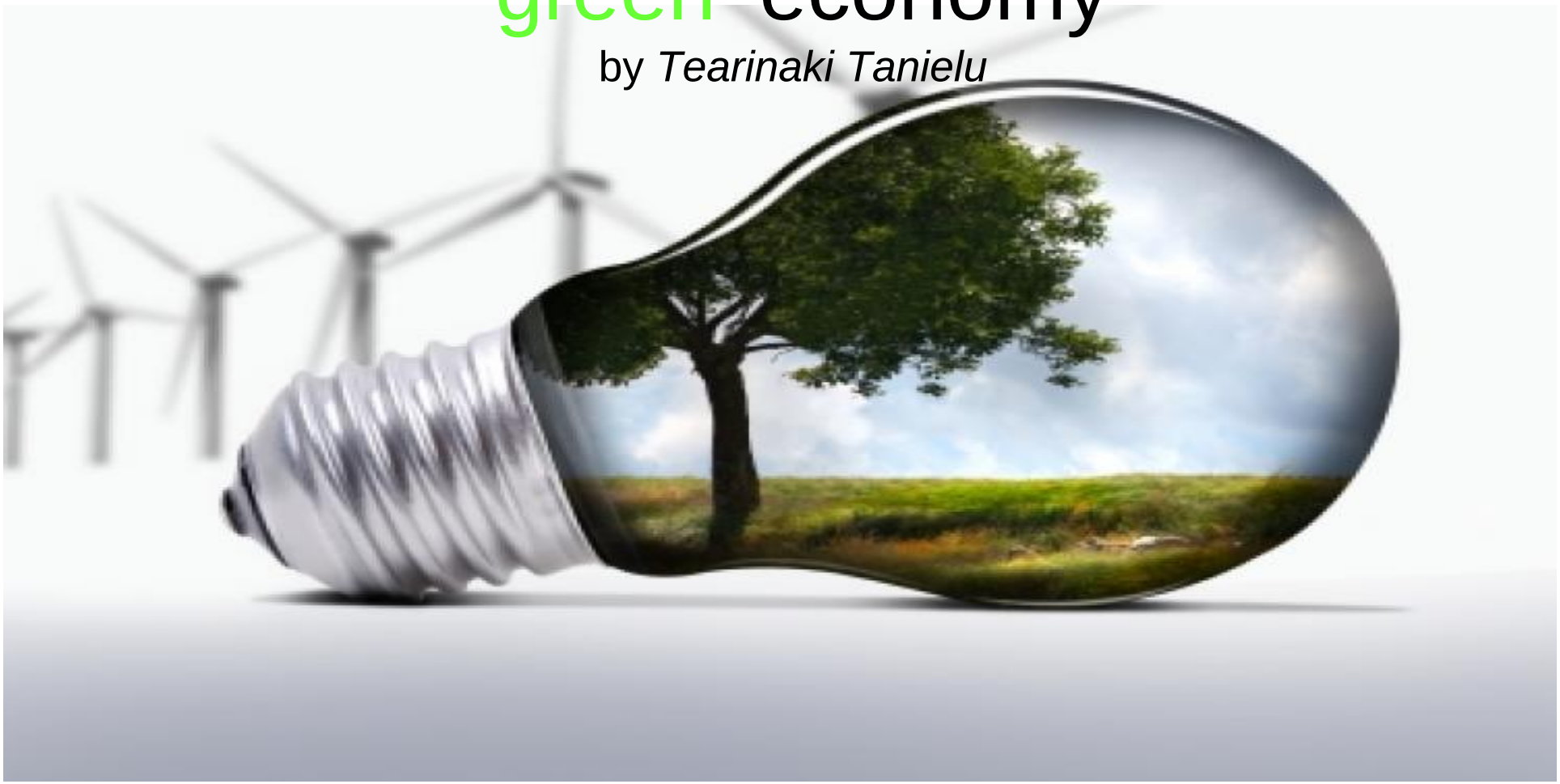
Deep Sea Minerals and the ‘green’ economy

by *Tearinaki Tanielu*



Outline

1. What are Deep Sea Minerals (DSM)?
    - Types, formation, geological setting

2. DSM- Why NOW?
    - Drivers for demand

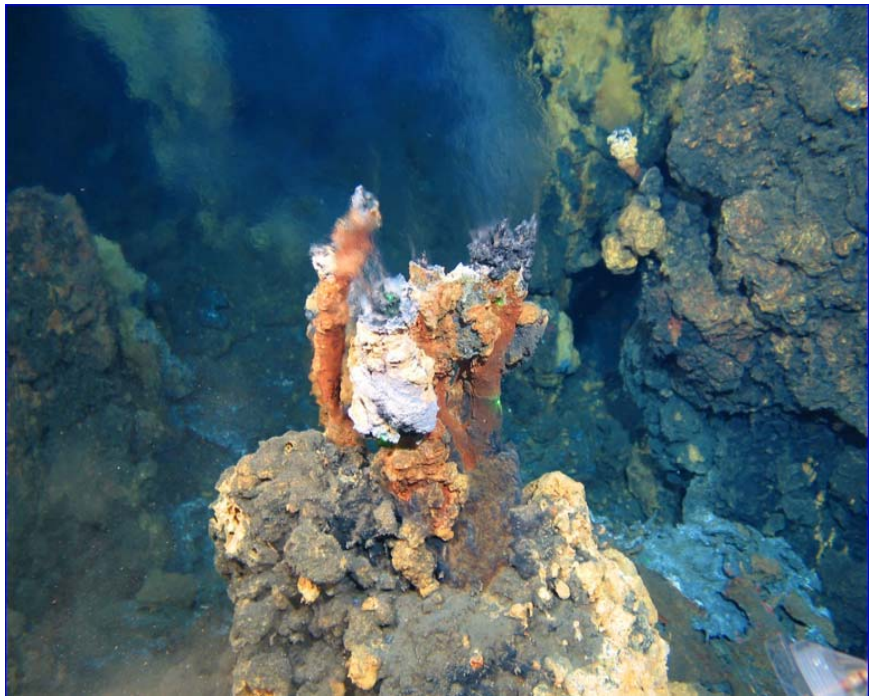
3. DSM- how it relates to renewable energy and the concept of a ‘greener’ tomorrow?

Important Points!

- Geological and physical parameters of Deep Sea minerals

- The critical role that Deep Sea Minerals play in the global need to shift towards Renewable energy

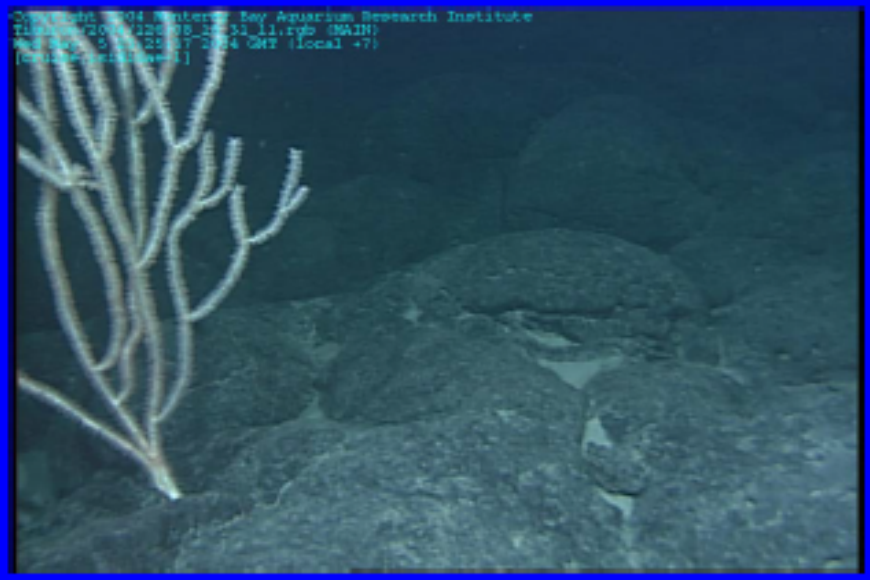
1. What are deep sea minerals (DSM)?



- **Sea-floor Massive Sulfides (Polymetallic Sulfides)**
- **Ferromanganese Crusts (Cobalt-rich Crusts)**
- **Manganese Nodules (Polymetallic nodules)**

Ferromanganese Crusts

- Grow on hard-rock surfaces on seamounts, ridges, and plateaus
- Found at water depths of ~400-7,000 meters
- Thicknesses range from <1 to ~260 millimeters
- Precipitate from cold ambient bottom water



Source: Hein, J, 2011

Seafloor Massive Sulfides

Precipitation from hydrothermal & magmatic fluids

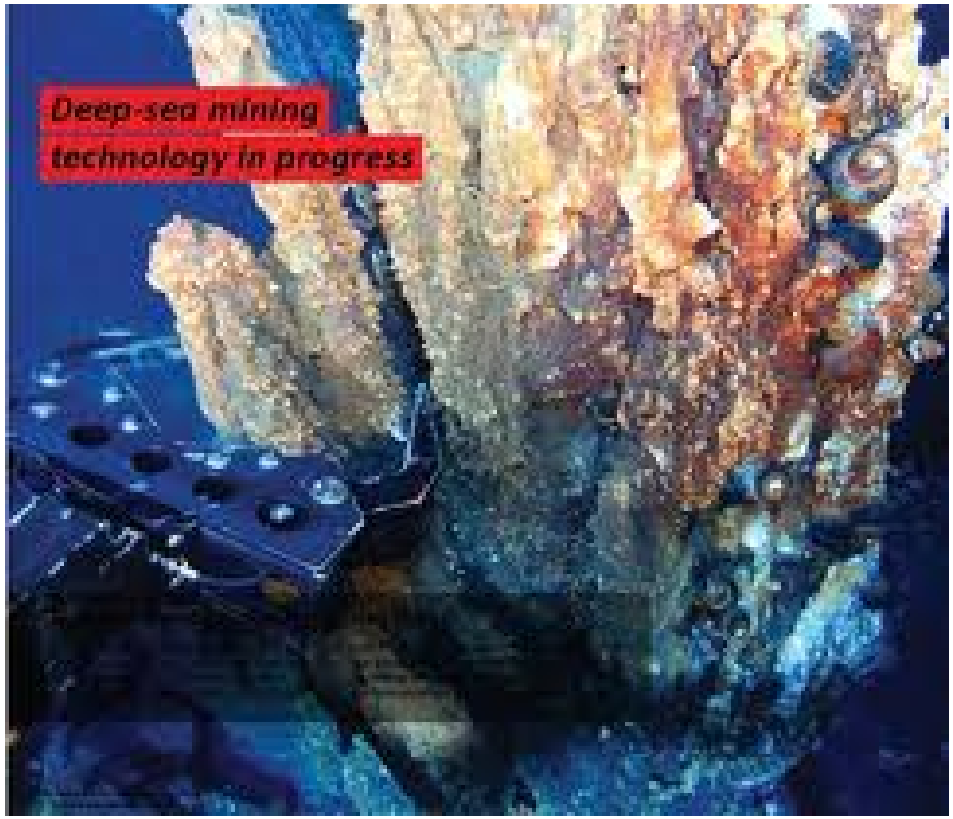
Black/white smokers produce sulfide/sulfate chimneys & mounds

Rich in Cu, Zn, Pb, Ba, Ag, Au (Cd, Sb, As, Ga, In)

Ephemeral vent fields

Source: Hein, J, 2011

Seafloor Massive Sulfides

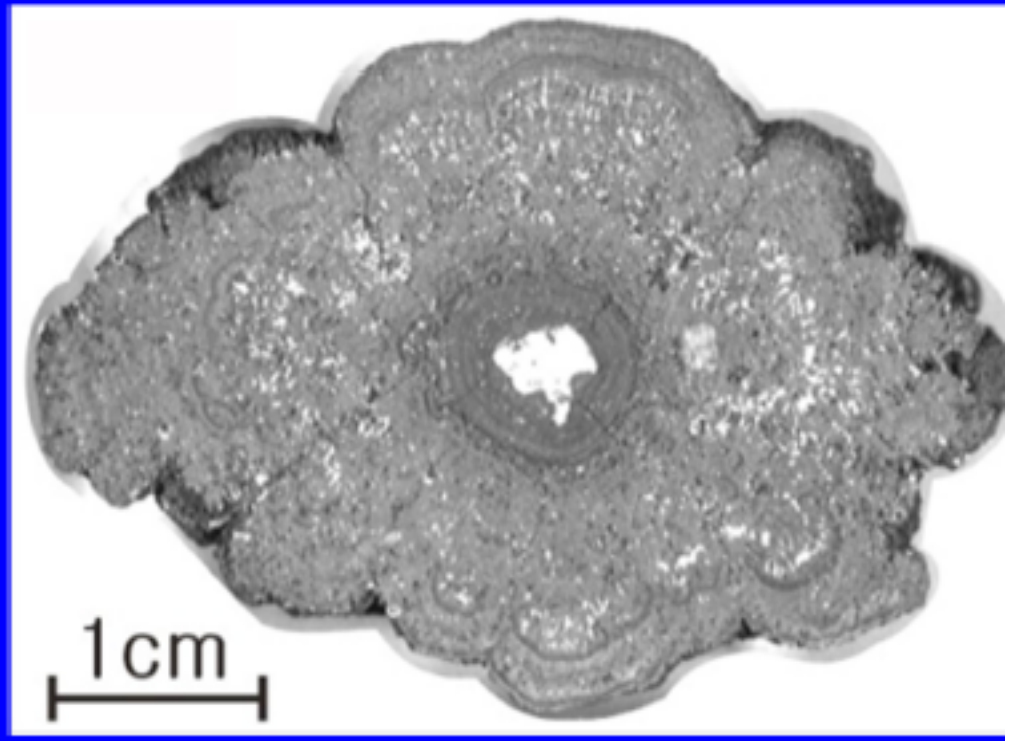


Manganese Nodules

Form on sediment-covered abyssal plains (4,000-6,500 meters water depths)

Composed of Mn & Fe oxides, with significant amounts of Ni & Cu

Form by precipitation from cold ambient bottom water & from sediment pore fluids



Manganese nodules

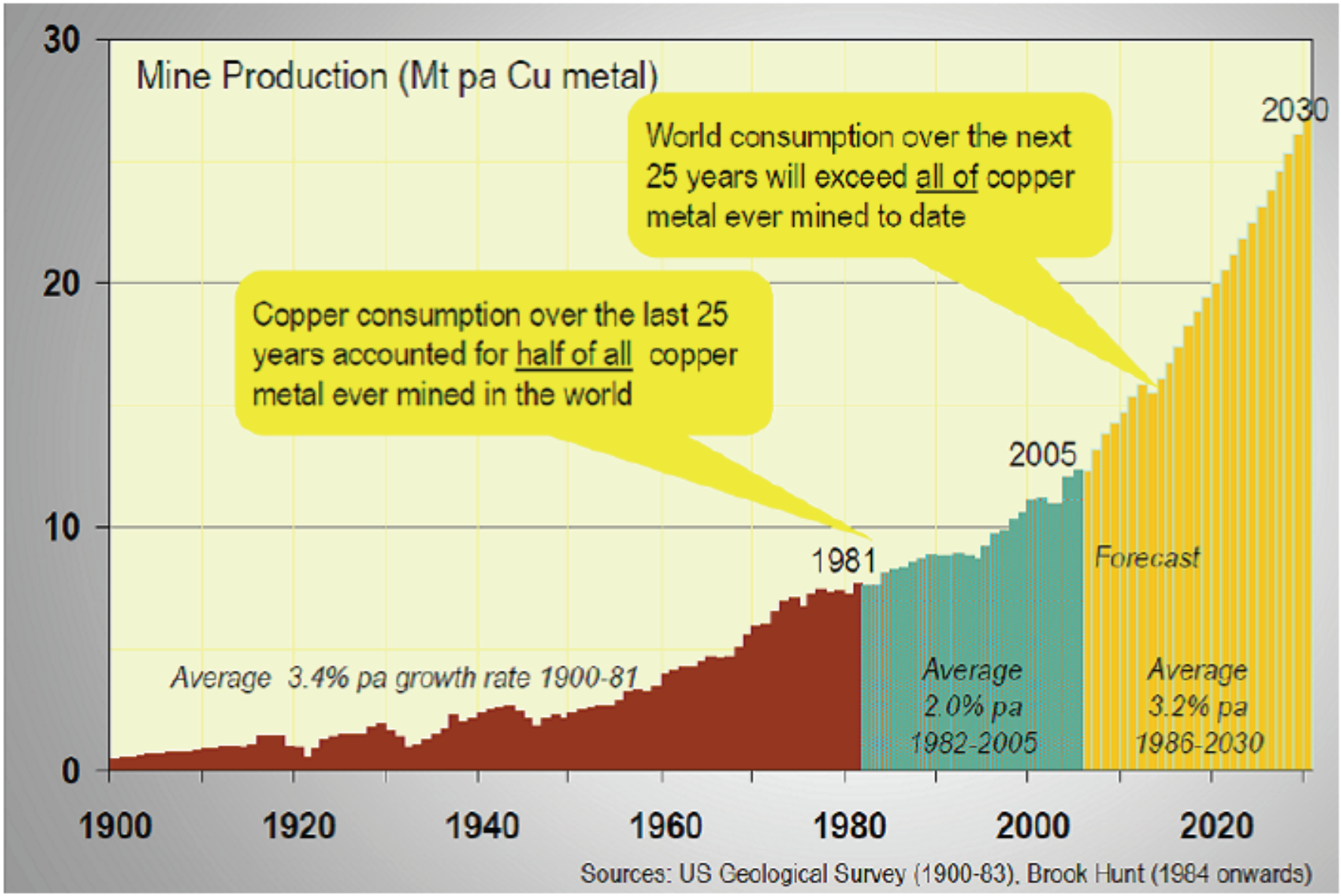
2. Deep Sea Minerals- Why NOW?

Rising global demand for metals

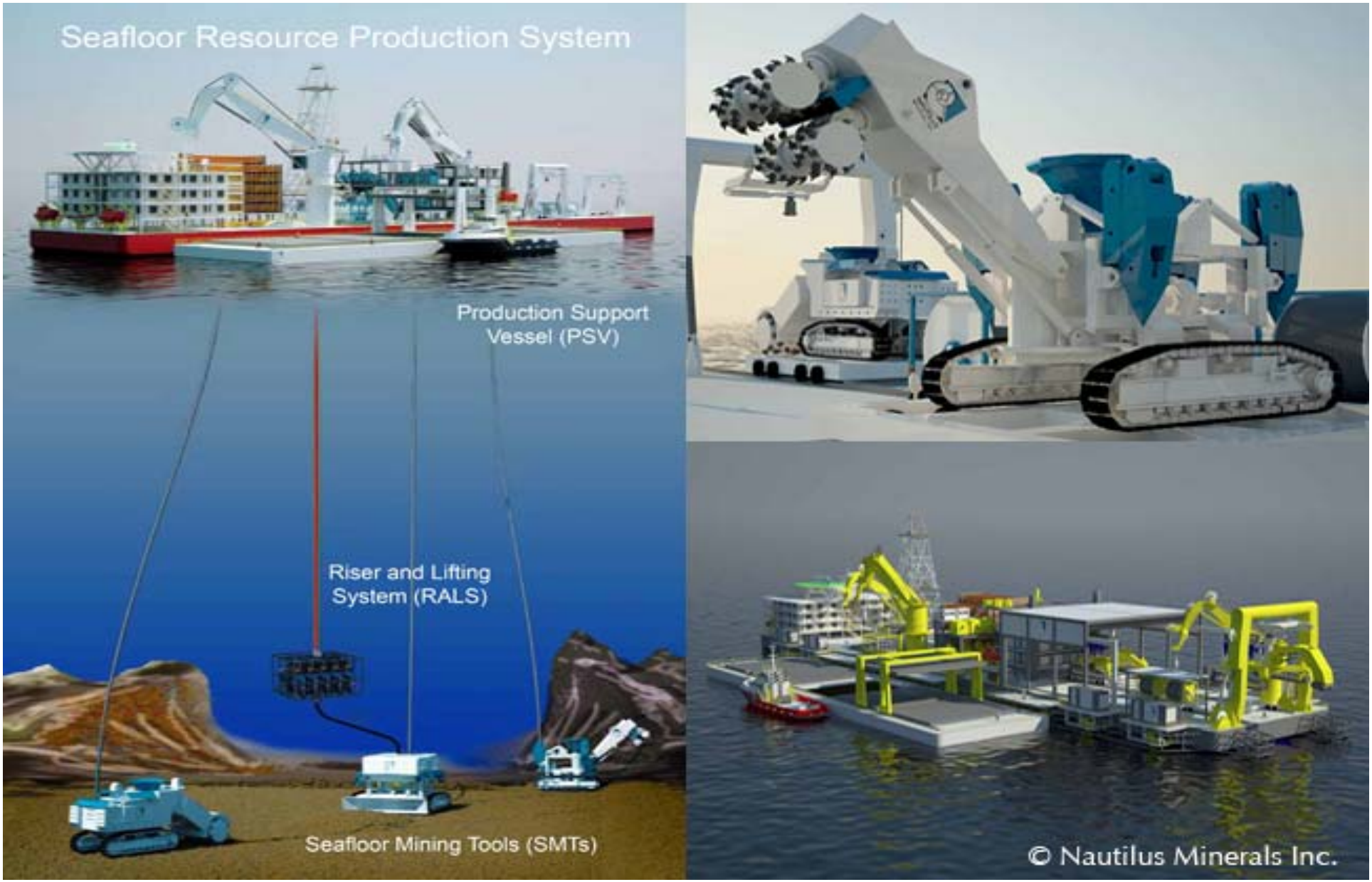
- Basic infrastructure and services require vast quantities of metals: housing, schools, hospitals, transportation systems, telecommunication systems, water pipes and electrical cables etc.

- Heightened demand for raw materials will likely continue for the foreseeable future with developing States such as China, India, Brazil and Indonesia (together representing over 40% of the world's population) committed to improving their standards of living and promoting large scale economic and social development.

Increasing Copper Demand



Significant advancement in technology



3. ‘Renewable energy’ and the ‘green economy’

2012

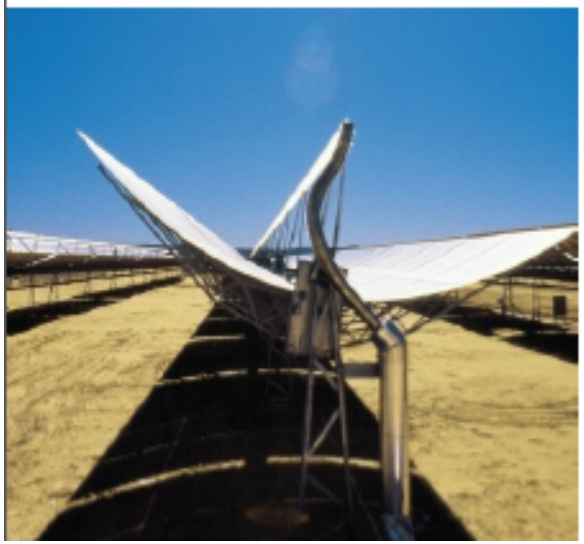
INTERNATIONAL YEAR OF

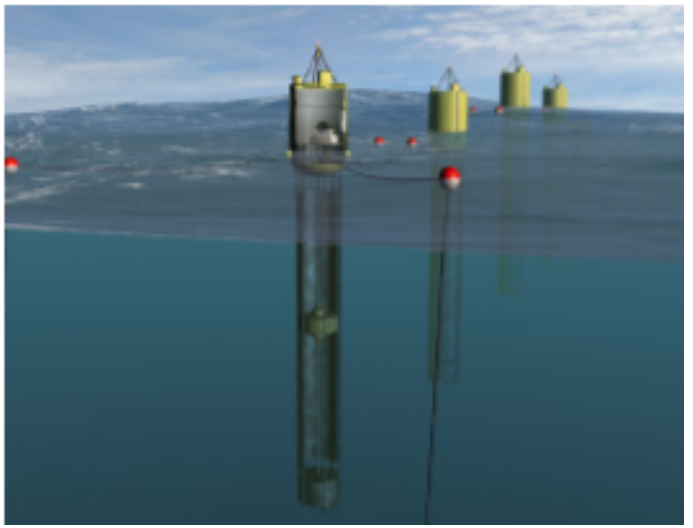
SUSTAINABLE ENERGY FOR ALL

Constraints??

A Green Economy is not possible without metals at affordable prices





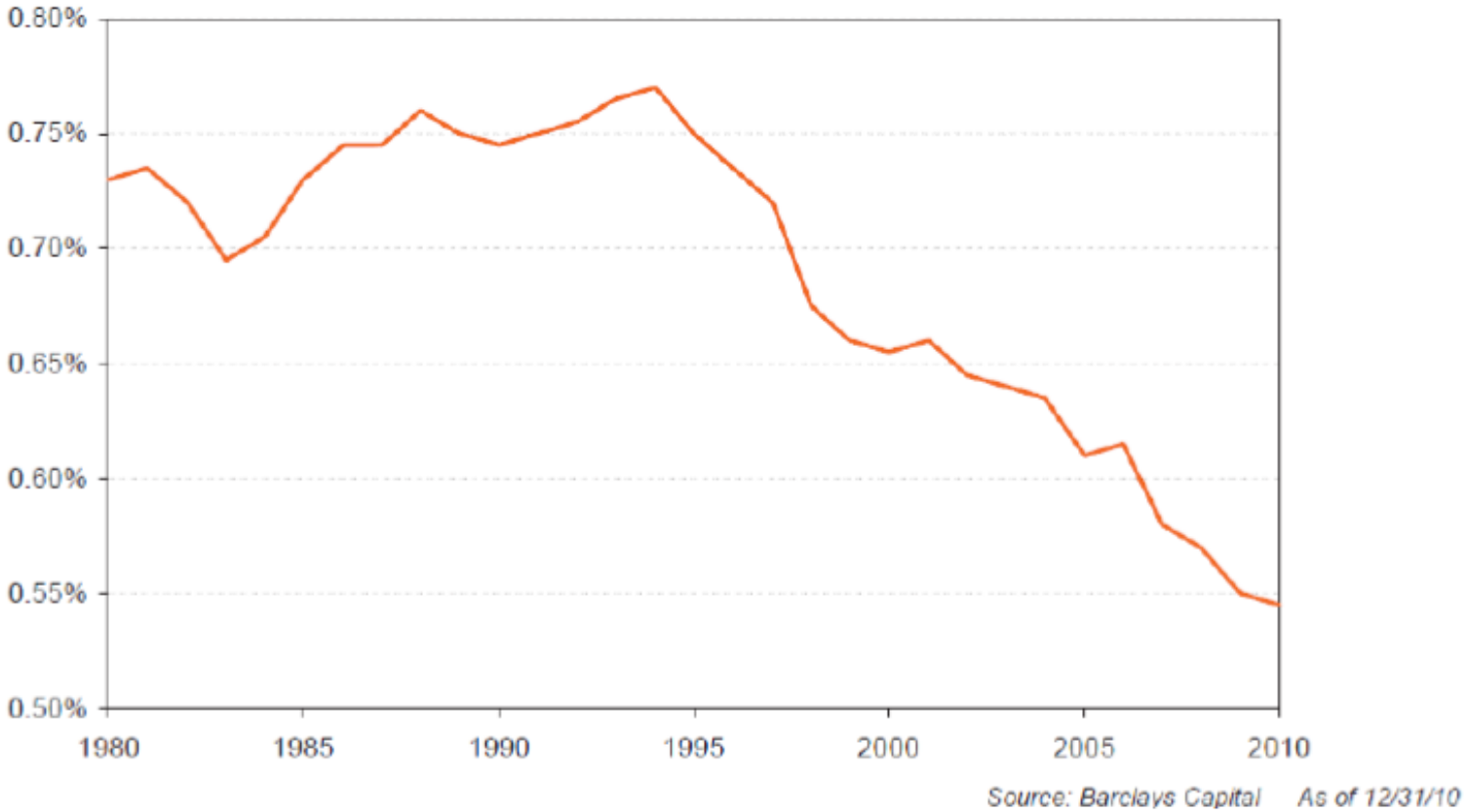

5MW Wind Turbine: 1500t steel, 5t Nickel,
15t Manganese, 5t Copper
5t Molybdenum
12x more Cu to create 1kw than
conventional power generation

An electric vehicle has over TWICE the Copper content of the average car - 2km of copper wiring

Nickel and Copper essential for batteries in Hybrid Cars.

Manganese is needed for high strength steel sheet to replace heavier mild carbon thus making vehicles lighter and improving fuel efficiency and reducing vehicle emissions.

Recoverable Copper Ore Yield Grade



Source: Barclays Capital As of 12/31/10

The extra copper supply needed will likely not come from land where we are having to mine more and more tonnes at lower and lower grades.

Need to dig more to supply global demands

DSM = High Grade

Terrestrial mines @ 0.55% Cu and strip ratio of 2:1

Why dig up ~ 600 tonnes of Earth just to get 1 tonne of Copper?

Is this the wisest use of the planet's environment?

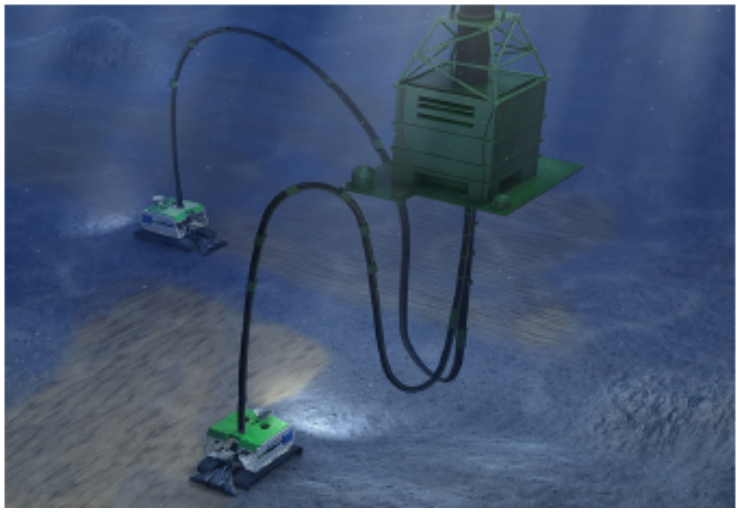
SMS deposits 5% Cu with no strip ratio = 30 times less material needed to be mined to produce same quantity of metal.

1 Nodule Mine vs 3 Land Mines

To produce same amount of metal

Copper Mine	5.3 Mtpa ROM + 12.0 Mtpa waste	= 17.3 Mtpa
Nickel Mine	5.3 Mtpa ROM + 5.3 Mtpa waste	= 10.6 Mtpa
Manganese Mine	4.5 Mtpa ROM + 4.5 Mtpa waste	= 9 Mtpa
	TOTAL Land Mine Movement **Ore + Waste**	= **36.9 Mtpa**
Nodule Mine	7.5 Mtpa ROM (wet) + Zero Waste	= 7.5 Mtpa

Nodule Mine 1/5th of the material to be mined than 3 land mines



DSM Technology Provides a Compelling Answer

- The extraordinary advancements over the last few decades in offshore technology, engineering and equipment has taken mankind to a point at which DSM can now be considered as potentially viable from a technological perspective.

- Importantly, it has become evident that DSM provides a viable solution from an environmental perspective as well.

? The Right Questions ?

Given:
(A) Developing States have a right to increase their standards of living; and
(B) The world needs to transition to a Green Economy; and
(C) Metals are critical to facilitating social and economic development and building the Green Economy…

…the critical question from an environmental perspective is not whether or not to mine, but rather, where and how such mining should take place…

Green Economy

- Alternative Energy systems depend heavily on copper to transmit the energy they generate with maximum efficiency and minimum environmental impact.

- Nickel plays an important role in air pollution abatement hardware.

- By supplying the minerals essential to building Green technologies (which are key to environmental quality in the future), DSM will make Green technologies more affordable and accessible to both developing and developed States.

Conclusion

- Deep sea minerals are important resources that are becoming more viable means of resources because of their geological setting (higher ore grades, environmental settings) and significant advancements in technology.
- Shifting to renewable energy requires strategic metals that are abundant in deep sea minerals.
- A ‘greener tomorrow’ will not be possible without the affordability of metal prices that can become a reality with deep sea minerals.

Something to think about!

1. Look around at our means for our daily living and think about where they come from!