Chinese Scientists Offer Future Energy Suggestions

After comprehensive studies, a panel of CAS Academic Divisions recently made advice on the long- and medium-term development strategy for energy sources that can supplement or substitute petroleum in China.

The report gauges the future development trends of energy sources both in China and the world, making forecasts on the availability of petroleum resources, their demand, and production capacities from 2020 to 2050. It consists of two parts, on supplementation and substitution of petroleum fuel and on improvement and substitution of the power systems of transport vehicles, respectively.

As the conventional petroleum shortage becomes increasingly acute and the crude oil prices keep soaring, the markets for non-conventional petroleum (referring only to extra-heavy oil, and the petroleum from oil sands and oil-shale) are expected to constantly expand, partly making up for the shortfall. Resources of coal and natural gas are relatively abundant in this country, and their conversion into the fuel driving transport vehicles is now technologically viable and could be competitive when prices of conventional fuels are at the high end of the range. During the period of the world's transition to a post-petroleum economy, increased use of coal and natural gas as a substitute of conventional fuel should be possible. Other optional substitutes include biomass-based ethanol, carbinol, dimethyl ether, bio-diesel, synthetic oil and hydrogen, which are also internationally seen as a direction for development, Azom.com said.

Equally significant are technological innovations with regard to transport vehicles. There is a need to develop energy-efficient vehicles, vehicles using substitute fuels or powered by electricity, as road transport is a most important part of the transport and communication industry. Rail transit system is a major approach for public transportation and a main way of energy conservation.

Regarding the development of petroleum substitutes, including fuels from non-conventional oil and coal, natural gas and biomass, the report makes the following proposals for action over the next five years:

As the conventional petroleum shortage becomes increasingly acute and the crude oil prices keep soaring, the markets for non-conventional petroleum are expected to constantly expand.

1. Vigorously promoting the prospecting and assessment of China's oil shale resources.

2. Deepening the research and development of key technologies that are directly or indirectly associated with liquefaction; providing support to the construction of demonstration plants with an annual production capacity up to one million tons of substitute fuels using the two technological alternatives, with a view to gaining experiences for industrial application of the production technologies.

3. A scientific verification on gasoline and diesel substitutes in an all-round manner should be completed as soon as possible. Also in need is the encouragement given to the technologies using cellulose and semi-cellulose as raw materials for ethanol production. Research should be conducted into the breeding of fast-growing energy-rich plants in desert and desolate areas that can provide biomass for bio-ethanol and bio-diesel manufacturing. Furthermore, efforts should be made to develop mass production bases for those fuels without the occupation of farmlands.

4. Continuously promoting industrialization of the production of bio-ethanol and bio-diesel from biomass.

The following proposals are raised on energy conservation in the transport and communication industry:

First of all, positive efforts should be made to promote the adoption of new power systems for the automobiles, which are good at energy saving and diversified for energy sources. Priority should be given to electrified power systems with zero discharge of exhaustive gases. There is the need to vigorously carry out the research and development of highly efficient, low-cost systems of fuel-cells and lithium ion batteries. The key issues in the application of electric vehicles and its early industrialization lie in the solution to the problems of electric power supply and hydrogen fuel storage on vehicles. To this end, resources should be pooled to remove the technological bottlenecks such as short service life, high production costs, poor reliability and performance of such systems. Meanwhile, feasibility studies and large-scale demonstration projects should be conducted on such infrastructure facilities as hydrogen fueling stations and electric vehicle charging stations so as to speed up the industrial development of fuelcells and lithium ion batteries.

Secondly, electrified rail transportation should be developed in a big way. Railway electrification and increased speed of passenger trains are the way of ensuring the dominant position of railways in the communication and transport industry. More efforts should be made to develop urban rail transit systems, with a view to effectively curbing the rapidly increasing number of automobiles used in cities and reduce the per vehicle consumption of oil.

The report notes that introduction of energy-efficient technologies is time consuming and has to be accomplished in well-planned phases. For work over the next five years, it suggests that support should be rendered to the research, development and pilot studies by various sectors in this regard. Initial work should be done on selective basis when putting such technologies to industrial application. Prudence should be the approach toward massive application of such technologies in industrial production in the current R&D phase, and only after a full verification will it be appropriate for the government to make a major decision to its large-scale industrialization. The report also proposes a key national research program in the field, which should be launched through coordination of the national authorities and implemented continuously under the centralized leadership and management.

Solar Energy Conversion Can Help Mitigate Global Warming

Solar energy has the power to reduce greenhouse gases and provide increased energy efficiency, says a scientist at the US Department of Energy's Argonne National Laboratory, in a report published in the March issue of Physics Today.

Last month, The Intergovernmental Panel on Climate Change (IPCC) of the United Nations released a report confirming global warming is upon us and attributing the growing threat to the man-made burning of fossil fuels.

Opportunities to increase solar energy conversion as an alternative to fossil fuels are addressed in the Physics Today article, co-authored by George Crabtree, senior scientist and director of Argonne's Materials Science Division, and Nathan Lewis, professor of Chemistry at Caltech and director of its Molecular Materials Research Center, Physorg.com said.

Currently, between 80 percent and 85 percent of our energy comes from fossil fuels. However, fossil fuel resources are of finite extent and are distributed unevenly beneath Earth's surface. When fossil fuel is turned into useful energy through combustion, it often produces environmental pollutants that are harmful to human health and greenhouse gases that threaten the global climate. In contrast, solar resources are widely available and have a benign effect on the environment and climate, making it an appealing alternative energy source.

"Sunlight is not only the most plentiful energy resource on earth, it is also one of the most versatile, converting readily to electricity, fuel and heat," said Crabtree. "The challenge is to raise its conversion efficiency by factors of five or ten. That requires understanding the fundamental conversion phenomena at the nanoscale. We are just scratching the surface of this rich research field."

Argonne carries out forefront basic research on all three solar conversion routes. The laboratory is creating next-generation nanostructured solar cells using sophisticated atomic layer deposition techniques that replace expensive silicon with inexpensive titanium dioxide and chemical dyes. Its artificial photosynthesis program imitates nature using simple chemical components to convert sunlight, water and carbon dioxide directly into fuels like hydrogen, methane and ethanol. Its program on thermoelectric materials takes heat from the sun and converts it directly to electricity.

The Physics Today article is based on the conclusions contained in the report of the Basic Energy Sciences Workshop on Solar Energy Utilization sponsored by the US Department of Energy. Crabtree and Lewis served as co-chairs of the workshop and principal editors of the report. The key conclusions of the report identified opportunities for higher solar energy efficiencies in the areas of:

--Electricity - important research developments lie in the development of new, less expensive materials for solar cells, including organics, thin films, dyes and shuttle ions, and in understanding the dynamics of charge transfer across nanostructured interfaces.

-- Fuel – solar photons can be converted into chemical fuel more resourcefully by breeding or genetically engineering designer plants, connecting natural photosynthetic pathways in novel configurations and using artificial bio-inspired nanoscale systems.

-- Heat – controlling the size, density and distribution of nanodot inclusions during bulk synthesis could enhance thermoelectric performance and achieve more reliable and inexpensive electricity production from the sun's heat.

Namibia Wind Farming Near Reality

High-tech wind-power systems along the coast may soon become a sustainable solution to the electricity shortage Namibia is facing.

About 102 freestanding wind turbines are to be installed along the coastline from Henties Bay in the north to Oranjemund in the south.

Walvis Bay will serve as the center of operations.

Aeolus Power Generation Namibia (APGN), the driving force behind the project, is a joint venture between United Africa Group and a Dutch investor, with the Dutch government contributing some N$300 million by way of a grant.

The total cost of the project is expected to reach the N$1 billion mark, fully funded by foreign investors.

Of all alternatives to boost the Namibian energy supply, the wind farm project looks to be the quickest solution, as the system is scheduled to be up and running by the end of next year.

The project is expected to create an estimated 300 job opportunities.

The Dutch investor, Leo van Gastel, realized the need for alternative electricity sources during a previous visit to Namibia.

According to him, the wind resource along the Namibian coast was one of the best in the world and would provide a suitable climate for his Green Energy wind-farming methods, which he says have been proven successful in countries across the globe, Allafrica.com said.

"South Africa has currently reached a level of energy requirement which will soon prevent it from supporting and exporting to neighboring countries," Von Gastel said in a press release.

"The shortage will be severe in the coming years, which is an uncertainty that is not viable for an economic growing country such as Namibia, needing to attract investors.

"South Africa's electricity shortage is putting this country into a state of extreme vulnerability, and it is clear that Namibia needs to secure its own uninterrupted energy supply and find a dependable alternative."

Haddis Tilahun, CEO of the United Africa Group, described the project as a vital investment in the country.

He said the results would benefit all Namibians and could result in a reduction of electricity tariffs.

According to the statement, the Electricity Control Board (ECB) has encouraged the involvement of independent power producers in solving the looming power shortage.

It says the ECB issued a license to Aeolus Green Energy Namibia for the purpose of establishing this billion-dollar wind-farming investment.

TWI Develops New Hydrogen Solution

One of the principal obstacles preventing the mass adoption of hydrogen as the 'clean' energy source of the future may be felled in Cambridge following major investment in a state-of-the-art materials testing facility by The Welding Institute (TWI), a nonprofit distributing independent research and technology organization based near Cambridge, UK.

The current hydrogen vessel and testing machine has paved the way for TWI's new world leading version. The testing system will be the only one of its kind in the world, providing the oil and gas and automotive industries with a unique opportunity to develop appropriate alloys for the safe storage of high-pressure hydrogen and is already attracting the interest of car manufacturers.

With the ability to expose metals to a pressure of 1,000bar--over seven tons per square inch--and temperatures between--150 °C and 85 °C, the facility is being housed at TWI's headquarters in Granta Park in a specially reinforced, blast-proof building, capable of absorbing an accidental explosion, Businessweekly.com said.

The development of the new test facility follows a program in which the existing facility was built and tensile testing was carried at TWI for the Japan Research and Development Centre which is working closely with TWI Industrial Member, Nippon Steel Corporation (NSC).

The tests were carried out within TWI's existing pressure vessel containing high purity hydrogen, at a pressure of 450bar. They were performed at both ambient temperature and 85 °C. The work, in conjunction with similar testing in Japan by NSC, was done to provide input to Japanese planning for the hydrogen economy.

Hydrogen is widely recognized as the long term answer to fossil fuels as it can be produced from renewable energies or nuclear energy and can be used in fuel cells, advanced combustion engines in vehicles and in gas turbines for small co-generation and for medium to large-scale electricity production.

However, according to the European Commission, a major drawback is hydrogen's very low storage density at atmospheric pressure, which would require a storage tank to be 3,000 times larger in order to store enough hydrogen gas to drive a car the same distance as one which runs on gasoline.

In particular, test data is required to ensure the safe performance of hydrogen storage and handling systems for automotive applications, on board vehicles.

The new tests will carry out fatigue testing as well as tensile, anticipating roughly 50,000 refuels during the lifetime of an automotive fuel tank.

TWI's project leader for the hydrogen facility, Ruth Hammond, believes the test equipment's ability to provide unique data could prove highly lucrative. "We are anticipating enough work to run both the new and older machine.

"The facility we have at the moment is the only one in Europe and with the new machine will be the only one in the world, so the market is potentially huge."

Though a potential rival does exist in to TWI in Japan with the ability to test at 1,000bar, it not able to reach the low temperatures that the TWI machine will reach.

"These low temperatures are where we see the worst effect of embrittlement. It is anticipated that service temperatures as low as -80°C will be seen due to adiabatic cooling of the hydrogen as it expands," said Hammond.

The facility to house and service the original mechanical test machine and pressure vessel was designed and built over some eight months, since then several tensile test programs have been completed.

Development of the new equipment follows this successful development and utilization of the first.

The new test vessel is in the design stage, with install-ation and commissioning due for completion later in the year and is located in an isolated building at Granta Park.

The current hydrogen vessel and testing machine has paved the way for TWI's new world leading version.

The building has a test booth for each pressure vessel, and a control room separated from these by thick steel doors, with a safety interlock.

The concrete walls are steel-reinforced, while the lightweight corrugated plastic roof over the test booth provides an easy escape path for any sudden pressure release or explosion, though TWI claims the combination of interlocks, gas and fire detectors and procedures, however, make this an extremely unlikely event.