Fraunhofer UMSICHT

FRAUNHOFER INSTITUTE FOR ENVIRONMENTAL, SAFETY, AND ENERGY TECHNOLOGY UMSICHT

FRAUNHOFER HIGH PERFORMANCE CENTER

DYNAFLEX®

DYNAMIC AND FLEXIBLE TECHNOLOGIES FOR THE ENERGY TRANSITION AND RAW MATERIALS SHIFT

DYNAFLEX®

FRAUNHOFER HIGH PERFORMANCE CENTER DYNAFLEX®

The energy and primary industries are growing together as part of the interconnection of sectors; moreover, volatilities in the energy system increasingly also influence production processes. As a result, the energy and production industry require dynamic models and digital platforms, which can be used to estimate the effects of highly volatile conditions on energy conversion and production. This makes it possible to anticipate and plan coordinated, adaptive and flexible production systems. "Flexibility" means the ability of technical systems to respond to changes within seconds and hours. "Adaptivity" aims at ensuring the continuous adaptation of the technology or the system to changing economic and political framework conditions over years and decades.

Goals

With the Fraunhofer High Performance Center DYNAFLEX®, the leading platform for process dynamics and adaptivity in the energy transition and raw materials shift is being established in the Ruhr metropolitan area. Internationally visible research, joint R&D roadmaps, digital business models as well as new aspects in teaching are the basis for a long-term strategic partnership between science and industry. Scientific and application-oriented developments to understand the dynamics of technical systems increase the flexibility and adaptability of processes and technologies, thus ensuring their competitiveness.

Further information
www.dynaflex.de

Method development and science networking

Expert knowledge about subsystems

How can time-dependent parameters of fluctuating technical systems be predicted?

Experts are developing completely new scientific foundations of process dynamics, such as dynamic balancing, modeling, forecasting methods and dynamic analytics. This allows to competently record, analyze, understand and predict the time-dependent parameters across many dimensions (from the molecule to the system).

Goals:

- Development of a toolbox as storage for excellent scientific methods
- Establishment of an open networking platform: www.dynaflex.de

Understanding the overall system through networking

How can the optimum operation mode of the coupled overall system be determined?

The optimum operation of the entire system of energy supply and production is not predetermined by the optimum operation of the individual subsystems. It is only determined once the essential variables of dynamics and flexibility of the individual components are known and are considered simultaneously for the complex overall system.

Goal:

- Development of a multi-scale co-simulation framework, with which many different individual models can be combined as desired to create an overall system.

System coupling energy industry and production

Operating concepts and business models

How can Verbund sites be optimized?

In order to optimize Verbund sites and efficiently integrate scattered decentralized productions, dynamic processes at the level of the "molecule" must be linked and understood in conjunction with dynamic processes at the "system" level. Model-based coupling and optimization of the energy supply and demand for dynamically operated plants therefore takes place at typical production sites.

Goal:

- Development of new operating concepts and business models

Perspectives for an energy-driven production

How can production be guaranteed even if the energy supply fluctuates?

In the future, smaller, modular systems will be needed that are flexible with regard to different raw materials and the different products that they are meant to produce. For example, processes must include storage or buffers so that production does not come to a standstill when the energy supply fluctuates.

Goal:

- Development of dynamic simulation methods for an energy-driven production

Project partner
University of Duisburg-Essen

Simulation concepts for cross-scale energy technologies and systems

Adaptivity of energy systems and processes

How can technologies be adapted to the new flexibility requirements?

The adaptation of energy conversion technologies to the increasing requirements for flexibility and adaptability necessitates in-depth detailed knowledge. Knowledge gaps at molecular and technological level must be identified and closed.

Goals:

- Development of substance data models
- Use of multi-engineering models for fast, efficient, and robust (adaptive) design of system components

Understanding and mapping the energy system of the future

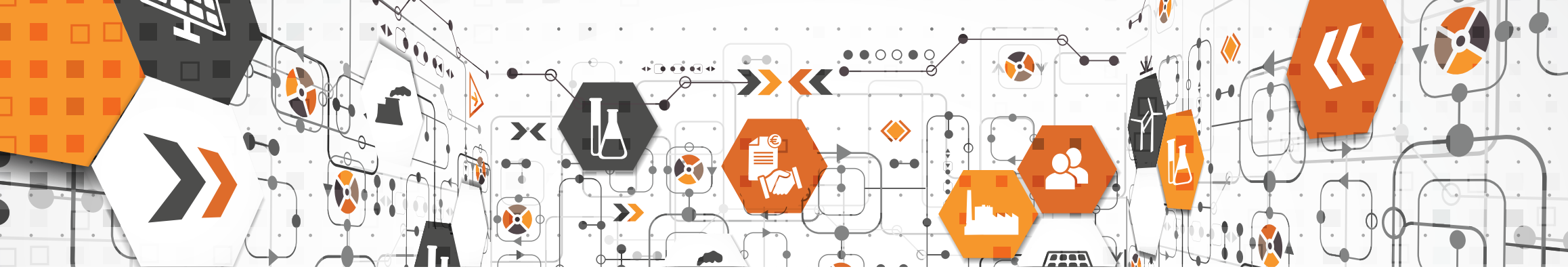
How adaptable is the overall energy system in the future?

The project partners develop new dynamic modeling approaches for mapping the flexible components in the future energy system and expand existing market and network models. This allows for the effects of these components on the overall energy system to be modeled, examined, and evaluated as appropriate.

Goals:

- Development of multi-agent systems for the evaluation of business models for decentralized flexibility technologies
- Expansion of existing market and power grid models with flexibility options

Project partners
Ruhr-Universität Bochum | TU Dortmund University



STRATEGY AND MANAGEMENT

As a transfer platform the High Performance Center DYNAFLEX® delivers fundamental research results to industry and teaching.

Transfer in the network: Clustering

Companies affected by the energy transition and raw materials shift benefit from sound scientific foundations and from the research platform. The High Performance Center creates the structural prerequisites for developing technology roadmaps, regional innovation centers and permanent clusters in cooperation with companies, regional universities, and Fraunhofer. The goal is to transfer knowledge into companies. This is done through joint R&D projects, stakeholder labs and an open internet platform.

Transfer roadmaps: Application projects

Researchers develop, process and provide methods as well as fundamental knowledge. Parallel to that, implementation projects are carried out with companies for the purpose of evaluating and demonstrating the scientific results and to identify new fields of action. Partners are companies from the energy, production, chemistry, biotechnology, and plant construction sectors.

Transfer through people: Teaching and professional development

Process dynamics is a complex and not very accessible discipline that is barely taught in undergraduate courses today. With the help of modern education and teaching programs using a variety of media in blended learning, the results of fundamental research and application are passed on to young scientists as well as, in the context of professional development programs, to those already in employment. Individual, company-specific programs are also planned. Partners are regional universities and the Fraunhofer Academy.

Cooperation

The cooperation with the Ruhr-Universität Bochum, TU Dortmund University and the University of Duisburg-Essen is established as a cluster in collaboration with strategic industrial partners.

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