

Yiannis Bartzilas

ESG Analyst, Bloomberg

WATER RISK VALUATION IN MINING

YIANNIS BARTZILAS

NOVEMBER // 23 // 2015

Bloomberg

WATER SCARCITY IS ALREADY HURTING COMPANIES

Bloomberg Business

Follow us on: [f](#) [t](#) [in](#) [v](#)

The Brief


Happening Now

WHERE'S THE MONEY?
Cash Seized From Brazilian Ex-Billionaire Batista Missing
an hour ago

BABY MILK UNDER THREAT
New Zealand Says Threat Made to Contaminate Infant Formula
17 minutes ago


MOVING UP
Asian Stocks Advance After U.S. Equities Rebound, Yen Weakens
4 hours ago

CPI UP 1.4%
China's Disinflation Eased in February on Holiday Spending
2 hours ago




Gross Has First Janus Redemptions

12:17 PM




What You Need to Know About the Apple Watch

6:51 PM




Airbus's Multibillion-Dollar Decision: Whether to Overhaul A380 Jumbo

3 hours ago



How Brady Dougan's Climb Up a Swiss Peak Ended: Timeline

an hour ago



Chile's Water Shortage Threatens Wines and Mines

an hour ago

...AND CAN BE VERY EXPENSIVE TO MITIGATE

Search BI

91 Actions

Internal

Page 1/6

Bloomberg Intelligence

Global

Environmental, Social & Governance Dashboard (BI BESGG)

51 Home

52 Environmental

53 Social

54 Governance

Chapter: Chile, Peru Water Risks

Chile Desalination Bill Implies **\$13 Billion Copper Mining Cost**

Analysts [Barbara Pomfret \(ESG\)](#) & [Kenneth Hoffman \(Metals\)](#)

Dashboard: [Environmental](#), [Social & Governance](#), [Global](#) (BI BESGG)

Jan 9, 2014

BHP and Rio Tinto's \$3.4 billion Escondida desalination plant investment implies a cost of \$2 per cubic meter (m3) of water, assuming copper extraction water use is 0.72 m3 per ton, and 70% water recycling, the median for large miners. This suggests Chilean miners would need to invest more than \$13 billion to realize all current reserves if desalination is enforced. Costs, up to half from energy, may vary widely depending on ease of access to seawater.

Chile Copper Mining Desalination Costs

Operating Company	Proven Chile Copper Reserves ('000 U.S. tons)	Total Water Use ('000 m3)	Potential Desalinated Water Use ('000 m3)	Total Desalination Cost (\$ '000)
Anglo American	4,189,775	3,016,638	904,991	1,809,983
Antofagasta	2,347,592	1,690,267	507,080	1,014,160
BHP Billiton	7,739,328	5,572,316	1,671,695	3,343,390
Codelco	10,295,588	7,412,823	2,223,847	4,447,694
Freeport McMoran	1,146,404	825,411	247,623	495,246
New Gold	708,898	510,406	153,122	306,244
Teck Resources	3,390,158	2,440,914	732,274	1,464,548
Glencore Xstrata	891,770	642,074	192,622	385,245
Total Desalination Cost				13,266,509

Source: Company Filings, Bloomberg Industries

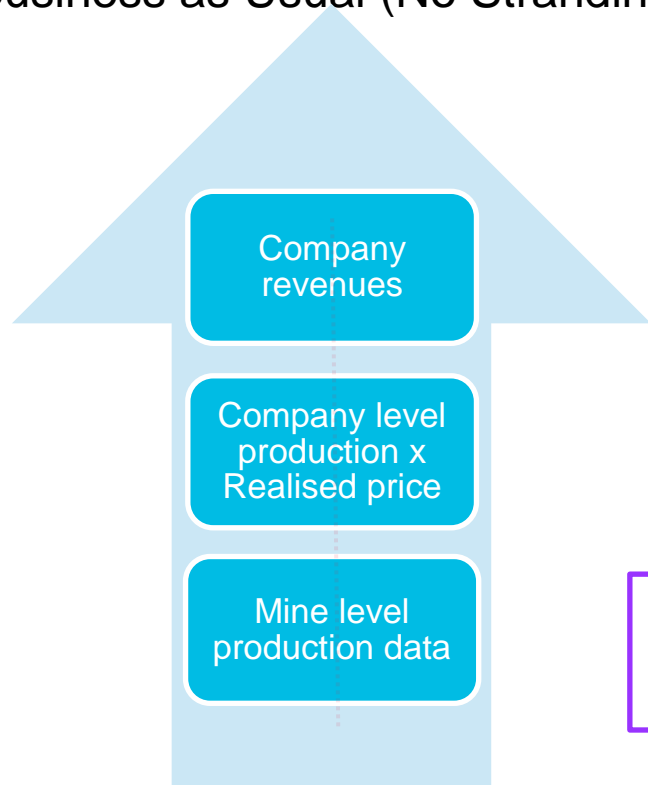
<

Page 1 of 6

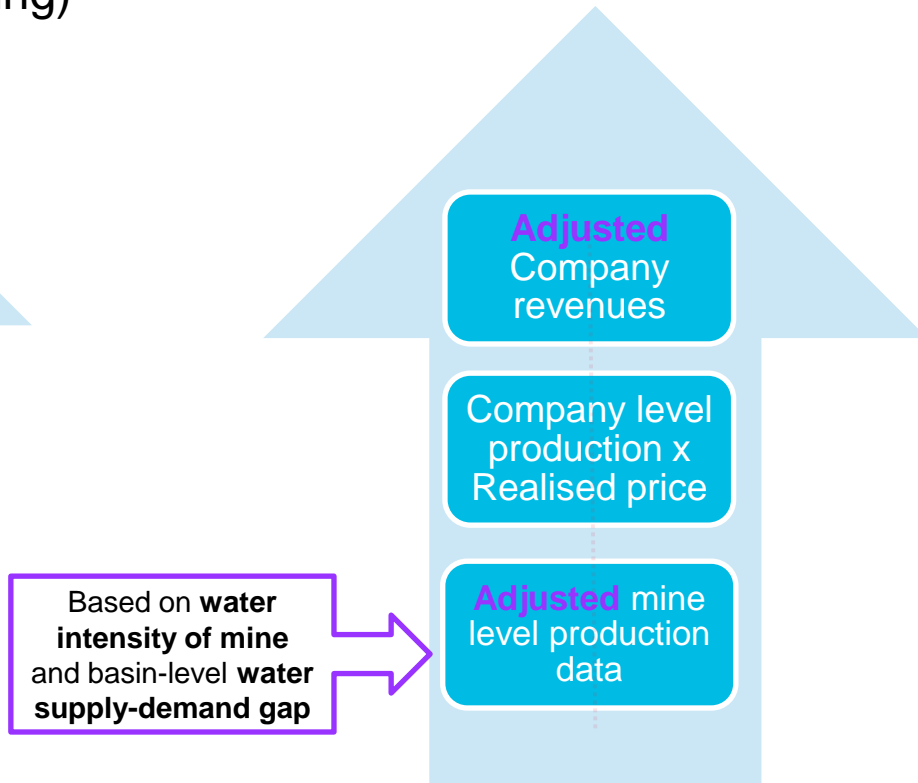
>

MODELLING BAU VS. WATER STRANDING

Business as Usual (No Stranding)



WATER STRANDING SCENARIO



COMPANIES ANALYSED IN THE MODEL

Company	Bloomberg Ticker
Acacia Mining Plc	ACA LN
Agnico Eagle Mines Ltd	AEM CN
Alamos Gold Inc	AGI CN
Anglogold Ashanti Ltd	ANG SJ
Argonaut Gold Inc	AR CN
Aurico Gold Inc	AUQ CN
Barrick Gold Corp	ABX CN
Centamin Plc	CEY LN
Eldorado Gold Corp	ELD CN
Gold Fields Ltd	GFI SJ
Goldcorp Inc	G CN
Kingsgate Consolidated Ltd	KCN AU
Kinross Gold Corp	K CN
Lake Shore Gold Corp	LSG CN
Newcrest Mining Ltd	NCM AU
Oceanagold Corp	OGC CN
Polyus Gold Ojsc	PLZL RM
Resolute Mining Ltd	RSG AU
Wesdome Gold Mines Ltd	WDO CN
Yamana Gold Inc	YRI CN
Antofagasta Plc	ANTO LN
Capstone Mining Corp	CS CN
Oz Minerals Ltd	OZL AU

- Together account for **50% of production of publicly listed gold producers** tracked by Bloomberg Intelligence (100+ companies)
- Largest impacts on production and revenues → **smaller & less diversified** companies
- **Capital expenditure** appears to be a viable route to value preservation in most cases

MODEL OVERVIEW



AGGREGATED COMPANY LEVEL WATER RISK

Bloomberg

Water Risk Valuation Tool

Anglogold Ashanti Ltd

Total Gold Output (M oz) - Latest Reported Year

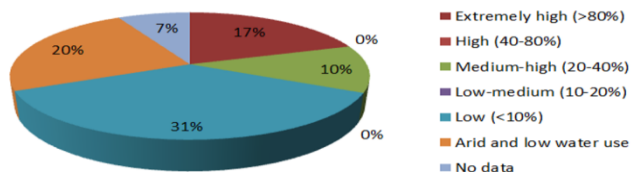
4.44

Projected (2020) Water Stress - World Resources Institute

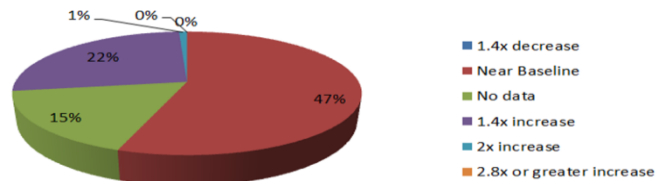
Overall Water Stress* - World Resources Institute	% Total Production	1.4x decrease	Near Baseline	No data	1.4x increase	2x increase	2.8x or greater increase
Extremely high (>80%)	17%	0%	5%	0%	12%	0%	0%
High (40-80%)	0%	0%	0%	0%	0%	0%	0%
Medium-high (20-40%)	10%	0%	0%	0%	10%	0%	0%
Low-medium (10-20%)	0%	0%	0%	0%	0%	0%	0%
Low (<10%)	31%	0%	31%	0%	0%	0%	0%
Arid and low water use	20%	0%	11%	8%	0%	1%	0%
No data	7%	0%	0%	7%	0%	0%	0%

*baseline year: 2010

Total Production Breakdown by Baseline (2010) Water Stress



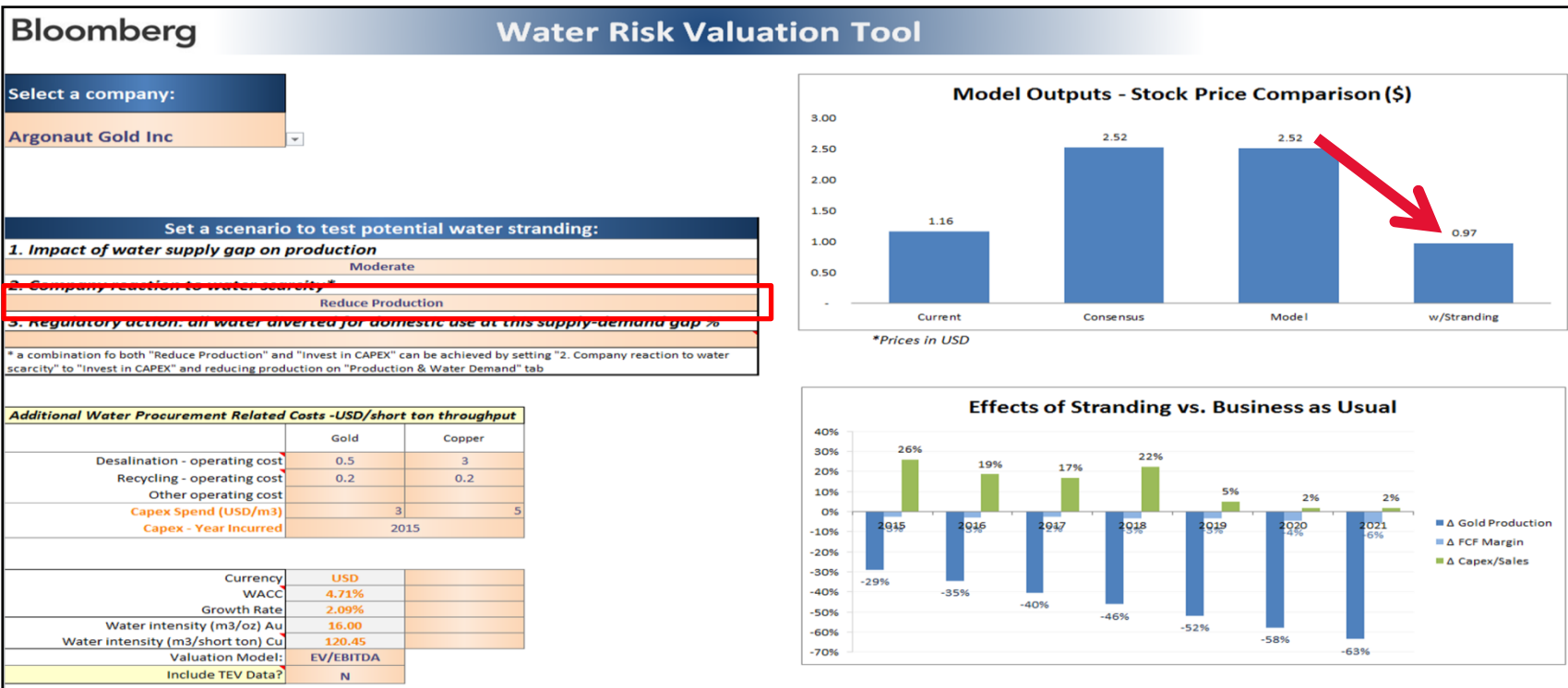
Total Production Breakdown by Projected (2020) Water Stress



PINPOINT EXPOSURE BY ASSET

List of AngloGold Ashanti Ltd Mine Sites						
Mine Name	Mine Ticker	Country	World Resources Institute - 2010 Water Stress Category	World Resources Institute - Projected Water Stress Category - 2020	Attributable Mine Output M oz	Mine Output % of Total Company Output
Morro da Gloria Gold Mine	0694760D Equity	Brazil	Low (<10%)	Near Baseline	-	
Raposos Gold Mine	0694792D Equity	Brazil	Low (<10%)	Near Baseline	-	
Mina Grande Gold Mine	0694774D Equity	Brazil	Low (<10%)	Near Baseline	-	
Kukuluma Gold Deposit	0694777D Equity	Tanzania	Low (<10%)	Near Baseline	-	
Cuiaba Gold Mine	0694798D Equity	Brazil	Low (<10%)	Near Baseline	-	
Velha Gold Mine	0694801D Equity	Brazil	Low (<10%)	Near Baseline	-	
Veduga Gold Deposit	0694788D Equity	Russia	Low (<10%)	Near Baseline	-	
Corrego do Sitio Tailings Gold Min	0694756D Equity	Brazil	Low (<10%)	Near Baseline	-	
LMS Gold deposit	0694799D Equity	United States	Low (<10%)	Near Baseline	-	
Rescatada Gold Deposit	0694770D Equity	Peru	Low (<10%)	Near Baseline	-	
Cerro Vanguardia Gold Mine	0694757D Equity	Argentina	Arid and low water use	Near Baseline	0.25	6%
Anglogold Ashanti Mi	0694781D Equity	Brazil	Low (<10%)	Near Baseline	0.40	9%
Cresson Gold Mine	0694796D Equity	United States	Extremely high (>80%)	Near Baseline	0.21	5%
Sunrise Dam Gold Min	0694782D Equity	Australia	Arid and low water use	Near Baseline	0.26	6%
Geita Gold Mine	0694802D Equity	Tanzania	Low (<10%)	Near Baseline	0.48	11%
La Colosa Gold Depos	0694783D Equity	South Africa	Low (<10%)	Near Baseline	-	
Gramalote Gold Deposit	0694772D Equity	Peru	Low (<10%)	Near Baseline	-	
Tropicana Gold Deposit	0694773D Equity	Australia	Arid and low water use	No data	0.36	8%
Crixas (Serra Grande) Gold Mine	0694779D Equity	Brazil	Low (<10%)	Near Baseline	0.07	2%
Sao Bento Gold Mine	0739304D Equity	Brazil	Low (<10%)	Near Baseline	-	
Teberebie Gold Mine	0694784D Equity	Ghana	Low (<10%)	Near Baseline	-	
Obuasi Gold Mine	0694797D Equity	Ghana	Low (<10%)	Near Baseline	0.24	6%
Teberebie Gold Mine	0694785D Equity	Ghana	Low (<10%)	Near Baseline	-	

COMPANY REACTION: REDUCE PRODUCTION (ASSETS STRANDED)



COMPANY REACTION: INVEST IN CAPEX

Bloomberg

Water Risk Valuation Tool

Select a company:

Argonaut Gold Inc

Set a scenario to test potential water stranding:

1. Impact of water supply gap on production

Moderate

2. Company reaction to water scarcity*

Invest in CAPEX

3. Regulatory action: all water diverted for domestic use at this supply-demand gap %

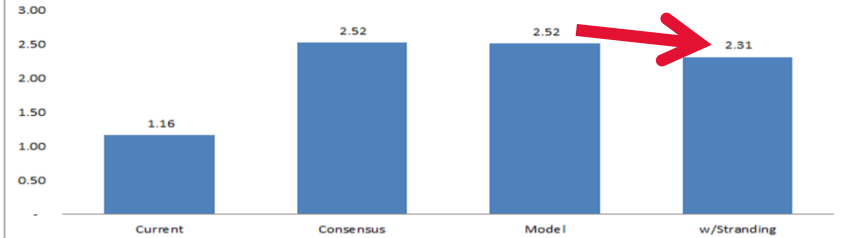
* a combination for both "Reduce Production" and "Invest in CAPEX" can be achieved by setting "2. Company reaction to water scarcity" to "Invest in CAPEX" and reducing production on "Production & Water Demand" tab

Additional Water Procurement Related Costs -USD/short ton throughput

	Gold	Copper
Desalination - operating cost	0.5	3
Recycling - operating cost	0.2	0.2
Other operating cost		
Capex Spend (USD/m3)	3	5
Capex - Year Incurred	2015	

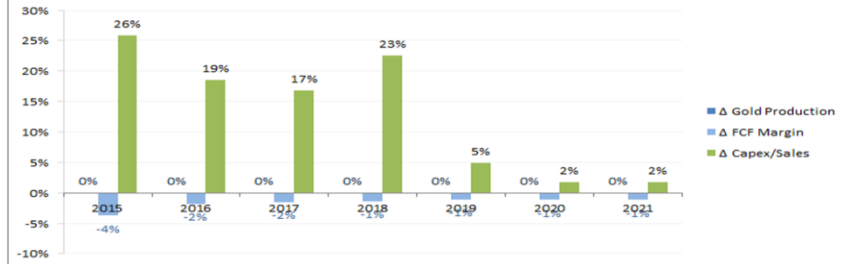
Currency	USD
WACC	4.71%
Growth Rate	2.09%
Water intensity (m3/oz) Au	16.00
Water intensity (m3/short ton) Cu	120.45
Valuation Model:	EV/EBITDA
Include TEV Data?	N

Model Outputs - Stock Price Comparison (\$)



*Prices in USD

Effects of Stranding vs. Business as Usual



INCLUDE SHADOW PRICE OF WATER

Bloomberg

Water Risk Valuation Tool

Select a company:

Argonaut Gold Inc

Set a scenario to test potential water stranding:

1. Impact of water supply gap on production

Moderate

2. Company reaction to water scarcity*

Invest in CAPEX

3. Regulatory action: all water diverted for domestic use at this supply-demand gap %

* a combination for both "Reduce Production" and "Invest in CAPEX" can be achieved by setting "2. Company reaction to water scarcity" to "Invest in CAPEX" and reducing production on "Production & Water Demand" tab

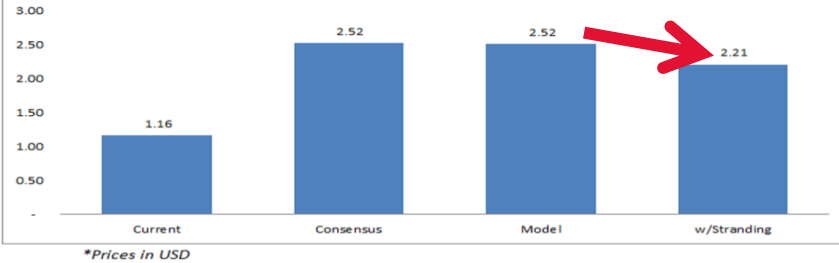
Additional Water Procurement Related Costs -USD/short ton throughput

	Gold	Copper
Desalination - operating cost	0.5	3
Recycling - operating cost	0.2	0.2
Other operating cost		
Capex Spend (USD/m3)	3	5
Capex - Year Incurred	2015	

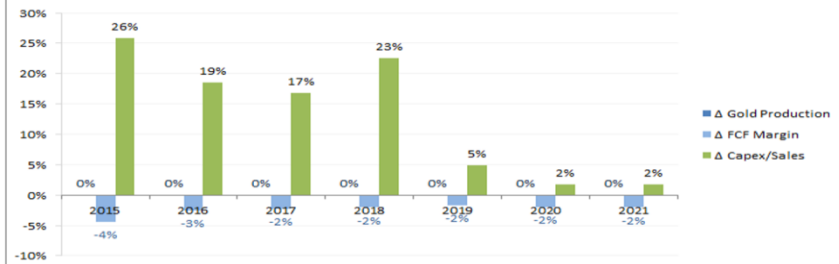
Currency	USD
WACC	4.71%
Growth Rate	2.09%
Water intensity (m3/oz) Au	16.00
Water intensity (m3/short ton) Cu	120.45

Valuation Model: Evycon DPA
Include TEV Data? Y

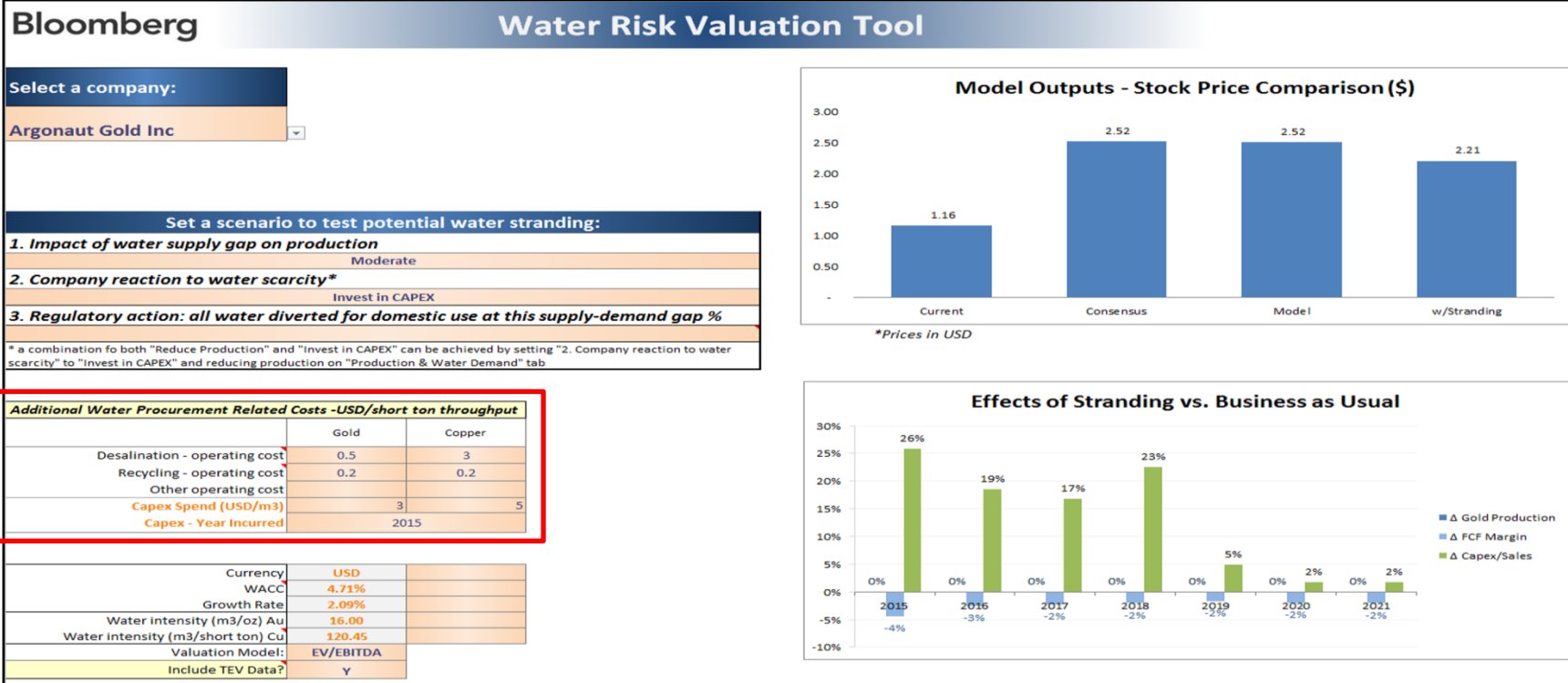
Model Outputs - Stock Price Comparison (\$)



Effects of Stranding vs. Business as Usual



CUSTOMIZE INPUTS: COST OF WATER SOLUTIONS



THANK YOU



YIANNIS BARTZILAS

YBARTZILAS@BLOOMBERG.NET

<http://www.bloomberg.com/bcause/new-tool-integrates-water-risk-considerations-in-equity-valuation-process>

METHODOLOGY: KEY POINTS

- “WATER RISK” = PHYSICAL AVAILABILITY OF WATER
- ASSUMPTIONS
 - Water scarcity does NOT impact the global/realized **metals prices**
 - Forecasting
 - Financial metrics in BAU scenario – **broker estimates**
 - Production figures at individual mine sites – **historical growth rates**
 - Future scarcity sets in a **linear** fashion 2010-20