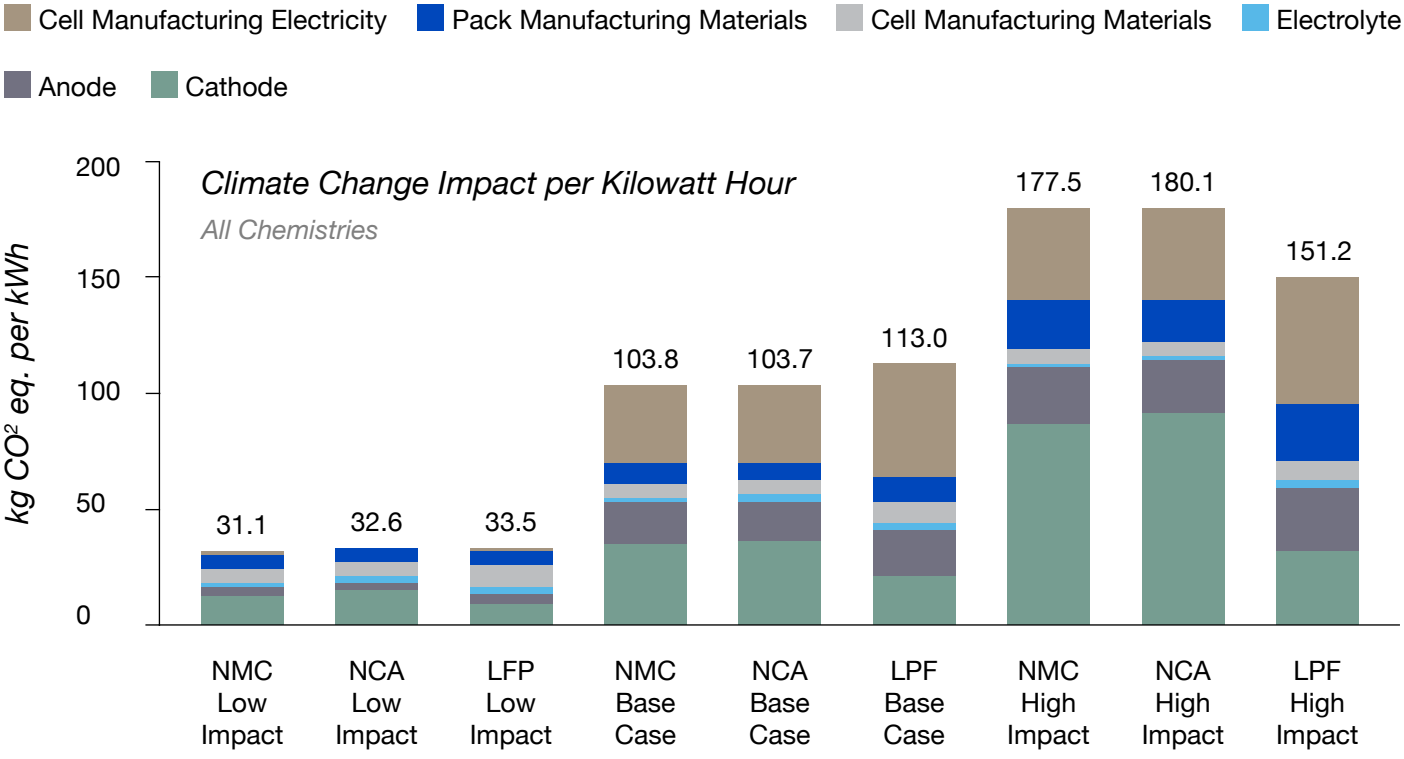
Summary: Climate Change Analysis of Manufacture and Use of Lithium-Ion Batteries

Electric vehicle (EV) batteries will be an essential part of decarbonising transportation and cobalt will play a crucial role in this. This report, prepared by Minviro and critically reviewed by a peer-review panel as per ISO 14040 requirements, finds that cobalt-containing battery chemistries have the potential to have the lowest carbon footprint.

The report analyses the climate change impacts of the manufacture and use of different types of lithium-ion (Li-ion) batteries: lithium nickel manganese cobalt (NMC: 8:1:1), lithium nickel cobalt aluminium (NCA: 8:1.5:0.5), and lithium iron phos-phate (LFP).

The cradle-to-gate climate change impacts of the different battery chemistries analysed is broadly similar (Fig 1). Fig 1 also shows that climate change impact depends on the materials sourced and the electricity used (high impact), highlighting the importance of environmentally conscious raw material procurement and decarbonisation of manufacturing. If that is pursued, NMC batteries have the potential to have the lowest climate change impact (low impact).

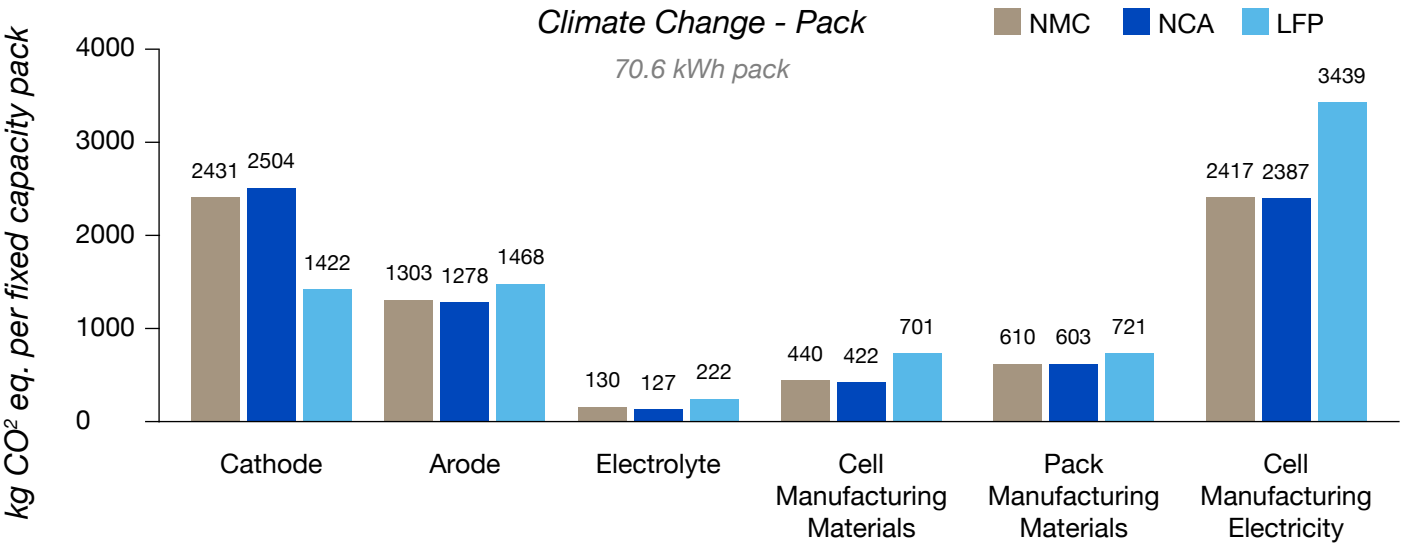
Figure 1: Manufacturing Climate Change Impacts Results Summary



LFP batteries have the lowest cathode-related climate change impact of the battery chemistries analysed, but far higher cell manufacturing electricity impacts (Fig 2) due to its lower energy density and greater size.

Whilst the amount of anode active material required per LFP cell is around 65% than required per NMC cell or NCA cell, LFP cell capacity is significantly less due to its lower energy density. This means that per kWh, the anode contribution of LFP batteries is higher.

Figure 2:
Base Case Climate Change Results for Manufacturing Pack of a Fixed 70.6 kWh Capacity



Lifetime emissions, including cradle-to-gate and use-phase emissions, for packs of a fixed 70.6 kWh capacity are broadly similar for all three chemistries. However, it should be noted that the climate change impact per battery for LFP is around 9% higher than NMC and NCA, when considering a 160,000 km use-phase in addition to battery manufacturing (Fig 3).

Figure 3:
Lifetime Climate Change Impact for Fixed Capacity Battery Packs Broken Down by Life Cycle Stage