

## Mining for Net Zero: The impossible task

*Alan G. Jones*

*Complete MT Solutions Inc.*

### Summary

#### Net Zero by 2050

The world aspires, as it must, to move away from fossil fuels to renewables for energy production and transportation as soon as possible. This notion is encapsulated in the United Nation's mission of Carbon Neutrality by 2050. The roadmap for this is laid out in the recent Flagship report "A Roadmap for the Energy Sector" by the International Energy Agency (IEA, 2021).

This aspirational goal of Net Zero by 2050 has been signed up to by 137 countries, and in fact some countries have accelerated the timeline. Uruguay plans to achieve Net Zero by 2030, Finland by 2035, Austria and Iceland by 2040, and Germany and Sweden by 2045. The goal for vehicles is that 60% of them would be EVs by 2030. On August 5<sup>th</sup>, 2021 US President Biden set the target that 50% of the vehicles sold in the US will be emissions-free – not quite 60% but close.

These goals have been set by politicians based on policy advice, but are they achievable?

I would like to lay out just why they are certainly NOT achievable, and that most likely geoscience advice was not sought in setting these goals.

Perhaps politicians and policy advisors think that the minerals and metals needed to achieve Net Zero are lying around waiting to be extracted, but:

- 1) many of our resources are being depleted,
- 2) we are not discovering new major ones and bringing them to market quickly enough, and
- 3) training of skilled geoscientists, particularly geophysicists, to find new resources in the 2030s and 2040s is in serious jeopardy.

#### Copper

Focusing on one metal that is essential for achieving Net Zero, copper (Cu), what are the needs and do we have the supply? Perhaps not well appreciated is the copper needs of electric vehicles (EVs). A standard internal combustion engine (ICE) automobile requires of order 9 kg of Cu. A hybrid EV requires 40 kg, over four times as much. A battery EV requires 83 kg, NINE TIMES the amount required by an ICE.

The world produces of order 100 million new vehicles each year, including busses and trucks (approx. 30%) with far greater Cu needs, so we need approx. 15 Bkg (=15 Mt) for these vehicles. Current recycling rate for Cu from vehicles is 55%, and is not likely to become much higher. So we need 7 Mt of NEW Cu each and every year by 2050 just for EVs alone, and to meet the 2030 goal of 60% of EVs then we need 4 Mt of new Cu by 2030.

For renewable energy sources, solar, onshore and offshore wind, similar calculations lead to a need of 1 Mt of NEW Cu each year by 2030, and double that by 2050. So we need 5 Mt of new Cu by 2030, and 9 Mt by 2050.

Right now we are producing 16 Mt of Cu globally per year, so we need to grow Cu extraction, processing and transportation by 25% by 2030, and by 50% by 2050. (And all of those steps should be done using renewable energies!)

BUT, the projections for global Cu production are decreasing, not increasing. Over 200 major Copper mines currently in operation will reach the end of their productive life before 2035. A Supply Gap of order 14 Mt of Cu is projected by 2035.

These same bleak projections exist also for other essential metals and minerals for achieving Net Zero, in particular lithium and cobalt.

Also, many of the minerals we need for Net Zero, especially critical minerals, are associated with supply predominantly from single sources and/or from areas with questionable human rights records. Countries and producers are adopting Supply Chain Diligence.

### **Finding more ethical metals and minerals**

*“Just find more! And from ethical supply.”*

OK, but the discovery rate of all metals and minerals is rapidly decreasing, the discovery space is getting deeper, and deposits are getting much harder to find and are smaller.

Also, time from economic discovery to mine has increased significantly. In the 1950s 50% of deposits became mines within 15 years, in the 2000s less than 10% became mines within 15 years.

So we need to find far, far more economic deposits in more and more inaccessible places (logistically and/or deeper) at an ever increasing rate over the next 30+ years. To achieve this we need to change our paradigm, and appropriately train young, enthusiastic minds in the broad, holistic skills required.

The paradigm shift required has already occurred in Australia, who has led the world in developing the Mineral System concept. We need to stop looking for deposits, but first take a regional view and search for physical/chemical anomalies in the mantle and deep crust that are

the sources of the mineralized fluids that found pathways to the surface where they exsolved to form mineral deposits.

The training of future generations of holistic geoscientists, especially geophysicists, is absolutely critical if we are to achieve Net Zero. We must pivot today from training geoscientists in O&G, which is a sunset industry, but train in broad-based mining geophysics. Federal and Provincial programmes need to be initiated with such training in mind. We don't need thousands of geoscientists, but we do need far more than are being trained right now.

Finally, Canada has to start national programmes for acquiring non-competitive data across the whole of our landmass that are equivalent to those in Australia, USA and China.

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### **References**

IEA (2021), Net Zero by 2050, IEA, Paris <https://www.iea.org/reports/net-zero-by-2050>.