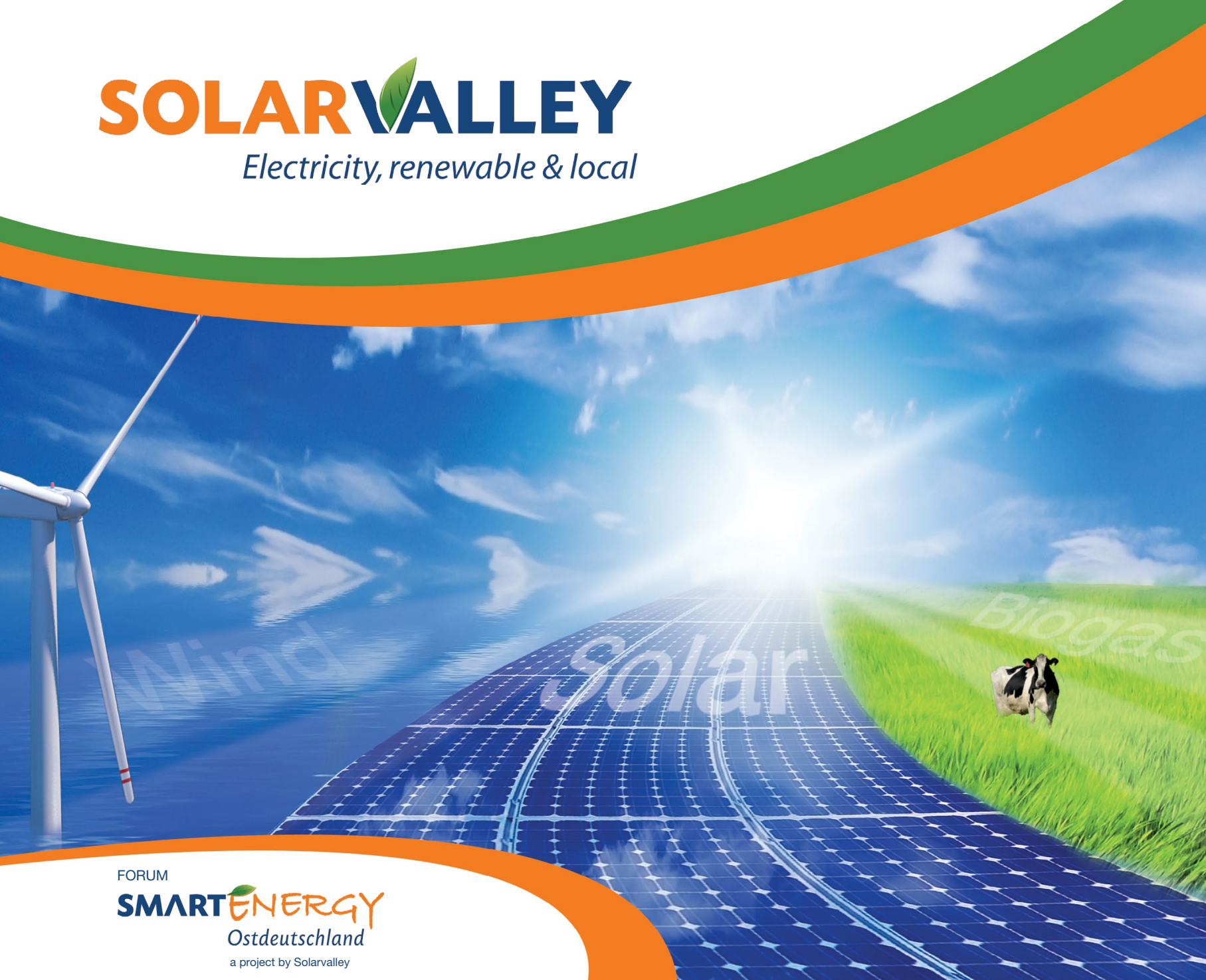


# SOLARVALLEY

*Electricity, renewable & local*



FORUM

**SMARTENERGY**

Ostdeutschland

a project by Solarvalley



## Editorial

The Solarvalley Mitteldeutschland e.V. has established itself as a widely connected international network for solar technology. Solar Valley GmbH is the operative part and the management platform of the group. Since 2009 more than 100 projects with a budget of € 120 million have been concluded within the framework of a „leading edge cluster“ sponsored by the Federal Ministry of Education and Research (BMBF) and additional funding from the federal states Saxony, Saxony-Anhalt and Thuringia. The results of the cooperation in research and development lead to considerable improvements in efficiency, quality and reliability in solar panels, an international network of research facilities, manufacturers, and universities, as well as an integral, cross-country, academic co-operation system.

The unique development of solar technology has rung in the energy revolution. Therefore the current subject is the entire energy supply chain:

- from energy production through to storage, distribution and use
- from regional optimisation of technical solutions to their integration in superordinate system technology
- from the self-learning operation of systems through to the climate prediction-dependant heat stores and cold reservoirs.

Ultimately, it's about a readjustment of the German and global energy sectors, away from conventional, centralised and CO<sub>2</sub>-emitting energy production to an economical, decentralised and sustainable energy supply based on renewable energy sources.

The strategy concept smartEnergy Ostdeutschland develops integrated technical solutions required for combining regenerative energy generation with distribution grids, storage facilities and capacities, and with information and communication technologies, as well as their final use.

Partners and Participants who would like to help in achieving this goal together are invited to join us!

Dr. rer. nat. Peter Frey  
CEO, Solar Valley GmbH

**SOLAR**VALLEY  
Mitteldeutschland




 FREE STATE OF THURINGIA

 FREE STATE OF SAXONY

 SAXONY-ANHALT

 BRANDENBURG

 BERLIN

 MECKLENBURG  
WESTERN POMERANIA

## Our aim

Our vision is an energy supply consisting of 100% renewable energy sources. The energy production technologies are selected without prejudice according to regional conditions to maximise productivity and cost efficiencies.

We want to contribute to the creation of high-quality jobs in Eastern Germany.

## Our approach

Solar Valley is focussed on the supply chain of the Energiewende / energy transition. In this area we connect Eastern German businesses with each other as well as research institutions and universities. We initiate joint research projects and therefore enable Eastern German businesses to develop innovations in cooperation with scientific institutions. We contribute to create high-quality jobs in Eastern Germany, strengthen the flexibility and innovative forces of the cluster, and open international markets to Eastern German business.

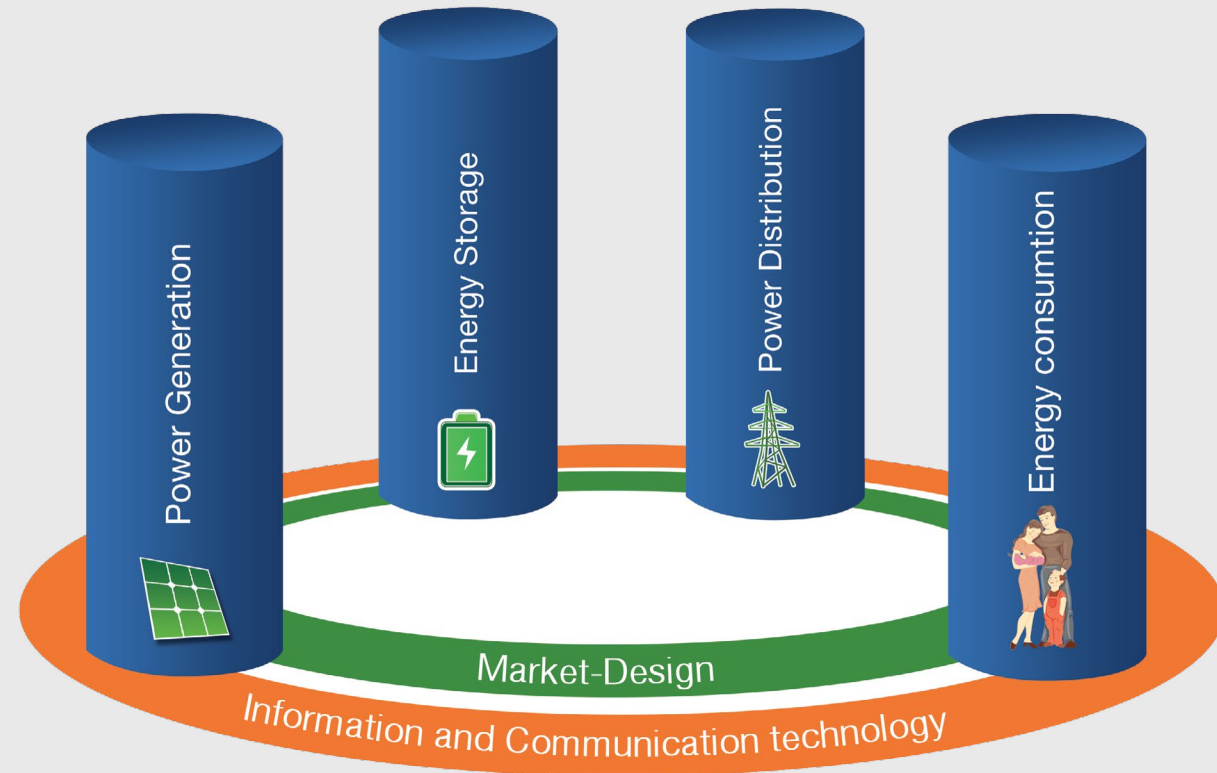
## Strategy

### Solar Valley GmbH

- is actively participating in the Energiewende/energy transition (smartEnergy)
- is joining the forces of Eastern German businesses
- connects businesses with research and development institutes
- initiates and coordinates large-scale projects in research, development and demonstration
- securing high-quality jobs in Eastern Germany
- is opening international markets to Eastern German businesses and research institutes

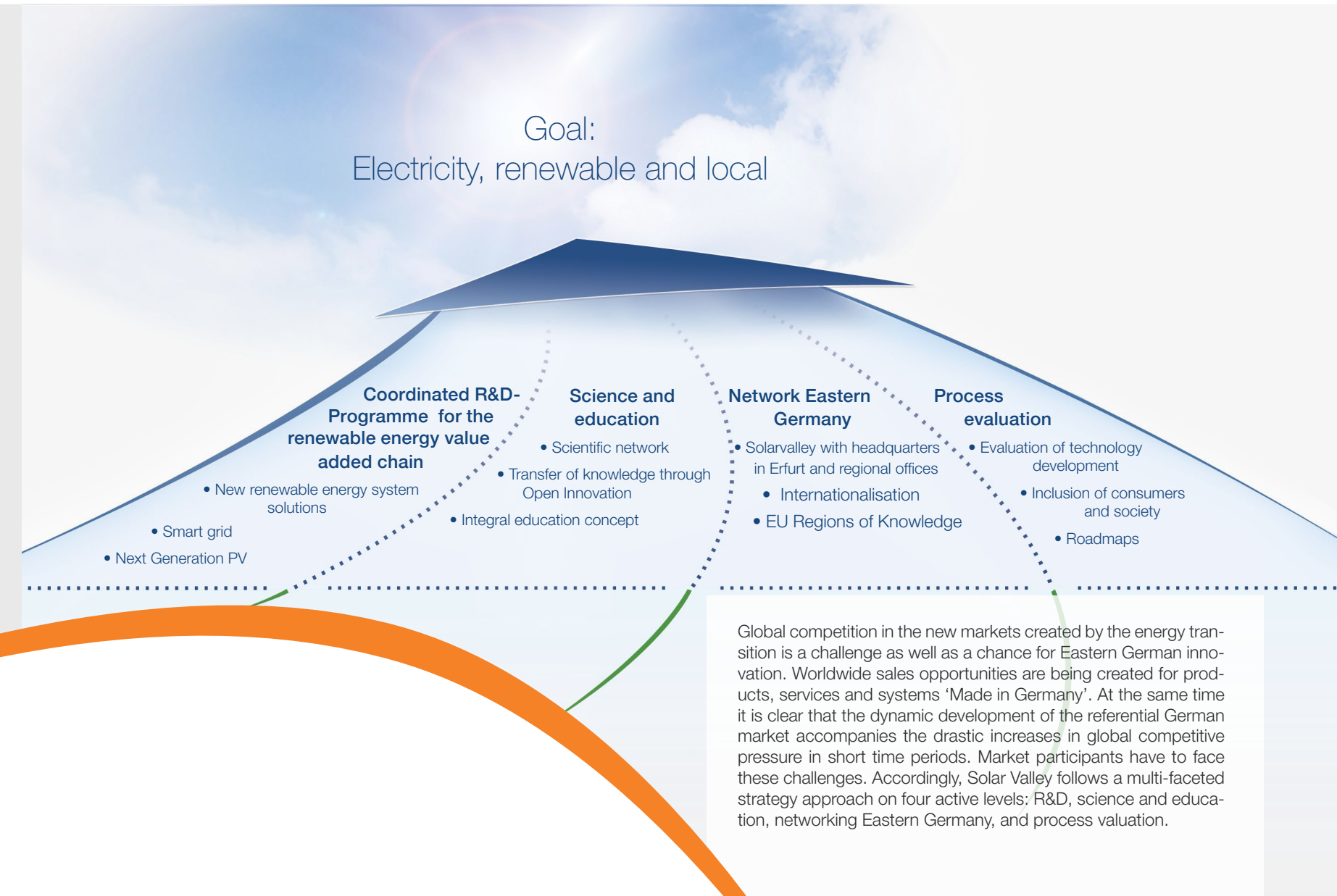
## Energiewende – Chance for the Eastern German economy

## Four impact directions for one goal – Electricity, renewable & local



Through a systematic approach, Solar Valley combines the 4 pillars of the energy supply chain. The areas of information and communication technology, and market design overlap with this matrix.

The resulting areas of operation are supported by Solar Valley GmbH's activities. The majority of activities is defined through a system of specific R&D model projects, and is currently defined and summarised by the smartEnergy project. The aim is the definition of a smartEnergy cluster-project. Market relevance for the model projects is expected to be reached between 2017 and 2020.



Global competition in the new markets created by the energy transition is a challenge as well as a chance for Eastern German innovation. Worldwide sales opportunities are being created for products, services and systems 'Made in Germany'. At the same time it is clear that the dynamic development of the referential German market accompanies the drastic increases in global competitive pressure in short time periods. Market participants have to face these challenges. Accordingly, Solar Valley follows a multi-faceted strategy approach on four active levels: R&D, science and education, networking Eastern Germany, and process valuation.



# Four levels of action - Across sectors and interdisciplinary

## Network Eastern Germany

Industrial companies, research institutions, universities and further partners from politics and associations and 6 federal states jointly obligated to one target: energy for generations ahead, renewable and reliable. This alliance is to be developed into an entrepreneurial community with high standards referring with a view to regional and societal responsibility.

The internationally established Solar Valley management platform with regional offices in Saxony, Saxony-Anhalt and Thuringia is being extended to Berlin-Brandenburg and Mecklenburg Western Pomerania. Primarily, it is a question of communication to the inside and the outside, of initiation, coordination and administrative support of the individual projects in the R&D field and education, of controlling in the performance of the strategic concept and the further development of the idea. The joint appearance at national and international branch representations, boards of experts and political instances is being organised. The international co-operations for knowledge transfer already existing on a European level are being extended.

The development concept ranges from fundamental research via demonstrators to the application in innovative products and production technologies and services. The industrially oriented R&D programme is being realised in a system of joint and individual projects together with demonstrators, the time and contents of which have been coordinated.

## R&D

Technological development is being pushed forward within the framework of a long-term innovation strategy coordinated across the individual steps of added value. The targets of security of supply, grid stability and reduction of energy generation costs stand over all the innovations. This is to be achieved by system efficiency being increased, reliability and lifetime of the components being improved and, in particular, their costs being drastically reduced.

## Science and education

An integral educational system for all value added phases, technical disciplines and qualification levels, agreed across the borders of federal states, ensures the experts needed. A smartEnergy Knowledge Region is to originate in Eastern Germany. Contents of studies in existing specialisations are being further developed, endowed chairs are being set up, new courses of studies launched. The established summer schools and the subjects at the existing post-graduate schools in photovoltaic are being extended.

s with their offer of knowledge will provide important input into the research infrastructure of industry. The industrial partners provide the universities with relevant definitions of subjects and also support the interaction of science and society.

New instruments of cooperation open up the knowledge and research resources of universities and external research institutions to the companies.

## Process evaluation

A continuous analysis of the environment secures success of strategy implementation. In this way, the critical and promising influential factors of market penetration are identified in good time, with the result that they can be included in the design concept of energy supply. The successful diffusion of renewable energies in Germany is thus being secured.

Under the central aspect of societal acceptance of the necessary processes of change, the influential factors are being determined. For this, both projects on accompanying environmental psychology research as well as projects for a lead market evaluation and a corresponding macroeconomic indicator observation are being started.

## smartLiving

In order to integrate renewable and local energy producers, the vision of a "Smart Grid" needs to be realised. This allows the customer the necessary user interaction. Inbound connections to household appliances as well as outward connections to the grid will be accessed through a communications- and information-technology gateway. In this way, climate information and predictions will be joined with the user profile, and automatic adjustments in the system (with regards to temperature changes, cold reservoirs, load profile modifications etc.) will be triggered. Low cost high-resolution metrological technology and information and communications technology is being developed and tested in model designs.

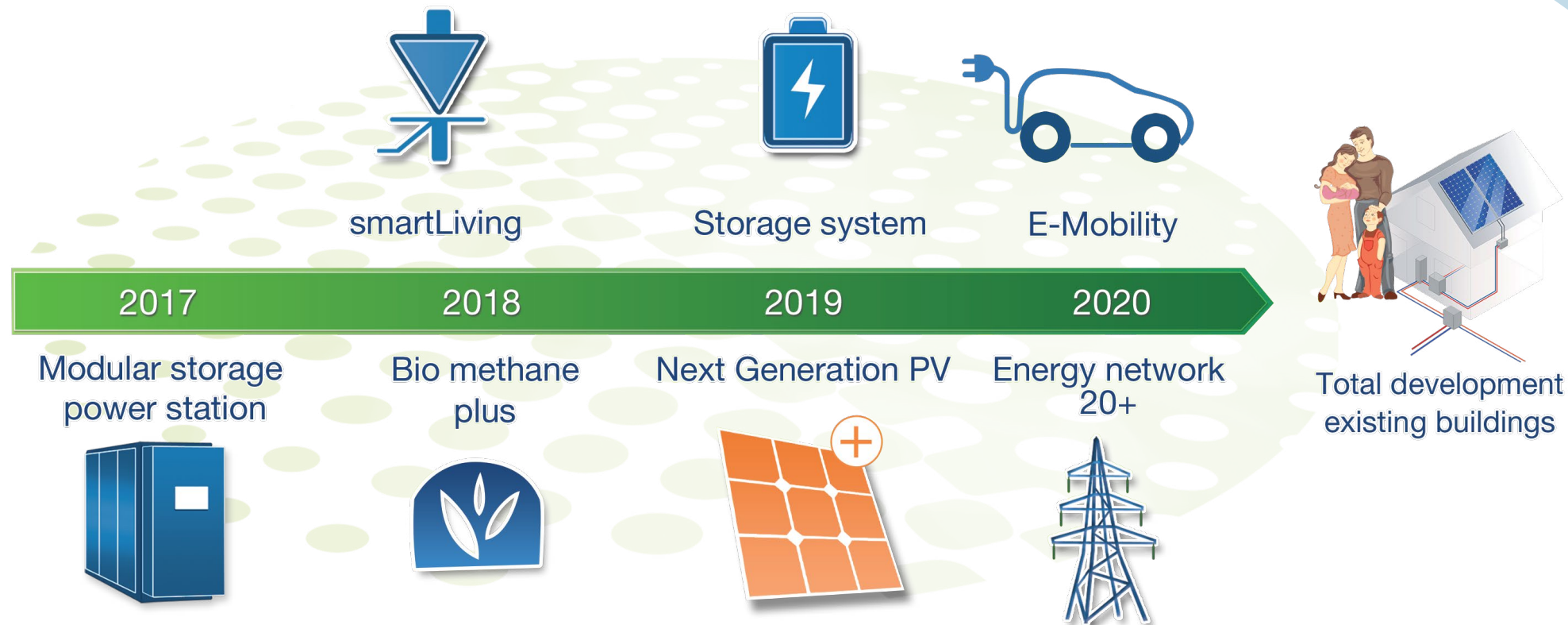
## Modular storage power station

Using high-pressure electrolysis, hydrogen storage, and generators with hydrogen gas motor components, a system solution for surplus energy production from solar panels has been proposed. An initial design with power output of 50kW can be scaled up to multi-MW systems. With regards to costs, mass-produced components are favoured for the system designs. The technology is ideal for distribution grid connection and stand-alone grids.

## Bio methane plus

Using a new technology, Biogas facilities can be used as load balancers in the electricity grids. The central idea is a process which converts the CO<sub>2</sub> present within Biogas to methane with the help of hydrogen, which can then be fed directly into natural gas grids. The hydrogen is produced via electrolysis, using excess electricity of the power grid. Alternatively, when energy demand exceeds supply, the bio methane can be used to power an electricity generator. Due to the excellent efficiencies and advanced system functions of conventional Biogas plants as energy stores, this concept is becoming of importance, particularly in rural areas. A 250kW plant is to be built for process development.

# smartEnergy Ostdeutschland – Innovations from the top regenerative energy production region



## Redox-Flow-Storage system

This battery type is perfect for stand-alone and distribution-connected grids on account of its high efficiency, long lifespan, cycle stability and flexible scalability, which renders it very useful as a buffer storage for excess energy from fluctuating, renewable energy sources. Originating from prototype-stacks (5kW-class), through to a energy management system specialised product, the battery is to be made market ready, and further developed for specific applications, performance and cost optimisation.

## E-Mobility

Currently the German car market is flooded with a multitude of new cars, in which a wide range of different batteries can be seen. The integration of storage technology in a virtual power plant, a standardisation of recharging concepts, a normalisation of communications platforms at charging stations and on vehicles, as well as a use-and weather dependant-trade in extractable energy are key points that are developed in this area.

## Energy network 20+

For the further expansion of renewable energy suppliers it is necessary to find compensation for the reduction of system-service-capacities due to the withdrawal of conventional energy suppliers. Under the consideration of system stability and profitability an optimisation of Energy-Infrastructure-System needs to happen. Conventional power stations have to be made more flexible (in balancing power, local energy storage), renewable energy plants have to be fitted with ancillary functions (idle power production capabilities, energy storage and active power performance). Strategies are being developed to optimise the dismantling of conventional power stations and construction of renewable ones, dependant on local and regional storage capacities.

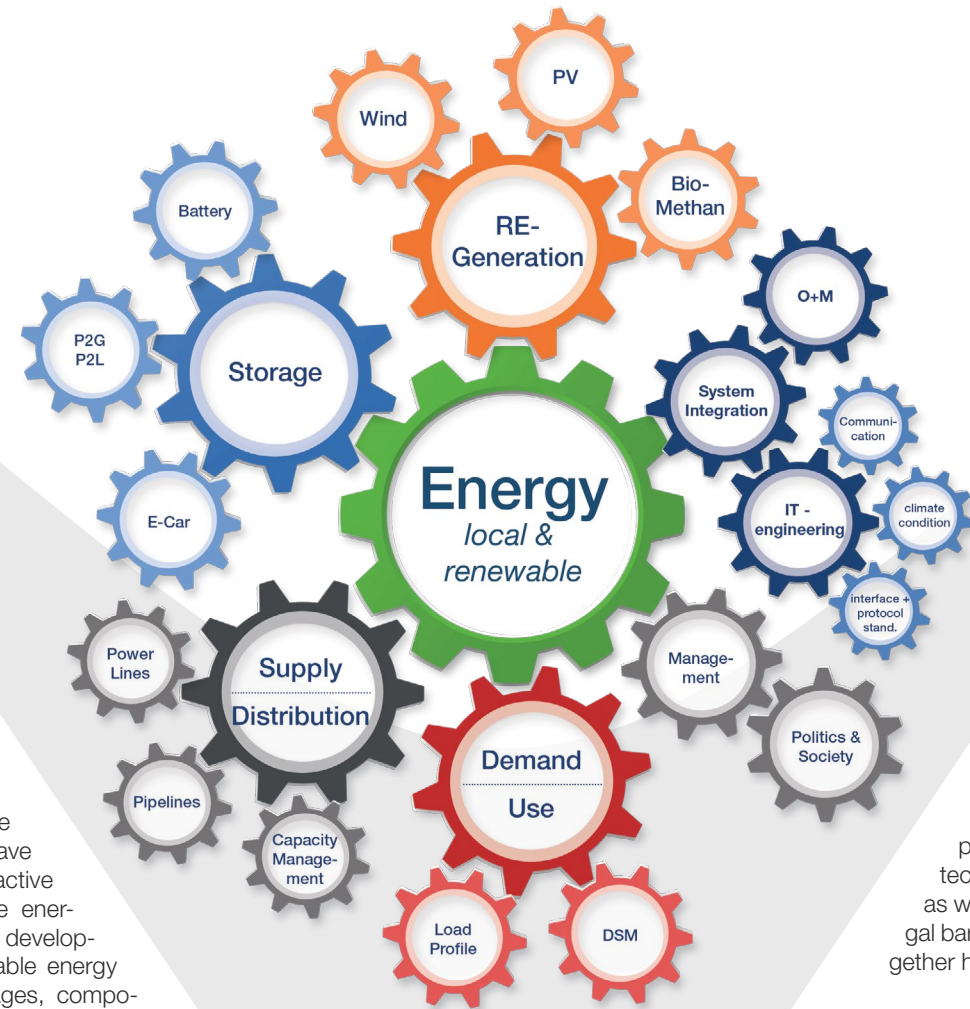
## Next Generation PV

New research approaches for the next generation of PV is set to lead to further reductions in energy generation costs. This includes new cell-designs with new material systems such as epitaxial hetero-systems on Si-Wafers for multi-junctions or for quantum wells, quantum dots, etc. The theoretical limit for Si-based PV efficiency (Shockley/Queisser Limit), is set to be surpassed. On systems level, methods are being developed to determi-

ne optimal relationships between module energy yields, generation profile, load profile, storage capacities and supply reliability, and therefore increase the profitability of PV systems. A further important point is the integration of multifunctional solar panels into building exteriors, in new builds as well as existing ones (BIPV). In this area, the operational framework should be focussed on the standardisation of PV manufacturing elements.



## The Solarvalley cluster – Cooperation across borders



Within Solar Valley, key figures who actively influence the development of the energy sector, and hence shape the energy transition, have joined together. These are active participants in the renewable energy industry, i.e. technology developers and producers of renewable energy plants/systems, energy storages, components and suppliers, EPCs (Engineering, Procurement and Construction) and marketers of

renewable energy. There are also representatives of conventional energy production and the grid operators present. The conviction that new technical and logistical solutions, as well as the overcoming of new legal barriers, can only be developed together has united them at Solar Valley.

## Cooperation of the Regions – Chance for PV in Europe



SOLARROK – SOLAR Regions of Knowledge. The most important European PV regions combine their strengths in a joint action plan. The regional specialisations are to be strengthened and technological and process orientated innovations through international cooperation projects are to be developed: innovations through co-operation of PV in Europe – the answer to the challenge posed by competition from asian manufacturers.

This project under leadership of the leading edge cluster Solar Valley Mitteldeutschland is supported by the European Union within the scope of FP7 Capacities “Regions of Knowledge” over a period of 36 months.

The SOLARROK consortium comprises 7 European regions from 9 countries, each with specific, complementing competencies.

## R&D Results – Innovation along the PV supply chain

Within the framework of the PV leading edge cluster, initiated and coordinated by Solar Valley Mitteldeutschland, and support by the German Federal Ministry for Education and Research, the federal states of Saxony, Saxony-Anhalt and Thuringia and a budget of € 120 million, 28 businesses, 9 research institutes and 10 universities started and/or completed over 100 R&D projects. The results lead to cost reductions in all areas of the PV supply chain.

### Silicon

The scientific understanding of silicon has been intensified. As a result of the increase of the detection precision of critical contaminations by a number of orders of magnitude and the development of close-to-industry measurement methods, the process parameters, the check of incoming material and quality assurance have been optimised.

### Crystals

Through the optimisation of process control and material design optimisation based on simulations, the costs involved in crystal pulling via the traditional Czochralski-Method were considerably decreased. Through a new Float Zone-Method it is now possible to produce outstanding crystals from cost-effective solar-grade raw material. Solar panels created with these crystals have shown very high efficiencies. The developed facility is designed for mass production. Further uses of these crystals lie in the high-performance electronics and electric mobility sectors.

### Wafer

A drastic cost reduction of over 40% was achieved in the sawing of crystals. This was made possible through the introduction of newly created wires and saw liquid (Slurry).

### Solar cells

New processes (PERC, PERT, IBC, Heterojunction) allow for efficiency to increase up to 22%, which are top global results. Through the increased efficiency, electricity generation costs sinks further.

### Module

The increases in performance and yield seen in the cells were successfully transferred to solar panels. Solar panel reliability was also considerably improved. In particular, the potential-induced degradation was successfully avoided through countermeasures introduced to the cells and panels.

### System

Thin-film panel producers developed special solutions for building-integrated PV. These new components now also take on structural capabilities as they can be directly used as part of the façade rather than a cover thereof. Also, a new inverter system was developed which allows for the optimal operation of BIPV systems.

## Solarvalley Graduate School – Innovation through science

The Solarvalley Graduate School for Photovoltaics addresses students looking to do a doctorate after their Master's degree. A broadly based course of training “also going outside the box” is made possible by the cooperation of three universities:

- **TU Bergakademie Freiberg**
- **TU Ilmenau**
- **Martin-Luther-Universität Halle-Wittenberg**

These universities cooperate with research institutes and universities of applied sciences in the three federal states of Saxony, Saxony-Anhalt und Thuringia.

The Graduate Schools of the three universities dedicate themselves to the following focal points:

### 1. Graduate School Photovoltaic (TU Bergakademie Freiberg)

The Graduate School for Photovoltaics started in September 2008 and has been integrated into the Graduate School of the Technical University Bergakademie Freiberg. It has set itself the objective of examining the backgrounds of photovoltaics and its industrial production along the entire value-added chain of silicon-based photovoltaics.

### 2. StrukturSolar (Martin-Luther-Universität Halle-Wittenberg/Hochschule Anhalt)

StrukturSolar was started in 2012 and is supported by the BMBF as a cooperative research institutions. Innovative structuring concepts for next-generation solar cells are developed.

### 3. PhotoGrad (TU Ilmenau)

PhotoGrad started in October 2012 with a new concept for a Graduate School. There is structured doctorate study in photovoltaics “from the cell to the system” in cooperation with industrial and research partners. In an innovative open novel approach, research of industry and science cooperate at the university both in setting the subject and also in implementation and financing.



# Solarvalley summer academy – Learning from experts

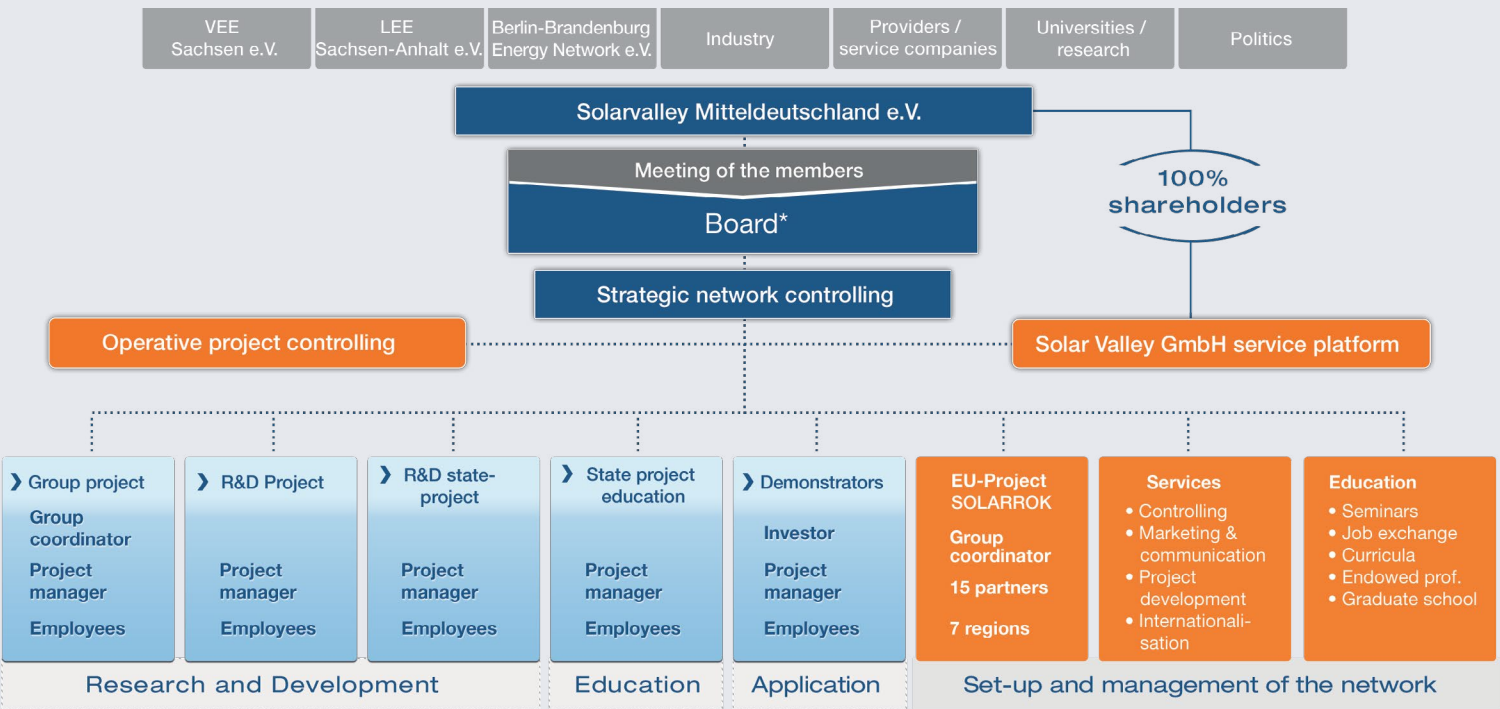
Solar Valley regularly organises a summer academy for bachelor, master and PhD students. Main focus areas are photovoltaic, storage, storage technologies, Smart Grids, renewable energy systems and energy management. In the past there have already been three summer academies organised in cooperation with the Martin-Luther-Universität-Halle and the TU Ilmenau.

The summer academy program offers educational and scientific development, which goes far beyond university course contents and focuses attention to innovative research topics. The content of the summer academy programs is as follows:

- Materials in photovoltaic: new demands
- Semiconductor material: thin films and interfaces, functions and interactions
- Glass for solar panels with high functionality
- Energy storage: types, electrochemical, construction, function
- Smart Grids and energy systems



# smartEnergy Ostdeutschland Network management – Locally present and globally connected



\*Dr. Hubert Aulich - Chairman (SC Sustainable Concepts GmbH), \*Prof. Dr. Jörg Bagdahn - Vice Chairman (Fraunhofer CSP), Dr. Claus Beneking (Reiner Lemoine Institut gGmbH), Dr. Andreas W. Bett (Fraunhofer ISE), Prof. Dr. Gerhard Gobsch (TU Ilmenau), Prof. Dr. C. Hoffmann (Fraunhofer IWES), \*Dr. Joachim Löffler Vice Chairman (KUMATEC GmbH), Prof. Dr. Alexander Michaelis (Fraunhofer IKTS), Dr. Bernd Rau (Roth&Rau AG)

The responsibility for the implementation of the strategy concept falls with Solarvalley Mitteldeutschland e.V. in close coordination with the partner associations Berlin-Brandenburg Energy Network e.V., VEE Sachsen e.V. and the state association Erneuerbare Energien Sachsen-Anhalt e.V. This consortium is open to further institutional and individual members. The services platform Solar Valley GmbH with its headquarters in Erfurt is controlled by the management board, which

supervises the operational implementation of network activities and supports the development of project consortiums and concepts. This board takes responsibility for final project selection and the strategic development of the network. The board is staffed with high-ranking representatives of the industry. Representatives from research institutes, as well as consulting representatives from the according state ministries in Eastern Germany complement this board of experts.



# Business areas of the management platform

smartEnergy Ostdeutschland  
Systems *Made in Germany* for the global market

smartEnergy Ostdeutschland	Internationalisation	Leading edge cluster
<ul style="list-style-type: none"><li>• Strategy development forum smartEnergy</li><li>• International competence marketing<ul style="list-style-type: none"><li>- News, Image, Media</li><li>- Delegations</li><li>- Business trips</li></ul></li><li>• Technology broker smartEnergy</li><li>• Cooperation network VESUW – intelligent distribution networks for optimised personal use</li><li>• Congresses and exhibitions/fairs</li><li>• R&amp;D consulting<ul style="list-style-type: none"><li>- Planning, R&amp;D funding</li><li>- Joint project management</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Solar Regions of Knowledge<ul style="list-style-type: none"><li>- Analysing potentials in 7 PV regions</li><li>- R&amp;D atlas, benchmark</li><li>- Regional action plans</li><li>- European action plan PV</li></ul></li><li>• EIT Climate-KIC affiliate partner</li><li>• R&amp;D coordination: Horizon 2020</li><li>• Cluster consulting</li><li>• Opening of strategic export markets (Africa, Turkey, India)</li><li>• Political consulting: EU-Parlament/Kommission</li></ul>	<ul style="list-style-type: none"><li>• Raw materials for the energy transition</li><li>• R&amp;D program development</li><li>• R&amp;D joint project in zwanzig20 C3 Consortium: PV Integrations in buildings</li><li>• Congresses and exhibitions<ul style="list-style-type: none"><li>- BauhausSolar (Weimar)</li><li>- PV-SEC</li><li>- Intersolar</li><li>- Clusterkonferenz (BMBF)</li></ul></li><li>• Panels and potential analysis</li><li>• Political consulting: federal government</li></ul>

Utilization strategy smartEnergy		
Mass products	Services	Systems
<ul style="list-style-type: none"><li>• High end PV</li><li>• Inverters for grid-service</li><li>• Information and communication technologies</li><li>• Battery system technology</li><li>• Smart PV systems</li><li>• Block storage power systems</li></ul>	<ul style="list-style-type: none"><li>• EPC (Engineering Procurement Construction)</li><li>• Algorithms for grid management</li><li>• Data management</li><li>• Diagnosis</li><li>• Forecasting</li><li>• Simulation</li></ul>	<ul style="list-style-type: none"><li>• Solar power station</li><li>• Virtual storage</li><li>• Virtual renewable power station</li><li>• Consortia of power stations (conventional/renewable)</li><li>• Island grids</li></ul>

In order to satisfy the many self-defined objectives, tasks are broken down into three subject areas and are accordingly differentiated. From this, the following task profile for the Solar Valley GmbH, the management platform of Solarvalley Mitteldeutschland e.V. can be defined.

Through the development of components for renewable energy production and their integration into intelligent systems and grids, german manufacturers and outfitters gain a sustainable perspective. These are new, special components and high-end electrical systems in the energy supply technology branch with high value stability and quality with which energy can be produced renewably and appropriately integrated into production and distribution infrastructure. Product and system accompanying services supplement the portfolio.

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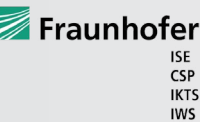
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Project:  
**SMART ENERGY Ostdeutschland**

AEP Energie-Consult GmbH

BAE Batterien GmbH

BTU Cottbus

Calyxo GmbH

Bauhaus-Universität Weimar

DAW von Robert Murjahn Stiftung & Co KG -Lithodecor

DELO Industrie Klebstoffe

DS Automation GmbH

Dr. Robert-Murjahn-Institut

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NaMLab gGmbH

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ISC

IGBCE, Industriegew. Bergbau, Chemie und Energie

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Solarwatt GmbH

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Energy for generations ahead

