



Australian Government
Department of Industry,
Innovation and Science

Office of the
Chief Economist

Global energy transformation: implications for Australia's resources and energy sector

Melissa Bray¹

General Manager, Economic Advice Service, Office of the Chief Economist[□]

18 October 2018

Event: AMPLA Annual Conference Keynote Address

Location: Perth, Western Australia

¹ Many thanks to Nikolai Drahos (Office of the Chief Economist) for his contribution to this speech.

Synopsis

The modern world has witnessed three great energy transformations, each based around harnessing a different fuel: coal was harnessed to power the Industrial Revolution, the rise of oil fuelled the spread of mass transportation and, more recently, natural gas has found a home in residential, industrial and electricity generation sectors. Past energy transformations have had significant implications for Australia. In particular, over the last decade, the rapid industrialisation and urbanisation of large emerging countries located on our doorstep — most notably China — has propelled strong growth in demand for Australia's energy commodities.

Looking to the future, the International Energy Agency has shed light on the wide range of possible energy pathways. The future direction of the global energy system will have implications for Australia's resources and energy sector — a sector worth almost a quarter of a trillion dollars each year. As the world's largest coal exporter, and potentially the world's largest LNG exporter around the turn of the decade, Australia is an energy superpower. Australia is also a significant exporter of other commodities that are affected by energy trends — lithium, nickel and copper. Melissa will discuss global energy transformations — past and possible — and the implications for Australia's resources and energy sector.

Introduction

Slide 1

The slide features a dark blue background with a city skyline at night and light trails from a highway. Text elements include: '2018 ANNUAL CONFERENCE' in yellow at the top left; 'ENERGY TRANSFORMATION' in large white letters; 'BLOCKCHAIN NETWORKING' in white at the top right; 'DECOMMISSIONING', 'INDUSTRY EXPERTS', 'MINE AUTOMATION', 'CORPORATE PPA'S', and 'IPSO FACTO' in white below the main title; 'Global energy transformation: implications for Australia's resources and energy sector' in white on the right; 'October, 2018' in white below the title; 'Melissa Bray, General Manager, Department of Industry Innovation and Science' in white; 'industry.gov.au/OCE' in white on a blue button; and the 'AMPLA' logo with the tagline 'Empowering Energy & Resources Companies' in the bottom right corner.

2018 ANNUAL CONFERENCE

ENERGY TRANSFORMATION

BLOCKCHAIN NETWORKING

DECOMMISSIONING
INDUSTRY EXPERTS
MINE AUTOMATION
CORPORATE PPA'S
IPSO FACTO

Global energy transformation:
implications for
Australia's resources
and energy sector

October, 2018

Melissa Bray
General Manager
Department of Industry Innovation and Science

industry.gov.au/OCE

AMPLA Empowering Energy & Resources Companies

The modern world has witnessed three great energy transformations based around harnessing three different fuels: coal, oil and natural gas. Today, these fuels are the foundation of the international energy system.

There are a number of possible energy futures ahead, and these will be influenced by the pace of technological change, the decisions of businesses and individuals, and the policy choices of governments.

The future direction of the global energy system has implications for Australia's resources and energy sector — a sector with exports worth around a quarter of a trillion dollars each year.

Australia is the world's largest coal exporter and could soon be the world's largest LNG exporter. We also have strengths in other commodities affected by global energy trends — lithium, cobalt, graphite, amongst others. And we have the potential to be an exporter of hydrogen.

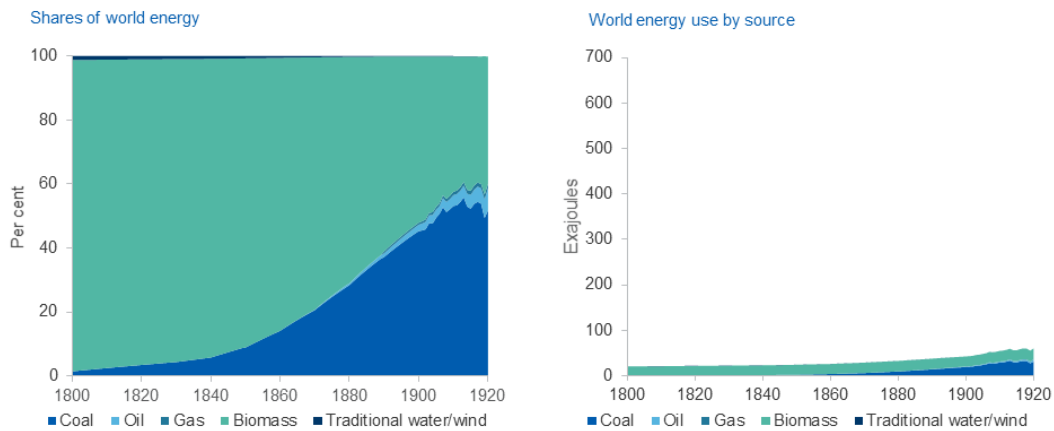
There are three areas I will cover today:

- Firstly, we will reflect on three past energy transformations
- Secondly, we will consider three future possible energy scenarios, as identified by the International Energy Agency
- Thirdly, we will look at the future of the global energy system and what a possible new energy transformation — be it gradual or rapid — could mean for Australia's resources and energy sector, both in the medium and the longer-term.

Three energy transformations

Slide 2

Coal powered the Industrial Revolution



Source: Court (2016) Energy, EROI, and economic growth in a long-term perspective

industry.gov.au/OCE

AMPLA
Engineering
Energy &
Resources
Lawyers

2018 Annual Conference

17-19 October
Perth

Firstly, let's step back in time and take a look at three previous energy transformations. The basic drivers of energy demand are economic growth, population growth and changes in technology. These drivers were at play in each of the energy transformations I'll discuss.

Pre-industrial societies used very little energy and relied on wood, wind, water and human and animal power to meet their energy needs.

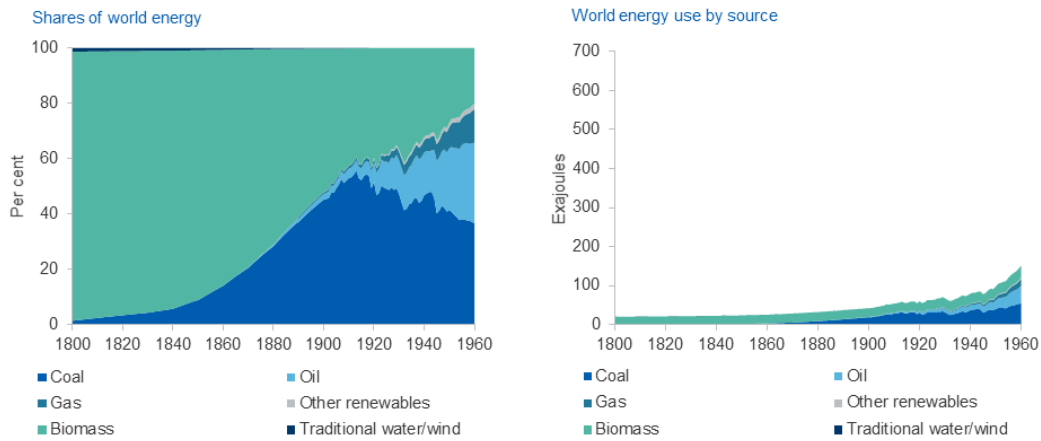
The Industrial Revolution between the mid-1700s and mid-1800s brought with it the first modern energy transformation.² The invention of the steam engine allowed coal to be harnessed as an energy source, and coal came to power factories, mining operations, ships and trains. Coal was also used to boost iron output, allowing for the creation of infrastructure such as rail networks and water systems. Coal went from providing 2 per cent of the world's energy in 1800 to a peak of 56 per cent in 1913.³

² Coal also fuelled a second period of rapid industrialisation over the late 1800s and early 1900s.

³ Court (2016) Energy, EROI, and Economic Growth in a Long-term Perspective. Human and animal food-energy have been excluded from global energy in line with the approach used by the International Energy Agency.

Slide 3

Oil took the world into the age of mass transportation



Source: Court (2016) Energy, EROI, and economic growth in a long-term perspective

industry.gov.au/OCE



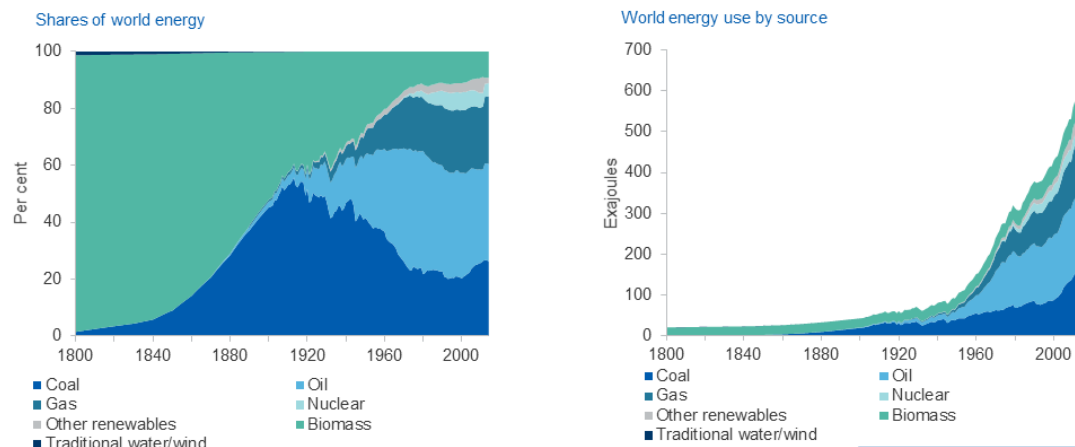
2018 Annual Conference

17-19 October
Perth

A second energy transformation started at the beginning of the 20th century. The mass production of automobiles from the early 1900s created huge demand for diesel and petrol. By the middle of the 20th century, oil had become the fuel of choice in transportation. Oil accounted for just 4 per cent of energy use in 1913, but had overtaken coal as the dominant fuel in the global energy mix by 1965.⁴

Slide 4

Gas' rise could be considered a third energy transformation



Source: Court (2016) Energy, EROI, and economic growth in a long-term perspective

industry.gov.au/OCE



2018 Annual Conference

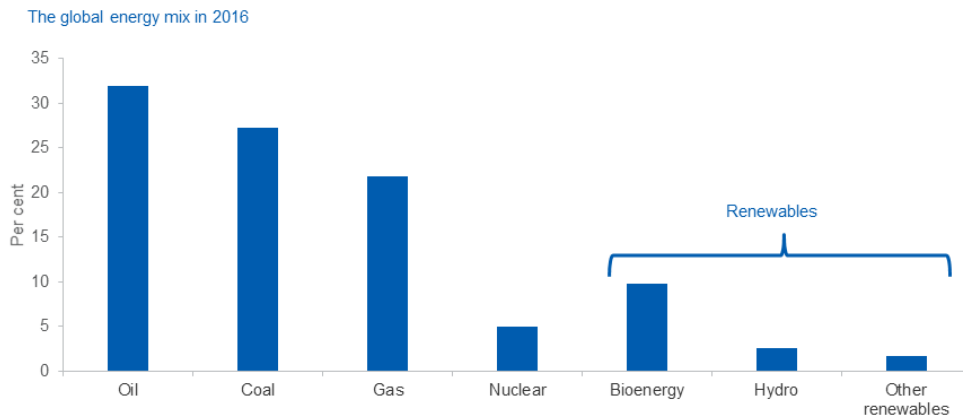
17-19 October
Perth

⁴ Court (2016) Energy, EROI, and Economic Growth in a Long-term Perspective.

The increased use of natural gas could be considered a third energy transformation. Natural gas production started to increase in the 1950s and two oil crises and predictions of ‘peak oil’ during the 1970s encouraged a so-called ‘dash for gas’ and greater use of the fuel. More recently, innovations such as hydraulic fracturing and horizontal drilling (together known as “fracking”) have unleashed the shale gas production boom in the United States.

Slide 5

Fossil fuels are the foundation of today’s international energy system



Source: IEA (2017) World Energy Outlook

industry.gov.au/OCE



2018 Annual Conference

17-19 October
Perth

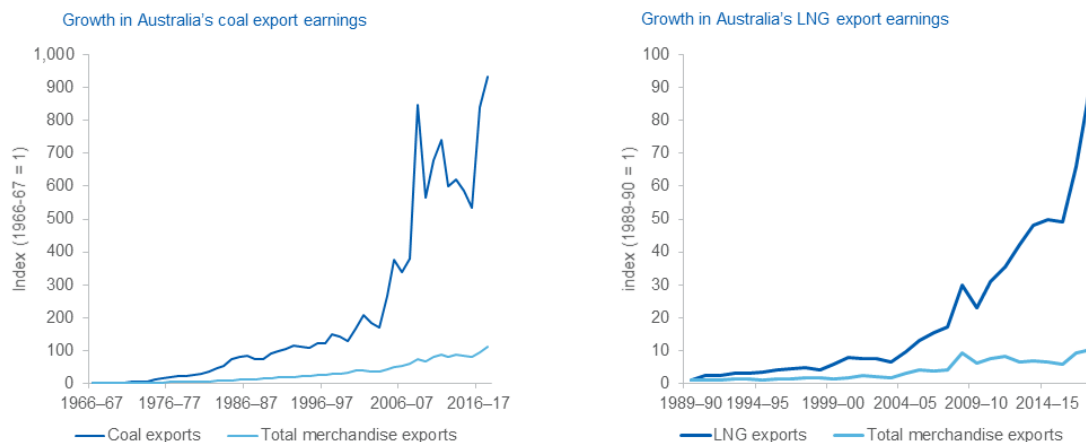
Over the past three centuries, fossil fuels — coal, oil and natural gas — have become the bedrock of the international energy system, fuelling economic growth and supporting the development of almost every aspect of modern life. Today, these fuels account for over 80 per cent of global energy demand.⁵ Coal is the most used fuel in electricity generation, oil dominates transport, and gas is important in both industry and power generation.⁶

The past three energy transformations have taken place against the backdrop of huge growth in energy demand, meaning that coal, oil and gas consumption have increased side-by-side. A key question now is to what extent different energy sources can grow side-by-side in any energy transformation in the future.

⁵ International Energy Agency (2017) World Energy Outlook

⁶ Nuclear energy accounts for just 5 per cent of world energy. Renewable energy — bioenergy, hydro, and other renewables — is currently a relatively small component of the global energy mix at 14 per cent. Bioenergy — energy generated from organic matter — makes up 10 per cent of world energy use; hydro currently sits at 3 per cent and other renewables (mainly wind and solar) at 2 per cent.

Australia has benefited as a supplier of coal, oil, gas and uranium



Source: ABS (2018); Department of Industry, Innovation and Science (2018)

industry.gov.au/OCE



2018 Annual Conference

17-19 October
Perth

The growing use of fossil fuels has benefited Australia as a major supplier of these commodities. In 1966–67, Australia’s coal exports were worth around \$800 million in today’s dollars. In 2017–18, export earnings from coal were \$60 billion — over a 70 fold increase.

Although we are a net importer of petroleum products, Australia is also a supplier of crude oil and condensate, exporting around \$7 billion worth per year.

Increasing global gas demand has led to development of Australia’s Liquefied Natural Gas (LNG) industry. Australia started exporting LNG in 1989 from Western Australia and a second LNG project was operating in Darwin by the mid-2000s. I remember visiting Dampier in the early 2000s when the fourth LNG train for the North West Shelf project was under construction.

Then came Australia’s recent wave of LNG investment. Eight new projects worth well over US\$200 billion were commissioned between 2007 and 2012, potentially making Australia the world’s largest LNG exporter within a few years.

We care about how a future energy transformation plays out because it will determine the level and composition of energy use and thus future demand for Australia’s energy commodities.

Three scenarios for the future

Background

I move now to the second area, consideration of three potential energy futures.

Each year, the International Energy Agency, or IEA, produces the World Energy Outlook, which provides several scenarios for the future of the world energy system. Each scenario depicts an alternative future, a pathway along which the world could travel if certain conditions were met.

Of course, the IEA does not have a monopoly on future energy scenarios; companies like Shell, ExxonMobil, BP, Bloomberg New Energy Finance and Wood Mackenzie are in the same business. But the IEA's scenarios are probably the most widely cited account of the range of possible energy futures.

The most recent World Energy Outlook contains three scenarios, which take us through to the year 2040.

- The Current Policies Scenario depicts an energy pathway along which existing policies — those which are firmly enshrined in legislation — would take the global energy system.
- The New Policies Scenario incorporates not only current policies, but also announced policies, such as official targets.⁷
- The third scenario is called the Sustainable Development Scenario. This scenario assumes that the energy system takes a pathway consistent with the goals of universal access to modern energy by 2030; emissions reduction in line with the Paris Agreement⁸; and improving air quality.

All three of these energy trajectories are possible, as is a pathway that lies somewhere in between. A key factor affecting which energy future unfolds will be the cost of different energy sources. None of the IEA scenarios factor in technological breakthroughs, but a common theme across all scenarios is a continual decline in costs for low-carbon technologies. How quickly low-carbon technologies become cost-competitive with other technologies in key countries like China — whether it be solar photovoltaics with coal in power generation or electric vehicles with internal combustion engine cars — remains to be seen.

⁷ Countries' National Determined Contributions made for the Paris Agreement are included in the New Policies Scenario. However, the New Policies Scenario does not put the world on an energy trajectory consistent with the aim of the Paris Agreement of keeping a global temperature rise this century well below 2 degrees celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees celsius. Under the Paris Agreement, collective progress towards achieving its aims will be assessed very 5 years to inform further action.

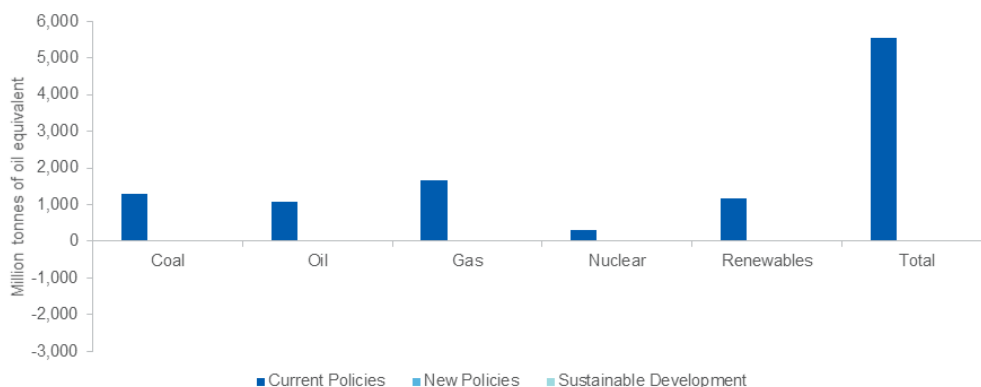
⁸ The Paris Agreement was agreed under the United Nations Framework Convention on Climate Change (UNFCCC) at the 21st Conference of the Parties (COP21) in Paris in late 2015.

The three different energy futures

Slide 7

Our current trajectory sees coal, oil and gas meet the majority of new energy demand

Change in energy use between 2016 and 2040 – Current Policies Scenario



Source: IEA (2017) World Energy Outlook

industry.gov.au/OCE



2018 Annual Conference

17-19 October
Perth

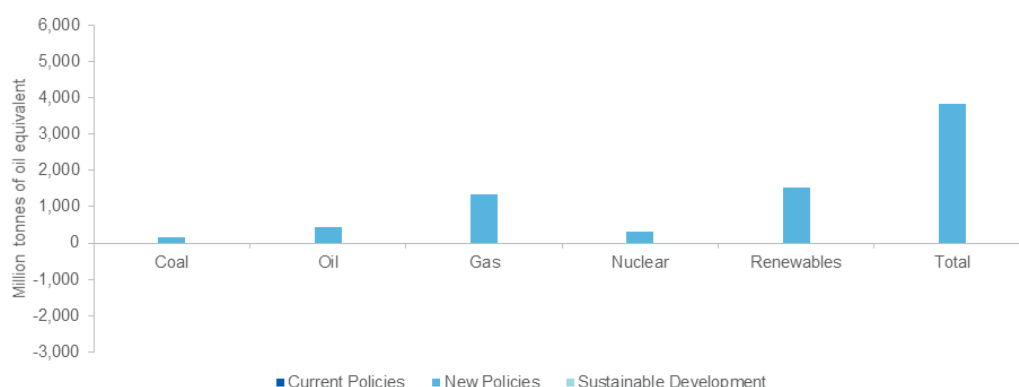
A common feature across all three IEA scenarios is that the world's energy needs continue to increase, driven by an increasing global population and economic growth. Addressing energy poverty remains a major challenge. There are still over 1 billion people who lack access to electricity.

Future energy usage grows rapidly in the IEA's Current Policies Scenario, and coal, gas and oil meet the bulk of new energy needs. The Current Policies Scenario might be characterized as a continuation of the current trajectory of the global energy system.

Slide 8

A gradual energy transition sees growth across all fuels, with gas and renewables in the lead

Change in energy use between 2016 and 2040 – New Policies Scenario



Source: IEA (2017) World Energy Outlook

industry.gov.au/OCE



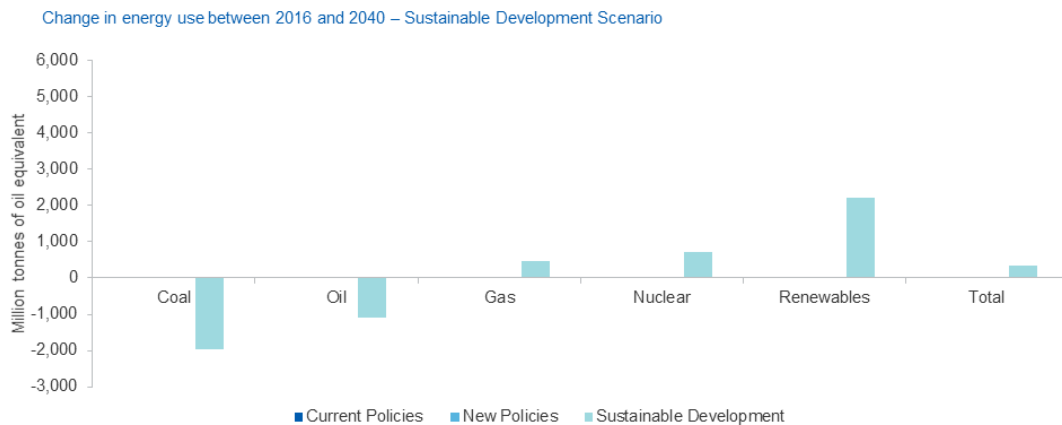
2018 Annual Conference

17-19 October
Perth

The IEA's New Policies and Sustainable Development scenarios involve an energy transition of varying degrees. In the New Policies Scenario, the energy transition takes place at a more gradual pace than envisaged in the Paris Agreement. Energy demand grows strongly, with renewables and gas meeting the bulk of new energy needs. Coal and oil demand remain relatively stable under the New Policies Scenario.

Slide 9

A rapid energy transition sees renewables, nuclear and gas expand



Source: IEA (2017) World Energy Outlook

industry.gov.au/OCE

AMPLA
Engineering
Energy &
Resources
Lawyers

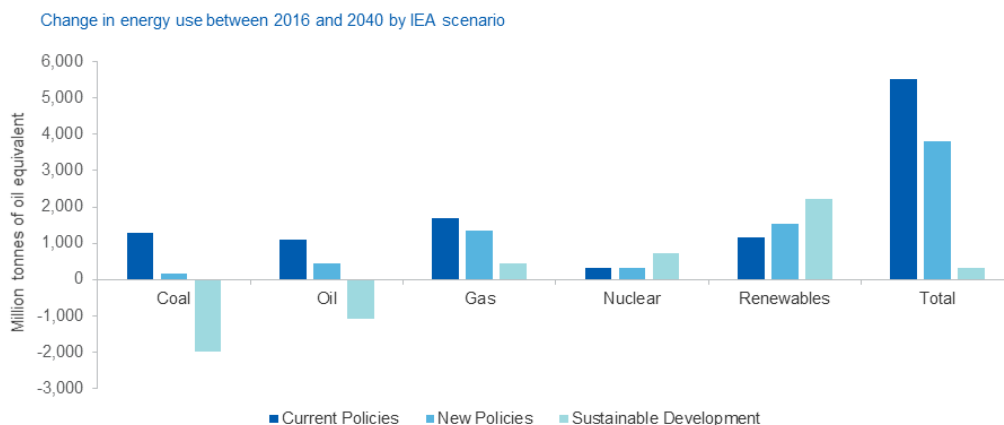
2018 Annual Conference

17-19 October
Perth

The Sustainable Development Scenario involves a more rapid energy transition. In this scenario, renewables increase quickly, doubling their share of the energy mix. Gas use edges up. Coal consumption and, to a lesser extent, oil consumption are reduced. Unlike in the other two scenarios, where energy use increases, demand for energy remains largely unchanged under the Sustainable Development Scenario.

Slide 10

Energy transformations — gradual or rapid — share several common features



Source: IEA (2017) World Energy Outlook

industry.gov.au/OCE

AMPLA
Engineering
Energy &
Resources
Lawyers

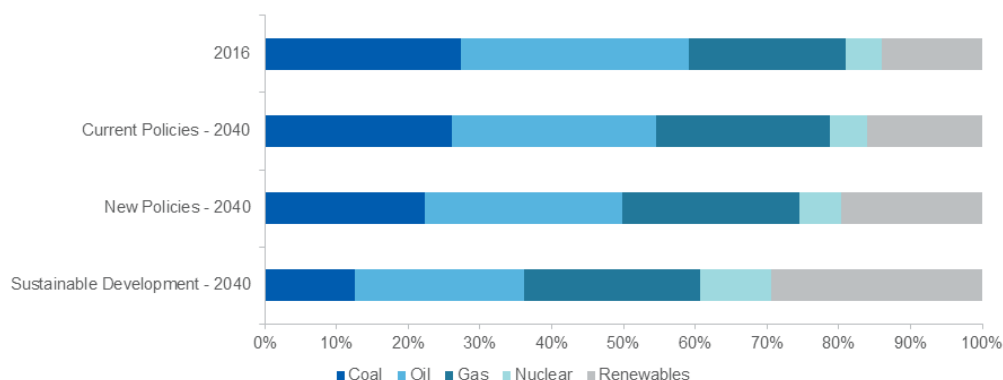
2018 Annual Conference

17-19 October
Perth

The New Policies and Sustainable Development scenarios — the two entailing the most pronounced energy transition — share some common features. One is that gas consumption increases, although by less than in the Current Policies Scenario. Gas plays an important role as a transition fuel, substituting for coal and oil at times and complementing the variability of renewable power. The other common feature under both the New Policies and Sustainable Development scenarios is that renewables grow rapidly, meeting more of new energy demand than any other fuel source. Under these two scenarios, demand for coal and oil is either largely stable, or even declines.

Slide 11

The global energy mix – 2016 vs IEA scenarios in 2040



Source: IEA (2017) World Energy Outlook

industry.gov.au/OCE

AMPLA
Empowering
Energy &
Resources
Lawyers

2018 Annual Conference

17-19 October
Perth

It is important, however, not to overstate the extent of the possible shift in the global energy landscape over the next 20 years. Fossil fuels remain an important part of the global energy mix even in an energy transformation that unfolds rapidly. Under the Sustainable Development Scenario, coal, oil and gas still account for over 60 per cent of the global energy mix in 2040.

Hydrogen

It is worth also considering the role that hydrogen could play in an energy transition. Hydrogen has potential uses in electricity generation, transport, heating and industrial applications. Hydrogen is a zero-emissions fuel in its use, but energy is required to produce it. Clean hydrogen can be produced in two ways; either from fossil fuels if carbon capture and storage is used, or from water using electricity generated from renewable sources. The IEA estimates that injecting hydrogen into natural gas streams could displace around 2 per cent of world natural gas consumption in 2040.⁹ Japan is potentially a major market with long-term plans for a 'hydrogen society', while South Korea has signalled its intentions to import hydrogen.

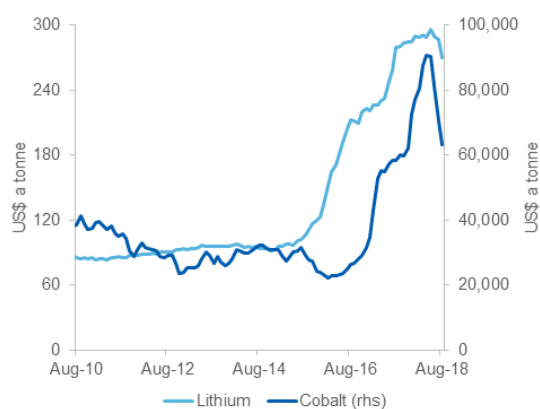
⁹ International Energy Agency (2017) World Energy Outlook

Batteries

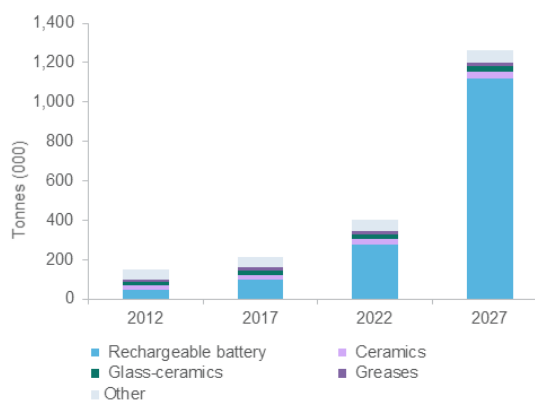
Slide 12

Electric vehicles to propel demand for lithium-ion batteries

Lithium and cobalt prices



Lithium usage by product



Source: Bloomberg (2018); Department of Industry, Innovation and Science (2018)

industry.gov.au/OCE



Engineering
Energy &
Resources
Lawyers

2018 Annual Conference

17-19 October
Perth

As we have seen, past energy transformations have been accompanied by technological advancement. Increased coal use was made possible by the invention of the steam engine. Oil's rise followed the invention of the internal combustion engine. Innovations in hydraulic fracturing and horizontal drilling unleashed the shale gas revolution in the United States.

Technological change will play a role in any future energy transition, whether it be gradual or rapid. The technology that I want to discuss today is batteries.

There are many types of batteries, but demand growth is expected to be particularly strong for Lithium-ion batteries, given their application in electric vehicles.

Lithium-ion batteries primarily use three commodities — lithium, graphite and cobalt. Over the past few years, lithium-ion battery demand has effectively pulled these commodities into a second commodity boom, with demand rising, prices spiking, and investment gathering pace. The outlook for lithium seems particularly bright, with lithium demand expected to increase six-fold over the next decade.

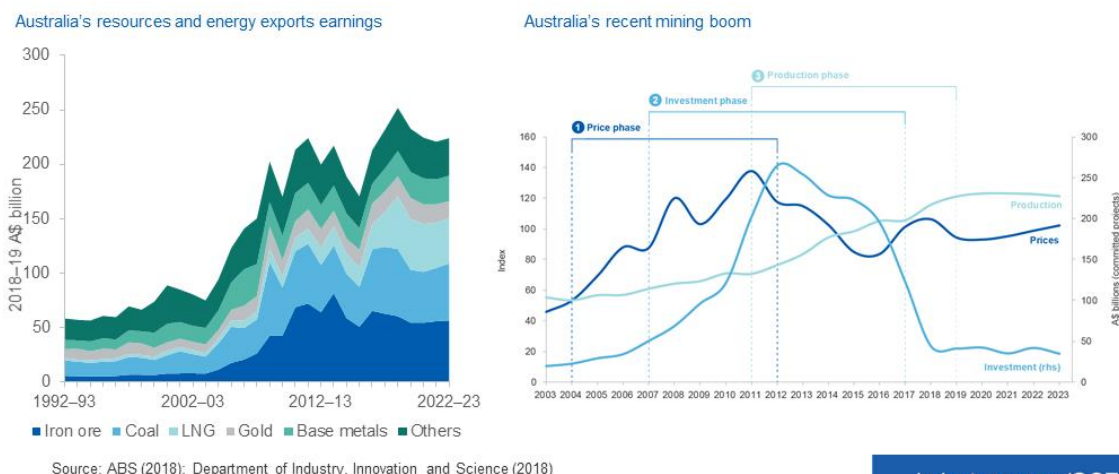
Energy trends will affect demand for other commodities Australia produces too. A battery electric vehicle, for instance, contains between 4 and 10 times more copper than a vehicle with an internal combustion engine.

Australia in a global energy transformation

The medium term: REQ forecasts

Slide 13

Export earnings to taper after this year, as the production phase draws to a close



industry.gov.au/OCE

AMPLA
Engineering
Energy &
Resources
Leaders

2018 Annual Conference

17-19 October
Perth

I move now to the third part of my speech, and what a future energy transformation could mean for Australia's resources and energy sector. While Australia's domestic energy policy settings have been a focus in recent times, what matters most for Australia's resources and energy sector is changes in the policy settings of the large energy consuming countries in Asia that affect demand for the energy commodities Australia supplies.

Every three months, the Office of the Chief Economist at the Department of Industry, Innovation and Science produces a report called the Resources and Energy Quarterly, the REQ, which forecasts the price, volume and export earnings from 12 of Australia's largest resources and energy export commodities.

This year, 2018-19, we are expecting resources and energy export earnings to reach a record of \$252 billion. This compares with an average of \$70 billion per year in the decade before the mining boom.¹⁰ Record high export earnings are the result of the recent rally in commodity prices and the growth in export volumes associated with the production phase of the boom.

After 2018-19, we are expecting the value of Australia's resources and energy exports to decline modestly. Recent commodity price strength is expected to moderate. On the energy side, oil prices, which also drive LNG prices in the Asia-Pacific, are expected to be constrained by growing US shale oil production. Coal prices are projected to decline, primarily due to moderating demand from Asia.¹¹ Meanwhile, the ramp up in export volumes from the third phase of the mining boom, the production phase, is expected to have run its course by the turn of the decade.

The legacy of Australia's recent mining boom, however, will live on for decades to come. The next five years alone will deliver well over \$1 trillion in resources and energy export earnings. But without the cushioning effect of growing export volumes, Australia's resources and energy export earnings will also be more susceptible to price shocks.

¹⁰ Average resources and energy exports earnings from 1994 to 2003.

¹¹ Thermal coal prices are forecast to decline, underpinned by an expected softening in import demand, particularly as domestic supply picks up in China, and as nuclear reactors come back online in Japan and South Korea. Metallurgical coal prices are forecast to be weighed down by the impacts of softening demand from China and improved supply from Australia following a series of weather and infrastructure related disruptions, outweighing growing demand from India. See the September 2018 *Resources and Energy Quarterly* for further information.

Our forecasts extend out five years, but there are also some long-term challenges and opportunities future energy transformations might present for Australia.

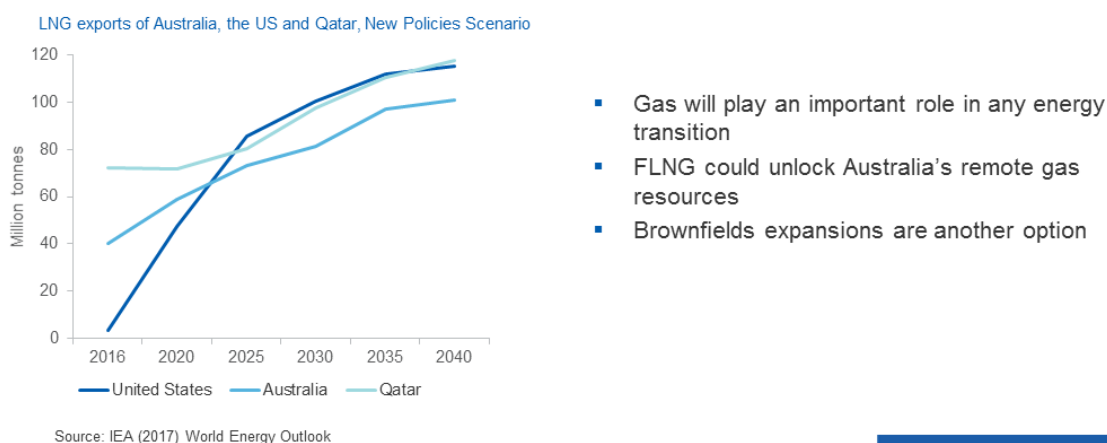
Australia's energy resources

Australia's resource base positions us to be a supplier of energy commodities for many years to come. Australia has identified resources of around 415 years of uranium, 280 years of black coal, 50 years of gas, and 30 years of oil at current production rates.¹² The Australian Government's Exploring for the Future program led by Geoscience Australia aims to shed further light on the mineral and energy resources available in northern Australia and parts of South Australia.

The long-term: gas

Slide 14

Australia seems unlikely to attract wave of LNG investment comparable to the last



industry.gov.au/OCE

AMPLA
Engineering
Energy &
Resources
Lawyers

2018 Annual Conference

17-19 October
Perth

In terms of the long-term for gas, the IEA anticipates that gas will likely play an important role in any energy transition. Growing gas demand is a market opportunity for Australia, but taking advantage of this opportunity is not without challenges. The recent wave of investment in Australian LNG mega projects has been plagued by cost overruns.

But Australia might not need to attract new LNG mega-projects to take advantage of growing gas demand. Brownfield expansions of existing LNG export infrastructure are one option. Another approach is Floating liquefied natural gas or FLNG — a technology that allows for the development of offshore gas deposits that are too remote or not large enough to justify the construction of an onshore plant and subsea pipelines.

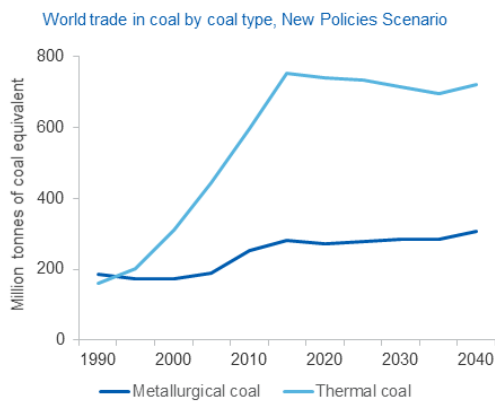
Shell's Prelude has been Australia's first, and the world's second, FLNG project. It is possible that FLNG will allow for further development of Australia's large but remote gas resources, as the cost of the technology comes down.

¹² Calculation based on total identified resources divided by annual production. Total identified oil and gas resources are from EnergyQuest (2018) EnergyQuarterly. Total identified coal and uranium resources are from Geoscience Australia's 2018 Australian Energy Resources Assessment. Production data is from the Department of Industry, Innovation and Science's Resources and Energy Quarterly (September 2018).

The long-term: coal

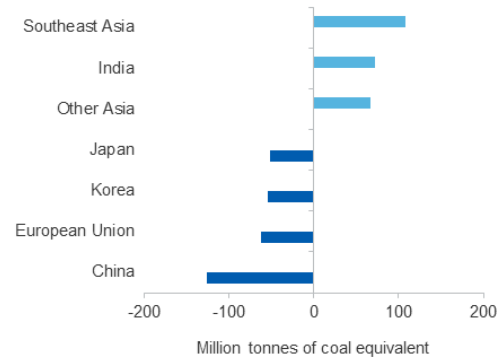
Slide 15

Australia is expected to continue to play a key role in meeting world coal demand



Source: IEA (2017) World Energy Outlook 2017

Change in net coal imports by region, 2016–2040, New Policies Scenario



industry.gov.au/OCE



2018 Annual Conference

17-19 October
Perth

In terms of the long-term for coal according to the IEA, coal consumption would remain relatively flat under a gradual energy transition, or fall sharply if a rapid energy transformation unfolds. However, these broad global trends mask differences in the outlook for different types of coal that could cushion the fall in demand for Australia's coal exports in any future energy transition.¹³

There is an often-missed distinction between metallurgical coal, which is used to make steel, and thermal coal, which is used in electricity generation. The long-term outlook for metallurgical coal, which accounts for two-thirds of Australia's total coal export earnings, is relatively positive: there are no proven competitive substitutes for metallurgical coal in blast-furnace steel-making and the ongoing urbanisation and industrialisation of emerging Asia will require steel.¹⁴

The outlook for thermal coal is more subdued, but different quality thermal coals face different prospects. For every tonne of thermal coal, its energy content, ash content, and moisture levels affect how much electricity and emissions are produced when it is burned. Australia's thermal coal, on average, is higher in energy content and has lower ash and moisture than the product of its major competitors. As countries seek to reduce emissions and air pollution, there is likely to be a growing preference for the higher quality thermal coal that Australia produces.

¹³ Australia's proximity to the world's fastest growing markets in Asia compared with the other major exporters — the United States, Colombia and South Africa — also advantages Australian producers.

¹⁴ Around 70 per cent of world steel is produced using blast furnaces, with the remaining 30 per cent made in electric arc furnaces. Steelmaker SSAB plans to build the world's first steel plant powered by hydrogen in Sweden. The pilot plant will be tested between 2020 and 2024.

The long-term: batteries

Slide 16

Australia is positioned to take advantage of growing demand for battery commodities



Lithium

Australia is the world's biggest producer of lithium.



Graphite

Australia has modest deposits of graphite with new projects currently being progressed.



Cobalt

Australia has sizeable reserves of cobalt, and a range of mines are producing it along with other commodities.

Source: Department of Industry, Innovation and Science (2018)

industry.gov.au/OCE



2018 Annual Conference

17-19 October
Perth

Turning now to batteries, and as I have already mentioned, the projections for lithium-ion batteries imply increased demand for lithium, cobalt, and graphite.

We have included a special topic on lithium in the September Quarter REQ which we released earlier this month. As the world's largest lithium producer, Australia is well positioned to take advantage of growing lithium demand. Australian producers also have a cost advantage in supplying lithium for electric vehicle batteries. Most of Australia's lithium resources occur within hard rock deposits in Western Australia, and can more easily be refined than the lithium produced from brine deposits by competitors Chile and Argentina. Around \$3 billion is being invested to build a series of refineries to transform Australian spodumene ore into more valuable lithium hydroxide, which will feed the rising electric vehicle market.

Australia also has significant cobalt reserves, second to only the Congo, which dominates world supply. Australia's reserves of graphite are comparatively modest, and there are currently no operating graphite mining projects. However, work is underway on a number of potential graphite projects in South Australia and Western Australia.¹⁵

It is far too early to coin the 'recharge phase' for Australia's resources and energy sector. Lithium exports were worth only \$800 million in 2017 out of total resource and energy export earnings of \$213 billion. However, there is a longer-term opportunity for Australia to market itself as a stable supplier of battery commodities.¹⁶ More broadly, diversifying our export base — whether that involves moving into other tech minerals or moving up the supply chain — would make us more responsive to new market opportunities and help to buffer our resources and energy exports against external risks.

The long-term: hydrogen

Finally, Australia may also have the potential to establish itself as a supplier of zero-emissions hydrogen to countries like Japan and South Korea. Australia is close to the emerging markets in Asia and has an abundance of renewable energy and fossil-fuel resources from which hydrogen can be produced. Indeed, the Australian Government is currently funding a pilot project in Victoria that involves producing clean hydrogen from brown coal, liquefying it, and shipping it to Japan. Projections from ACIL Allen suggest that Australia could export anywhere from \$3-13 billion of hydrogen by 2040.¹⁷

¹⁵ These include projects operated by Hexagon Resources and Mineral Resources in Western Australia and projects operated by Archer Exploration, Lincoln Materials, Oakdale Resources and Quantum Graphite in South Australia.

¹⁶ Cobalt, graphite and lithium are not the only battery commodities. Others include nickel, manganese, copper.

¹⁷ ACIL Allen (2018) Opportunities for Australia from hydrogen exports

Conclusion

Slide 17

Further information



Melissa Bray
General Manager
Economic Advice Service
Office of the Chief Economist

Phone: (02) 6102 8229
Email: Melissa.bray@industry.gov.au

 Follow us [@economist_chief](https://twitter.com/economist_chief)

industry.gov.au/OCE



2018 Annual Conference

17-19 October
Perth

In conclusion, the modern world has witnessed three great energy transformations. Over the next few decades, the global energy system could continue on its current trajectory, begin a gradual energy transition or undergo a rapid transformation.

Any energy transition, gradual or rapid, will create opportunities and challenges for Australia's resources and energy sector. While increasing global gas demand would be unlikely to lead to a wave of LNG investment in Australia akin to the last 10 years, it could support brownfield expansions and the development of remote gas resources.

Australia's high quality coal could partially insulate Australian producers from any moderation in demand in thermal coal markets. Australia's metallurgical coal exports face less downside risk because of a lack of competitively priced substitutes.

Finally, Australia is potentially well-positioned to be a supplier of both zero-emissions hydrogen and some battery commodities, with lithium a potential bright spot.

While it is impossible to predict the future, Australia must be prepared for whatever energy future awaits, including the next energy transformation.