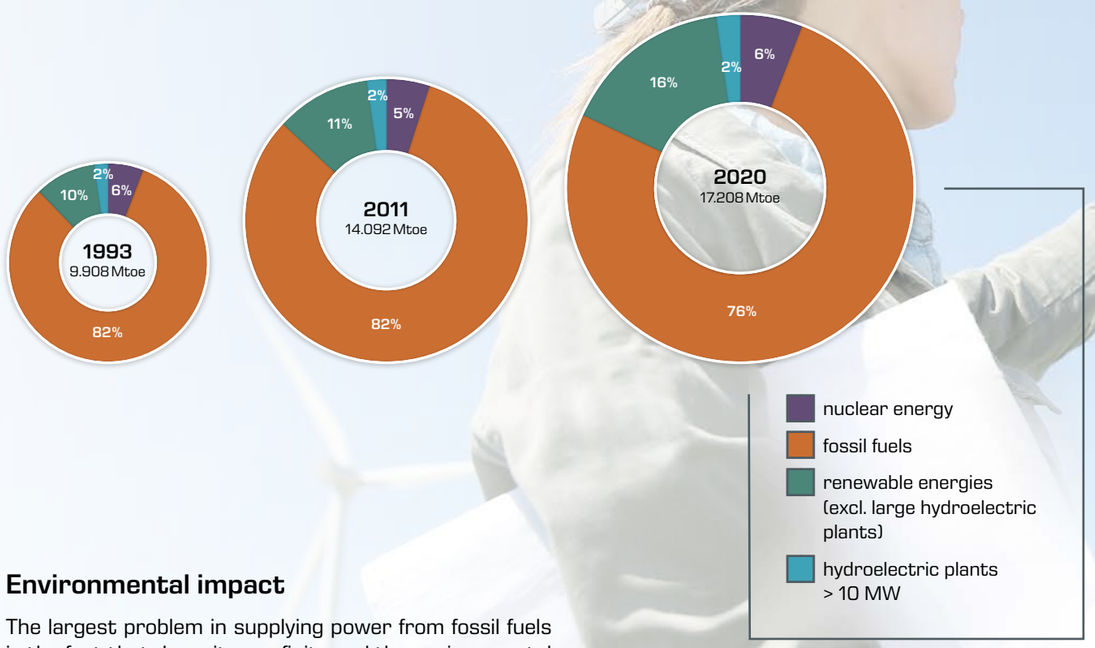
Basic Knowledge

Renewable Energies and Energy Efficiency

Rise in global energy consumption

A steadily growing global population and increasing industrialisation have, in recent decades, led to a sharp increase in global energy consumption.

The diagram from the World Energy Council (WEC) shows the rising consumption of primary energy from 1993 to 2011 and a forecast for 2020. Despite an increasing share of renewable energies, it is evident that the total quantity of fossil fuels being used is rising.



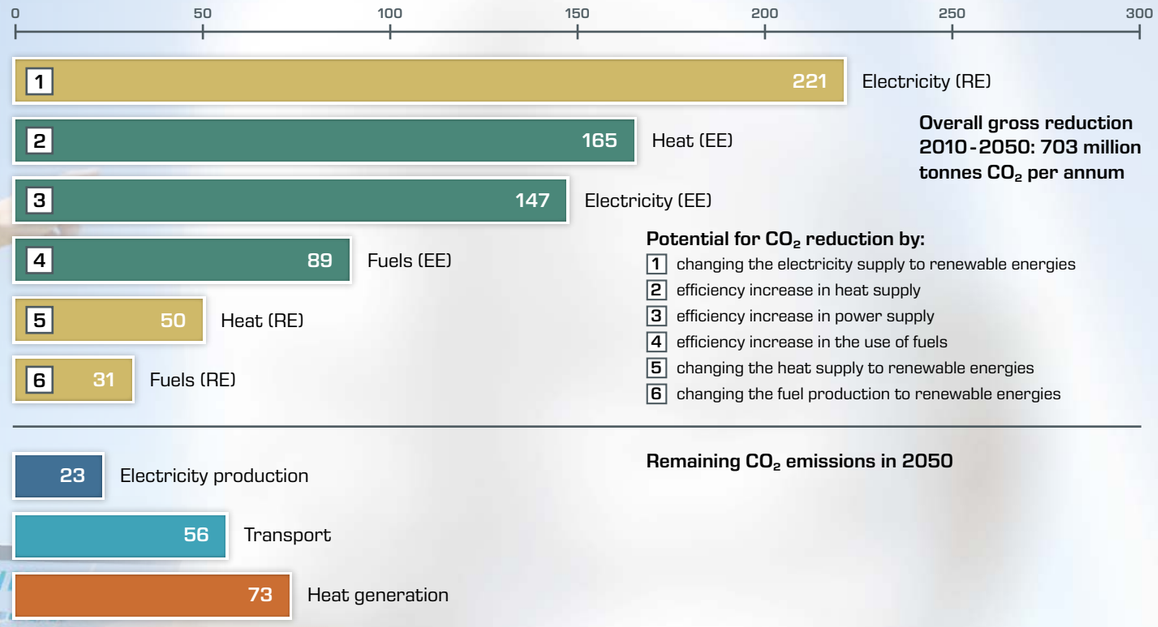
Source: WEC Survey of Energy Resources
Mtoe – million tonnes of oil equivalent
1 Mtoe = 0,041868 EJ (exajoule) = 11630GWh

Environmental impact

The largest problem in supplying power from fossil fuels is the fact that deposits are finite and the environmental impact of harmful waste products. Both the CO_2 emissions from combustion processes and the nuclear risks of nuclear power plants mean hazards for people and the ecosystem. Therefore, in addition to covering the energy demand, the main requirement of a future energy supply is the avoidance of waste products.

Protecting the climate through renewable energies (RE) and energy efficiency (EE)

In view of climate change, it is necessary to assess the suitability of energy supply technologies through their potential to reduce greenhouse gases. This is mostly done in consideration of technical, economic and social perspectives. The graphic below summarizes the results of a study for Germany (pilot study 2010) for a given scenario. It shows the expected reduction in CO_2 emissions for Germany in million tonnes per annum for 2010 to 2050.



CO_2 reduction potentials 2010 to 2050; remaining CO_2 emissions, million tonnes per annum

Source: Pilot study 2010 (BMU - FKZ 03MAP146)

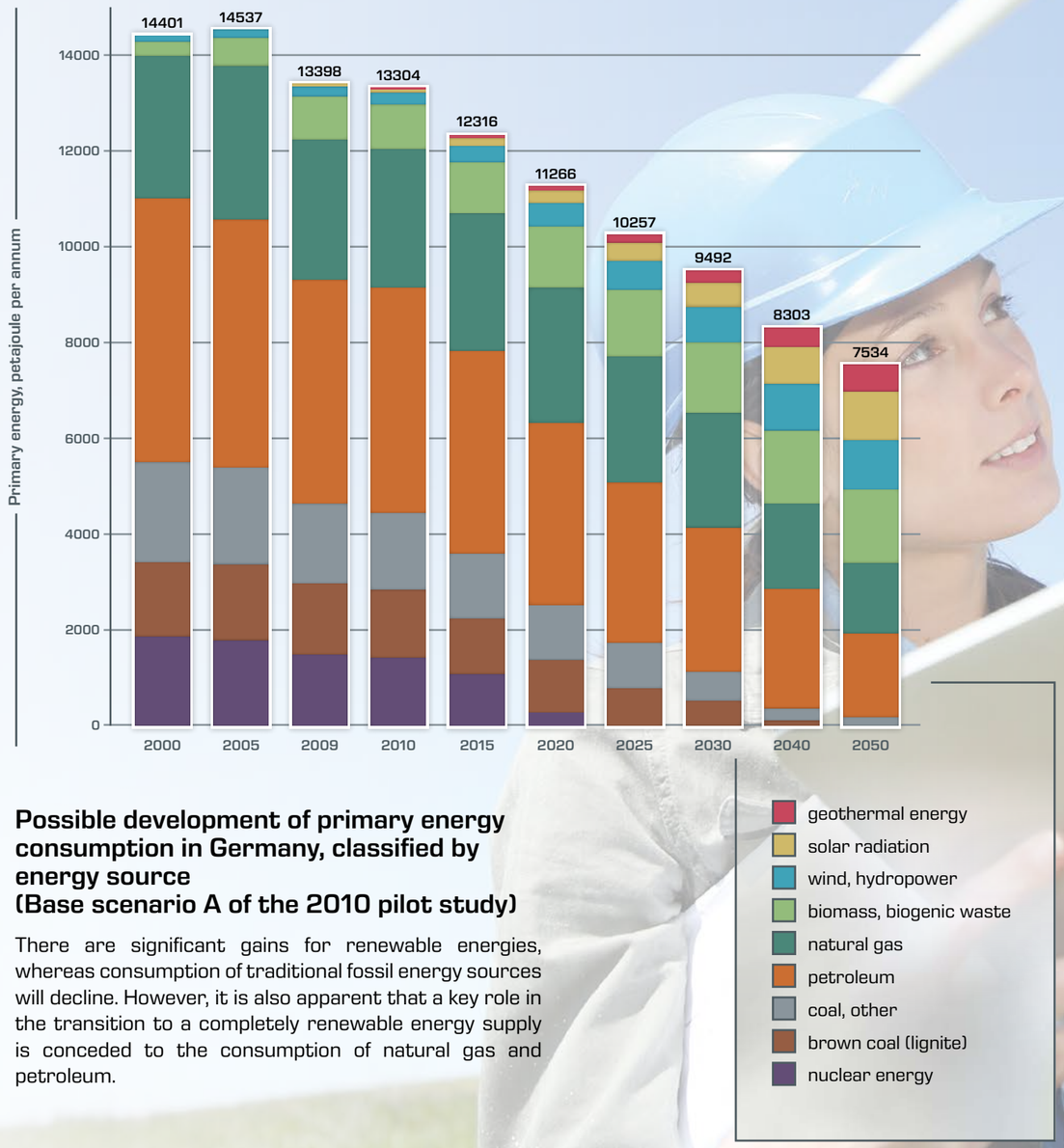
It is apparent from the graphic that, in the given scenario for Germany, a CO_2 saving of 703 million tonnes total per annum is achieved from 2010 to 2050. The graphic also lists 152 million tonnes of CO_2 emissions remaining in 2050, classified by sector. Energy production from renewable energies delivers the highest contribution to cutting CO_2 emissions. A comparable order of magnitude is achieved by energy efficiencies in heat and electricity generation. The basis for the scenario is phasing out nuclear energy use by 2020.

The graphic on the following page shows the development of energy production from separate sources over time.

Basic Knowledge

Renewable Energies and Energy Efficiency

Development of renewable energies / Reduction of energy demand



Possible development of primary energy consumption in Germany, classified by energy source (Base scenario A of the 2010 pilot study)

There are significant gains for renewable energies, whereas consumption of traditional fossil energy sources will decline. However, it is also apparent that a key role in the transition to a completely renewable energy supply is conceded to the consumption of natural gas and petroleum.

Efficient use of energy

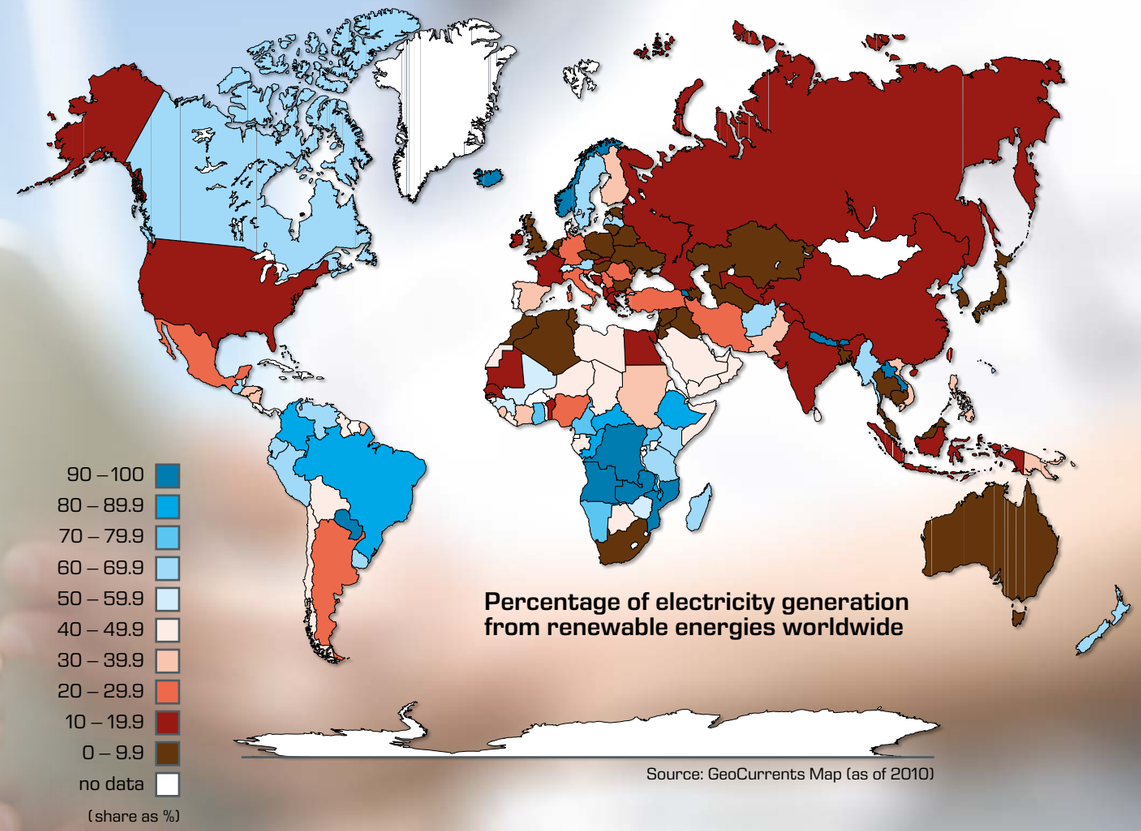
Besides increasing the share of renewable energies, one considerable challenge lies in the efficient use of available energy. It is only once adequate progress can be made in both areas at the global level that we will succeed in reducing the dangerous output of greenhouse gases to a tolerable level.

With our carefully structured product range in the 2E area, our intention is to support your efforts in teaching the fully qualified experts required to face up to these challenges.

Energy use in the global context

Climate protection and the changeover to a sustainable energy supply are tasks that can only be solved in a global context. On the introductory pages to the Solar Energy, Hydropower/Ocean Energy and Wind Power chapters, we offer you a global overview of the availability of the respective energy source in the form of a world map.

The figure below shows a summary of global energy production by renewable energies:



Percentage of electricity generation from renewable energies worldwide

Source: GeoCurrents Map (as of 2010)

Subject Areas
Renewable Energies and Energy Efficiency

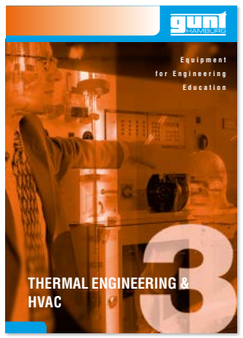
Energy for the world of tomorrow

Historically, the fields of solar energy, wind power, hydropower, biomass and geothermal energy have emerged from the field of renewable energy engineering. The division of these areas developed from the various primary sources of renewable energy. What is more, we consider the optimisation of energy systems in particular and the improvement of energy efficiency in buildings especially as the most effective opportunities to implement the holistic approach of the 2E area.

The fundamentals of energy engineering

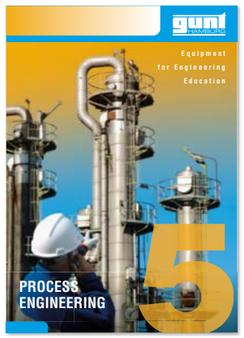
Knowledge of conventional energy engineering is an important foundation for renewable energies as well. This, for example, includes thermodynamics, heat transfer, cyclic processes, steam generation and turbomachines.

Basic knowledge in the field of fluid mechanics is required for understanding wind power and hydropower. Process engineering aspects are an important basis in the field of using biomass to produce energy. Our catalogues include devices which are relevant to these fundamental areas:



Catalogue 3
Thermal Engineering and HVAC

Catalogue 4
Fluid Mechanics



Catalogue 5
Process Engineering

We provide you with the most appropriate teaching systems for putting the areas of the 2E curriculum into practice through experimentation. The graphic shows the key elements, which we have sub-divided into the main areas.

Solar Energy
Photovoltaics, Solar Thermal Energy

Hydropower and Ocean Energy

Wind Power
Fundamentals of Wind Energy Engineering, Application Engineering in Wind Power Plants

Biomass
Bioethanol, Biogas, Biodiesel

Geothermal Energy
Heat Exchangers, Shallow Geothermal Energy, Deep Geothermal Energy

Energy Systems
Conversion, Storage

Energy Efficiency in Building Services Engineering
Heat Supply and Air Conditioning, Inclusion of Renewable Energies, Energy Efficiency in Business and Industry