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The Rise of Renewable Resources in Global Energy Supply

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Introduction

The global energy demand of approximately 12 billion tons of oil equivalent (toe) is currently being met by mainly fossil fuels such as crude oil (34%), coal (27%), and natural gas (22%).

Industrialized nations face a growing dependence on crude oil imports (USA ~60%, Europe ~70%). The mobility sector is one of the major consumers of fossil fuels and thus primarily vulnerable to insufficient crude oil supply and price volatilities.

Current Developments

Since 2008, the energy consumption of Non-OECD countries has exceeded OECD demand, with China utilizing more energy than the USA in 2009. For the next two decades, energy consumption is predicted to rise about 30-40%, especially due to the economic rise of BRIC countries (Brazil, Russia, India, and China). Fossil fuels are expected to primarily cover energy demand (80%) within the short term perspective, with renewable energies increasing their market share. The priorities of global energy consumption are changing from thermal energy demand (especially for residential heating) to increasing demand for electric power.

Critical Factors

Security of Energy Supply

Due to restricted production of conventional oil („Peak Oil“), unconventional oils (deep sea oil; oil sand and tars) are under reinforced exploration and utilization. Production and liquefaction of coal has become a key issue to secure energy supply in various countries.

Carbon Neutral Energy Sources

Increasing greenhouse gas emissions from fossil fuel use and the consequential global warming and rising frequency of extreme weather conditions have prompted climate protection policies and encouragement of carbon-neutral energy technologies. These include technological development to utilize renewable energies as well as carbon capture and storage for fossil fuel power plants. Costs, efficiencies and reliabilities of these new technologies will be decisive for their market success.

Solution Approaches

Energy Saving

A major potential of energy saving options has been identified for residential households, industry, and mobility services. Zero emission houses have been proven technologically feasible and are likely to become mandatory standard for new buildings in countries such as Germany. Both technological and behavioral approaches can reduce energy consumption and should be the first option for economizing resource effectiveness.

Increasing Efficiency

While industrial production processes have advanced far in terms of energy efficiency, large efficiency increases are expected in household applications (heating, cooling, electric consumption) as well as in the mobility sector (advanced combustion engines, hybrids, fuel cell and electric technologies).

Utilizing Renewable Energies

Even with energy saving and increased efficiency, the energy demand is expected to rise. This increase may be met by utilizing renewable energies. Volatile fossil fuel prices, long-term cost increase caused by necessity of tapping unconventional fossil resources, as well as considerable technological advancement in renewable power generation technologies have rendered them viable solutions for an increasing number of applications. Both small and large scale renewable power technologies have been developed and can be applied in closed as well as grid-connected systems.

Outlook

The pathway towards a renewable energy based system is linked with crucial challenges and marks a paradigm shift in our energy system. Historically, energy production followed demand, and base load power stations were complemented with peak load production units. In a future power regime with a substantial renewable content, consumption will have to follow seasonal and even hourly oscillations in energy production.

Renewable energies primarily produce electric power (wind and solar technologies) with a versatile application range. However, electricity distribution networks are yet inadequate for transmitting the expected production volume of renewable electricity production from remote locations such as offshore wind farms. The existing central grid system was designed for conventional power plants located near the major consumers, and most suited renewable power production locations have been identified to be remote from the former production sites (e.g. off-shore wind power projects). Fluctuating renewable power production (wind and solar) requires storage and buffer capacities, a suitable transmission infrastructure, as well as intelligent demand side management (Smart Grid, Smart Metering).

Legislation on expanding renewable power production capacities has induced technological development but also reinforced new and decentralized capacity additions to a scale that will be incompatible with the current infrastructure. The transformation to a renewable energy system thus changes both industrial production and transmission concepts as well as demand side management at the customer's end. This will have to be adequately channeled by an appropriate policy framework to mitigate economic and technological frictions in the transitional period. Such policy should also influence the development of an adequate renewable energy mix in order to smoothen the transition.

Data Sources: Live Energies proprietary calculations; International Energy Agency World Energy Outlook 2010.

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