Getting to Net Zero Energy:  
Cleantech Innovation & Mining

Tom Rand, PEng. PhD.  
CMIC, Toronto, June 4

ArcTern Ventures Fund II  
Cleantech Venture Capital
Markets and existing technology are not enough – despite promises.
Markets and existing technology are not enough – *despite low costs.*

$/MMBTU on a relevant time scale
Markets and existing technology are not enough – *despite low costs.*
Mining & EPC – what drives innovation (into mines) ?

Traditional ‘ecosystem’ model …
Mining & EPC – what drives cleantech (into OPERATING mines)?

Commercial partner model …

Innovation expands design space!

Owners: profit & priorities

EPC: design constraints & possibilities

Operators: reliability

Partners:
- WSP
- TETRA TECH
- AECOM
- MacLean
- HATCH
- SNC-Lavalin
Mining & EPC – Renewables and a bit of storage?

**Idealized Daily Output Variations**

**Actual Daily Output Variations**

Area under curve equals sun hours

[Graphs showing solar power output variations with morning, noon, and evening peaks.]
Mobile electrical storage – maybe run a few machines from solar?
Mining & EPC – overstuffing to replace diesel?
Mining & EPC – what you really need is baseload!

Base Load
Advanced CAES - Daily cycle electrical storage

Getting to scale and bankability in market

Charge
As compressed air is sent into the air storage cavern, water is displaced via a flooded decline or shaft.

Discharge
As water enters the air storage cavern, hydrostatic pressure forces air to the surface.
Getting to scale and bankability in market
**Fund I – Advanced CAES**

**Getting to scale and bankability in market**

- **Site:** Strathalbyn, South Australia
- **Rating:** 60 MWh
- **Status:** Under Construction
- **In-Service Date:** 2020-Q3
- **Capital Cost:** US$20 million
- **Support:** ARENA, South Australia
- **Enables:**
  - $100 million bonding capacity
  - $250 million performance guarantee coverage
  - Marketing showcase
E-Zn – (very) long-term storage.

■ Which means very low-cost incremental kwh …
And efficiency always matters – eg smart Analytics for mines …
Ultimate Disruption – Urban Mining = Full Circular Economy?

The Urban Mining Innovation Centre
Norman B. Keevil Institute of Mining Engineering
University of British Columbia, Vancouver, Canada
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