Testimony of
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Thank you, Mr. Chairman and distinguished Subcommittee members, for the opportunity to provide testimony to the Committee on Science & Technology, Subcommittee on Energy & Environment for the "Biomass for Thermal Energy and Electricity Through a Research and Development Portfolio for the Future" hearing. I appreciate this opportunity to share Catalyst Renewables' operational lessons learned and insights on this important topic, which is a core area of commercial and environmental concern to Catalyst Renewables. Mr. Chairman, Catalyst was a successful "green," renewable and sustainable energy company before being "green" was so popular.

Catalyst Renewables develops and owns energy projects deploying leading-edge technologies using clean, renewable resources—woody biomass and geothermal—to produce power and thermal energy. Our goals include creating environmentally sound, renewable energy alternatives that can be sustained in current and future energy markets, and to actively engage the communities that we serve. Catalyst builds fiscally and environmentally responsible solutions that free us from the limited supply and unstable pricing of fossil fuels as we, in fact, build a new pathway to energy's future.

Our operational biomass experience originates with Lyonsdale Biomass at Lyons Falls, New York. We purchased this 19 MWe Combined Heat and Power (CHP) facility in 2003. At that time, the plant was in distress, but after significant private capital transfusions and re-establishment of trust and confidence with the men and women of the local forest community logistics pipeline, we have been able to help Lyonsdale Biomass return to viability. We were successful in competitive renewable energy credits auctions for the New York State Renewable Portfolio Standard (RPS)…the only woody biomass facility ever to do so. In an important sidelight, to qualify for the RPS, Catalyst had to develop, prepare and deploy a New York State Department of Environmental Conservation (NYSDEC)-approved sustainable forestry management plan, which became the first plan deployed in New York State. Today, we are anecdotally told by NYSDEC that the Lyonsdale "wood basket" is considered the healthiest forest in New York State.

Wood from the forest and farmed purpose grown woody biomass energy crops offers a significant renewable alternative and environmentally more acceptable replacement options to diminishing fossil-based energy supplies. In our western forests, this energy harvested in a thoughtful management plan and released via controlled combustion or gasification instead of devastating forest fires, can produce significant distributive CHP that will spur economic vitality. Across the Northern Forest of New York, New Hampshire, Vermont and Maine, our neighbors are equally embracing the challenge of energy from mixed northern hardwood trees produced in close proximity to urgent demand for renewable energy. This effort is being led by renewable energy generation innovators like Catalyst Renewables and their strategies can be applied to all our United States forests using the extensive renewable energy stored and continually produced by wood.

Woody biomass from the forest and from farmed and purpose-grown woody biomass energy crops holds significant revitalization potential for the rural economies of our forest and farm communities by creating an alternative source of income for landowners and circulating wealth-creating energy dollars through the local economy. In New York, which is characterized by a fossil fuel-intensive power generation sector (~ 51% of power generated), substituting woody biomass for coal-powered electrical generation significantly reduces imported energy costs. Naturally possessing a short supply chain, woody biomass is produced in close proximity to demand and the end-user. This provides an important link and business relationship between the power plant and local community. As these fuels are available locally, the financial resources are spent locally, thereby encouraging the local economy and providing income for local businesses. Wood energy adds financial value to the forest and supports critical restorations and improvements from timber-stand management thinnings. The sustainability of local woodsheds can be enhanced by the inclusion of purpose grown woody biomass on under-utilized or abandoned farmland including fast-growing Root Process Method ® (RPM) native hardwoods and short rotation woody crops such as shrub willows developed by SUNY-ESF and being commercialized by Catalyst Renewables.

The energy life cycle analyses of the purpose grown woody biomass energy crop systems and subsequent conversion of biomass to electricity via combustion and gasification is positive in many ways. The net energy ratio for the production and conversion of purpose grown woody biomass is 1:11 for co-firing and 1:16 for a gasification system. This means that for every unit of nonrenewable fossil fuel energy used for growth and harvest, 11-16 units of useable energy are produced. In essence, forests and purpose grown woody biomass energy crops are large solar collectors that capture the sun’s energy and store it as woody biomass. The net energy ratio for woody biomass is far superior to the net energy ratio for electricity from a combined cycle natural gas system (1:0.4). Research directly correlates this data to wide scale energy applications of mixed northern hardwood feedstocks from our northeast states and feedstocks of western hardwood feedstocks.

Woody biomass from the forest and from farmed and purpose-grown woody biomass energy crops are CO_2 neutral, which means that energy and other products can be produced with no net addition of CO_2 to the atmosphere. Biomass for bio-energy including liquid transportation fuels can be drawn from a variety of feedstock sources including forests, agricultural crops, organic residue streams and dedicated woody or herbaceous crops. Research suggests development and deployment of woody biomass resources have distinct energy, economic and environmental advantages over traditional agricultural crop sources:

- Woody biomass is available year round and from multiple sources. End users are not dependent on single source material.

- The net energy ratios for bio-energy and bio-products including liquid transportation fuels derived from woody biomass are large and positive, meaning that considerably more energy output is produced from these systems than is used in the form of fossil fuels to produce the woody biomass and generate end products.
- Woody biomass can be sustainably managed and produced, while simultaneously providing an array of environmental and socioeconomic benefits.
- The physical-chemical characteristics of woody biomass from hardwoods are fairly consistent even when supplied from multiple sources.
- The forest products industry and wood-based renewable energy generation firms have developed superior technical and engineering competencies to manage woody biomass.

USDOE/USDA estimates sustainably harvested forest woody biomass can nationally provide at least 368 million dry tons of wood per year. Nationally, the net annual incremental forest woody biomass growth on almost 500 million acres of U.S. timberland exceeds forest woody biomass removals by almost 50%. In the north-central states growth exceeds removals by 95%. This ratio is even greater in the northern forest of the northeast states, where growth exceeds removals by 125%. In New York State, there are over 18.5 million acres of timberland with over 750 million tons of standing biomass. The net annual increment growth vs. removals on New York timberland is more than 300%.

At a Catalyst Renewables facility, Lyonsdale Biomass, in Lyons Falls, woody biomass is being used to generate 19MWe of electricity for the grid and post-generation thermal power at 15,000 pph for the Burrows Paper Company. Catalyst Renewables is presently harvesting and installing planting stock at Catalyst's commercial shrub willow energy crop plantations in and around Central New York. This 600-acre plantation is the first commercial shrub willow energy crop plantation in North America. For every MWe of renewable power produced, Catalyst off-sets 2,500 tons of coal and $90,000 of exported energy cost. This is very important because New York State imports over $2,500 worth of mostly fossil-based energy for every man, woman and child in the State.

Consumers increasingly need base-load energy that is renewable, clean, and affordable from renewable sources like geothermal and biomass. One of the simplest and oldest of renewables is direct combustion of wood. Wood supplied more energy than fossil fuels in the United States until the 1880s, when coal superseded wood. Today, due to re-growth of forests and improved technologies, sophisticated thermal combustion is being used across Europe, supplying heat, cooling, and power and reducing greenhouse-gas emissions. A high-efficiency wood-burning plant was recently opened in Simmering-Vienna with total thermal capacity of 65 MW, delivering electricity to the grid and heat to the city’s district energy system. More than 1000 woody biomass facilities have been constructed in Austria, nearly all local community–based; more than 100 combine heat and electric power. The facilities emit remarkably low quantities of air pollutants, including greenhouse gases, and have thermal efficiencies across the system approaching 90%. Europe’s thousands of new community-scale woody biomass facilities clearly demonstrate that, woody biomass can be rapidly implemented, can reduce oil imports and greenhouse gas emissions, and can increase energy security with wood drawn from local woodsheds including purpose grown woody biomass from under-utilized or abandoned farmland.

Regionally, areas with sustainable wood supplies need to deploy woody biomass CHP as new construction and renovated fossil CHP sites. Such initiative is well targeted to the Northeast United States, given the region’s abundant forest land and dependence on heating oil. Woody biomass CHP has great potential in the Southeast and West as well. Relatively rapid transitions to woody biomass CHP heating and cooling are technically and economically achievable in schools, municipal offices, hospitals, prisons, and industrial facilities. This includes better use of wood collected by municipalities from diseased and storm-damaged trees and from construction sites. The volume of safely combustible urban wood in the United States is nearly 30 million tons per year. Often, local communities dispose of this wood at some expense and incurring negative environmental results while missing energy benefits that could come from its clean combustion..

The potential thermal value of community-based CHP alone is significant. If New York were to commission one hundred community-scale 0.75 MW CHP projects per year over a 5-year construction period at an incremental investment would be about $100 million for each of the five construction years. However, fuel savings would increase to at least $100 to $180 million per year, and emissions of fossil CO_2 could decrease by 0.75 to 1.0 million tons per year. The woody biomass required by such an initiative totals less than 20% of a recent estimate of New York’s energy-wood supply. By increasing the purpose grown biomass component of the supply with fast-growing Root Process Method ® (RPM) native hardwoods and short rotation woody crops such as shrub willows developed by SUNY-ESF and being commercialized by Catalyst Renewables on New York’s abandoned and under-utilized farm land the pressure on the open-loop biomass supply could be reduced by 20%.

Total U.S. energy consumption is presently about 100 quads [100×10^{15} British thermal units (BTUs) or 25.2×10^{15} kcal] per year. U.S. wood delivers about quads per year and the national sustainable energy-wood supply potentially contains about 5 quads per year. Although these rates may seem small, they are enormous quantities of energy, comparable to power production from hydroelectric sources (~3 quads per year) or the content of energy in the nation’s Strategic Petroleum Reserve (~4quads). Considering controversial plans to expand the nation’s nuclear capacity, presently at 10 quads per year, applying purpose grown woody biomass for future potential wood energy is reasonable and prudent as it enhances development from forests and woodlands with resources from low-productivity, abandoned and under-utilized agricultural lands and from urban brownfield sites.

So, why does woody biomass…around for eons…merit your attention and inclusion in a Research and Development Portfolio for the Future? Wood wins in all the environmental, economic and effectiveness categories. Likewise, using woody biomass offers a clear national strategic advantage of a clean, renewable home-grown base-load thermal energy and electricity resource and woody biomass comes with a significant practical advantage: a proven, reliable national logistics handing system. We appreciate the value of crop residues as a potential bio-power feedstock, but we are daunted by our national absence of an efficient and effective crop residue collection and delivery system. On the other hand, the nation’s forest products industry’s logistics system is mature and readily adaptable to the demands of CHP systems. This asset is our first research and development focus suggestion: That is, design, development and operational test and evaluation of appropriate regional logistics systems including integration of rail transport and strategic staging areas of woody biomass and crop residue feedstocks. Such systems are not "chicken or egg" situations. Integrated handling systems must be designed and tested to be commercially and operationally effective and suitable with a minimum of handling "touches." In addition, integrating woody biomass with other available feedstocks, such as livestock nutrients, biosolids, and similar products is problematic with currently available handling and processing equipment. A concerted effort to advance comingled biomass supplies would enhance resource utilization and reduce cost. We suggest multiple regional demonstrations suited to regional feedstocks are reasonable and prudent. Delivery system inefficiencies as dollars per ton of biomass, manifests throughout the CHP conversion process. Costs saved during biomass harvest, preparation and delivery multiple as costs savings to end users of both electrical energy and thermal power.

Catalyst Renewables is constantly seeking cleaner, more reliable production of renewable base-load heat and power. Presently, we have a 37MWe facility "Onondaga Renewables" under development in Geddes, New York. Already permitted, Catalyst Renewables asserts based on existing state-of-the art technology that "Onondaga Renewables" will be the cleanest woody biomass generating facility in North America. Employing a Bubbling Fluidized Bed (BFB) boiler, the technology is widely recognized as the most efficient conversion device for combusting woody biomass residue. The BFB's tolerance for fuels having low heating density, having significant moisture content, are irregularly sized and potentially contaminated with miscellaneous inert materials such as soil and rocks make the BFB the premier system for efficiently and reliably converting loggings residues into useful energy.

Owing to the relatively low operating temperatures of BFBs, they intrinsically thermally fix lower amounts of oxides of nitrogen (NOx) relative to conventional boiler systems. Owing to intimate commingling in the fluidized bed between fuel, hot bed medium and oxidizing gases, combustible material is combusted to completion. Additionally, alkali absorbent material within the fluidized bed can capture and control potential pollutants such as sulfur and acid gases.

However, fluidization comes with a significant, associated energy penalty–pressurized airflow. Large quantities of air are required to counter-balance the mass of the boiler bed and propel the mass into a fluidized state. The associated fan and blower power demands result in a 6% system efficiency penalty as compared to less environmentally beneficial traditional, fixed grate boiler systems. As applied to Onondaga Renewables project, the annual power required for air handling is the equivalent of 21,000 megawatts-hours. Therefore, we suggest a second important research and development focus area is the mitigation of fluidized-bed parasitic power loss. Specifically, biomass CHP would significantly benefit from research and development of more efficient fans, blowers and electric motor drive units for all fluidized bed boiler systems. Likewise, research designed to achieve pressure drop reductions through air conveyance ductwork would reduce associated power requirements and significantly improve overall system efficiency.

Based on Catalyst Renewables' commitment to environmentally benign heat and power production is the elimination of Greenhouse Gas emission. Already CO_2 neutral, woody biomass is also virtually sulphur-free, which leaves emissions of oxides of nitrogen (NOx) as the next major consideration. Modern combustion installations often reduce NOx emissions, by causing a chemical reaction between NOx and a reagent, typically ammonia or urea. The speed and completeness of the reaction is facilitated with catalyst. Popular catalytic NOx reduction systems include selective catalytic reduction (SCR) and regenerative selective catalytic reduction (RSCR). In both systems, the catalyst is a ceramic matrix, often honeycomb like, contained within a housing comprised of several tons of catalyst.

Fresh catalytic units are capable of continuously reducing NOx by more than 98%. In typical industrial/power generation application such as Onondaga Renewables, catalyst is expected to operate at high conversion efficiency for approximately 10,000 hours after which, the catalyst must be replaced and disposed of as a solid waste –presently, NOx reduction catalysts cannot be regenerated. As a third research and development focus, Catalyst Renewables suggests operational effectiveness and suitability at biomass conversion facilities can significantly benefit from research and development designed to extend the useful operating life of NOx reduction catalysts. Whether the deactivation mechanism be physical, thermal or chemical, the biomass conversion operator is focused on permit emission limits and whether the catalyst can produce the desired level of control. Catalyst recharge/replacement is a significant inefficiency; it requires the cessation of operations resulting in opportunity losses, capital expenditure for fresh catalysts, loss of un-reacted reagent while using aged catalyst with lower conversion efficiency, labor expense and disposal costs. For our Onondaga Renewables biomass facility, associated catalyst costs for typical lifecycle amount to more than $1.00 per megawatt-hour of generation.

The final and most difficult research and development focus involves maintaining optimum chemical reaction temperatures in regenerative selective catalytic reduction (RSCR) units operated for the elimination of oxides of nitrogen (NOx), while eliminating the use of high quality fossil fuels as an energy source. Presently, distillate oil or more typically natural gas is burned to maintain flue gas temperatures to effect rapid and high NOx conversion. For a modern biomass conversion power plant, the heat input to a RSCR unit approaches 10% of the total biomass energy value. Although RSCR systems are designed to recapture and recycle heat between its multiple sub-units, the reliance on a continuous supplement of fossil fuel remains a substantial huddle to widespread use. Not only does RSCR auxiliary fuel use directly reduce the overall plant conversion efficiency, its emissions contribute to climate change emissions. Furthermore, fossil fuel use even at this relatively low level can ensnare most biomass electrical generating units in regulations for the control and reporting of greenhouse gases. For these reason we advocate for research and development energy improvements that would eliminate the need auxiliary fuel usage in regenerative-SCR NOx, control devices.

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