# Environmental impact analysis of lithium-sulphur battery manufacturing

## Project description

The significantly increasing demand for lithium-ion batteries (LIBs) for EV and grid storage applications puts pressure on critical raw materials such as lithium, cobalt and graphite. Development of “beyond-lithium” technologies such as lithium-sulphur batteries (LSBs) has been hailed as being a sustainable alternative to lithium-ion batteries (LIBs), because sulphur is cheap, abundant and geographically evenly distributed. However, no in-depth analysis, comparing the economic and environmental gains/losses between all lifecycle stages of Li and S and their impact on the overall life cycle cost and sustainability, has been done to confirm this.

To truly compare the two battery types, a lifecycle assessment (LCA) of both needs to be performed in a consistent manner, comparing the environmental impacts of all processes involved in extracting, processing, manufacturing, using and recycling or disposing of both LSBs and LIBs. In this work, the student will focus on assessing all manufacturing steps and processes for LSBs, investigating the inputs and outputs from each step and their impacts. We want this project to help us answer the question of whether, in terms of the early lifecycle stages, replacing LIBs with LSBs is worthwhile, looking into the following sub-questions:

* What are the environmental gains/losses of the LSB manufacturing processes?
* What are the environmental “clean-up” requirements for the manufacturing processes for both LSBs and LIBs?
* As most manufacturing processes will still be lab-scale, how do we estimate their expected impacts at commercial scale?

## Learning Objectives

* Understanding of the working principle of batteries and applications
* Obtaining insights into the battery value chain, associated challenges and key solutions
* Development of LCA models tailored towards engineering problems
* Understanding of materials extraction and processing for LIBs and LSBs

**Supervisors**: Jacqueline Edge, Laura Lander

**University**: Imperial College London

**Location**: Online (meetings through MS Teams)

**Start date:** The internship is a full-time role for 8 weeks; within June – September 2022

## Eligibility

You must be a registered, full-time undergraduate student from a UK university.

You must undertake the internship within the years of your undergraduate study (i.e. not in final year or during a subsequent Masters’ programme).

You must not have been a FUSE intern in a previous year.

Experience of any kind with batteries (either experimentally, theoretically, or otherwise) would be useful, but not essential.

You should be familiar with the methodology behind life cycle assessment methods and experience with an LCA software package would be useful.

## Funding

A salary of £11.05/hour will be provided. This will be determined by the working address of the appointee, not the university's location. The internship is a full-time role for a period of 8 weeks between June and September. The funding is provided by the Faraday Institution.

## Additional activities

During the FUSE internship you will be able to attend Faraday Masterclasses and cohort events which will focus on a variety of topics to further develop your understanding of career opportunities in battery sector. At the end of the programme, you will be invited to share a poster about your work and prizes will be awarded.

## Application

In order to apply for a Faraday Undergraduate Summer Experience (FUSE) 2022 internship, please send a one-paragraph cover letter and CV to j.edge@imperial.ac.uk or l.lander@ imperial.ac.uk by May 6th 2022 with ‘FUSE Application’ in the subject field.

## Diversity

The Faraday Institution is committed to creating a dynamic and diverse pool of talent for the fields of battery technology and energy storage. We at Imperial College are committed to equality of opportunity, to eliminating discrimination and to creating an inclusive working environment for all. We therefore encourage candidates to apply irrespective of age, disability, marriage or civil partnership status, pregnancy or maternity, race, religion and belief, gender identity, sex, or sexual orientation. We are an Athena SWAN Silver Award winner, a Disability Confident Leader and a Stonewall Diversity Champion.

## Terms and Conditions

By applying to this position, you agree that Imperial College London and the Faraday Institution can share information about you, such as your name, contact details, and personal information, with each other, for the purpose of carrying out the Faraday Institution Summer Experience 2022.