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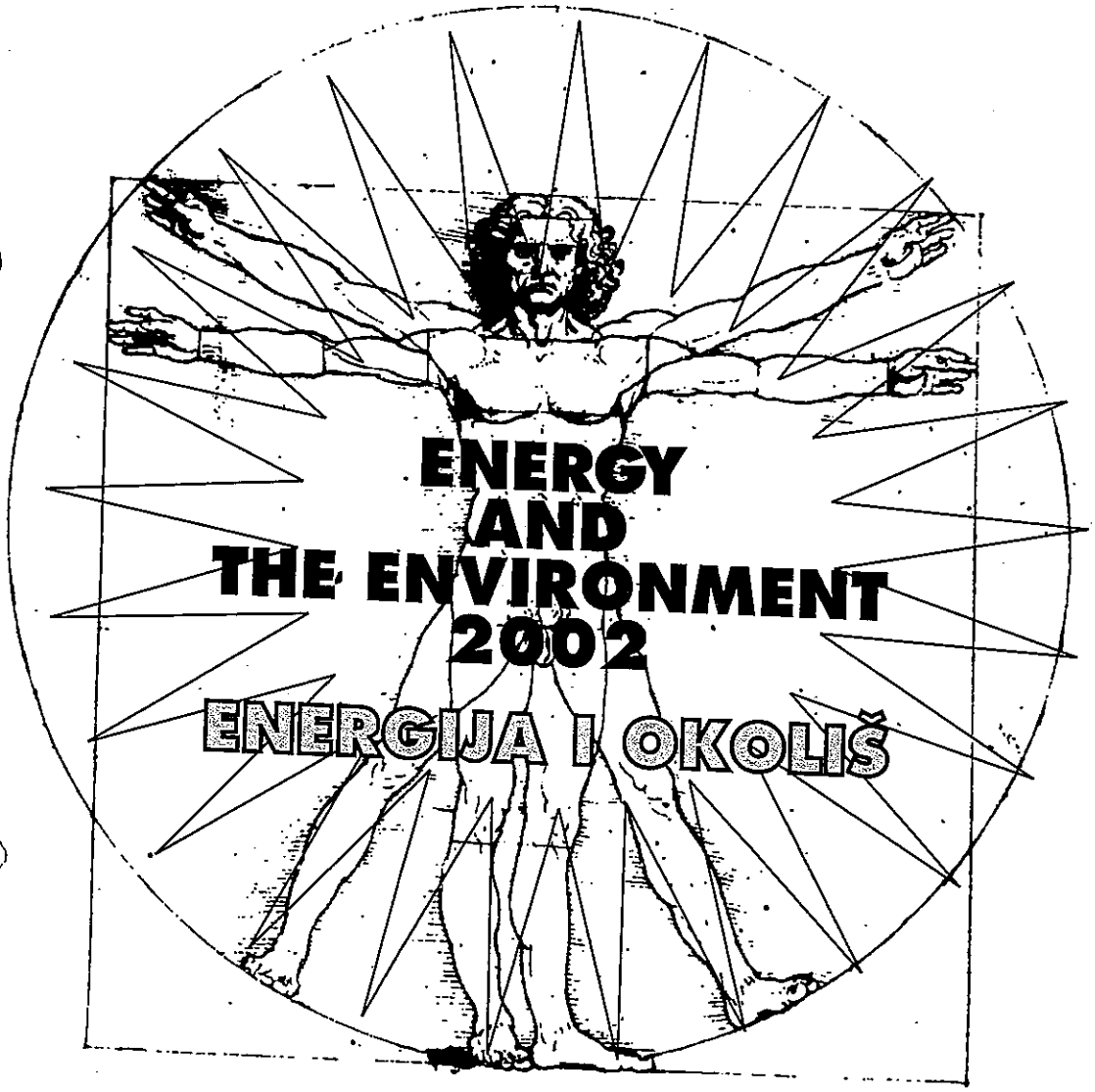

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ENERGY POLICY CHALLENGES FOR A SUSTAINABLE FUTURE

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Abstract: Reducing energy intensity, improving energy efficiency and increasing clean, indigenous renewable energy resources are the aims shared by both secure energy supplies and sustainable development. The inclusion of external costs in energy bills, within a stable economic framework, is likely to be an incentive for energy efficiency and investment in new and renewable energy technologies. Regulation and fiscal policy are two instruments available to governments. Such measures could reduce the relative price of renewable energy, produce economies of scale and thus significantly boost the role of renewables. Increases in demand are common to all energy sources, in particular imported sources, both across the EU and accession countries. Given the common vulnerability of all key energy sectors, it is imperative that solutions be found which increase diversity and viability of indigenous resources.

Key words: energy, sustainable development, renewable energy sources, energy policy

1. INTRODUCTION

Secure energy supplies and sustainable development share similar aims: reducing energy intensity, improving energy efficiency and increasing clean, indigenous renewable energy resources that simultaneously serve both environmental and energy supply objectives. One of the challenges for energy supply policy will be definitely to de-link economic growth and increase in energy consumption.

2. ENERGY POLICY IN THE LAST THREE DECADES

Renewable energy and energy efficiency have been an issue within the European Union (EU) since the 1970s. The concerns for energy security and the heavy dependence on oil ("oil shocks" of 1973 and 1978) are still relevant today with continuing fluctuations in oil prices. These have been joined by environmental concerns with acid rain emerging in the 1980s and climate change in the 1990s. Although the knowledge of greenhouse gases and the greenhouse effect has been known and addressed by scientific circles for many years, it started to attract strong public attention only in the 1980s. Added to this has been a desire to develop flexible and diversified forms of energy supply, which would better support the differing requirements of regional development across Europe.

Although the patterns of energy use and production have changed in the sense that the energy intensity of industrial and domestic activities have been drastically reduced, the increased demand for consumer goods has, in general, cancelled out any energy saving benefits of the

new technology. For example, in transport, increasing the efficiency of cars has not reduced petrol needs because the growth in the number of cars and passenger miles has more than cancelled out any savings [1]

3. CONVENTIONAL FUELS

Oil a has larger share of the energy market than any other fuel type, although this proportion is falling. In 1970, oil represented more than 60% of primary energy supply. This figure is now down to 44%. Demand for oil continues to grow, particularly in the transport sector. Transport is almost completely dependent on oil as an energy source and is also one of the major customers for oil.

Energy diversification, reductions in energy intensity, the almost general exclusion of oil products from the production of electricity and heat and structural changes in Europe's economy, which has changed from being an industrial society to a services society, have lessened the impact of erratic fluctuations in the prices of oil.

Natural gas is increasingly becoming the favoured fuel for electricity generation, replacing oil and coal. Gas powered plants have a low investment cost which give a quick return on investment and are more efficient. Due to its chemical composition, gas has lower greenhouse gas emissions than oil and coal for many types of energy services.

Natural gas, which was discovered at the beginning of the 1950s, took decades to earn its place in the energy sector. Once considered to be a second-rate energy product (by-product of the exploitation of oil) it has now become a multi-faceted source of energy. Gas is in competition with all energy products on all markets.

Coal has in the past been associated with pollution and is still a large emitter of CO_2. Economically, coal offers the advantage over oil and gas of relatively stable prices, partly due to an excess of supply over demand.

In the long term, coal is likely to remain important as new technologies come on stream that reduce extraction costs, reduce emissions and dramatically increase its efficiency. It is likely that coal will continue to be used for electricity generation in the long term, to the benefit of energy diversity and security of supply.

Under the pressure of ecological concerns, solid fuels as well as **nuclear energy** have fallen from grace and seem set to play less of a role in the production of electricity.

Community resources in conventional primary energy cannot, at their current stage of development, form the basis for European energy self-sufficiency [2]. Only technology-effective renewable resources can help mitigate the present trend towards increasing energy dependence.

The surest and most effective way of decreasing CO_2 emissions, reducing pollution, safeguarding the environment and improving the quality of life within Europe, is simply increase the efficiency with which we use fossil fuels – thus reducing the energy waste in industrial processes, transport, commercial and domestic uses [3, 4]. Given the time horizon

for large-scale commercial use of wind, wave and solar energy, the research undertaken on saving traditional fossil fuels may prove to be the most effective of all.

4. RENEWABLE ENERGY SOURCES (RES)

The major RES sectors are wind, photovoltaic (PV), solar thermal power plants and solar energy in buildings, hydro (small and large scale), biomass and geothermal. Their obvious attraction in terms of energy supply is that they are either naturally occurring or can be replaced quickly, do not need to be imported, and in general have less impact on the environment than conventional energy sources.

Installed capacity for **wind** energy more than doubled in the 1990s and the potential is for a further dramatic growth. In the long term, and subject to tackling technical and local planning barriers, wind energy could have potential to contribute up to 30% of the current electricity demand (15% of overall primary energy in the EU) [1]. As new technologies for offshore installations, lighter structures and variable speed generators come on stream, the contribution of wind to the energy balance is likely to grow significantly, with greater capacity wind turbines and large dispersed wind farms. This makes wind energy a potential powerful instrument in energy supply policy, subject to stability of production and electricity storage or back-up possibilities.

The future of **PV** production in the EU is likely to be decentralised – integration into buildings and multi-purpose installations or the development of PV kits. PV is very attractive in urban situations where space is limited. Even today, PV is cost-effective in many off-grid applications. Overall, unless the price can be reduced quickly, PV is unlikely to be a significant contributor to the energy balance in the short term, but will be an important factor in electricity supply in specific local situations.

Solar thermal collectors, which produce low temperature heat for domestic applications, face similar economic barriers to PV, although they are less dramatic. Solar energy has further uses in buildings, such as for lighting and cooling, which can significantly reduce energy demand.

Solar power is the most obvious source of sustainable energy. It also helps to preserve resources, prevent the greenhouse effect due to CO_2 emission and provide energy without any significant environmental impact. The problem, under current taxation regimes, is its cost.

Although small **hydro** currently represents only 3% of all hydro production, the main growth in this area is likely to be in small-scale hydro (<10 MW) for local, decentralised generation [1]. Small-scale hydro has high efficiency and potentially low installation costs. Decreases in head height, variable speed generators, reductions in the cost of equipment and environmental mitigation technologies will enhance the attractions of mini-hydropower.

Electricity generation form **biomass** (such as forestry and agriculture residues) potentially offers environmental benefits, socio-economic benefits from re-deployment of surplus agricultural land and energy independence. Biomass is very much a regional energy source.

Biofuels emit between 40 and 90% less in the way of greenhouse gases than other fossil fuels [2]. They also give off less particulate and carbon monoxide and hydroxide. Biofuels will also help to create jobs in rural areas and thus preserve the rural fabric by providing agriculture with new outlets. In this respect, care needs to be taken to ensure that biofuels do not lead to a continuation of highly intensified forms of agricultural production. In the longer term, the possibilities of other renewable sources of fuels, such as hydrogen, need to be exploited.

Renewable sources of energy have considerable potential for increasing security of supply in Europe. Developing their use, however, will depend on extremely substantial political and economic effort [5]. In the medium term, renewables are the only source of energy in which the EU has a certain amount of room for manoeuvre aimed at increasing supply in the current circumstances. This form of energy cannot be neglected.

The progress made in the renewables sector is offset by the increase in consumption. It has stagnated at around 6% of global consumption despite consistent annual growth in the sector of 3% and spectacular growth of more than 2000% in the wind energy sector in 10 years [2]. Supply-side efforts will only succeed if they are accompanied by policies to rationalise the demand for energy. In the years ahead, renewables' share in energy consumption will have to increase in absolute terms. Their proportion (in relative terms) in the energy balance will depend largely on being connected to the electricity network and being competitive in decentralised production [6].

Renewables represent around 14% of electricity generation – a figure that was fairly constant throughout the 1990's. This figure disguises significant real increases in RES production (over 30%) because energy demand also grew over the same period [1].

Much RES technology is still at a relatively immature stage of development, compared with conventional energy technology. Moreover, new entrants often have a difficult task in entering traditional markets, and energy is no exception.

Short of a technological breakthrough the position of renewable energy sources on the market could be improved by high oil prices or through inclusion of the "price of emission certificates" in the investment cost of conventional sources of energy.

5. TRANSITION TO HYDROGEN ECONOMY

Steam and the internal combustion engine have driven the rapid advances of society and industry in the 20th century. However, these rely largely on fossil fuels that are limited and environmentally damaging. One area of research of interest to supply security and diversification of energy supply is hydrogen exploitation. Hydrogen can play a major role in bringing about clean energy conversion, in particular in combination with fuel cells. Further development is needed for smaller cost-effective systems, which produce hydrogen from methanol and petrol.

The planet is thought to have considerable reserves of gas hydrates, which, if exploitable, could fuel this revolution. However extraction is highly problematic and creates the risk of possible methane leakage [7].

Subject to technological progress, hydrogen could be to the 21st century what oil was to the 20th. In a fuel cell, hydrogen and oxygen combine to form water and the energy released produces an electric current. The reaction is electrochemical and the potential electrical conversion efficiency is up to three times higher than the useful energy produced by combustion. The conversion from hydrogen to electricity takes place with low emissions, and a replacement of the internal combustion engine is one application being developed.

By directly converting chemical energy into electric energy, fuel cell technology [8, 9], attains higher efficiencies than burning fuels. Fuel cells are also much less noisy, have less polluting emissions, they are small in size and relatively easy to move around and replace. Potentially, fuel cells could substitute for large parts of today's combustion systems and make a contribution to energy reduction, decrease exhaust gas emissions – improve the diversification of the energy supply and sustainable development in general.

Fuel cell systems are recognised as a key technology for CO_2 reduction, greater fuel efficiency compared to internal combustion engines, and near zero emission of harmful substances like NO_X, CO, particulates, etc. Investment costs are generally still too high to compete with existing infrastructure investment in traditional technologies, current weak emission regulations, and approaches to fossil fuel taxation.

6. FUNDING RESEARCH

Technology will be critical in meeting the needs of current and future generations and de-linking economic growth from environmental degradation, both in the present EU and in an enlarged Europe. In the energy field, technological change is not cheap – research is expensive [10] and requires a long development and lead-in period and the pay back is often uncertain. Successful marketing and consumer education [11] are also key factors in their success.

Governments have for many years recognised the need for intervention to provide the right incentives and price signals to firms and influence consumers' awareness and behaviour. Thus, public funding has a pivotal role in financing basic research underlying innovation in clean technologies and support for the development of markets for substantial stock of more energy-efficient technologies that are close to being competitive.

Helped by technology advances, costs in some sectors, e.g. wind, have fallen dramatically over the previous decade and continue to fall.

7. FULL PRICING

RES energy is attractive to energy supply for environmental and geopolitical reasons. The raw fuel – sunlight, wind, waste etc – is free or cheap. Renewable energy has the potential to provide a safe, clean and affordable energy supply, without threat of external disruption or depletion of reserves.

RES do not compete on an equal basis with conventional fuels. As well as technical and practical barriers, a major obstacle is the high cost of RES technologies compared to the cost

of fossil fuel based technologies. This suggests the need for appropriate financial incentives to promote renewables. Another obstacle is the exclusion of external costs from the price of fossil fuels, coupled with an inheritance of subsidies on the part of conventional energies (including nuclear).

Changing pricing mechanisms so that external (environmental, health, social) costs [12] are included in energy prices would increase their attraction. In the long term, the inclusion of external costs in energy bills, within a stable economic framework, is likely to be an incentive for energy efficiency and investment in new and renewable energy technologies, both of which are favourable to energy supply security. Regulation and fiscal policy are two instruments available to governments. The example of nuclear energy shows the potential for governments to transform energy supply by a targeted programme of measures. Such measures could bring down the relative price of renewable energy and produce economies of scale and thus significantly boost the role of renewables [13].

As long as there is no "full pricing" of traditional fossil fuels, the impact of such energy research will be relatively weak. Conversely, research on improving the use of traditional fossil fuels is likely to have a relatively greater commercial impact – and indeed impact on health and environmental issues.

A further improvement in energy supply prospects is the creation in recent years of new European networks and decentralised generation.

8. CONCLUSION

Solid fuels and nuclear energy have been decried, oil is subject to geopolitical hazards that are hard to control, renewables are failing to penetrate the market because they present technological difficulties and are not profitable enough. Natural gas supplies could, in the long run, be subject to risks of instability. Demand is changing, adapting to new rules governing the operation of the market and taking increasing account of environmental concerns. Energy supply considerations are coloured by environmental, economic and political developments.

Increases in demand are common to all energy sources, in particular imported sources, both across the EU and accession countries. Given the common vulnerability of all key energy sectors, it is imperative that solutions should be found which increase diversity and viability of indigenous resources.

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IZAZOVI ENERG

Sažetak: Smanjenje inten
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Ključne riječi: energija, o

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IZAZOVI ENERGETSKE POLITIKE ZA ODRŽIVU BUDUĆNOST

Sažetak: *Smanjenje intenziteta energije, povećanje energetske djelotvornosti i povećanje izvora čiste, lokalno raspoložive obnovljive energije predstavljaju ciljeve kako sigurne opskrbe energijom tako i održivog razvoja.. Uključivanje vanjskih troškova u energetske obračune predstavlja unutar stabilnih gospodarskih okvira podsticaj za energetsku djelotvornost i investiranje u nove tehnologije obnovljive energije. Državna regulativa i fiskalna politika su instrumenti koji stoje na raspolaganju vladama. Takve mjere mogu uzrokovati pad relativne cijene obnovljive energije i ekonomskim putem bitno pospješiti značaj obnovljivih izovra. Povećanje potražnje zajedničko je za sve izvore energije, naročito uvozne izvore, kako diljem zemalja Europske Unije tako i zemalja pristupnica. Upravo zbog zajedničke ranjivosti svih ključnih energetskih sektora, imperativ je pronalaženje rješenja koja će povećati raznolikost i raspoloživost lokalnih izvora.*

Ključne riječi: energija, održivi razvoj, obnovljivi izvori energije, energetska politika