THE FUTURE OF FUEL: PROSPECTS FOR INTERFUEL COMPETITION

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The whole history of anthropogenic energy deals with the development of interfuel competition. The continuous search for applications of new energy sources widens the range of options to satisfy energy needs. At first, people had only their own muscular energy. Anthropogenic energy appeared when they started to use the muscular energy of tamed animals, and afterwards wind and falling water energy. Fossil fuels have been intensively applied as energy sources only for about 150 years. During this relatively short time the image of civilisation changed dramatically – its energy needs grew 35 times [1] and the population increased almost 6 times [2,3]. The coal and then oil era led us to industrial, and now to post-industrial society. Most of the countries passed through a first and second demographic transition. According to the results of research conducted by the Energy Research Institute of the Russian Academy of Sciences [1] the slowdown in world energy consumption means a transition to a new stage of world energy development.

It is important to mention that every new applied energy source has been more concentrated than the previous ones, until our recent turn towards renewables. And, crucially, it was technological development that enabled this intense increase in use of new energy sources. In fact, energy-efficient technologies promote energy consumption growth – personal computers would never have become so widely used if their function was still based on vacuum tubes.

On the one hand, we have approached a new stage of energy development with slowing energy consumption growth. On the other, we don't see prospects for commercialisation of any new highly-concentrated energy source (e.g., IEA research on energy technologies reveals very little hope for a hydrogen economy [4]). Opportunities for switching between fuels are considered to be quite limited now. On the whole, there is little information available on multifuel equipment. The first estimates of substitution elasticities made by D. Noel [5] and then R. Pindyck [6] are much higher than gained in more recent studies, based on more complicated and less aggregated by time and place models [7]. The

contemporary world energy consumption is much larger and more sophisticated; does this mean that interfuel competition is no larger a topical issue?

Indeed, interfuel competition terms differ by sector. In the industrial world, energy consumption is quite diversified and is characterised by the growing share of electricity. Oil, oil derivatives, and especially coal drive industrial growth in developing countries, but their share tends to decrease. In households and the commercial sector the growing share of energy consumption is also occupied by electricity, as the most easy to handle energy source for all energy needs.

Probably the most interesting tendencies in terms of interfuel competition are occurring in the transport sector, where for the last 35 years the share of oil products hasn't changed much. In recent years, the governments of the majority of developed countries, and a lot of developing countries, to promote consumption of alternative motor fuels. The prospects for development of GTL, CTL, biodiesel and biogasoline technologies differ by region, but taking into account moderate oil price growth, these technologies won't lead to sharp changes in the world energy balance of the transport sector [1]. Another technological breakthrough that can affect the world transport sector concerns the development of electric cars. The main restrictions to the mass use of electric cars are their price, battery efficiency, and underdeveloped infrastructure. But even without a substantial upgrade, electric vehicles will occupy a rising share in the world transport sector. To some extent, the growth of electric vehicles will smooth out the unevenness of electricity consumption.

The main area for interfuel competition nowadays is the electricity sector. For the last 35 years, the fuel basket of the world's electricity sector has been the most dynamic among other consumption sectors. Oil products were largely substituted by coal, the share of natural gas grew twofold, the share of nuclear energy more than fourfold. According to the ERI RAS projections, the share of electricity will approach half of world energy consumption of primary energy [1].

Although there have been no huge technological breakthroughs in the energy sector recently over the last few decades important steps were made in the commercialisation of unconventional fuels (deep and hard-to-recover oil reserves, different types of biomass) and technologies – gas turbines, wind and nuclear power stations, photovoltaics, batteries, etc. As a result, the resource base has been expanded considerably. These expansions have also contributed a lot to the widening of opportunities for energy source substitutions.

The ecological orientation of energy policies in most countries became another promoter of substitution between fuels. The consumer's choice of energy is influenced not only by tax, subsidies and the price of CO_2 emissions, but also through different non-price policy measures.

Eventually, the analysis demonstrates that interfuel competition strongly influences energy balances and, through rapid growth of electricity use, promotes the integration of all markets for energy sources. ■

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