DISRUPTIVE NEW SOURCE OF BATTERY METALS FOR THE GREEN TRANSITION

Seafloor polymetallic nodule harvesting
Erika Ilves, Head of Strategy
Smart Mine?

✔ Abundant resource
✔ Bottom of the cost curve
✔ Environmental & social impact
  - Low carbon footprint
  - Zero waste or tailings
  - Zero deforestation
  - No dislocation of communities
  - Equitable development
Today: 5 million EVs out of 1.3 billion vehicles
2030: 125 million EVs

2047: 1 billion EVs
Trend towards more nickel intensive battery chemistries

Li-ion battery cathode composition
Kg / KWh

NMC 111
NMC 622
NMC 811

Li  Ni  Co  Mn

0  0.5  1  1.5
We will need a lot of nickel and cobalt

75KWh EV battery with NMC 811 cathode chemistry contains:
• 56 kg of Ni
• 7.1 kg of Co
• 6.6 kg of Mn

To electrify 1 billion ICE cars, the world would need:
• 56 million tonnes of Ni
• 7.1 million tonnes of Co
• 6.6 million tonnes of Mn
EV manufacturers are worried about
• Security of supply
• Climate & environmental impact
• Human rights
• Price
Li-ion battery triples $\text{CO}_2$ emissions from manufacturing

75KWh Tesla Model 3 battery would generate

- 13.2t of $\text{CO}_2$ if manufactured in Asia
- 50% can be removed with 100% renewable power
- The rest comes from production of raw materials
A better way to supply EV batteries: Naturally occurring, polymetallic nodules sitting unattached on the deep ocean’s abyssal plain. It is the world’s largest undeveloped high-grade base-metal resource. No child labor. No social displacement. No deforestation. No waste. No toxic tailings.
“NMC battery in a rock”
THE CLARION CLIPPERTON FRACTURE ZONE (CCZ)

Total CCZ resource estimate

34 billion tonnes of nodules
- 6 billion tonnes of manganese
- 270 million tonnes of nickel
- 234 million tonnes of copper
- 46 million tonnes of cobalt

Enough to electrify 1 billion cars 4 times over

Source: Resource Estimates of the Clarion-Clipperton Manganese Nodule Deposit, Morgan 1999
Nodule collection got started in the 1970s but halted due to lack of regulations.
Resource harvesting in the CCZ is now regulated by the International Seabed Authority (ISA)

- **1994**: UNCLOS enters into force and ISA is established
- **2001**: First Exploration Contracts granted to Government Institutions
- **2011**: NORI Area rights acquired by DeepGreen, sponsored by Nauru
- **2015**: Marawa Area rights acquired by DeepGreen, sponsored by Kiribati
- **2017**: Draft Exploitation Regulations issued by ISA
- **2020**: Final Exploitation Regulations in place, ISA open for Exploitation applications
DeepGreen is the only pure-play commercial player to hold two concessions in the CCZ.
We have completed three offshore survey campaigns
WORLD CLASS 43-101 RESOURCE

893M/T
HIGH GRADE POLUMETALLIC MANGANESE NODULES

CONTAINING
29.2% Manganese
1.3% Nickel
1.1% Copper
0.2% Cobalt
Comparable to three mines in one

<table>
<thead>
<tr>
<th></th>
<th>Total NORI Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundance</td>
<td>13.1 kg/m²</td>
</tr>
<tr>
<td>Resource (wet)</td>
<td>893Mt</td>
</tr>
<tr>
<td>Nickel</td>
<td>1.30%</td>
</tr>
<tr>
<td>Manganese</td>
<td>29.2%</td>
</tr>
<tr>
<td>Copper</td>
<td>1.08%</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.18%</td>
</tr>
<tr>
<td>Cu Equiv</td>
<td>6.5%</td>
</tr>
</tbody>
</table>

**Nickel**
- Vale / Goro Nickel Project

**Manganese**
- Eramet / Moanda Mine

**Copper**
- Taseko / Gibraltar Mine
Comparing to undeveloped land-based nickel deposits

Assuming the following commodity prices: Cu $7,084/tn, Ni $19,926/tn, Au $1,250/oz, Ag $18/oz, Co $50,993/tn, Mn $4/tn, Mo $11/lb, Pt $1,200/oz, Pd $800/oz.

Source: DeepGreen PEA April 2019, WoodMac, mining project/company websites
Scaling through partnerships

Convert Exploration Contracts for NORI and Marawa Areas into Exploitation Contracts

Acquire new high quality ground in CCZ and EEZs

Drive strong focus on ocean health to secure the social operating license

Engage well-capitalized strategic partners for test, design, build & operate offshore and onshore production systems. Maintain strong in-house system design capability to challenge partners to innovate

Pre-sell battery precursors directly to EV manufacturers and battery gigafactories

Build a consumer-facing brand to drive consumer preference for Green Metals

Strategic partnership in place, a major shareholder

Strategic partnership in place, a major shareholder

Discussions in progress with several potential partners
Nodule collection

Production vessel
Length: 225m
Station Keeping: DP2
DWT - 79,000 Te
POB: 120
Power: 75 MW
Nodule Storage: 70,000 Te

Harvester vehicle
L x B x D: 19 x 12 x 6 M
Weight: 325 Te (Air)
Weight: 46 Te (water)
Zero waste processing
Expecting to produce at the bottom quartile of the nickel cost curve...

World's cumulative nickel production by miner, million tonnes
...and at a fraction of CO₂

Electrifying 1 billion vehicles
Gigatonnes of CO₂e attributable
to production of battery cathode metals¹ and copper 2018-2047²

1 Nickel, cobalt contained in metal sulphates; copper contained in copper cathode; manganese contained in FeMn. Allocation of CO₂ based on economic value of contained metal. Mass-based allocations would include an allocation to 171Kt of fertilizer grade ammonium sulphate with very low economic value and lead to much lower values for key metals derived from ocean nodules.

2 Taking into account ore grade degradation for land-based nickel and copper between now and 2047

Source: Published academic papers on metal production from land ores; Company PEA April 2019; Comparative LCA analysis of producing metals from land ores vs. ocean nodules (using Ecoinvent database)
Driving consumer preference for Clean Metals together with EV manufacturers
THANK YOU FOR YOUR TIME

Erika Ilves
Head of Strategy & Business Development
erika@deep.green