ENERGY

Gas from biomass: A research facility

While approximately 20 firms currently produce commercial-scale biomass gasifiers (converting urban garbage, agricultural and forest wastes into gas), until now there has been no research facility to test the technology. Now the Department of Energy's Solar Research Institute at Golden, Colo., has built the first such plant, designed to simulate real-life applications and to provide "good scientific data that people should have taken in the past" for commercial operations, says Tom Reed Sr., senior staff scientist for the Bio/Chem Branch of SERI. He says the plant will burn densified wood pellets in a limited amount of oxygen to produce up to 500,000 Btu per hour of carbon monoxide and hydrogen. These gasses can be used for heating in agriculture and industry, and for internal combustion engines. The plant will provide low and medium Btu gas. Low Btu gas (150 Btu to 200 Btu per cubic foot) is usually used in industry for heating. Medium Btu gas (350 Btu to 700 Btu per cubic foot) is pure enough to use as a chemical feedstock, to synthesize methanol, ammonia and gasoline.

The results of the experiments could lead to the development of a gasifier for houses. The test plant itself has potential as a model for a retrofittable unit in industrial gas and oil burners and in apartment and commercial buildings, Reed says.

The Branch plans to test other gasifier designs in the future, including one using external heating sources, such as solar heat, Reed says.

Fuel from biomass: A positive balance

The ethanol mixed with gasoline to make gasohol usually is made from grain that has been moistened, fermented with yeast and then distilled and dehydrated, to produce water-free alcohol. The distillation consumes 50 to 80 percent of the energy used in the manufacture of ethanol, and is part of the reason why ethanol alone has been considered a bad bet as a biomass-derived fuel: It produces less combustion energy than is needed to manufacture it — it has a negative energy balance.

Now, researchers at the Laboratory for Renewable Resources Engineering at Purdue University in West Lafayette, Ind., say they have a scheme for a positive energy balance in the final distillation step. Michael R. Ladisch and Karen Dyck report in the Aug. 31 SCIENCE that their process, which employs starch (the same basic feedstock material as used for ethanol), can result in an end combustion energy 10 times greater than the energy needed to carry out the dehydration. Ladisch explains how his distillation works: The initial fermented broth contains 6 to 12 percent ethanol. This broth is partially distilled until it contains about 90 percent alcohol. Much more distilling requires much more energy, so rather than have it continue boiling, as in conventional processes, Ladisch passes the alcohol-water vapor over materials that will absorb the rest of the water, but not the alcohol. He can do this by using cornstarch and ground corn at 90°C, a temperature far lower than is required by conventional processes. Experiments 40 years ago recorded a similar process using calcium oxide (CaO), resulting in alcohol concentrations as high as 99 percent. But the temperature needed to regenerate the CaO is about 170°C, almost twice that needed for starch, which also can yield a 99 percent alcohol concentration, Ladisch says. He adds that there may be another advantage to his scheme. The water-saturated starch may be used directly as feedstock for more ethanol, saving the cost of drying the starch (to store it), and then rewetting it to ferment it, although drying it will also yield a positive energy balance, he says. Other research now shows a possible positive energy balance in the first distillation steps, improving the chances for a total positive energy balance for ethanol, Ladisch says.

EARTH SCIENCES

Planning a National Climate Program

When Congress passed the National Climate Program Act last year, it required the program office, directed by Edward S. Epstein of the National Oceanic and Atmospheric Administration, to publish a five-year plan within the next year (SN: 10/7/78, p. 246). So they did — in a July report called, predictably, "National Climate Program Preliminary 5-year Plan."

The program, designed to put to the best, most coordinated use the nearly $100 million spent each year on climate research, has three parts: Climate Impact Assessment, Climate System Research and Data, Information and Services. The research prescribed for each part will be divided among several agencies, including NASA, NOAA, the Department of Energy, the Department of Defense and the National Science Foundation.

Climate Impact Assessment, the bottom line of climate research, aims to identify and measure the biological, physical, socioeconomic and resource consequences of changes — natural or human-induced — in climate. Models will be developed to assess climate effects on major world crops, energy conservation and production, grazing-land production, marine fishery production and livestock. The social and economic effects of climate-wrought changes in these systems will be analyzed and the climate factors influencing drought, desertification, erosion and water resource planning will be determined.

Climate System Research will examine the physical workings of climate. Climate changes over time, as well as the mechanisms responsible for such change — such as heat storage in the oceans and the behavior of compounds that can alter climate — will be examined. And, again, lots of models will be developed — models that simulate parts of the climate and all of it together, models to test the sensitivity of the climate to natural or human-caused disturbances, models to test the limits of predictability, models to improve the applicability of models.

Data, Information and Services will concentrate on increasing the accuracy, reliability and availability of climate data. Among the proposed projects to beef up the usefulness of climate data are an ocean monitoring system and a satellite system that would measure the radiation emitted by the earth's surface and the radiation reflected and emitted at the top of the atmosphere. The program will also research carbon dioxide effects on climate and will establish experimental climate forecast groups to test "innovative approaches to climate prediction."

And to further complicate matters . . .

Just to illustrate how complicated all that modeling is going to be, particularly for the CO_2 issue, a report in the Aug. 23 NATURE throws another wrench into the works. Bhaskar Choudhury of Computer Sciences Corp. in Silver Spring, Md., and George Kukla of Lamont-Doherty Geological Observatory in Palisades, N.Y., present calculations that suggest that CO_2, by reducing the infrared radiation absorbed by the surface of snow and water, can result in a cooling rather than the oft-predicted warming effect (SN: 2/25/78, p. 116; 4/14/79, p. 244). Snow has a high albedo (reflectivity), which delays its melting and enhances cooling. The absorption of IR causes recrystallization of the snow, reducing albedo and causing melting. A reduction in IR of the amount that would result from the predicted doubling of CO_2 could delay that process. Choudhury and Kukla point out that, though they have not factored in the added heating of the atmosphere due to increased CO_2, the reduced IR absorption could lead to longer snow and ice seasons, more cold arctic air masses in winter, delayed spring snowmelt and early autumn snow. The point of their exercise is to show that "CO_2 impact on global climate is too complicated to be reliably solved by simple annually-averaged general circulation models."