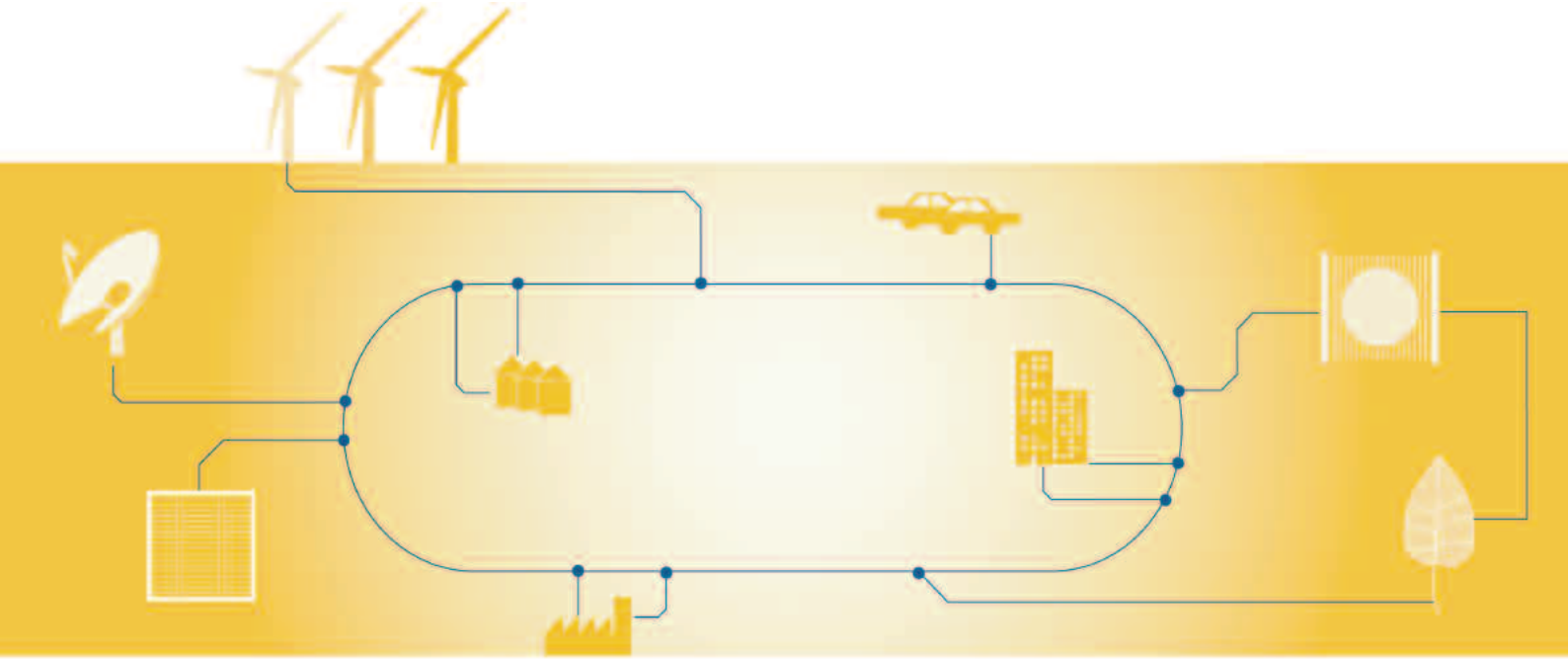
Electrical system technology, grid management and distributed power stations



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The liberalisation of the energy market and the European target of increasing the share of renewables in electricity production to 22% by 2010 demand considerable restructuring within the European integrated grid system. The evolution of the electricity supply from large, centralised power stations to a system consisting both of centralised and distributed electricity suppliers also places new demands on equipment technology and electrical engineering.

The greater the proportion of distributed "micro power stations", the more deeply they must be integrated into the grid control system. The management units and the communications concepts which need to be developed for this will be essential in realising the concept of "distributed electricity generation".

Autonomous electricity supplies based on photovoltaics, wind power, solar thermal electricity generation, hydropower or hybrid systems are key to the development of regions with underdeveloped infrastructure throughout the world, as well as to supplying off-grid systems in Europe. They represent a large global export market, which is especially attractive for the diversification of German companies.

In order to open up these markets using reliable and cost-effective systems, new technologies will be needed for control technology for stand-alone grids, optimised energy management for the operation of complex systems and optimised system management at the planning stage.

Research and development requirements

The aim of future R&D efforts must be to organise the changing supply structures in such a way as to enable network stability and supply reliability. In addition to a proper energy mix, high-performance communications structures, online procedures and forecasts for greater capacity planning, and bidirectional energy management and trading systems will be crucial for the dialogue between energy generators,

distributors, and consumers. The development of modern information and communications technologies is indispensable for improved energy management methods.

Furthermore, the following are among the most important goals of applied research and development:

- Integration of fluctuating renewables and distributed electricity generation into integrated grids (energy and communications interfaces, output forecasting and control)
- Development of grid management systems and grid control processes as well as overall models for technological, economic and ecological optimisation (for all technologies and grid levels, including the low voltage level)
- Research in the area of controlling electricity consumption by private and industrial users as the basis for comprehensive grid management.
- Development of intelligent, communication-capable and multifunctional power converters to provide energy and capacity, emergency power supply and network quality improvement for all technologies in distributed electricity generation and storage.
- Research in the field of power electronics as key technology in energy system technology (new components/technologies, digitalisation/automation, thermal optimisation)
- In the medium-term, electricity storage facilities will be required for large volumes of energy.
- Technologies in the fields of compressed-air storage, flywheels, supercaps and superconductive coils will be extremely important for the provision of high capacities.
- Development of modelling and simulating tools for the design of energy supply systems.

For autonomous electricity supplies, developments in control engineering, energy management for flexibly expandable systems and management control centres to optimise the maintenance of many individual installations distributed over a wide area are just as important as opening up new appropriate applications and energy conversion technologies. At the same time, electrification in rural areas particularly requires an even better understanding of socio-economic and socio-technological relationships. This knowledge must be taken into account when developing new concepts and products for rural electrification in order first to allow the construction of small-cell electricity supplies in the region of a few hundred watts, which can then be connected to local and regional power supply structures as the grid is expanded.

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