World Forum on Natural Capital
EDINBURGH · 2015

Yiannis Bartzilas

ESG Analyst, Bloomberg

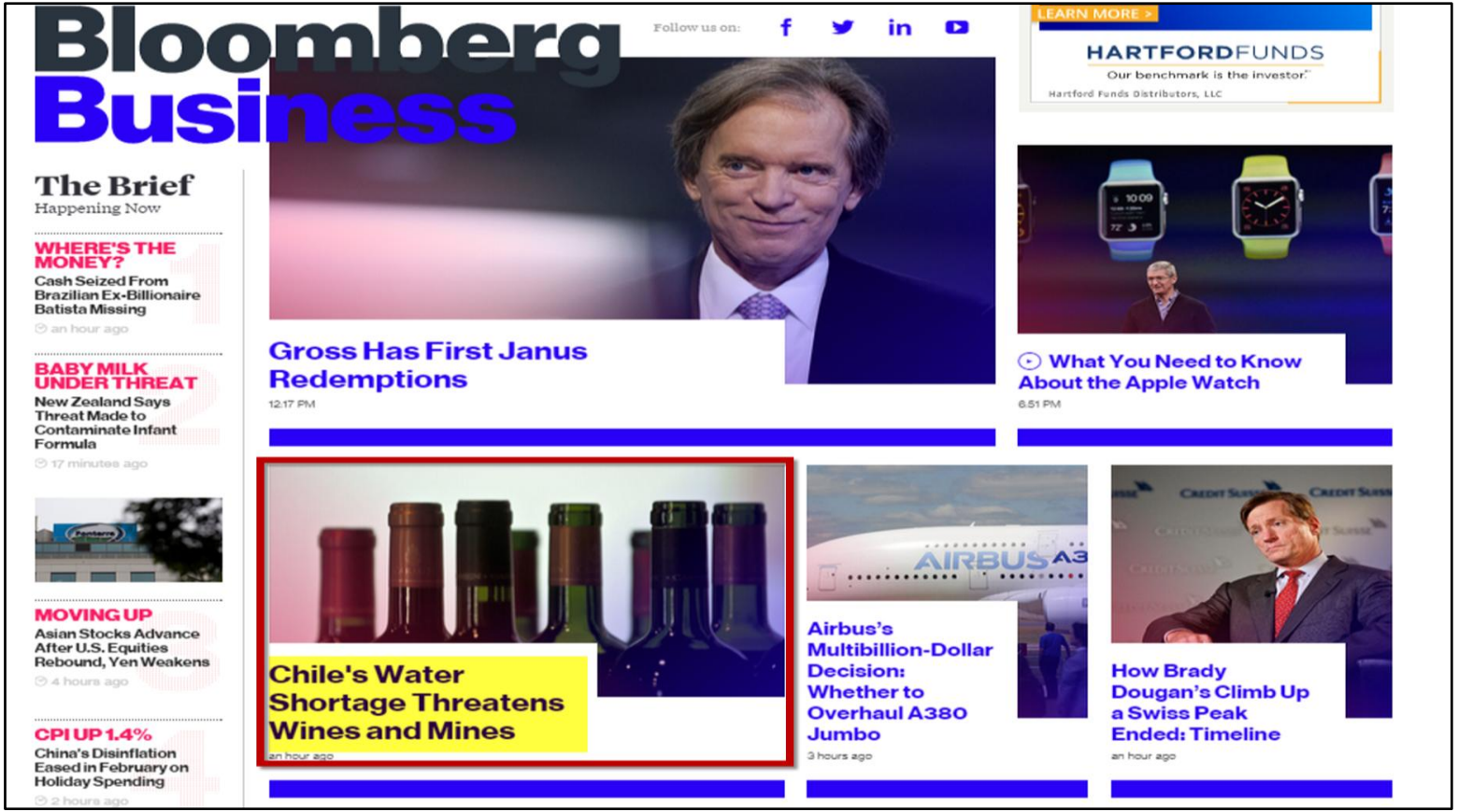
WATER RISK VALUATION IN MINING

YIANNIS BARTZILAS

NOVEMBER// 23 // 2015

Bloomberg

WATER SCARCITY IS ALREADY HURTING COMPANIES

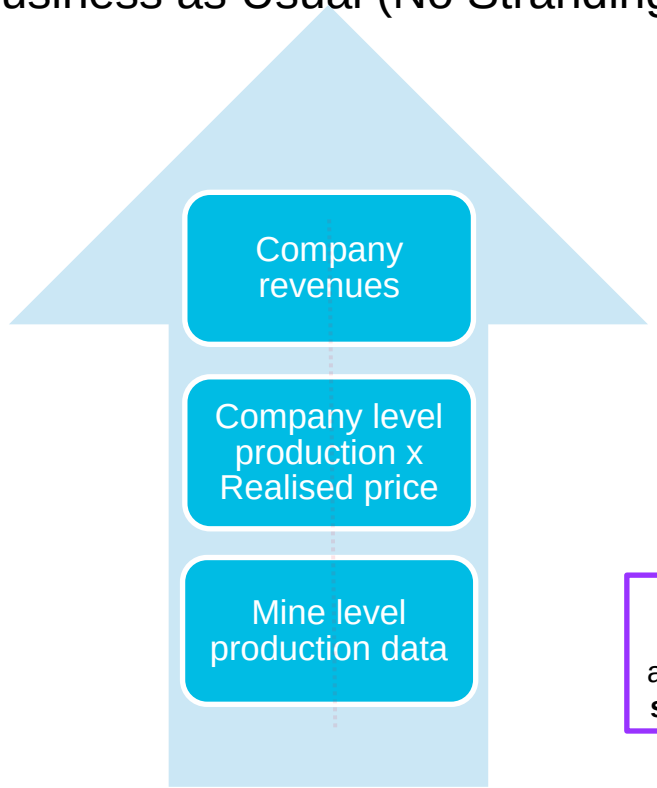


…AND CAN BE VERY EXPENSIVE TO MITIGATE

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

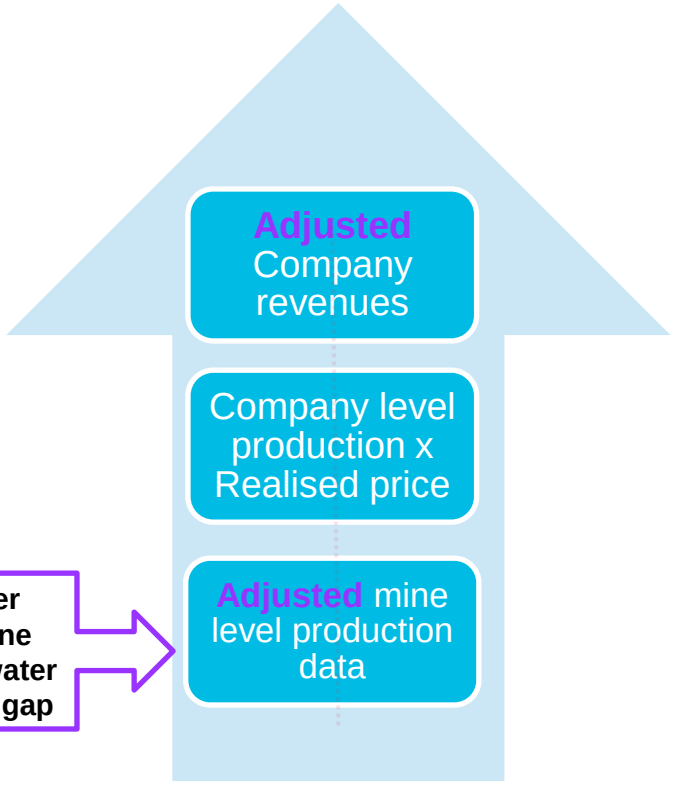
MODELLING BAU VS. WATER STRANDING

Business as Usual (No Stranding)



Based on **water intensity of mine** and basin-level **water supply-demand gap**

WATER STRANDING SCENARIO



WATER RISK VALUATION TOOL

Bloomberg

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

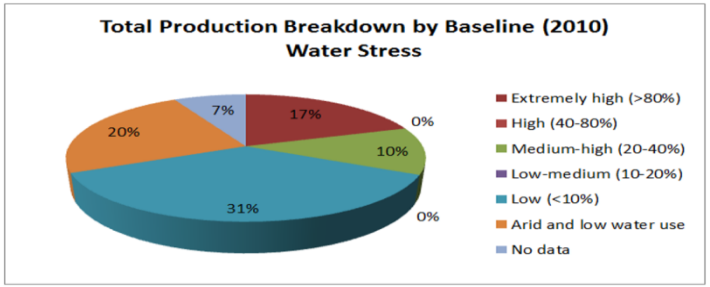
Water Risk Valuation Tool

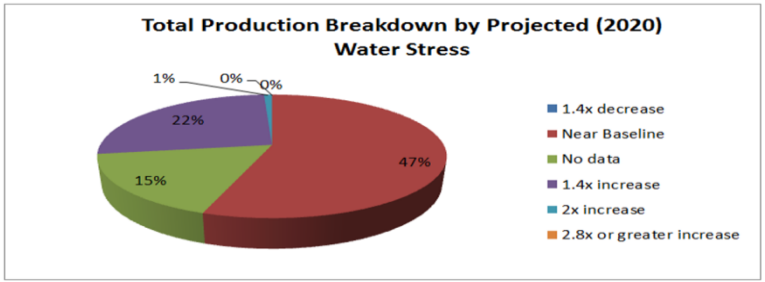
Anglogold Ashanti Ltd

Total Gold Ouput (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





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	0694786D Equity	Ghana	Low (<10%)	Near Baseline		

COMPANY REACTION: REDUCE PRODUCTION (ASSETS STRANDED)

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

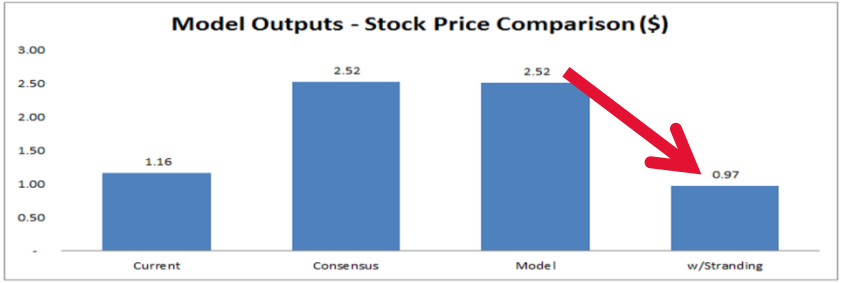
Moderate

*2. Company reaction to water scarcity**

Reduce Production

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

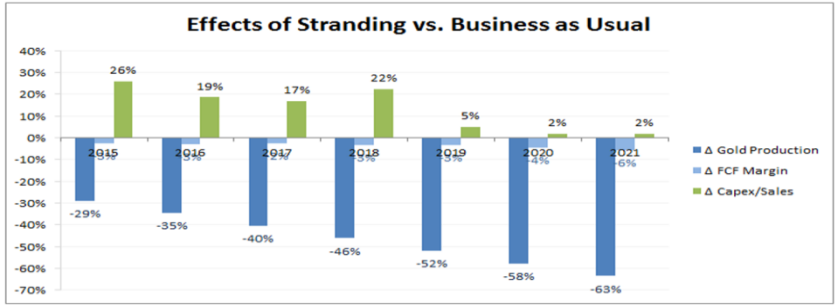
* a combination fo both "Reduce Production" and "Invest in CAPEX" can be achieved by setting "2. Company reaction to water scarcity" to "Invest in CAPEX" and reducing production on "Production & Water Demand" tab



*Prices in USD

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	



COMPANY REACTION: INVEST IN CAPEX

Bloomberg

Water Risk Valuation Tool

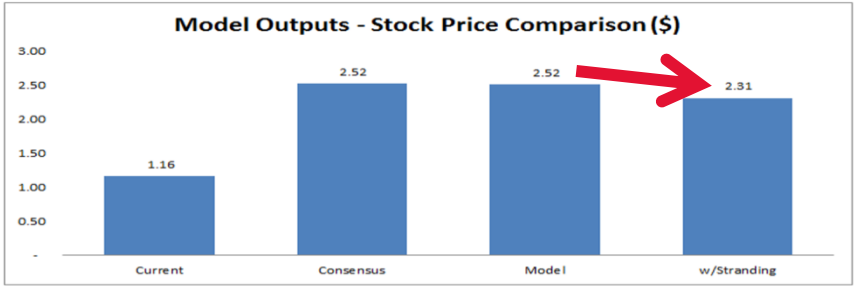
Select a company:
Argonaut Gold Inc

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 %	

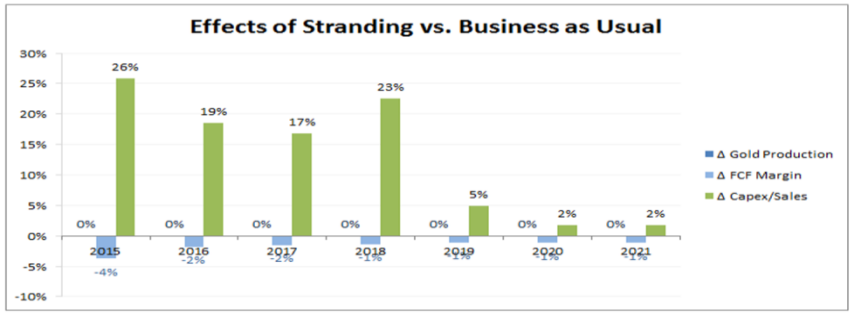
* a combination fo both "Reduce Production" and "Invest in CAPEX" can be achieved by setting "2. Company reaction to water scarcity" to "Invest in CAPEX" and reducing production on "Production & Water Demand" tab

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	



*Prices in USD



WATER RISK VALUATION TOOL

Bloomberg

INCLUDE SHADOW PRICE OF WATER

Bloomberg

Water Risk Valuation Tool

Select a company:

Argonaut Gold Inc

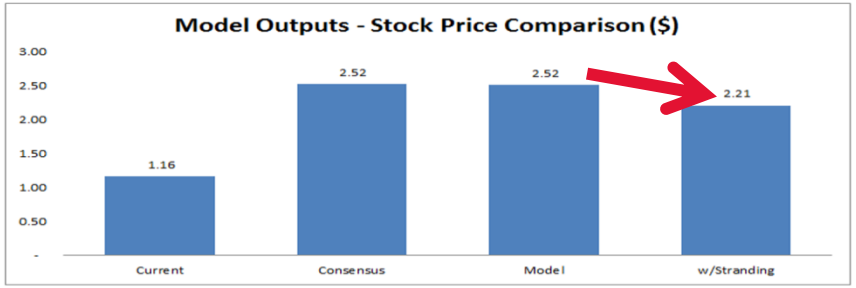
Set a scenario to test potential water stranding:

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 %	

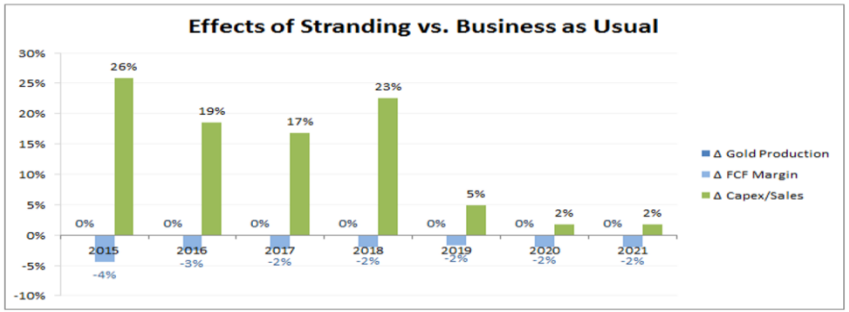
* a combination fo both "Reduce Production" and "Invest in CAPEX" can be achieved by setting "2. Company reaction to water scarcity" to "Invest in CAPEX" and reducing production on "Production & Water Demand" tab

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?	Y	



*Prices in USD



WATER RISK VALUATION TOOL

Bloomberg

CUSTOMIZE INPUTS: COST OF WATER SOLUTIONS

Bloomberg

Water Risk Valuation Tool

Select a company:

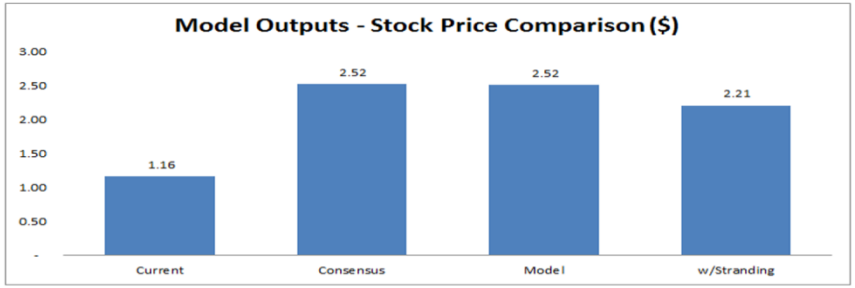
Argonaut Gold Inc

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 %

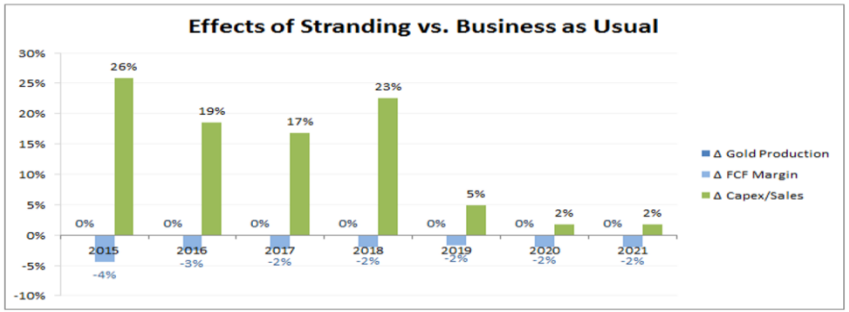
* a combination fo both "Reduce Production" and "Invest in CAPEX" can be achieved by setting "2. Company reaction to water scarcity" to "Invest in CAPEX" and reducing production on "Production & Water Demand" tab

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?	Y	



*Prices in USD



WATER RISK VALUATION TOOL

Bloomberg

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