

Voiceover:

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Nikoleta:

So, welcome everyone to the second episode of the Battery Caffè, focusing on battery recycling. I'm Nikoleta Piperidou from the Clean Energy and Infrastructure team at KTN, hosting today's episode, alongside my colleague, Sheena Hindocha.

Hi Sheena!

Sheena:

Hi Nikoleta. I'm with the Chemistry and Industrial Biotechnology team at KTN, with a focus on materials chemistry.

Nikoleta:

Thank you. And just to say that the Battery Caffè is an initiative of the Cross-Sector Battery Systems Innovation Network, a community funded by KTN and the Faraday Battery Challenge.

So, this Innovation Network aims to open new markets for the battery industry, promote innovation in batteries and help decarbonise a wide range of users.

And, if you haven't already, please, do go check out our online platform at ukbatteriesnetwork.org. You will find lots of useful material and our first episode, that focused on investment in batteries.

So, today with us we have two very special guests, Alberto Minguela of HSSMI, and Dr. Laura Lander of Imperial College.

Hi Alberto!

Alberto:

Hi Nikoleta, how are you doing? So, I'm Alberto Minguela. I'm the Research Innovation Manager for HSSMI, and I've been leading the project VALUABLE for 3 years. How are you doing?

Nikoleta:

Thank you, fantastic. And, hi Laura!

Laura:

Hi Nikoleta! Thank you for having me today.

So, I'm a postdoctoral research associate in the Electrochemical Science & Engineering group at Imperial College London, and I have a background in material science, working on batteries for six years, seven years, and I'm currently focused on the techno-economics and environmental impact of batteries.

Nikoleta:

Fantastic, thank you. So, everyone, make yourself a coffee and join us! So, today, I'd like to start with Sheena. So battery end of life and recycling is a particular interest of yours.

Why is this such an important topic at the moment?

Sheena:

Yes, it's a really good point Nikoleta. So, it is an important topic at the moment, and really topical as well.

So, as you know, the UK government, actually globally, we are pushing towards electrification of vehicles and automobiles, as well as other uses for batteries. This means there's going to be an increasing number of batteries coming to the end of life as we move forward.

The question is: what do we do with these? Where do we put them, where do they go? Do we put them in the landfill? Actually, that doesn't feel like the right thing to do.

So, how do we maintain the value of these batteries, as we move through end of life? In addition, actually there's a lot of really valuable materials inside a battery. If you take lithium ion, for example, there might be cobalt, lithium, and different materials that we might want to recover to make use of, again.

So, lots of interesting work is going on not just about how we recycle batteries back to the elements and the different materials that are in them, but how we make our life extend longer, particularly in second use or second life applications. And, this is something that I really want to ask Alberto about because, so HSSMI are involved in the Faraday Battery Challenge project VALUABLE.

Could you tell us a little bit about the aims of the project and the work that has been done throughout that activity?

Alberto:

Thank you Sheena, so yes, I've been leading that for three years. So, the main aim is developing significant second life supply chains for recovering that value that you mentioned that are inside those batteries at end of life.

And, we wanted to, you know, add value to the UK battery supply chain through these actions, and with the aims of reducing battery waste, but also looking at optimising the battery design.

What we've done there, is a different action for a group of seven partners in which we've looked at cell testing systems and brought use in second life cells. So, how we move those, monitor those, and understand what is the best action to those. Then, there are options for re-manufacture.

Underpinning this project is a circular economy principle, so from repair, re-manufacture, re-use. Also re-purpose and recycling. So, we look at the processes in those supply chains.

Also, we look at the regulation, which is very important, and the life cycle cost of these batteries, of these different recovery strategies. With UCL and NPL we look at different methods for testing at this stage and being able to make a decision on what route to take. So that's what we've done on that, Sheena.

Nikoleta:

Thank you very much, Alberto. And Laura, you also cover this topic in your research, and you explore the techno economics of battery recycling. Can you talk about it in a bit more detail?

Laura:

Yes, sure. So, as Sheena mentioned before, we will see a huge surge in EV lithium-ion batteries and on the market. And, while indeed the battery manufacturing industry is significantly increasing, on the other hand we also need the battery recycling industry, which takes care of the end of life batteries. But, the sector is not growing as quickly as it should.

And, this is partially due to the low profitability of the recycling process.

So, to be able to identify cost hotspots in the recycling process and to develop strategies on how to make it more financially viable, we performed the holistic technical economic assessment of battery recycling, in which we took into account the whole recycling chain starting from the collection, transport to the recycling facility, disassembly and the recycling process itself. And then also, the value which you create through reselling the materials that you recover.

And, in this assessment we included also different battery chemistries such as NMC, LFP and NCA, different recycling processes and recycling sets which are located all over the globe such as in Asia, Europe and the US. And through the study, we were able to compare the recycling profitability across a large number of parameters, and also to decide under which set of conditions we can create a financially viable recycling process and ultimately how to incentivise the expansion of this industry sector.

Nikoleta:

Thank you very much, Laura. That was excellent. And, Alberto last year, HSSMI published an interesting report on the different end of life strategies for EV lithium ion batteries. What are the different considerations that need to be taken into account?

Alberto:

Thank you for picking that up, Nikoleta. So, indeed, as Laura was saying and I was mentioning on VALUABLE, we look at the different considerations. And, well, first and foremost, you need to consider the business context in which these strategies are relevant and to assess these strategies. you will need to look at different considerations such as the volume of inner buy batteries that you will reach at the end of life and apply depending on the manufacturer or OEM, the state of health of this, so what's the state, how they are when they reach end of life. Regulation is a big important aspect of that to consider what to do next. And, as Laura was saying, the financial return, you know what, what's the actual cost of doing one strategy against another and what is the return. So within VALUABLE HSSMI developed a methodology to understand the cost implications of each of those strategies during recycling. And, very important as well as the competition: who else is doing what, and the business models. All these have some considerations. It is very important. So, how you can actually recover the value from within the batteries will determine, you know, will be determined by the design of this.

So, these are the main considerations, but we are happy to talk about this more in detail. Thank you.

Nikoleta:

Thank you. And, within the Cross-Sector Battery Systems Innovation Network, we've seen an increasing interest in battery end of life strategies.

We've actually seen that the interest keeps growing. We currently have over 100 organisations which have indicated battery end of life as a key area of interest in our landscape map.

You can find the map on our online platform ukbatteriesnetwork.org and explore all the sector and supply chain interests of all the organisations who have signed up.

And, if your organisation is missing from the landscape map, don't forget to sign up. We've also noticed the increased interest in battery recycling through our work with the Faraday Battery Challenge when organising cohort events for the recycling community. Back in 2018, we were gathering 50/60 participants and last month, during the event we ran, we had over 200 participants split across three webinars throughout the day, and you can find all the recordings in the Hub. So yes, definitely more and more interest in this space.

Sheena:

I would just like to follow up with Laura if that's alright, Nikoleta. You've already mentioned the different chemistries that are in batteries and actually how these will have an impact on the type of recycling or the type of reuse, and the strategy that is thought about. How is this taken into account? Do companies think about this at the beginning of their battery design journey or is it something considered a lot later? Is it a secondary consideration at the moment?

Laura:

I would say right now it's more of a secondary consideration because obviously the battery manufacturing industry is much more advanced and hasn't really thought about the impact of recycling at the end of life.

I think a big factor for the impact of battery chemistries on the recycling industry is obviously the value you can create from the battery itself. Because, as you mentioned, high value materials such as Cobalt and Nickel are only in NMC batteries so you create much more value out of those batteries and make a higher profit. With for example LFP batteries, iron or phosphate they're not as valuable. So, the profit you will make off selling those will be much lower. So, I guess this will also be a consideration: which processes you will choose for your recycling, how deep you dig to recover your materials.

Sheena:

Yes, that's really interesting and it actually leads me on to another question. So, when you think about the life cycle of batteries on the environmental impact, how is that kind of measured? Is that taken into account in your research at the moment? Is it the impact of the recycling process, how do we look at that and is that a consideration at the moment?

Laura:

I think it becomes more and more a fact in the life cycle assessment of the overall life cycle of the battery. And the importance of recycling, you know, becomes more important especially now that the circular economy way of thinking is more adopted in the battery community.

And, what is also very important is that we recognise that recycling is not necessarily always good. So, obviously, depending on the process you apply you have high energy consumption, you have harsh chemicals that you use, which on their own create another environment, negative environment impact, which you have to take into account.

So to have an overall positive impact on the environmental footprint of the battery through recycling, I think the research community has to work towards a more sustainable recycling process itself.

Sheena:

Yeah, that's great. Thank you.

Nikoleta:

And, Alberto, what do you think about the role of data and battery monitoring can play in end of life strategies?

Alberto:

So that's quite interesting.

In fact, you know, data will enable the strategies and the recycling to actually flourish and have the lowest environmental impacts.

If you understand what has happened to that battery throughout the lifecycle, and furthermore, you go, certain element testing devices or the strategies to understand, that will enable the decision making of those receiving the batteries and end of life, or the OEMs that produce those batteries to really make an informed decision and take the best strategy to recover the most valuable parts of the battery. So, I believe that the role is very very important on data and battery monitoring.

Nikoleta:

Thank you for your excellent insights so far, but there is one last question that comes to mind. We're talking about end of life sustainability so, how about the whole life cycle of batteries and the ethical supply of raw materials? What do you think, Laura?

Laura:

It's a very complex question, and a lot of factors have to be taken into account.

Regarding the ethical supply of materials I assume you target the mining of Cobalt?

And so, this is a very big issue. And, what I personally found always interesting is we have alternatives on the market. There are LFP batteries which do not need cobalt, and the only negative point with LFP batteries or why they're not as much widely used as NMC chemicals is because they have a lower performance.

So, this is why they don't find as much acceptance in the industry. And, I feel we also have to tackle this problem on consumer and industry level so, could we accept to have a bit lower performance, make a sacrifice on our standards, on our comfort and accept a technology which is maybe not as high performing as an NMC Battery.

Nikoleta:

Thank you, Laura. Alberto, any thoughts of this?

Alberto:

Oh, definitely. You need to understand where the things are coming from, you know, to understand the impact of your products. And, there are elements, so for example the battery passport concept is very very useful for that in which you know there's a detailed identity of a battery and you can trace that to the mining and really understand whether it has been a major social impact. But also, you can track that to the end of life, and back. So, I believe that that would be the role, the role in society, and the battery passport can enable that.

Nikoleta:

Thank you very much for that and yes indeed let's see where that takes us. So, thank you to our brilliant guests, and thank you all for listening. We hope you enjoyed this discussion as much as we did.

And don't forget to visit our online hub on ukbatteriesnetwork.org and register to receive our news and updates and participate in the networking area of the hub. Our next episode will focus on market trends for solid state batteries, so see you next time. Bye.

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Notes: this transcript has been produced verbatim and includes all the quirks and idiosyncrasies of the speakers.