Gas treatment by means of membrane technology makes use of the different material transport speeds (permeation rates) of individual gas components passing through a membrane. The engineering investment required for membrane technology is relatively low in comparison with other gas treatment methods. Membrane technology has a modular structure allowing it to be quickly adapted to changing operating conditions and a wide range of loads. The technology can be used for various separating tasks, such as the treatment of biogas to produce biomethane, and it is also suitable for smaller plants.

Range of services
- Test facility for the characterisation of membrane modules
- Investigation of dynamic long-term properties of gas by-products
- Dimensioning gas treatment systems

Facilities
- Versatile test bench:
  - Operating pressure: 0–16 bar
  - Operating temperature: 5–60°C
  - Volume flow: 0–20 m³STP/h
  - Variable gas compositions, e.g. H₂, CH₄, CO₂, CO, N₂, H₂O, air
  - Gas analytics and quantity measurement

Services for research and industry:
- Conception
- Basic Engineering
- Demonstration plant construction
- Test operation
- Monitoring

Facilities
- Test facilities suitable for endurance testing
- Various reactor types
- Gas analysis systems (IR, FT-IR, WLD, FID, GC and MS)
- Volume flow measurement systems
- Thermogravimetric analysis
The modelling and simulation of power plants and renewables-based synthesis processes are an essential factor in the expansion of renewable energy sources. The process efficiency and the profitability of planned plants must be quantified under variable conditions before recommendation for energy sources. The process efficiency and profitability of planned synthesis processes are an essential factor in the expansion of renewable energy supplies. ZSW has extensive expertise in the field of technical monitoring, which encompasses monitoring of many decentralised energy systems with low power outputs (e.g. combined heat and power in the domestic energy supply) and centrally installed power systems with industrial megawatt outputs. Some of the highlights of this work include scientific supervision of the flagship Calixus project in terms of the preparation of fuel cell combined heat and power (CHP) units for market launch and also the technical monitoring of Audi’s 6 MW Power-to-Gas plant in Werlte. As part of the monitoring process, ZSW provides technical expertise in the development of concepts, supports the production of basic calculations, defines the required measurement points and creates data transfer concepts. ZSW has a comprehensive IT infrastructure that ensures the efficient collection and processing of data. As part of the reporting process, the data is analysed, and this analysis forms the basis of recommendations for process optimisation.

**Range of services**
- Identification of detailed mass and energy balances for plant engineering
- Simulation-based development of innovative process combinations for power plant processes and synthesis processes
- Process optimisation by means of simulating alternative plant configurations
- Recommendation of favourable operating conditions via sensitivity analysis
- Monitoring and analysis of existing plants by means of process simulation

**Facilities**
- IPSEpro process simulation software
- Commercial and own model libraries

Since 2001, ZSW has been active in the field of thermochemical biomass conversion in fluidised bed reactors. Making use of its high-quality laboratory infrastructure, ZSW has focused on developing innovative processes to convert mineral-rich substitute fuels, such as biogenic residues. Since 2011, ZSW has developed associated new processes for coal and gasification. ZSW has extensive expertise in the field of technical monitoring, which encompasses monitoring of many decentralised energy systems with low power outputs (e.g. combined heat and power in the domestic energy supply) and centrally-installed power systems with industrial megawatt outputs. Some of the highlights of this work include scientific supervision of the flagship Calixus project in terms of the preparation of fuel cell combined heat and power (CHP) units for market launch and also the technical monitoring of Audi’s 6 MW Power-to-Gas plant in Werlte. As part of the monitoring process, ZSW provides technical expertise in the development of concepts, supports the production of basic calculations, defines the required measurement points and creates data transfer concepts. ZSW has a comprehensive IT infrastructure that ensures the efficient collection and processing of data. As part of the reporting process, the data is analysed, and this analysis forms the basis of recommendations for process optimisation.

**Range of services**
- Development of concepts for plant monitoring
- Recording existing data and measurements
- Data processing and evaluation
- Reporting and analysis of recommendations for process optimisation

**Facilities**
- IT expertise for data transmission

Thermogravimetric analysis (TGA) measures the mass change in a sample based on temperature and time. Therefore, the conversion in the gas-solid reactions can be broken down into periods of time and the influence of individual parameters (temperature, pressure and gas composition) can be determined by changing the reaction environment. TGA makes it possible to study the individual steps of gas generation, gas conditioning and gas purification and it also allows materials like sorbents and catalysts to be characterised.

**Range of services**
- Identification of favourable reaction conditions for catalysts
- Studying deactivation mechanisms
- Kinetics measurements
- Screening of catalytic activity
- Cycle stability tests
- Identification of sample composition
- Research on biomass conversion properties during pyrolysis or gasification

**Facilities**
- Netzsch STA 409 CD atmospheric thermobalance
- Rubotherm DynTherm high-pressure thermobalance (pressure-operated to 40 bar) linked to IPI GAM 400 mass spectrometer
- Rubotherm DynTherm high-pressure thermobalance (pressure-operated to 40 bar) linked to IPI GAM 400 mass spectrometer