For tritium breeding in future fusion reactors, large amounts of lithium are needed in the breeding blankets. Here, the lithium reacts with the neutrons generated in the plasma and forms tritium that is being extracted from the breeder material.

Natural lithium contains the two isotopes, $^6\text{Li}$ and $^7\text{Li}$. Most important for tritium breeding is the isotope $^6\text{Li}$, as it has a significantly higher cross-section for the breeding reaction. Unfortunately, the natural occurrence of $^6\text{Li}$ is only 7.4 % whereas 30 – 90 % are needed in the blankets, dependent on the chosen breeding concept. An enrichment process is thus needed to adjust the isotope composition.

In history, lithium enrichment was done excessively in the 1950s and 1960s in the Oak Ride, TN, US. This facility was dismantled in the 1980s and since then, no large-scale production facility exists anymore and the relatively small demand on global scale is satisfied by the stockpile built up at this time. For a DEMO machine, some ten tons of $^6\text{Li}$ will be needed. To provide a sustainable fuel supply for power plants that produce electricity for the grid, even more $^6\text{Li}$ will be needed. It is unclear where this large amount will come from, as no production facility exists today that could supply this market.

This paper outlines the need of lithium enrichment and presents isotope separation processes developed and used in the past. It is clearly shown that further R&D is urgently needed to tackle this key issue for the development of fusion power plants.