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Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Ulm site:
Helmholtzstr. 8, 89081 Ulm, Germany

## Lithium-ion batteries from Germany

## ZSW Sets Up Industrial Pilot Production Plant

**Germany makes electric cars, but not the batteries that power them. To change this, the government and industry have stepped up their research and development activities in recent years. These efforts are now bearing fruit: A joint endeavor with the Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) has succeeded in manufacturing automotive-grade lithium-ion cells industrially in a pilot plant. The facility has made standard cells in PHEV 1 format fully automatically, at a high production rate. Funded by the Federal Ministry of Education and Research and the State of Baden-Württemberg, the 3,000+ square meter pilot production plant at ZSW is equipped with specially developed manufacturing systems and has been in operation for over a year. The pilot line operation commenced in early 2015.**

The experience gained at the ZSW pilot plant has helped significantly bring down the technological barriers impeding the commercial production of battery cells in this country. "The construction of a production facility for automotive battery cells presents a unique opportunity for Germany to sustain its value chain and ability to compete," says Prof. Werner Tillmetz, a member of ZSW's board of directors and head of the Electrochemical Energy Technologies division. "Now it's up to the industry and suppliers to set the gears in motion."

Some companies are already aware of this and pitched in to gear up the technology for this endeavor; specifically, BASF, BMW, Daimler, Elring Klinger, Manz, Robert Bosch, Rockwood Lithium, SGL Carbon and Siemens. The pre-competitive research platform in the ZSW Laboratory for Battery Technology (eLaB) at Ulm is open to all companies and research institutions seeking to research battery cell production with advanced materials and manufacturing processes.

### More than 1,300 kilograms of active materials and 11 km of electrode sheets

Since operations kicked off a year ago, ZSW has processed 1,300 kilograms of active materials into slurries, coated 11 km of electrode sheets, and assembled more than a thousand cells automatically using these components. The plant's capacity to manufacture at the target rate of one cell per minute and steadily reduce scrap rates was demonstrated successfully.

"We gained an enormous amount of experience in producing automotive lithium-ion cells during the pilot plant's first year of operation, and

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are gaining valuable new experience every day; that is, extremely valuable experience needed to successfully establish commercial manufacturing capability," says ZSW board member Prof. Werner Tillmetz.

It will take more development effort to meet all the requirements for future cells, for example, for capacity and durability targets. Nevertheless, these results attest to the impressive success that the German industry and the research community have jointly achieved in recent years. To date, only very few German experts understood the entire manufacturing process for lithium-ion cells—from the production of electrodes and cell assembly to formation and testing.

The researchers opted for the most widely used combination of materials, lithium nickel manganese cobalt oxide (NMC)/graphite, to qualify manufacturing processes. Advanced materials that enable higher energy densities to extend vehicles' range will be employed in newly launched projects. The researchers also aim to optimize cell design and the individual manufacturing processes.

## Global e-car boom an opportunity for German industry

Electric vehicles are making inroads around the world. More than 500,000 were manufactured worldwide in 2015. New factories are being built mainly in Asia to meet the automotive industry's fast-growing demand for batteries.

Lithium-ion cells are the heart of electric cars. They determine the range, safety and cost of an e-vehicle and contribute up to 40 percent of value-add. Local battery cell manufacturing presents an opportunity to maintain the automotive industry's vertical integration and value-add, which is so extensive and so important to Germany.

---------- Info box ----------

**Research platform for near-series production of lithium-ion cells**

*ZSW Laboratory for Battery Technology (eLaB), Ulm*

Battery cells are manufactured in eight steps:

- Homogenize and weigh active materials and additives
- Use mixing stations to prepare coating slurries
- Coat collector sheets
- Dry electrodes
- Compact electrode layers in calenders
- Cut the electrode sheets
- Assemble all cell components fully automatically
- Charge (form) the cells for the first time

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Several hundred high-quality cells can be made per day in a reproducible way in these facilities. The plant's modular layout allows new processes and system components to be assessed all along the value chain in a foolproof testing environment.

The Federal Ministry for Education and Research (BMBF) provided €25.7 million in funding for equipment. The state of Baden-Württemberg's Ministry of Finance and Economy (MFW) contributed €6 million in subsidies to extend the buildings.

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The Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Centre for Solar Energy and Hydrogen Research Baden-Württemberg, ZSW) is one of the leading institutes for applied research in the areas of photovoltaics, renewable fuels, battery technology, fuel cells and energy system analysis. There are currently around 230 scientists, engineers and technicians employed at ZSW's three locations in Stuttgart, Ulm and Widderstall. In addition, there are 90 research and student assistants.

## Media contacts

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Temperature controlled mixing station for preparing electrode slurries in 60-liter-batches. Source: ZSW/Duckek

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Electrode ready for calendering process. Source: ZSW/Duckek

200 m² dry room for testing new assembly technologies. Source: ZSW/Duckek