High range sensors for carbon monoxide.

Just when everybody had stopped producing high range sensors for carbon monoxide, a new application turns up that requires them, and with even higher ranges!
The applications meant here are Pyrolysis or gasification of biomass. These options are available for material that cannot be broken down by bacteria (bio digestion) and cannot be used in the immediate vicinity for heat or electricity production for one reason or another. This applies to wood off-cuts, brush clearance or similar. The lignin in wood cannot be broken down by the present anaerobic bacteria, although efforts are being made to produce bacteria strains through genetic engineering that will be capable of this. The use of genetic engineering is a matter of discussion in many countries, but this type of application that is not related to the food chain may cause less controversy.

There are a number of ways to measure carbon monoxide, of which infrared and electrochemical sensors are presently the most popular and best suited to semi-continuous measurement. Both methods have advantages and disadvantages, as is only to be expected! The major disadvantage to electrochemical sensors for this application is the cross-sensitivity to hydrogen seen in most of these sensors. The reaction will produce a relatively high concentration of hydrogen, depending on the method used.

Fast pyrolysis is a thermal decomposition process that occurs at moderate temperatures with a high heat transfer rate to the biomass particles and a short residence time of hot vapour in the reaction zone. Several reactor configurations have been shown to create this condition reliably and to achieve yields of liquid products as high as 75 % based on the initial dry biomass weight . They include bubbling fluid beds, circulating and transported beds, cyclonic reactors, and ablative reactors.
Fast pyrolysis of biomass produces a liquid product, pyrolysis oil or bio-oil that can be readily stored and transported. Pyrolysis oil is a renewable liquid fuel and can also be used as feedstuff for the chemical industries. Fast pyrolysis has now achieved commercial success for production of chemicals and is being actively developed for producing liquid fuels. Pyrolysis oil has been successfully tested in internal combustion engines, turbines and boilers, and been upgraded to high quality hydrocarbon fuels, although at a presently unacceptable energetic and financial cost. Future developments in this field are expected to bring improvements with time.

When biomass is heated with no oxygen or only about one-third the oxygen needed for efficient combustion (the availability of oxygen and other conditions determine if biomass gasifies or pyrolyses), it gasifies to a mixture of hydrogen and carbon monoxide—synthesis gas or syngas. This gas is very similar in composition to the old town gas formed by heating coal.

Even fast pyrolysis will produce significant quantities of syngas. If this is not needed for heating the process then it may be used as a separate fuel for other purposes.

Combustion is a function of the mixture of oxygen with the hydrocarbon fuel. Gaseous fuels mix with oxygen more easily than liquid fuels, which in turn mix more easily than solid fuels. Syngas therefore inherently burns more efficiently and cleanly than the solid biomass from which it was made. Biomass gasification can thus improve the efficiency of large-scale biomass power facilities such as those for forest industry residues and specialized facilities such as black liquor recovery boilers of the pulp and paper industry—both major sources of biomass power. Like natural gas, syngas can also be burned in gas turbines, a more efficient electrical generation technology than steam boilers to which solid biomass and fossil fuels are limited.

A combination of gasification and biogas production by anaerobic decomposition is a possibility that would enable all parts of the biomass to be converted to a transportable fuel or used efficiently locally. The gases can be mixed with the existing infrastructure for transporting natural gas. A high level of dilution would ensure that the gas can be used without difficulty in standard household appliances that are designed for use with natural gas. In the pure form this would cause problems due to the variable composition and lower energy content. Syngas is poisonous due to the presence of carbon monoxide, but suitable dilution would make it viable for domestic use.

Both syngas and biogas can be used industrially without any problems either for heating or to produce electricity.

Sensors for this gas composition serve two important functions. One is process control, ensuring that the reaction is proceeding correctly and safely. Since the quantity of oxygen present is critical to the outcome of the process, then this factor must also be measured.

The other reason for measuring the composition is for pricing, should the gas be delivered to a third party as fuel. Since the composition will vary widely, which is not the case for natural gas, a simple measure of the delivered volume is not sufficient here. Thus a combination of continuous monitoring of the composition and hence energy content must be used together with measurement of the volume.