U.S. House of Representatives

House Committee on Science and Technology
Subcommittee on Research and Science Education
The Honorable Brian Baird, Chairman

Hearing: "*Biomass for Thermal Energy and Electricity: A Research and Development Portfolio for the Future"*

Testimony of

Joseph J. James
President, Agri-Tech Producers, LLC
Columbia, SC

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Mr. Chairman and distinguished members of the Subcommittee, thank you for this opportunity to appear before you today. I am Joseph J. James, President of Agri-Tech Producers, LLC (ATP), a company, which is commercializing innovative torrefaction technology, developed by NC State University, which cost effectively converts cellulosic biomass, like wood and agricultural materials, into a dry, more energy dense and more useable renewable fuel, which can be co-fired with coal and used for a variety of other renewable energy purposes. Most of our efforts are focused on making world-class torrefaction equipment, but we also plan to be involved in a limited number of biomass processing plants, using our torrefaction technology.

Overview of Testimony:

I would like to discuss why it is important to treat cellulosic biomass, in order to make it a cost-effective source of renewable energy, and why that is important to developing effective biomass supply chains necessary for our nation's clean energy future. I will obviously talk about torrefaction and the important role that technology can play, in addition to the need for densification processes to enhance the logistics of shipping and handling cellulosic biomass. Lastly, I will describe the role our federal government has played in helping our company compete in the global market place and what additional measures are necessary for our company's and our nation's success.

The Problem:

There are substantial economic and logistical challenges in shipping woody biomass out of the forested areas or agricultural biomass from farming areas, in a cost-effective manner, to distant end-users. Untreated cellulosic biomass, woody or otherwise, is moist and bulky, which limits its ability to be cost-effectively transported to ultimate users and renders a lot of otherwise available biomass useless.

In addition, many forests go without mechanical treatments to remove overgrown underbrush, which is necessary for fire hazard reduction and forest health, because the resultant biomass is not close enough to markets to generate sufficient offsetting revenues.

Solutions:

Solutions to these economic and logistical problems will require new processes, which can cost-effectively remove much of the moisture found in cellulosic biomass, increasing the energy density of the material, converting it into a substance more easily used by the end-user and making it a more valuable substance, before shipping. Also, it is common practice to use physical densification methods, to pelletize or briquette cellulosic biomass, in order to make it more physically dense, so that more energy per ton can be shipped. For example, toffefied biomass has been shown to make stronger, more energy rich and water resistant pellets and the torrefaction process may eliminate the need for a separate drying system, used by most pellet makers, who incur substantial capital and operating costs for such systems.

The US Department of Energy has funded projects to enhance the effectiveness of biomass supply chains and more planning and research in that area is needed, including, in my opinion, research and demonstrations on how to develop small-scale biomass operations, which can generate jobs in many, poor rural communities.

Torrefaction Technology:

Torrefaction is a relatively mild heat treatment of biomass, carried out under atmospheric pressure in the absence of oxygen, at a temperature between 200-300 °C. North Carolina State University (NCSU) has a variation in the temperature by which its torrefaction process is run. During torrefaction, all moisture and volatile organic compounds in the biomass are removed and the properties of biomass are changed to obtain a much better fuel (more energy dense), lowering transportation costs and improving combustion (higher heating value).

Water and the volatile organic compounds (e.g., pinenes and turpenes) are vaporized in the torrefaction process, as is some of the hemicelluloses. In NCSU's process, the gaseous products of torrefaction are captured and combusted to allow the process to run on minimal external energy inputs. When green wood (approximately 50% water by weight) is torrefied, ideally about 80% of the original energy is available in the final torrefied product, which is roughly 30% of the initial green weight. The energy density of the torrefied biomass is approximately 11,000 BTU's, which is comparable to that of coal, at 12,000 BTU's, but with no net carbon dioxide emissions and other pollutants, that make coal a concern.

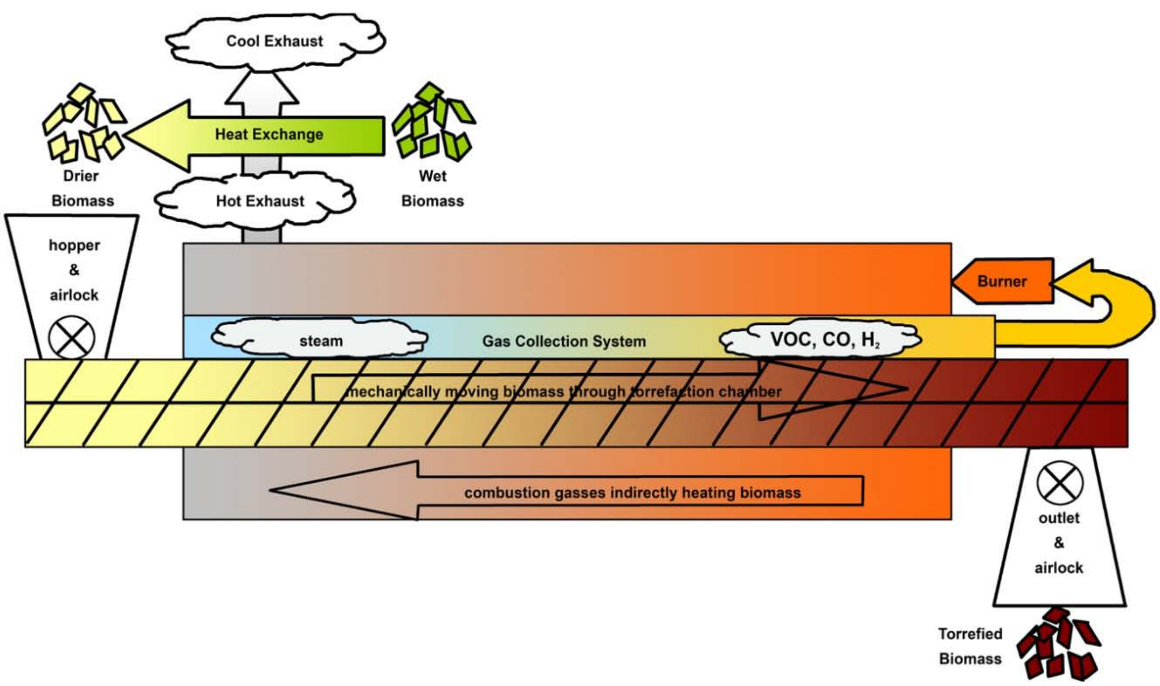
The innovations to the basic torrefaction process, which NCSU has developed, is most easily understood as a mix of counter-flow heat exchanger, indirect heating gasification and wood chip conveyor (see Figure 1, below). The woody biomass (chips) enters a torrefaction chamber (mild steel pipe) that is sealed from the heating fluid surrounding it (combustion gases). The biomass is mechanically conveyed from the cool end to the hot end of the torrefaction chamber and is heated by simple conduction from hot gases moving from the hot end to the cool end, outside the torrefaction chamber. The biomass is also heated by pyrolitic reactions within the torrefaction chamber.

As the biomass is heated, water vapor, volatile organic compounds, carbon monoxide, carbon dioxide, hydrogen, and methane are released and move from the torrefied material, under natural draft to a flame source, where all but the water vapor are combusted with atmospheric oxygen. The combusted gasses and water vapor move around the torrefaction chamber and release their heat to the incoming biomass, before being released to the atmosphere.

The biomass in pipes, within the interior of the torrefaction chamber is not exposed to either a direct flame or the combustion gasses. Volatile organic compounds and water vapor are inhibited from moving out of the torrefaction chamber by the wood chips in the hopper above the wood-metering device, at the inlet of the torrefaction chamber. The torrefied wood is cooled in a sealed chamber while being conveyed to a briquetting or pelletizing machine, a waiting truck or a storage container.

Torrefaction changes cellulosic biomass from a moist, fibrous, perishable, material into a dry, grind-able, stable fuel that can be used as a coal substitute and a feedstock for many other energy-making uses. Torrefaction eliminates the costs associated with transporting the moisture in the biomass, elevates the heating value of the biomass fuel, and reduces the volume of the biomass. The energy density of the torrefied product can be 2 to 3 times, more dense than untreated biomass, on a weight basis, and 2 to 4 times, on a volume basis. Torrefied biomass offers higher co-firing rates for coal-fueled power generation plants than can be achieved with the combustion of untreated biomass. In addition, torrefaction renders cellulosic a more brittle substance, which can easily be crushed along with coal, without any substantial equipment upgrades by the utility.

Figure 1: Schematic of Torrefaction Machinery



Federal Government Support Provided to ATP:

ATP has been helped by several federal programs, including funding received by ATP's affiliate, under the US Forest Service's Woody Biomass Utilization Grant Program, as well as a grant received by ATP from the Forest Service's Wood Education and Resource Center (WERC) and by ATP under the US Department of Energy's Small Business Innovation Research (SBIR/STTR) Program.

Under the Woody Biomass Utilization Grant Program, our affiliate is working with the Francis Marion & Sumter National Forest, in South Carolina, to find new markets for the woody biomass which results when the Forest does its mechanical thinning, to remove underbrush and small trees, in order to reduce the hazard of severe forest fires and to promote forest health.

It was while operating that program that we learned of the challenges of shipping cellulosic biomass to distant customers. The Forest Service has amended that grant agreement to allow our affiliate to collaborate with ATP, this spring, to demonstrate how torrefaction might overcome the logistical challenges of shipping National Forest biomass to distant customers. Hopefully, the new revenues received might allow more acreage in the National Forest to receive much needed thinning.

Our observations have shown that different types of cellulosic material torrefy differently. ATP's WERC grant allows ATP and NCSU to determine the differences between the way hardwoods torrefy, as compared to softwoods, and to develop processes which will allow hardwoods to be torrefied successfully.

This week, Clemson University will be submitting a grant proposal, allowing us to collaboratively determine how best to torrefy and densify switchgrass, as well.

Lastly, ATP has recently been awarded a Phase I Doe STTR grant, which will allow us to determine the feasibility of developing mobile torrefaction units. Such units may make it easier to convert smaller, dispersed sources of agricultural and forestry biomass, from individual farmers or from individual foresters. Such units might also be able to intercept urban wood waste, prevent it from clogging landfills and convert it into a renewable fuel. Such systems may also be able to convert downed trees, in a disaster area, into renewable fuels and much needed revenues.

Suggestions for Additional Federal Support:

1. ATP is ever so grateful for the support we have already received from state and federal sources, but there are additional things which need to be done to help companies, like ours, effectively compete in the global marketplace.

Three of these additional things are:

- Increasing the Availability of Financing for Small Clean Energy Businesses – Although ATP does not now need financing for its core equipment manufacturing operations, it will need financing to become involved in developing biomass processing plants, using its torrefaction technology. Unfortunately, credit for small businesses, especially those using new technologies, is nearly non-existent. Most federal renewable energy financing programs are geared towards very large projects or rural enterprises.

- Protecting Small Business IP in Third-World Markets – ATP has been regularly contacted by businesses from Third-World countries, like China, India and Russia, where it is difficult to protect intellectual property (IP). Although ATP would like to offer its equipment in such countries, it is afraid to do so, for fear of having its machines copied and losing US technology and jobs.

  We recommend that our government negotiate special protections for small, clean energy business IP, as it has bi-lateral discussions with such Third-World countries, who are demanding access to climate change technology. We also hope that patent applications for renewable energy technologies, which are pending in the US Patent Office, be given expedited treatment. We understand that such a measure may be under consideration by the U.S. Secretary of Commerce.

- Funding to Create and Demonstrate Community-Scale Biomass Production Systems – ATP believes that its torrefaction process and other technologies might be able to reduce rural poverty, if funding for developing small-scale biomass conversion facilities was available. The development of community-based biomass systems is complex and will take a sustained and coordinated effort, especially encouraging and assisting smaller farmers to grow dedicated bio-crops, as well as developing the supply chain elements needed to make such systems work. Funding, similar to DOE's large-scale Biomass Supply Systems program, would be very helpful, along with adding new flexibility to some of the Rural Development Programs offered by the US Department of Agriculture. By the way, USDA's Biomass Capital Assistance Program (BCAP) looks like a very helpful program.

Closing Remarks:

In summary, it is important to treat cellulosic biomass, in order to make it a more cost-effective source of renewable energy. New technologies, including innovations to processes, like torrefaction, can play important roles, in addition to densification processes, to enhance the logistics of shipping and handling cellulosic biomass. Lastly, our federal government has played an important role in helping our company compete in the global market place, but there are additional federal measures necessary for our company's and our nation's success in the clean energy economy.

On behalf of Agri-Tech Producers, LLC and our partners and supporters, I thank you for your time and attention. I would be pleased to answer any questions that you may have.