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Energy and energy scenarios

In this technological age, energy is an important key to prosperity. Here, precise definitions will be explained. A focal point of this report features documented energy scenarios up to mid-2000. From these, it can be seen that in this century a reconstruction of the energy economy will be absolutely necessary. Changes in the scenarios will be made possible through political and economic based actions. The global trend to solar energy technology will continue with increased impetus. Research and development work in agricultural engineering should take account of these facts.

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Keywords

Energy reserves, energy resources, useable energy, primary energy, secondary energy, energy transformation, energy scenarios

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Energy is stored work and therefore has the potential to provide work. Energy appears in various forms. This can be as chemical energy, as molecular or atomic compound energy, as energy from electromagnetic rays, as electrical current energy, as mechanical movement energy with potential and kinetic energy, and as heat energy. All the energy forms used in agricultural technology are interchangeable with not-usable losses and, from that, equivalent to one another from a physical point of view. Energy, or the physical system of work reserves, is based on the concept that the total energy in a closed system stays constant and that, according to the Einstein equation – $E\ [J] = m\ [kg] \bullet c^2\ [m^2s^{-2}]$ – every mass m is an energy E equivalent, whereby c represents the speed of light. Not to be forgotten is the muscle work as work reserve of a physiological system which, globally observed, makes possible a practical interplay with physical systems. Energy is measured in the same units as work, thus:

1 joule = 1 J = 1 Watt second = 1 Ws = 1 Newton metre = 1 Nm = 1 kg m^2s^{-2}.

Energy transformation, energy definition and energy reserves

Primary energy is the energy available before anthropogenic energy transformation. To this belongs, under fossil energies, the raw materials from different coals, crude oil, natural gas; under nuclear energies the raw materials uranium and thorium compounds; under regenerative energies, solar rays, environmental heat, kinetic energy from water and wind power, energy content of biomass, energy content of sea waves and the tides, the temperature layers of oceanic water mass and the energy of the Earth magma.

Secondary energy is the energy after transformation of primary energy, or from further transformation of other secondary energies: for instance electricity from coal or sunshine; petrol or heating oil from crude oil; briquettes from coal; hydrogen from natural gas or electricity. Steam, hot water, electrical current, hydrogen are all secondary energy carriers which can be stored and transported in the form of heat, electrical energy or chemical energy.

Usable energy is the end energy which can be used by the consumer. Usable energy makes possible the wished-for energy service in the form of heat, light, power and communications energy. The aim of all efforts is the availability of usable energy with as little loss as possible. The usable energy is also changed to heat in the end and emitted into the environment.

End energy is energy changed into a form which can be used. It originates from primary and secondary energy reduced through transformation, storage, transportation and processing losses.

Energy stores are divided into energy reserves (economically usable) and energy resources (not economically usable). It has already been estimated that the energy reserves of petroleum and natural gas will be used-up in the middle of the 21st century, those of coal in the 22nd century, and of uranium through simple use (anthropogenically transformed) in the 21st century [2, 4].

World population

In the last 170 years, the world population has risen from 1,000 million to 6,000 million and will probably reach 8,000 million by

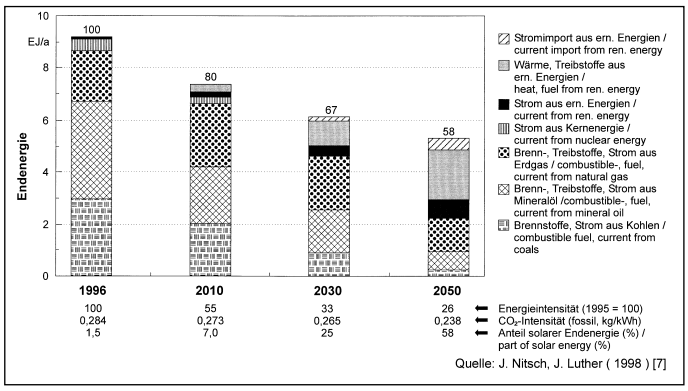

Fig 1: Structure of end-energy use in the future scenario for Germany

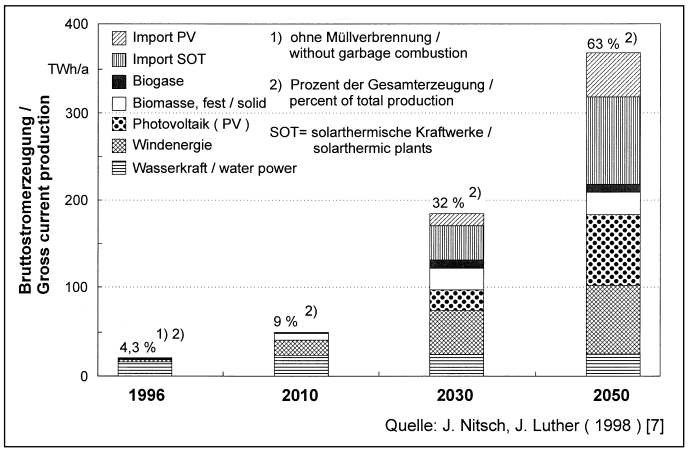

Fig 2: Contribution of renewable energies to the current supply in Germany

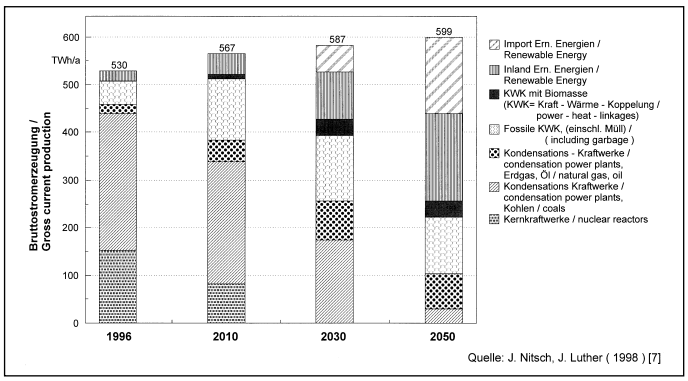

Fig 3: Structure of current production in the future scenario for Germany

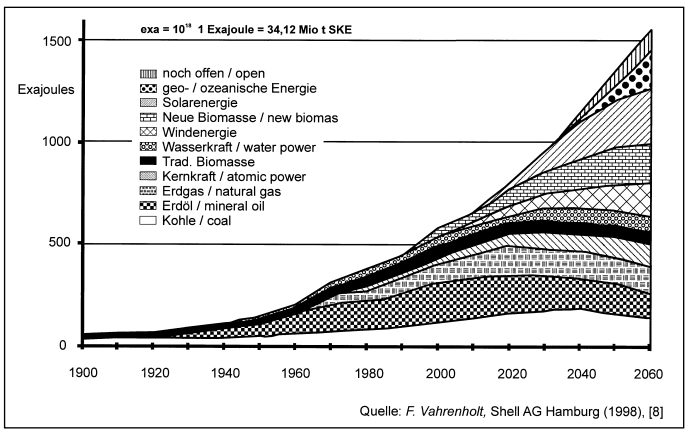

Fig 4: Energy scenario "Sustainable Growth" up to 2060

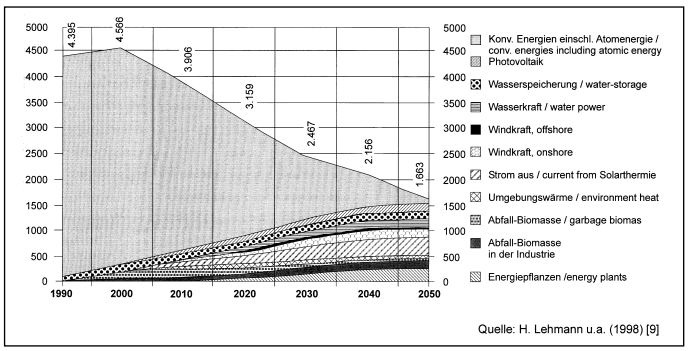

Fig 5: Energy scenario for Europe up to the year 2050

2020. The world energy consumption between 1990 and 2020 will, according to prognoses, be more than all previous energy use. The largest growth rates will be achieved outside of the current industrial lands. Even before 2010, Germany will be up to around 70% dependant on imported energy. In order to fulfil future generations' demands for prosperity, the question as to the energy reserves of tomorrow must be repeatedly gone into. With the resources "Knowledge and technical advances", improved exploration techniques could help in the transformation of energy resources into energy stores, and also the efficiency of the energy transformation could be improved so that resources are protected. Thus, for energy transformation into 1 kWh of electrical current today is required around 300 g stone coal units, that is around one half less than in the middle of the last century [3].

Reserves and consumption

The great earth oil reserve areas, which between them hold more than 68 million t of earth oil are also described as the "giants". Notable is the geologically-explainable fact that in a fraction of these "giants" – the megagiants – is stored the main part of the world's earth oil reserves [4]. The supply curve from the individual giants normally takes the form of a bell. By the summit peak of this graphic, some 50% of the available stores are used. This point is called "depletion midpoint". Today, one can reliably estimate that the point of 50% consumption of all earth oil will be reached around from 2010 to 2020. Nearly all the OECD countries [*], have already passed the depletion midpoint. Most OPEC countries [**] have – because of the megagiants – still to reach this point and because of this will, from a worldwide point of view, raise their supply quota. With this, it is not out of the question that there might occur situations comparable with the oil price crises in the years 1973/74 and 1979/80. The efforts of the EU countries towards a return to import independence becomes, therefore, a real background. Hardly understandable is the wide-spread ignorance regarding this subject. Not enough attention has been paid to the fact that we stand before an energy revolution as we enter the third millennium – this must take place in order to secure the viability of our industrial locations. The 20th century was the century of cost-efficient pumpable oil.

Energy scenarios

These are shown in *figures 1 to 5* [5, 6]. Solution recommendations [10 to 13] should be worked on.

Abbreviations

[*] OECD = Organisation for Economic Cooperation and Development. Headquarters: Paris, 29 member countries, mainly western industrial countries and a few in eastern Europe and Asian.

[**] OPEC = Organization of the Petroleum Exporting Countries. Headquarters: Vienna, 12 member countries (Algeria, Gabon, Indonesia, Iraq, Iran, Quatar, Kuwait, Libya, Nigeria, Saudi Arabia, Venezuela, United Arab Emirates; Equador left OPEC in 1992).