption: a 1% increase in projected gas demand results in a 0.25% increase in new CSG activity (i.e. new wells) in the study area. This is based on the share of NSW energy consumption relative to the country level consumption in 2014–15 (Department of Industry 2016).

Scenario 2. Increasing gas demand translates into new CSG activity at average 2010–14 levels.

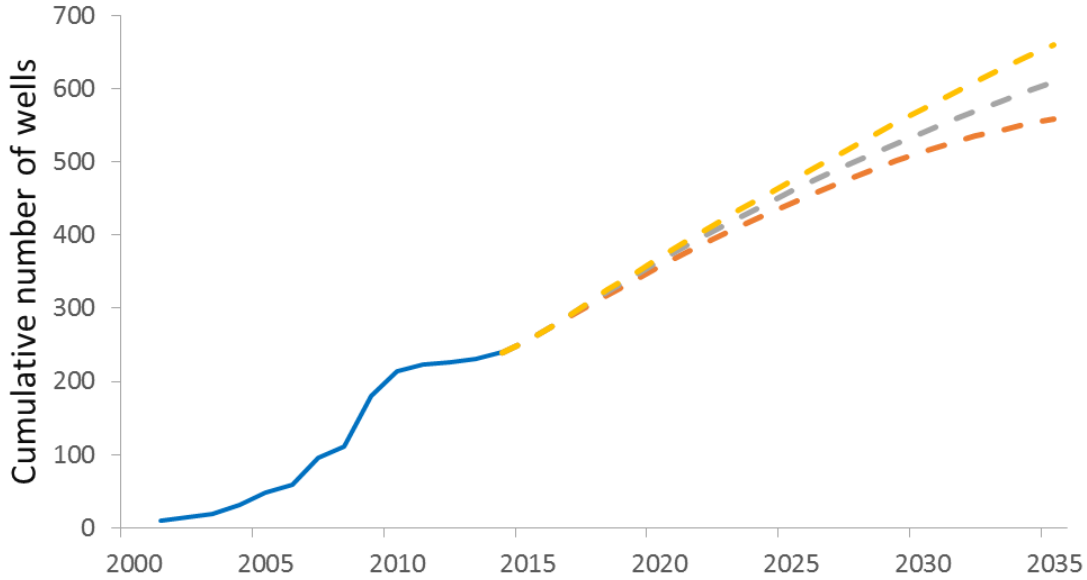
a) Wells drilled per year



c) Income effect of CSG activity



b) Cumulative number of wells

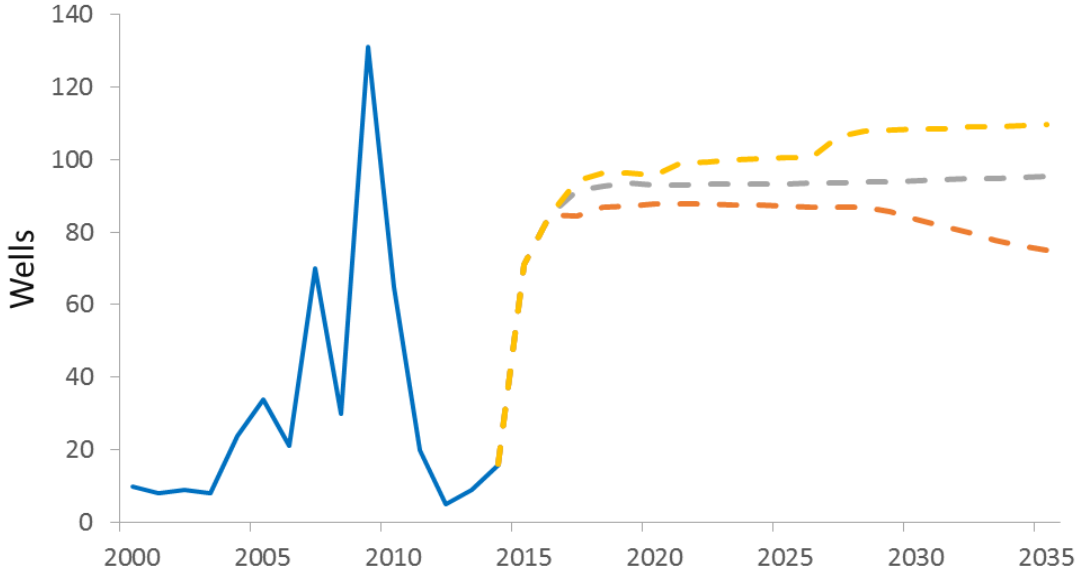


Outcomes:

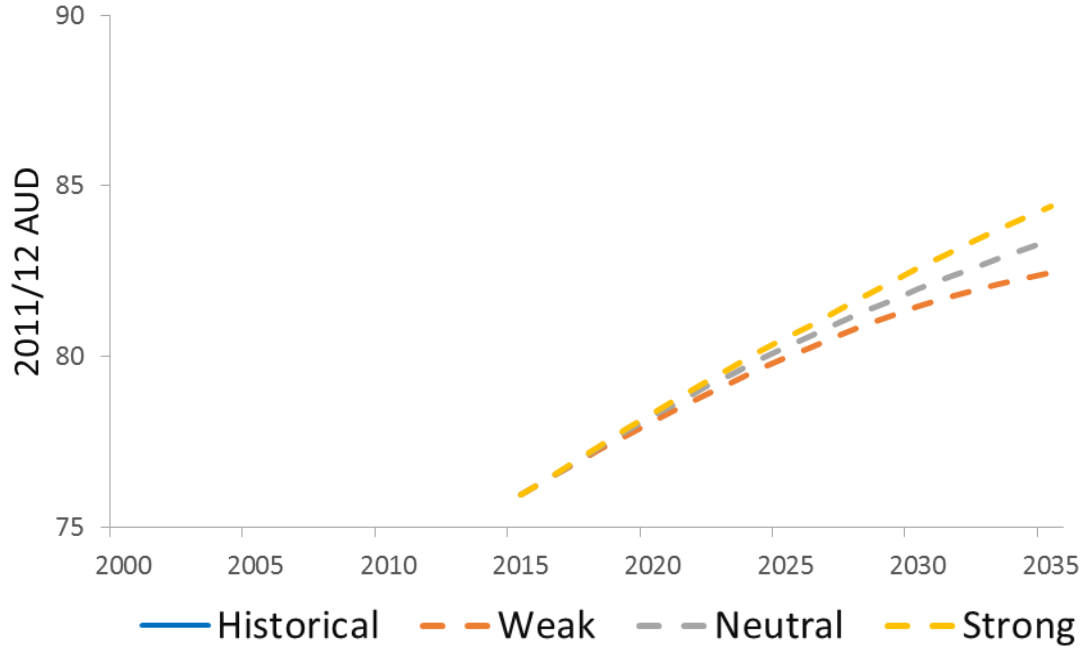
- An average number of **33 new CSG wells per year** during the period 2015–2035 (Fig. a).
- Between **660 and 800 new wells by 2035**.
- The increasing level of CSG activity (i.e. well density) under the weak, neutral, and strong gas demand outlooks was associated with a **6.68%, 6.71% and 6.75% higher weekly median family income to 2035** relative to regions without CSG activity (Fig. c).

Scenario 3. Increasing gas demand translates into new CSG activity at average 2010–14 levels.

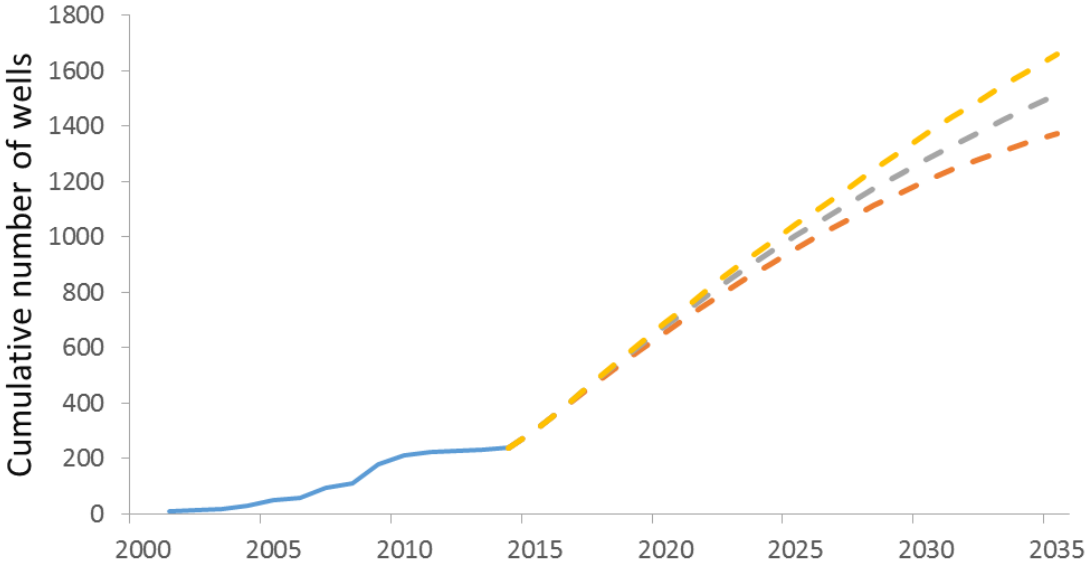
a) Wells drilled per year



c) Income effect of CSG activity



b) Cumulative number of wells



Outcomes:

- Around **94 wells per year** (Fig. a).
- **1,800 to 2,240 new wells**.
- By 2035, **7.35%, 7.46%, and 7.57% higher** weekly median **family income** in CSG regions.
- 0.75% higher median weekly family income level than the scenario 2 projections.
- The large number of new wells under this scenario does not translate into a larger income effect due to the small well density coefficient.

Projected scenarios in the context of the Narrabri project

- Up **to 850 new CSG wells** could be in operation in the **Narrabri region** between 2018 and **2043** if the Narrabri gas project is implemented.

- CSG activity under **scenario 2** (changes relative to the average 2010–14 CSG activity) represent **86% of the size of the Narrabri project** (735 new wells).

- **Scenario 3** corresponds to **2.4 times more new wells than the Narrabri project**. However the average number of new wells per year is 30% less than the maximum observed in 2009 in NSW and only **6% of the maximum number of wells drilled in a year in Queensland** (1634 in 2013-14) (Department of Natural Resources and Mines 2017).

- If additional CSG activity only occurs as part of the Narrabri gas project we would expect changes in the CSG income effect estimated during the period 2001-2011.

- Higher income around the Narrabri region would be expected to continue but the CSG income effect could disappear in areas where CSG activity stops.

Concluding remarks

- Strong **assumptions** were made to link projected **changes in domestic gas demand** with **changes in CSG activity** in NSW.
- We assumed that each 1% change in projected **domestic gas demand** would result in a 0.25% change in CSG well drilling. It is likely that demand **shocks** will be covered by increased supply from regions with already **established conventional gas or CSG industries**.
- If future levels of **CSG activity deviate significantly from 2001-11 patterns** the statistical analysis would not provide an accurate estimation of the potential impacts of the industry.
- However, **the analysis reflects what 'on average' we could expect given the different scenarios presented for potential future CSG activity in NSW**.
- The results could inform future research on the economies of regions experiencing CSG industry activity in New South Wales.