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Scaling up and dow

Batteries for wearable electronics

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Battery Innovation Days 2025

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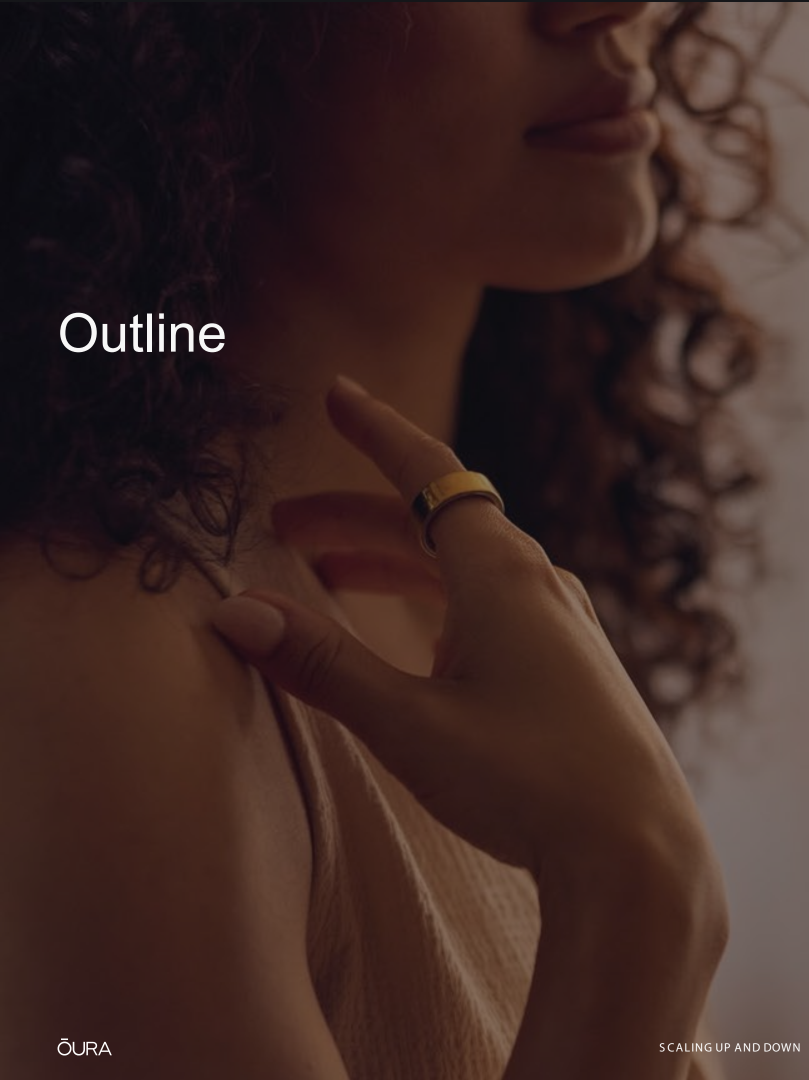
From Finland



Outline

Scaling up

- Wearable electronics batteries as a tool to bring innovations from lab to industry

Scaling down

- Design concepts when miniaturizing batteries

Summary

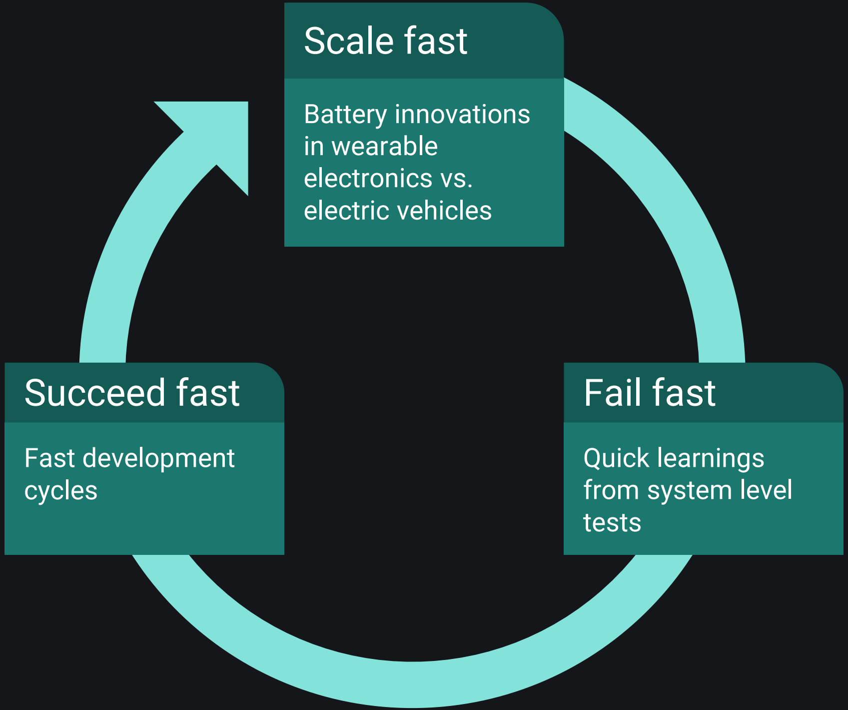
- My message to researchers, policy makers and battery industry

Scaling up

Europe has been focusing in the EV and stationary storage batteries.

New battery innovations are often first tested in consumer electronics products. If Europe starts with EV batteries, we are already late.

Wearable electronics offer a faster path from lab to market



5.5M

Rings Sold

$1B

Revenue expected
by end of 2025

150+

Countries w/
Oura Members

Scaling down

Design concepts when scaling down

What to consider in research projects

Energy density

Ratio of active vs. inactive material changes when the battery volume changes. Smaller batteries have, relatively, more inactive materials due to casing etc.

Put focus on effective casing.

Perimeter to area ratio

Scaling up and down is more challenging than just scaling up as the edge effects start to dominate. See e.g., a nice paper by Scurtu et al.: From small batteries to big claims | Nature Nanotechnology

Understand the edge effects.

Form factor

The product defines the battery shape. Or does the battery define the product shape? In any case, the battery must match the device's geometry. Non-rigid, curved batteries are needed in several consumer electronics or medical products.

New form factors enable freedom of design.

C-rate

Thicker electrodes increase energy density but slow down charging rates. Fast charging has an impact on degradation, especially if thick electrodes are used.

Balancing charging speed, energy density and cycle life is a must.

Sub-optimization does not lead to success.

Optimising the battery life in wearable electronics products

Maximise battery capacity:

Volumetric energy density (Wh/l) is the key; specific energy (Wh/kg) is not that relevant. Every increase in capacity must be achieved by higher energy density materials, not size increase. Everything is limited by the trade-off between size and runtime.

Minimise energy use:

For example, Smart Sensing in Oura Ring 4 is powered by an algorithm that works with the sensors to dynamically select the best signal pathway. Because it's constantly finding the best and most efficient signal pathway, it optimizes battery usage by only using the power it needs.

Scaling up and down

How to use the limited research funding in a sustainable way

Sensitivity

If a material works only inside a glove box, it can’t be used by industry.

Reporting protocols

Plan the work so that it will fulfil e.g., the Battery 2030+ protocols to avoid over-optimistic promises.

Communication between academy & industry

Find a way to discuss your work with industry.

Processability

Processability needs to be considered already in an early stage. Yield losses due to inconsistent quality must be avoided.

Safety

For example, solid-state batteries are advertised as a safe option. But are all of them safe?

Publications

Your work can have a big impact! Publications are read in industry too.

My message

To battery industry

Wearable electronics batteries enable you to **scale fast & fail fast**, and thus, succeed fast.

To policy makers

We can't forget scalability in funding: **Safe, sustainable and scalable by design** (SSSbD) approach is needed.

To researchers

Think out of the glove box when testing your ideas.

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Questions?