

INDUSTRY'S ROLE IN COMMERCIAL GASIFICATION: THE AGENDA 2020 PERSPECTIVE

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THE AMERICAN FOREST & PAPER ASSOCIATION IS PARTNERING WITH THE U.S. DEPARTMENT OF ENERGY ON FUNDAMENTAL RESEARCH AND THE COMMERCIALIZATION OF NEW TECHNOLOGY.

PREVIOUS ARTICLES IN THIS SERIES ON GASIFICATION initiatives have described the technical opportunity to make black liquor and biomass gasification a reality. This article explains what the industry is doing through the American Forest & Paper Association (AF&PA) to advance the commercialization of these processes.

In 1994 the AF&PA began development of a technology vision and research agenda to carry the pulp and paper industry into the next century. A unique partnership was forged at the Department of Energy (DOE) in which the DOE agreed to accept input from the AF&PA with regard to the funding of government-supported research. The overriding objective of this program is to improve the global competitiveness of the U.S. forest products industry by allocating federal research funding to projects identified by the industry as important to its long-term success.

The focus is geared toward two specific areas: fundamental research and new technology commercialization. These areas tend to have long time horizons or high initial costs and are unlikely to receive much upfront funding from individual companies. As a result, they can benefit most from government assistance.

Under the Agenda 2020 framework, six task forces were created in the areas of:

- Energy performance
- Capital effectiveness
- Environmental performance

- Sustainable forest management
- Recycling
- Sensors and controls.

The AF&PA member companies are encouraged to have representatives participate in these task forces. The groups identify key research needs, advertise those needs, and request research proposals to address them. Recommendations for funding are made to a Chief Technology Officers (CTO) group, which prioritizes and then passes on those recommendations to the Department of Energy.

COMMERCIALIZATION STRATEGY

The research efforts are seen as key to the future viability of our industry, but ultimately they are of little value if the results are not used commercially. Therefore, the task forces have also been working to develop a strategy to facilitate commercialization of new technology. The current activity on gasification is the first manifestation of that effort.

The energy performance task force identified gasification as its top energy priority. Implementation of gasification in its various forms would address four of the five key needs that were identified in the energy area:

- Fuel production and enhancement
- Fuel conversion and electricity production
- Manufacturing process efficiency and heat recovery

- Environmental impact of energy production and utilization.

The only key need not addressed here is a wider use of renewable resources.

In addition to the work of the energy performance task force, the capital effectiveness task force also identified gasification as one of its top two strategic priorities.

The 1997 Kyoto protocol on global climate change created an additional compelling argument in favor of gasification.

ADVANTAGES OF GASIFICATION

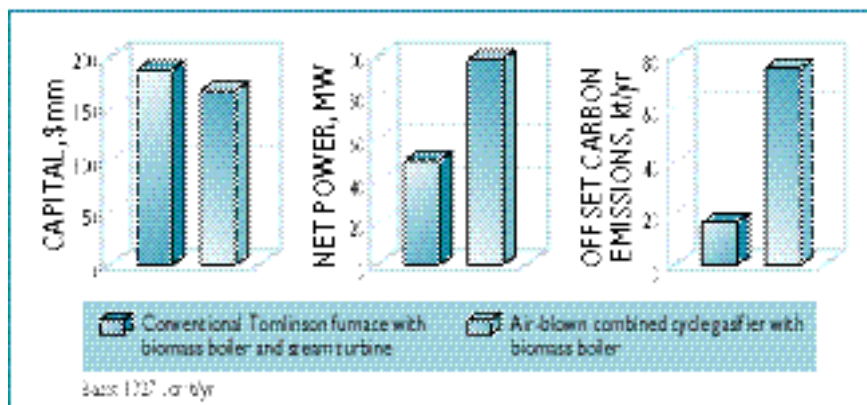
Gasification produces much more additional electricity than a conventional liquor recovery steam cycle, and it does so from a CO₂ neutral biomass fuel. It can provide our industry with its most significant opportunity to respond to any regulations that may be designed to restrict CO₂ emissions from fossil fuels.

Implementation of gasification will not simply lead to incremental improvements. Gasification is a high impact technology that will result in dramatic changes in operational efficiency, as Fig. 1 illustrates. Depending on the configuration chosen, total capital costs for a combined cycle black liquor gasification system will be roughly equivalent to, if not cheaper than, a conventional Tomlinson recovery furnace.

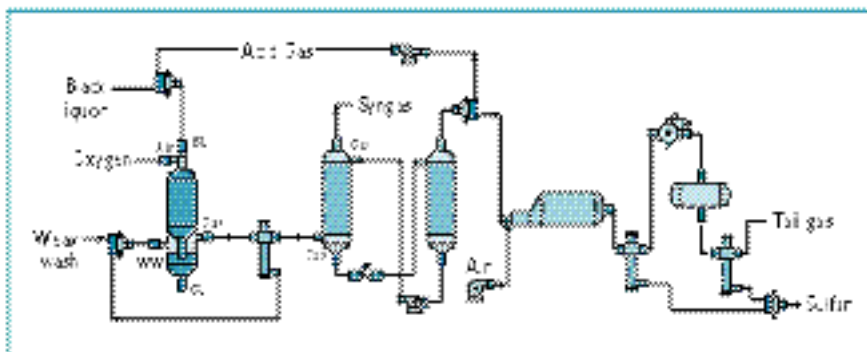
At this same relative cost, combined cycle systems generate two to three times the electrical power of the conventional liquor recovery steam cycle. The annual economic value of that power on a 1300 oven-dry metric tons/day line is roughly US\$ 12 to \$17 million. In addition, the offset carbon emissions from reduced fossil fuel use would be roughly an additional 60,000 tons of carbon per year. Some additional benefits include expectations of greater operational safety, higher thermal efficiency (as much as 10% higher), higher reduction efficiency for the kraft cooking chemicals (on the order of 5%), and lower environmental emissions.

RESEARCH EFFORTS

Over the last few years the AF&PA and DOE have translated the high priority given gasification into considerable economic support. Research programs that have been funded include a full economic assessment of bio-



1. Comparison of air-blown combined cycle gasifier with conventional Tomlinson furnace.



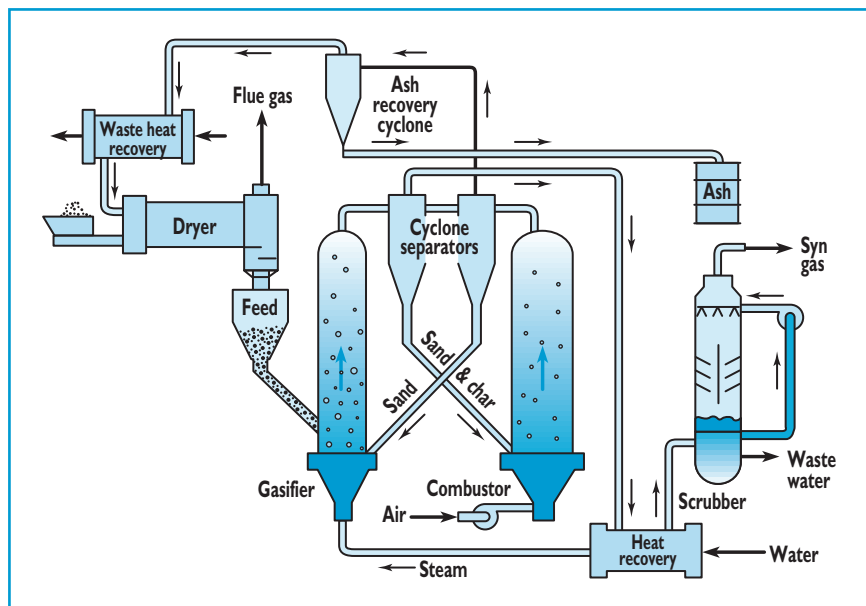
2. Chemrec combined cycle black liquor gasification project at Champion International's Courtland, AL, mill

mass gasification/combined cycle by Weyerhaeuser. This economic assessment tried to estimate all the costs associated with gasification, including growing the biomass, taking the residuals out of the forest, and transporting them to the mills. It attempted to look at the effects of deregulation on electricity prices with an extensive study of what future electricity costs would be in the Southeast region.

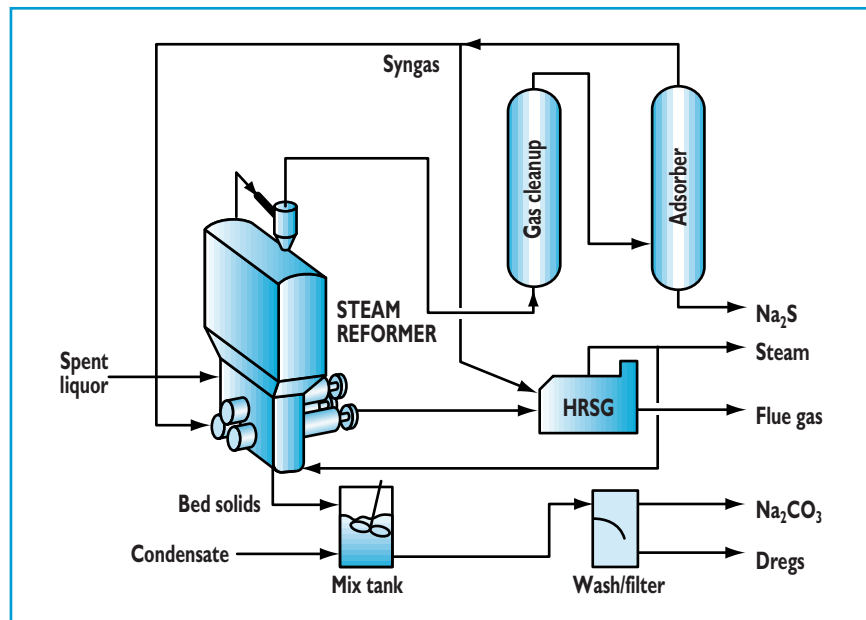
Another study that was chartered by this AF&PA/DOE initiative was an economic analysis of the costs and benefits of integrating black liquor gasification into a kraft mill. There were also studies at the National Renewable Energy Laboratory (NREL) characterizing gasification tars, as well as studies at Battelle directed at improving biomass gas cleanup.

Money has also been made available for a fundamental study of pressurized black liquor gasification kinetics at the Institute of Paper Science and Technology (IPST).

In addition to all this research funding, the association has been moving to facilitate gasification commercialization. In January 1997, a workshop was held in Princeton to bring together equipment vendors, industry representatives, and technology developers to try to identify the principal roadblocks to commercialization. This workshop started a process that culminated in 1998



3. Biomass gasification project using Battelle/FERCO fluidized bed technology at Weyerhaeuser's New Bern, NC, mill



4. Pulse-enhanced steam reforming demonstration project at Georgia-Pacific's Big Island, VA, mill

Each of these processes has been under development for more than 15 years, and each has been demonstrated at least at the pilot scale. A commercial demonstration is the obvious next step. However, a significant barrier to commercial demonstration is the high financial risk—on the order of US\$ 30 to \$60 million—that is going to be incurred by the first adopters of this technology. The Gasification Initiative has been designed to mitigate that risk while enhancing dissemination of the technology to the rest of the industry. This effort enjoys the unanimous support of the CEO advisory group for the AF&PA.

DEMONSTRATION PROJECTS

The Chemrec proposal for Courtland is a 550 metric tons/day black liquor system. Figure 2 provides a brief description of the process. It features an oxygen-blown, pressurized, entrained flow gasifier. It will supply 55% of the Btus to an existing Frame 6 turbine.

The biomass gasification project, illustrated in Fig. 3, will be a 640 moisture-free metric tons/day unit using Battelle/FERCO fluidized bed technology. It is being installed at the Weyerhaeuser New Bern mill.

Another demonstration project is currently underway in Burlington, VT, at a 200 tons/day scale burning willow as a fuel source. The basic principle is to burn low-moisture biomass at atmospheric conditions in a steam fluidized sand bed. The biomass is endothermically pyrolyzed and gasified, creating a medium Btu synthesis gas. The unreacted char is separated from the gas and burned with air in a separate combustor, which reheats the

sand before returning it to the reactor. In principle, gas cleanup from a system like this should make the synthesis gas suitable for feed to a gas turbine. However, in this application Weyerhaeuser is planning to use it to replace fuel oil fired to the lime kilns and power boilers. There are plans, however, to do experiments on the gas coming out of the system to demonstrate that it can be used in a gas turbine.

in the industry biomass gasification initiative. The gasification initiative calls for the AF&PA to work with the DOE to obtain federal funding to assist with three different commercial scale demonstration projects. One project is the Kvaerner Chemrec gasifier that is planned for the Champion Courtland mill. Two of the other projects are Battelle's fluidized bed biomass gasification process and the MTCI StoneChem steam reforming gasifier.

Yet another demonstration, shown in **Fig. 4**, will use pulse-enhanced steam reforming developed by MTCI to gasify a semichemical black liquor from Georgia-Pacific's Big Island mill. Georgia-Pacific's primary incentive for pursuing this project is the inability of their current smelters to meet the MACT II regulations. They are looking for an environmentally acceptable replacement technology.

In this process, spent liquor is endothermically gasified in the steam fluidized bed. The medium Btu syngas passes through an absorption tower for sulfide recovery. A portion of that gas is fed back and burned in pulse combustors in the steam reformer, which provides indirect heating of the bed. The remaining gas will be burned in a heat recovery steam generator. The unit is expected to handle 180 metric tons/day of dry solids, which is the total liquor requirement for that mill.

FUNDING RATIONALE

The total budget for these projects is US\$ 160 million. Why has the DOE been so willing to assist in securing cost share funding? The answer lies in the perception that commercialization of gasification is clearly in the national interest.

As mentioned earlier, biomass and black liquor gasification provide a very heavy hammer for reducing carbon dioxide emissions.

- Replacement of just 10% of existing boilers would reduce carbon emissions from our entire industry by the 7% proposed by the Kyoto protocol.
- Gasification would greatly increase the extent of renewable energy production, thereby reducing our dependence on foreign oil.
- Commercialization of gasification will enhance the global competitiveness of the U.S. pulp and paper industry. Recovery boilers in the United States are generally older than in Europe and Asia. As more energy efficient gasifiers replace these units, the reduced energy costs will contribute to making gasifier users the lowest cost producers.

Why is the industry interested in getting DOE funding? Why is the industry as a whole willing to push for federal cost share funding for three of our competitors?

I believe it is recognized that this step is needed to get the job done at all. The first installation of a major technology like this carries 30% to 40% higher capital costs than subsequent units. Extended commissioning periods also put pulp production at risk while running up higher initial operating costs. Without some mechanism to defray the extra costs, no producer is likely to gamble on this new technology. In addition, introduction of government funding opens the projects up to the public, ensuring that the information learned from these

demonstrations is available to the rest of the industry.

One other issue on the table that still needs resolution is the incorporation of an innovative technology clause in the MACT II regulations that would allow the companies involved some relief if the technology is unsuccessful. It is believed that these technologies are going to allow mills to meet the existing environmental regulations. If unforeseen problems persist and they are unable to use the technology, they need some mechanism that will allow them to come into compliance on a more extended time schedule.

As a first step toward funding approval, US\$ 1 million was appropriated in FY 1999 for the initial engineering phases of these projects. There is currently US\$ 9 million earmarked in next year's federal budget. If that funding materializes, the schedule has projects coming online either in late 2001 or early 2002. **TJ**

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