The scenario-based approach for energy transition

The Paris Agreement aims to limit global warming to below 2 degrees Celsius and preferably to 1.5. This requires an unprecedented transition away from fossil fuels to low carbon technologies, all of which use metals. In this article, we explore possible energy transition scenarios which form the basis of projections for future metals demand

Why we use scenario planning to analyse metals demand

The world is changing rapidly and governments, as well as companies, are in need of a framework to consistently evaluate and respond to this ever-changing backdrop. ING Research uses scenario planning to scan the highly uncertain future of the energy transition, to better understand the trends that are driving the global energy market and the demand for metals. This research reveals that policy and technology are the main uncertainties behind this transition, and the related rise in metals demand from emerging green technologies.

Technology and policy: uncertain factors with impact

Weighing the scenario drivers

Drivers with high uncertainty

- Government policy
- Technology

Drivers with low(er) uncertainty

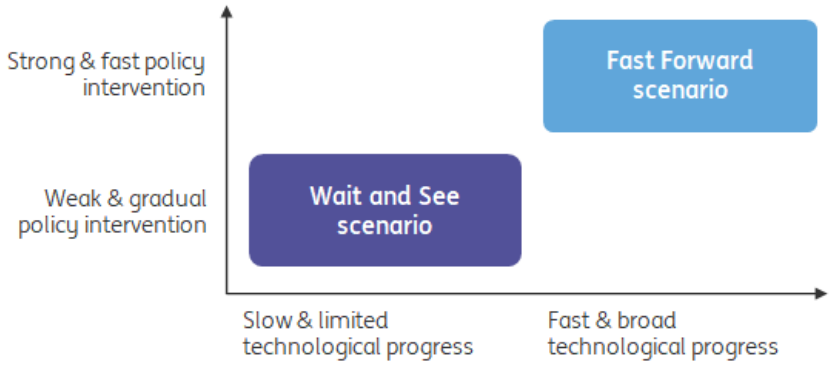
- Ecology and climate
- Economy
- Demography

Source: ING Research

In theory, different policies and technology can be used to identify three scenarios for the energy transition. In practice, we believe that it is most productive to focus on the extremes, as shown in the diagram below.

Our two scenarios to explore the wide range of future outcomes for metals demand

Energy transition scenarios based on technology and policy trends



Source: ING Research

Fast Forward scenario: full speed ahead

The 'Fast Forward' scenario represents a world of rapid change towards a more sustainable future, in which technology and policy reinforce each other to phase out fossil fuels and limit global warming to 2 degrees Celcius.

Wait-and-See scenario: too little too late

The alternative to this is the 'Wait-and-See' scenario. This would see the majority of businesses

continue to operate as normal, boosting emissions and global warming. If the world continues on its pre-Covid energy journey, the physical risks of climate change are high and global warming could increase by 3-5 degrees Celcius by the end of the century.

Likely Tech scenario: what we believe is likely to happen

While our 'Wait-and-See' and 'Fast Forward' scenarios set the boundaries of the wide range of possible outcomes for future metals demand, our 'Likely Tech' scenario, pictures a plausible path for the global energy transition and corresponding metals demand.

Scenarios at a glance

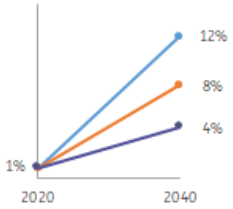
The speed at which energy-intensive sectors become less carbon-intensive by investing in green technologies sets these three worlds apart. While our scenarios consider a broad range of low carbon technologies, this article focuses on the technologies that are decisive for long term metals demand:

- An increasing amount of power needs to be generated with renewable sources in order to reduce carbon emissions in the power sector. Hence, more solar panels and wind turbines are needed, especially as global power demand is expected to have doubled by 2040.
- In transportation, electric vehicles are the main driver of metals demand from batteries, both in light-duty and heavy-duty vehicles.

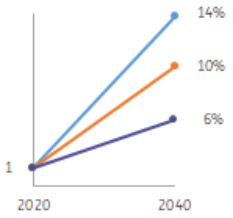
Drivers for metals demand are strongest in Fast Forward scenario

Global development for main drivers of metals demand

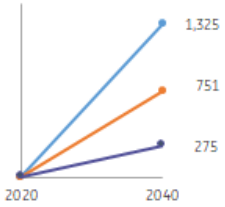
More solar panels
Share of solar power in power mix



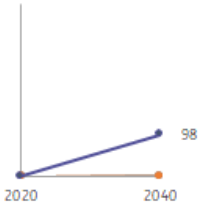
More wind turbines
Share of wind power in power mix



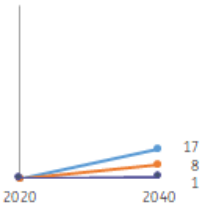
More full electric vehicles
Number of BEVs in million vehicles

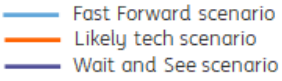


More hybrid vehicles
Number of PHEVs in million vehicles



More full electric trucks
Number of electric trucks in millions





Source: ING Research

What metals stand to benefit?

As the charts above show, all drivers for metals demand suggest significant upside. Not only is the share of renewables in the power mix set to grow, but electricity demand is also set to see substantial growth between now and 2040. This certainly bodes well for metals demand. In addition, all our scenarios, even the most pessimistic, show strong growth in electric vehicle sales between now and 2040, which will again provide a boost to demand for a number of metals.

Electric vehicle batteries get a lot of attention when it comes to future growth, but with a growing share of variable renewable energy in the mix, energy storage will also become crucial, though admittedly, this market is significantly smaller than the EV market.

While we recognise that a wide range of metals will benefit from this transition, we will focus on five key metals - copper, aluminium, nickel, cobalt, and lithium. However, it is also important to note that while these metals will benefit from technologies currently in use, the raw material used in future technology could be very different, particularly when it comes to metals used for batteries.

These changes could be driven by rising raw material costs, concerns over adequate supply in the longer term and possibly a push towards using materials that have a lower carbon footprint or do not have the same social concerns as certain metals. For example, there is already a move to

minimise the amount of cobalt used in lithium-ion batteries, given the concentration of risk around supply, as well as social concerns. The battery industry is also looking beyond lithium-ion batteries towards perhaps the increased adoption of sodium-ion batteries in electric vehicles.

Solar photovoltaics (PV) are made up of several raw materials, including copper and aluminium. Copper is used in several components of solar PVs. This includes the use in modules, inverters, and the rest of the solar PV system apart from the panels, where the bulk of copper is used. Meanwhile, aluminium is used in solar module frames, mounting systems, and can also be used as a substitute for copper in inverters. However, much of this will depend on the relative prices.

Wind turbine production will use a significant amount of steel, although the market for them will also be beneficial for copper and aluminium demand.

Investment and expansion in transmission and distribution for power grids will also provide a boost to copper and aluminium demand. Aluminium is predominantly used in overhead transmission and distribution lines, while copper is heavily used in underground and subsea lines.

A growing share of variable renewable energy increases the need for growth in energy storage. As a result, this will boost demand for battery metals, which include nickel, cobalt and lithium, along with copper and aluminium. There are a number of battery chemistries available, and so metals demand will be dependent on the battery mix used in future.

Similarly, for electric vehicles, the same battery metals will benefit, while EVs also have a higher content of copper and aluminium relative to a traditional internal combustion engine vehicle. A growing EV fleet will also mean an increased need for charging infrastructure, which again will be constructive for copper and aluminium demand.

Metal use by application

Commodity	EVs	EV charging infrastructure	Transmission & distribution	Solar	Wind	Stationary energy storage
Copper	✓	✓	✓	✓	✓	✓
Aluminium	✓		✓	✓	✓	✓
Nickel	✓					✓
Lithium	✓					✓
Cobalt	✓					✓

Source: ING Research

In the next article we will summarise the potential additional metals demand from the above applications under our three different scenarios.

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