

Development and Application of Intelligent, Stationary Energy Storage Systems



Life in motion

Application of the Rhine-Neckar Metropolitan Region
in the „Spitzencluster“-competition of the
Federal Ministry of Education and Research of Germany



Metropolregion
Rhein-Neckar

StoREgio

Development and Application of Intelligent, Stationary Energy Storage Systems

Background

Renewable sources are going to play an ever increasing role in securing a sustainable energy supply globally. In Germany the share of renewable electrical energy is due to increase from its present 20% to 50% by 2035 and to 80% by 2050.

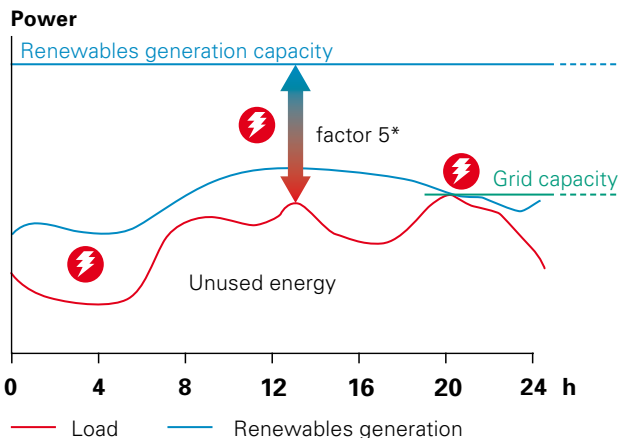
Electricity generation from wind and solar is strongly fluctuating over daytime and seasons. Feed-in is going to happen much decentralized and increasingly at mean to low voltage levels. At

the same time electricity demand increases due to new loads such as electric vehicles.

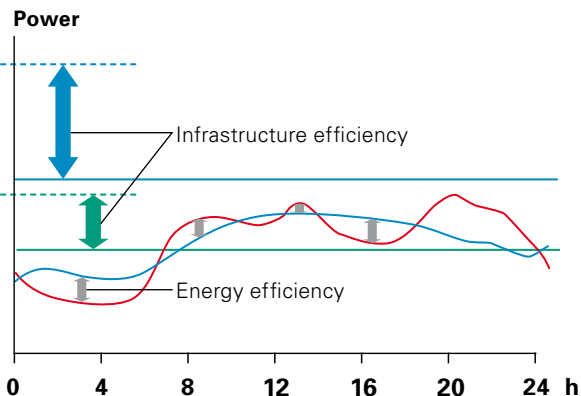
This calls for a radical redesign of today's electricity supply systems. Besides the physical integration of distributed energy sources a multidirectional communications landscape will be needed to operate the grid. Intelligent, stationary energy storage systems will make an essential contribution to secure a stable, secure and economic energy supply in the future. This is where StoREgio is joining in.

Contribution of storage systems to an economic energy supply

Isolated approach:
Fluctuation tolerance through overcapacity



Combined approach:
Fluctuation management through storage



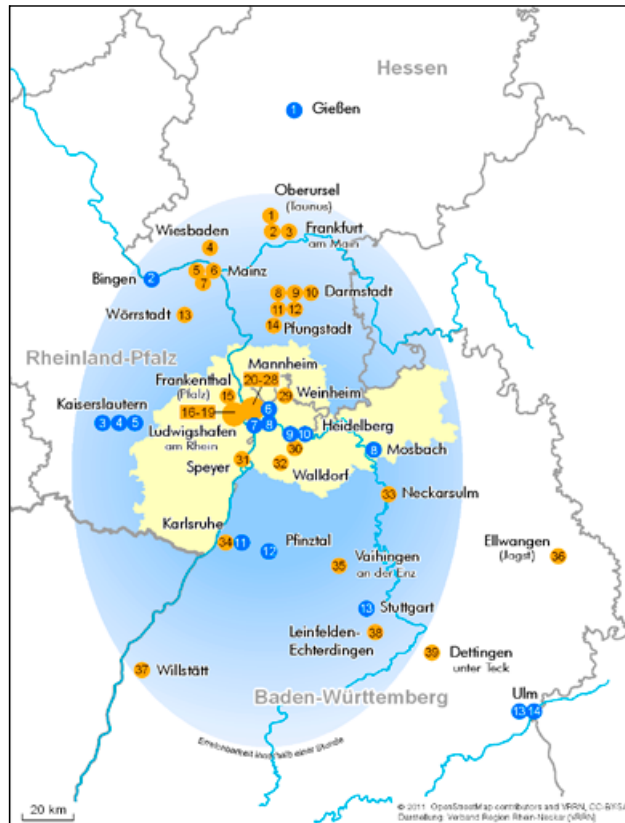
Source: BCG, FhG ISE, StoREgio

* Assuming 20% secure supply from water, wind and solar

The cluster initiative StoREgio

The cluster StoREgio develops integrated system solutions for the application of stationary energy storage systems. Such systems have to meet the technical and economic challenges of a global market as well as insure safe and reliable operation.

Many companies, academic institutions and public entities have joined forces in the cluster StoREgio bringing their competences together across the whole value chain. This is seen as a starting point to building a high-tech storage industry in Germany with a huge and long term value added potential.



- | | | | |
|----|--------------------------------------|----|------------------------------|
| 1 | Outotec | 1 | University of Gießen |
| 2 | Chemetall | 2 | Transferstelle Bingen |
| 3 | Boston Consulting Group | 3 | FhG IESE |
| 4 | SGL | 4 | FhG ITWM |
| 5 | Schott | 5 | TU Kaiserslautern |
| 6 | Schott Solar | 6 | Hochschule Mannheim |
| 7 | GIP | 7 | Graduate School Rhein-Neckar |
| 8 | HSE | 8 | Duale Hochschule BW |
| 9 | T-Systems | 9 | ifeu |
| 10 | Ingenieursozietät Katzenbach | 10 | University of Heidelberg |
| 11 | Akasol Engineering | 11 | KIT |
| 12 | IHK Darmstadt, Rhein Main Neckar | 12 | FhG ICT |
| 13 | JUWI | 13 | ZSW |
| 14 | Younicos | 14 | WBZU |
| 15 | KSB | 15 | FhG IWES |
| 16 | BASF | 16 | RWTH Aachen |
| 17 | Technische Werke Ludwigshafen | 17 | University of Münster |
| 18 | Eurosol | 18 | FhG ISE |
| 19 | IHK Pfalz | | |
| 20 | ABB | | |
| 21 | Fischer Architekten | | |
| 22 | MVV Energie | | |
| 23 | Friatec | | |
| 24 | TÜV Süd | | |
| 25 | Energetechnik Großkraftwerk Mannheim | | |
| 26 | HWK Mannheim, Rhein-Neckar-Odenwald | | |
| 27 | IHK Rhein-Neckar | | |
| 28 | Alstom | | |
| 29 | Freudenberg | | |
| 30 | Heidelberg | | |
| 31 | Stadtwerke Speyer | | |
| 32 | SAP | | |
| 33 | KACO | | |
| 34 | EnBW | | |
| 35 | FuMA-Tech | | |
| 36 | VARTA Microbattery | | |
| 37 | Leclanché | | |
| 38 | ads-tec | | |
| 39 | Schneider Form | | |
| 40 | Consolar | | |
| 41 | energy&meteo systems | | |
| 42 | Vescon | | |

Additional supporting organizations:

- Federal Employment Agency
- BASF Venture Capital GmbH
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- Mannheim start-up center (Mafinex)
- New Energy and Industrial Technology Development Organization (NEDO)
- Roland Berger Strategy Consultants
- City of Mannheim
- City of Ludwigshafen
- Technology transfer center Ludwigshafen
- Verband kommunaler Unternehmen e. V. (VKU)

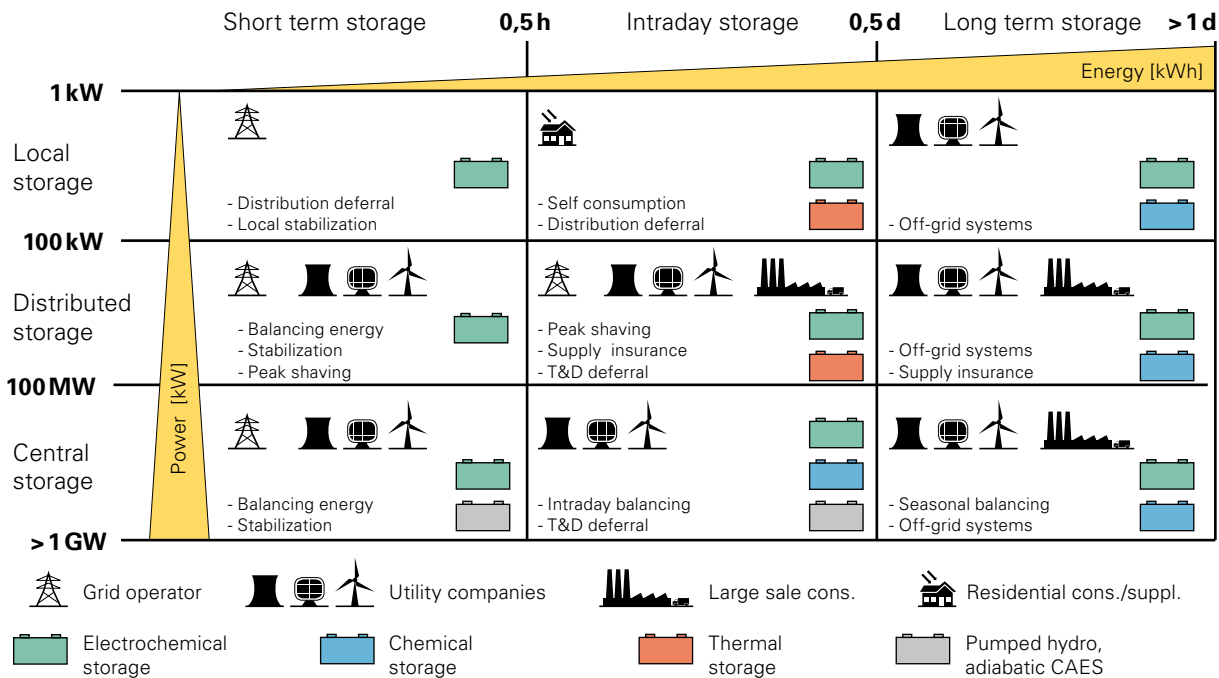
Challenges and goals

The application opportunities for storage systems are diverse. They stretch from providing short term positive and negative power to the grid to balancing seasonal fluctuations. A mix of different technologies will be needed to cover all requirements from these applications.

The key challenge for the next years will be to develop

storage system solutions that are sufficiently attractive to investors. This requires significantly reduced investment and operating costs for most storage technologies. Additionally, the same storage system needs to serve multiple applications in order to operate economically. Sophisticated control systems, communication protocols and standards as well as an appropriate regulatory landscape are a fundamental basis for this development.

Application landscape of stationary energy storage systems



Source: Clusterteam



StoREgio pursues the following objectives:

- Development of scaling processes for the industrial production of storage systems and efficient recycling technologies
- Research on future storage systems
- Grid integration and demonstration of the technical and economical performance of storage systems in real time operation
- Development of information and communication control systems, as well as data security systems
- Qualification of skilled labor and experts in all professional categories
- Intensive communication with investors and user groups
- Early analysis and response to potential market entry barriers
- Creation of international standards and norms, as well as an appropriate regulatory environment in the target markets

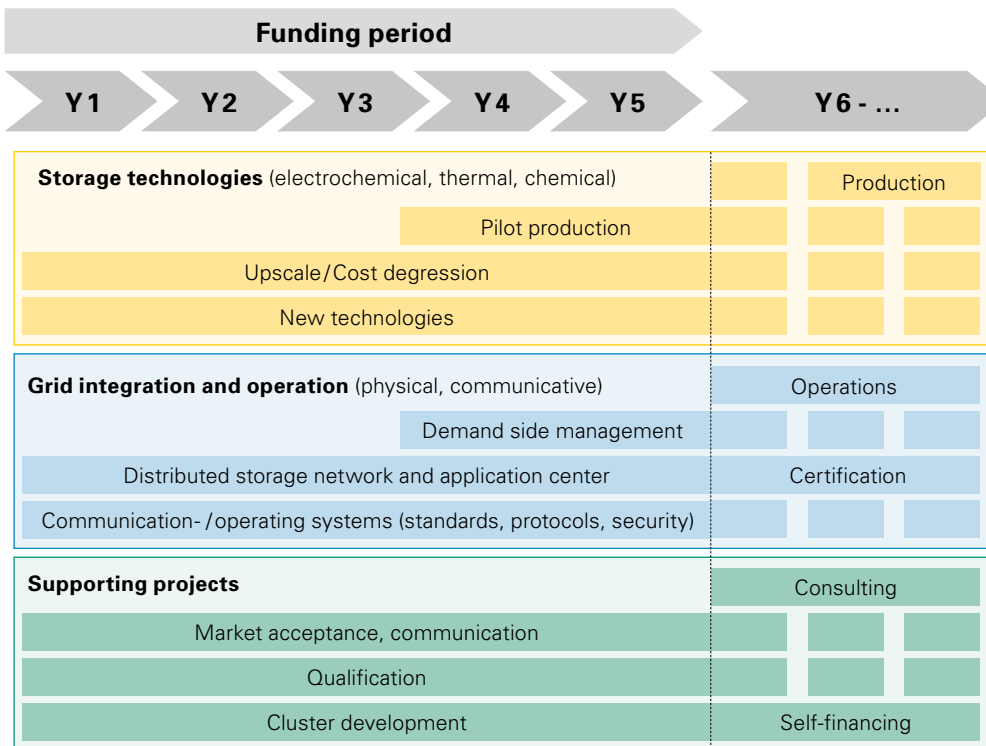
Development roadmap and projects

StoREgio's development roadmap covers electrochemical, thermal and chemical storage technologies together with their grid integration and management. Initial focus will be placed on electrochemical storage systems, for which a particular

dynamic market development is expected. In the course of the cluster activities chemical storage will gain in importance since such systems are essential for long term energy storage.

Demand side management at an industrial level is going to be an additional topic for the second funding phase.

Development roadmap StoREgio



In a key StoREgio-project a real time operated distributed storage network will be installed within the cluster partners' energy grids.

To operate the storage network an integrated communications platform, serving as reference architecture, is going to be implemented. Storage management can take place via direct or market-based control mechanisms, thus creating a precedent for the new market role of an integrated storage manager.

Simultaneously, as part of this project, an application center for training and demonstration purposes will be launched by StoREgio, with the objective to develop it into a certification center for stationary energy storage systems.

Two additional key projects address the industrial up-scaling of a Vanadium-Redox Flow storage system to the multi MW stage, as well as the development of a cost-reduced, Lithium ion battery specifically designed for stationary application.

The technically-oriented development projects will be complemented by several supporting projects. A very important aspect is the qualification of international professionals to support industry development.

Intensive communication with user groups will be used to investigate potential acceptance issues and to provide appropriate solutions.

Cluster environment

The cluster StoREgio is located in one of Germany's economically strongest and attractive regions. The connection to the Rhine-Neckar Metropolitan Region GmbH enables StoREgio to use long established structures, as well as to access a wide service spectrum (e.g. support for business startups).

The Cluster management is legally represented by the StoREgio e.V. (established the end of 2011) and the StoREgio GmbH. In addition to its partners, StoREgio is supported by numerous organizations in specific energy storage related issues. StoREgio is interested to engage in international co-operations.

The cluster StoREgio is supported by the state governments of Rhineland-Palatinate, Baden-Wuerttemberg and Hesse, as well as the city authorities of Mannheim and Ludwigshafen.



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