Fact sheet #7
Climate information for sustainable energy

www.wmo.int/wcc3

By the World Meteorological Organization (WMO), with UN-Energy, the United Nations Industrial Development Organization (UNIDO), the World Bank and other international partners

The thought that likely comes to most people's minds when they hear "energy and climate" is that of the effects of the energy sector on climate — the role fossil fuel burning plays in global climate change. The relationships, however, go in the other direction as well: climate significantly affects energy in a variety of ways. Understanding how climate is changing now and will change in the future, together with its influence on energy sources and demand, is crucial.

The energy sector must balance the demands of multiple users, from industry and agriculture to dwellings and public works. Population growth, together with high demands for industrial development, are adding pressure to the energy supply. Global energy demand is expected to exceed supply by 20 per cent by the year 2030. To plan for sustainable energy supply into the future, climate predictions and information must be integrated into the design, development and management of energy supply systems. The challenges of climate change also create the need to use the available climate data to explore other potential energy sources and to develop energy-efficient systems.

Temperature is a powerful control on energy needs, dictating day-to-day energy demand. Cold and heat extremes spike energy use for heating and cooling. Miscalculating the demand for electricity can result in power disruptions, as illustrated by blackouts in the United States of America and Canada in August 2003. The blackouts were the result of summer peak energy demand exceeding the supply on hand. Energy managers require accurate weather and climate information to help avoid such situations and to manage everyday energy requirements and long-term energy investments and planning. With the Intergovernmental Panel on Climate Change (IPCC) projecting more weather extremes, including cold waves and heatwaves, in the future, the need for quality observations and reliable seasonal-to-multidecadal climate predictions becomes even more acute.

Water is essential to the operations of both hydroelectric and nuclear power plants. Decreased precipitation and increased evaporation due to higher temperatures and wind speeds lowers water levels in reservoirs, lakes and rivers and can significantly reduce the output of hydroelectric power stations. Recent droughts in parts of Africa led to power shortages, which in turn resulted in large losses in industrial production. A drought in 2001 crippled Brazil's hydroelectric operations, contributing to widespread blackouts in the country, which generates 85 per cent of its electricity from hydroelectric power stations. Conversely, increased snowmelt or precipitation can boost hydroelectricity production. For nuclear plants, the challenge is having a water supply cold enough for their cooling requirements, especially in the summertime.

Warming temperatures and associated changes in rainfall patterns could provide short-term boosts to corn and sugar crops used for biofuel, but water shortages and weather

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extremes could reduce yields in other areas. Climate also influences wood energy, an important resource in developing countries; changes in temperature and precipitation affect forest areas and vegetation.

Other forms of renewable energy, however, are less negatively affected by climate extremes and offer potential options for sustainable energy supplies. Wind and solar power provide a valuable potential source for sustainable energy. Unlike hydroelectric and biofuel energy, these forms of energy are dependent on climate elements that are less variable, and they deserve further exploration.

For traditional oil and gas sources, climate variability and change threaten key infrastructures. In the Arctic region, higher temperatures melt permafrost, thus threatening roads, airplane landing strips, oil and gas pipelines, electrical transmission towers and natural gas processing plants. In coastal regions throughout the world, storms can endanger offshore oil and gas rigs and related infrastructure.

Managing climate risks and opportunities for the energy sector requires the identification of specific vulnerabilities and decision-making based on reliable climate predictions. Communities can manage water supplies to plan for anticipated seasonal shifts in hydroelectric supply and demand. Additional hydroelectric power transmission lines can be built to connect areas expected to be water-rich to areas that could be more drought-prone. Most importantly perhaps, regions can diversify their energy portfolios to protect against the shortfall of any single energy source.

Charting energy supply and demand

Identifying the needs of the energy sector in the face of a changing climate is an important step countries must take to shore up their defences. Climate models can inform energy planners about expected changes in both supply and demand over specific periods of time. A 2007 study charted such expected changes for Switzerland up to the year 2050.

A project of Switzerland's Advisory Body on Climate Change and ProClim, a forum for climate and global change, the study looked at potential impacts of climate variability and change on all sectors in Switzerland based on a warming of approximately 2 degrees Celsius in autumn, winter and spring, and just under 3 degrees Celsius in summer. Under this scenario, less heating will be required in winter and more cooling in the summer, shifting energy demand from fuel to electricity. It also projects a reduction in hydropower production by 5 to 10 per cent by 2050 due to smaller runoff and a decline in cooling capacity for its nuclear power plants. In the short term, however, more water will be available for hydropower due to melting glaciers. Overall, the prospects for renewable energy will increase in the future, the report says, as the demand rises for carbon-neutral sources and competitiveness increases. Wood energy is expected to grow as forests expand.

Generally, the changing climate will increase uncertainty for Switzerland's energy sector, and so the report recommends diversification to strengthen its capacity for change. New technologies will also help, such as solar cooling and free-cooling (dissipating heat into the air at night). Consideration of shorter-term climate predictions is also necessary. The report notes that such predictions vary widely in quality across areas and time spans, but that they can be invaluable in forecasting extreme weather events more than a week ahead. Increased development of such tools based on reliable climate information is essential. This type of climate-based analysis is helpful for any country seeking to plan its energy needs.

Climate information in support of energy planning

Several other countries are using climate predictions and information to gauge their current and future energy requirements. A sampling of such efforts includes the following:

WMO-supported operational meteorological satellites throughout the world play an important role in the generation of the short-term and seasonal weather and climate forecast products that are employed in the energy sector. Forecasts and warnings of severe weather events, such as hurricanes, droughts and heatwaves, all enable informed energy decisions. Satellite data also inform supertankers and offshore oil and gas exploration facilities of maritime conditions.

The Solar and Wind Energy Resource Assessment (SWERA) provides policymakers, utility companies, energy developers, investors and consumers with access to high-quality information about renewable energy resources. A United Nations Environment Programme effort that includes contributions from WMO Members, SWERA produces weather and climate information that is vital to making informed energy management and investment decisions.

In 2008, the Federal University of Rio de Janeiro completed a study of the future effects of climate on Brazil's energy supply. It found that a rise in average temperatures will cause electricity consumption to rise by 8 per cent by 2030, extrapolated from climate change forecasts for 2071 to 2100. To cope, Brazil is planning policies to encourage alternative energy sources, such as wind and biofuel, in addition to hydroelectric power. High-tension transmission lines built since the 2001 energy crisis will help offset energy shortages in drier areas.

The Vulnerability – Adaptation – Energy System Resilience (VAR) project aims to help policymakers understand which issues need to be addressed to ensure energy access and security under changing climate conditions in Africa. A Helio International Project, VAR is using energy-related indicators to assess the vulnerability and resilience of energy systems to climate change in 10 countries: Benin, Burkina Faso, Cameroon, the Democratic Republic of Congo, Kenya, Mali, Nigeria, Senegal, the United Republic of Tanzania and Uganda.

The HELIOSAT-3 project, financed by the European Commission, is designed to exploit geostationary satellite data to support the use of solar energy. The project aims to provide high-quality solar irradiance data, as well as information on the distribution of sunlight, to improve the cost-effectiveness and viability of solar energy systems.

The United Nations Convention to Combat Desertification advocates the use of non-food crops as agrofuel to both increase energy production and store carbon in the Earth, while minimizing environmental impact. Several developing countries, including India and Mali, are using the jatropha plant, which grows in low-rainfall regions on wasteland and does not compete with food crops for cultivated land. Jatropha's use as an agrofuel not only significantly reduces competition between food security and energy security, but also could provide income-generation opportunities. In addition, such agrofuel crops have the potential to curb the amount of carbon released into the atmosphere through soil degradation.

Facts and figures

- Hurricanes *Katrina* and *Rita* in 2005 destroyed more than 100 offshore oil and gas platforms in the Gulf of Mexico and damaged 558 pipelines. Direct losses to the energy industry in 2005 as a result of hurricanes are estimated at US$ 15 billion. [Minerals Management Service, 2006]

- The projected rise in average temperatures in Brazil will increase electricity consumption 8 per cent by 2030, according to some climate change scenarios. [Federal University of Rio de Janeiro]

- The 2003 heatwave in Europe caused six power plants to be shut down completely in France. If the heatwave had continued, as much as 30 per cent of national power production would have been at risk. [Létard and others, 2004, via the IPCC]

- By 2030, global energy demand is expected to exceed supply by 20 per cent. [International Energy Agency (IEA)]

- A 1 degree Celsius temperature increase in Japan in the summer would increase electricity demand by about 5 million kW. And a 1 degree Celsius increase in cooling water temperature would result in a 0.2 to 0.4 per cent reduction in the generation of electricity by thermal power plants and a 1 to 2 per cent reduction in output at nuclear power plants. [IPCC]

- Economic impacts from curtailment of hydropower generation from Lake Kariba in Zimbabwe as a result of the 1991–1992 drought were estimated to be a loss in GDP equal to US$ 102 million, a loss in export earnings of US$ 36 million, and loss of 3,000 jobs. [Benson and Clay, 1998, via the IPCC]

- In sub-Saharan Africa, biomass, including wood fuel, supplies more than 80 per cent of the energy consumed. Climate change could worsen current trends in the depletion of biomass energy stocks in Africa, which is expected to become drier. [IPCC]

- The 2003 energy blackouts in the United States and Canada affected approximately 50 million people, with economic losses estimated between US$ 5.8 billion and US$ 11.8 billion. [Committee on Earth Observation Satellites]

WCC-3 will initiate actions to enhance climate services for climate adaptation and the management of climate risks and opportunities around the world.

For more on climate and sustainable energy:

United Nations Industrial Development Organization:
http://www.unido.org

SWERA:
http://swera.unep.net/

Climate Change and Switzerland 2050 report:
http://www.proclim.ch/products/ch2050/ch2050-report.html

Committee of Earth Observation Satellites page on energy resource management:
http://www.eohandbook.com/eohb05/ceos/part2_3.html

VAR project:
http://www.helio-international.org/projects/VAR.cfm

HELIOSAT-3:
http://www.heliosat3.de/home.html

UN Convention to Combat Desertification:
http://www.unccd.int

International Energy Annual of the US Energy Information Administration:
http://www.eia.doe.gov/iea/

Energy studies at Federal University of Rio de Janeiro:
http://www.coppe.ufrj.br/english/programas/frame_programa.php?programa=25

RISOE DTU National Laboratory for Sustainable Energy:
http://www.risoe.dk/?sc_lang=en

USA National Renewable Energy Laboratory:
http://www.nrel.gov

Sustainable Bioenergy: A Framework for Decision Makers, UN Energy:
http://esa.un.org/un-energy/pdf/susdev.Biofuels.FAO.pdf

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