

THE GLOBAL ENERGY CONTEXT — CHANCES AND CHALLENGES FOR THE 21ST CENTURY



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Abstract

Energy is the driving force towards economic and social development. Global demand for energy will keep growing for many years to come due to ongoing, although reduced population growth, and due to the needs of up to 2 billion people who are still without access to commercial energy. To meet this growing demand for energy, all options have to be kept open, with fossil fuels, nuclear and hydro dominating the energy mix for the next decades, and “new” renewables coming in only slowly. Considering the resulting strain on the environment, and looking at existing disparities in energy supply, the next few decades will not be free of tensions. A turning point may appear in the mid 21st century with world population coming to a halt, distinctly improved energy efficiency also in the Developing World, and with new technologies available. Thus, mainly challenges will determine the first half of the century, whereas chances are on hand for the second half of the century – **if we act now**. The single most important instrument to meet these challenges and to take advantage of the chances is a concentrated move towards energy efficiency and innovation, supported by market reform and appropriate regulation.

1. INTRODUCTION

Any discussion of global energy problems in the 21st century has to take into account three fundamental aspects:

First, the chances and the challenges in the first half of the 21st century will be quite different from those dominating the second half (with development of world population as the determining factor).

Secondly, energy must never be discussed in a one-sided way, but always in its interactions with the other important “E”s: the Economy, the Environment and, last not least, with Education.

Thirdly, notwithstanding rapid globalisation in such elemental fields as energy, information technologies, biotechnology etc., which seem to call for global answers, it is very likely that the best answer will lie in local capacity building and local decision taking rather than in ever larger, faceless supra-national or even global bureaucracies.

2. THE 21ST CENTURY – A TURNING POINT?

Within the 21st century, two different periods have to be distinguished: The next few decades, leading us, roughly, to the year 2030, and the time beyond:

- Exploring, producing, distributing and supplying energy is, even in fast-moving times like today, characterized by long lead-times. Over the next decades, therefore, no radical changes in energy trends are likely to occur. This is too short a time-frame for new technologies, changes in capital stock, different lifestyle patterns, and institutional reforms to have a major impact on a global scale.

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- World population – still the decisive factor for the growing need for energy and an increasing strain on the environment – is still growing, although slower and slower. It might come to a halt before the mid of the century, thus signalling a turning point for world development as a whole.

It is for these reasons, why we can predict the decades lying immediately ahead of us rather precisely, although we can influence the actual developments only to a very limited extent. On the other hand, the far future has more uncertainties, but offers a much greater scope for initiating new developments. In short: The challenges are prevailing today, whereas the chances wait in the future - but only if we begin to act on them *now!*.

3. THE CHALLENGES

What now are the foreseeable developments and challenges during the next few decades?

- We know that today's world population of 6 billion people will continue to grow, according to the latest estimates to as much as 8 billion people in 2020, and 9 billion people in 2050 (1900: 1,6; 1950: 2,5).
- We know that this growth in world population will lead to a growing need for energy: 13 G toe in 2020 and up to 20 G toe in 2050 are not an unrealistic expectation (2000: 10 G toe). Growing need for energy, by the way, means in particular a growing demand for electricity. These dry figures conceal alarming specific developments: Rapid urbanisation – by 2050, more than half of the world's population will live in big cities; rapid increase of the "car population" of the world – 700 persons per car in China as against less than 2 persons in the USA is a rather threatening potential; and, consequently, a steady growth in CO₂-emissions.
- We know also that meeting this demand for energy will be possible only, if we can provide on a global basis sufficient – and "sufficient" here means large additional – quantities of oil, coal, natural gas, nuclear, hydropower.

Some question the need for fossil fuels and nuclear, recommending different priorities: Saving energy, and development of wind, solar, biomass and other "new" renewable energies. Unfortunately, these priorities are – at least for the next decades – illusions rather than real options:

Saving energy will not be able to stop the growing demand for energy. At best, saving energy can help to delay this process, mainly in Industrialized Countries which have the necessary know-how and finance available. Energy saving in Developing Countries is quite a different story, not to mention the almost 2 billion people who have to exist without any access to commercial energy – "saving" energy certainly is no solution to their problems!

New Renewables are a nearly unlimited supply for energy if one considers the energy needs of mankind compared with the energy we receive from the sun. They are also mostly domestic or local and therefore secure. The trouble is that new renewables cannot generally compete with conventional energy sources or replace them without large subsidies. However, this does not mean that it is not worth promoting renewables to benefit from the likely economies of scale and learning curves that increased deployment and competition will bring. In 2020 new renewables could contribute some 5% and in 2050 well over 10% to global energy supply. To achieve a more rapid growth, the underlying additional cost would be enormous.

The contribution “new” renewables can make realistically in the foreseeable future should be aimed not at substituting fossil fuels or nuclear, but at substituting so-called non-commercial energies, which in many discussions are overlooked, although they are a serious problem on the way to achieving a sustainable energy supply:

Non-commercial energy still represents 14% of the world’s total final energy consumption, most of it taking place in developing countries, and just over 12% of the world’s total primary energy supply. Most of this energy (fuel wood, crop wastes and animal dung) is not sustainable unless it is developed into modern biomass. It still represents almost double the quantity of energy supplied by hydropower, and nearly six times the amount supplied by “new” renewables. It is to be feared that “traditional” non-commercial (mostly biomass and wastes) contributions will remain on the same level of annual consumption to 2020, unless modern biomass or other “new” renewable energies can be brought in as a substitute.

- We then know, or should know, that securing a sufficient supply of energy – which we, living in Industrialized Countries, tend to take for granted – is everything but a natural thing to Third World countries. For them, it is an enormous challenge. Energy poverty for many countries is not just empty words but a serious threat.

Without an adequate supply of energy, however, it will hardly be possible to break the vicious circle of poverty and uncontrolled consumption of natural resources, nor will it be possible to improve the standard of living in the Third World. “Improved standard of living”, in this context, by no means is the standard of living we have become used to in many affluent societies of the West. To call for a better standard of living in the Third World rather is aimed at fighting mass poverty as it still exists in large parts of Latin America, Africa and South Asia, is aimed at the 25% of the world population which still today are without clean drinking water, and is aimed at the 15 million children who die each year unnecessarily from malnutrition or diseases.

- Furthermore, we know that the next few decades may bring far-reaching geopolitical changes and shifts. Just a few facts and figures may serve to illustrate this: Twenty years from today, less than 20% of the world’s population will live in Industrialized Countries (consuming, however, the major part of all energy produced), whereas more than 80% live in the so-called “Third World” (having to be content with consuming the remains). Or take resources: More than 80% both of the global oil and the global natural gas resources are concentrated in only two regions of the world which are certainly not amongst the most stable ones – the former Soviet Union and OPEC-Countries. A run of resource-poor regions, such as Western Europe and Asia-Pacific, for access to these vital resources is more than just a theoretical possibility, and such a run might well develop into a fight, hopefully carried out with peaceful weapons only. These are just some of the disparities and discrepancies typical for today’s global energy picture. Should they persist, they might very well lead to serious political tensions, reaching beyond the sector of energy.
- Finally, we are becoming more and more aware of the severe test to which we put the environment of our globe due to the dominance of fossil fuels which is bound to continue for at least a few decades more.

4...AND CHANCES?

The perspectives for the decades lying immediately ahead of us, which I have just mentioned, namely increased world population, increased energy demand, increased strain on the environment may seem threatening. And yet there is no reason to despair, to fall into resignation, or pessimism, because there are a number of long-term factors which justify a “guarded optimism” for the second half of the 21st century:

- Population growth rates have already started to decrease in many, if not in most countries. It should be noted, however, that such a slow-down of growth rates, which eventually will lead also to a lower demand for energy, always goes hand in hand with – or rather is the consequence of – a positive economic development. In other words: Only where the minimum subsistence level is guaranteed, there is the willingness and the ability to learn, which again is the precondition not only for family planning but also for a more rational and efficient use of energy.

The same, by the way, is true for man's approach to and use of the environment: As long as he has still to fight for his own survival, he will not give much thought to preserving the environment – consciousness for the environment has come and will come only from and through prosperity.

- As just mentioned, economic development in the Third World will eventually – as was the case in all Industrialized Countries – lead to higher energy efficiency, thus easing the pressure from an ever growing need for energy.
- As another positive factor, we can be certain that a few decades from now, and for the rest of the century new, more efficient energy technologies will be available. Nobody can predict exactly today whether this will be the fuel cell, hydrogen or nuclear fusion. We know from experience, however, that technological development is not loosing, but gaining speed. Obviously, such developments will not come by itself. This means that we have to invest in them – on the broadest possible scope, and careful not to rule out any specific technology too early – already today, even if we can expect to reap the benefits only tomorrow, or even later.

To illustrate that the future holds many surprises indeed, let me give you a little piece of experience from the past:

In the thirties, the American President Franklin D. Roosevelt commissioned his administration to undertake a vast study of the coming technologies. When the study was published it made a very big impression. There was just one problem: it had not predicted the coming of television, nor that of plastic, or jet planes, or organ transplants, or laser beams, not even of ball-points pens!

5. THE STRATEGY: BRIDGING THE GAP

What is the conclusion, now, from the fact that the challenges lie immediately ahead of us, whereas the chances become visible and tangible rather in the future? The logical consequence is, I think, to follow a strategy of “bridging the gap”. The gap – this is the period of the next 30 years, after which we can expect an easing of tensions due to a reduced growth of world population, increased energy efficiency and the benefits of new technological developments. Such a bridge to the future can not, however, be built on black-or-white solutions, nor on utopias or on illusions. What is needed, is action based on reality, which means above all two things:

- First, in order to solve the short- and medium-term problems, we need the intelligent and responsible use of fossil fuels and of nuclear energy on a world-wide level, combined with resolute energy efficiency measures, and with the enhancement of “new” renewable energies.
- Secondly, in order to prepare ourselves for the far future, we need long-term research and development, opening up horizons for altogether new energy systems

Again: It will only be towards the mid, and in particular during the second half of the 21st century, that population growth may come to a halt. Then, and only then, we shall see greenhouse gas emissions stabilized or decreased. Then, and only then, will new energy systems such as fuel cells, solar,

advanced nuclear technologies, super conductors etc. be likely to come on stream. But, if all of this is to become reality, we must start taking the necessary decisions *now*.

Above all, we need a realistic approach. It is far better to act and use even modest tools available now than to dream of, or wait for solutions achievable only in the future. Two practical examples may serve to illustrate this: The – literally – burning problem of slums in the megacities of Africa, Asia and Latin America can hardly be solved with the idea, tempting as it may be, of constructing strictly biologically designed buildings like the one used by Amory Lovin's Rocky Mountain Institute. And the 1.5 litre automobile, built with carbon-fibre, will hardly be available in time to stop the avalanche of motorization just begun in China, India and elsewhere.

6. THE GOALS: ACCESSIBILITY, AVAILABILITY, ACCEPTABILITY

A detailed discussion of these three energy goals can be found in the World Energy Council's Statement 2000 "Energy for Tomorrow's World – *Acting Now!*" Here it may suffice to highlight just the most important aspects.

Accessibility to modern energy means that energy must be available at prices which are both affordable (low enough for the poorest people) and sustainable (prices which reflect the real costs of energy production, transmission and distribution to support the financial ability of companies to maintain and develop their energy services).

This definition may sound rather theoretical, but the problems concealed by this formula are very real: It is the problem of the 1.6 billion people who do not have such access to commercial energy, a number, which could grow to 2 billion in the year 2020; the growing problem of supplying both exploding megacities and remote rural areas with the appropriate energy; the problem of non-payment, a serious signal of social problems (and often aggravated by the process of liberalization).

Availability covers both quality and reliability of delivered energy. The continuity of energy supply, particularly electricity, is essential in the 21st century. Unexpected power cuts bear a high cost for society that cannot be ignored. The world's growing reliance on information technologies makes reliability even more critical. Energy availability requires a diversified energy portfolio consistent with particular national circumstances. It should be obvious that all energy resources will be needed over the next fifty years, and that there is no case for the arbitrary exclusion of any source of energy.

Speaking here at the IAEA, obviously calls for a particular word on the future role of nuclear, as seen by the World Energy Council:

- (1) At present, with providing 18% of global electricity production, and as a CO₂-free energy source, nuclear energy plays an important role globally and in many countries which base the better part of their electricity on nuclear.
- (2) While the future of nuclear power is questioned by some WEC members, the great majority of WEC's almost 100 Members Committees believes that the role of nuclear power needs to be stabilized with the aim of possible future extensions.
- (3) Nuclear is still a relatively young industry, both in terms of technology and in terms of institutional management. A number of problems, therefore, are still on the nuclear agenda: long-term demonstration of operational safety, the treatment and disposal of waste, risks of proliferation to name a few. Another concern is the general feeling that nuclear is a "secret" industry which provides limited and sometimes biased information and which is not democratically controlled.

- (4) To secure a role for nuclear in the global energy mix also in the future, it is imperative, therefore, that the nuclear industry must become completely transparent, impartially regulated and controlled, and accountable for its safety and economic record, with waste disposal as a major concern for winning acceptability.
- (5) Should, however, the present stagnation in nuclear power development in some countries lead to a long-term world-wide decline of nuclear power, it has to be clearly seen that the goal of reducing greenhouse gas emissions would be jeopardized unless there were a break-through in terms of increased energy efficiency, in the cost of new renewables, or in the commercial availability of carbon sequestration technologies.

Acceptability is an issue for both traditional and modern energy. This covers many issues: Deforestation, land degradation or soil acidification at the regional level; indoor or local pollution such as that which exists in Africa and Asia from burning traditional fuels, or in China or South Africa because of poor quality coal briquettes; greenhouse gas emissions and climate change; nuclear security, waste management and proliferation; and the possible negative impact of the building of large dams or large-scale modern biomass developments.

In this context, a few principal remarks on **environmental problems** may be in place:

- (1) Energy and the environment must not be seen as an alternative, or even as a contradiction: Those who want to develop or use energy have to take into account the possible impact on the environment (“eco-audit”, in fact, is becoming more and more the state of the art). Those who want to protect the environment, will have to realize that this, in most cases, requires the direct input of energy and, in all cases, an economic basis for which again energy is an indispensable requirement.
- (2) Regrettably, the issue of environment very often is discussed in a too narrow and in a one-sided way:

- Too narrow, because in many discussions environmental problems are dealt with as being identical with the problem of climate change – obviously an unjustified simplification and a much too narrow approach: For the majority of the world’s population, it is not climatic change, but other environmental problems – contamination of air, water and soil – which give cause for concern, and which are considered as alarming.

Those who are in danger to suffocate with the smog and dust obscuring the megacities they have to live in – or think of the recent garbage avalanches in Bombay and Manila! – will hardly think of the possibility of a climate change in the next century as a real threat.

- Too isolated, because improving the environment in our Western countries has only a very limited global effect. The environmental problems will shift more and more from Western countries to the Third World: Within a few decades, more than 80% of the total world population will be living in this Third World. The consumption of energy, which will more or less stagnate in our Western countries, will triple in the Third World. The consequences for the environment: Nearly 70% of the global sulphur and dioxide emissions, and almost 60% of the global CO₂-emissions will soon come from these countries.
- (3) We, who live in Industrialized Countries, therefore, should not be content with keeping our own house in good order, because even with ever higher absolute investments the achievable improvements in energy efficiency will become smaller and smaller. Our financial capacity, our technical know-how is better placed in the Third World, where with the same US-Dollar, the same Euro, the same British Pound a much higher improvement of efficiency can be achieved.

- (4) As to the specific problem of a possible climate change, a dual strategy should be followed:
- Firstly, intensification of the scientific work on climate change, in order to clarify the still existing grave scientific uncertainties, and in parallel
 - secondly: Intensification of all activities aimed at improving energy efficiency, because such activities also help to reduce CO₂-emissions – “minimum regret policy” or “win-win-strategy”.

Let us hope that such a dual strategy will be carried out through solid technical and scientific work, undisturbed by excited or even sensational public and political discussion as was – regrettably – so often the case in the past.

- (5) Apart from all arguments, facts, figures, modelling etc., we would be well advised, I think, to remember from time to time that neither the environment nor the climate is something static, but has always undergone change. Therefore, not every change of the climate or the environment is, by law of nature or by necessity, a catastrophic event.

7. THE INSTRUMENTS

There are long lists and catalogues of instruments to be used, and of actions which should be taken on the different levels. I am not going to repeat all of them here, but will restrict myself to highlighting the two decisive aspects:

All listed instruments and actions, although differing in detail, have one common denominator, namely the improvement of **energy efficiency** on all levels of production, transportation and use of energy. Whether you take the extraordinary technical achievements in the oil & gas sector – unfortunately overshadowed by events like Exxon Valdez or Brent Spar – or the drastic reduction of emissions from coal-fired power plants, or many other examples: They all – through improved efficiency – serve more than one purpose: Reduction of production cost, extension of the lifetime of resources, protection of the environment. A concentrated move, a campaign directed towards efficiency improvement and innovation is therefore the best we can do, both under energy and environmental aspects, at the beginning of the 21st century!

Obviously, such programmes will require high investment and – equally important – a reliable policy framework for the energy sector. It is for this reason that the World Energy Council is opening its recently published decalogue of Policy Actions for the 21st century with: “Reap the Benefits of **Market Reform** and **Appropriate Regulation**”.

It would lead too far to discuss all these actions here in detail. The wide range and the weight of these recommendations is well enough illustrated, however, by quoting the titles:

- (1) *Reap the Benefits of Market Reform and Appropriate Regulation*
- (2) *Keep All Energy Options Open*
- (3) *Reduce the Political Risk of Key Energy Project Investments*
- (4) *Price Energy to Cover Cost and Ensure Payment*
- (5) *Promote Greater Energy Efficiency*
- (6) *Foster Financing Partnerships Linked to Environmental Goals*
- (7) *Ensure Affordable Energy for the Poor*
- (8) *Fund Research, Development and Deployment*
- (9) *Advance Education and Public Information*
- (10) *Make Ethics a Strong Component of Energy System Governance*

8. THE MESSAGE

What, now, are the prospects, what is the overall message for the 21st century as to the two critical and crucial concerns – Energy and Environment?

On a broader basis, TIME Magazine in its last edition of the year 1999 had identified three truly historical developments which came out of the last century, and which will impact and determine also the future. They were

the emergence of democracy as the dominating form of government, together with its economic twin, the market economy;

the recognition of civil rights, for which people like Mahatma Ghandi, Martin Luther King, Nelson Mandela and others have taken up the fight;

and finally the progress of science and technology as the very motor, the driving force of change in human life.

It will be science and technology also in our field of interest, Energy and the Environment in the 21st century, I think, which will help us to find the right answers, and which justifies an overall message of “guarded optimism”.

Powerful as science and technology can be as a driving force in devising innovative ways of utilizing the resources of the world, they have to be – and this is an equally important part of the message – acceptable to society. M. Menon, the famous Indian scientist and philosopher, called this “*Combining Science and Wisdom to build Bridges with Society*”, pointing out that sustainable development cannot be brought about through a purely technological fix. To understand and respect this link, this inner connection is the challenge and test before us as we seek from science new solutions that will – to quote the World Energy Council’s Mission Statement – “*promote the sustainable supply and use of energy for the greatest benefit of all*”.

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