Utilization of non-food, lignocellulosic biomass such as trees and grasses provides unprecedented opportunity to sustain a lifestyle which benefits from plastics, chemicals and fuels. These feedstocks are rich in the carbohydrate polymers cellulose and hemicellulose, which can be broken down and chemically reduced to the same fuels and chemicals that we currently derive from petroleum. With a focus on production of chemicals including p-xylene, we demonstrate a new technology to convert sugars derived from cellulose to furans and eventually six-carbon aromatics. Combination of a zeolite catalyst with favorable reactor conditions results in a new process capable of achieving 90% selectivity to p-xylene. Alternatively, a focus on producing renewable fuels targets a mixture of oxygenated hydrocarbons with properties necessary for direct replacement of gasoline, diesel or jet fuel. Our strategy utilizes a two-step process to initially convert lignocellulosic biomass to a liquid called bio-oil, which is subsequently catalytically refined to liquid fuel. Production of bio-oil remains the key problem, because conventional mixtures are too acidic and unstable for conventional refining operations. Using a new technique called ‘thin-film pyrolysis’ developed at the University of Massachusetts, we reveal the chemistries that determine the quality of biomass-derived bio-oil and demonstrate the potential for producing higher quality bio-oil directly from woody biomass.