Fraunhofer ISE

Press release

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Storage and heat transformation technologies – important pillars of the energy transformation

Fraunhofer ISE expands range of research and development with new site

Since being founded more than 30 years ago, the Fraunhofer Institute for Solar Energy Systems ISE has covered a wide range of complementary technologies, optimally preparing it for the challenges facing the energy transformation. In addition to solar technology research, the systemic aspects and questions regarding energy storage also played a role right from the start. Today energy storage technologies and efficient heating and cooling processes are two topics particularly in the focus of the energy transformation. Fraunhofer ISE has now consolidated its activities in these areas at its new site on the Auerstrasse in Freiburg. The new location offers much more space which has allowed the Institute to significantly expand its laboratory equipment. On July 2, 2015, the new center for storage and heat conversion technologies was officially inaugurated in the presence of representatives from several German federal ministries as well as from industry associations and the industry itself.

"Substantially expanding our options for research into storage systems as well as heating and cooling does justice to several key issues that are decisive for our path to an energy supply system based on renewable energy," says Institute Director Prof. Eicke R. Weber.. New technical laboratories are dedicated to battery systems for photovoltaics and mobility, redox flow batteries, hydrogen generation using electrolysis, high-temperature solar thermal storage systems, as well as heat pumps and chillers powered by electricity, gas or heat.

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Battery systems
As a result of their modular construction and high levels of energy efficiency, battery systems occupy a crucial role in the use of fluctuating renewable energy sources such as photovoltaics or wind power, enabling them to considerably reinforce system stability. As the development of new technologies progresses, the energy and power densities of batteries are also increasing, opening up new areas of use, such as electric mobility. Depending on the application and operating profile, the demands placed on battery systems can be huge: The primary aim of Fraunhofer ISE's research work is therefore to optimize both key components and entire systems, as well as to improve reliability while simultaneously minimizing storage system costs. R&D will look at the central tasks of battery systems technology, such as battery management and thermal management, as well as investigating the aging processes of batteries in a range of applications and for various cell chemistries, both in the laboratory and using state-of-the-art simulation tools.

Hydrogen generation using electrolysis
Hydrogen can be generated by electrolysis using power from renewable sources. This option will become particularly interesting if large quantities of excess power become available as a result of growing shares of solar and wind energy in the supply system. Hydrogen is the only energy carrier with the potential to chemically store very large amounts of energy over a long period of time. In addition to its use in the reconversion of electricity in stationary fuel cell systems or gas engines, hydrogen also powers fuel cell vehicles and therefore represents the missing link to zero-emission mobility. Water electrolyzers will become valuable control devices for (de)centralized, adjustable grid loads for utility companies and grid operators, as they can be used to quickly adapt power generation to demand, stabilizing grid frequency. Fraunhofer ISE's activities focus on electrochemical hydrogen generation from membrane electrolysis as a key

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element in materials-based storage systems for renewable energy.

In addition to 25 years of experience in researching and developing PEM electrolysis, Fraunhofer ISE distinguishes itself through the size of its testing unit at the Auerstrasse site. Cell stacks for utility-scale PEM electrolyzers of up to 4,000 amperes can be tested at the site. The Institute's delivery system for blending hydrogen into the local gas pipeline networks underlines the application-oriented nature of Fraunhofer research.

High-temperature solar thermal storage systems
Fraunhofer ISE researches and develops solar thermal storage systems for both high and low temperatures. At the Auerstrasse site, the focus is on high-temperature thermal storage systems for solar power plants. In solar thermal power plants, large reflector arrays focus solar radiation onto absorbers. A heat-transfer medium (e.g. thermal oil, water/steam, molten salt or air) flows through the absorbers to withdraw the resulting heat, which can then be used to drive gas or steam turbines and produce electricity. Integrating high-temperature storage systems into solar thermal power plants allows power to be generated in line with demand, even at night or on cloudy days.

Fraunhofer ISE develops, measures, evaluates and optimizes storage designs for extremely high temperatures. At the new site, it will be possible for the first time to test temperatures of up to 550 °C and to work with high-pressure steam in screw heat exchangers. Industrial-scale process steam units, which also require storage systems for temperatures of up to 180 °C, represent another potential field of application.

Heat pumps
Heating and cooling buildings is becoming an increasingly important element of the energy transformation. Around 40 percent of the energy consumed in Germany is in this area,

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which means that more efficient and sustainable processes could unearth immense energy saving potential. Heat pump technology is able to meet these demands. The biggest advantage of heat pumps is the fact that heat (and cooling) is predominantly drawn from ambient energy. The remaining energy is furnished as electrical energy, for example, which – in our changing energy system – increasingly comes from renewable sources. This makes electrical heat pumps very compatible with solar and wind power generation. Gas heat pumps are replacing today's heating boilers, rendering them eminently important as they are much more efficient at converting fuel as they additionally exploit environmental heat.

At the new Auerstrasse site, Fraunhofer ISE has been able to increase the laboratory space for heat pump activities ten-fold, including the installation of a brand new test and development center for heat pumps and chillers. Based on 20 years of heat pump and chiller developments, the Institute is able to provide the industry with quick and comprehensive support for developing new devices – from component development to systems evaluation. What makes the new site unique is that all measuring devices meet the strict safety regulations for working with flammable refrigerants, such as propane, thus driving forward the development of novel refrigerants with low carbon dioxide emissions. Close collaboration with the Institute's other research departments, such as sorption and storage materials or smart grids, is a frequent source for innovative approaches and product ideas.

This press release, as well as topic-specific press releases, including photos are available to download from
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View of the Fraunhofer ISE ServiceLab Batteries. ©Fraunhofer ISE

Test stand for water electrolyzers. ©Fraunhofer ISE

Measuring a distribution system for a refrigerant evaporator.
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