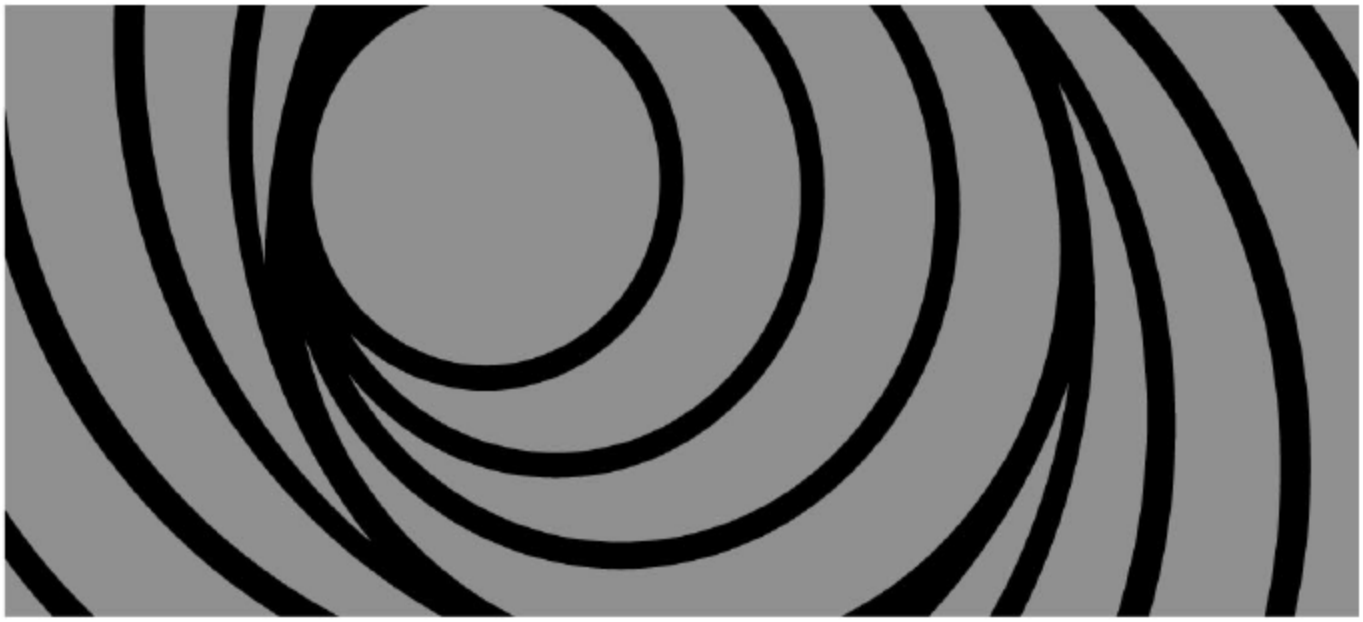
World Energy Assessment

United Nations Development Programme
United Nations Department of Economic and Social Affairs
World Energy Council

energy and the challenge of sustainability



key messages

energy,

when produced and used wisely, can play a pivotal role improving the lives of people today and simultaneously protecting the prospects of future generations. This balance is embodied in the idea of 'sustainable development', a goal firmly committed to by the United Nations and its Member States. Although the energy technologies and resources are available with which to achieve sustainable development, this goal will go unrealized unless fundamental changes are made in the production, distribution and use of energy. Specific changes needed are: higher levels of energy efficiency, a greater contribution of modern renewables tothe fuel mix, accelerated development and deployment of advanced technologies, and enabling policy frameworks to support such changes.

Social equity issues and environmental impacts are the two most critical energy-linked threats to sustainability

Secure supplies of affordable energy services are a pre-requisite to, and an essential ingredient of, economic growth and human development. However, critical problems – the most serious being equity issues and environmental impacts – are linked to current patterns of energy production, distribution and use.

- **Two billion people struggle to meet their basic needs without access to affordable and adequate energy services.** A third of the world's people lack access to electricity with which to satisfy basic household needs and support livelihoods. The world's oldest energy technology, the cooking fire, remains the most widespread fuel-using technology today. A reliance on traditional fuels and technologies, because of associated time demands and localized air pollution, is a hardship that keeps a large fraction of humanity—particularly women—locked into cycles of poverty, ill-health and deprivation.
- **Energy-linked emissions pollute and degrade the environment at the local, regional and global levels.** Compromised health, resulting in some 3 million premature deaths per year, equivalent to 5–6 percent of global mortality, dominates local impacts associated with energy use. Energy activities account for about 85 percent of anthropogenic emissions of sulphur dioxide, a major contributor to local air pollution as well as regional acidification. About 78 percent of human-caused carbon dioxide emissions are linked to fuel combustion. These emissions are a major factor in global warming, which represents an unprecedented threat to humanity.

Our reliance on fossil fuels

Fossil fuels are now and will continue to be an important part of the overall fuel mix; the challenge is to use them in cleaner, safer and more efficient ways. The fossil resource base is at least 600 times current fossil fuel use—oil and gas reserves are expected to last well into this century, and coal will be abundant for centuries to come. Thus, fuel scarcity will not be a major driver of change in energy systems. Even the most ecologically-driven of the scenarios considered in the report shows petroleum and coal products supplying more than half of energy demand in the year 2050. Unless the substantial environmental impacts linked to fossil fuels are addressed soon, global warming will accelerate and local and regional pollution will continue. Emerging technologies show great promise for utilizing fossil fuels in cleaner and safer ways, but policy support will be needed to encourage their rapid development and deployment.

Opportunities afforded by more efficient use of energy

The possibilities offered by more efficient use of energy are tremendous, since overall global energy efficiency is estimated at 37 percent. In other words, in conversion processes from raw material to useful energy, 63 percent of energy is dissipated, mostly as wasted heat. Many energy efficiency gains have already been realized, especially in centralized processes, which have helped loosen the historically tight link between economic development and energy consumption. In this century, the average conversion efficiency of power stations rose from around 3 percent to more than 50 percent for today's combined-cycle gas-fired power stations. The energy inputs to Western European industry have remained relatively constant for the past 20 years, while output grew by 2 percent per year. A large unrealized potential for greater energy efficiency exists at the point of end-use, for example, through more efficient vehicles, appliances, and buildings. The report finds that gains in energy efficiency of 25-35 percent are cost-effectively achievable in industrialized countries over the next 20 years, with higher potentials (30-45 percent) achievable in developing and transitional economies. In both cases, the higher percentages assume the introduction of effective policy measures to encourage energy conservation.

Renewable energy

Although renewable energy flows to Earth are three orders of magnitude higher than total global energy consumption, harnessing these flows to useful forms of energy is complicated. As a result, 'new' renewables (which include modern forms of biomass, as well as small hydropower, wind, solar, and geothermal energy) contribute just 2 percent of global energy, seven-eighths of which comes from biomass. While solar photovoltaics and wind energy capacity are growing at about 30 percent per year, it may be decades before they represent a large contribution to the energy mix. Future prospects for renewables are dependent on an enabling policy environment. Today the ability of renewables to compete in the marketplace is hampered by pervasive (and often perverse) subsidies to fossil energy. Factoring in some of the environmental costs borne by society at large into the price of energy would be a huge stimulus for the renewables market. More widespread use of renewables, in turn, would mean expanded energy services with relatively low environmental impacts.

Advanced technologies

Increased development, deployment and diffusion of new energy technologies is critical in any scenario of success. The direction and rate of technological change can have the same magnitude of influence on future emissions as population

growth, economic development and energy consumption taken together. However, current investments in research and development in both the public and private sectors are inadequate to meet the challenges ahead. The energy innovation chain, from research and development through demonstration projects, deployment and diffusion, is sometimes a decades-long process, and progress can be stalled at any point along way. Continued technological advances are needed in all aspects of the energy system, especially in renewables, energy-efficiency, and fossil fuel utilization. Advanced nuclear energy technologies could play a role in de-carbonising the world energy system in the next 50 years, but only if public concerns about reactor safety, proliferation, and waste disposal can be satisfied. Promising advanced fossil fuel technologies include superclean 'syngas' derived from coal or natural gas for the near term, fuel cells over the medium-term, and large-scale recapturing and storage of carbon dioxide over the longer term. In some respects, developing countries with little installed capacity, are well-positioned to become leaders in introducing innovative technologies, leapfrogging up the technology curve.

Finding ways to widen access to adequate energy services

Targeted strategies are needed to address the needs of the two billion people with inadequate access to energy services—most of whom live in rural areas of developing countries. The lives and productivity of this large group could be enormously improved over the short term with relatively small inputs of energy. For instance, the cooking needs of those not served by modern fuels correspond to about 1 percent of global commercial energy consumption, or 3 percent of global oil consumption. Where extension of electricity grids is not economically feasible, decentralized solutions, including diesel and biomass systems, wind and solar power, are viable options that also offer opportunities for local control. Innovative approaches and financing mechanisms, tailored to local conditions, will be needed to bring modern forms of energy to rural areas, just as rural electrification in many now-industrialized countries was accomplished with government support in order to achieve social and economic objectives.

Investing in sustainable energy

There is no need to choose between economic growth and environmental protection: investing in substantially cleaner, safer forms of energy now will avoid higher costs later. Investment in sustainable energy is not occurring rapidly enough, especially in the developing countries, where demand for energy is most acute. Official development assistance fell by about 20 percent (in real terms) during the 1990s, and represents a shrinking fraction of net resource flows. Foreign direct investment has continued to grow worldwide, but tends not to reach the least developed countries. Building institutional and technical capacity in these countries are pre-requisites for improving capital flows, including investments in energy. Clearly the ingenuity and dynamism of the private sector will be critical to meeting the challenges ahead. However, market forces alone will not meet the needs of the most vulnerable groups, protect the environment and ensure energy security. Far-sighted policies are needed to address these issues.

Policy matters

The economic, social and environmental goals of sustainable development as expressed in the United Nations summits of the 1990s cannot be achieved unless energy is produced, distributed and utilized in fundamentally different ways in the future. Energy scenarios suggest that sustainable energy futures that can support a prosperous, equitable and environmentally sound world are indeed possible, but that ambitous policy measures, initiated in the near term, will be required to achieve them. Complementary efforts at the local, national, regional and international levels are called for. Some promising policy options include:

- Removal of subsidies to conventional fuels (except when there are no other viable approaches to bring modern energy to unserved populations)
- Rational pricing approaches that reflect social and environmental costs associated with various forms of energy use
- Complementing market approaches with regulatory measures to protect public benefits
- Encouraging technological advance at every stage of the energy innovation chain
- Supporting technological leapfrogging in developing countries

The urgency of our situation

Unless wise decisions are made in the next few decades, many opportunities to change our energy course may be lost. Because energy systems and infrastructure are capital intensive and long-lived, and much capacity will be installed in the coming decades, a limited window of opportunity is now open in which to get energy right. Thus choices about the world's future energy systems are relatively wide open now, but by 2020 many investment decisions will have been made that will affect the world for years to come. The current window of opportunity is particularly significant where much infrastructure has yet to be installed, offering the possibility of a rapid introduction of new, environmentally sound technologies. Once infrastructure is in place, a phase of mostly replacement investments begins. Changes can be made in this phase, but they take much longer to affect average system performance. Thus, if sound decisions are not made during the next few decades, we will be locked into those choices, and certain development opportunities might not be achievable later. ■

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