

### **NEWS RELEASE**

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#### **Minerals Australia Briefing**

BHP Minerals Australia President, Mike Henry, today outlined plans to grow value and improve returns on capital across the Company's Australian operations.

Speaking to investors and analysts at a briefing in Adelaide, Mr Henry said BHP's large, long-life, low-cost Australian assets underpin current margins and future optionality.

"The quality, scale, concentration and location of our assets support improvement initiatives, compelling latent capacity options, efficient technology deployment and attractive investment opportunities.

"By sharing knowledge and replicating best practice across our global portfolio, we've been able to substantially reduce unit costs at our Australian mining operations over the last five years. But we have further to go. We can make ourselves safer and even more productive, and expect to lower our unit costs by a further 10 per cent over the medium-term.

"Through strengthening our maintenance capability and processes, including by bringing in expertise from other industries, and through better leveraging technology, our global Maintenance Centre of Excellence is enabling a step-change in maintenance performance across BHP. With our global technology initiatives and asset-level programs to unlock resources and lower costs, we expect our Australian mining operations to deliver US\$1.6 billion of additional productivity gains over the next two years," Mr Henry said.

"We also have a suite of attractive medium-term investment opportunities. While these remain subject to our strict Group-level capital allocation framework tests, with average returns potentially exceeding 40 per cent, they are well placed to compete for capital."

Mr Henry highlighted the Brownfield Expansion option (BFX) at Olympic Dam as an example of a project with the potential to deliver sustainable returns to shareholders, government and the local community.

Also speaking at the briefing, Olympic Dam Asset President Jacqui McGill, said the BFX option could provide a capital efficient path to increased capacity through accelerated development into the Southern Mine Area.

"As we move into the Southern Mine Area we expect to see the copper grade increase to 3 per cent by financial year 2023, which we believe would coincide with a structural deficit in the copper market.

"If approved, the BFX option could lift production capacity to 330 ktpa and move Olympic Dam into the first quartile of the cost curve, which is where we strive to be with all our assets at BHP. Any investment however, must compete for capital against all other options, including returns to shareholders."

Ms McGill also outlined longer-term development options that had the potential to significantly increase the volume of copper produced, including the use of heap leach technology.

Combined, these plans create significant value and support improved returns both at Olympic Dam and across BHP's minerals operations in Australia.

Presentations will be webcast live at https://edge.media-server.com/m6/p/3vman8qu and all materials be available on our website at http://www.bhp.com/-/media/documents/media/reports-andpresentations/2017/171128\_mineralsaustraliaupdateandolympicdambriefing.pdf.

Further information on BHP can be found at: **bhp.com** 

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## **Minerals Australia**

Realising value and improving returns across our portfolio

Mike Henry President Operations, Minerals Australia 28 November 2017

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## **Key messages**

Portfolio	Large, long-life, low-cost ore bodies close to key Asian customers Portfolio quality, simplicity and optionality supports current margins and future opportunities
Maximise cash flow	Productivity gains of >US\$1.6 billion to be delivered over the next two years Targeting >10% reduction in copper equivalent unit costs over the medium term
Capital discipline	Attractive investment options well-suited to market outlook but subject to strict capital allocation framework tests >40% average IRR <sup>1</sup> for medium-term investment options
Value and returns	Driving value through productivity, technology, latent capacity and investment Detailed plans to further improve Return On Capital Employed <sup>2</sup> to ~30% by FY22

Latent capacity and brownfield projects for Minerals Australia assets; consensus prices, refer to slide 12 for additional detail.
 Average Minerals Australia ROCE is calculated after tax at FY17 realised prices; excludes Nickel West.

Minerals Australia: Realising value and improving returns across our portfolio

## **Our strategy**

Value and returns are at the centre of everything we do



## Simple portfolio with valuable optionality

High-margin upstream assets competitively placed on the cost curve

- Quality resource
  - average Fe grade of 61%1; ~25% lump; strip ratio of 1.3x1
  - premium hard coking coal (coke strength<sup>2</sup> 64%) and energy coal (calorific value<sup>2</sup> >6,000 kCal/kg)
  - third largest copper equivalent deposit (ore at >2.5% average copper grade for decades)
- Large scale, concentrated footprint in favourable jurisdiction, close to tidewater and to Asian markets
  - largest seaborne metallurgical coal supplier and major iron ore supplier
  - Life of Asset plans range from 50 to 125 years, with growth optionality
- Experienced leadership team enabled by streamlined operating model
  - improved connectivity between assets
  - reducing overheads while improving functional support
- 1. Average from FY18 to FY22.
- 2. Coke Strength after Reaction (CSR); calorific value is Gross As Received (GAR); Wood Mackenzie data.
- 3. BFX project remains subject to strict capital allocation framework tests; consensus prices and FX; Life of Asset planning subject to future mine planning.
- 4. QCoal coking coal cost curve position excludes Blackwater; Wood Mackenzie data.

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#### 28 November 2017

### Minerals Australia portfolio

(FY17 EBITDA margin, %)



## Safety is our first priority

### We must continue to drive to eliminate fatalities and injuries

- Fatal incident at Goonyella (August 2017)
- Continued reduction in TRIF<sup>1</sup> to 6.2 in FY17

### Our approach to improve safety

- **Safety Field Leadership:** deployed across the organisation including in-field verification of material and fatal risks
- **Manufacturing mindset:** improving our tooling, standardising and simplifying our systems, and redesigning our work
- Asset integrity: Maintenance practices to reduce unplanned outages and enhanced Process Safety Management
- **Technology:** using automation and data analysis to remove our people from harms' way

### Safety performance

(12-month rolling average TRIF)





1. TRIF: Total Recordable Injury Frequency per million hours worked.

2. SIF: Significant Injury Frequency per million hours worked (including first aid cases and above that occurred in scenarios that could have resulted in a fatality).

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## **Contributing to our communities**

### Significant contribution to the Australian economy

- US\$15 billion<sup>1</sup> in FY17
- includes US\$3.8 billion of taxes and royalties paid to the Australian government (Federal 47%, State 30% and Local 23%)

### Engaging our communities

- local buying program started in Queensland, has been extended to NSW and most recently rolled out to SA and WA
- school-based trainee and apprenticeship program
- Indigenous Employment Plan focused on attraction, retention, and leadership development

### Advocating for our communities

- to ensure our success is shared with our host communities
- Operating sustainably
  - endowments established to ensure sustainable conservation activities, including Five Rivers Conservation

1. Represents BHP's economic contribution to Australia; BHP FY17 Economic Contribution Report.

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### US\$15 billion in total economic contribution in FY17





**Five Rivers Conservation** 



## Improving returns by driving performance

Specific plans to improve after tax Return On Capital Employed to ~30% by FY22 (at FY17 prices)

	Western Australia Iron Ore	Queensland Coal	NSW Energy Coal	Olympic Dam	Minerals Australia
FY17 – ROCE	26%	23%	22%	1%	~20%
σ	Improved truck productivity	Improved truck and shovel productivity	Improved truck and wash plant productivity	Increased jumbo and truck productivity	
jy, ices an ellence	Rail scheduling optimisation	CRSC <sup>1</sup> ramp up	Ayredale pit development	Smelter campaign maintenance	
chnolog k pract of Exce	Train Loadout remote loading	Integrated Remote Operations Centre	Multiple Elevated Roadways	Integrated Remote Operations Centre	
Culture, teo standardised wor Global Centres	Truck and drill automation	Truck and drill automation	Production creep	High-grade Southern Mine Area	
	Port availability program initiatives	Blackwater 4 Mtpa expansion		Refinery upgrade	
	Production creep	Production creep		Expand the materials handling capacity	_ ↓
FY22 – ROCE <sup>2</sup>	~40%	~40%	~30%	~6% <sup>3</sup>	~30%

1. Caval Ridge Southern Circuit.

2. Minerals Australia assets' ROCE is calculated after tax at FY17 realised prices; excludes Nickel West.

3. Prior to the completion of Brownfield Expansion (BFX); if approved.

## Technology improves safety, costs and unlocks resource

Digital technologies will remove overloading and variability providing a stable base for safety and improvement



### Improving safety

### Removing people from harms' way

- Jimblebar <u>autonomous haulage</u> demonstrating lower TRIF and a 2% utilisation improvement, plans to replicate at other sites
- Intelligent risk dashboards allow simple access to material risks, critical controls and verifications
- <u>Driver Safety System</u> deployed in buses at Yandi to reduce fatigue-related driver risk

### Minimising exposure to environmental hazards

 <u>Electric Light Vehicle</u> trials at Olympic Dam to reduce worker exposure to Diesel Particulate Matter by 50%

### **Delivering productivity**

### Minimising variability in operations

- <u>Automation</u> of blast hole drills at WAIO, to be extended to trucks, longwall and shiploading activities
- <u>IROC</u> to be replicated at Olympic Dam, building on successful Coal replication from WAIO
- <u>Real-time condition monitoring</u> to prevent unplanned breakdowns using sensors on conveyors to check belt thickness
- <u>Rail scheduling optimiser</u> is improving rail utilisation rates at WAIO by transforming human expertise and data into digital knowledge for faster decisions
- <u>Maintenance Centre of Excellence</u> to utilise machine learning and data analytics to reduce unplanned work and accelerate best practice

### **Unlocking resource**

### Improving resource understanding

- <u>Real time data capture capability</u> via down hole assay tools in exploration and blast holes minimises drilling in waste
- Advanced sensors installed at Olympic Dam to establish foundation for <u>Precision Mining</u>
- <u>Blast movement transmitters</u> at Nickel West lift precision in low-grade Nickel Sulphide recovery
- NSWEC <u>3D seismic survey</u> enable us to exploit resource strengths to overcome its challenge
- <u>Heap leaching</u> technology program progressing at Olympic Dam with potential to deliver cost efficient processing



## **Reducing costs through productivity**

### **Delivers sustained incremental cash flows**

- Benchmarking with one enterprise system, better integration of operational data and improved efficiency with standardised equipment
- >US\$9 billion productivity gains delivered since FY12 and >50% reduction in copper equivalent unit costs<sup>1</sup>
- Expect to deliver >80% of BHP's US\$2 billion productivity gains over next two years and >10% reduction in unit costs<sup>1</sup> over medium term

Unit costs <sup>2</sup>	WAIO (US\$/t)	Queensland Coal (US\$/t)	NSW Energy Coal (US\$/t)	Olympic Dam (US\$/lb)	Nickel West (US\$/Ib)
FY12	30	148	56	4.04	8.54
FY17	14.60	60	41	1.81	4.70
FY18	<14	59	46	~2.10	~4.50
Best practice replication and productivity benchmarking	Port Availability Program initiatives	Increasing pre-strip productivity	Multiple Elevated Roadways	Increased jumbo and truck productivity	Haul truck utilisation improvement
	Deliver improved equipment productivity	Effective equipment allocation via IROC	Ayredale pit development	Reset asset stability	Value chain extended to nickel sulphate
	Crusher interface improvements	Improved wet weather haulage	Improved wet weather haulage	High-grade Southern Mine Area	Refinery debottlenecking
Medium term	<13	~54	~40	~1.00 <sup>3</sup>	Different product mix

1. Operating cost per copper equivalent tonne presented on a continuing operations basis excluding royalties and BHP's share of volumes from equity accounted investments; copper equivalent production based on FY17 average realised prices.

2. WAIO, QCoal and NSWEC exclude freight and royalties; OD FY12 includes freight and is presented gross of by-product credits (~US\$1.40/lb), FY17 onwards excludes freight and is presented net of by-product credits; Nickel West includes third party purchases and additional costs to move downstream, with FY18 results normalised using FY17 nickel price. FY18 guidance and medium-term unit cost targets are based on an exchange rate of AUD/USD 0.75 and are in nominal terms.

3. Prior to the completion of Brownfield Expansion (BFX); if approved.

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## Further to go on our productivity journey

### Focused on key productivity enablers across the business



### Improving NSWEC stripping productivity









### Rising BMA wash plant productivity



1. Truck hours exclude queue time; 793 trucks for Western Australia Iron Ore and Nickel West, Ultra Class trucks for Queensland Coal (BMA) and NSW Energy Coal.

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## Simple portfolio with valuable optionality

### Attractive options well-suited to the commodity price outlook but subject to strict capital allocation framework tests

	Sustaining	Latent capacity	Brownfield	Greenfield	Future optionality
WAIO	South Flank	Creep to 290 Mtpa			<ul> <li>Resource to support beyond 290 Mtpa</li> </ul>
Queensland Coal	<ul><li>Saraji pit restarts</li><li>Creek diversions</li></ul>	<ul><li>CRSC</li><li>Blackwater expansion</li></ul>	Caval Ridge     expansion	<ul><li>Wards Well</li><li>Goonyella second longwall</li></ul>	<ul> <li>Saraji expansion</li> </ul>
NSW Energy Coal		Potential to increase     bypass coal	Ayredale pit     development		
Olympic Dam	Restore operational stability	• SMA (to 230 ktpa)	• BFX (to 330 ktpa)	<ul> <li>ODEP (to 450-500 ktpa)</li> </ul>	
Nickel West	Resource transition	Debottlenecking refinery to 84 kt	<ul> <li>Nickel sulphate</li> </ul>		<ul><li>Cobalt sulphate</li><li>Cathode precursor</li></ul>
<i>Capital</i> (US\$ billion)		1.2	2.3		
Average IRR <sup>1</sup> (%)		>70%	~25%		
CuEq volume <sup>2</sup> (kt)		>380	~240		
		>40% average IRR <sup>1</sup> for m	edium-term growth options		

Note: CRSC – Caval Ridge Southern Circuit; SMA – Southern Mine Area; BFX – Brownfield Expansion; ODEP – Olympic Dam Expansion Project.

1. Weighted by capital expenditure; consensus prices.

2. Copper equivalent production based on FY17 average realised prices; represents average production after ramp-up (irrespective of date achieved); BHP share.

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## WAIO: Maximising value from installed infrastructure

- Pathway to 290 Mtpa run rate by end FY19
  - ramp up of additional primary crusher and conveying capacity at Jimblebar
  - rail capacity improvement through scheduling optimisation, without additional tracks
  - working with government and local communities to increase export license to 290 Mtpa
- South Flank project to be submitted for Board approval mid-CY18; first ore targeted CY21
  - capital cost in the range of US\$30-40/t, fits within US\$4/t sustaining capex over the next five years; IRR >30%<sup>1</sup>
  - increases Fe grade and lump proportion for overall product mix
  - improves MAC product grade
- Multiple high-grade resources with size >1 Bt as longer-term sustaining options (not required until after 2040)

#### 1. Consensus prices.

2. BHP share.

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### Improving product mix with South Flank<sup>2</sup>





Source: Publicly available information and BHP internal analysis. Peer group comprises Vale, Fortescue Metals Group and Rio Tinto.



## **QCoal: Latent capacity and expansion opportunities**

- Caval Ridge Southern Circuit latent capacity project tracking to plan
  - 10 Mtpa (100% basis) wash plant capacity enabled through project execution
  - IRR<sup>1</sup> >80% and capital investment of US\$204 million (100% basis)
  - first production expected in early FY19
- Potential future opportunities with attractive returns
  - Blackwater expansion would support 4 Mtpa (100% basis) capacity increase through increased metallurgical coal bypass
  - expansion of the Caval Ridge wash plant with the addition of a third module would unlock 5.7 Mtpa (100% basis) capacity
  - greenfield underground longwall potential at Wards Well premium hard coking coal resource

**Productivity offsets closed operations** (Production<sup>2</sup>, Mtpa)



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<sup>1.</sup> Consensus prices.

<sup>2.</sup> BHP share

## **NSWEC: Managing monocline challenge**

- Potential increase in bypass coal with volumes expected to increase to ~22 Mtpa in the medium term
  - 'Path to Value' study concluded in CY17
  - re-opening Ayredale Pit in FY18 to gain earlier access to high margin resource with average strip ratio ~9% lower than the remainder of the operation over the next decade
  - Multiple Elevated Roadways to mitigate cycle time impacts caused by the monocline: optimised haulage route to reduce cycle times and increase productivity

### Multiple Elevated Roadways (MERs) reduces cycle times<sup>1</sup> (Average cycle time, minutes)



### MERs enable flatter haulage to reduce cycle time





Without MERs

With MERs



1. Estimated results using BHP internal analysis.

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## Nickel West: Extending life and increasing margins

- Production sustained by the discovery and development of resources at Venus, Yakabindie and Leinster B11
  - increasing confidence of life extension to 2040
- Kwinana Refinery debottlenecking aspiring to take capacity to 84kt over medium term
- Margin improvement by moving to higher value products
  - Stage 1 nickel sulphate plant to 100 kt approved
  - first production expected in April 2019
  - capital investment of US\$43 million and IRR<sup>1</sup> >40%
  - Stage 2 to 200 kt nickel sulphate potential

**Potential to debottleneck refinery capacity** (Capacity, ktpa)



Source: BHP analysis.

1. Consensus prices.

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## **Key messages**

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Appendix

## **BHP guidance**

Copper	FY18e	
Olympic Dam		
Production (kt)	150	Major smelter maintenance campaign is phased through August to December 2017.
Unit cash costs (US\$/lb)	~2.10	
Iron Ore	FY18e	
Western Australia Iron Ore		
Production (Mt, 100% basis)	275 – 280	
Unit cash costs (US\$/t)	<14	Excludes freight and royalties; based on an exchange rate of AUD/USD 0.75.
Sustaining capital expenditure (US\$/t)	4	FY18e-FY22e average; includes capital cost for South Flank; +/- 50% in any given year.
Coal	FY18e	
Queensland Coal		
Production (Mt)	44 – 46	
Unit cash costs (US\$/t)	59	Excludes freight and royalties; based on an exchange rate of AUD/USD 0.75.
Sustaining capital expenditure (US\$/t)	8	FY18e–FY22e average; +/- 50% in any given year.
NSW Energy Coal		
Unit cash costs (US\$/t)	46	Excludes freight and royalties; based on an exchange rate of AUD/USD 0.75.
Sustaining capital expenditure (US\$/t)	5	FY18e–FY22e average; +/- 50% in any given year.



## **WAIO: Asset snapshot**

**Overview of asset** Western Australia Iron Ore (WAIO) is an integrated system of four processing hubs and five mines, connected by more than 1,000 kilometres of rail infrastructure and port facilities in the Pilbara region of northern Western Australia.

At each mining hub – Newman, Yandi, Mining Area C and Jimblebar – ore from mines is crushed, beneficiated (where necessary) and blended to create high-grade hematite lump and fines products. Iron ore products are then transported along the Port Hedland – Newman Rail Line to the Finucane Island and Nelson Point port facilities at Port Hedland.

WAIO's port facilities at Nelson Point are owned by the Mt Newman JV, and Finucane Island is owned by the Mt Goldsworthy JV. BHP interest varies between 85 and 100% across joint ventures.





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## **Queensland Coal: Asset snapshot**

**Overview of asset** Queensland Coal comprises the BHP Mitsubishi Alliance (BMA) and BHP Mitsui Coal (BMC) assets in the Bowen Basin in Central Queensland, Australia.

BMA operates seven Bowen Basin mines (Goonyella Riverside, Broadmeadow, Daunia, Peak Downs, Saraji, Blackwater and Caval Ridge) and owns and operates the Hay Point Coal Terminal near Mackay. With the exception of the Broadmeadow underground longwall operation, BMA's mines are open-cut, using draglines and truck and shovel fleets for overburden removal. BMA is owned by BHP (50%) and Mitsubishi (50%).

BMC owns and operates two open-cut metallurgical coal mines in the Bowen Basin (South Walker Creek and Poitrel). BMC is owned by BHP (80%) and Mitsui and Co (20%).

Queensland Coal has access to key infrastructure in the Bowen Basin, including a modern, multi-user rail network and its own coal-loading terminal at Hay Point. Queensland Coal also has contracted capacity at three other multi-user port facilities, including the Port of Gladstone (RG Tanna Coal Terminal), Dalrymple Bay Coal Terminal and Abbot Point Coal Terminal.





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## **NSWEC: Asset snapshot**

**Overview of asset** New South Wales Energy Coal (NSWEC) consists of the Mt Arthur Coal open-cut energy coal mine in the Hunter Valley region of New South Wales, Australia. The site produces coal for domestic and international customers in the energy sector. BHP interest is 100%.

BHP owns a 35.5% interest in Newcastle Coal Infrastructure Group (NCIG), which operates the Newcastle Third Port export coal loading facility.





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## **Olympic Dam: Asset snapshot**

**Overview of asset** Olympic Dam is one of the world's largest ore bodies. Located 560 kilometres north of Adelaide, it is one of the world's largest deposits of copper, gold and uranium, and it also has a significant deposit of silver. Olympic Dam operates a fully integrated processing facility from ore to metal.

Olympic Dam's underground mine is made up of more than 450 kilometres of underground roads and tunnels. The asset extracts copper uranium ore, with the ore hauled by automated train to feed underground crushing, storage and ore hoisting facilities.

Olympic Dam's processing plant consists of two grinding circuits in which high-quality copper concentrate is extracted from sulphide ore through a flotation extraction process. The asset includes a fully integrated metallurgical complex with a grinding and concentrating circuit, a hydrometallurgical plant incorporating solvent extraction circuits for copper and uranium, a copper smelter, a copper refinery and a recovery circuit for precious metals. BHP interest is 100%.





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## **Nickel West: Asset snapshot**

**Overview of asset** Nickel West is a fully integrated mine-to-market nickel business. All nickel operations (mines, concentrators, a smelter and refinery) are located in Western Australia. The integrated business adds value throughout our nickel supply chain, with the majority of Nickel West's production sold as powder and briquettes. Low-grade disseminated sulphide ore is mined from Mt Keith, a large open-pit operation. The ore is crushed and processed on-site to produce nickel concentrate. High-grade nickel sulphide ore is mined at Cliffs and Leinster underground mines and Rocky's Reward open-pit mine. The ore is processed through a concentrator and dryer at Leinster. Nickel West's concentrator plant in Kambalda processes ore and concentrate purchased from third parties. The three streams of nickel concentrate come together at the Nickel West Kalgoorlie smelter, a vital part of our integrated business. The smelter uses a flash furnace to smelt more than 700 ktpa of concentrate to produce nickel matte. Nickel West Kwinana then refines granulated nickel matte from the Kalgoorlie smelter into nickel powder and premium-grade nickel metal briquettes containing over 99 per cent nickel. Nickel matte and metal are exported to overseas markets via the Port of Fremantle.





Minerals Australia: Realising value and improving returns across our portfolio



## **Bulk operations material moved and strip ratios**



BMC (Material moved, Bt) (Strip ratio<sup>1</sup>, x) - 12.0 0.4 0.2 6.0 0.0 0.0 **FY13 FY14** FY15 FY16 **FY17** FY18e FY19e

Material moved





-- Strip ratio

1. Represents total overburden stripping (bcm) to production (tonnes).

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## Further productivity initiatives to reduce unit costs



WAIO – High margins driven by product mix and improvement initiatives (Unit cost, US\$ per tonne)

**QCoal – Low cost producer in the Bowen Basin with competitive margin performance** (Unit cost, US\$ per tonne)



- FY17 costs of US\$14.60/t includes rail program (US\$0.20/t), stock write offs (US\$0.15/t), exploration (US\$0.30/t), and private royalties (US\$0.30/t)
- Unit cost <US\$14/t in FY18 and <US\$13/t in medium term
  - Port Availability Program to reduce downtime
  - delivery of benchmark equipment productivity
  - optimising mine plans, reducing no-feed delays and re-handle
  - optimising shutdown performance (duration and frequency)
- FY17 unit costs of US\$60/t impacted by Tropical Cyclone Debbie
- Unit cost <US\$59/t in FY18 and ~US\$54/t in medium term
  - best practice and Playbook program to benchmark and improve truck production hours
- Employee agreement renewal to focus on flexibility to better enable simplicity, safe productivity improvements and cost efficiencies

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## On the journey to sustainable unit cost



**Nickel West – Developing higher margin products** (Unit cost<sup>1</sup>, US\$ per tonne)

**NSWEC – Mitigating geological constraints** 



• FY17 cash costs of US\$41/t

- FY18 cost of US\$46/t as we mine through the monocline structure and additional buy-in stripping costs in Southern pit areas
- Medium-term guidance of ~US\$40/t
  - Multiple Elevated Roadways (MERs) and new mining sequence has increased stripping productivity enabling lower unit costs in the medium term
- Margin improvement driven through entry into downstream nickel sulphate investment
- Unit costs impacted by nickel price linked third party nickel feed
   purchases
- Transition to our new mines in the northern region will underpin unit cost performance

1. Nickel West unit costs include third party purchases and additional costs to move downstream; FY18 and medium term unit costs have been normalised using FY17 Nickel price.

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### **Optimised mine plan at NSWEC mitigates adverse cost impacts**

### Reduces truck cycle times delivering sustainable margin improvement







### Post the monocline





**Current Mine Plan** cross-pit bridges

### **New Mine Plan - a fundamental change**

- Exploits resource strengths to overcome its challenge
  - large constant strip ratio post monocline enables longterm resource to be traded for lower costs today
- Nil "buy-in" cost which benefits low delivery risk
- Delivered by underlying mine design

### **New Mine Plan - traversing the monocline**

- Still less dump volume released per strip mined
- Waste still hauled further back and higher up, but higher bridge has eliminated down haul component
- Reduced inefficiency enables lower cycle times

### New Mine Plan - post the monocline

- Ultimate pit and dump geometry unchanged but, the crosspit bridge grows and more roadways as pit deepens
- Hauling waste down eliminated and much less waste hauled up leading to shorter cycle times and higher truck productivity

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# BHP

# **Marketing Minerals**

Bringing commercial insight to all steps of the value chain

Vicky Binns Vice President, Marketing Minerals 28 November 2017

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## **Key messages**

Commercial	Leveraging market intelligence from mine to customer to drive value creation
acumen	Using commercial expertise to ensure products are placed with the right customers for the best price
Global	Sustained growth in global steel demand over the next decade
steel	Long-term demand driven by emerging Asia, enabled by China's Belt and Road Initiative
Bulk	Chinese policy impacting short-term demand and pricing
commodities	Structural reform underpins longer-term demand for high-quality iron ore and metallurgical coal
Copper outlook	Structural deficit to emerge in the early 2020s Demand is expected to grow at 2-3% CAGR to 2025, emerging markets to drive growth Supply growth challenged by grade decline, increased costs and limited new developments
Uranium	Inventory overhang supressing short-term price outlook
outlook	Olympic Dam's first quartile cash cost position ensures profitable uranium stream

## Our approach to value creation is end to end



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# **China's winter restrictions**

Will cut steel production but support stronger steel profitability





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Market share of "2+26" cities in China



Note: Forward margin calculation based on forward curve as of 3 November 2017. Coking capacity includes a few cities outside "2+26" region which also join winter production cut. Source: NBS; Fenwei Energy; Mysteel; SHFE; DCE; BHP.



# **Structural reform in China**

Underpins long-term demand for high quality iron ore and metallurgical coal





### Metallurgical coal portfolio skewed towards premium quality

(BHP supply in the seaborne metallurgical coal market, pictorial representation)



Note: The normalised price performance is the difference between the expected price based on ViU on prompt basis. Peer group comprises Rio Tinto, Vale and FMG. Source: BHP assessment based on publically available information.

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# **Emerging Asia to drive long-term steel demand**

### **Enabled by China's Belt and Road Initiative**



Map of new integrated steel plants<sup>2</sup>



Source: Platts; worldsteel; BHP analysis.

1. Emerging Asia includes India, ASEAN and other South Asian countries.

2. New integrated steel projects commissioned or being built since 2017.

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# **Shorter-term copper market drivers**

Copper market expected to remain finely balanced over the next few years

### Copper concentrate shortfall 2017-2020 (Mt Copper in concentrate) 2 — Blister imports Scrap imports Domestic scrap (Cat 7) ~1.5Mt Scrap imports (Cat 6) Domestic mines ~0.7Mt Cathode imports (less stocks) Concentrate 0 imports Chinese primary smelter Copper in concentrate

Chinese consumption by source – 2016

Source: Wood Mackenzie; BHP analysis.

capacity growth

1. Represents incremental net capacity or mine supply (contained copper basis, net of disruption) in 2020 over 2017 excluding Copperbelt intermediate products which are unlikely to be available as concentrate.

Source: BGRIMM Li Lan; BHP analysis.

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supply growth<sup>1</sup>

# **Strong longer-term copper fundamentals**

Structural deficit to emerge in the early 2020s as additional supply is required to meet growing demand

### Significant capital investment required to meet supply gap

Grade decline, increased input costs and limited new discoveries (US\$bn over the next 10 years)



Source: BHP analysis.

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#### Two-thirds of the world have significant upside in consumption With demand expected to grow at 2-3% CAGR to 2025 (kg Cu/capita, 2016)



Source: Wood Mackenzie, BHP analysis.

Consumption per capita is based on Total Copper Consumption.

Advanced Economies: USA; Canada; Europe; Japan; Korea; Taiwan; Australia.



# Electric Vehicles – positive for long-term copper demand

EVs contain four times as much copper as a conventional medium sized car

Global light duty EV annual sales forecast (2018-2030)



Analyst forecast to 2025 includes UBS; BoAML; IDTechEx; Liberum; Woodmac; BNEF; Navigant and IHS. Source: BHP analysis. 'EVs' include both Battery Electric Vehicles and Plugin Hybrid Electric Vehicles

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**BEV copper intensity by car segment in China – 2016** (kg/unit)



Source: Fbetter. BEV: battery electric vehicles.

### Incremental copper demand from Hybrids and EVs



Source: IDTechEx.

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# **Renewables – positive for long-term copper demand**

Attractive long-run economics and the importance of decarbonisation drive a sustained high-growth path for wind and solar



### Cu intensity by power generation type (kg/KW)



#### Source: ICA; BHP analysis.

Source: BHP analysis.

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# **Risks – China substitution and emergence of scrap**

Risks from aluminium substitution in power cable and growing use of scrap

#### Tracking substitution developments



Source: ICA; BHP analysis.

- 1. National Code for Design of Cables for Electric Engineering (GB50217). Recommendation applies to voltages above 1kV.
- 2. CNIA: China Non-Ferrous Industry Association, MIIT: Ministry of Industry and Information Technology.
- 3. International Copper Association: power cable production Mar-Aug 2017 vs Mar-Aug 2016.

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China semis copper demand and old scrap generation



Source: BHP analysis.

# Uranium outlook muted in the short term

### Reliable supplier despite subdued short-term market conditions

- · Low spot price exposes many mines despite long-term contracts
  - many producers are "out of the money" at spot prices
- Inventory overhang prevails amid lacklustre short-term growth

### Our position is resilient in a long-term downside scenario

- Even if US and EU reactor retirements advance or renewables gain larger share, Asia will need uranium
- Olympic Dam envious position
  - proximity to growing Asian market
  - first quartile cash cost position with uranium as a by-product





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# BHP

Maintenance Centre of Excellence A distinctive enabler

Brandon Craig Vice President, Maintenance 28 November 2017



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#### 28 November 2017

# **Key messages**

Safety and productivity	Maintenance Centre of Excellence (MCoE) to drive step-change in safety and productivity Analysing data and designing processes to reduce unplanned work and accelerate continuous improvement
Efficiency	Data analytics applied to a single enterprise-wide system leverages BHP's scale and simplicity Standardised, repeatable process applied to our most critical equipment, replicated globally
Performance	Targeting a >3.5% increase in the availability of our top 70 equipment categories by FY22 Equivalent to an additional ~8 Mt iron ore, ~2 Mt coal and ~45 kt copper
Value and returns	Targeting a 15-25% reduction in maintenance costs by FY22 Delivers savings of US\$60 million in FY18, US\$170 million in FY19 and ~US\$700 million p.a. by FY22

# Why a Maintenance Centre of Excellence?

A critical enabler to delivering a step-change in safety, operating and capital costs



Maintenance Centre of Excellence: A distinctive enabler 28 November 2017

# **BHP's Maintenance Centre of Excellence**

### A fundamentally different way of partnering with our operations

- Operating Model increases specialisation of maintenance professionals
  - global hub and spoke model
  - drives improved performance across each stage of the maintenance value chain
- Leading-edge data science and analytical techniques applied to one enterprise-wide system
- Globally standardised ways of planning and performing work
  - scale leads to greater frequency of task repetition and faster improvement cycle
  - rapid identification and replication of best practice
  - planning co-located with supply chain teams for optimal frontline productivity
- Automation and continuous improvement of maintenance systems and processes





# Harnessing our systems to enhance safety and culture

### Designing for safety across maintenance work

- Targeting a significant reduction in BHP's total recordable injury frequency (TRIF)
  - maintenance represents ~35% of all injuries occurring across our operations
- Development and continuous improvement of equipment strategies and work design is integral to safety
  - eliminating unnecessary work
  - standardising how tasks get performed
- Planning accuracy and stability has reduced unplanned activity, leading to a safer and more productive working environment

### A more controlled and stable working environment

(Schedule adherence to the week<sup>1</sup>, %)



1. Schedule adherence to the week measures whether a work order was completed within the week that it was scheduled to be executed. Represents work associated with the control of material risks (Minerals Australia).

# Data analysis to accelerate improvement

Leveraging our enterprise-wide system to extract value from millions of data points

### Data science and analytical techniques enable optimised equipment strategies

- Automated analysis of component failure history
- Optimised equipment strategies to reduce life of asset cost and improve availability
- Allows us to better predict failures through machine learning algorithms
- · Identifies critical spare parts to support inventory management

### **Global solutions that accelerate continuous improvement**

- Algorithms perform analysis in "real-time" and more accurately than our traditional approach
- System produces recommendations for review
- Our time is spent making decisions not performing analysis
- Best practice can be rapidly implemented across the globe





# Maintenance planning hubs deliver improved performance

Planning, scheduling and executing optimised work strategies leads to improved performance and reduced cost

### Quality planning turns our maintenance strategies into reality

- Optimises the supply chain with the right parts at the right time
- Enhances frontline safety and productivity
- Reduces unplanned work which lowers costs and increases asset availability

### Our approach is already improving performance<sup>1</sup>

- Schedule accuracy<sup>2</sup> (i.e. no changes to plan) has improved from 40% to 85%
- Supply chain accuracy (i.e. right parts at the right time) has improved from 86% to 92%
- Schedule adherence to the week<sup>3</sup> has improved from 70% to 79%
- Workforce utilisation has improved from 74% to 86%

- 2. Schedule accuracy measures how much change occurs from when a work order is created until it is executed.
- 3. Schedule adherence to the week measures whether a work order was completed within the week that it was scheduled to be executed.

#### 793F schedule accuracy (Minerals Australia)



### Stream planning productivity (Minerals Australia)



Maintenance Centre of Excellence: A distinctive enabler

#### 28 November 2017

<sup>1.</sup> Improvement since MCoE began partnering with Minerals Australia in February 2017.

# Value-driven pipeline of work

### A standardised, repeatable process applied to our most critical equipment first to create new global strategies

ted	Cat 793F trucks	VS\$8.6m in cost savings in FY18 and US\$88m over the life of BHP's existing Minerals Australia fleet (20% reduction)
nplet	Leibherr T282 trucks	US\$2.4m in cost savings in FY18 and US\$17m over the life of BHP's existing global fleet (22% reduction)
Cor	Cat D10/D11 dozers	US\$29m over the life of BHP's existing global fleet (18% reduction)
		Joy 4100 shovels
S		Blackwater Coal Handling Processing Plant Shovel and truck strategies target productivity improvements at both BMA and
gres		Cat 495HR/7495 shovels Escondida
pro		Cat 797B/F trucks Coal Handling Processing Plant strategies complement improved mining
-		Peak Downs Coal Handling Processing Plant productivity
		additional opportunities
		Saraji Coal Handling Processing Plant
		Marion 8050 Draglines
		Bucyrus 1370W Draglines
ned		Port Hedland Inflow
Plan		Goonyella Riverside Coal Handling Processing Plant
		Area C Inflow & Outflow
		Yandi Inflow OHP3 & OHP1
		additional opportunities

# Case study: Caterpillar 793F haul trucks

Caterpillar 793F maintenance strategy outcomes at Yandi (Western Australia Iron Ore)



US\$88 million in cost savings over the life of BHP's existing Minerals Australia fleet of Caterpillar 793F haul trucks and US\$8.6 million in savings for FY18

Maintenance Centre of Excellence: A distinctive enabler



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# BHP

# **Olympic Dam**

A world-class resource with valuable optionality

ALLER & ST. S. STRATES TRADBURG

Jacqui McGill Asset President, Olympic Dam 28 November 2017

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## **Statement of Mineral Resources**

#### **Mineral Resources**

The information in this presentation that relates to the FY2017 Mineral Resources (inclusive of Ore Reserves) was first reported by the Company in compliance with the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves, 2012' ('The JORC Code 2012 Edition') in the 2017 BHP Annual Report of September 2017.

#### All reports are available to view on www.bhpbilliton.com.

Olympic Dam Mineral Resources are reported by Shane O'Connell (MAusIMM). Escondida and Antamina Mineral Resources are compiled by Martin Williams (MAusIMM).

The Company confirms that it is not aware of any new information or data that materially affects the information included in the original market announcements and, in the case of estimates of Mineral Resources, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcements continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Persons' findings are presented have not been materially modified from the original market announcements.

The above-mentioned persons are full-time employees of BHP, and have the required qualifications and experience to qualify as Competent Persons for Mineral Resources under the 2012 edition of the JORC Code. The compilers verify that this presentation is based on and fairly reflects the Mineral Resources information in the supporting documentation and agree with the form and context of the information presented.

Copper Operations BHP 30 June 2017 Measured Resources					Indicated Resources								Inferred Resources							Total Resources										
	%	Ore Type	Tonnes	Cu	U3O8	Au	Ag	Мо	Zn	Tonnes	Cu	U3O8	Au	Ag	Мо	Zn	Tonnes	Cu	U3O8	Au	Ag	Мо	Zn	Tonnes	Cu	U3O8	Au	Ag	Мо	Zn
			millions	%	kg/t	g/t	g/t	ppm	%	millions	%	kg/t	g/t	g/t	ppm	%	millions	%	kg/t	g/t	g/t	ppm	%	millions	%	kg/t	g/t	g/t	ppm	%
Olympic Dam	100	Sulphide	1,460	0.96	0.30	0.41	2		-	4,680	0.79	0.25	0.34	1	-	-	3,920	0.71	0.24	0.28	1	-	-	10,100	0.78	0.25	0.33	1	-	-
Escondida	57.5	Sulphide	5,350	0.63	; -	-	-	-	-	3,510	0.57	-	-	-	-	-	9,570	0.51	-	-	-	-	-	18,400	0.56	-	-	-	-	-
		Oxide	104	0.69	) –	-	-	-	-	83	0.57	-	-	-	-	-	20	0.53	-	-	-	-	-	207	0.63	-	-	-	-	-
		Mixed	70	0.62	- 2	-	-	-	-	82	0.47	-	-	-	-	-	59	0.44	-	-	-	-	-	211	0.51	-	-	-	-	-
Escondida (Pampa Escondida)	57.5	Sulphide	294	0.53	3 -	0.07	-	-	-	1,150	0.55	-	0.10	-	-	-	6,000	0.43	-	0.04	-	-	-	7,440	0.45	-	0.05	-	-	-
Escondida (Pinta Verde)	57.5	Sulphide			-	-	-	-	-	23	0.50	-	-	-	-	-	37	0.45	-	-	-	-	-	60	0.47	-	-	-	-	-
, ,		Oxide	109	0.60	) –	-	-	-	-	64	0.53	-	-	-	-	-	15	0.54	-	-	-	-	-	188	0.57	-	-	-	-	-
Escondida (Chimborazo)	57.5	Sulphide	-	-	-	-	-	-	-	139	0.50	-	-	-	-	-	84	0.60	-	-	-	-	-	223	0.54	-	-	-	-	-
Antamina	33.75	Sulphide Cu only	155	0.89	) –	-	7	330	0.14	517	0.86	-	-	8	260	0.15	816	0.82	-	-	8	240	0.14	4 1,490	0.84	-	-	8	260	0.14
		Sulphide Cu-Z	n 75	0.94		-	17	100	1.91	322	0.92	-	-	15	80	1.80	430	0.98	-	-	15	80	1.5	2 827	0.95	-	-	15	80	1.66

#### **Metal equivalents**

The metallurgical recoveries and price information used to calculate copper equivalent figures in this presentation that relates to the FY2017 Mineral Resources (inclusive of Ore Reserves) were sourced from and can be found in the 2017 BHP Annual Report of September 2017 and the 2017 United States Securities and Exchange Commission Form 20-F.

All reports are available to view on www.bhpbilliton.com.

Copper equivalent grade calculations for BHP assets are listed below.

Olympic Dam: CuEq = Cu % + (U<sub>3</sub>O<sub>8</sub> kg/t x 0.901) + (Au g/t x 0.504) + (Ag g/t x 0.0066); Escondida: CuEq = Cu % + (Au g/t x 0.687); Antamina: CuEq = Cu % + (Zn % x 0.38) + (Mo % x 1.99) + (Ag g/t x 0.0082); Molybdenum price used = US\$7.41/lb.

### Key messages

Unique	World's third largest copper equivalent deposit offers scale and optionality
resource	Copper grade to average >2.5% (~3.6% CuEq) <sup>1</sup> over next 30 years
Maximise	Detailed plans to improve operational reliability underway
cash flow	Move into the Southern Mine Area will see copper grade increase to 3% by FY23
Capital	Three stage option-based approach to development with potential to more than double capacity
discipline	Medium-term focus on capital-efficient BFX option, subject to capital allocation tests
Value and returns	If approved, BFX would move Olympic Dam into the first quartile on the cost curve Increase in asset-level ROCE to 13% with BFX option (at consensus prices)

1. Copper equivalent grade calculated per metal equivalents note on slide 3.

#### Overview

### Staged resource development strategy

Resource development via staged, independent, investment options, subject to strict capital allocation framework tests



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# **Our relentless pursuit to improve safety**

• Our goal is zero fatalities

Overview

- committed to reducing TRIF by systematically managing risk through operational control and management processes
- Safety Field Leadership replicating best practice across BHP
  - single fatality and material risk management
  - implementation of Safety Management System
  - improved hazard reporting
- Investing in safety performance
  - Whenan shaft refurbishment enables personnel movement and removes trucks
  - extension of Rail Materials Handling System (MHS) to remove trucks
  - trialling use of electric light-vehicles underground to reduce exposure to diesel particulates

#### Safety performance and Field Leadership activities

BFX



#### Investing to reduce safety risk

(Number of trucks required post MHS completion, index, baseline=100)





ODEP

6

7

**Building social investment and community partnership** 

- Supportive policy environment in South Australia
  - South Australia's Copper Strategy aims to produce 1 Mtpa by 2030
- Secure tenure under the Roxby Downs (Indenture Ratification) Act
- Raising profile of BHP in South Australia through value-driven
  partnerships
  - Mining Minds (community-driven education program in Roxby Downs)
  - Arid Recovery (predator-free ecosystem restoration and research)
  - TARNANTHI (festival of Aboriginal and Torres Strait Islander contemporary art)
  - Adelaide Crows AFL Women's team
- Collaborating to increase local participation in Olympic Dam
  - Local Buying Program launched in South Australia
  - establishing a new project construction services panel
- · One of the largest employers in South Australia





BUILDING OUR FUTURE TOGETHER



ODE

25+ years of industry experience

20+ years of industry experience

• Underground / open cut mining

Business development

Underground mining

Australia: USA

Business development

Processing

Australia

### **Experienced leadership and workforce**

### Asset Leadership Team

- Bringing the best talent from across our portfolio with global expertise and proven track-records
- >80 years combined experience in mining and minerals processing across functions, commodities and continents

#### Workforce

- · Largest private sector employer in South Australia
- Female and Indigenous participation levels increasing
  - female target ~30% by FY22 (current 14%)
  - indigenous target ~8% by FY22 (current 4%)

### Leveraging our Operating Model

- · Connecting global expertise to replicate best practice
- Leveraging functional support
- Minerals Australia leadership in same geography and time zone







### Chris Barnesby | General Manager Surface

Jacqui McGill | Asset President Olympic Dam

• 20+ years of diverse industry experience

**Troy Wilson |** General Manager Mine

- Steel making, processing, oil and gas
- Major projects; maintenance; operations; HSE
- Australia; USA; Trinidad and Tobago



### Dan Heal | General Manager Integrated Operations

- 15+ years of industry experience
- Underground / open cut mining
- Business development
- Australia; Canada; Chile



### A unique resource with valuable optionality

- Large, polymetallic ore body: 10.1 Bt at 0.78% Cu (1.18% CuEq)<sup>1,2</sup>
  - third largest copper equivalent deposit in the world
  - largest uranium and third largest gold deposit
  - resource remains open at depth, offering potential upside
- · High-grade ore body, suited to selective underground mining
  - >1 Bt of minable underground material
  - Cu grade projection increasing to ~3% (~4.2% CuEq)^1
  - Cu grade to average >2.5% (~3.6% CuEq)<sup>1</sup> over next 30 years
- Largely untapped, particularly in the Southern Mine Area (SMA) which represents ~70% of remaining resource
- Supports medium and long-term optionality



- 1. Copper equivalent resource and grade figures calculated per metal equivalents note on slide 3.
- 2. Breakdown by Resource classification is provided on slide 3.
- 3. Industry average copper grade represents average grade weighted by ore processed. Source: WoodMackenzie.
- 4. Olympic Dam previous plan represents underground mine plan using traditional grade estimation.

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### **Resource modelling supports more efficient development**

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### Increased understanding supports optimal mine development

- Ore body is well defined (>3,200 km resource drilling in over 11,000 drill holes, >1 million drill core samples)
- Geostatistical algorithms improved our understanding of the grade variability through the resource
  - identified significant volumes of high-grade ore (>2.5% Cu)
  - suited to selective sub-level open stoping (SLOS)
- Optimal resource development strategy leverages grade variability
  - tailored stope design
  - sequence stopes to prioritise high-grade ore first
- Development strategy improves overall resource recovery and capital efficiency, while lowering operating costs to maximise investment returns
- Preserves optionality for future development scenarios
  - defer lower-grade ore for a transition to a high-volume strategy





Southern Mine Area

BH

### **Mine development**

- Significant volume of untapped mineralisation, particularly in the SMA
- Resource continues to be open at depth in parts of the SMA and laterally in the NMA



### BFX Life of Mine development and stope inventory (Year 2100)

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### Yet to realise Olympic Dam's full potential

- Infrastructure integrity issues and external factors have affected historical financial performance
  - average ROCE over 5-year period (FY13-FY17) of 1%
- Maintaining operational stability has been challenging as major asset integrity events have impacted operational reliability
  - Clark hoist (FY10)
  - Svedala mill (FY15)
- External factors have also impacted financial performance
  - power supply instability on the South Australian grid led to statewide blackouts in 2016 (US\$105 million FY17 EBITDA impact)
  - power costs increased by 100% since FY15 to ~9% of FY17 cost base (US\$50 million FY17 EBITDA impact)





- 1. Copper equivalent production based on FY17 average realised prices.
- SCM refers to a major smelter maintenance campaign.
- Copper price represents average LME copper cash spot index. Source: Bloomberg.

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300

280

260

### Sustainably lowering costs and investing in stability

- Cost out and transformation initiatives underpin a ~50% improvement in unit costs since FY12
- Targeting unit cash costs of US\$1.65-1.85/lb in FY19e
- Future cost reduction initiatives underway
  - improved plant and equipment utilisation
  - optimised maintenance strategies reduce unplanned work



#### Unit cash costs<sup>1</sup>

- Systematic review of infrastructure risk undertaken, improvement plans developed and being executed
  - investing to restore operational stability
- Development strategy has shifted to prioritise high-grade ore suited to selective sub-level open stoping
  - expand the mine footprint into the higher-grade SMA
  - new materials handling system (MHS) into SMA



1. FY14 onwards excludes freight and is presented net of by-product credits. FY12 and FY13 include freight and are presented gross of by-product credits (~US\$1.40/lb).

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28 November 2017

13
1. Excludes BFX option investment; subject to internal and third party approvals.

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Base operations

### Investing in operating stability on the surface

- Delivering stability through ~US\$0.8 billion (FY18-FY21e) planned investment<sup>1</sup> in surface infrastructure
  - smelter campaign maintenance in FY18 (>80% complete)
    - reline flash furnace refractories
    - electric slag furnace rebuild
    - waste heat/gas system replacement
  - water supply upgrade (~30% complete)
  - electrolytic refinery upgrade (~50% complete)
  - tailings storage facility (study, execute FY19-FY21)
  - SCM21, during which BFX smelter scope tied-in
- Investment increases Cu production to ~215ktpa in FY19, with improved risk profile
- Technology in development IROC (FY19) and automated smelter tapping (during FY21/26 SCM)





### **Electrostatic Precipitator Replacement (Oct 2017)**







ODEP

### Investing in operating stability in the mine

- Delivering stability and a strong foundation for growth through planned investment of ~US\$1.3 billion<sup>1</sup> (FY14-FY22e) in the mine
  - expansion into SMA commenced in 2014
    - 3 new SMA blocks being developed (1st SMA ore Q1 FY18)
    - 20km mine development, 6 ventilation raise bores in SMA
  - increased resource production drilling (6 drill rigs FY17, 12 drill rigs FY18, increasing further)
  - expand materials handling capacity (~US\$0.7 billion)
    - development of a third decline (~45% complete)
    - Whenan shaft refurbishment (~25% complete)
    - extension of underground rail into SMA (study, execute FY20-FY22, staged delivery)
- Technology to be deployed to improve productivity, utilisation and safety
  - underground fleet management system
  - rapid advance mine development
  - electric light-vehicles
- 1. Includes ~US\$230 million spend FY14-FY17; excludes BFX option investment; subject to internal and third party approvals.
- 2. Ore hoist excludes ore decline volumes.
- 3. Jumbo metres advance per day; truck tonne kilometers per month.





(Equipment productivity<sup>3</sup>, index, FY17=100)



### **BFX option: the second stage of the Olympic Dam story**

- BFX would accelerate planned development into SMA to access more ore at higher grade (12 Mtpa at 3% Cu), increasing copper production to 330 ktpa
- Investment of US\$2.1 billion<sup>1</sup> with 45% related to mine development
  - subject to strict capital allocation framework tests
- Ore processed utilising latent capacity and targeted debottlenecking of existing surface facilities
- No change required to existing primary government approvals for water, power supply and production
- BFX currently in study phase, indicative milestones
  - seek Board approval to execute mid-CY20
  - first incremental production targeted late-CY21
  - project ramp-up and completion targeted late-CY22

3. Spot prices as at 13 November 2017.

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BFX project	IR (nom	R Investment <sup>1</sup> inal) (US\$bn nominal)	Payback (years)				
Consensus prices	>20	% 2.1	4 - 5				
10-year average (FY23-FY32) <sup>2</sup>							
Cu production (kt)	330	Opex (US\$m/year, real)					
Cu Eq production (kt)	510	Sustaining capex (US\$m/year, real) 400					
U production (kt)	7	C1 (net) / Cu (US\$/lb, real) (					
Au production (ktoz)	270	Capital intensity (US\$k/t CuEq) 14					

#### **Olympic Dam ROCE**

(% including US\$3.2 billion of mineral rights)



<sup>1.</sup> Execution amount, excludes study costs of ~US\$240 million, subject to internal and third party approvals.

<sup>2.</sup> At consensus price and exchange rate forecasts.

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**BFX option: improving cost and capital competitiveness** 

- Targeting first quartile cost curve position in the medium term
  - higher metal volumes would dilute our fixed cost base





- Attractive capital intensity despite additional investment required for downstream smelting and refining processes
  - no third party treatment and refining costs incurred

Brownfield project capital intensity<sup>2,3</sup>

(Capital expenditure, US\$ million)



(Incremental copper equivalent production, kt)

Source: Wood Mackenzie; BHP analysis.

- 1. Olympic Dam forecasts at consensus price and exchange rates.
- 2. BFX incremental copper equivalent production based on consensus prices, represents 10-year average (FY23-FY32).

3. Project peer group includes Collahuasi grinding line 5, El Teniente 137-180kt/d, Metalkol, Andina expansion, Centinela Mill 2, Quebrada Blanca, Zaldivar Sulphide Project, Spence, Lomas Bayas.

## BFX option: investment in the mine to access grade

**Base operations** 

- BFX mine investment of US\$1.0 billion would include
  - increase in resource production drilling (18 drill rigs)
  - new mining blocks development
  - mine ventilation, services and infrastructure (including additional fourth decline)
  - ore and waste materials handling capacity
- US\$0.7 billion of mine development costs accelerated from existing plans
- Technology enabling transformational change in underground (e.g. rapid advance development, fleet management system)



BFX

### **BFX option: would utilise existing latent surface capacity**

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**Base operations** 

- ~70% of planned BFX surface plant spend is in the primary copper production stream
- Increases ore throughput towards limit of current water / power capacity and Government production approvals (350 ktpa Cu)
- Would utilise existing latent capacity in the surface processing and debottleneck targeted areas to deliver efficient incremental Cu
- Investment of US\$1.1 billion would include:
  - mill and concentrator expanded to ~12 Mtpa (from ~10 Mtpa)
  - existing smelter to ~800 ktpa concentrate (from ~540 ktpa)
  - copper refinery to ~330 ktpa (from ~235 ktpa)
  - uranium and gold capacity expanded
- Technology enabling change in surface operations (e.g. automated refinery, smelter tapping)



BFX

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BFX



Courtesy Outotec.

### **BFX option: power and water solutions in place**

#### Power

- Existing power infrastructure expected to meet BFX requirements
- South Australian government working hard to resolve power issues
- Demand reduction initiatives underway (e.g. mine ventilation on demand)
- Studies underway to evaluate reliable, lower-cost supply and technologies to reduce emissions

#### Water

- BFX option covered by existing water approvals of 42 ML/d capacity
- Water infrastructure continuing to be upgraded to meet reliability requirements and BFX growth
- Studies underway investigating water saving efficiencies

#### Power requirements



Water requirements



### **ODEP option: longer-term development being evaluated**

- Long-term options under study to identify highest returning alternative
  - subject to strict capital allocation framework tests
- · Potential for significant increase in volume of ore
  - ~22 Mtpa ore at ~2.4% Cu
  - average Cu production to 450-500 ktpa (700-780 ktpa CuEq)<sup>1</sup>
- Low-cost mining and surface processing are key to highvolume expansions
  - investment in mine footprint, access to ore
  - additional materials handling capacity, including new SMA rock and logistics hoist
  - cost efficient heap leach technology, integrated with the existing surface plant
- Heap leach technology development program progressing
- · Studies for power and water options underway
- 1. At consensus price forecasts.

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### Key messages

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Value and returns	If approved, BFX would move Olympic Dam into the first quartile on the cost curve Increase in asset-level ROCE to 13% with BFX option (at consensus prices)

1. Copper equivalent grade calculated per metal equivalents note on slide 3.



# Appendix

### **Production**



1. Copper equivalent production based on FY17 average realised prices.



### **Current / BFX Flowsheet**



### **ODEP potential flowsheet**



