The power of the Sun and the train of the future at German Aerospace Day

08 September 2011

How much power is there in the Sun? How warm does a cold thumb get when it touches a thermoelectric module? And what will the trains of the future look like? Visitors to German Aerospace Day at the German Aerospace Centre (Deutsches Zentrum für Luft- und Raumfahrt; DLR) in Cologne on 18 September 2011 will have the opportunity to learn about DLR's work in the energy and transport research areas.

A solar future

Scientists at the DLR Institute of Solar Research - founded this year - will demonstrate the power of the Sun. A parabolic mirror with the shape of a satellite reception antenna and an area of only 1.77 square metres will precisely focus the Sun’s rays to a point where it will become so hot that visitors will be able to melt five and 10 Euro cent coins. Those interested will be able to witness how scientists at the Cologne solar furnace use the Sun in their everyday research work. There is an approximately 60-square-metre mirror that reflects the incident sunlight onto a concentrator. In the centre, temperatures can reach up to 2500 degrees Celsius. The solar radiation, concentrated up to around 5200 times, is guided into the laboratory area of the solar furnace. Here, DLR researchers can conduct experiments - including the process of producing hydrogen with the help of solar energy. The scientists also test how different materials behave at these high temperatures before they are used in large commercial power stations. The power of the Sun when its radiation is concentrated will be shown by means of a safe on display in the laboratory, through which the researchers have melted a large hole for demonstration purposes.

A cross-section of a solar power station will be on show in front of the DLR Institute of Solar Research. The researchers in Cologne are testing a 30-metre long by 4-metre high parabolic reflector. These mirrors focus sunlight onto a tube positioned at the focal point of the mirror. This component reaches a temperature of up to 500 degrees Celsius and steam is produced; this technique is used in the large solar-thermal power stations already in operation in Spain, for example. The steam then goes on to produce electric power using a similar process to the one used in conventional power stations. DLR researchers use this cross-section of a solar power station to show how these power stations function and how the mirrors track the Sun across the sky throughout the day.

Visitors can try controlling a solar power station

In order to generate electricity safely and efficiently, a solar power station must be correctly managed; visitors will be able to find out what this entails for themselves. Using a simulation programme at the Institute of Solar Research, they will be able to control a solar power station with a joystick. The researchers will also show how they take temperature measurements with an infrared camera. These measurements are important at solar-tower power stations, for example, where the Sun's rays are directed by a number of mirrors onto the tower's receiver inlet and the power station operators need to know how hot the surface is.

Electric mobility and transport data for major events

Energy consumption also plays a role in DLR's train of the future transport research project, Next Generation Train (NGT) . As part of the scientific presentation agenda, NGT project manager Joachim Winter will present various ideas and objectives for the NGT from 11:15 to 11:50. Besides the cryogenic wind tunnel at the DLR site in Cologne, visitors will also have the opportunity to see wind tunnel models of the next generation high-speed train developed by DLR. From 12:45 to 13:20, DLR transport scientist Barbara Lenz will be giving a talk on 'Electric

mobility – how will we get about in the future?' in the DLR presentation tent. Also in the presentation tent from 15:00 to 15:25, Ulrich Wagner, DLR Executive Board Member for Energy and Transport, will present an insight into the desert electricity project 'DESERTEC', in which DLR has had considerable involvement from the very beginning.

At 'Zulu Stand', part of Cologne-Bonn Airport, where aircraft will be on static display during German Aerospace Day, DLR transport researchers will present 'VABENE'. This project focuses on traffic management during major events or disasters. DLR researchers are developing traffic simulations and forecasts, designed to help emergency services such as the police and fire departments arrive at their destination faster in complicated situations. To do this, DLR scientists work with traffic data collected from both the ground and air, extracting, processing and evaluating them and making them available on a special online portal accessible to the emergency forces. The main component of this project is the 'crisis simulator', which processes the details of the situation, the infrastructure and the traffic information, generating a traffic overview and forecast. Visitors to Zulu Stand can take a look at the mobile ground station as well as the DLR Cessna 208B Grand Caravan research aircraft, from which the air-based traffic data is recorded.

Hot and cold

In the TEG-Line building of the DLR Institute for Materials Research, visitors can expect to see a great variety of experiments on the subject of thermoelectric energy. The 'cold thumb' exhibit consists of a power supply and a box with two pushbuttons, with a thermoelectric module attached to it. The module becomes hot or cold at the push of a button and is used by the scientists to demonstrate the relation between current direction and how heat or cold is produced.

At the 'gauge demonstrator', visitors can place their hand on a thermoelectric module and heat the module up. A light-emitting diode strip visually displays the generation of current from warmth.

What's more, there will be an exhibit that demonstrates thermoelectricity using a toy train track. Two tea lights placed under a cooling tube structure generate enough power to propel the toy train.

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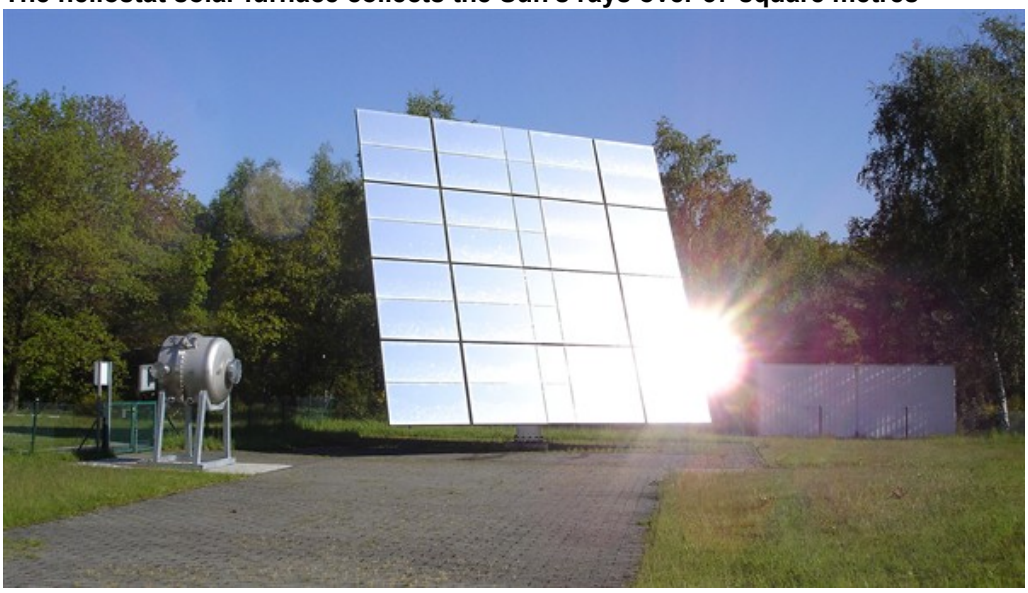
Solar simulator – test stand at the DLR Institute of Solar Research

Using artificial sunlight, researchers use this test stand to investigate the optical, geometrical and mechanical quality of the mirrors that capture and concentrate the sunlight in a solar power station, as well as the properties of the pipes that absorb the energy and transfer it in the form of heat.

Credit: DLR.

The heliostat solar furnace collects the Sun's rays over 57 square metres



The heliostat of DLR's solar furnace in Cologne collects the Sun's rays and reflects them onto the 'concentrator' – 157 separate, slightly curved and precisely aligned mirrors that focus the radiation. The radiation is concentrated by a factor of 5200 and falls on the approximately four-metre by four-metre test chamber of the solar furnace.

Credit: DLR (CC-BY 3.0).

DLR solar furnace in Cologne

A 57 square metre mirror collects sunlight and directs it towards the facetted mirrors (left in the picture). These mirrors concentrate the incoming radiation up to around 5200 times and direct it to the research laboratory of the Cologne solar furnace (the beam of light can be seen on the right of the image).

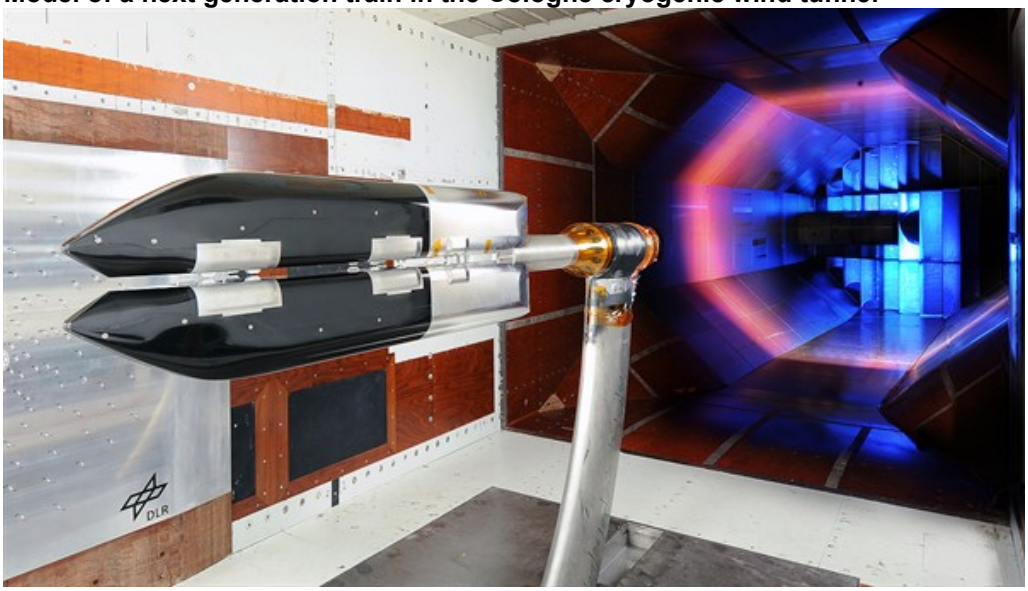
Credit: DLR (CC-BY 3.0).

The Next Generation Train

In the Next Generation Train (NGT) project, DLR personnel from nine research institutes are investigating the general conditions for the high-speed trains of the future. This includes, in particular, scientific questions relating to high-speed rail transport in the fields of aerodynamics, structural dynamics, the dynamics of vehicle movement, propulsion, energy management, materials science and lightweight construction. The goal is the development of high-speed trains suitable for type approval and with greatly reduced specific energy requirements as well as improved passenger comfort and noise characteristics.

Credit: DLR.

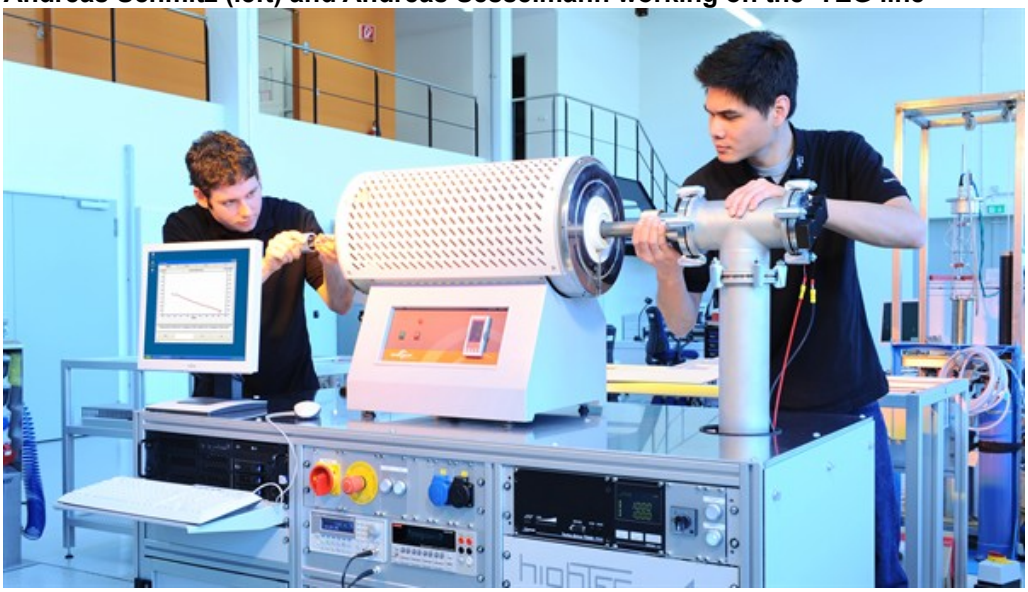
Model of a next generation train in the Cologne cryogenic wind tunnel



With this double-deck train model made from carbon-fibre-reinforced composite, DLR researchers measure, among other things, the noise emitted by a high-speed train.

Credit: DLR (CC-BY 3.0).

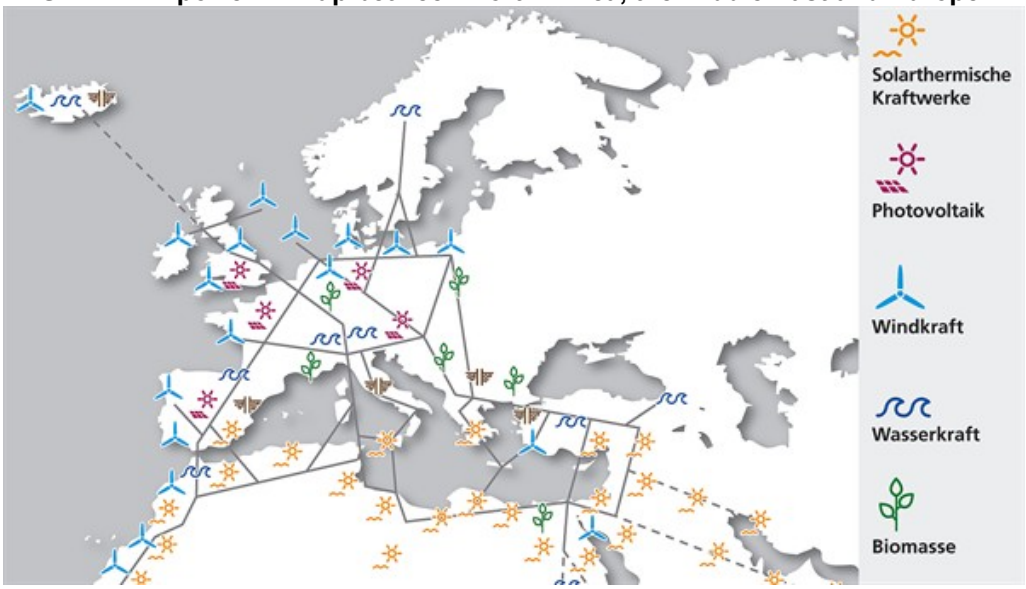
Andreas Schmitz (left) and Andreas Sesselmann working on the 'TEG line'



Scientists from the DLR Institute of Materials Research will use the 'TEG line' to further advance the development of thermoelectric materials and generators. They have around 400 square metres of laboratory space at their disposal.

Credit: DLR (CC-BY 3.0).

DESERTEC – power link-up between North Africa, the Middle East and Europe



Map showing the various sources of renewable energies in a network between North Africa, the Middle East and Europe. The desert power project, DESERTEC, is based on studies provided by DLR researchers from the Institute of Technical Thermodynamics in Stuttgart.

Credit: DLR (CC-BY 3.0).

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