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Energy for Sustainable Development: Ensuring Economic Growth and Universal Access

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The Three Green Pillars of Energy for Sustainable Development

At the crossroads

A turnaround in energy policy on a global scale is an elementary precondition to sustainable development. Globalized flows of commodities and capital as well as worldwide risks such as climate change or disastrous reactor accidents, mean that this precondition can only be met by a joint effort of North and South. We are still far away from that, however: Extreme energy wastage in the North and challenging energy shortages in the South are undeniable signals of the unsustainable trends in the global energy system. If the current global trends of primary energy consumption and $C0_2$-emissions increases are not changed and if the developing world tries to copy the unsustainable use patterns in regard to fossil and nuclear fuels in the North the risks of climate change, of nuclear accidents and of geo-strategic conflicts on scarce oil and gas resources will inevitably increase.

On the other hand, a scenario-based look into the future shows that this gloomy development does not have to happen.It can be changed by ambitious politics, new technologies, sensible behaviour and more sustainable patterns of production and consumption. There is no lack of viable visions, but – as the World Summit for Sustainable Development (WSSD in Johannesburg 2002) stated - of resolute implementation. Mankind is at the crossroads: Within the next 5 to 10 years it has to be decided whether we want to rely on the current risky and unsustainable patterns of energy use. Or if we decide to switch to more sustainable energy paths, putting highest priority on energy end use and supply efficiency and fostering the market introduction of a broad mix of renewable energies within an integrated strategy.

Targets and strategies for uncertain energy futures (“back-casting”)

More than 400 long-term global energy scenarios (2050/2100) have been charted out. These differ greatly in terms of economic and population growth, as well as CO_2 emissions. The technology mix assumed ranges from an expansive use of coal and nuclear power to abandoning nuclear energy worldwide and far-reaching phase-out of fossil energy sources. What are the messages derived from these exercises for decision makers: Everything is possible in an uncertain future? Wait and see, let the markets find the right solutions? The answers are no, because "business as usual" (BAU) would be a disaster. The picture changes completely when we ask "How do we **want** to live in future and how do we get to agreed societal goals?" founding new politics on a "back-casting" scenario analysis and cost-effective energy services. For example, scenarios can answer the following questions: Are ambitious CO_2 emissions reduction targets technically feasible, what socio-economic implications could occur (e.g. impacts on energy costs, competitiveness, employment etc. ?) and what strategies and bundles of instruments are necessary additionally to BAU-policies to initiate sustainable markets and technological developments?

The extremely different simulations of the future are in some instances artefacts of hardly robust assumptions, even horror visions, of a world of catastrophic climatic changes, which **must never be permitted to develop**. Is there any scientific evidence that these gloomy pictures are more realistic and probable than sustainable paths? Should`nt we concentrate on investigating robust technological alternatives and strategies, showing that there is room for manoeuvre and for decision making? We can`t avoid future uncertainties and surprises, but we can change **known** unsustainable trends now and base our long term decisions on precautionary and insurance principles.

Up to now, only few scenarios give guidance to decision makers on how to steer the energy system within acceptable climate protection corridors (about 450-550 ppm CO_2 concentration; reducing CO_2 emissions by 50 % from 1990 baseline). Even less orientation has been given by scenarios how - for risk minimization reasons - a phase-out of nuclear energy and a closing per-capita income gap between the North and the South could be reached. Nevertheless: Less scenarios demonstrating the feasibility of sustainable energy systems do not "prove" that the future unsustainable energy systems derived from the majority of traditional supply driven scenarios are based on better science. It seems to be the other way round: The still small number of scenario analyses and of solution oriented scientific advice for sustainable energy policies is an alarming indicator of the deficits and barriers for sustainability research which have to be overcome.

Enhancing energy productivity: The key to sustainable development

Many visions of the future of the energy system are only so gloomy because they vastly underestimate the opportunities for more climate-friendly and risk minimising technological progress (stepping up energy and material productivity; widespread market introduction of renewables) and for energy-policy learning-by-doing processes. One reason for these forecasts is that their assumptions often reflect the priorities of the dominant energy suppliers. If instead we shift the perspective to the needs of consumers and how to protect the global commons, then we base our vision on the huge potentials for more rational use of energy and on **providing energy services** stemming to the greatest possible degree from renewable sources.

This perspective leads to the following technically feasible strategy: Cut per-capita energy consumption in industrialized countries drastically (at least by half) through more efficient use energy without decreasing living standards. Keep the necessary development-related increase in per-capita energy consumption in developing countries as low as possible from the very outset by deploying state-of-the-art energy conversion technology, while standards of living can grow rapidly.

The importance of energy efficiency can be demonstrated with a popular scenario produced by Shell in 1996 – a typical representative of supply-led strategies. The scenario became famous because it was the first from a leading oil company to draft a worldwide energy system built **predominantly (60% in 2060) upon renewables.** Shell assumed that the mix of renewables taken for the scenario would be economically viable by the year 2020. However, the **additive diversification of energy supply side** (the renewables are added to the supply block of fossil and nuclear capacities) determined by Shell is only necessary – and attractive from a sellers point of view – if the growth in primary energy consumption continues unabated and if we don`t care about climate change. This makes it painfully clear that even very ambitious efforts to introduce renewables into the markets are not enough to abate the climate problem and other risks associated with rising energy consumption. On the contrary: Following the Shell strategy CO_2 emissions would roughly double by the year 2050 instead of dropping by 50 percent as the Intergovernmental Panel on Climate Change (IPCC) demands. For 60 years and more, humanity would continue to face oil and gas dependencies, as well as the risks of nuclear energy. Can we really afford this risky perspective and aren't there any robust alternatives? They do exist, as will be demonstrated in the presentation on a world wide scale and for the case of Germany.

Lessons learned from target oriented scenarios for Germany

Advisory commissions for the German Government have produced the most comprehensive and detailed studies for a long run sustainable energy system for an OECD country; these are typical “back casting” scenarios which tried to answer the questions whether a 80% $C0_2$-reduction target up to 2050 can be reached when at the same time the decided phase out of nuclear energy will be finished up to the year 2025. The following lessons learned from the German scenarios can be summarized:

- Scenarios and strategies which ignore risks and external costs are – at the long run - not sufficient for policy advice and successful energy policies
- Though many future uncertainties exist a robust technological corridor to sustainable energy systems can be identified. Sustainable energy systems are based on „three green pillars“: Rational use of energy (RUE), trigeneration and renewables
- To make nuclear phase out and climate protection happen: more decentralisation, democratisation, new incentive schemes, proactive energy policies and a strategic efficiency initiative are needed
- Ambitious climate protection policies must give end use energy efficiency highest priority - irrespective of the supply side
- Fostering renewables without buying down the costs by efficiency will fail because of social acceptance problems
- Integrated programs (R&D&D&M) are neccessary with changed priorities in favour of efficiency, renewables and systems solutions
- Within a sustainable energy scenario (phase out of nuclear in 25 years; 80% CO_2-reduction by 2050) the share of energy system costs to GDP in 2050 will only increase moderately (plus 1% in 2050). Recognizing the societal benefits

from these additional costs (e.g. positive employment effects, rising competitiveness in world markets for innovative energy technologies) even the highest additional costs "are socially acceptable - especially when external costs are taken into account" (German Energy Enquete Commission)

Making the utopia come true: Create markets for energy services and for green energy

To close the implementation gap and to foster the creation of "green energy markets" we have to change our perspectives from a pure supplier's view to an integrated view and a fair level playing field of the supply and demand side. Focusing on the real demands of the customers not only the methologies and the optimisation criteria must change (using integrated resource planning (IRP)), but also new frame conditions for competitive markets for least cost energy services have to be institutionalized. The user wants the utility derived from energy (e.g. electric power, communication, mobility), the kilowatt-hours of final energy are merely the means to these ends. The more effectively final energy is transformed into energy services by means of highly efficient conversion technologies, modern management methods and far-sighted behaviour across the entire process chain, the lower are environmental impacts and resource consumption for the same or higher output. The ultimate economic goal of energy use are not cheap and risky kilowatthours, which can be extremely expensive if external costs are added. Instead the economic rationale of sustainable energy systems aims to deliver least cost energy services, which are calculated on a life cycle cost base (including a pragmatically calculated adder for external costs) plus the incremental costs of most efficient conversion technologies.

Best practice examples of the EU demonstrate that in liberalized and deregulated markets new frame conditions can be institutionalized which change the incentive structure for delivering cost effective energy services based on green energy (renewables, trigeneration).

With that background our main thesis is the following: The IPCC climate protection goal (50-60 % CO_2 emissions reduction up to 2050) and a strategy of risk minimisation (e.g. avoiding the risks of nuclear energy as much as possible) is achievable if worldwide private-sector planning and state energy policy shift their perspectives to focus on highly efficient technologies on the production and demand side and to the diversified green supply from distributed power systems. If this were the case, sufficient energy services could be provided for a growing world population without additional energy consumption and CO_2 emissions rising to levels incompatible with climate protection.