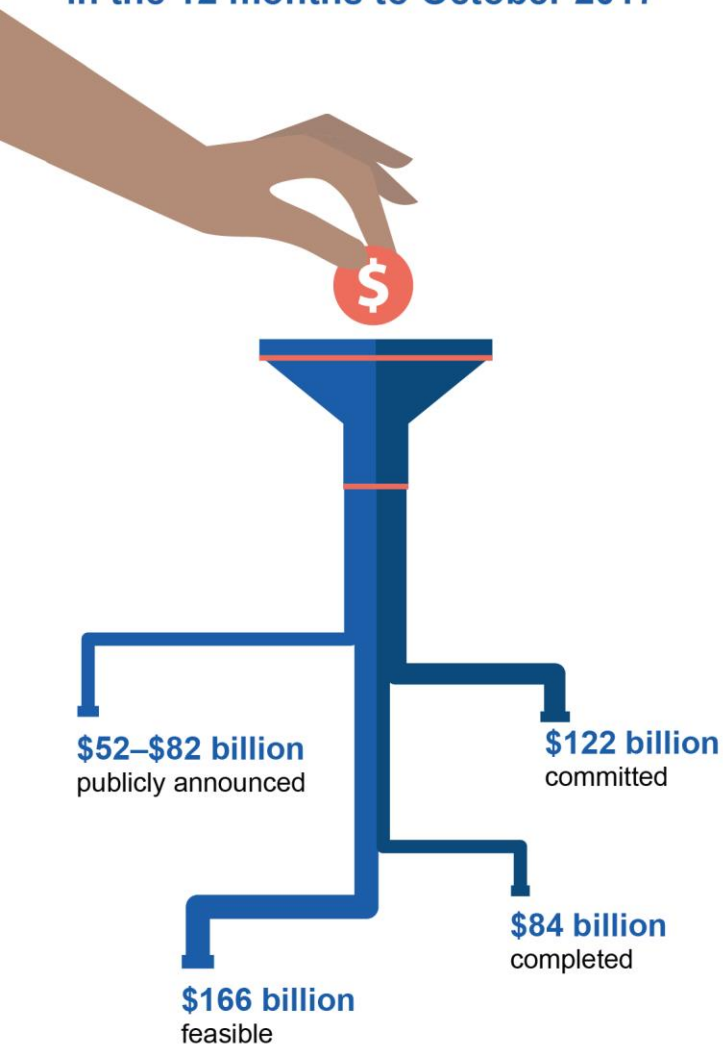


Major Projects

Resources and Energy Quarterly December 2017

Value of resource and energy projects in the investment pipeline in the 12 months to October 2017



Per cent share of value of committed projects by commodity groups



\$60 billion Gorgon LNG project
Australia's largest single resource project ever developed



Major projects include over **30 different mineral varieties**



15.1 Overview

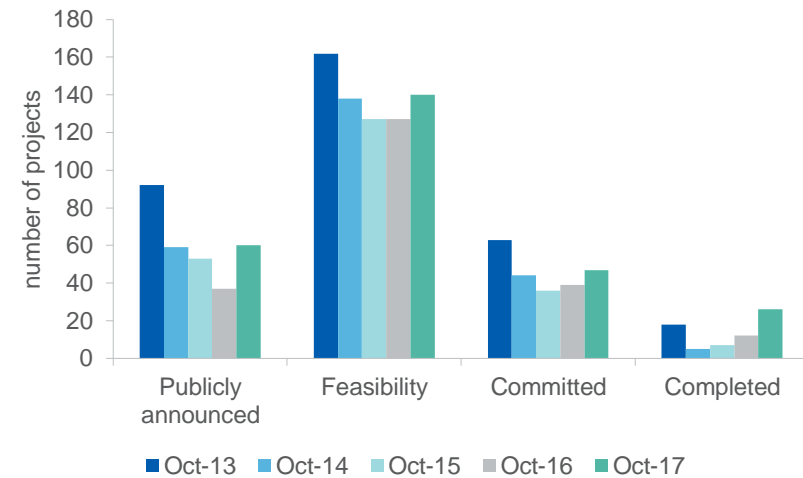
A year on from the release of our last Major Projects publication, the number of committed projects has increased by 5.1 per cent to 41, largely driven by an increase in the number and value of copper, gold, nickel and other minor commodity projects. The value of publicly announced projects as well as projects moving to the feasibility stage have also increased over the past 12 months, in line with higher exploration expenditure and higher resource and energy commodity prices.

While the past few years have been characterised by cutting costs to ensure the commercial viability of existing assets, 2017 has seen some renewed optimism for market conditions and increased producer interest in brownfield expansions and new projects.

As expected the value of ‘committed’ resource and energy projects has fallen by 17 per cent, new projects where a final investment decision (FID) has been taken will see construction activity commence in the coming months. The decline is largely due to the transition of Gorgon — Australia’s largest LNG project and the Roy Hill iron ore project — to the ‘completed’ stage, while the backlog of projects at the ‘feasibility’ stage continued to grow.

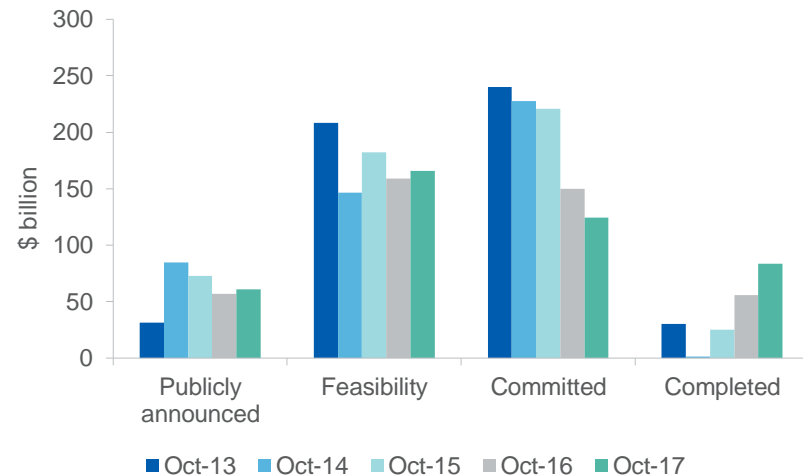
Although the outlook for resource and energy investments is forecast to be relatively subdued with the value of committed projects expected to decline in 2018 and 2019, three mega LNG projects (projects over \$5 billion) remain in the investment pipeline at the committed stage. These include Wheatstone, Ichthys and the Prelude Floating LNG project, which are estimated to be worth \$100 billion combined. These three projects are expected to be completed by 2018 — largely concluding the current investment phase.

Figure 15.1: Number of projects in the investment pipeline



Source: Department of Industry, Innovation and Science (2017)

Figure 15.2: Value of projects in the investment pipeline



Notes: value of projects at publicly announced is estimated as the mid-point of the range.

Source: Department of Industry, Innovation and Science (2017)

Table 15.1: Summary of projects in the investment pipeline

	Publicly announced		Feasibility		Committed		Completed	
	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m
Aluminium, Bauxite, Alumina	0	0	0	0	2	1,963	0	0
Coal	14	12,500–20,237+	33	54,787	5	8,693	5	1,569
Copper	3	750–1,747	6	1,376	4	1,991	0	0
Gold	2	0–498	8	2,364	6	1,340	4	448
Infrastructure	7	5,250–9,991	7	7,349	2	1,126	3	4,580
Iron ore	7	5,250–10,493+	16	23,536	3	966	2	11,038
Lead, Zinc, Silver	3	0–747	2	420	3	1,011	1	563
LNG, Gas, Petroleum	7	24,500–27,497+	12	60,749	11	106,167	6	64,965
Nickel	11	3,750–8,989	2	2,960	1	443	0	0
Uranium	2	250–499	4	1,915	0	0	0	0
Other Commodities	1	250–499	35	10,590	4	893	1	800
Total	57	52,500–81,197+	125	166,046	41	122,379	22	83,963

Source: Department of Industry, Innovation and Science (2017)

15.2 Introduction

Resources and Energy Major Projects provides a review of the mining, infrastructure projects and processing facilities that increase, extend or improve the output of mineral and energy commodities in Australia. This edition of the report is an update on project developments over the 12 months to October 2017. Its purpose is to measure the value of the current and potential investment in the mining and energy sectors, and to provide an analysis of the key trends and issues underpinning the level of investment. The value of this investment is an important economic indicator for Australia: capital expenditure associated with resources and energy major projects has been a major source of economic activity over the past five years.

The OCE gathers information on major projects from a number of sources, including company websites, Australian Stock Exchange reports, media releases, and from direct contact with company representatives. Although there is substantial investment by mining and energy companies in replenishing equipment, plant and other property, the focus of this report is on 'major' investments — those over \$50 million. Smaller scale operations are also an important contributor to the sector and the broader Australian economy. However gathering data on such projects is challenging, as many are undertaken by private companies which have fewer obligations to report progress.

Developers of resources and energy projects often use different planning processes and assessment methods to support an FID. Thus, there is no standard project development model with clearly defined stages and terminology that can be applied to every resources and energy project.

To broadly represent the general lifecycle of a project, OCE use a four-stage model of the investment pipeline to measure the potential investment in Australia's resources and energy sectors. Earlier stages of developing mining and energy projects, such as identifying deposits and exploration activities, are not included in the model. While these activities remain important, it is beyond the scope of this report to assess

exploration activities on a project-by-project basis. Instead, a summary and analysis of aggregate exploration expenditure is provided. To be included on the major projects list that accompanies this report, there must be evidence of project activities that support the project progressing to an FID within the next five years.

The four stages in the OCE investment pipeline model are: publicly announced, feasibility, committed and completed.

Publicly announced stage

Projects at the publicly announced stage are usually very early in their development, and are typically undergoing an initial feasibility study to assess the commercial aspects of developing an identified resource. To include a project on the list at this stage, preliminary information on the project schedule, planned output or cost must be publicly available. Projects that have stalled in progressing towards an FID, and that are investigating alternative development options, are also classified as Publicly Announced to reflect their longer planning times.

As they are still in early planning stages, projects at the publicly announced stage may not have finalised the engineering designs or estimates of construction costs. To reflect this uncertainty, project costs are quoted as a cost band in the Major Projects list. In most cases, this is based upon an estimate developed by OCE using industry averages for similar construction activities. The cost bands used by the OCE in this report for publicly announced projects are:

- \$0 – \$249m
- \$250m – \$499m
- \$500m – \$999m
- \$1,000m – \$1,499m
- \$1,500m – \$2,499m
- \$2,500m – \$4,999m
- \$5,000m+

Feasibility stage

This stage of the project development cycle is when the initial feasibility study for a project has been completed and the results support further development. Projects that have progressed to the feasibility stage have undertaken initial project definition studies and commenced more detailed planning work. This work includes Front-End Engineering Design studies, Bankable Feasibility Studies, developing the final project scope, commercial plans and environmental surveys (in support of finalising an Environmental Impact Statement).

While there is an opportunity to progress projects at the feasibility stage to the committed stage, this is not guaranteed to occur, as the evaluation of commercial prospects has not yet been finalised and all regulatory approvals are yet to be received. Projects at the feasibility stage have not been committed to, and are only potential investments that may occur under the appropriate conditions. Therefore, the total value of projects at the feasibility stage cannot be directly compared to the value of the projects at the committed stage — in order to forecast the future of capital investment in Australia's resources and energy sectors.

Committed stage

Projects at the committed stage have completed all commercial, engineering and environmental studies, received all necessary Government regulatory approvals, and finalised the financing of the project to allow construction. Such projects are considered to have received a positive FID from the owner(s). In most cases, projects at this stage of development have already started construction, as there are typically pre-works undertaken as part of exploration and design activities.

Projects at the committed stage typically have cost estimates, schedules, and mine outputs that are well defined and often publicly released. Most projects that progress to the committed stage will eventually commence production. Nevertheless, post-FID, there are still technical and financial risks that, if realised, can result in delays, scope changes and cost

overruns, or even affect the commercial viability of a project and possibly lead to its cancellation.

Completed stage

A project reaches the completed stage when construction and commissioning activities are substantially completed and full commercial level production has commenced. As many projects include multiple stages and scope elements that can be independent of each other, the timing around when a project reaches the completed stage can be difficult to assess.

15.3 Exploration

Exploration is a key stage in the mining project development cycle. It is an investment in knowledge about the location, type, quantity and quality of deposits, which helps to inform future development. Before making the decision to undertake exploration activities, resources and energy companies consider a range of factors to ensure the benefits of exploration activities exceed the costs. Factors to be considered include initial and long term land access agreements, prevailing and expected commodity prices, regulatory environments, geological prospects, and tax and royalties arrangements.

Exploration expenditure continues to decline

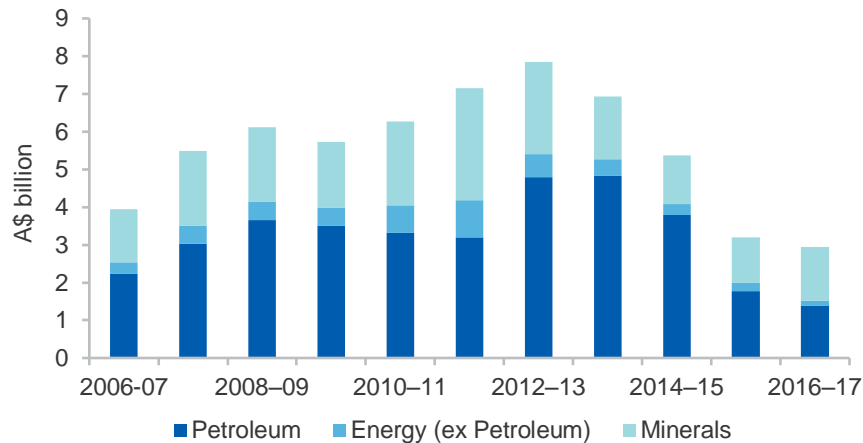
Australian exploration expenditure fell by 8 per cent in 2016–17 to \$2.9 billion. The main contributor to the fall was lower petroleum exploration expenditure, which decreased by 23 per cent to \$1.4 billion. The declines were smaller than in 2015–16, supported by a recovery in both onshore and offshore exploration activity in the first half of 2017. Nonetheless, both offshore and onshore petroleum expenditure remain around their lowest level in the last decade. Australia's wave of LNG investment saw exploration expenditure reach record levels between 2012 and 2014, but a difficult price environment has weighed on petroleum exploration expenditure since 2015.

Partially offsetting the fall in petroleum exploration is a rise in minerals exploration, up 10 per cent in 2016–17 to \$1.6 billion. The increase in minerals exploration was largely driven by nickel, cobalt, and gold, all of which were subject to recent favourable movements in commodity prices.

Exploration expenditure on coal declined by 31 per cent in 2016–17, to \$120 million, reflecting significant uncertainties around future movements in coal prices.

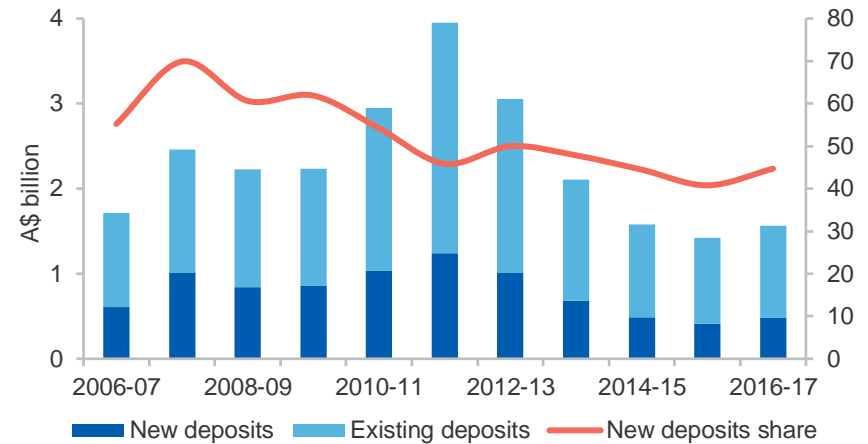
After 5 consecutive years of declines since 2012, exploration expenditure on iron ore has stabilised, remaining unchanged from 2015–16 levels of \$291 million. Growing global supply and expectations of low prices have discouraged a rebound in exploration activity.

Figure 15.3: Exploration expenditure



Source: ABS (2017) Mineral and Petroleum Exploration, Australia, 8412.0

Figure 15.4: Mineral exploration by deposit type



Source: ABS (2017) Mineral and Petroleum Exploration, Australia, 8412.0

In 2016–17, mineral exploration expenditure targeting new and existing deposits increased by 17 and 7 per cent, to \$0.5 and \$1.1 billion, respectively. Market conditions encouraged exploration at new deposits, with greenfield exploration for mineral deposits not already known to exist becoming more appealing as commodity prices increased.

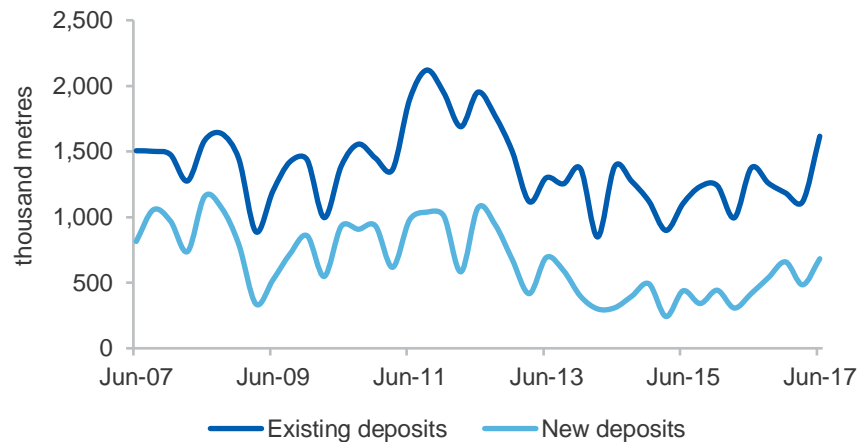
Gold exploration expenditure increased by 26 per cent in 2016–17 to \$689 million — accounting for 44 per cent of Australia’s total minerals exploration expenditure during the financial year. Exploration activity has been encouraged by higher world gold prices and the lower AUD/USD, which has improved the profit margins of Australian gold producers.

Base metals exploration expenditure rose by 17 per cent in 2016–17 to \$271 million, supported by higher commodity prices. This was the first yearly improvement since low prices triggered a steady decline in 2012. Notably, Australia’s copper exploration expenditure increased by 5 per cent, to \$136 million — accounting for 50 per cent of Australia’s total base metals exploration expenditure. The rise was driven by an improved outlook for copper prices.

Exploration expenditure on nickel and cobalt also recorded a strong rise in 2016–17, up by 59 per cent to \$81 million. This was supported by an increase in nickel prices, following stronger than expected demand growth in China, which is seeking to increase its output of stainless steel.

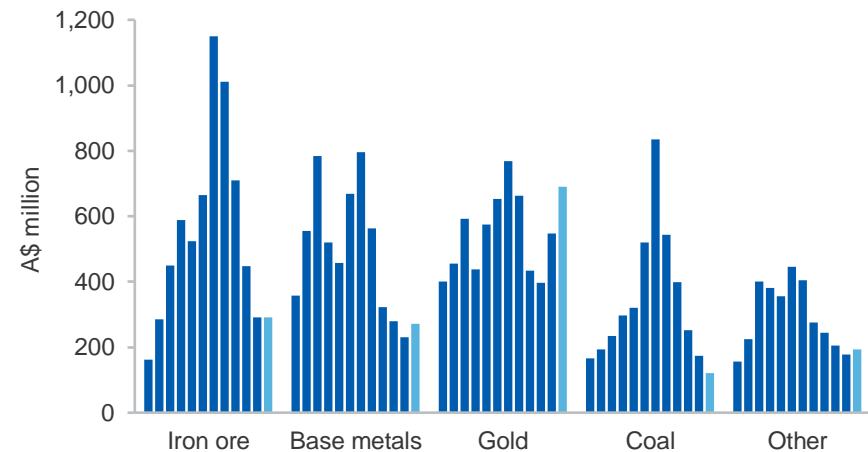
Other base metals recorded a rebound in exploration activity in 2016–17. Exploration expenditure on zinc, lead and silver increased by 10 per cent, to \$55 million. Increased zinc prices also supported renewed interest among resource companies.

Figure 15.5: Minerals exploration, metres drilled quarterly



Source: ABS (2017) Mineral and Petroleum Exploration, Australia, 8412.0

Figure 15.6: Exploration expenditure by commodity, 2006–07 to 2016–17



Source: ABS (2017) Mineral and Petroleum Exploration, Australia, 8412.0

15.4 Projects at the publicly announced stage

Recently announced infrastructure projects will help to boost Australia’s export capacity from the 2020s

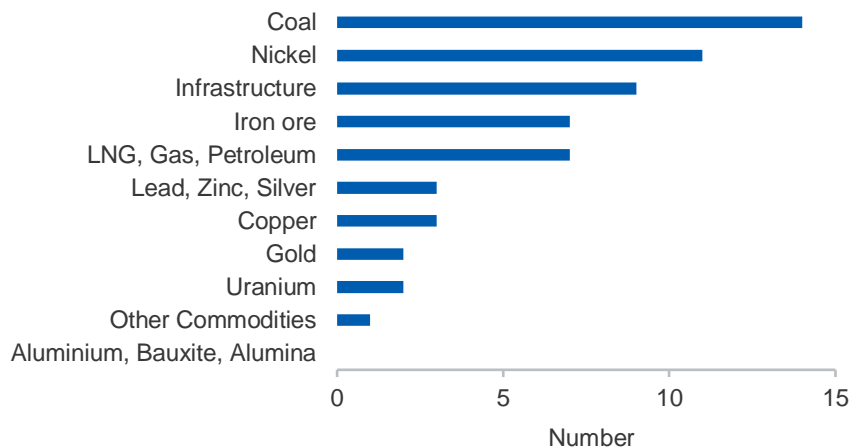
After 5 years of decline, the value of projects at the publicly announced stage picked up over the past twelve months to October, rising by almost \$10 billion to \$66 billion. This was driven in part by rising prices for commodities such as zinc and lithium, which have encouraged some fast-tracking and increased exploration for those minerals over the past twelve months.

Several nickel projects were publicly announced in the past twelve months, including BHP’s Yakabindie mine in WA and Metallica Resources’ Nornico mine in Queensland. The long-term feasibility of both projects remains under review, with underlying price movements over the next 12–24 months are likely to play an important role in the progression of the projects.

Some large infrastructure projects have also been announced in Queensland, notably the expansion work at the Port of Townsville, which is expected to occur in three stages (with completion in the 2020s).

The pipeline of new gas projects in the eastern gas market remains closely watched. Origin announced that it is targeting FEED on its Ironbark gas project in the Surat Basin — which it first acquired in 2009 — in 2017–18. Galilee Energy stated that it will proceed with FEED on its Glenaras gas project in the Galilee Basin in 2019, with production planned for 2022. Gas from the Glenaras project will be delivered to the east coast gas market with the assistance of the pipeline company Jemena.

Figure 15.7: Number of projects at the publicly announced stage 2017



Source: Department of Industry, Innovation and Science (2017)

15.5 Projects at the feasibility stage

A substantial number of projects remain stuck at the feasibility stage

The value of projects at the feasibility stage increased 4.5 per cent to \$166 billion in 2017, the number of such projects remained steady at 125. The size and scale of mining projects has been falling for several years, and this is the first year this trend appears to have improved.

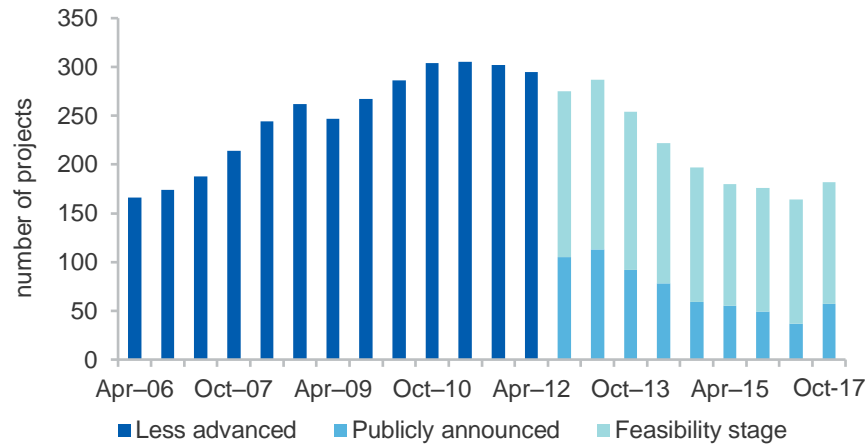
Current market conditions have led to a backlog of projects at the feasibility stage, as companies delay decisions to see how market conditions unfold. There are currently 40 coal projects at the feasibility stage, with several new ones being added over the past year.

Several iron ore projects reached the feasibility stage in 2017, with Fortescue Metals now considering two additional projects — Eliwana, within the Western Hub, and Iron Bridge in the Pilbara region. The Eliwana mine will maintain Australia’s Hematite capacity if the project receives board approval.

Offsetting this were several large LNG projects, which were moved to the committed stage.

Woodside announced an expansion at the Pluto LNG project in Western Australia in February 2017, and is targeting an FID in the second half of 2018. Woodside has outlined two options for the expansion. The first — a debottlenecking task — would add around 0.7 million tonnes of production capacity. The second — an off-the-shelf train that would plug-in to the existing infrastructure — would add 1 to 1.5 million tonnes.

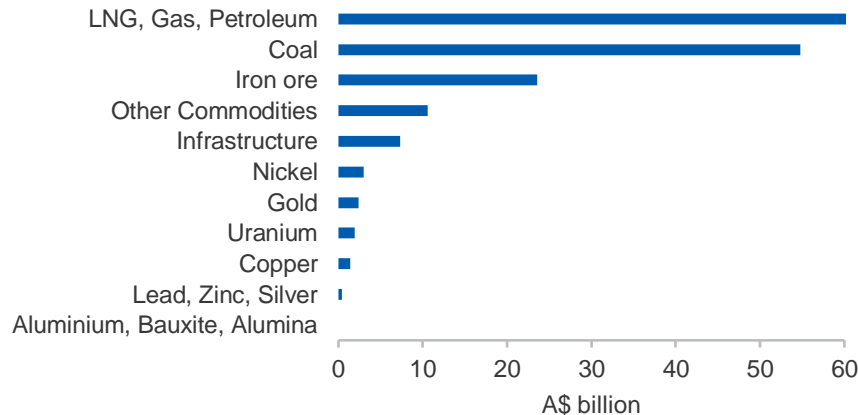
Figure 15.8: Number of uncommitted projects



Notes: 'less advanced' projects was the previous classification for projects at the publicly announced and feasibility stage.

Source: Department of Industry, Innovation and Science (2017)

Figure 15.9: Value of projects at the feasibility stage by commodity 2017



Source: Department of Industry, Innovation and Science (2017)

15.6 Projects at the committed stage

The value of committed projects has fallen away as fewer projects are judged feasible.

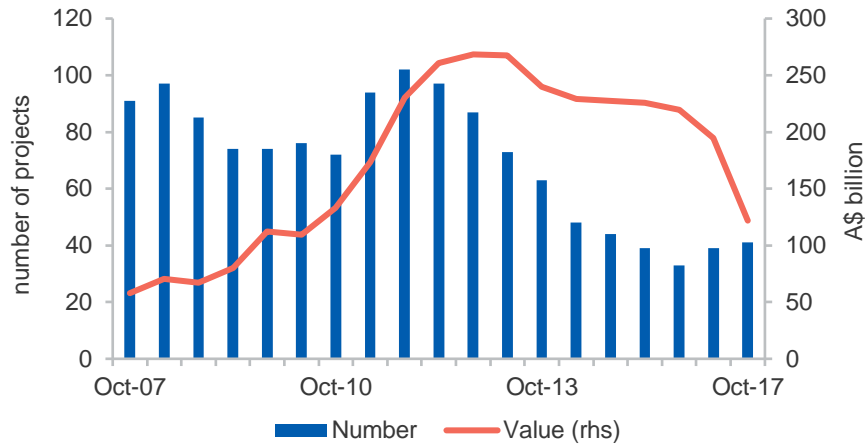
The value of projects at the committed stage declined sharply from \$194 billion to \$122 billion over the twelve months to end October 2017. This largely reflects the rising backlog of projects stranded at the feasibility stage, as well as the transition of several large LNG projects to completion.

The decline resulting from the completion of these projects was partially offset by FIDs for a number of projects across the gas, oil, copper and gold sectors. This included FIDs for Cooper Energy's \$550 million Sole gas project, offshore of Victoria, and for upgrades to APA's \$250 million Orbest Gas Plant (which will process gas from Sole). The Sole project — which has proved and probable reserves of 249 petajoules — is expected supply 24 petajoules of gas into the east Australian market from 2019.

The Wheatstone LNG project in Western Australia remained at the committed stage of development in 2017. While Wheatstone produced its first LNG from train 1 in October, Train 2 is not expected to be completed until sometime between April and June 2018.

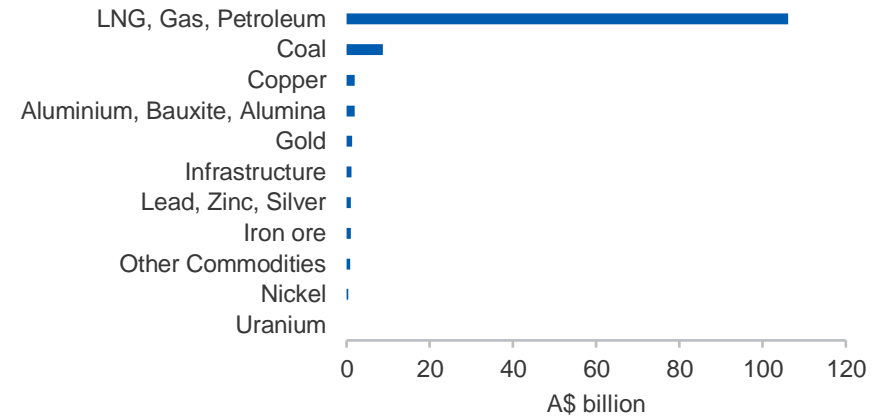
Newly committed gold projects include the MT Morgans project in Western Australia, (which is expected to add significant capacity from its start-up date in 2018) as well as projects at Dalgaranga, Dargues Reef and Kalawinda. Two new copper projects were also subject to final approval — the Carrapateena mine in South Australia and the Mount Gordon mine in Queensland — both of which are expected to start up by 2019.

Figure 15.10: Number and Value of committed projects



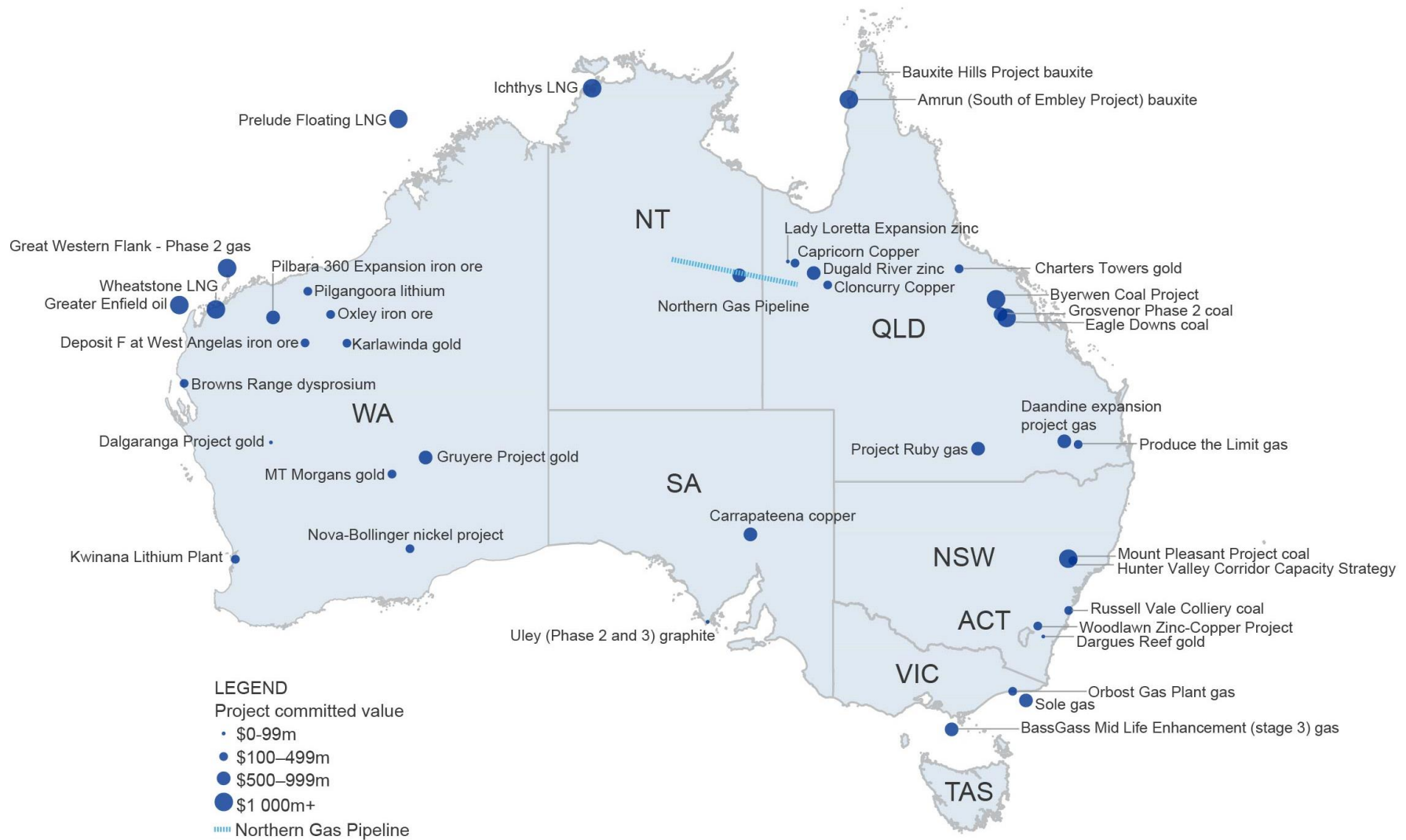
Source: Department of Industry, Innovation and Science (2017)

Figure 15.11: Value of committed projects by commodity 2017



Source: Department of Industry, Innovation and Science (2017)

Image 15.1: Location of projects at the committed stage



Source: Department of Industry, Innovation and Science (2017)

15.7 Projects at the completed stage

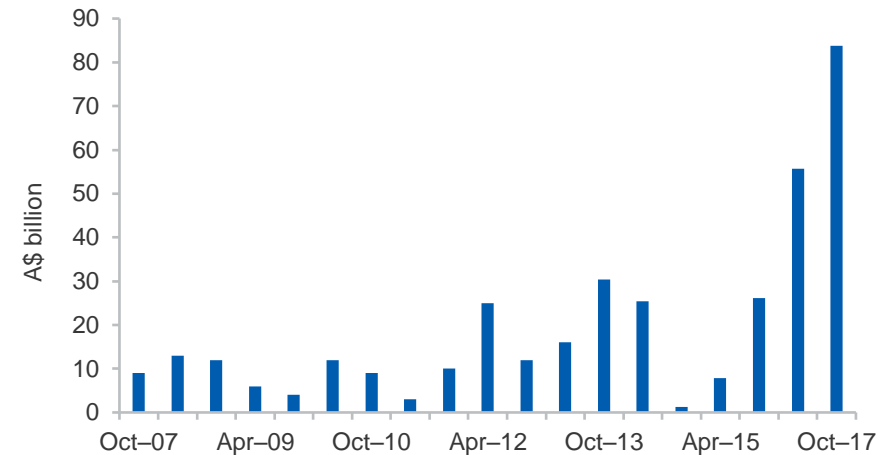
The value of projects at the completed stage has increased with the Gorgon gas project's completion.

22 projects — valued at \$84 billion — progressed to the completed stage in the twelve months to October 2017. This was largely due to the completion of the largest project on the Resources and Energy Major projects list: the US\$54 billion Gorgon LNG project in Western Australia. The third and final train at Gorgon started producing LNG in March 2017, bringing the nameplate capacity of the project to 15.6 million tonnes per annum. QGC's \$1.7 billion Charlie gas project also progressed to the completed stage.

Coal projects remain largely focused on high quality coal, with two such projects completed in 2017. Expansion has concluded on BHP's Appin project in NSW, which is expected to add significantly to coking coal output at the site. Anglo American's Grosvenor coal mine was also completed in 2017.

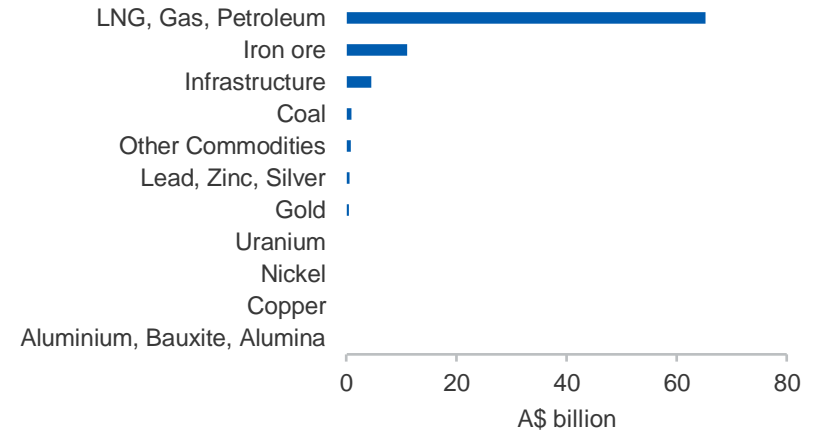
Other completed projects include the redevelopment of the Port Pirie mine, which will extract lead, zinc and copper in South Australia. 2017 also saw the commencement of the world's first modular ammonium nitrate plant in Western Australia.

Figure 15.12: Value of completed projects



Source: Department of Industry, Innovation and Science (2017)

Figure 15.13: Value of completed projects by commodity 2017



Source: Department of Industry, Innovation and Science (2017)

15.8 Outlook for resources and energy investment

The value of committed projects is expected to fall sharply in 2018, driven by the completion of the three remaining mega-projects in the project pipeline. The three LNG projects — Wheatstone, Ichthys, and Prelude — have a combined value of around \$100 billion and are scheduled for completion by the end of 2018.

Box 15.1: Methodology

While the resources boom over the past decade stimulated considerable investment in Australia's resources and energy sector, not all projects that were initiated ended up progressing through to construction. Accordingly, projects at the publicly announced and feasibility stages can only be viewed as potential investment.

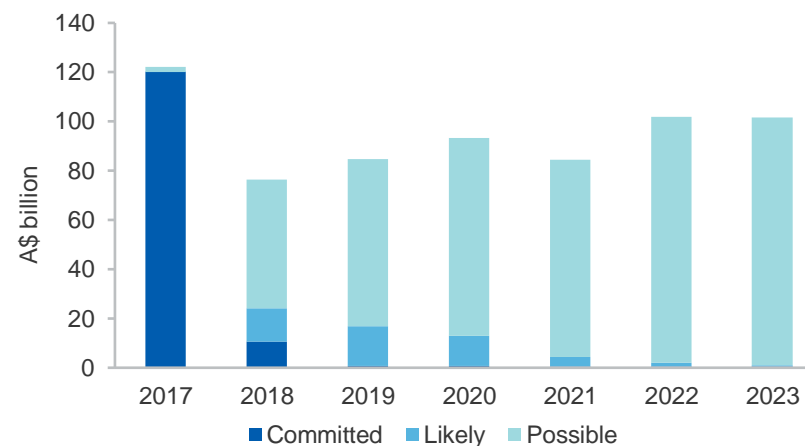
Resources and Energy Major Projects employs a project-level analysis to provide a profile of future investment. Projects at the feasibility and publicly announced stages are rated as either 'likely', 'possible' or 'unlikely' to progress to the committed stage. This assessment is based on a range of internal and external factors. Where data is available, projects are assessed based on their position on the relevant commodity's cost curve. The timing of when projects are likely to progress to the committed stage is based on schedules announced by the project's developers. Projects that have been assessed as 'unlikely' to proceed are not included in the forward projection of the value of committed investment.

Although assessments are made at a project level, these are not provided in the Resources and Energy Major Projects analysis because some of the information used is treated as commercial in confidence.

Woodside's Wheatstone project is likely to be the first of the three projects completed, with train 2 due online between April and June 2018. First LNG at Inpex's Ichthys project is expected to be completed in the March quarter 2018, with some reports indicating that train 2 could commence operations as soon as a few months later. The Prelude Floating LNG project is likely to be the last of Australia's recent wave of seven LNG projects to be completed, with Shell indicating Prelude will be completed between May and August 2018.

Challenging market conditions over the past few years has encouraged Australian producers to focus capital investment towards lowering the cost of existing operations and increasing output. New, large scale low-cost projects are expected to drive investment in 2022 and beyond. Over 66 per cent of possible investment in 2022 and 2023 is attributed to just nine new large scale projects in gas, coal and iron ore.

Figure 15.14: Scenarios for committed project investment



Source: Department of Industry, Innovation and Science (2017)

Table 15.2: Summary of projects at the publicly announced stage

	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m
Aluminium ,Bauxite, Alumina															0	0
Coal	4	2,000-3,746	10	10,500-16,491+											14	12,500-20,237+
Copper			1	250 – 499	2	500 – 1,248									3	750 – 1,747
Gold					1	0 - 249	1	0 - 249							2	0 - 498
Infrastructure			4	3,500 – 6,495	3	6,000-6,998+									7	5,250 – 9,991+
Iron ore					5	3,500-7,495			2	1,750-2,998					7	5,250 – 10,493
Lead, Zinc, Silver	1	0 - 249	1	0 - 249	1	0 - 249									3	0 - 747
LNG, Gas, Petroleum			2	3,000 – 4,998	4	16,500-17,499+	1	5,000– 5,000+							7	24,500– 27,497+
Nickel			2	250 - 748	9	3,500 – 8,241									11	3,750 – 8,989
Other Commodities											1	250 - 499			1	250 - 499
Uranium			1	250 - 499	1	0 - 249									2	250 - 499
Total	5	2,000-3,995	20	17,750-29,979+	26	25,500-37,978+	2	5,000-5,249+	2	1,750-2,998	1	500 - 998			57	52,500-81,197+

Source: Department of Industry, Innovation and Science (2017)

Table 15.3: Summary of projects at the feasibility stage

	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m
Aluminium ,Bauxite, Alumina															0	0
Coal	5	4,168	27	50,476							1	143			33	54,787
Copper	1	131			1	202	1	190	2	563	1	291			6	1,376
Gold	1	215	1	134	5	969	1	1,046							8	2,364
Infrastructure	1	351	4	5,084	1	1,250			1	663					7	7,349
Iron ore	1	2,900			12	15,386			3	5,250					16	23,536
Lead, Zinc, Silver	1	350			1	70									2	420
LNG, Gas, Petroleum	1	2,000	4	3,800	5	54,500					2	540			12	60,749
Nickel					2	2,960									2	2,960
Other Commodities	7	1,798	5	1,473	11	2,974	4	2,676	2	193	4	1,186	2	290	35	10,590
Uranium			1	350	3	1,565									4	1,915
Total	18	11,913	42	61,317	41	79,876	6	3,912	8	6,669	8	2,160	2	290	125	166,046

Source: Department of Industry, Innovation and Science (2017)

Table 15.4: Summary of projects at the committed stage

	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m
Aluminium, Bauxite, Alumina			2	1,963											2	1,963
Coal	2	1,750	3	4,794											5	6,544
Copper			2	481					2	1,510					4	1,991
Gold	1	80	1	246	4	948									6	1,275
Infrastructure	1	326					1	800							2	1,126
Iron ore					3	966									3	966
Lead, Zinc, Silver	1	140	2	871											3	1,011
LNG, Gas, Petroleum			3	1,100	4	61,200	1	42,567			3	1,300			11	106,167
Nickel					1	443									1	443
Other Commodities					3	843			1	50					4	893
Uranium															0	0
Total	5	2,296	13	9,455	15	64,400	2	43,367	2	1,560	3	1,300	0	0	41	122,379

Source: Department of Industry, Innovation and Science (2017)

Table 15.5: Summary of projects at the completed stage

	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m	No. of projects	Value A\$m
Aluminium, Bauxite, Alumina															0	0
Coal	3	1,389	2	180											5	1,569
Copper															0	0
Gold					3	328	1	120							4	448
Infrastructure			2	4,440	1	140									3	4,580
Iron ore					2	11,038									2	11,038
Lead, Zinc, Silver									1	563					1	563
LNG, Gas, Petroleum			1	1,700	3	62,065					2	1,200			6	64,965
Nickel															0	0
Other Commodities					1	800									1	800
Uranium															0	0
Total	3	1,389	5	6,320	11	74,371	1	120	1	563	2	1,200	0	0	22	83,963

Source: Department of Industry, Innovation and Science (2017)