

European Mining Business Forum 2018

Panel 2

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**The Future of Energy
and its Impact on Mining:
Technology and Economics**

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**An international consulting company specialized in mining & energy
...and their interface**

**Weekly Reports: China news & Climate Change, ETS, Green Finance
Broker between project owners & sources of capital**

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Energy Today ...

Enviro: emissions targeted

‘2020 package’: binding legislation for EU to meet climate & energy targets for 2020

3 key targets:

- 20% cut in GHG (from 1990 levels)
- 20% of EU energy from renewables
- 20% improvement in energy efficiency

Technology: Coal being cleaned -- or reduced [except in Asia]; nuclear? Gas -- a stop-gap solution; Renewables on the rise, incl. off-shore – with storage; EV

Economics: ETS, CL List update May 8 '18; Renewables auctions, towards grid parity; Extremely cheap US gas due to fracking; China's role

... Energy Today

Examples

- Mitsubishi Hitachi PS receives 1st order for integrated fuel cell & gas turbine hybrid power generation system, Jan 31 '18
- Swedish steel plant to run on H₂, 2'18
- Volvo's new gas-powered truck filled at Calor LNG refueling, 3'18
- Scientists turn to 'self-heating' to make Li batteries more efficient, 3'18
- US truck driver shortage points to bigger problems, FT, 4'18
- One bitcoin transaction uses as much energy as your house in a week

The Future of Mining...

- Lower emissions: Methane & CO2 *'predominant GHGs into atmosphere mainly contributed by fugitive emissions, purchased electricity, heat, & water'*.
- Other enviro prevention, protection, restoration
- Innovation
- Automation
- EV
- Public acceptance & CSR in developed countries
- China investment in less developed ones

...The Future of Mining

Examples

- Tesla turning to Chile for its Li: Andy Home, 2'18
- BMW mining deals imminent as Co price powers on, 2'18
- New study rips into Co, Li price bulls, 3'18
- Of all things, Mo could crash Co, Ni price party, 3'18

- Electric mine-truck pilot project for Aitik, Swe, 2'18
- PDAC 2018: Energy technology optimism buoys mood at convention, 3'18
- How resource companies are using the blockchain, 3'18
- DigiMine: Sibanye-Stillwater partners w/ Wits to create the 'mine of the future', 3'18

Links between Energy and Mining...

Energy uses of minmets

- Steel, Al, Cu, cement etc in all energy projects & infrastructure
- Cu important across renewables, PV solar cells
- Rare earths in [i] catalytic converters to reduce emissions...
- ...and [ii] in several lighting applications
- Urban mining, eg recycling of gold, rare earths & other minmets; example: US lab mines gold from discarded SIM cards
- Silica & minor metals in PV cells
- Rare earths in permanent magnets for wind turbines
- Cu, Al in decentralized transmission & distribution systems

...Links between Energy and Mining...

Methods

- Recycling—cyclical economy: *life cycle approach* to be adopted. Life cycle assessment [LCA] methodology: where in the metal production life cycle focus on energy efficiency should be & evaluate potential opportunities for reducing GHG footprint of primary metal production
- Energy efficiency in minmet production: LCA of main primary metal production processes, current & predicted global metal production rates, ore grades and grind/liberation size: ‘endeavors to improve energy efficiency of primary metal production should focus mainly on *metal extraction* stage, particularly for steel and Al’
- Also: ‘declining ore grades & more complex ore bodies to significantly increase energy required for comminution of main metal ores & to present opportunities for improving energy efficiency of primary *metal production*’

...Links between Energy and Mining

Examples

- GE's digital smelter solutions enhance efficiency, productivity for Aluminium of Greece, 2'17--Alcoa & Rio Tinto: world's 1st C-free Al smelting process, 5'18
- Swedish steel plant to run on Hydrogen
- Li-ion batteries used in electric & hybrid vehicles, 2'18
- Mg-ion batteries, 2'18
- Chile's state mining company ENAMI to run with 100% renewables, 3'18
- Total Eren targets Africa's power-starved mining sector, 3'18
- Dormant Swedish graphite mine comes alive in rush for car batteries, 3'18
- Clean energy world needs thriving mining sector - Co, Cu, Vn, Li, FT, 4'18
- Hainan Province all vehicles to run on new energy [NEVs] by 2030, 4'18

What Lies Ahead? -- The 'Known Unknowns'...Rumsfeld

- Decentralized generation & distribution
- Smart metering, demand management
- RES at mine sites
- Energy storage
- New trends in financing & investment: preparing for subsidy-free RES market, green bonds, insurance companies eg Allianz cutting back on coal insurance, banks divesting from fossil fuels
- Hybrid power reduces electricity costs & boosts security of supply of mining ops. Can also unlock investments into new & sustainable mining & industrial activity in Africa: Juwi commissioned world's largest off-grid hybrid (solar /diesel /storage) power plant at DeGrussa Copper/Gold mine in W. Australia – w/ 20% fuel savings & reduction of 12,000 mt CO2/yr, + improving power quality/ reliability. 6 '16

...What Lies Ahead? -- The 'Known Unknowns'...

Examples

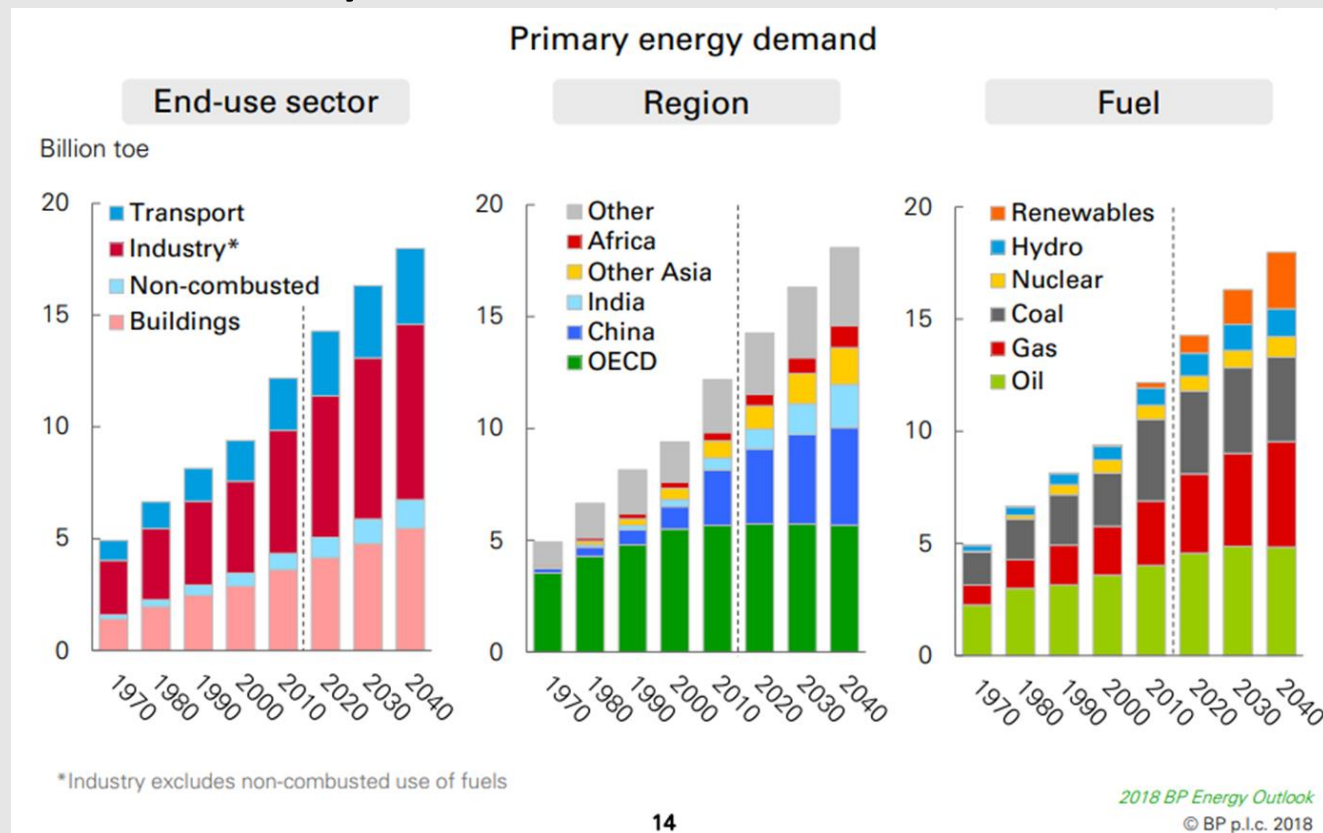
- 1'18: Energy Storage: Arizona Proposes Biggest Storage & Clean Energy Target Yet, would pursue 80 pct clean energy by 2050 and 3,000 MW of energy storage by 2030
- 2'18: CATL, Chinese battery maker will soon surpass Tesla in capacity: China overtook the US in 2015 to become the world's biggest market for electric cars, providing huge domestic market for battery makers like CATL
- 2'18: Climate: Exxon plans for carbon-constrained future
- 2'18: Ni producer Eramet eyes expansion in EV metals
- 2'18: ELEMED (ELectrification of the Eastern MEDiterranean) project set to make breakthrough in environmental protection *at sea*, creating shoreside units offering electrical power to vessels at berth

...What Lies Ahead? -- The 'Known Unknowns'

- Yitai Coal CH to use ABB's digital solutions/services for intelligent control & mgmt optimization of plants, production costs ↓, safety ↑, productivity & information ↑, -integration of informatization & industrialization, intelligent upgrading, 2'18
- Co role ↑ in transition to renewable power sources
- Why EV could fracture the Ni market, 3 '18
- US DoE: 'Si most common material used in solar cells, offers low costs, high-efficiency, long lifetime – BUT:
- 2030s: Si panels could be hitting their economic/technical limits. Innovation eg Perovskites — crystalline minerals 'the undisputed leader' among emerging solar technologies — & other ideas for superior alternatives to standard Si panels, 3 '18
- Emissions-free shipping

What Lies Ahead? -- The 'Unknown Unknowns'...

Here our crystal ball becomes less clear



What Lies Ahead? -- The 'Unknown Unknowns'...

- Redefinition & disruption of service models and products
- Harari's 'Sapiens': man [i] creates inorganic extensions of himself, [ii] conversely, gives a human mind to a computer, [iii] creates computers that can think for themselves: 4th Industrial Revolution, artificial intelligence, internet of things
- How would these developments affect mining?
- ...energy?
- ...their interface?
- **Not clear**—To provoke you, just think that
- Cypriot Nobel price winner Pissaridis predicted: 'in the future, Nobel prices could be awarded to robots'! 5 '18

Thank you for your attention!

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