

# Modelling Opportunities for Improved Energy Efficiency

Presentation to NFEE Workshop

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# Outline

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- Introduction
- MMRF-Green model
- Modelling methodology
- Modelling results
- Key points
- Conclusion

# MMRF-Green

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- MMRF-Green is a complete bottoms-up model of the Australian economy
  - covers the six states and two territories
  - models each region as an economy in its own right
    - region-specific prices
    - region-specific consumers
    - region-specific industries, etc.
- It has explicit representations of
  - intra-regional, inter-regional and international trade flows based on regional IO data developed at CoPS
  - detailed data on state and federal government's budgets

# MMRF-Green continued ...

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- Aggregated input-output database of 37 industries in each state, including:
  - separate single-product industries producing oil, natural gas and brown coal
  - five separate electricity generating industries and a single electricity distribution industry
    - generators distinguished by primary-fuel
    - distributor allowed to substitute between sources of generation
- Technical change in the model
  - Energy supply 0.6 % per annum improvement
  - Energy end use 0.5 % per annum improvement

# MMRF-Green continued ...

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- Technical change in the model
  - Improvement in output per unit of intermediate input, based on historic rates of change
  - Encompasses 'autonomous energy efficiency improvement'
    - Energy supply at 0.6 % per annum improvement
    - Energy end use at 0.5 % per annum improvement
- Model assumes economy is technically efficient
  - Economy is on the production possibility frontier, with no opportunity for improvements in the efficiency of resource use

# Modelling Methodology

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- SEAV-developed input data on energy efficiency opportunities based on industry by industry technical studies
  - Beyond 'business as usual'
- Configured as two exogenous shocks for input to MMRF-Green for
  - Capital expenditure by industry and households
  - Value of energy savings by industry and households

# Modelling Methodology continued ...

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## ➤ Capital expenditure

- Increase in investment expenditure on energy saving equipment (other manufacturing) and services (construction)

## ➤ Energy savings

- Reduction in primary fuels and electricity per unit of output

## ➤ Methodology

- For industries - shift in technology of production away from energy and towards other manufacturing and services capital inputs
- For households - shift in tastes away from energy towards other manufacturing and services capital inputs

# Modelling Results

## Comparison of Economic Impact : Phases 1, 2 & 3

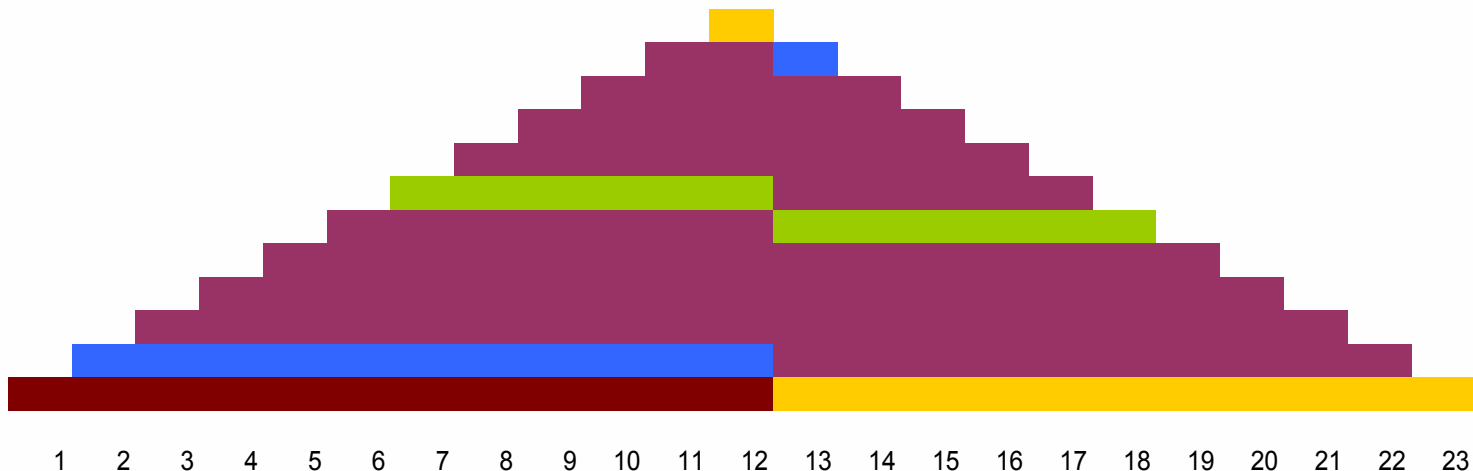
Variable	Unit	Phase One <sup>1</sup> Ave 4 year payback	Phase Two <sup>1</sup> Up to 4 year payback	Phase Three <sup>2</sup> 1% NEET
Real GDP	\$ Billion	+1.8 (+0.2%)	+0.97 (+0.1%)	+1.57 (+0.2%)
Real Private Consumption	\$ Billion	+1.8 (+0.35%)	+0.72 (+0.1%)	+1.03 (+0.2%)
Employment	Persons	+9200 (+0.09%)	+2600 (+0.02%)	+1940 (+0.02%)
GHG Emissions from stationary energy sector	Mt of CO <sub>2</sub> -e	-32 (-9.2%)	-10 (-2.8%)	-16 (-5.4%)
Stationary final energy consumption	PJ	-213 (-9.1%)	-76 (-2.8%)	-131 (-5.4%)
Direct Energy Savings Despatched	PJ (Rebound) (%)	-268 (21%)	-106 (28%)	-183 (28%)

1. Year 12 change relative to base case

2. Year 10 change relative to base case

# Phase 2 Modelling

- '50 per cent – low' energy efficiency opportunities with revised energy efficiency data (including EMET and Energetics)
  - paybacks up to 4 years
- Investments equally spaced over 12 years
  - Year 1 investments last until year 12
  - Year 12 investments last until year 23

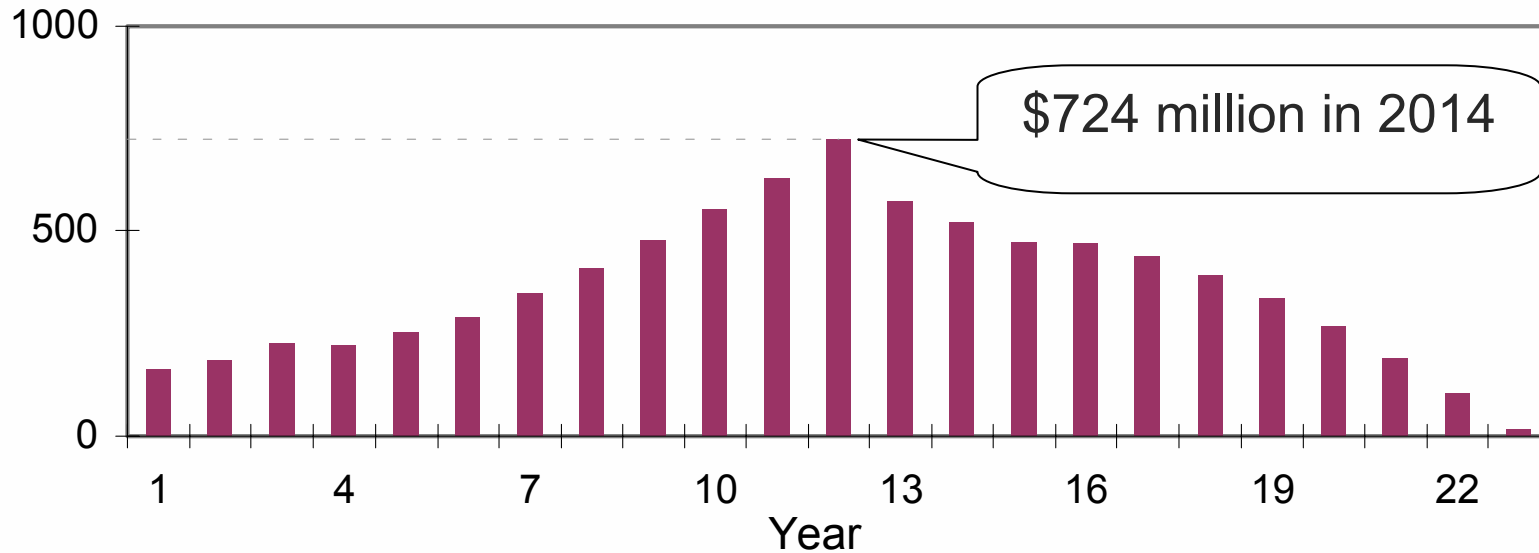


# Phase 2 Modelling Results

## IMPACT ON NATIONAL REAL PRIVATE CONSUMPTION, 50 PER CENT – LOW SCENARIO

NPV<sub>4</sub> \$5286 million

Absolute deviations  
from base case (\$m)



# Phase 2 Modelling Results

## IMPACT ON REAL PRIVATE CONSUMPTION, 50 PER CENT – LOW SCENARIO, BY STATE AND TERRITORY, YEAR 12

Absolute deviations  
from base case (\$m)

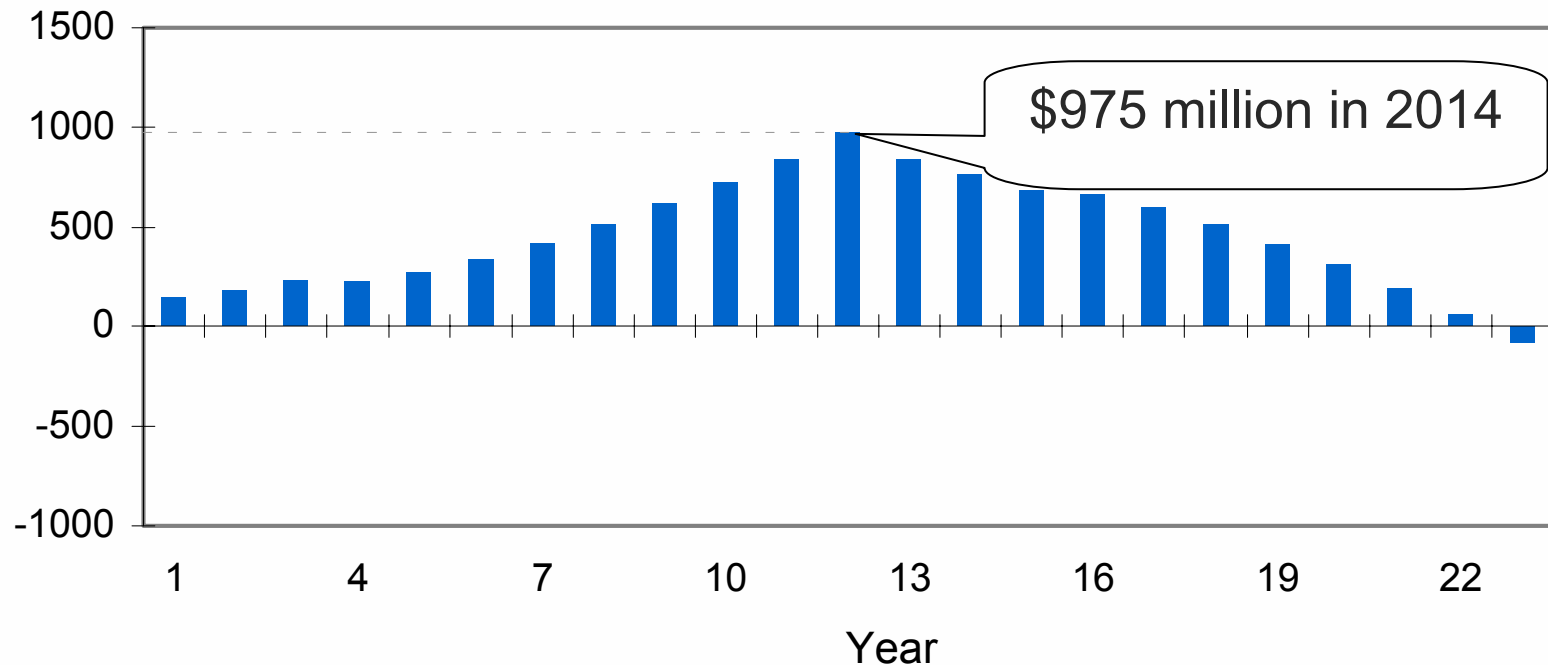


# Phase 2 Modelling Results

## IMPACT ON GDP, 50 PER CENT – LOW SCENARIO

Absolute deviations  
from base case (\$m)

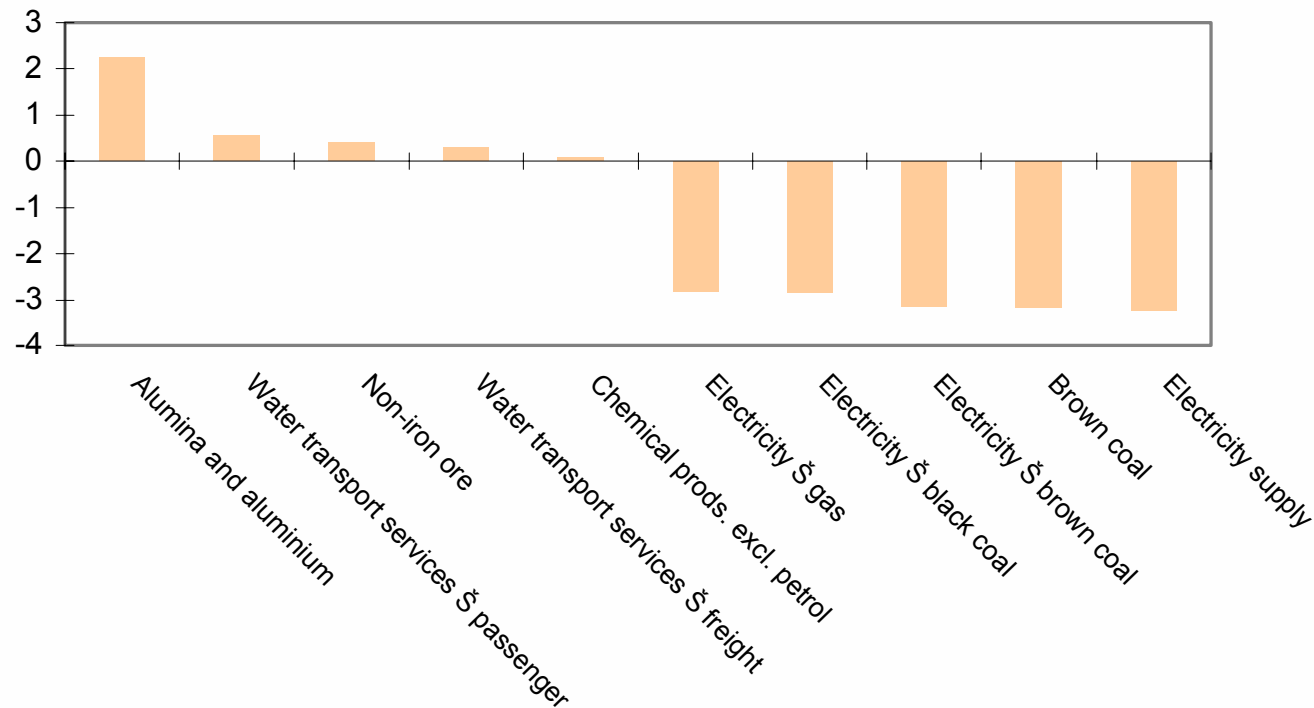
NPV<sub>4</sub> \$6617 million



# Phase 2 Modelling Results

## IMPACT ON INDUSTRY OUTPUT — INDUSTRIES EXPERIENCING MOST SIGNIFICANT GAINS AND LOSSES, 50 PER CENT – LOW SCENARIO, YEAR 12

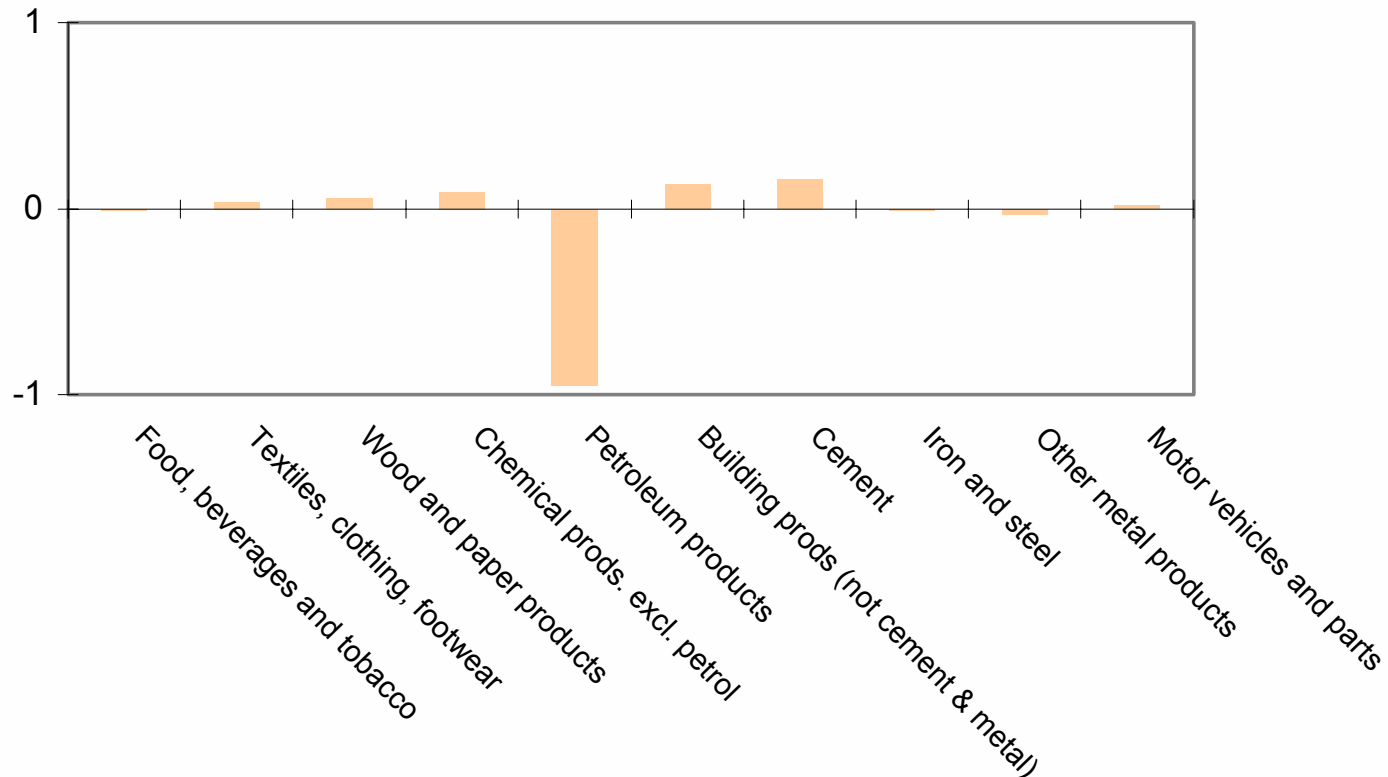
Percentage deviations  
from base case



# Phase 2 Modelling Results

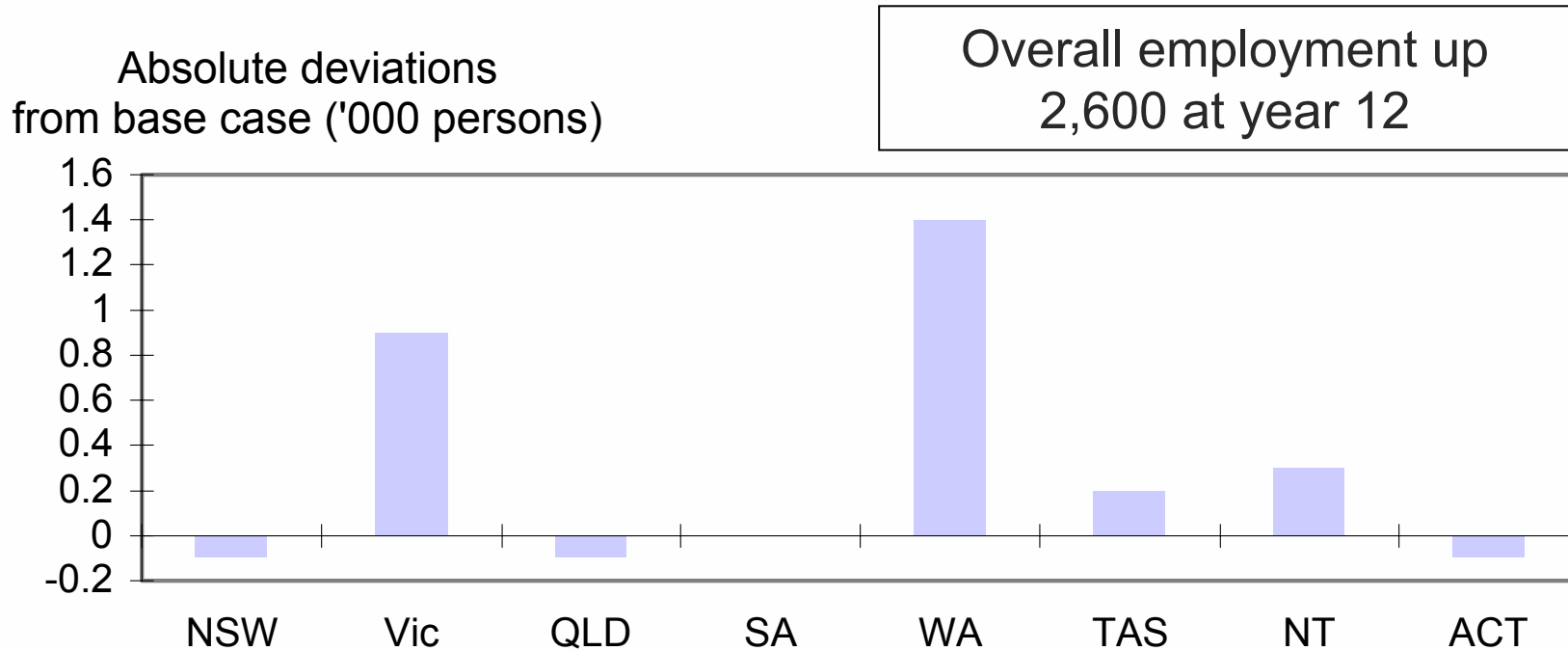
## IMPACT ON INDUSTRY OUTPUT — INDUSTRIAL SECTOR, 50 PER CENT – LOW SCENARIO, YEAR 12

Percentage deviations  
from base case



# Phase 2 Modelling Results

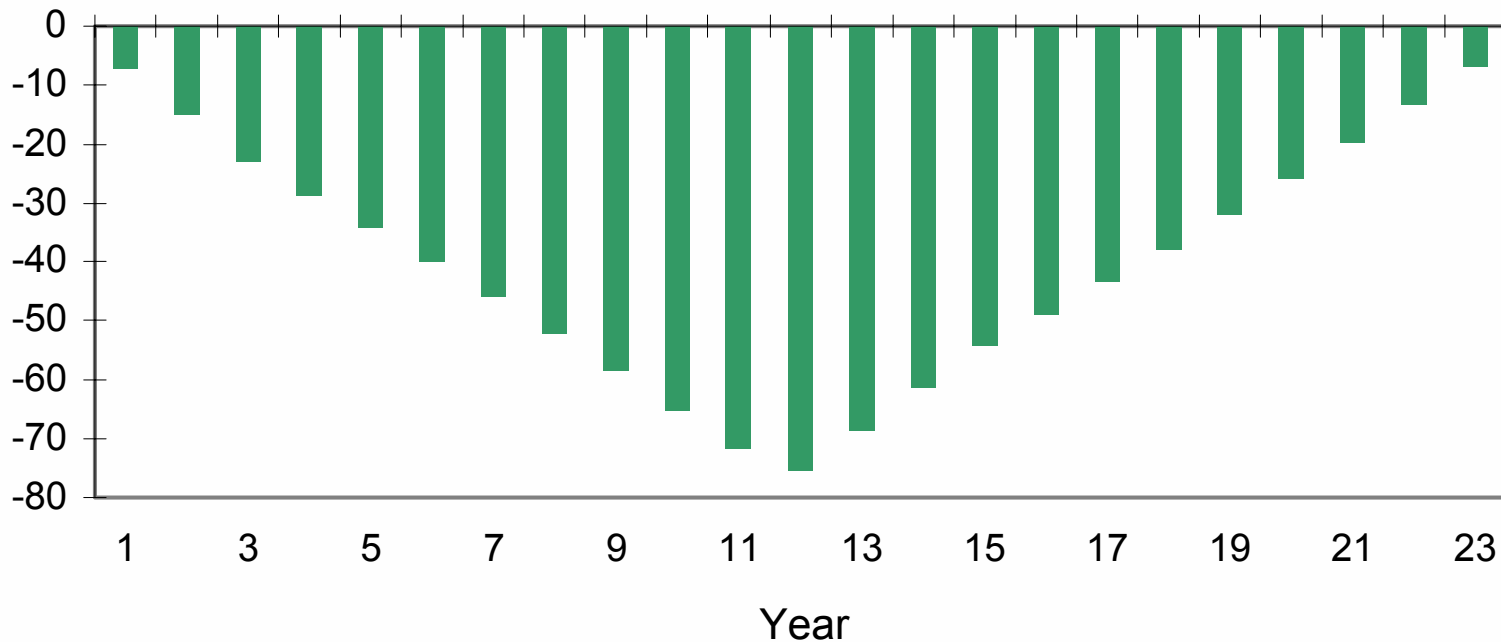
## IMPACT ON EMPLOYMENT, 50 PER CENT – LOW SCENARIO, BY STATE AND TERRITORY, YEAR 12



# Phase 2 Modelling Results

## ENERGY SAVED FROM IMPROVED ENERGY EFFICIENCY MEASURES, 50 PER CENT – LOW SCENARIO

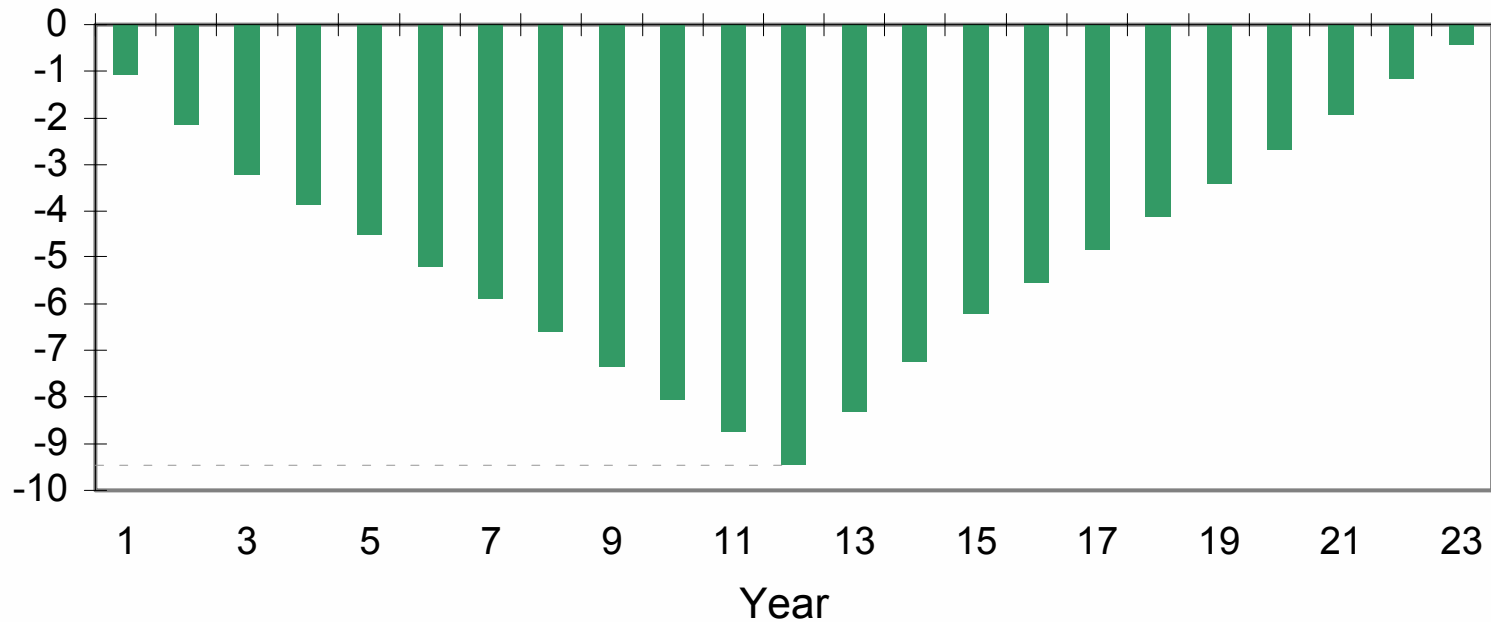
Absolute deviations  
from base case (petajoules)



# Phase 2 Modelling Results

## IMPACT ON NATIONAL GREENHOUSE GAS EMISSIONS — STATIONARY ENERGY EMISSIONS ONLY, 50 PER CENT — LOW SCENARIO

Absolute deviations  
from base case (CO<sub>2</sub>-e)



# Modelling Results

## Comparison of Economic Impact : Phases 1, 2 & 3

Variable	Unit	Phase One <sup>1</sup> Ave 4 year payback	Phase Two <sup>1</sup> Up to 4 year payback	Phase Three <sup>2</sup> 1% NEET
Real GDP	\$ Billion	<b>+1.8</b> (+0.2%)	<b>+0.97</b> (+0.1%)	<b>+1.57</b> (+0.2%)
Real Private Consumption	\$ Billion	<b>+1.8</b> (+0.35%)	<b>+0.72</b> (+0.1%)	<b>+1.03</b> (+0.2%)
Employment	Persons	<b>+9200</b> (+0.09%)	<b>+2600</b> (+0.02%)	<b>+1940</b> (+0.02%)
GHG Emissions from stationary energy sector	Mt of CO <sub>2</sub> -e	<b>-32</b> (-9.2%)	<b>-10</b> (-2.8%)	<b>-16</b> (-5.4%)
Stationary final energy consumption	PJ	<b>-213</b> (-9.1%)	<b>-76</b> (-2.8%)	<b>-131</b> (-5.4%)
Direct Energy Savings Despatched	PJ (Rebound) (%)	<b>-268</b> (21%)	<b>-106</b> (28%)	<b>-183</b> (28%)

1. Year 12 change relative to base case

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# Phase 3 Modelling

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## ➤ Scenario 1: 1 % NEET (beyond BAU)

- Saving 1% of the previous years end use energy 2005 to 2014
- 1.5% beyond 'frozen efficiency' with 0.5% AEEI
- Quick ramp up over 3 years (0.33%, 0.67%, 1%) to 2007
- Ramp down over 3 years (1%, 0.67%, 0.33%) to 2014

## ➤ Scenario 2: Slower ramp up rate sensitivity

- 1% NEET
- Quick ramp up over 5 years (0.2%, 0.4%, 0.6%, 0.8%, 1%) to 2009
- Ramp down over 3 years to 2014

## ➤ Scenario 3: Target sensitivity

- 0.5% NEET
- Quick ramp up and ramp down

# Modelling Results

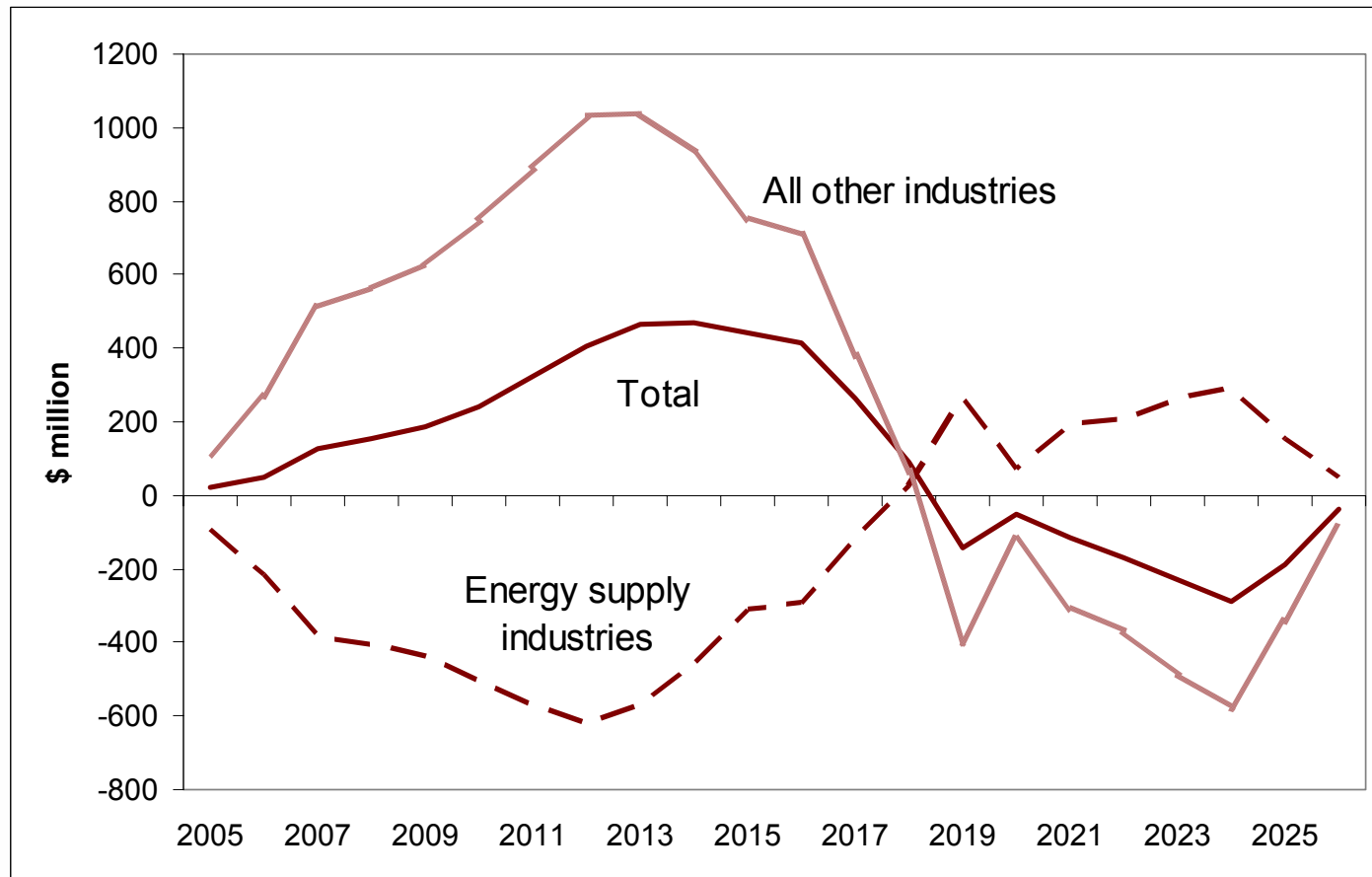
## Phase 3 at 2014

Variable	Unit	Phase Three <sup>1</sup> 1% NEET Fast ramp up	Phase Three <sup>1</sup> 1% NEET Slow ramp up	Phase Three <sup>1</sup> 0.5% NEET Fast ramp up
Real GDP	\$ Billion	<b>+1.6</b> (+0.2%)	<b>+1.4</b> (+0.2%)	<b>+0.8</b> (+0.1%)
Real Private Consumption	\$ Billion	<b>+1.0</b> (+0.2%)	<b>+0.9</b> (+0.2%)	<b>+0.5</b> (+0.1%)
Real Private Consumption NPV 2005 - 2026	\$ Billion	<b>+8.5</b>	<b>+7.6</b>	<b>+4.1</b>
Energy Prices (2010)	Gas Electricity (per cent)	<b>-3.3%</b> <b>-4.3%</b>	<b>-3.6%</b> <b>-4.2%</b>	<b>-1.6%</b> <b>-2.1%</b>
GHG Emissions from stationary energy sector	Mt of CO <sub>2</sub> -e	<b>-16</b> (-5.4%)	<b>-14</b> (-4.7%)	<b>-8</b> (-2.6%)

# Modelling Results Phase 3

## Scenario 1 : 1 % NEET

### Composition of Investment – Deviation from Base Case



# Conclusion

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- End use energy savings in gas and electricity deliver significant
  - Increases in consumption, GDP, investment and employment
  - Reductions in greenhouse gas emissions
  - Lower prices for electricity and gas