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RENEWABLE ENERGY TARGET REVIEW: *ISSUES PAPER, AUGUST 2012*

APPEA Submission

SEPTEMBER 2012

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1. INTRODUCTION

The Australian Petroleum Production & Exploration Association (APPEA) welcomes the opportunity to provide comment on the Renewable Energy Target (RET) Review: *Issues Paper, August 2012*, issued by the Climate Change Authority on 20 August 2012.

APPEA is the peak national body representing the Australian upstream oil and gas industry. APPEA member companies collectively produce around 98 per cent of Australia's oil and gas. Further details about APPEA can be found at our website, at www.appea.com.au.

APPEA's submission addresses specific sections of the *Issues Paper*, focussing on those areas that are particularly important for the upstream oil and gas industry.

2. THE RENEWABLE ENERGY TARGET: GENERAL COMMENTS

With a carbon price mechanism now in place through the *Clean Energy Act 2011*, the continued purpose of the RET, which forces a fixed quantum of renewable energy into the supply mix, displacing lower cost non-renewable but relatively low-emission alternatives (most notably natural gas) should be the subject of rigorous assessment.

As reviews by the Productivity Commission, Garnaut Climate Change Review and the Strategic Review of Australian Government Climate Change Programs (the Wilkins Review) have found the continuation of the RET with the carbon price mechanism mean that the RET will not result in extra greenhouse gas emissions abatement, but will result in extra cost.

This is acknowledged in the *Issues Paper* at page 42, which states:

> *The LRET and SRES increase the cost of electricity to consumers.*

APPEA has commissioned new independent analysis by BAEconomics that reinforces this finding. The BAEconomics report is considered further in section 2.2.

2.1 Renewable Energy Target: results of previous analysis

There have been a range of analyses of the RET and its interaction with a carbon price mechanism conducted in recent years.

As the Treasury economic modelling conducted in 2008 and again in 2011 shows[1], the RET costs around three times the cost of a domestic emissions trading scheme (ETS) for the same expected abatement. It is also likely that, based on current expectations of renewable energy supply and costs, the RET will drive the deployment of increasingly expensive technologies.

Analysis by the Productivity Commission in 2008 clearly demonstrates the non-complementary nature of the RET, resulting amongst other things in an inefficiently

[1] Australian Government (2008), *Australia's Low Pollution Future* (see www.treasury.gov.au/lowpollutionfuture for further information) and Australian Government (2011), *Strong Growth, Low Pollution: Modelling a Carbon Price* (see archive.treasury.gov.au/carbonpricemodelling/content/report.asp).

low level of investment in gas-fired electricity generation[2]. The Commission found that (see page XVII):

> *An MRET operating in conjunction with an ETS would not encourage any additional abatement, but still impose additional administration and monitoring costs. To the extent that the MRET is binding (which is its purpose) it would constrain how emission reductions are achieved — electricity prices would be higher than otherwise and market coordination about the appropriate time to introduce low-emissions energy technologies would be overridden. If it was non-binding, it would simply increase administrative, compliance and monitoring costs. Moreover, it would also help to foster a perception that governments are amenable to interfering with the least cost abatement objective of the ETS. This could encourage other potential beneficiaries to seek special programs that neither increase abatement nor reduce its cost.*

In its 2008 Report, the Strategic Review of Australian Government Climate Change Programs (the Wilkins Review)[3], similarly found (see page 141):

> *… the Review considers that schemes such as the RET, FITs and demand driven subsidies for the deployment of solar power are not complementary to an ETS. They will, as discussed recently by the Productivity Commission, add to the cost of achieving an abatement target rather than producing additional abatement. The Review would concur with the Productivity Commission's analysis that the RET is likely to add to the cost of abatement, and would not be complementary.*

The Garnaut Report[4] in 2008 found that (see page 356):

> *… there is an interesting and seemingly perverse consequence of expanding MRET at the same time as the emissions trading scheme is to be implemented. Having both schemes operating side by side could see an increase in coal-fired power generation (by more than 2,000 MW) as gas-fired plants are crowded out by MRET. This would not occur if the emissions trading scheme were operating without MRET.*

At least in the medium-term, the result will be a higher cost to achieve the same level of overall carbon constraint than would have been achieved in the absence of the RET.

2.2 Renewable Energy Target: BAEconomics report, *Implications of the RET for the Australian economy*

To inform its understanding of the implications of the RET for the economy, electricity market and the Australian upstream oil and gas industry, APPEA commissioned economic advisory firm BAEconomics to analyse and model the implications for the Australian economy of the RET over the period out to 2030.

In particular, the cost of combining this policy with a domestic ETS (through the *Clean Energy Act 2011*) was examined for the likely impacts on economic output (GDP), carbon prices, real wages, greenhouse gas emissions and the electricity sector, with a particular assessment of the likely impacts of the target on gas penetration in the electricity market.

[2] Productivity Commission (2008), *What Role for Policies to Supplement an Emissions Trading Scheme?,* Submission to the Garnaut Climate Change Review, May (available from www.pc.gov.au/__data/assets/pdf_file/0003/79716/garnaut.pdf).
[3] Mr Roger Wilkins AO (2008), *Strategic Review of Australian Government Climate Change Programs* (available at www.finance.gov.au/publications/strategic-reviews/docs/Climate-Report.pdf).
[4] Professor R Garnaut (2008), *The Garnaut Climate Change Review: Final Report* (available at www.garnautreview.org.au/pdf/Garnaut_Chapter14.pdf).

The economic implications of four policy options relative to a reference case in which no climate change policies are adopted was assessed:

- A domestic ETS policy scenario versus a domestic combined ETS + RET policy scenario; and

- An ETS policy scenario versus a combined ETS + RET policy scenario, in which the Australian ETS is linked to the European Union ETS (ETS_EU)[5].

In addition to the quantitative assessment, BAEconomics outlined the likely impacts of the RET on the electricity sector. This included the mix of generating technologies that might be used to meet the target, issues around location and number of plants needed to meet the target and the reliability of the grid, including requirements for back-up supply.

A copy of the BAEconomics report, *Implications of the RET for the Australian economy*, can be found at Attachment 1. In summary, it found:

- That the combination of the ETS with the RET is significantly **less** efficient than an unadulterated ETS in achieving a given level of emissions abatement;

- To reach the emission target of five per cent below 2000 levels in 2020, the combined ETS + RET policy:

  - costs Australia $3.5 billion in today's dollars more than the ETS in GDP losses in 2020; and

  - causes substantial switching away from gas-fired generation compared with an ETS, by 3,824 gigawatt hours (GWh) in 2020;

- A mandated renewable energy target such as the RET is less efficient at achieving a given environmental outcome because it forces higher cost renewable energy into the electricity generation mix at the expense of exploiting lower cost emissions abatement opportunities from gas generation and elsewhere in the economy;

- The larger reduction in GDP as a result of the RET is a consequence of the design of the scheme. The RET is a prescriptive technological mandate that requires renewable generation facilities to be commissioned, irrespective of whether lower cost alternatives (such as gas technologies) are available to meet the emissions objective. It is therefore more efficient and less economically damaging to employ a pure ETS policy strategy to achieve a given level of emissions abatement than it is to adopt a combined (ETS and RET) policy approach;

- The negative GDP impacts modelled in this report are likely to be conservative. This is because a significant portion of the RET target will be met from high cost, small-scale domestic installations, such as rooftop solar PV and solar hot water installations, which are not explicitly modelled in this exercise. Furthermore, a high reliance on renewable

[5] Reflecting the Australian Government and European Commission announcement on 28 August 2012 (see www.climatechange.gov.au/minister/greg-combet/2012/media-releases/August/JMR-20120828.aspx and europa.eu/rapid/pressReleasesAction.do?reference=IP/12/916&format=HTML&aged=0&language=EN&guiLanguage=en for further information).

generation, particularly on intermittent technologies such as wind, imposes significant additional costs on the electricity system, for instance in terms of additional stand-by capacity required;

- Similar effects arise when the Australian ETS is linked with the European ETS. A combined ETS_EU + RET policy:

  - reduces Australian GDP by $6.5 billion in today's dollars more than the unadulterated ETS_EU in 2020; and

  - reduces gas-fired generation compared with the ETS_EU by 2,313 GWh in 2020;

- Linking the Australian ETS with the EU ETS also implies that the Government's 2020 domestic emissions reductions target will be partly met by additional abatement in Europe. In these circumstances, Australia will be a net permit buyer before 2020 and the domestic carbon price will instead be set by the price of EU emissions allowances. Lower prices for EU allowances then translate into lower domestic carbon prices, and lower levels of domestic abatement and a transfer of income from Australia to the European Union;

- Irrespective of whether a stand-alone domestic ETS or a domestic ETS linked to the EU ETS is modelled, the overall effect on electricity generation is less under an ETS than it is under an ETS combined with the RET. This is because the abatement task is spread more evenly across the economy under an ETS and electricity prices are relatively lower. With a mandated renewables target, the electricity sector takes on a disproportionate abatement burden (given the marginal cost of abatement in the sector compared with marginal costs elsewhere in the economy) for a given abatement task;

- By 2020, average annual electricity wholesale prices relative to the reference case will be 27.8 per cent higher in the ETS_EU + RET scenario, and 19.5 per cent higher in the ETS_EU scenario. The relatively smaller price increase in the ETS_EU scenario is a reflection of the lower carbon price in this scenario, which is in turn a function of lower prices for EU allowances.

The combination of the RET with a domestic ETS policy means that the share of generation from expensive renewables is more than doubled, at the expense of generation from lower cost natural gas and adjustments in other sectors. In 2020, Australian GDP under the ETS_EU + RET policy option is $6.5 billion lower in today's dollars, as compared to GDP under the ETS_EU policy only option.

This outcome is inconsistent with the Government's policy objective to reduce greenhouse gas emissions at lowest cost to the Australian economy. It is also at odds with the recent APEC Leaders' Declaration[6], which committed APEC Leaders to

> *… review the current state and prospects of energy markets of the APEC region, with a view to increasing the share of natural gas in the energy mix as one of the most widespread and cleanest*

[6] Asia-Pacific Economic Co-operation 2012 Leaders' Declaration, *Vladivostok Declaration – Integrate to Grow, Innovate to Prosper, Annex B – Strengthening APEC Energy Security* (available at www.apec.org/Meeting-Papers/Leaders-Declarations/2012/2012_aelm/2012_aelm_annexB.aspx).

> *burning fossil fuels in the region in order to facilitate the transition to a lower carbon economy without prejudice of other energy sources …*

The RET is an economically inefficient policy operation that should be discontinued.

3. THE RENEWABLE ENERGY TARGET: SPECIFIC COMMENTS ON THE *ISSUES PAPER*

While the RET is in place, there are a number of elements of operational provisions of the *Renewable Energy (Electricity) Act 2000* that are of particular importance to the upstream oil and gas industry.

These are focussed on Section 5.1 and 5.3 of the *Issues Paper*:

- The 20 per cent by 2020 commitment;
- The treatment of trade-exposed industries through the Partial Exemption Certificate (PEC) provisions; and
- Self-generator provisions.

3.1 *Issues Paper*, Section 5.1: the 20 per cent by 2020 commitment

The *Issues Paper* at section 5.1 discusses the policy commitment of the Government to ensure 20 per cent of renewable energy should come from renewable energy sources (the 20 per cent by 2020 commitment).

The phrase 'at least 20 per cent' or '20 per cent' is used in various places in the supporting materials for the *Renewable Energy (Electricity) Act 2000*. For example, the Explanatory Statement to the *Renewable Energy (Electricity) Amendment Regulation 2012 (No. 1)*[7] says:

> *The Renewable Energy (Electricity) Act 2000 (the Act) establishes a Renewable Energy Target (RET) scheme to encourage additional electricity generation from eligible energy sources. The RET scheme is designed to* ***ensure that 20 per cent*** *of Australia's electricity supply is generated from renewable sources by 2020.* [Emphasis added]

As the *Issues Paper* notes on page 22, the *Renewable Energy (Electricity) Act 2000* does not reference this commitment. Instead, it sets out a fixed GWh target of 45,000 GWh of electricity generation should be sourced from renewable energy sources.

The *Issues Paper* also notes recent analysis by the Australian Energy Market Operator (AEMO) that suggests that the fixed annual level provided under the Act will result in a level of renewable energy generation well above 20 per cent (maybe 25 per cent or more). This means that the RET, already a costly approach reducing greenhouse gas emissions, is imposing costs on the economy over and above the level at which 20 per cent of Australia's electricity supply is generated from renewable sources by 2020.

[7] Available at www.comlaw.gov.au/Details/F2012L00399/Explanatory%20Statement/Text.

The fixed gigawatt hour target should be revised down to reflect the level required to achieve the 20 per cent by 2020 commitment.

3.2 *Issues Paper*, Section 5.3: Treatment of trade-exposed industries

The policy intent of the treatment of trade-exposed industries and the use of the Partial Exemption Certificate (PEC) approach is set out by the Clean Energy Regulator as follows[8]:

> *Partial exemption is provided in recognition of an increase in electricity prices as a result of the expanded RET …*

This refers to the cost imposed on trade-exposed industries by the RET – costs that are in many cases, particularly for the production of liquefied natural gas (LNG), not borne by international competitors and which cannot be passed through to end-consumers.

Australia's LNG projects face fierce global competition. Australia's major LNG competitors include Qatar, Indonesia, Malaysia, Trinidad & Tobago, Peru, Oman, Yemen, the Russian Federation, the United Arab Emirates, Egypt, Equatorial Guinea, Nigeria, Algeria and Brunei[9]. In the future they will include PNG and potentially the US (on their back of their enormous shale gas developments in recent years) and East Africa (with prospective gas resources in countries such as Tanzania and Mozambique).

Very few of Australia's major LNG competitors are taking on emissions reduction obligations. Indeed, none have policies in place that impose an "effective" carbon price on their LNG exporters. The prospect of our competitors taking meaningful action in the foreseeable future is low.

Australia's LNG exporters are amongst the most trade-exposed of all Australian exporters. They cannot pass increased costs on to consumers and any loss of international competitiveness would benefit Australia's international LNG competitors or suppliers of alternative, higher greenhouse gas emitting, energy sources.

This means that while APPEA supports this policy intent of the PEC approach, a partial exemption means that trade-exposed industries continue to face cost increases that inefficiently and unnecessarily reduce their international competitiveness. Indeed, the PEC is in effect, a "partial, partial" exemption, as the PEC only applies to the portion of the RET above the former Mandatory Renewable Energy Target (MRET) target of 9,500 GWh.

In the case of LNG, a PEC set at 60 per cent was included in Part 38 of the *Renewable Energy (Electricity) Amendment Regulation 2012 (No. 1)*[10], which amended the *Renewable Energy (Electricity) Regulations 2001* and was made on 22 February 2012. This means that the industry remains exposed to significant additional costs associated with the RET. This reduces Australia's international competitiveness for LNG production and does not reduce greenhouse gas emissions in Australia.

[8] See, for example, ret.cleanenergyregulator.gov.au/ArticleDocuments/205/presentation-pec-workshops-0510.pdf.aspx.
[9] See BP (2012), *BP Statistical Review of World Energy, June 2012*, p. 28 (available at www.bp.com/statisticalreview).
[10] Available at www.comlaw.gov.au/Details/F2012L00399.

The PEC for trade-exposed industries, including LNG, should be increased to 100 per cent.

3.3 *Issues Paper*, Section 5.3: Self-generator provisions

3.3.1 Self-generator provisions under the expanded national Renewable Energy Target scheme: policy intent

The policy intent of the self-generation provisions was set out in the COAG review of specific RET issues Discussion Paper 2 *Self-generation provisions under the expanded national Renewable Energy Target scheme*[11], as

> … *supporting the development of self-generation, for which a substantial proportion uses more efficient cogeneration technologies and less greenhouse-intensive natural gas or renewables.*

APPEA supports the policy intent of the existing provisions. The natural gas industry, including the LNG industry, uses natural gas for self-generation purposes (or proposes to) at many facilities around Australia.

Natural gas produces significantly fewer greenhouse gas emissions than coal when used in power generation and is generally significantly lower than the average emissions intensity of grid-based power supply. The self-generation provisions, as they apply to the natural gas industry, are important in supporting lower emissions power generation options.

The provisions also support efficient commercial decision-making, by allowing projects, particularly those operating in rural and remote areas distant from the grid, to access the most cost effective form of power supply available to them.

Any move to further limit the application of the self-generation provisions would run counter to this policy intent.

The policy intent of the self-generation provisions was considered as part of the 2003 review of the operation of the *Renewable Energy (Electricity) Act 2000*. The Review's report, *Renewable Opportunities—A Review of the Operation of the Renewable Energy (Electricity) Act 2000*[12], endorsed the provisions.

The provisions contained in subsection 31(2) of the *Renewable Energy (Electricity) Act 2000* should be retained. Further, subsection 31(2) should, as is considered in subsection 3.3.2 below, be amended to address the adverse impact of the strict eligibility criteria that apply under subsections 31(2)(a) and 31(2)(b).

3.3.2 Self-generation provisions under the Renewable Energy Target scheme: impact of strict eligibility criteria and areas for improvement

The self-generation provisions contain strict eligibility criteria through restrictions on ownership (the end-user of the electricity must have generated the electricity), distance (the electricity is to be used less than one kilometre away from the point of generation) or

[11] Available at www.climatechange.gov.au/government/submissions/renewable-energy-target/~/media/government/submissions/RET-COAG-Discussion-paper-2-Self-generation-issues-PDF.pdf.
[12] See catalogue.nla.gov.au/Record/5037766 for further information.

line-use (there is a dedicated line between the point of generation and the point of use). These criteria limit the ability of self-generators to avail themselves of the provisions.

By limiting access to the self-generation provisions, these criteria can impact adversely on optimal project design for a range of upstream oil and gas projects. This is particularly so in the case of a number of LNG projects currently in the planning and/or construction stages around Australia.

A number of contemporary or planned projects may not meet the strict eligibility criteria outlined above. Project proponents may then be forced to make development decisions that are non-economic, purely to meet the requirements of the Act.

Some examples illustrate relevant circumstances facing project proponents in the upstream oil and gas industry and highlight the adverse impacts of the current strict eligibility criteria:

- Three large scale coal seam gas (CSG) developments are being developed in eastern Australia. These developments essentially represent single resource projects, but in many cases production infrastructure and electricity demand is dispersed over a large area. In many cases, combined demand will be over 100 megawatts but not necessarily in any single location. In addition, if the project proponent builds a dedicated generation plant, it may be within one kilometre of one demand centre, but more distant from others;

- In areas that are relatively distant from existing generation sources, some project proponents may consider sharing a transmission line with the proponent of another resources development. In this case, the most efficient model may be for the proponents of the two projects to jointly construct a power station and invest in a transmission line they would then share (although this may be longer than one kilometre due to the factors considered in the dot point above). The self-generation provisions currently provide an incentive for each project to invest in its own separate generation, leading to duplicate infrastructure; and

- All else being equal, if a project proponent invests in self-generation there may also be economic merit in investing in a grid connection to provide power in the event of an outage at their own plant. The self-generation provisions provide a disincentive for the project proponent to do this.

Whilst these examples are not exhaustive, they serve to illustrate the adverse impacts of current restrictions in the self-generation eligibility provisions on optimal project design, project viability and emissions outcomes.

The COAG review's report, *Renewable Energy Sub Group Report to the Council of Australian Governments' Select Council on Climate Change COAG Review of Specific RET Issues*[13], while largely endorsing many of APPEA's observations, made a majority recommendation for retention of the existing arrangements. Western Australia, the home of many of the relevant developments, endorsed APPEA's position and recommended changes in line with those recommended.

[13] Available at www.climatechangeauthority.gov.au/sites/climatechangeauthority.gov.au/files/COAG-RET-review-report.pdf.

The self-generation provisions contained in subsection 31(2) of the *Renewable Energy (Electricity) Act 2000* should be amended to allow for contemporary resource development projects, such as those currently planned in the upstream oil and gas industry, to also be eligible under the provisions.

ATTACHMENT 1. BAECONOMICS REPORT, *IMPLICATIONS OF THE RET FOR THE AUSTRALIAN ECONOMY*

Implications of the RET for the Australian economy

A report for APPEA

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Executive summary

This paper examines the implications for the Australian economy of the renewable energy target (RET). The RET requires 45 000 GWh of electricity generation to be sourced from renewable energy resources by 2020. Under current policy settings, the RET operates in parallel with the Carbon Pricing Mechanism, an emissions trading scheme (ETS).

The economic implications of four policy options have been assessed relative to a reference case in which no climate change policies are adopted:

- a domestic ETS policy scenario versus a domestic combined ETS + RET policy scenario; and
- an ETS policy scenario versus a combined ETS + RET policy scenario, in which the Australian ETS is linked to the European Union ETS (ETS_EU).

The analysis shows that the combination of the ETS with the RET is significantly **less** efficient than an unadulterated ETS in achieving a given level of emissions abatement.

The modelling shows that to reach the emission target of five per cent below 2000 levels in 2020, the combined ETS + RET policy:

- costs Australia $3.5 billion in today's dollars more than the ETS in output (GDP) losses in 2020; and
- causes substantial switching away from gas fired generation compared with an ETS, by 3 824 GWh in 2020.

A mandated renewable energy target such as the RET is less efficient at achieving a given environmental outcome because it forces higher cost renewable energy into the electricity generation mix at the expense of exploiting lower cost emissions abatement opportunities from gas generation and elsewhere in the economy.

Similar effects arise when the Australian ETS is linked with the European ETS. A combined ETS_EU + RET policy:

- reduces Australian GDP by $6.5 billion in today's dollars more than the unadulterated ETS_EU in 2020; and
- reduces gas fired generation compared with the ETS_EU by 2 313 GWh in 2020.

However, linking the Australian ETS with the EU ETS also implies that the Government's 2020 domestic emissions reductions target will be partly met by additional abatement in Europe. In these circumstances, Australia will be a net permit buyer before 2020 and the domestic carbon price will instead be set by the price of EU emissions allowances. Lower prices for EU allowances then translate into lower domestic carbon prices, and lower levels of domestic abatement and a transfer of income from Australia to the European Union.

1. Introduction

1.1. Policy context

The RET has its origins in the 2001 Mandatory Renewable Energy Target (MRET), which required that 9 500 GWh of electricity be generated from renewable energy sources from 2010 to 2020. The scheme obliges electricity retailers to purchase electricity from renewable energy sources. Retailers are required to surrender Renewable Energy Certificates (RECs), corresponding to one MWh of eligible renewable energy, purchased from accredited renewable energy generators, or alternatively pay a penalty. The costs of sourcing RECs are recovered from customers.

In June 2009, the then Rudd government legislated to raise the target to 45 000 GWh by 2020 (extending to 2030), corresponding to what was then estimated to be a 20 per cent share of renewables. In January 2011, the RET was split into a 'Large-scale Renewable Energy Target' (LRET) with a target of 41 000 GWh by 2020, and a 'Small-scale Renewable Energy Scheme' (SRES) with an implicit target of 4 000 GWh. The LRET created a financial incentive for large-scale renewable power stations such as wind and commercial solar, while the SRES encouraged retailers to support small scale technologies such as solar photovoltaic (PV) panels and solar hot water heaters. All aspects of the RET, including the LRET, the SRES, the associated liability and eligibility provisions and the impact of the RET on the electricity market are currently the subject of a review by the Climate Change Authority.

1.2. Scope of this study

The Australian Petroleum Production and Exploration Association (APPEA) has commissioned BAEconomics to undertake a quantitative assessment of the implications for the Australian economy of the RET, and to compare alternative policy options for reducing Australian emissions:

- through the combination of the Carbon Pricing Mechanism, an emissions trading scheme (ETS), and the RET; or
- by relying solely on an ETS.

These policy options are examined for their impacts on gross domestic product (GDP), real wages, electricity prices, Australian emissions and implications for electricity generation.

1.3. Structure of this report

This report is structured as follows:

- Section 2 describes the analytical and modelling framework used;
- Section 3 describes the modelling results; and
- Section 4 sets out the policy conclusions.

2. Analytical and modelling framework

The following describes BAEconomics' general equilibrium model BAEGEM, the reference case and policy scenarios that have been modelled and key model assumptions.

2.1. BAEGEM model description

The modelling simulations undertaken for this project were performed using BAEconomics' general equilibrium model, BAEGEM. General equilibrium models are a tool for determining the direct and indirect macroeconomic impacts of government policies by projecting changes in macroeconomic aggregates such as GDP, real wages, investment and private consumption in response to changed policy settings.

2.1.1. Structure of BAEGEM

BAEGEM is a general equilibrium model of the world economy. The core model code of BAEGEM is based on the concepts of the Global Trade Analysis Project (GTAP) model, which relies on a global social accounting matrix to establish linkages between industries and countries. The model incorporates four interlinked modules: a government module, a GHG emission module, a technology mix module, and an energy module. For each year, BAEGEM simulates the interactions and feedbacks across these modules.

The technology mix module has been constructed specifically for the electricity and transport sectors. In the technology mix module, electricity is generated from a combination of twelve technologies: brown coal, black coal, gas, oil, hydro power, nuclear, wind, solar, biomass, waste, geothermal and other renewables. Under this setting, electricity generators are allowed to choose their mix of technologies in response to changes in relative capital and operating costs in the model. This modelling feature is of central importance for evaluating climate change policies as operating costs of non-zero emission technologies will change after a carbon pricing mechanism is put in place. Capital and operating costs for each technology are fully represented in BAEGEM.

2.1.2. Data

The BAEGEM database is based on a number of sources. The global social accounting matrix (SAM) is based on the GTAP v8 database with a base year of 2007. The GTAP v8 database covers 129 countries/regions across the world and 57 commodity groups. To better represent the energy and mining sectors, the commodity groups in BAEGEM have been expanded to 70.

The emissions database is sourced from International Energy Agency (IEA), the United National Framework Convention on Climate Change (UNFCCC) and the US Environmental Protection Agency (EPA), and covers around 99 per cent of the global greenhouse gas emissions in 2007. The data in the technology mix and energy modules are sourced from IEA and the World Bank.

For the purpose of the modelling undertaken in this report, the BAEGEM database was aggregated into 14 regional/national economies and 23 production sectors as not all regions and sectors are relevant to this simulation exercise. Electricity technologies were also aggregated to increase the modelling efficiency (Table 2-1).

Table 2-1. Regions, sectors and technology

Regional / national economies	Production sectors	Electricity technologies
Australia	Crops	Brown Coal
EU27	Livestock	Black Coal
United States	Forestry	Oil
Canada	Fishing	Gas
Russia	Black coal	Nuclear
Rest of Europe	Brown coal	Hydro Power
China	Metallurgical coal	Wind
India	Oil	Solar
Indonesia	Gas	Other Renewables
Japan, Korea and Taiwan	Coke	
Rest of Asia	Nuclear Fuel	
Central and South America	Petroleum products	
Middle East and North Africa	Iron Ore	
Sub-Saharan Africa	Other minerals	
	Food	
	Chemicals, rubber and plastics	
	Non-metallic minerals	
	Manufacturing	
	Iron and Steel	
	Non-ferrous metal	
	Electricity	
	Heat	
	Services	
	Road transport	
	Water and air transport	

Source: BAEGEM

An important feature of the simulation exercise is the specification of the carbon content in all economic activities and of the economic environment in which the strategic developments are assumed to take place. In the simulations it is assumed that consumers choose their bundle of consumption goods based on utility maximisation. Likewise, producers choose their mix of inputs and technologies based on cost minimisation. Under a carbon mitigation policy, consumers and producers will gradually move away from carbon-intensive goods and carbon-intensive technologies to less carbon intensive products and lower or zero emission technologies.

2.2. Reference case and policy scenarios

BAEGEM is a recursively dynamic model that solves year-on-year over a specified timeframe. The model is then used to project the relationship between variables under different scenarios over a predefined period. A typical modelling analysis is comprised of a reference case projection that forms the basis of the analysis. Set against this reference case are the one or more policy scenarios under consideration. The impacts of the policy change (the achievement of the strategic targets) are measured by differences between the reference case and policy scenarios at given points in time.

For the purpose of the modelling analysis in this paper, the reference case assumes that there is no emissions reductions target, and that there is no ETS and no RET. The reference case thus represents a benchmark against which the outcomes under the policy scenarios can be quantified and assessed.

In addition to the reference case, four policy scenarios have been modelled in this report, reflecting various government policy announcements:

- The Australian Government has made an unconditional commitment that Australia will reduce its emissions by 5 per cent compared with 2000 levels by 2020. Accordingly, two policy options for achieving this emissions reductions target have been modelled:
    - ETS + RET scenario. In this scenario, the RET operates in parallel to an ETS, with the ETS operating from 2012-13 onwards.
    - ETS scenario. In this scenario, emissions reductions are solely achieved through the application of a carbon price (i.e. the RET is abolished).

  The above policy scenarios have been designed to achieve an emissions reduction target of 5 per cent below 2000 levels by 2020, and 15 per cent below 2000 levels by 2030. This corresponds to total Australian emissions of around 470 Mt by 2020 and around 420 Mt by 2030, excluding emissions from Land Use, Land Use change and Forestry (LULUCF). In these scenarios, it is assumed that a limited number of domestic emissions permits are issued, corresponding to the Government's emissions reductions target. The domestic carbon price therefore adjusts to balance domestic supply and demand. International trading of emissions permits is not permitted under these scenarios.

- On August 28, the Minister for Climate Change and Energy Efficiency announced that the Australian ETS would be linked with the European Union Emissions Trading System (EU ETS), so that Australian liable entities would have access to EU allowances. The following additional policy options have therefore been modelled:

- ETS_EU + RET scenario. In this scenario, the RET operates in parallel to a domestic (Australian) ETS that is linked with the EU ETS from 2015 onwards.
- ETS_EU scenario. In this scenario, emissions reductions are solely achieved through the operation of the Australian ETS, which is linked with the EU ETS.

In the above EU linkage scenarios, the price of Australian domestic emissions permits is determined by the supply and demand of emission permits in the two markets.

All scenarios, that is, the reference case and the four policy scenarios are modelled over the period from 2007 to 2030.

2.3. Key modelling assumptions

2.3.1. Renewable energy target

The two RET scenarios modelled (i.e. ETS + RET and ETS_EU + RET) assume that the overall renewable energy target of 45,000 GWh will be met by 2020. The future GWh contribution of the SRES to the RET target is uncertain, since it depends on the number of small-scale renewable installations taken up by household in response to state and Commonwealth policies. It is clear, however, that, in aggregate, the Government expects the combined LRET and SRES to achieve the overall RET target.[1]

2.3.2. Macroeconomic assumptions

Key macroeconomic assumptions for the reference case are shown in Table 2-2. GDP growth in policy scenarios is determined in the course of the general equilibrium modelling.

[1] As set out in the Government's 2010 discussion paper (p. 7): '*The LRET's 41,000 GWh target for 2020 has been set to achieve a level of large-scale renewable electricity generation above what was expected under the existing Renewable Energy Target. The LRET portion of the target will be increased to ensure the 45,000 GWh target is still met in 2020 if the uptake of small scale technologies is lower than anticipated, but the annual LRET targets will not be reduced if uptake of small-scale technologies is greater than anticipated.*' Australian Government 2010. Enhancing the Renewable Energy Target – Discussion Paper, March.

Table 2-2. Key macroeconomic assumptions

	Average annual growth 2011 to 2020 (per cent)	Average annual growth 2021 to 2030 (per cent)
Australia		
Gross domestic product (GDP)	2.6	2.4
Population	1.3	1.0
Rest of the world (GDP)		
China	7.5	5.1
India	7.6	6.5
Japan, Korean and Taiwan	2.0	1.6
EU-27	1.6	1.7

Source: IMF, UN and BAEconomics' estimates.

2.3.3. Technologies

It is assumed that no new large-scale hydropower project will be built by 2030. Electricity generation from hydropower is counted towards the RET baseline. Further, it is assumed that carbon capture and storage technology is not commercially viable before 2030, and that the average lead time from planning to completion of a commercial renewable project is four years.

2.3.4. Electricity generation

Table 2-3 presents the Australian electricity generation mix in 2010.

Table 2-3. Electricity generation and share of electricity generated by technology (2010)

Generation technology	Energy generated (GWh)	Share of energy generated (per cent)
Black Coal	123 463	51.5
Brown coal	55 611	23.2
Oil fired	3 284	1.4
Natural gas	35 927	15.0
Nuclear	0	0
Hydropower	12 367	5.2
Wind	4 759	2.0
Solar	275	0.1
Other renewable	274	1.6
Total	549	100.0

Source: IEA

3. Results

The results of the modelling analysis are presented in the following. We consider, in turn, the implications of the four policy options for:

- the carbon price;
- growth in real GDP;
- growth in real wages;
- Australian greenhouse gas emissions; and
- the Australian electricity sector, including for aggregate electricity generation, electricity prices, and for generation from different technologies including gas and renewables.

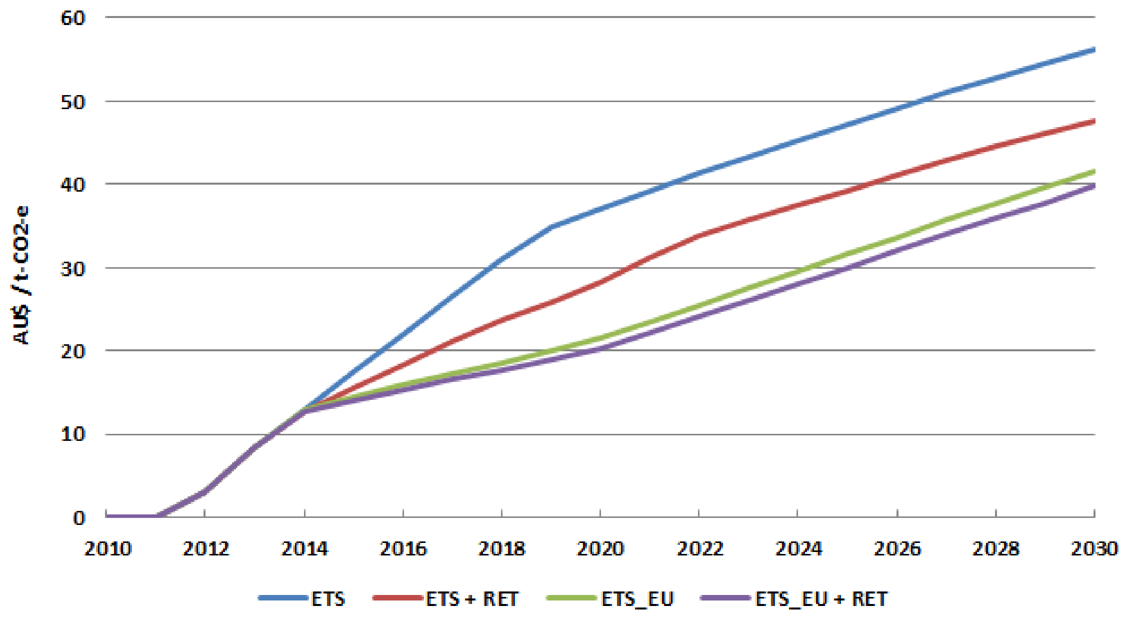
3.1. Policy implications for carbon prices

Figure 3-1 shows the evolution of carbon prices under the four policy scenarios considered in this analysis:

- Under the ETS and the ETS + RET scenarios, the domestic carbon price is projected to increase considerably to meet the Government's emissions reductions objective. In the ETS scenario, the carbon price rises to around A$ 37/t-CO_2-e in 2020 and to A$ 56/t-CO_2-e in 2030. In the combined ETS + RET scenario, the carbon price increases to A$ 28/t-CO_2-e in 2020 and to A$ 48/t-CO_2-e in 2030.
- The domestic carbon price is projected to be considerably lower in the EU linkage scenarios, given that it will be largely determined by the price of EU allowances. Australia will become a net permit buyer before 2020. The price of EU allowances is projected to be below A$20/t-$CO_2$-e before 2020, but will increase slightly to around A$22/t-$CO_2$-e after the Australian and EU ETS' are linked. In the ETS_EU scenario, the carbon price then increases to A$22/t-$CO_2$-e in 2020 and to A$42/t-CO_2-e in 2030. In the ETS_EU + RET scenario, the price increases to A$20/t-$CO_2$-e in 2020 and to A$40 in 2030.

Irrespective of whether a stand-alone domestic ETS or a domestic ETS linked to the EU ETS is modelled, the combination of an ETS and the RET tends to lower the carbon price. This is because the RET imposes a technological mandate on liable entities and, thus artificially reduces the demand for emission permits.

Figure 3-1. Evolution of the domestic carbon price (A$/t-$CO_2$-e)



Source: BAEGEM.

3.2. Policy implications for real GDP

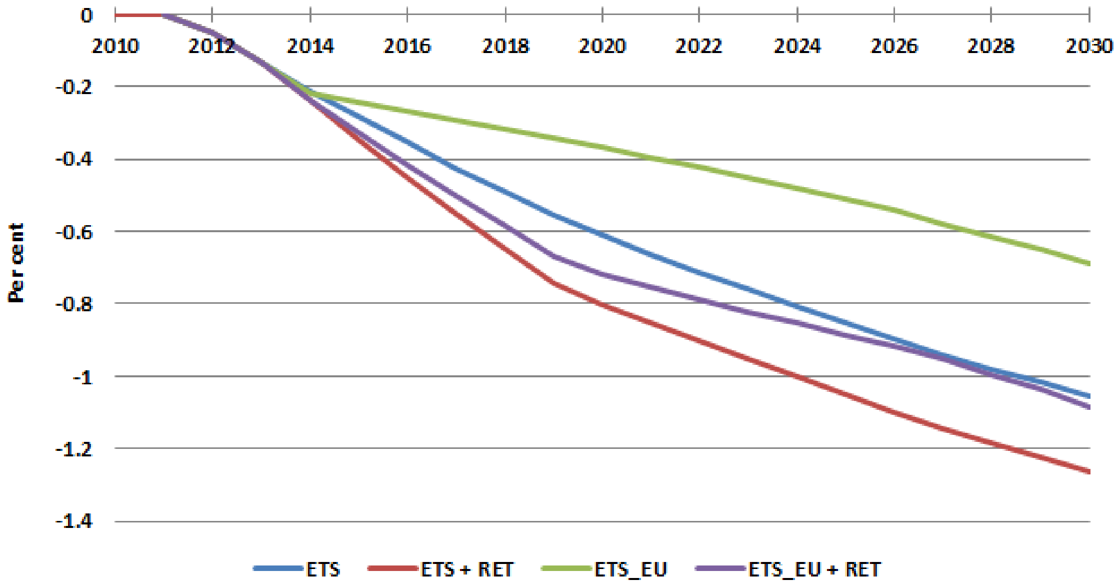
Figure 3-2 shows the deviations in real GDP levels under the policy scenarios relative to the reference case:

- relative to the reference case which does not incorporate climate change policies, real GDP is reduced in all policy scenarios; however,
- the combination of an ETS *and* the RET reduces GDP (significantly) more than a stand-alone ETS, irrespective of whether a purely domestic ETS or an ETS with EU linkages is modelled.

The larger reduction in GDP as a result of the RET is a consequence of the design of the scheme. The RET is a prescriptive technological mandate that requires renewable generation facilities to be commissioned, irrespective of whether lower cost alternatives (such as gas technologies) are available to meet the emissions objective. This is in contrast to a market based carbon price mechanism, which supports economy-wide least-cost abatement. It is therefore more efficient and less economically damaging to employ a pure ETS policy strategy to achieve a given level of emissions abatement than it is to adopt a combined (ETS and RET) policy approach.

The negative GDP impacts modelled in this report are likely to be conservative. This is because a significant portion of the RET target will be met from high cost, small-scale domestic installations, such as rooftop solar PV and solar hot water installations, which are not explicitly modelled in this exercise. Furthermore, a high reliance on renewable generation, particularly on intermittent technologies such as wind, imposes significant additional costs on the electricity system, for instance in terms of additional stand-by capacity required.

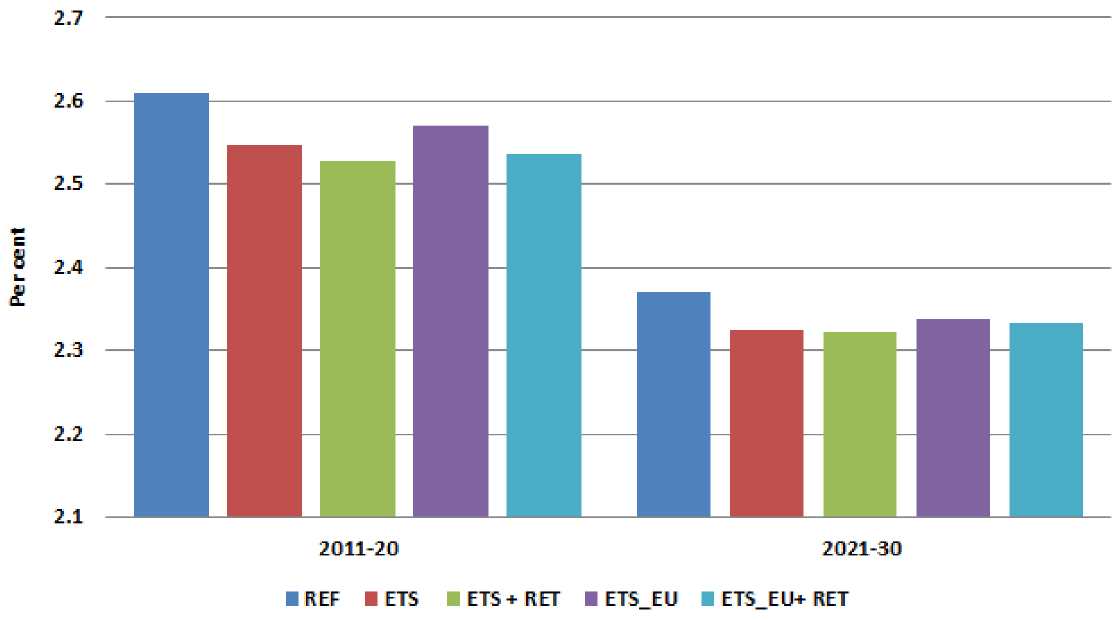
Figure 3-2. Real Australian GDP, deviation from the reference case



Source: BAEGEM.

Figure 3-3 shows average annual real GDP growth rates between 2011 and 2020, and between 2021 and 2030, respectively, for the reference case and the four policy scenarios. In all policy scenarios average real GDP growth is reduced relative to the reference case, but the existence of the RET depresses economic growth further. The reduction in average real GDP growth is less in the EU linkage scenarios (ETS_EU and ETS_EU + RET), given that electricity prices are projected to be lower in these scenarios (see Section 3.5.2).

Figure 3-3. Real Australian GDP, average annual growth rates



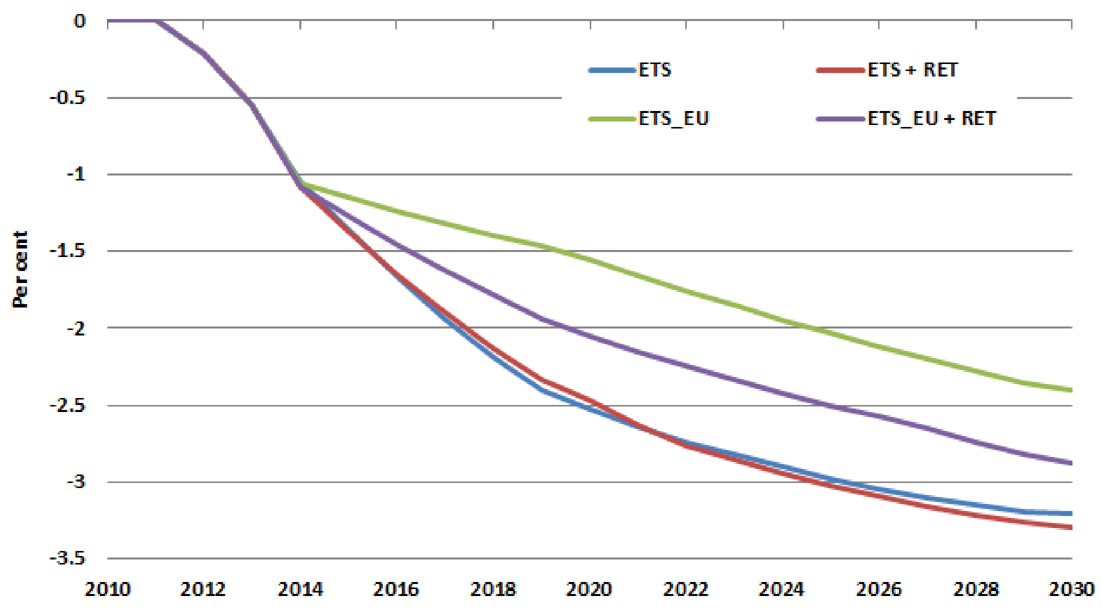
Source: BAEGEM.

3.3. Policy implications for real wages

Figure 3-4 highlights changes in real wages relative to the reference case in the four policy scenarios. All the climate change policies modelled here depress real wages relative to the reference case, but there are some differences depending on whether the domestic ETS is linked to the EU ETS or not:

- The reduction in real wages is very similar in the ETS scenario and the ETS + RET scenario. Real wages are reduced by around 2.5 per cent in 2020, and by around 3.3 per cent in 2030. This effect arises because the RET requirement to install additional renewable electricity capacity by 2020 temporarily places upward pressure on wages. This upward pressure largely compensates for the downward pressure on wages arising from lower GDP growth and higher electricity prices.
- This wage effect does not occur in the two scenarios in which the domestic ETS is linked with the EU ETS (ETS_EU and ETS_EU + RET). In these scenarios, the decline in real wages is significantly less than in the non-linkage scenarios. The temporary upward pressure from installing additional renewable electricity capacity is not enough to compensate for the downward pressure arising from lower GDP growth and higher electricity prices.

Figure 3-4. Real wages, deviation from the reference case



Source: BAEGEM.

3.4. Policy implications for greenhouse gas emissions

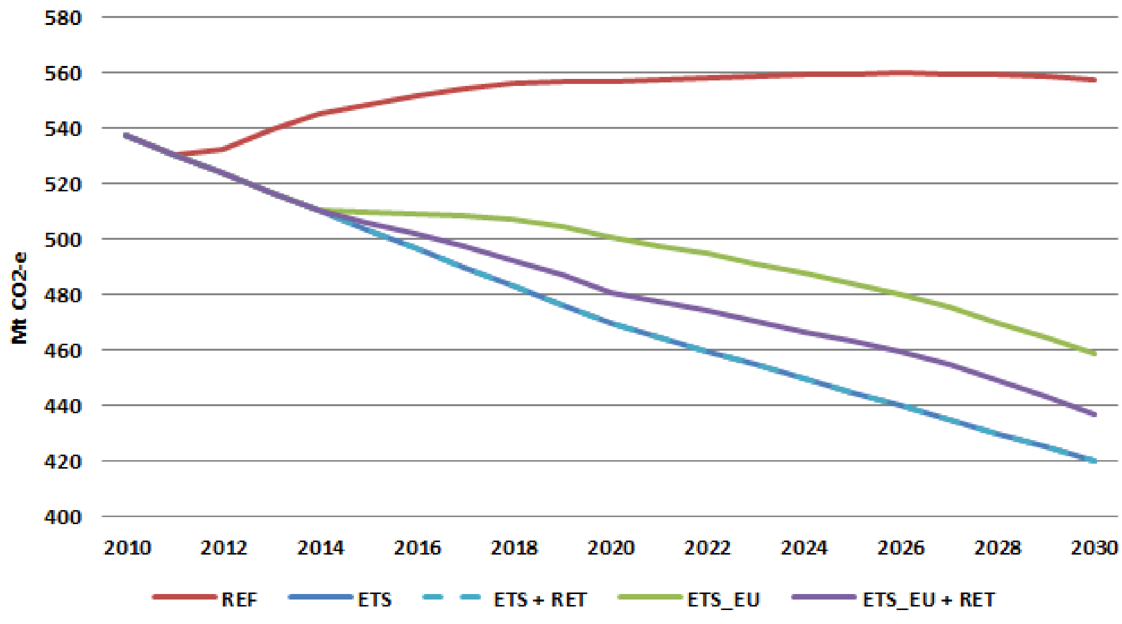
Figure 3-5 shows total Australian greenhouse gas (GHG) emissions, excluding emissions from LULUCF under the reference case and the policy scenarios. In the reference case scenario no GHG abatement measures are taken. Aggregate Australian GHG emissions increase from around 538 Mt CO_2-e in 2010 to around 558 Mt CO_2-e in 2020. Emissions level off at around 560 Mt CO_2-e from 2023 onwards and then begin to decline to around 558 Mt CO_2-e in 2030. This is a far lower level of emissions than assumed in Treasury modelling to date.

In the scenarios where the domestic ETS is not linked to the EU ETS, the carbon price pathway to 2030 is solely determined by the Government's emissions target. The ETS and the ETS + RET scenarios therefore generate the same levels of domestic emissions abatement; GHG emissions fall to 470 Mt CO_2-e in 2020 and to 420 Mt CO_2-e in 2030.

In the EU linkage scenarios, domestic carbon prices are determined by the prices of EU allowances, which reflect the EU emissions target and are projected to be relatively low over the forecasting horizon, and by the Government's domestic emissions target. Domestic carbon prices are projected to be lower than those in the scenarios without EU linkage because Australian firms can access cheaper permits from Europe (Figure 3-1). A lower domestic carbon price implies that the Government's emissions targets will be partly met by additional abatement in the EU:

- in the ETS_EU + RET scenario, Australian emissions fall to 481 Mt CO_2-e in 2020 (2.3 per cent above the 2020 target), and to 437 Mt CO_2-e in 2030; while
- in the ETS_EU scenario, Australian emissions fall to 501 Mt CO_2-e in 2020 (6.6 per cent above the 2020 target), and to 459 Mt CO_2-e in 2030.

Figure 3-5. Total Australian emissions (excluding LULUCF)



Source: BAEGEM.

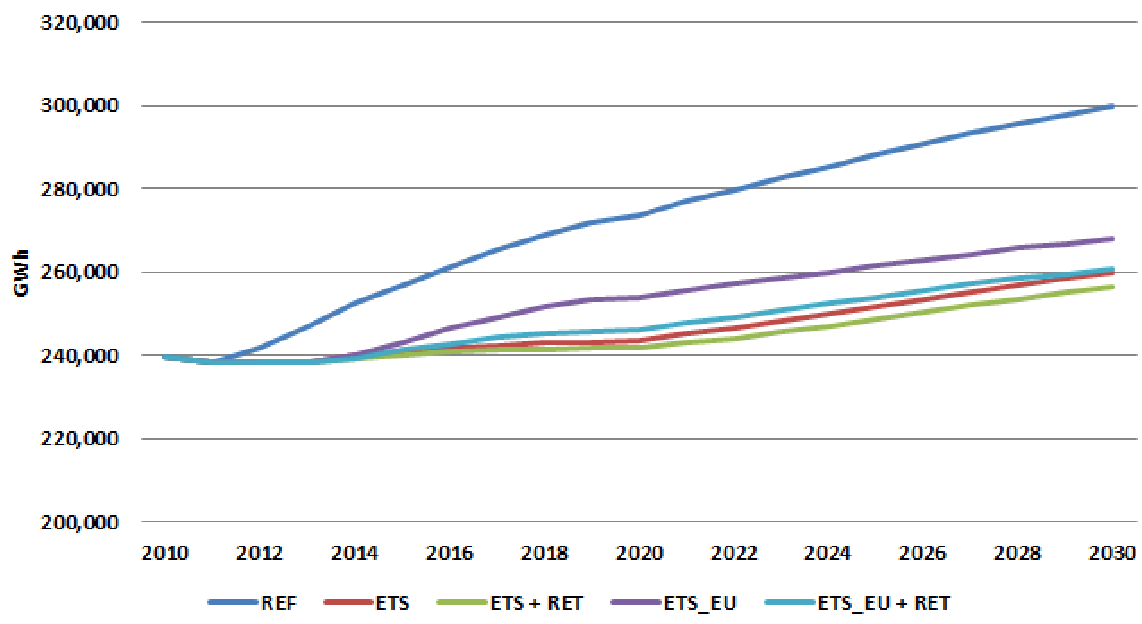
3.5. Policy implications for the electricity sector

3.5.1. Aggregate electricity generation

The effects of the different climate change policies on electricity generation are shown in Figure 3-6. Aggregate electricity generation, excluding small scale generation, falls significantly relative to the reference case in all policy scenarios, although this effect is least pronounced in the ETS_EU scenario. In the ETS policy scenario, aggregate electricity generation falls to around 244 TWh by 2020, a reduction of 11.1 per cent from electricity generation of 274 TWh in the reference case. In the ETS + RET policy scenario electricity generation falls to 242 TWh by 2020, an 11.7 per cent reduction. In the EU linkage scenarios, electricity generation in the ETS_EU + RET scenario is projected to be 246 TWh in 2020 (a 10.1 per cent reduction), and in the ETS_EU scenario electricity generation is 254 TWh (a 7.2 per cent reduction).

Irrespective of whether a stand-alone domestic ETS or a domestic ETS linked to the EU ETS is modelled, the overall effect on electricity generation is less under an ETS than it is under an ETS combined with the RET. This is because the abatement task is spread more evenly across the economy under an ETS and electricity prices are relatively lower. With a mandated renewables target, the electricity sector takes on a disproportionate abatement burden (given the marginal cost of abatement in the sector compared with marginal costs elsewhere in the economy) for a given abatement task.

Figure 3-6. Aggregate electricity generation in Australia (GWh)

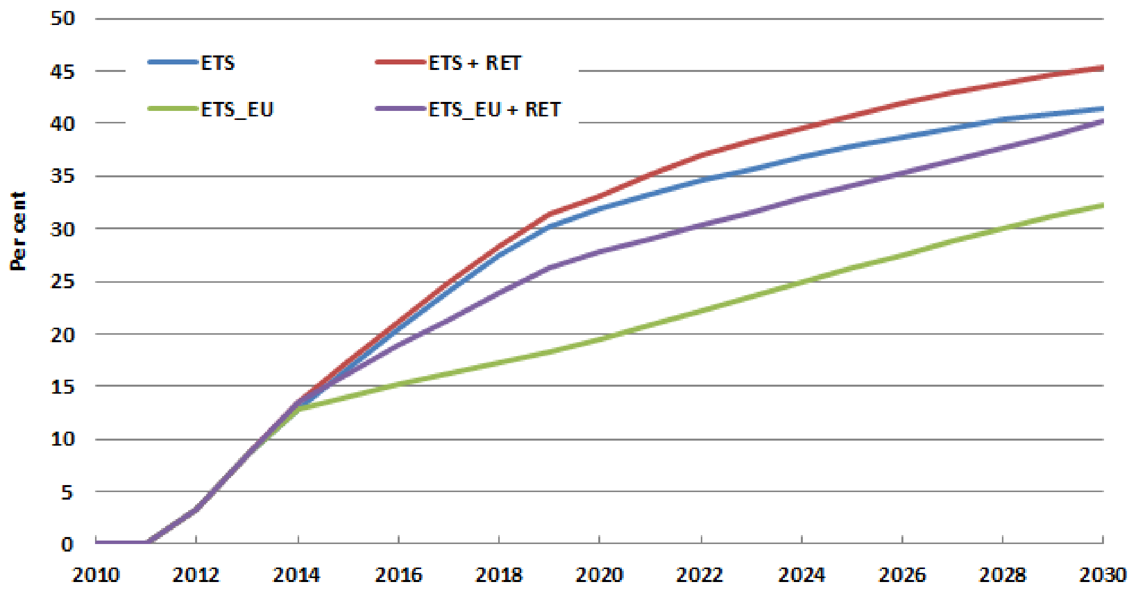


Source: BAEGEM.

3.5.2. Wholesale electricity

Figure 3-7 shows increases in average annual electricity wholesale prices relative to the reference case. By 2020, electricity prices will be 33.1 per cent higher in the ETS + RET scenarios, and 31.8 per cent higher in the ETS scenario. Wholesale electricity price increases are lower in the EU linkage scenarios; prices in 2020 will be 27.8 per cent higher in the ETS_EU + RET scenario, and 19.5 per cent higher in the ETS_EU scenario. The relatively smaller price increase in the ETS_EU scenario is a reflection of the lower carbon price in this scenario, which is in turn a function of lower prices for EU allowances.

Figure 3-7. Electricity price deviations relative to the reference case

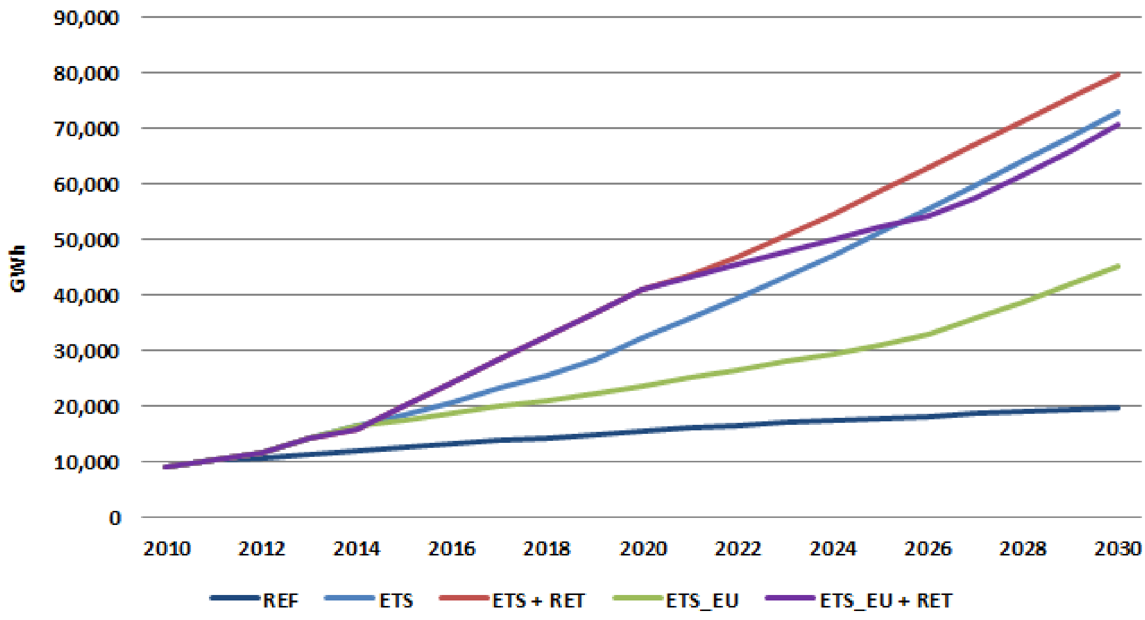


Source: BAEGEM.

3.5.3. Electricity generation by fuel source

Figure 3-8 shows electricity generation from renewable energy sources. Generation from renewables is higher under either of the RET scenarios (ETS + RET and ETS_EU + RET), given that this policy mandates the amount of renewable electricity generated in each year. Under either of the non-RET scenarios (ETS and ETS_EU), the amount of electricity generated from renewable energy sources is considerably lower. This result arises because, for a given abatement target, a sole reliance on renewable generation is not the least cost solution.

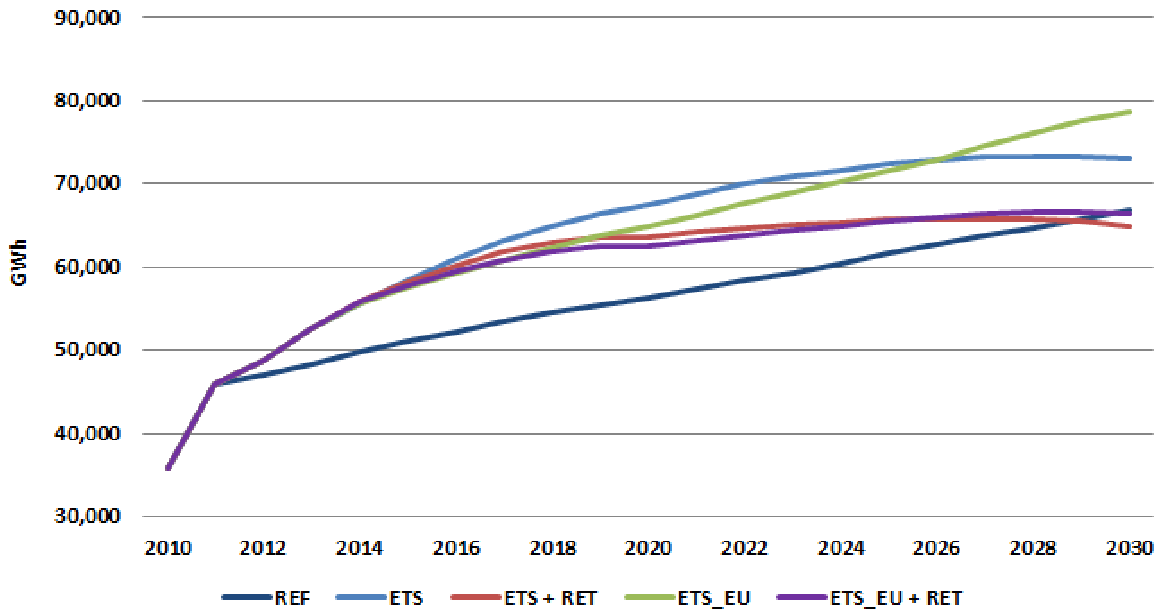
Figure 3-8. Electricity generation from renewable energy sources (excluding hydro)



Source: BAEGEM.

Figure 3-9 shows projections of electricity generation from natural gas for the reference case and the policy scenarios. Electricity generation from natural gas is higher than in the reference case for all policy scenarios, and is highest in the ETS scenarios (ETS and ETS_EU). In these scenarios, the existence of a carbon price allows the emissions abatement objective to be achieved at least cost, by increasing the amount of generation from gas, which is less emission-intensive than coal. The renewable energy mandate of the RET, in contrast, forces more generation from (more costly) renewable energy sources.

Figure 3-9. Electricity generation from natural gas

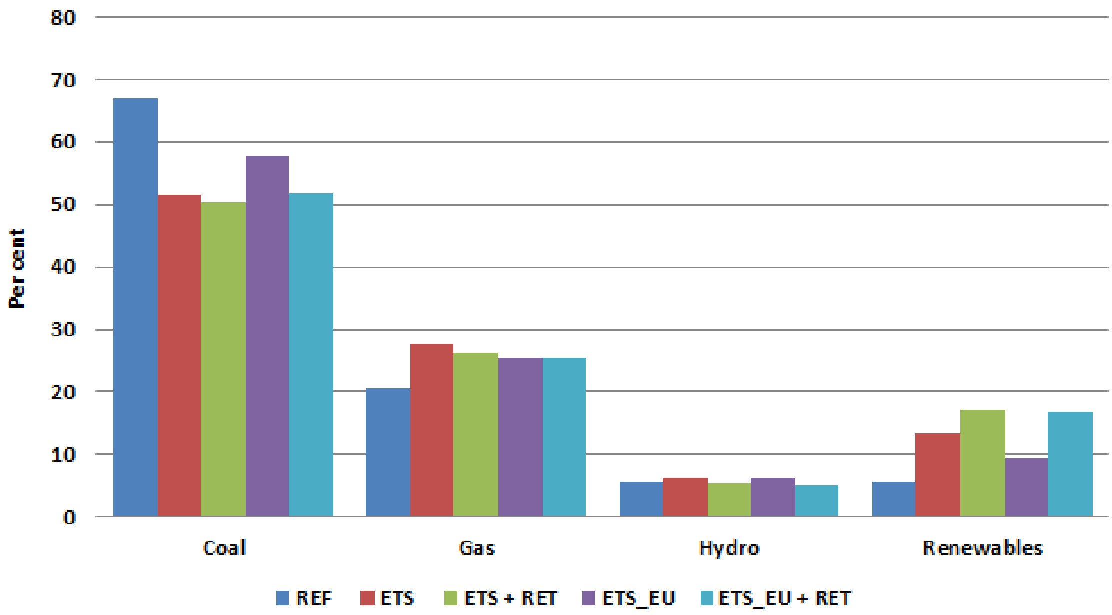


Source: BAEGEM.

Figure 3-10 and Figure 3-11 show the projected generation mix in 2020 and 2030. In all policy scenarios, coal-fired generation is reduced while generation from gas and renewables increases; these effects become more pronounced in 2030.

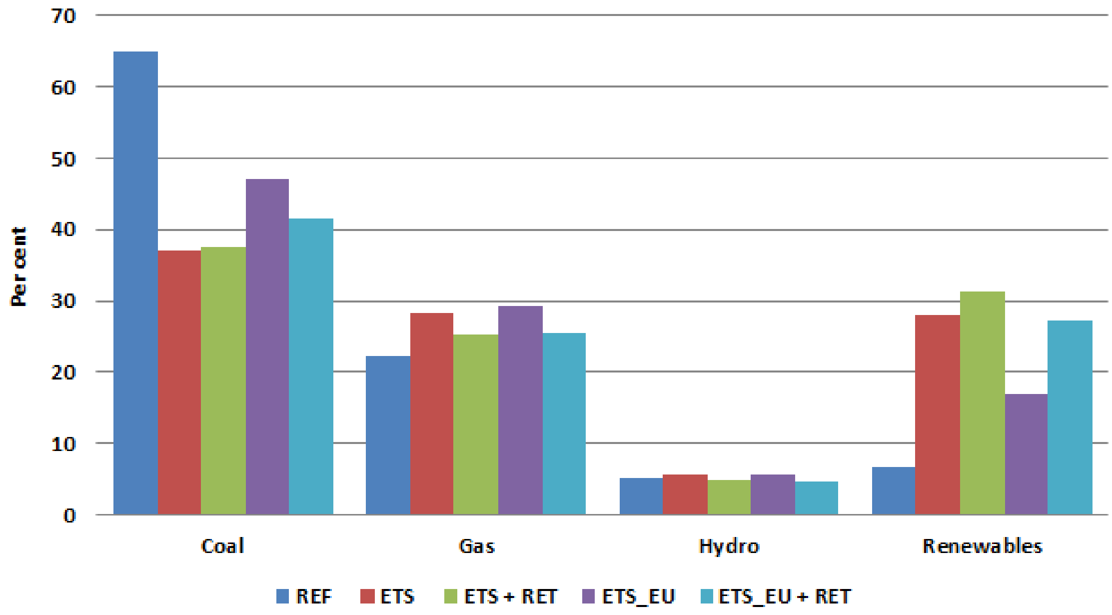
The share of generation from gas is always higher in the stand-alone ETS scenarios (ETS and ETS_EU), than in the RET scenarios (ETS + RET and ETS_EU + RET). A stand-alone ETS provides a least-cost solution to emission abatement through a market-based mechanism resulting in greater reliance on gas. To achieve an efficient outcome, it is crucial that the scheme includes a broad range of sectors across the economy. The RET, on the other hand, requires a disproportionate amount of abatement to be obtained from the electricity generation sector and, moreover, from more expensive sources.

Figure 3-10. Electricity generation mix in 2020



Source: BAEGEM.

Figure 3-11. Electricity generation mix in 2030



Source: BAEGEM.

4. Policy conclusions

The key economic effects of the four climate change policies analysed in this report are shown in Table 4-1. The combination of an ETS with the RET is (significantly) less efficient than a 'pure' ETS policy, irrespective of whether the ETS is purely domestic in scope or whether it is linked with the EU (Table 4-1):

- For the same level of abatement, the combined ETS + RET policy requires that the share of generation from expensive renewables is more than doubled, at the expense of generation from lower cost natural gas and adjustments in other sectors. In 2020, Australian GDP under the ETS + RET policy option is $3.5 billion lower in today's dollars, as compared to GDP under the ETS policy option;
- Linkage of the Australian ETS to the EU ETS somewhat reduces the negative impact on GDP growth that would arise under a purely domestic ETS. The operation of the RET in parallel to the ETS has a similarly depressing effect on economic growth.

Table 4-1. Comparison of economic effects under alternative climate change policies (2020, percentage differences from the reference case)

	ETS (per cent)	ETS + RET (per cent)	ETS_EU (per cent)	ETS_EU + RET (per cent)
Real GDP (Australia)	-0.6%	-0.8%	-0.4%	-0.7%
Wages	-2.5%	-2.5%	-1.6%	-2.1%
Emissions	-15.6%	-15.6%	-10.0%	-13.6%
Electricity generation	-11.1%	-11.7%	-7.2%	-10.1%
Electricity wholesale prices	31.8%	33.1%	19.5%	27.8%
Generation from renewables	107%	164%	53%	164%
Generation from gas	19.9%	13.1%	15.2%	11.1%

Source: BAEGEM.